

THE EFFECTIVENESS OF SOY MILK AND COW'S MILK IN REDUCING DYSMENORRHEA PAIN: A SYSTEMATIC LITERATUR REVIEW

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ABSTRACT

Primary dysmenorrhea is a common menstrual problem among adolescent girls and is often associated with elevated prostaglandin levels, which trigger excessive uterine contractions and pain. Nutritional interventions are increasingly explored as *non-pharmacological* alternatives to reduce *dysmenorrhea*, with *soy milk* and *cow's milk* being two commonly studied options. This study aims to synthesize existing evidence on the effectiveness of *soy milk* and *cow's milk* in reducing *primary dysmenorrhea* among adolescents. Method: This study used a *Systematic Literature Review (SLR)* based on the *PICO framework*—population (adolescent girls), intervention (milk consumption), comparison (*soy milk* vs. *cow's milk*), and outcome (reduction in *dysmenorrhea* pain). Articles published from 2015-2025 were searched in Google Scholar, Scopus (via Publish or Perish), and PubMed using Boolean keywords related to adolescents, *soy milk*, *cow's milk*, and *dysmenorrhea*. Eligible studies included original research on adolescents with *primary dysmenorrhea*, clear milk dosage and duration, standardized instruments, and full text in Indonesian or English. After duplicate removal, screening, and full-text assessment, data on study characteristics, milk type, dosage, duration, and pain reduction were narratively synthesized. The initial literature search identified 1,007 journals from After going through a selection process, 4 journals met the requirements for analysis. The synthesis revealed that both *soy milk* and *cow's milk* reduce *primary dysmenorrhea* based on *NRS score*, but *soy milk* showed more consistent effects. Consumption of 250 ml *soy milk* once daily for 1-2 days reduced pain by 3-4 *NRS* points. This benefit is supported by its nutrient content, where 250 ml *soy milk* contains 25-40 mg isoflavones (*genistein daidzein* and *glycitein*) and 200-300 mg calcium, or up to 500 mg in fortified products. *Cow's milk* also reduced pain, with the best effect at 1,000 mg calcium/day (reduction of 4-5 *NRS points*), but its results were less stable. Overall, *soy milk* was more consistently effective than *cow's milk*. *Soy milk* is a simple, safe, and effective *non-pharmacological* option for managing *primary dysmenorrhea* in adolescents, offering stronger and more consistent results than *cow's milk*. It may be recommended as part of menstrual health education and daily nutritional intake for adolescent girls.

Keywords: *Soy Milk, Cow's Milk, Primary Dysmenorrhea, Isoflavones, Calcium.*

INTRODUCTION

Women commonly experience pain during menstruation, with varying levels of severity ranging from mild to highly disruptive; this condition is known as *dysmenorrhea* (Artawan, 2022). *Dysmenorrhea* is characterized by severe lower abdominal pain occurring before or during menstruation, usually in the form of cramps that can radiate to the thighs or lower back (Fadila, 2015). In addition to cramping, this condition is often accompanied by supporting symptoms such as nausea, vomiting, headaches, diarrhea, fatigue, and back pain, all of which can exacerbate discomfort. These symptoms can significantly impair daily activities, academic concentration, work productivity, and overall quality of life for affected women (Barcikowska et al., 2020).

Dysmenorrhea is clinically classified into two main types: *primary dysmenorrhea* and *secondary dysmenorrhea* (Martire et al., 2023). *Primary dysmenorrhea* refers to menstrual pain arising from increased uterine contractions without any underlying pelvic pathology (Nuha et al., 2023). This increase in contractions occurs when levels of *prostaglandins* and active lipid compounds rise just before or during menstruation. Excessive uterine contractions subsequently reduce blood flow to the myometrium, triggering ischemia and causing pain or menstrual cramps. Therefore, the process of *primary dysmenorrhea* begins with elevated *prostaglandins* → strong contractions → ischemia → onset of pain. Although *primary dysmenorrhea* generally has a favorable prognosis, it remains a factor that reduces quality of life (Bernardi et al., 2017).

In contrast, *secondary dysmenorrhea* is caused by pelvic

pathologies (Nuha et al., 2023). Pain arises due to pathological processes in the reproductive organs, leading to abnormal contractions or inflammation, such as endometriosis, adenomyosis, pelvic inflammatory disease, or anatomical abnormalities, whether obstructive or non-obstructive (Huang et al., 2022). *Secondary dysmenorrhea* accounts for approximately 10% of *dysmenorrhea* cases, with endometriosis being the most common etiologic factor (McKenna & Fogleman, 2021).

In addition to the mechanism of uterine contractions, hormonal factors play an important role in the onset and intensity of menstrual pain. Fluctuations in estrogen and progesterone levels before menstruation affect the stability of the endometrial lining and the sensitivity of tissues to pain. When progesterone levels decrease significantly, the uterine lining releases more *prostaglandins*, which trigger stronger and more coordinated contractions. This condition causes the uterus to contract intensely to shed the endometrial lining, while at the same time compressing surrounding blood vessels (McKenna & Fogleman, 2021). This compression can reduce oxygen supply to tissues, resulting in sharp and throbbing pain. In some women, the nervous system becomes more sensitive to pain stimuli, making the perception of pain more severe compared to others. Genetic factors are also believed to influence pain thresholds and the tendency to experience severe *dysmenorrhea* (McKenna & Fogleman, 2021).

Globally, the incidence of *dysmenorrhea* is relatively high, with 50-90% of women of reproductive age experiencing pain, most commonly due to *primary dysmenorrhea*. In Indonesia, it has

been reported that 55% of women experience *dysmenorrhea* during menstruation. According to the *World Health Organization (WHO)*, incidence rates vary between 45% and 79% across different age groups and countries. The prevalence of *primary dysmenorrhea* among students is 41.7-51.1% in China, 64.0% in Mexico, 80.01-85.7% in Saudi Arabia, 80.6% in Lebanon, 85.4% in Ethiopia, 89.1% in Iran, and 95% in Indonesia (Lestariningsih et al., 2024).

The prevalence of *dysmenorrhea* in Indonesia remains alarmingly high, affecting not only adolescent girls but also women across various reproductive age groups, thereby posing substantial challenges to public health and daily functioning. According to data from the national *Basic Health Research (Riskesdas)* 2018, approximately 64.25% of Indonesian women report experiencing *dysmenorrhea*, with the majority—54.89%—classified as *primary dysmenorrhea* and the remaining 9.36% as *secondary dysmenorrhea*, highlighting the widespread nature of this condition nationwide (Edward et al., 2025). Regionally, On a regional level, the prevalence in Central Java Province stands at 56%, underscoring significant geographic variations in occurrence (Wulandari & Widiyaningsih, 2023). Although specific data for Banyumas Regency are limited, local studies show that *dysmenorrhea* is also a significant complaint among school-aged and reproductive-aged women.

Among adolescents, *dysmenorrhea* is commonly found, but not all adolescents necessarily experience it. The prevalence of *dysmenorrhea* in adolescents ranges from 43% to 93%, with most cases (approximately 74-80%) classified as mild. In early adolescence (ages 10-14), *primary dysmenorrhea*

complaints are more frequent due to hormonal imbalance from immature reproductive maturation. In late adolescence (ages 15-19), *primary dysmenorrhea* remains dominant, though some cases of *secondary dysmenorrhea* begin to appear, triggered by minor reproductive organ abnormalities such as functional cysts or mild infections.

In young to adult women (beyond adolescence), *dysmenorrhea* continues to be a significant problem. *Primary dysmenorrhea* may still occur due to increased prostaglandin production causing excessive uterine contractions. Meanwhile, *secondary dysmenorrhea* is more frequent in this age group due to the increasing risk of reproductive disorders such as uterine fibroids, adenomyosis, or pelvic infections. Overall, it is estimated that 60-70% of Indonesian women experience *dysmenorrhea*-related complaints, and approximately 15% report that their daily activities are disrupted due to menstrual pain (Kemenkes, 2022).

Dysmenorrhea is thus a cross-age issue, making interventions, including nutritional approaches such as *soy milk* and *cow's milk*, important to study.

Overall, *dysmenorrhea* is considered a significant health issue among adolescents. Other studies report that the prevalence of *dysmenorrhea* among menstruating adolescents ranges from 70% to 91% (Dixon et al., 2023). These figures indicate that menstrual pain is a significant health problem requiring special attention, especially among students.

Management of *dysmenorrhea* can be carried out using both *pharmacological* and *non-pharmacological* approaches. From a *pharmacological* perspective, *non-steroidal anti-inflammatory drugs (NSAIDs)* are commonly prescribed to

alleviate menstrual pain by inhibiting *prostaglandin* synthesis, thereby reducing uterine contractions and cramping. Among several *NSAIDs*—such as naproxen, ibuprofen, diclofenac, aspirin, and ketoprofen—studies have demonstrated that ibuprofen offers the most favorable balance of efficacy and safety, making it the optimal analgesic for the management of *primary dysmenorrhea* (Nuha et al., 2023). Conversely, *non-pharmacological* approaches, including herbal therapy, are considered safer alternatives and can often be practiced independently without medical supervision. Various natural ingredients, such as cinnamon, turmeric, ginger, cloves, and soy, have been traditionally utilized to alleviate menstrual pain due to their *anti-inflammatory* and antispasmodic properties. These herbal remedies have shown potential in reducing the severity and duration of *dysmenorrhea* symptoms, thereby improving comfort and quality of life among women who prefer natural treatment options (R. Putri et al., 2018)

The use of traditional remedies with minimal or no side effects can be an effective option to alleviate *dysmenorrhea*. Adequate intake of essential nutrients, including calcium, magnesium, and vitamins A, B6, C, and E, has been shown to play a crucial role in reducing *dysmenorrhea*. One recommended food during menstruation is high-calcium foods, such as soy (Budiarti & Novita, 2015). Soy contains iron, calcium, B-complex vitamins, and lecithin. Additionally, soy contains isoflavones, which act as phytoestrogens, helping suppress uterine smooth muscle contractions by inhibiting *prostaglandin F2a* reactions (Herlina et al., 2025). Soy-

based products, such as *soy milk*, are rich in calcium and isoflavones that may help reduce *dysmenorrhea* pain by balancing estrogen levels (Amalia et al., 2018). Isoflavones in *soy milk* also function to stabilize estrogen levels in the body, both when low and excessively high (Rosiana, 2023).

According to the Indonesian Food Composition Table, soybeans contain considerable amounts of calcium, iron, and protein. Per 100 grams of soybeans, the calcium, iron, and protein content are 222 mg, 10 mg, and 40.4 g, respectively (Kemenkes, 2023). Besides being nutrient-rich, soy contains a high amount of isoflavones, ranging between 130-380 mg per 100 grams. Isoflavones can reduce the *PGF2a* response in uterine muscles and inhibit smooth muscle contractions, thereby preventing *dysmenorrhea* (Seriana, 2021). Therefore, soybeans are better processed as a food to prevent *dysmenorrhea*.

Furthermore, *cow's milk* contains a variety of essential macronutrients and micronutrients that support overall body function. It serves as an important dietary source of calcium, magnesium, and vitamins A, E, B6, and C, all of which are believed to contribute to the reduction of menstrual pain experienced during *dysmenorrhea*. Calcium, in particular, plays a vital role in regulating muscle contraction, including that of the uterine muscles, by maintaining proper neuromuscular function, thereby helping to alleviate cramps and discomfort. Insufficient calcium intake may lead to increased muscle tension and cramping; therefore, consuming calcium-rich milk is highly recommended as part of *dysmenorrhea* management. On average, each 100 ml of milk contains approximately 100-150 mg of calcium. (Febriani, 2018).

According to Lavon Dunne in the *Nutrition Almanac* (2002, dikutip dalam Febriani et al., 2018), calcium intake of 800-1,000 mg daily is recommended to reduce *dysmenorrhea* pain, with practical dosing of 250-500 mg administered every 4 hours during acute episodes. Additional research supports that a consistent 1,000 mg daily calcium regimen more effectively diminishes the intensity of *primary dysmenorrhea* pain than combined calcium and vitamin D supplementation. This analgesic effect is attributed to calcium's ability to regulate neuromuscular excitability in the uterus, thereby counteracting hypercontractility induced by elevated prostaglandin levels during menstruation.

Cow's milk has been proven to reduce the intensity of *primary dysmenorrhea* due to its high calcium content, vitamin D, and essential amino acids such as tryptophan. Calcium in milk helps regulate neuromuscular activity in the uterus, reducing cramps and contractions that trigger excessive prostaglandin production during menstruation. Additionally, vitamin D aids in optimal calcium absorption, which, along with protein, healthy fats, and other nutrients in *cow's milk*, contributes to an *anti-inflammatory* effect, thereby suppressing cytokine and eicosanoid production that cause *dysmenorrhea* pain (Febriani et al., 2018).

LITERATURE REVIEW

Dysmenorrhea, which is menstrual pain caused by uterine contractions triggered by prostaglandins, can reduce quality of life and disrupt daily activities (D. R. Putri et al., 2024). One physiological factor underlying this pain is a mineral imbalance, particularly calcium, which affects the ability of

muscles including uterine muscles to relax after contraction (Novitasari et al., 2024). When calcium intake is insufficient, uterine contractions may become stronger or prolonged, resulting in cramps and menstrual pain. Therefore, adequate calcium intake during menstruation is essential (Febriza et al., 2022).

Empirical studies support this hypothesis: demonstrating a significant association between low calcium intake and higher intensity of menstrual pain in women (Febriza et al., 2021; Subchan, 2024). Conversely, adequate calcium consumption including through *cow's milk* or other sources has been linked to reduced frequency and severity of *dysmenorrhea* (Rahayuningsih et al., 2023). Based on physiological rationale and empirical evidence, milk both *soy milk* and *cow's milk* as a source of calcium can be considered a *non-pharmacological* strategy to alleviate *dysmenorrhea*, although further studies are needed to compare the effectiveness of each type of milk.

Therefore, this study aims to synthesize existing evidence on the effectiveness of *soy milk* and *cow's milk* in reducing *primary dysmenorrhea* among adolescents using a *Systematic Literature Review (SLR)* method. This review synthesizes evidence from previous studies to compare the effectiveness of both interventions and to support the use of nutritional approaches as *non-pharmacological* strategies for managing *primary dysmenorrhea* in adolescents. Accordingly, the research question of this review is: Is *soy milk* administration more effective than *cow's milk* administration in reducing *dysmenorrhea* pain in adolescents?

RESEARCH METHODS

This study employed a *Systematic Literature Review (SLR)* method to analyze the effectiveness of *soy milk* and *cow's milk* in reducing *primary dysmenorrhea* pain in adolescents (Seriana, 2021). The *Systematic Literature Review (SLR)* process began with the *PICO Framework*, which was used to define the population (adolescents), intervention (milk administration), comparison (*soy milk* administration and *cow's milk* administration), and outcome (reduction in *dysmenorrhea* pain levels). The research question in this review is: "Is *soy milk* administration more effective than *cow's milk* administration in reducing *dysmenorrhea* pain in adolescents?"

The literature search for this study was conducted systematically using Google Scholar and Scopus databases through the Publish or Perish application, as well as a manual search of the PubMed website. The journal search was conducted using the following Boolean combination keywords: (adolescent OR teenager OR "young women" OR "female students") AND ("soy milk" OR "soy beverage" OR "soybean milk" OR "cow milk" OR "dairy milk" OR milk) AND (dysmenorrhea OR "menstrual pain" OR "menstrual cramps" OR "menstrual discomfort") AND (effectiveness OR effect OR intervention OR impact OR efficacy). This search process was limited to articles published between 2015 and 2025.

The inclusion criteria in this review include: (1) Adolescents with *primary dysmenorrhea* symptoms; (2) Discussing the effectiveness of *soy milk* or *cow's milk* administration on reducing *dysmenorrhea*; (3) Including the dose and duration of *soy milk* or *cow's milk* administration; (4)

Focusing on reducing *dysmenorrhea* pain; (5) Focusing on reducing *dysmenorrhea* pain (pre-post intervention score); (6) Journal published between 2015 and 2025. (7) The journal provides full text; (8) The type of article is original research (not a review, book, or proceedings); (9) Published through OJS or indexed journals (e.g. Scopus, PubMed, Google Scholar); (10) Written in Indonesian and English; (11) The journal article has complete scientific components (background, methods, instruments, analysis, results and discussion); (12) The journal is not duplicated (appears in more than one database such as Scopus, PubMed, or Google Scholar); and (13) The study uses a questionnaire or standard instrument to measure *dysmenorrhea* pain.

And the exclusion criteria in this review include: (1) Adolescents with *secondary dysmenorrhea* and non-adolescents; (2) Does not discuss the effect of *soy milk* or *cow's milk* on reducing *dysmenorrhea*; (3) Does not discuss the dosage and duration of *soy milk* or *cow's milk* administration; (4) Does not discuss reducing *dysmenorrhea* pain; (5) Does not provide analyzable data, (6) Journal published before 2015; (7) Journal not available in full text; (8) Not original research (review, opinion, book, proceedings); (9) Not published in an OJS journal or indexed journal; (10) Written in a language other than Indonesian or English; (11) Journal article does not have complete scientific components (background, methods, instruments, analysis, results, and discussion); (12) Duplicate publication (appears in more than one database such as Scopus, PubMed, or Google Scholar); (13) Research using a non-standard questionnaire.

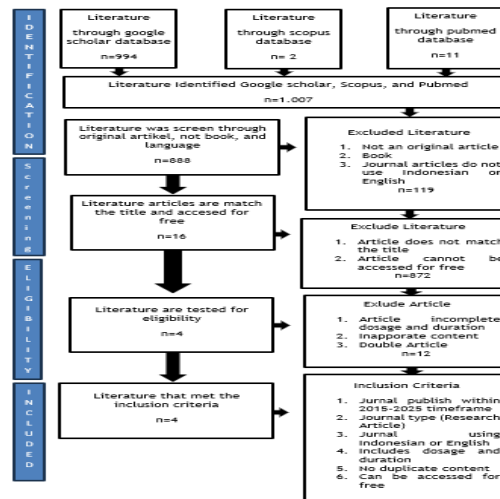


Figure1. Flowchart Of PRISMA Diagram

RESEARCH RESULT

Tabel 1. Literature Review

| Title Articles | Authors and Year of Publication | Purpose | Setting | Methods (Design, Sample, Variables, Instruments, Analysis) | Results | Conclusion |
|--------------------------------------------------------------------------------|---------------------------------------------|-----------------------------------------------------------------------|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| The Effect of Soy Milk on Reducing Primary Dysmenorrhea Among Adolescent Girls | Gufron Wahyudi & Devy Putri Nursanti (2025) | To determine the effect of soy milk on reducing primary dysmenorrhea. | SMK Puspa Bangsa Banyuwangi, East Java | <i>Design:</i> Quasi-experimental (pretest-posttest with control). <i>Sample:</i> 20 students (10 intervention, 10 control), ages 14-16. <i>Variables:</i> Independent = soy milk; Dependent = pain level. <i>Intervention:</i> 250 ml/day for 2 days when experiencing menstrual pain. <i>Instrument:</i> NRS. <i>Analysis:</i> Shapiro-Wilk, Paired t-test, Independent t-test. | Pain decreased from 7.50 to 3.40 (p = 0.000). Greater reduction than control. | Soy milk significantly reduces dysmenorrhea due to calcium and isoflavones aiding uterine relaxation. |
| Effect of Cow's Milk | Devi Febriani, | To examine the effect | SMKN 2 Malang | <i>Design:</i> True experiment | Significant | Cow's milk significantly |

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| Consumption on Primary Dysmenorrhea | Dewi Ariani & Inggita Kusumastuty (2018) | of cow's milk on dysmenorrhea intensity. | | (pretest-posttest with control). <i>Sample:</i> 21 students in 3 groups: 1000 mg Ca, 800 mg Ca, control. In the experimental group, cow's milk was given twice with an interval of 4 hours during the 8-hour research period, while the control group was given the same amount of cow's milk as the experimental group 2 after 8 hours of research period. <i>Variables:</i> Independent = calcium dose; Dependent = pain intensity. <i>Instruments:</i> SQ-FFQ, NRS. <i>Analysis:</i> Shapiro-Wilk, Paired t-test, ANOVA, Pearson correlation, Regression. | differe nces among groups (p = 0.000). Largest reduction in 1000 mg Ca group ($\Delta = 4.57$). | decreases dysmenorrhea; 1000 mg calcium is most effective. |
| Effect of Calcium Supplementation Through Dark Chocolate and Milk on Dysmenorrhea | Cia Aprilianti (2021) | To compare the effects of dark chocolate and milk on dysmenorrhea. | Poltekkes Kemenkes Palangka Raya | <i>Design:</i> Quasi-experiment. <i>Sample:</i> 50 students (25 chocolate, 25 milk). <i>Variables:</i> Independent = chocolate/milk; Dependent = pain intensity. <i>Instrument:</i> NRS. <i>Analysis:</i> Wilcoxon, Mann-Whitney. | Dark chocolate reduce d pain from 3.40 → 1.96 (p = 0.000); milk from 4.36 → 3.00 (p = 0.003). Dark chocola | Both interventions reduce pain; dark chocolate is more effective due to higher calcium-magnesium content. |

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|--------------------------------------------------------------------|-----------------------------------------|--------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-----------------------------------------------------------------------------------------------------|
| Non-pharmacological Therapy with Soy Milk for Primary Dysmenorrhea | Rani Fitriani & Eva Mesi Setiana (2024) | To determine the effect of soy milk on reducing dysmenorrhea pain. | MA Walisongo, Lampung Utara | <p><i>Design:</i> Quasi-experimental (pretest-posttest control). <i>Sample:</i> 20 students (10 intervention, 10 control) using purposive sampling. <i>Intervention:</i> 250 ml soy milk on first day of pain. <i>Variables:</i> Independent = soy milk; Dependent = NRS pain score. <i>Instruments:</i> NRS, questionnaire. <i>Analysis:</i> Shapiro-Wilk, Paired t-test, Independent t-test.</p> | te more effective (p = 0.021). | Soy milk effectively reduces dysmenorrhea and provides greater benefit than health education alone. |
|--------------------------------------------------------------------|-----------------------------------------|--------------------------------------------------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-----------------------------------------------------------------------------------------------------|

DISCUSSION

The synthesis of various studies shows that both *soy milk* and *cow's milk* have the potential to reduce *primary dysmenorrhea* pain in adolescent girls (Fitriani & Setiana, 2024). However, findings consistently indicate that *soy milk* provides a more stable and consistent effect compared to *cow's milk*. This advantage mainly comes from the isoflavone content found in soy, such as *genistein*, *daidzein*, and *glycitein* (Oliás et al., 2023). These compounds act similarly to estrogen and help regulate hormonal activity during menstruation. In addition, the calcium content in *soy milk* also contributes to reducing pain intensity, even though the amount is not as high as that in *cow's milk*. The combination of isoflavones and calcium creates a synergistic effect that helps relax uterine smooth

muscles, improve blood flow, and lower prostaglandin production, which is responsible for pain (Silva, 2021).

Empirically, several analyzed studies show a similar pattern: consuming approximately 250 ml of *soy milk* per day can reduce pain from moderate or severe levels to mild within the first two to three days of menstruation (Miraghajani et al., 2012). This consistent reduction in pain is a strong indicator that soy milk has a more stable therapeutic effect in managing *primary dysmenorrhea* compared to *cow's milk*. Respondents who regularly consumed *soy milk* during menstruation also experienced faster improvement in cramps and abdominal discomfort.

Meanwhile, *cow's milk* has also been shown to reduce menstrual

pain, but its effectiveness is strongly influenced by the amount of calcium consumed. Its response pattern tends to be dose-dependent, where the highest reduction in pain occurs at higher calcium intake. Unlike *soy milk*, *cow's milk* does not contain additional bioactive compounds such as isoflavones that can suppress prostaglandins or help (Rahayuningsih et al., 2023) stabilize hormones. Therefore, although *cow's milk* remains beneficial, its effectiveness is more limited and highly dependent on calcium adequacy.

The most notable difference between the two types of milk lies in their bioactive components. Isoflavones in *soy milk* act as phytoestrogens capable of binding to estrogen receptors in uterine tissue (Jaya et al., 2019). This mechanism helps reduce prostaglandin production, which is responsible for excessive uterine contractions, thus reducing cramps. Activation of these receptors also improves blood flow and decreases smooth muscle spasms, directly reducing pain sensations. *Cow's milk* does not provide this mechanism because it does not contain hormone-mimicking compounds.

Calcium in both *soy milk* and *cow's milk* contributes to reducing *dysmenorrhea* through its role in stabilizing muscle contractions, regulating nerve impulses, and decreasing neuromuscular excitability, which often worsens menstrual cramps. In *soy milk*, despite its lower calcium content, the presence of isoflavones makes its overall effect remain significant. This explains why *soy milk* can still be effective even when its calcium content is not as high as that of *cow's milk*.

Regarding the comparison between *soy milk* beverages and whole soybeans, both contain similar

isoflavone profiles. However, processing methods used in making *soy milk* such as boiling, grinding, and filtering may slightly reduce isoflavone levels. Even so, the beverage form remains effective and relevant because it is easier to consume and aligns well with adolescents' dietary habits.

From a methodological standpoint, the analyzed studies mostly used *quasi-experimental* designs, with one study adopting a *true experimental* design and another using a *pre-experimental* approach. The use of *quasi-experiments* is common because they are easier to implement in school environments while still capable of demonstrating cause-and-effect relationships. The inclusion of control groups helps minimize external influence, making the results sufficiently valid.

The respondents ranged from 14 to 22 years old. This age group is known to have higher prostaglandin levels, making them more prone to *dysmenorrhea*. Studies on late adolescents show that nutritional interventions through *soy milk* or *cow's milk* still produce positive responses, although pain intensity tends to be more stable compared to early adolescence. This indicates that nutrition-based interventions remain flexible and effective across different developmental stages.

Based on nutrient conversion in 250 ml of *soy milk*, the amount of isoflavones ranges from 25 to 40 mg, with *genistein daidzein* and *glycitein* as the main components. Calcium content ranges from 200 to 300 mg in *non-fortified* products and can reach around 500 mg in certain formulations. Although this is lower than the calcium content in *cow's milk*, the combined effect of isoflavones and calcium makes *soy milk* more holistic and stable in reducing pain intensity. This

becomes the fundamental reason why *soy milk* is considered more effective than *cow's milk* in managing *primary dysmenorrhea*, especially among adolescent girls.

Researchers assume that the effectiveness of *soy milk* in reducing *primary dysmenorrhea* pain is not only due to its calcium content, but primarily due to isoflavones such as genistein, daidzein, and glycitein, which have anti-inflammatory and antioxidant activities. Isoflavones are known to suppress the production of inflammatory mediators, particularly prostaglandins, which play a role in increasing uterine contractions and the intensity of *dysmenorrhea* pain. Furthermore, the antioxidant activity of isoflavones plays a role in reducing oxidative stress by neutralizing free radicals, thereby reducing the inflammatory process in uterine tissue. This is in line with research (Goh et al., 2022) which shows that genistein and daidzein have anti-inflammatory effects by inhibiting the cyclooxygenase (COX-2) pathway and reducing prostaglandin (PGE₂) synthesis, thus contributing to reduced *dysmenorrhea* pain. Although present in lower concentrations than genistein and daidzein, glycitein has been reported to contribute to the antioxidant and anti-inflammatory activities of soy isoflavones through modulation of cellular signaling pathways involved in oxidative stress and inflammation (Wang et al., 2025). In addition to their anti-inflammatory and antioxidant roles, isoflavones in soy milk have also been reported to support cell regeneration and tissue repair by stimulating endothelial cell proliferation and activity, which contribute to wound healing. Another study showed that genistein, one of the main isoflavones, promotes the

mobilization of endothelial progenitor cells to the site of injury, which supports tissue regeneration and repair (Peng et al., 2023). Based on these biological mechanisms, researchers believe that the isoflavone content in *soy milk* provides a more comprehensive effect in reducing *primary dysmenorrhea* pain than *cow's milk* interventions that rely solely on calcium, as it includes reducing inflammation, protecting against oxidative stress, and supporting cell regeneration.

CONCLUSION

Based on the synthesis of research findings, it can be concluded that both *soy milk* and *cow's milk* are effective in reducing *primary dysmenorrhea* among adolescents, however, *soy milk* demonstrates more consistent and significant results. The superiority of *soy milk* primarily lies in its isoflavone content such as *genistein*, *daidzein*, and *glycitein* which functions as phytoestrogens capable of suppressing prostaglandin production, enhancing vasodilation, and relaxing uterine smooth muscles.

These hormonal and neuromuscular effects are not found in *cow's milk*, giving *soy milk* a dual benefit despite its lower calcium content. Meanwhile, *cow's milk* also contributes to pain reduction, but the effect is highly dependent on calcium dosage, making its overall impact less pronounced than that of *soy milk*. The predominance of *quasi-experimental* research designs also indicates that this nutritional intervention can be practically implemented in school settings while still producing valid outcomes. Overall, the findings confirm that *soy milk* is a simple, safe, and effective *non-pharmacological*

approach for managing *primary dysmenorrhea*, particularly among adolescents who are more sensitive to hormonal fluctuations and elevated prostaglandin levels during menstruation.

Based on the analyzed studies, it is recommended that adolescent girls experiencing *primary dysmenorrhea* consider consuming 250 ml of soy milk per day for two days during painful episodes, as this intake has been shown to provide stable and meaningful pain reduction.

SUGGESTION

Schools and healthcare providers may also incorporate education on the benefits of soy-based nutrition into adolescent reproductive health programs. For future researchers, it is suggested to conduct *experimental* studies exploring additional sources of isoflavones beyond soybeans, such as other legumes (red beans, lentils) and herbal plants like red clover, which also contain phytoestrogens and may offer similar benefits for *dysmenorrhea* pain reduction. Furthermore, combining isoflavone-based interventions with other herbal remedies known to alleviate *dysmenorrhea* such as chamomile, ginger, and fennel.

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