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## **Exercise Intervention in Adolescent Premenstrual Syndrome: A Comprehensive Review**

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### **Abstract**

Many women experience physical or psychological changes during the days leading up to menstruation. When these symptoms persist during each menstrual cycle and significantly impact a woman's daily life, they are clinically referred to as premenstrual syndrome (PMS). It is estimated that more than 75% of adult women experience premenstrual symptoms, increasing the need for medical treatment for PMS. Comprehensive understanding of exercise effects on PMS and premenstrual symptoms might help for specialists in sports sciences. We conducted searches in global databases, which encompassed PubMed, Google Scholar, and Science Direct. Keywords included "premenstrual syndrome", "premenstrual symptoms", "adolescent", and "exercise". Two authors conducted article screening, and these authors extracted all studies examining the effects of exercise on premenstrual symptoms from the

eligible literature, irrespective of the specific type of exercise. This study generated 13 studies met our inclusion criteria. All exercises appear to reduce PMS and premenstrual symptoms. The prevalence of PMS ranges from 10% to 75% in adolescents. The most widely used exercise form of intervention to reduce PMS and premenstrual symptoms is stretching exercise. Exercise can alleviate PMS and premenstrual symptoms regardless of exercise time and frequency. Exercise proves to be a successful intervention for alleviating PMS and premenstrual symptoms in adolescents. The lack of sufficient research on the effects of exercise dose at school for premenstrual symptoms in adolescents. Further high-quality research is needed to provide evidence-based policy recommendations concerning the efficacy of exercise.

**Keywords:** Premenstrual Syndrome, Premenstrual Symptoms, Exercise, Adolescent, Review

### **Introduction**

According to the guidelines set forth by the American College of Obstetricians and Gynecologists (ACOG), premenstrual syndrome (PMS) is characterized by both physical and mood symptoms occurring the day prior to menstruation, which then subsides following the menstrual period <sup>[1]</sup>. These symptoms happen monthly and disrupt a woman's daily existence <sup>[1-3]</sup>. The typical indications of PMS are categorized into psychological symptoms and physical symptoms. Symptoms related to emotions encompass depression, episode of crying irritability, anxiety, social isolation, confusion, sleep disorder increased napping, and change in sexual desire. Manifestations of the physical condition encompass abdominal bloating and increase body mass, altered thirst and hunger sensations, breast soreness, headache, edema in the extremities, discomfort and weariness, dermatological issues, gastrointestinal disturbances as well as abdominal distress <sup>[1]</sup>.

More than 75% of adult women experienced premenstrual symptoms during their lifespan <sup>[2, 3]</sup>, whereas 61.4%-96% of adolescents experienced at least one premenstrual symptom <sup>[4-7]</sup>. The diagnosis of PMS by an obstetrician-gynecologist requires a woman experiences symptoms occurring in the 5 days preceding menstruation and continuing for a minimum of three consecutive menstrual cycles. These symptoms subside within 4 days after the period starts, and interfere with some regular activities <sup>[1]</sup>.

The prevalence of PMS ranges from 10%-61.4% in adolescents <sup>[6]</sup>, and 8%-41% in adults <sup>[8-10]</sup>. Notably, there was an elevated occurrence of PMS observed among adolescent females compared to adults. PMS has been associated with negative health related behaviors <sup>[11]</sup>, nutritional strategies <sup>[6]</sup>, and pharmacological strategies <sup>[12]</sup>. Various biological hypothesis have been put forward regarding the biological origins of PMS and premenstrual symptoms, but the etiology of PMS remain elusive. The ACOG suggests that regular aerobic exercise lessens PMS and premenstrual symptoms for many women, including reducing

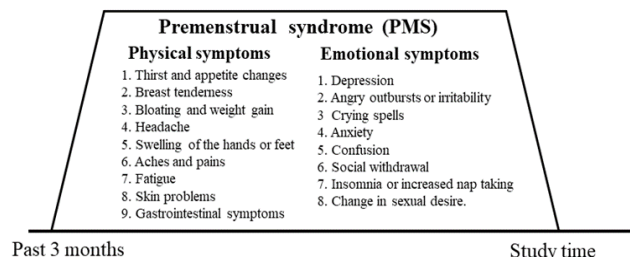
fatigue and depression [13]. This report systematically reviewed past studies that investigated the influence of exercise on PMS and premenstrual symptoms in adolescents.

**Materials and Methods**

This review included quasi-experimental and cross-sectional studies investigating the influence of different exercises on PMS and premenstrual symptoms. The targeted participants were adolescent females. The electronic databases utilized in this study were PubMed, Google Scholar, and Science Direct. The selected keywords consisted of "premenstrual symptoms," "premenstrual syndrome," "adolescent," and "exercise." The search strategy was developed by utilizing MESH (Medical Subject Headings) terms. Excluded from the analysis were review and qualitative studies, articles written in languages other than English, as well as articles that did not provide full-text access. There were no restrictions in assessing physical and emotional symptoms. The disclosure of interest was exercise, the targeted participants were adolescents, and the out-come of interest was PMS and premenstrual symptoms.

Adolescent is defined as the period of life beginning with onset of secondary sex characteristics until the cessation of growth and emotional maturity [14]. Premenstrual symptoms include physical symptoms and emotional symptoms. The participants who experienced premenstrual symptoms within the past three months were defined as PMS in this review

(Fig 1).

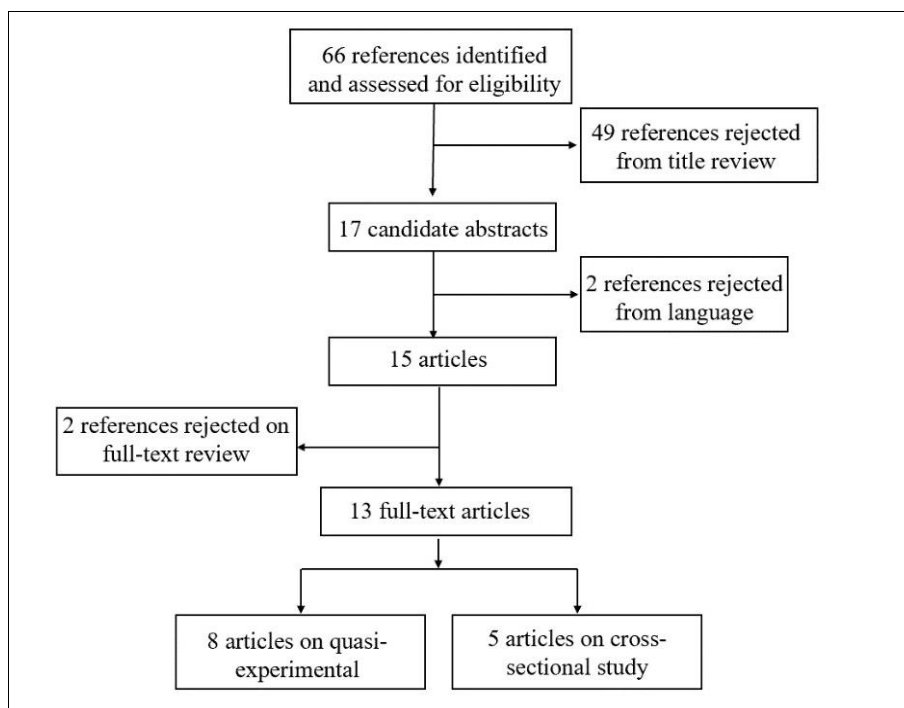


**Fig 1:** The definition of premenstrual syndrome (PMS)

Our study did not require ethical approval as it did not involve the collection of primary data. Each included study was evaluated for potential bias by authors using the Cochrane risk-of-bias tools, taking into account in research design. Studies that did not specify the type of exercise and symptom. Finally, the studies were reviewed based on the criteria for inclusion and exclusion.

In this study, we categorized anelastic training, whole body vibration (WBV), resistive exercise, Jacobson’s progressive muscle relaxation exercises, Flamingo balance, progressive muscle relaxation as stretching exercises and ball games, gymnastics, physical activity, regular exercise, track, swimming, fighting sports as aerobic exercises.

**Results**



**Fig 2:** Flow chart of literature review of articles in the association between premenstrual symptoms and exercise in adolescents

A total of 13 studies were reviewed, which represented research from 7 countries, the age of 12-20 years old with a total of 2423 participants. Figure 2 displays the study selection process and the outcomes of the literature search conducted for this review, resulting in a total of 66 relevant articles. We excluded reviews, duplicates, and studies conducted on adolescents investigating the relationship between premenstrual symptoms and exercise. We included total of 13 full-length papers that 8 quasi-experimental

studies and 5 cross-sectional studies. Exercise related to intervention of premenstrual symptoms are divided into 2 groups, namely stretching exercise and aerobic exercise. The characteristics of quasi-experimental studies are presented in Table 1 including population, the authors, study design, sample size, the premenstrual symptoms level, intervention exercise type, exercise duration, and out-come. The studies were conducted in different countries, used different diagnostic criteria and methods of data collection.

The PMS diagnostic including but not limited to Persian version of the Syndrome Symptoms Screening Questionnaire (PSSST) [15, 16], the Daily Record of Severity of Problems (DRSP) [16], Premenstrual Symptoms Questionnaire (PSQ) [3], and modified versions developed by different countries. The reported incidence rates of PMS varied widely across the studies. The highest reported incidence rate was 75% [17], while the lowest was 10% [3].

All studies were published between 2013 and 2021, with sample size from 13 to 506 participants and the participants' age from 12-20 years old. Stretching exercise including elastic exercise [15], resistive exercise [18], Jacobson's Progressive Muscle Relaxation (PMR) exercise [18-20], progressive muscle relaxation exercise and a kind of stretching exercise [16, 22], all those stretching exercises were capable of effectively reducing PMS and premenstrual symptoms, or mitigating the impact of PMS on adolescent school life. Stretching exercise resulted in a notable decrease in the intensity of mood, physical, and emotional symptoms [15, 16, 19, 20, 21, 22]. Whole body vibration and resistance exercise had a beneficial impact on enhancing premenstrual symptoms, such as anxiety, depression, craving, and hyperhydration [17]. A lack of exercise was identified as a risk factor of PMS and premenstrual symptoms for adolescent students [23-25].

There were 5 cross-sectional studies, the description of the cross-sectional experimental study in Table 2, including the author, country, study design, sample size, the exercise experience in PMS and no PMS, exercise type, exercise duration, and outcome. Three of them from Japan [22, 24, 26],

one from Iran [17], and one from Korea [25]. Included studies were published between 2016 and 2022, with sample size from 151 to 901 and the target participants from 14 to 19 years old. The 5 studies including 1 stretching exercise and 4 aerobic exercises, all demonstrated a positive relationship between premenstrual symptoms and exercise. Aerobic exercise including habitual exercise [17], weekly physical activity [22, 26], regular exercise (more than one time per week), activities demonstrated a positive effect on reducing PMS symptoms and school absenteeism [25]. One body-stretching exercise could reduce the physical symptoms severity of PMS. Regarding the relationship between athlete performance and premenstrual symptoms, one study showed that premenstrual symptoms may increase their risk of a stress fracture, and deteriorated balance during the premenstrual period [26].

In regard to exercise duration, no significant influence was observed on the modification of PMS and premenstrual symptoms. The elastic exercise was evaluated 3 sessions (45 minutes) per week for eight weeks [15], and resistive exercise 3 times per week for 12 weeks [15]. In 2 studies, Jacobson's progressive muscle relaxation exercise was given once a day for one month [19, 20], progressive muscle relaxation exercise was performed for 45 minutes daily for 10 days [16], stretching exercises for 3 days per week, performing 2 sessions per day, with each session lasting 20 to 30 minutes, over an 8-week period [21]. Exercise durations were not specific in 2 studies, while exercise types were aerobic exercise including regular exercise and swimming, respectively [13, 23].

**Table 1:** Description of the quasi-experimental study characteristics

First Author (Year)	Country	Study Design	Sample size	Premenstrual symptoms level of pre and post test	Interventions Exercise type	Exercise duration	Outcome
Maryam, K (2021)	Iran	Applied and experimental study	40 subjects (15-20 yrs)	Mean scores 15.20±2.45 → 8.00±1.25	Anelastic training	8 weeks	Mood-behavioral and physical symptoms ↓
ElDeeb, A (2020)	Egypt	Applied and experimental study	60 adolescents (16-19 yrs)	None	Whole body vibration (WBV) and resistive exercise	3 times/week for 12 weeks.	Anxiety depression, craving, hyperhydration symptoms ↓
Sudhadevi, M (2021)	India	pre test- post test design study	35 ninth standard students	Prevalence rate Mild: 46.7% → 96.7% Moderate: 50% → 3.3% Severe: 3.3% → 0%	Jacobson's Progressive Muscle Relaxation Exercises	45minutes, daily	The level of premenstrual syndrome ↓
GAYATHRI, M (2018)	India	Quasi-experimenta study	60 adolescent girls (12-14 yrs)	Mean scores 111±20.0 → 55.13±9.55	Jacobson muscle relaxation therapy	28 days	Effective in reducing premenstrual syndrome ↓
Taghizadeh, Z (2013)	Iran	Quasi-experimental study	123 students (17-19 yrs)	Mean scores 53.9 ±17.3 → 41.52 ± 15.04	Regular exercise	3 weeks	Somatization, anxiety and hostility ↓
OZER, S (2018)	Turkey	Unspecified	13 subjects (13.3±0.7 yrs5)	Menstrual and premenstrual 4.38±2.22 → 2.54±2.22	Flamingo balance	4 months	The balance scores in the premenstrual period are lower ↓
Dewi, M (2021)	Indonesia	Quasy-experimental study	54 adolescents (16-18 yrs) Intervention	(Pre) Mild: 15% Moderate: 36.5% Severe:48.5%	Progressive muscle relaxation	45mts/day, for 10 days	Decreasing premenstrual syndrome ↓

**Table 2:** Description of the cross-sectional study characteristics

First Author (Year)	Country	Study Design	Sample size	Exercise experience prevalence in PMS and No PMS	Exercise type	Exercise duration	Outcome
Mostafa Rad (2018)	Iran	Cross-sectional study	200 female high school students (15–17 yrs)	64.67%, 72%	Habitual exercise	3 times/week	PMS ↓
Takashi Takeda (2016)	Japan	Cross-sectional study	506 female students (16.4±0.78yrs) active athletes.	41.1%, 58.9%	Ball games, gymnastics, track, swimming, fighting sports and other sports	15.4±8.4hours/week	PMS ↓
Jungetsu Sei (2020)	Japan	Prospective intervention study	151female students in senior high school	74.2%, (none)	Body-stretching exercise	≥3 times / week	Physical symptoms ↓
Mari Tadakawa (2016)	Japan	Cross-sectional study	901 girls aged 15–19 yrs	9.9%, (none)	Regular exercise	≥1 time/week	School absenteeism ↓
Hye Jin Kim (2019)	Korea	Correlation al study	200 girls attending middle school (13.92±0.80)	Mean score: 25.3 out of 60 (none)	Activities	None	Stress levels ↓

## Discussion

This review showed that exercise was an effective intervention for reducing PMS and premenstrual symptoms. Most of the intervention exercise is stretching exercise. Exercise can alleviate PMS and premenstrual symptoms regardless of exercise time and frequency. But the effectiveness of exercise on specific premenstrual symptoms was not reported. Many underlying causes for premenstrual syndrome have been reported, including but not limited to increase levels of renin and plasma aldosterone, leading to sodium edema and reabsorption, decreased levels of progesterone, estrogen, and dysfunction in neurotransmitter secretion, particularly gamma aminobutyric acid (GABA) and serotonin [15, 26, 27].

Regular physical activity promotes venous blood return by engaging in continuous muscle contractions. It also helps prevent the accumulation of prostaglandins and other substances in the pelvis, thereby reducing physical symptoms [27]. Stretching exercise, when performed to improve endurance, muscle strength, and power, help reduce spasms. Effective management of muscle contractions can lead to a reduction in fat, an increase in prostaglandin displacement. Ultimately provide relief from muscle pain in targeted regions of the upper body [28]. Stretching exercise, such as PMR, belong to the real of mind-body practices that involving muscle group contraction and relaxation. These systematic methods are employed to achieve profound relaxation, with research indicating their beneficial effects on the quality of life in diverse medical and psychiatric disorders [29]. Furthermore, PMR has the potential to cultivate a deep understanding of tension and generate sensations of calmness throughout the entire body, leading to gradual alleviation of anxiety [30].

In this review, stretching exercises were shown to reduce the incidence of fatigue and headache, and even to decrease the incidence of headache by half [21]. The elastic training has the potential to alleviate physical symptoms by to 50% [15, 20]. After resistive exercise and WBV showed significant decreases of cramp and back pain [18].

The increase in estrogen, decrease in progesterone, heart rate, respiratory rate, and plasma cortisol level, in addition, magnesium deficiency can lead to emotional and psychological changes as well as manifesting various psychological symptoms [15, 20, 31]. Engaging in physical

activity can have a positive impact on mental health by decreasing the amount of body fat, which leads to lower levels of estrogen and higher secretion of progesterone. The maintenance of hormonal balance contributes to the improvement of psychological symptoms and can also aid in alleviating insomnia [15]. Intense exercise, low oxygen levels, and acidic conditions can trigger the release of beta-endorphins, a natural pain-relieving agent. This supports that elastic training has positive effects on reducing both pain and anxiety [32]. Depression may cause changes in mood by decreasing the levels of beta-endorphin in the brain and increasing the release of cortisol hormone from the adrenal glands. As there is a negative correlation between endorphin levels and depression, engaging in physical activity can alleviate depressive symptoms and enhance mental well-being by promoting endorphin synthesis [33-38].

Aerobic exercise has been found to significantly elevate serum progesterone levels, potentially leading to positive effects on mood and stress reduction through modulation of neurotransmitter systems such as GABA and serotonin that are influenced by sex steroids [39]. In this review, elastic training showed reducing the severity of mood behavioral symptoms by half [15]. The severity of anxiety, depression, and carving symptoms can be reduced by half through WBV and resistive exercises [18]. The elastic training can also reduce the severity of psychological symptoms by half [20], furthermore, after stretching exercise intervention, mood symptoms can be reduced by two-thirds [21].

The substantial release of endorphins during exercise has been shown to be correlated with the alleviation of pain, anxiety, and depression in premenstrual syndromes, counteracting the potential reduction of endorphins during the luteal phase. Aerobic exercises such as swimming and ball games have demonstrated positive effects on the mental well-being of young individuals [36]. According to a study conducted on high school female students showed that those who participate in physical education classes twice a week had a lower incidence of PMS [40].

Previous studies have demonstrated that stretching exercises are effective in reducing anxiety, depression, and insomnia [41-43], which corresponds to the emotional manifestations of PMS encompass a range of symptoms such as feeling of depression, anxiety, sudden outbursts of anger, irritability, and insomnia. Regular exercise of stretching can improve



one's ability to handle various stressful situations and increase feeling of self-regulation<sup>[44-47]</sup>.

This can provide an explanation for the effectiveness of stretching exercises in reducing premenstrual symptoms among adolescents. In addition, stretching exercise can be practiced anywhere making it easy for people to benefit from the technique to relax their body and mood over time<sup>[48-50]</sup>. This may explain why most of the intervention exercises in adolescents are stretching exercises. According to the ACOG, puberty is a time when an adolescent's body changes and becomes more like an adult, it is a distinct period in the growth and development of humans marked by notable alterations in both psychological and physical aspects<sup>[24]</sup>. During puberty, hormones cause the first menstrual period and a majority of changes, which were closely associated with the emotional symptoms of PMS.

In this review, intervention exercises both stretching exercise and aerobic exercise showed effectiveness in reducing PMS<sup>[51]</sup>. However, this is different from the aerobic exercise recommended by ACOG which recommends brisk walking, running, cycling, and swimming. There are few types of exercise interventions, none of which is school sports such as badminton, basketball, football, baseball, and tennis.

Exercise at the recommended public health dose is an effective standalone treatment for mild to moderate major depressive disorder<sup>[5]</sup>. This review showed that there was no difference in results for the exercise three days per week and the five days per week. The key determinant for the reduction and remission of symptoms is the total energy expenditure, and it is recommended that adults engage in at least 30 minutes of moderate-intensity exercise on most, if not all, days of the week. This can significantly decrease the risk of premature mortality and morbidity from a range of diseases<sup>[5]</sup>. It is recommended to engage in aerobic exercise or mind-body exercise, with a level of intensity, for 3-5 sessions per week over a period of 4-16 weeks<sup>[52]</sup>. As well as ACOG recommendations, a good goal of aerobic exercise is at least 30 minutes per day.

Participating in regular exercise will be more beneficial in declining premenstrual symptoms, such as elastic exercise 3 sessions per week, every session 45 minutes<sup>[15]</sup>, resistive exercise 3 times per week<sup>[18]</sup>, stretching exercises 3 days per week, and 2 times per day with a duration of 20-30 minutes<sup>[21]</sup>. Regular stretching exercises enhance coping abilities in various stressful situations and contribute to feelings of self-control<sup>[35-39]</sup>. However, the exercise frequency and time are different even in the intervention of the same sports, for example, Jacobson muscle relaxation 45 minutes once a day for one month<sup>[19]</sup> and 25-30 minutes once a day for 28 days have the similar effect on reducing the level of PMS among adolescents<sup>[20]</sup>.

In this review, among all the studies, fatigue was the most prevalent somatic symptom, whereas depression was the most common affective symptom among adolescent female students. There are several studies to detect the impact of exercise on PMS and premenstrual symptoms, elastic training and consumption of *Foeniculum Vulgare* led to a notable reduction the intensity of both physical and emotional symptoms<sup>[15, 26, 22]</sup>.

This study had some constraints. Firstly, due to the different diagnostic criteria of PMS, intervention exercise type and duration, the results of this study were prone to bias. Secondly, there were no standards for the sample size of

participants, which may lead to the bias of results.

## Conclusion

Exercise is an effective intervention for alleviating PMS and premenstrual symptoms in adolescents. The most effective intervention exercise is stretching exercise. The paucity of research on the exercise dose at school for premenstrual symptoms in adolescents. More high-quality research and evidence-based policy recommendation regarding the effectiveness of exercise is required.

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