

Influence Of Pre-Menstrual Syndrome On Athletes' Performance: A Systematic Review

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Abstract

Background: Female reproductive hormones fluctuate over the course of the menstrual cycle and are known to have an effect on a number of physiological aspects, which may then have an effect on their physiology and athletic ability when they exercise.

Objective: This study was to investigate whether premenstrual syndrome had any possible performance-related effects on female players.

Methods: We searched Google Scholar, Pubmed, and Elsevier with filters to search articles reporting the prevalence of PMS and its effect on the performance of female athletes, covering the time span from February 2000 until August 2022. This review was conducted following the standard of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Result: A total of 3100 search results were yielded. About 1192 papers were reviewed of which 481 studies were assessed for eligibility. Of these, only 18 precisely investigated the influence of pre-menstrual syndrome on the performance of female athletes, they included a total of 553 elite female participants. Among these studies, one performed hormonal testing through the sampling of blood. The remaining relied on athletes' menstruation diaries.

Conclusion: This systematic review gave the idea that premenstrual syndrome has effects on physical as well as mental aspects and that affects athletes' performance due to unbalanced hormone levels. Therefore, it is necessary to handle the performance-based evaluation of female athletes by not using the same standards as male athletes taking this element into consideration.

Keywords: Pre-menstrual syndrome, PMS, performance, female athletes, menstrual cycle, prevalence

Introduction

Premenstrual syndrome (PMS) is a condition marked by the co-occurrence of psychological symptoms such mood swings, depression, lack of confidence, anxiety, and irritability with physical symptoms without the existence of an underlying psychiatric problem.¹ It is a natural physiological occurrence, but even little changes in the frequency of cycles or flow during the periods might affect a woman's ability to go about her daily activities comfortably and effectively, therefore, it highly affects the performance of a female in any area of work.² To determine the prevalence of premenstrual disorders and to establish the occurrence of premenstrual syndrome (PMS) in cross-sectional studies and particular clinical cases, numerous types of studies have been carried out to deal with the issue based on normal physiological process for a female with durable ideas and solutions.³ In India, estimates of the reported prevalence of PMS have ranged from 14.3% to 74.4%. Diagnostic standards or methods, as well as sociodemographic and subcultural variations within a multicultural nation like India that affect the expressivity of symptoms, are all factors that affect prevalence estimations.⁴

It is evident that female participation has increased dramatically from the 1960 Games in Rome, where there were 11% of female athletes overall. At the Olympic games in Paris in 2024, there will be complete gender

parity in terms of the number of athletes. As athletes frequently respond differently to a similar training stimulus and the training load necessary for adaptation may range dramatically between sexes, a one size fits all strategy is impractical. Any personalized strategy to training should ideally combine technical and scientific resources with approaches catered to the needs of each athlete.⁵ Accordingly, researchers' interest in the health effects of this tendency has increased.⁶ The majority of sports science research has been done on male subjects, and the conclusions of this study have been improperly extrapolated to female athletes. One important element required to create a female evidence base in sports science is the investigation of the effects of menstrual cycle phase on physical performance. The growth of this body of knowledge may help us better understand how the menstrual cycle may affect athletes and guide the design and implementation of training, recuperation, and athlete monitoring regimens that take menstrual cycle phase into account.⁷

As the prevalence is seen to be larger in number this issue needs to be addressed, so, there are many studies showing evidence for effect of PMS on athlete's menstrual cycle as well as their performance. One of the study showed that, regular exercise alters cyclic exposure to oestrogen and progesterone. Even when no other changes in the menstrual cycle are apparent, women who participate in vigorous physical activity may experience a shorter luteal phase. Lowered follicular-phase estradiol, reduced luteal-phase progesterone, and the absence of the midcycle luteal hormone surge are possible hormonal changes responsible for these modifications. It should be mentioned that the nature of athletic activities affects the prevalence of oligomenorrhea, amenorrhea, and dysmenorrhea.⁸ The cycle-related changes in hormone levels produce a variety of confusing factors that affect performance. Some writers compiled a list of sports performance factors that could be impacted by the menstrual cycle, including cardiovascular, pulmonary, cognitive, orthopaedic, and metabolic characteristics. These factors could have an impact on strength as well as aerobic and anaerobic performance. Olympic medal-winning performances have nonetheless occurred across all periods of the menstrual cycle, despite the fact that some female athletes see a decline in their physical capacity over the course of their cycle.⁵

As a result, even though hormonal changes are not properly taken into account when tailoring women's training, the menstrual cycle might be recognised as a possible performance factor. However, novel research has recently been published that examines how female athletes' menstrual cycles may affect their training. This article also illustrates the scope of the problem across several industries. Therefore, in order to give evidence-based recommendations for training individualization related to performance, this systematic review was done to thoroughly assess research procedures that have examined the relationship between menstrual cycle phases and performance in elite female athletes. Selected studies that specifically examined the impact of menstrual phases on indicators of top performance were discussed.

Eligibility

The review only included prospective, controlled, or uncontrolled intervention trials that had been written about in scholarly journals. Multiple baseline designs, case reports, case series, comments, letters to the editor, and expert opinions are not included in this evaluation. The language was not a barrier in this assessment. Studies on female athletes' abilities in top-level tournaments are necessary.

As was already noted, the search was designed to include all research that looked at how premenstrual syndrome affected female athletes' performance. We decided to stop running trials in situations where several variables were offered or permitted at the same time. The review was restricted to studies that examined premenstrual syndrome's physiology, psychological causes, and premenstrual syndrome-related performance evaluations. Studies that did not demonstrate a connection between premenstrual syndrome's hormonal imbalances, physiology, psychological consequences, physical changes, and performance enhancement, etc., were removed. We excluded case studies in ongoing trials, retrospective studies, publications in other languages, and items that were wholly unrelated after evaluating the titles and abstracts. Young female athletes with normal menstrual cycles made up the population of interest.

The only papers selected for the review were those that were peer-reviewed and had full texts available in English. All research articles, irrespective of the study's design, were approved. We excluded studies that were solely disseminated as abstracts or dissertations.

Inclusion and exclusion criteria

The following criteria were used to extract data: year of publication from 2000 to 2022, sample size from 30-300, recruiting approach, age 15-30 years old, female athletes, level of performance (low-high), population of non-athletes, types of sports, and study types. As shown in Table 2.

Search Strategy

We carried out a thorough, systematic literature search to find all pertinent English papers using the following databases: Google Scholar, Pubmed, and Elsevier with filters to search articles as English articles covering the time span from February, 2000 until August, 2022, we chose 2000 as the lower cut-off as before that menstrual cycle was not the subject on which studies were published. The following keywords were used : Premenstrual syndrome, PMS, female athletic performance, menstrual cycle, prevalence of premenstrual syndrome in India. No other records from several other sources were discovered. We skimmed the titles and abstracts for case studies in current trials, retrospective research, publications in other languages, and even papers that were completely unrelated. See Fig. 1.

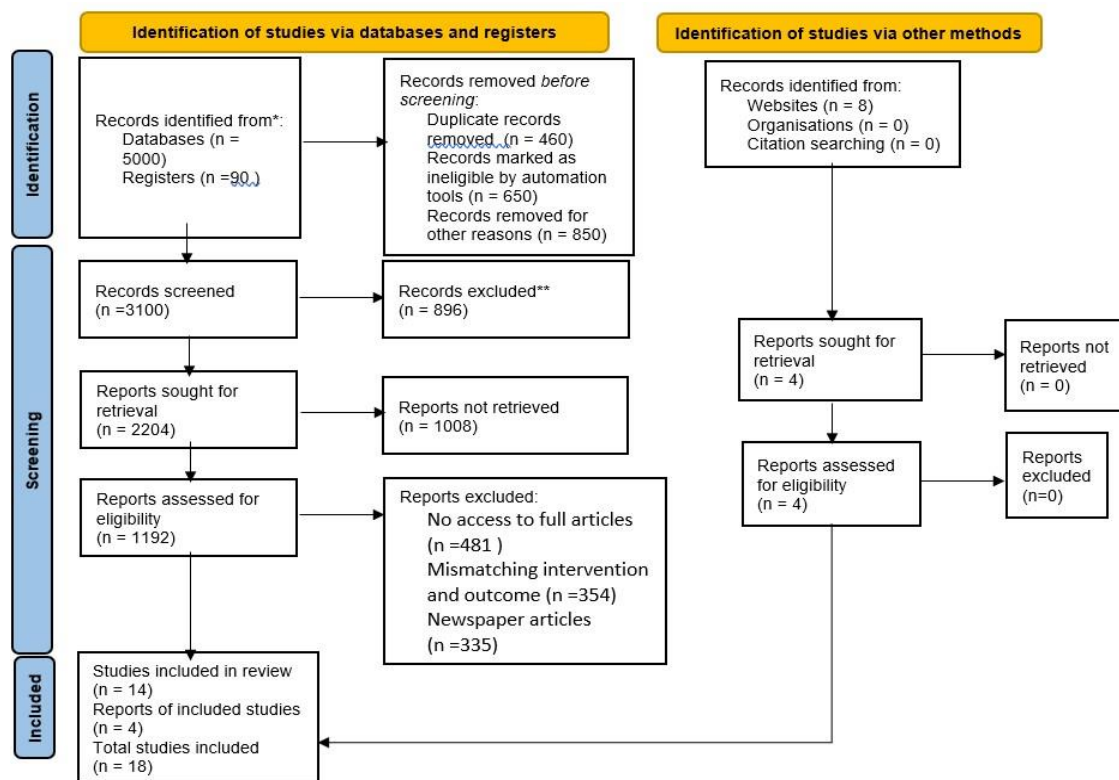


Fig 1. Prisma Flow Diagram -Search Strategy and Retrieval OF ARTICLES

Result

As discussed in Table 1, **R. Momma et al. (2021)** considered it necessary to carefully choose the time of the luteal phase when PMS manifests, and it will be necessary for the future to split the menstrual cycle into more precise stages, including the assessment of hormone concentrations.⁹ Whereas, **R. Findlay et al. (2020)** gave the first in-depth look into how athletes experienced their periods and how they felt it affected their preparation and performance. It emphasizes how differently people respond to menstrual "problems" and underscores how important it is for physicians and support personnel to profile and monitors the menstrual cycle as well as continue to increase their awareness, openness, knowledge, and comprehension of it.¹⁰ However, a study done by **M. Czajkowska et al. (2019)** showed that prior to their first period, girls who engage in intense physical activity can delay menarche, and competitive sports can encourage premenstrual syndrome and premenstrual dysphoric disorder.⁶ An observational study done by **R. Julian et al. (2017)**

suggested that there may have been a decrease in maximal endurance performance during the LP of the menstrual cycle. The performance decline was not seen for sprinting or jumping, though. In order to ensure that variations in performance are consistent with the outcome and not caused by the impacts of the menstrual cycle, practitioners should maintain menstrual cycle phase constant when performing routine physical assessments with their athletes. Alternately, the cycle phase should at the very least be noted and considered when interpreting the data.¹¹ However, Premenstrual symptoms may have an impact on athletic performance and increase the incidence of stress fractures in adolescent athletes, according to **T. Takeda et al. (2016).**¹²

Table 1: Depicts The Result Evidence And Strategies.

Author/Year	Study type	Aim of the study	Participants	Outcome Measures	Result
R. Momma 2021 ⁹	Observational Study	To look at the connection between female track and field competitors' jump performance and PMS	16 female athletes who have natural basal body temperature patterns with the menstrual cycle	Physically, countermovement jump (CMJ) and rebound jump (RJ) were tested in the low-temperature phase and high-temperature phase using the premenstrual syndrome questionnaire developed by ACOG.	Participants who experienced PMS-related breast discomfort displayed greater drops in CMJ jump height (p = 0.038) and RJ index (p = 0.015) during the high-temperature period.
R. Findlay 2020 ¹⁰	Observational Study	To investigate athletes' past, present, and perceptions of the menstrual cycle in connection to how it affects their ability to compete in sports.	15 international female rugby players	Audio-recorded interviews were done with all the participants about their medical records, hormonal contraceptive history, menstrual cycle status, sanitary protection, symptoms, and discomforts.	93% of women had period symptoms, 33% experienced significant bleeding, and 67% thought it had an impact on their performance
M. Czajkowska 2019 ⁶	Observational and Cross-sectional Study	To evaluate menstrual cycles, menstrual disorders, and the prevalence of PMS and PMDD in competitive female gymnasts and their contemporaries who do not participate in any activity.	The total number of females was 85. In the study group, there were 45 professional gymnasts 15-17 years of age, and the control group had 40.	PSST Questionnaire	The results of the study indicated that competitive sports encourage premenstrual syndrome and premenstrual dysphoric disorder and that rigorous exercise by girls before their first period is a menarche-delaying factor.
R. Julian 2017 ¹¹	Observational Study	To ascertain whether a high-level soccer-specific population's menstrual cycle phase affects several physical performance measures connected to soccer.	35 high-level female soccer players, all players of the local second-league female football team PLOSONE	Counter-movement jump (CMJ), 3x30m sprints, Yo-Yo Intermittent Endurance test (Yo-Yo IET), and blood collection	Yo-Yo IET performance was lower in mid-LP compared to early FP.
T. Takeda 2016 ¹²	Cross-sectional Study	To look into the connection between PMS and the likelihood of stress fracture.	394 female athletes who had a normal menstrual cycle	Premenstrual Symptoms Questionnaire (PSQ)	8.9% of women reported having moderate-to-severe PMS. Additionally, 66 athletes (16.8%) said they had a stress fracture.
T. Takeda 2015 ¹⁷	Cross-sectional Study	To ascertain the occurrence and effects of PMS and PMDD in Japanese collegiate athletes, focusing on how they affect their ability to perform athletically.	232 female collegiate athletes	PSST questionnaire	Moderate to severe PMS and PMDD prevalence rates were 8.6% and 2.9%, respectively. In a match or practice, 44.3% of participants' athletic performance was found to be impaired.

Table 2: Level and quality of evidence supporting the influence of PMS on female athletes' performance

Influence of PMS on athletes' performance		PEDro Item Scoring										Scoring	
Author	Sackett Level of Evidence	1	2	3	4	5	6	7	8	9	10	11	PEDro Total Score
R. Reid et al(2022) ¹⁸	IV	1					1	1		1		1	5
R. Momma et al (2021) ⁹	III	1		1	1	1		1	1	1			7
M. Carmichael et al (2021) ⁷	II	1					1	1	1		1	1	6
A. Dutta et al (2021) ⁴	I	1					1	1	1	1	1		6

A. Meignie et al (2021) ⁵	I	1		1			1	1	1		1	1	7
B. Dilbaz et al (2021) ¹	III	1	1	1	1	1		1	1			1	8
M. Gao et al (2021) ¹⁴	V	1	1	1	1			1	1	1		1	8
R. Findlay et al (2020) ¹⁰	III	1	1		1	1	1	1	1	1		1	9
M. Czajkowaska et al (2019) ⁶	III	1	1		1	1	1	1	1		1	1	8
A. Durairaj et al (2019) ¹⁶	III	1	1		1	1	1	1	1		1	1	8
R. Julian et al (2017) ¹¹	II	1	1	1	1	1	1	1					7
T. Takeda et al (2016) ¹²	II	1			1	1	1	1		1	1	1	8
T. Takeda et al (2015) ¹⁷	I	1		1	1	1	1	1	1	1		1	8
M. Czajkowaska et al (2015) ³	II	1	1		1	1	1	1	1			1	8
P. Michael et al (2014) ¹³	V	1						1	1	1	1		6
P. Mukherjee et al (2014) ⁸	III	1	1	1			1			1	1	1	7
M. Giacomoni et al (2000) ¹⁵	II	1		1	1	1		1	1	1	1	1	9

Sackett's Levels of Evidence

Levels	Intervention Studies
I	A systematic review of randomized, controlled trials (RCTs) Large RCT with narrow confidence interval (n_100)
II	Smaller RCTs (n_100) Systematic Reviews of cohort studies Very large ecological studies
III	Cohort studies (must have concurrent control group) Systematic Reviews of case control studies
IV	Case series Cohort studies without concurrent control groups Case-control study
V	Expert opinion Case study Bench research Expert opinion based on theory or physiological research Common sense anecdotes

Discussion

Few research examine how physical activity affects the intensity as opposed to the frequency of PMS symptoms. In accordance with the ACOG criteria, no research has been done to date on PMS in competitive athletes. Prospective studies have demonstrated that some PMS symptoms can be reduced or eliminated by modest physical activity; nevertheless, there has been no discernible improvement in the affective domain (i.e., tension and irritability)¹³. Age raises the likelihood of PMS in athletes. The study's adolescent and female subjects' ability to operate professionally, socially, and interpersonally is hampered by a few PMS and PMDD symptoms.³It has also been hypothesized by many studies that great female soccer players' physical prowess is closely correlated with their level of training and maximum capacities; as a result, it may be argued that success depends on maintaining such elevated levels all across the cycle.¹ The findings of a sequential and ongoing treadmill running test showed that in 78% of the population, a decrease in the number of meters finished was seen in the mid-LP. It is widely known that a woman's resting body temperature can vary between phases by between 0.3 and 0.5 C. The spike in progesterone seen during the LP has been linked to this rise in body temperature.¹⁴ It has been hypothesised that the resulting rise in body temperature will reduce the capacity for sustained exercise and exacerbate cardiovascular strain. This has been observed in earlier research, which showed increased VO2 levels during exercise at specific percentages of VO2 max, along with elevated heart rhythms and RPE values.¹¹A study showed that amenorrheic endurance-trained athletes recover from plantar flexion exercises more slowly than their eumenorrheic counterparts, suggesting that ovarian hormone status may have an impact on muscle phosphate recovery. The natural ovarian cycle is characterised by wide fluctuations in sex hormone concentrations that may affect athletic performances.¹⁵The most prevalent illness in adolescent girls is dysmenorrhoea, and doctors frequently overlook PMS in favour of dysmenorrhoea. But the statistics revealed that 41.1% of young females athletes had premenstrual symptoms that negatively impacted their athletic performance. The female athlete triad is a well-known substantial health concern for bone fracture in female athletes. Because of this, there haven't been any prior research on bone fractures in female athletes who have regular periods. It is challenging to evaluate our information with other data from populations like ours.² Those with PMS showed a noticeably larger postural instability than women without PMS, according to a prior study. It's probable that premenstrual physical symptoms disrupted motion, causing gawky movement and adding additional stress to athletes' bones. It has also been seen that athletes' motion is further disrupted by PMS, which makes pre-existing mastalgia worse and causes excessive breast motion that causes breast pain. Athletes experience substantially more burden as a result of their behavior during competition.¹² A large percentage of female athletes think their menstrual cycle phase affects their performance, yet numerous studies have found no difference in performance between MC stages. Resilience and aerobic effectiveness were most consistently cited to be compromised

in the late luteal phase, as well as anaerobic efficiency was often reduced in the late follicular phase, although there were discrepancies in the results of the research that did examine a menstrual cycle effect on performance.¹⁶ Regarding perceived performance, one of the phases where athletes felt their performance dropped off was the late luteal phase. Menstrual cycle phases have distinct effects on strength, aerobic, and anaerobic performance, according to research that indicates the menstrual cycle does play a mediating function in physical performance.⁷ Some studies show that athletes experience significant stress due to intense training and competitive anxiety. Exposure to stress may cause long-lasting changes in the neuroendocrine system and PMS/PMDD. Premenstrual symptoms that affected athletic performance were "Difficulty concentrating" and "Fatigue or lack of energy." Elite athletes experience greater pressure than non-elite athletes because they are subject to greater expectations or attention.¹⁷ Several research, including the current study, have not discovered a connection regarding physical activity and PMS, despite the fact that numerous societies have advised against it in the management of PMS. Per the studies, menstrual syndrome symptoms or premenstrual symptoms (PMS) may have an impact, presumably by affecting the stretch-shortening cycle for tendons and ligaments.¹⁸ There is currently little research on the subject, making it difficult to draw any definitive conclusions on which performance factors are impacted by hormonal changes and when and how. However, according to a recent analysis, female athletes' reactions to physical exercise can be enhanced by adjusting to menstrual cycle stages.⁵

In spite of this, several of these findings highlight the necessity for menstrual cycle analysis and monitoring by researchers and support professionals, as well as the ongoing development of understanding, awareness, understanding, and knowledge of menstrual cycle.

Conclusion

The preponderance of studies that are now available indicates that premenstrual syndrome affects female athletes' performance both physically and psychologically because of the unbalanced hormone levels that occur during the menstrual cycle phases.

Therefore, it is necessary to handle the performance-based evaluation of female athletes using the same standards as male athletes without taking this element into account.

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