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# MENSTRUAL CYCLE DISORDERS IN FEMALE ATHLETES: PREVALENCE, CAUSES, AND CLINICAL MANAGEMENT

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**ABSTRACT**

**Introduction:** Menstrual cycle disorders are a common and clinically significant health problem among female athletes. They occur more frequently in physically active women than in the general population and are often associated with low energy availability, excessive training load, and psychosocial stress. These disturbances may impair reproductive health, bone metabolism, and overall athletic performance.
**Objective:** To review the current scientific literature on the prevalence, causes, clinical classification, and management of menstrual cycle disorders in female athletes.
**Methods:** A narrative review of recent scientific literature was conducted using peer-reviewed studies, review articles, and clinical recommendations concerning menstrual dysfunction in physically active women. The review focused on the epidemiology, etiology, diagnostic approach, and current management strategies for menstrual cycle disorders in female athletes.
**Conclusions:** Menstrual cycle disorders in female athletes represent an important clinical and public health issue and should not be regarded as a normal consequence of sports participation. Early identification, restoration of energy balance, multidisciplinary support, and individualized management are crucial to improve both long-term health outcomes and athletic performance. Greater awareness among athletes, coaches, and healthcare professionals is necessary to ensure effective prevention and timely intervention.

**KEYWORDS**

Amenorrhea, Oligomenorrhea, Luteal Phase Defect, Female Athlete Triad, Relative Energy Deficiency in Sport, Sports Medicine, Female Athletes

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## 1. Introduction

Women who participate in competitive sports are significantly more likely to experience menstrual cycle disorders than the general population [1]. A regular menstrual cycle is an important indicator of health in female athletes, reflecting proper energy balance and hormonal function. Conversely, cycle abnormalities such as amenorrhea, oligomenorrhea, or other ovulatory disorders are common signs of physiological overload in female athletes [2]. Such disorders can adversely affect both health and athletic performance, contributing to infertility, reduced bone mineral density, and increased injury risk, among other consequences [1], [3].

The predominance of menstrual disturbances in athletes is multifactorial. Intense physical training, if not matched by adequate nutritional intake and recovery, can create a state of low energy availability that disrupts the neuroendocrine regulation of the menstrual cycle [4], [5]. Under the strain of heavy exercise, caloric deficit, and psychological stress, the hypothalamic–pituitary–ovarian (HPO) axis may suppress gonadotropin-releasing hormone pulsatility [1], [6]. This leads to lower follicle-stimulating hormone and luteinizing hormone output, hypoestrogenism, and ultimately menstrual dysfunction [3]. Exercise- and stress-induced cessation of menses in the absence of organic disease is termed functional hypothalamic amenorrhea, and it represents one of the most frequent causes of secondary amenorrhea in athletes [1]. Contributing factors often overlap, including prolonged energy deficiency, low body fat, high training volume, poor recovery, and psychosocial stressors [3]. Notably, these menstrual irregularities are a core component of the Female Athlete Triad and the broader Relative Energy Deficiency in Sport syndrome, which link energy imbalance with impaired menstrual and bone health [7].

Given the potential short- and long-term health implications, there is a need for heightened awareness and proactive management of menstrual cycle disorders in female athletes. This article reviews recent evidence on the prevalence of menstrual disorders in athletes, examines the underlying causes and mechanisms, discusses the clinical classification of these disorders, and outlines current best practices in management. Understanding these aspects is critical for coaches, sports medicine clinicians, and the athletes themselves to ensure athletic training is balanced with health and hormonal well-being.

## 2. Methodology

This study is a narrative review and provides an analysis of the current scientific literature concerning menstrual cycle disorders in female athletes. The aim of this review was to identify studies describing the prevalence, underlying mechanisms, clinical spectrum, and current management strategies related to menstrual dysfunction in physically active women.

The literature review was based on peer-reviewed publications addressing menstrual disorders in athletes, functional hypothalamic amenorrhea, low energy availability, and Relative Energy Deficiency in Sport. The analysis included review articles, observational studies, cohort studies, and clinical recommendations published in English. Particular attention was given to studies concerning prevalence, endocrine mechanisms, diagnostic evaluation, and interdisciplinary management of menstrual dysfunction in female athletes [1], [3], [5], [12].

## 3. Prevalence

Multiple studies in recent years have confirmed that menstrual cycle disorders are notably common among female athletes. The prevalence varies widely across sports and competitive levels, but remains consistently higher than in non-athletic populations. In the general population, only an estimated 5–10% of women of reproductive age experience chronic menstrual irregularities [8]. By contrast, athletes in certain sports exhibit much greater rates of dysfunction. A 2022 rapid review of 48 studies reported prevalence of athletic menstrual disorders ranging from 0% up to 60% across different sports [1], [8]. Endurance and aesthetic disciplines tend to show the highest frequencies. For example, cycling, long-distance running, gymnastics, ballet, and similar leanness-focused sports show particularly elevated rates of secondary amenorrhea and oligomenorrhea [1], [8], [9].

Importantly, while athletes in leanness-focused sports are at highest risk, menstrual disturbances are not confined to those disciplines alone. Recent survey data from a cohort of 584 elite female athletes in Germany across 64 sports showed that athletes from diverse sports also reported menstrual dysfunction [2]. In this large sample, about 31% of athletes not using hormonal contraception had an active menstrual disorder, including oligomenorrhea, secondary amenorrhea, and primary amenorrhea [2]. These findings reinforce that the problem is widespread and should not be limited only to sports with strong weight-related pressures.

There is also a tendency to underestimate the prevalence of menstrual irregularities in athletes. Tracking menstrual status is rarely done in a systematic way in training programs [1], [2], and both athletes and coaches may regard the absence of menstruation as an expected side effect of vigorous training [9], [10]. Additionally, some athletes take hormonal contraceptives that produce withdrawal bleeding, which can hide the presence of underlying menstrual disturbances [2], [10]. In practice, this means that menstrual dysfunction may remain unrecognized for long periods.

Such scenarios underscore the need for active monitoring and greater awareness. Even a seemingly regular monthly cycle may not reflect normal ovarian activity in a female athlete. In summary, menstrual cycle disorders affect a significant fraction of female athletes, far more than in non-athletic populations. This high prevalence, combined with frequent under-recognition, makes it essential for those involved in athlete care to actively monitor menstrual health as part of routine sports medical oversight.

## 4. Etiology

The etiology of menstrual cycle disorders in athletes is multifactorial, but the primary cause is functional hypothalamic amenorrhea resulting from energy imbalance and physiological stress [3], [13]. At the core is low energy availability, a state in which the calories remaining after exercise are insufficient to support normal endocrine function. In practical terms, many female athletes combine rigorous training schedules with inadequate caloric intake, whether due to unintentional undereating, dieting, or disordered eating, leading to a chronic energy shortfall [3], [14]. When the body perceives an energy deficit, it conserves resources by downregulating the reproductive axis. This adaptive mechanism involves the hypothalamus reducing its pulsatile secretion of gonadotropin-releasing hormone, which in turn diminishes pituitary release of luteinizing hormone and follicle-stimulating hormone and leads to impaired ovarian estrogen production [3], [5].

Multiple interrelated factors contribute to this energy-driven reproductive suppression. High training load and intensity increase energy expenditure, and if athletes do not proportionally increase dietary intake, they enter a state of negative energy balance [11], [14]. Inadequate nutrition concerns not only total calories but also micronutrient deficiencies that may worsen the situation [3], [17]. Low body fat levels often accompany energy deficiency, and a certain threshold of body fat is thought to be necessary for regular ovulatory cycles.

Psychological stress also plays a significant role. Competitive sport may impose mental stressors such as performance pressure, perfectionism, and anxiety, which activate the hypothalamic–pituitary–adrenal axis and increase cortisol levels. Chronic elevations in cortisol and other stress hormones have an inhibitory effect on gonadotropin-releasing hormone secretion and can exacerbate reproductive suppression [4], [16]. In practice, it is often the combination of metabolic stress and psychological stress that leads to menstrual dysfunction in athletes.

Crucially, these athletic menstrual disturbances are functional and largely reversible. They represent the body's adaptive response to extreme conditions rather than a permanent defect. Classic evidence shows that when energy availability falls below a critical threshold, luteinizing hormone pulsatility and ovulatory cycles are disrupted [19]. Conversely, restoring energy balance may reinstate hormonal rhythms. Nutritional intervention and training modification remain central to recovery [12], [17].

Other medical causes of amenorrhea or oligomenorrhea, such as pregnancy, polycystic ovary syndrome, thyroid dysfunction, or hyperprolactinemia, should always be considered during clinical evaluation. However, in competitive athletes, the majority of cases are functional rather than organic [5], [12]. Thus, while differential diagnosis is essential, most athlete menstrual disorders stem from the interaction of energy deficit, physical stress, and psychosocial burden leading to suppression of the HPO axis [1], [3].

## 5. Clinical Classification

Menstrual disorders in female athletes are not a uniform clinical entity. They form a spectrum that includes subtle ovulatory defects as well as complete cessation of cycles. Most often, these conditions are a consequence of chronic energy deficits and training loads that gradually impair HPO axis function [1], [18].

### 5.1 Primary Amenorrhea

Primary amenorrhea is relatively rare in athletes, but it always warrants evaluation. It is defined as the failure to attain menarche by age 15–16 in the presence of normal secondary sexual development. In female athletes, primary amenorrhea is usually related to a combination of intense training and low body weight, leading to a functional delay in maturation of the HPO axis. However, such cases must be distinguished from genetic or anatomical abnormalities [3], [12].

### 5.2 Secondary Amenorrhea

Secondary amenorrhea is the most common menstrual disorder in female athletes. It is defined as the absence of menstrual bleeding for at least three months in a woman with previously regular cycles, or for six months in a woman with previously irregular cycles. Once pregnancy is excluded, the diagnosis in athletes most often points to a functional absence of menstruation of hypothalamic origin [3], [12].

### 5.3 Oligomenorrhea

Oligomenorrhea is characterized by infrequent or irregular menstrual bleeding, typically with cycle lengths longer than 35 days. In practice, it reflects a partial inhibition of the HPO axis. In some sportswomen, this condition precedes amenorrhea, while in others it persists chronically [18]. Chronic oligomenorrhea and amenorrhea are both associated with reduced fertility and adverse hormonal consequences [8], [18].

### 5.4 Luteal Phase Defect

Luteal phase defect occurs frequently in athletes, although it is easy to miss. In this scenario, ovulation occurs, but the luteal phase is too short or progesterone production is insufficient. The athlete may experience premenstrual spotting, earlier-than-usual menstrual bleeding, or difficulty with embryo implantation [20], [21]. The athlete often believes that her cycles are regular, which makes diagnosis more difficult [20], [22].

### 5.5 Anovulation

Anovulation refers to the absence of ovulation despite menstrual bleeding. In female athletes, anovulation often coincides with periods of intense training and weight reduction. Hormonal or ultrasound assessment may be needed for confirmation. Prolonged anovulation disrupts hormonal balance and may adversely affect both bone health and endometrial physiology [19], [20].

It is useful to think of these disorders as a continuum of severity rather than separate conditions. Under the stress of low energy availability, the reproductive axis often progresses through stages: normal ovulatory cycles, ovulatory cycles with a shortened or deficient luteal phase, anovulatory cycles, oligomenorrhea, and finally amenorrhea [3]. Not every athlete progresses through all stages, but this sequence is commonly observed and highlights the importance of early detection.

From a diagnostic viewpoint, any athlete with menstrual irregularity should undergo a thorough evaluation to exclude non-functional causes. Pregnancy must be excluded in any amenorrheic athlete. Serum hormone tests such as follicle-stimulating hormone, luteinizing hormone, estradiol, thyroid function, and prolactin help distinguish hypothalamic suppression from other causes [5], [12]. In practice, a diagnosis of athletic functional hypothalamic amenorrhea is made when an athlete has an irregular or absent cycle, evidence of energy deficit or stress, and other causes have been excluded [1], [3], [12].

## 6. Management

The cornerstone of treatment for exercise-related menstrual disorders is correcting the underlying energy deficit and reducing excessive physiological stress. The first-line approach is nutritional and lifestyle intervention. Athletes with amenorrhea or oligomenorrhea are advised to increase caloric intake and/or reduce exercise energy expenditure until a healthier energy balance is re-established [1], [17]. The goal is to restore energy availability and normalize endocrine function.

Addressing nutrient deficiencies is another key aspect of management. Female athletes with menstrual dysfunction often have insufficient intake of calcium, vitamin D, iron, and other micronutrients essential for bone and hormonal health [1], [17]. A sports dietitian should assess the athlete's diet, and supplementation may be recommended when necessary. Adequate intake of protein, carbohydrates, and dietary fat is also critical for recovery and hormonal stability [14], [17].

Because athlete menstrual disorders often involve components of nutrition, training, and mental health, an interdisciplinary team is ideal [3], [16], [17]. In addition to sports physicians or endocrinologists, care should include a sports dietitian and, when needed, a psychologist or counselor, especially if disordered eating or significant stress is contributing to the condition [3], [16].

Once interventions are in place, close monitoring is important. Athletes are often advised to keep a menstrual calendar or use menstrual-tracking applications, as the resumption of menses is a primary marker of recovery. Bone health should also be monitored carefully, especially in athletes with prolonged amenorrhea, as they are at high risk for low bone mineral density and stress fractures [1], [4], [17].

The primary goal of treatment is always to restore natural menstrual function through lifestyle changes. Pharmacological therapy may be considered only as an adjunct in selected cases, particularly when prolonged hypoestrogenism poses a threat to bone health [4], [12]. Oral contraceptives may mask symptoms without addressing the underlying cause and therefore should not replace nutritional rehabilitation and training modification [12], [17].

Ultimately, management of menstrual cycle disorders in female athletes centers on restoring energy balance, improving nutrition, adjusting training load, and addressing psychological stress. A collaborative, multidisciplinary approach provides the best support for recovery and long-term health.

## 7. Conclusions

Menstrual cycle disorders in female athletes are a clear signal of excessive strain on the body. They remain among the most frequent health problems in women engaged in high-level sport and should not be regarded as a normal or harmless effect of training. These disturbances carry important health consequences, including impaired fertility, reduced bone health, and a higher risk of injury.

It is encouraging that most cases are functional and reversible. Restoring energy balance, improving nutrition, adjusting training loads, and addressing psychological stress usually lead to the recovery of regular cycles. For athletes, coaches, and medical teams, the menstrual cycle should be recognized as an essential indicator of health and performance.

Maintaining regular menstruation is not in conflict with achieving sporting excellence. On the contrary, athletes who support their hormonal health may benefit from better well-being, greater resilience, and more sustainable performance. The key challenge ahead is to translate growing scientific knowledge into everyday practice, ensuring that no athlete sacrifices long-term health in the pursuit of success.

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