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BEYOND THE PHASE: A CRITICAL REVIEW OF THE MENSTRUAL CYCLE AND FEMALE ATHLETIC PERFORMANCE

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ABSTRACT

Background: The influence of the menstrual cycle on female athletic performance is a topic of growing interest, yet the scientific literature is characterized by widespread and often contradictory findings. This inconsistency is largely attributed to historical methodological shortcomings, creating a confusing evidence base for athletes, coaches, and practitioners.
Aim of the study: This critical review synthesizes the contemporary evidence on the menstrual cycle's influence on athletic performance, injury risk, and physiological mechanisms. It critically analyzes the factors contributing to the literature's inconsistency and proposes an evidence-based path forward for research and practice.
Materials and Methods: A comprehensive review of contemporary and foundational literature was conducted through a search of the PubMed database. This review synthesized 52 studies, which were thematically organized to analyze the evidence pertaining to objective performance outcomes, athlete perception and symptoms, injury risk profiles, physiological mechanisms, and emerging methodological standards.
Conclusions: The evidence suggests the menstrual cycle's direct impact on performance is likely trivial. However, its influence becomes profound when considering effects on overall health, symptom experience, and recovery physiology. The most critical factor appears to be the presence of a healthy, ovulatory cycle, as performance and physiological markers remain stable in anovulatory athletes. For ovulatory women, the primary influence may not be on maximal capacity but on recovery and a dynamic injury risk profile that shifts throughout the cycle. Therefore, this review concludes that a personalized, athlete-centered approach focused on monitoring cycle health and managing symptoms is a more evidence-based strategy than universal, phase-based training guidelines.

KEYWORDS

Menstrual Cycle, Female Athlete, Athletic Performance, Injury Risk, Symptoms, Hormones

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Introduction.

The landscape of sport has undergone a dramatic transformation in recent decades, marked by a surge in female participation and professionalism at all levels. Yet, this explosion in athletic endeavor has not been met with a commensurate evolution in the sports science that supports these athletes. A significant research gap persists, with a historical and ongoing bias towards using male participants as the default model. This is starkly illustrated by a landmark systematic review from Costello et al. (2014), which found that female participants made up a fraction of subjects in sport and exercise medicine research. A more recent analysis by Paul et al. (2023) confirms this disparity, revealing that even in high-impact journals, female-only studies remain vastly outnumbered. This creates a critical problem: a "one-size-fits-men" approach is often applied to female athletes, despite fundamental physiological differences.

At the heart of this research disparity lies the complexity of female physiology, primarily the menstrual cycle- a dynamic and intricate biological rhythm governed by fluctuating sex hormones. For decades, researchers have often viewed these fluctuations as a methodological inconvenience. As highlighted in a key editorial by Bruinvels et al. (2017), this has led to a persistent oversimplification of female physiology in research, such as restricting testing to the early follicular phase when hormone levels are lowest to mimic a more "stable" male-like state. This approach, while convenient, inherently overlooks the broader hormonal influences on female athletic performance and perpetuates the very knowledge gaps that limit evidence-based support for women in sport. In response, a consensus has emerged, championed by authorities like Elliott-Sale et al. (2021), calling for new methodological standards to address this historical neglect.

The consequence of this legacy is a vast and often contradictory body of literature. Studies have reported that performance can be improved, impaired, or entirely unaffected by the menstrual cycle, leaving athletes,

coaches, and practitioners with a confusing evidence base and no clear guidance. This review aims to critically synthesize this complex literature. It will move beyond a simple tally of conflicting findings to explore the reasons for this inconsistency, examining the distinct influences of cycle health versus cycle phase, the role of injury risk and recovery, and the powerful impact of athlete perception. By organizing the evidence into its key thematic components, this review will provide a clear and nuanced overview of the current state of knowledge and outline the emerging, methodologically robust path forward for female athlete research.

Methodology

This critical review was conducted through a comprehensive search of the PubMed database to identify contemporary and foundational literature. The search period primarily covered the last decade, from January 2015 to May 2025, to ensure the inclusion of the most current evidence in this rapidly evolving field.

The search strategy employed a combination of keywords and MeSH terms related to three core concepts: the menstrual cycle, athletic performance and its components, and the female athlete population. The aim was to identify diverse types of studies relevant to the review's topic, including primary research (experimental, observational, and qualitative), systematic reviews, meta-analyses, and study protocols.

Initial search results were screened by title and abstract for relevance. Full texts of potentially relevant articles were subsequently retrieved and reviewed to determine their final inclusion. This process yielded 48 articles that directly addressed the review's objectives. These studies were organized using a thematic approach. The main body of this review is therefore structured around the following six core themes:

1. Foundational Reviews & Critical Perspectives
2. The Core Performance Debate
3. Underlying Mechanisms: Physiology, Recovery, and Health
4. A Dynamic and Multi-faceted Injury Risk Profile
5. The Subjective Experience: Perception, Symptoms, and the Culture of Sport
6. A Methodological Blueprint for Future Research

To provide essential historical and conceptual context in the introduction, four studies were purposefully selected for their significant impact on the field. An exception to the primary search time frame was made for one of these key papers (Costello et al. 2014) due to its landmark status. In total, the final review is based on a synthesis of 52 articles.

The 'Big Picture' – Foundational Reviews & Critical Perspectives

A large-scale systematic review and meta-analysis by McNulty et al. (2020) synthesized data from 78 studies to determine the effect of the menstrual cycle on performance. Their findings indicated that while performance may be trivially reduced during the early follicular phase, the overall effect size was not practically meaningful for most individuals. Critically, the authors graded the overall quality of the available evidence as “low,” primarily due to the widespread lack of robust methodological practices, such as hormonal verification of cycle phases, in the included studies. Given the trivial effect and low-quality evidence base, they concluded that creating universal training guidelines is not warranted, instead advocating for a personalized approach tailored to an individual athlete's response to their cycle.

Recent reviews have exposed a significant gap between athletes' subjective experiences and the available objective evidence. A narrative review by Carmichael et al. (2021) first identified this critical discrepancy, noting that while athletes consistently report feeling impaired, objective data remains highly inconsistent. This uncertainty is particularly acute at the highest levels of sport, as a systematic review by Meignié et al. (2021) concluded that research on elite athletes is exceptionally scarce and inconclusive, making evidence-based recommendations impossible. Ultimately, the current body of literature, as synthesized by major reviews from Carmichael et al. (2021); McNulty et al. (2020), and more recently Vogel et al. (2023), converges on a single, clear conclusion: while athletes perceive an effect, the objective evidence is too inconsistent and methodologically flawed to support universal training guidelines.

The reason for this inconsistency is likely rooted in methodological and philosophical shortcomings. In a key perspective piece, Bruinvels et al. (2022) argue that traditional research, by focusing on a few stable, mid-phase time points, often overlooks the most critical periods of the menstrual cycle. They contend that the transitions between phases—such as the pre-menstrual window- are where athletes experience the most significant symptom burden. Further deepening this critique, Legerlotz & Nobis (2022) argue that the complexity of the issue may stem from the very way research is approached. They critique the prevalence of a “deficit-oriented” view that frames female physiology as inherently problematic and warn that researchers

often oversimplify the relationship by seeking a single, causal link between hormones and performance. This combined methodological and philosophical critique helps explain why the evidence remains so fragmented and reinforces the call for a new research paradigm.

The Core Performance Debate – Conflicting Objective Findings

Evidence for Phase-Based Performance Decrements

While many studies find no consistent effect, a significant body of evidence suggests that certain types of performance are indeed impaired during specific menstrual cycle phases, particularly those requiring high levels of fatigue resistance or complex motor control. Providing evidence for this, a study by Graja et al. (2022) examined repeated sprint performance in female handball players and found that performance was significantly impaired during the late luteal phase. Specifically, athletes demonstrated both lower peak power output and a greater decline in power (i.e., a higher fatigue index) during this phase compared to the late follicular and mid-luteal phases. This highlights how specific types of performance, especially those involving fatigue resistance, may be more sensitive to cyclical hormonal changes.

Similarly, submaximal aerobic efficiency appears to be vulnerable. Using hormonal verification, Goldsmith & Glaister (2020) reported that running economy was significantly impaired (i.e., the oxygen cost of running was higher) during the mid-luteal phase, which they linked to the thermogenic and ventilatory effects of high progesterone levels. Beyond hormonal effects on neuromuscular control or efficiency, other research points to a more direct, physical mechanism for performance changes: menstrually-related fluid retention. A groundbreaking study by Sawai et al. (2018) used MRI to objectively measure muscle edema and found that fluid content in the calf was significantly higher during the menstrual phase. Crucially, this increase in edema was negatively correlated with agility performance, which was at its worst during this time. This is a highly significant finding, as it provides a tangible physiological explanation for the common subjective symptoms of “heaviness” and “bloating”. It also suggests that performance decrements may be highly task-specific, affecting complex, coordinated movements like agility while leaving simpler measures of strength and power unchanged, which could help explain some of the inconsistent findings across the wider literature.

Evidence for Performance Stability Across the Menstrual Cycle

In direct contrast to studies showing performance decrements, a substantial body of evidence concludes that performance remains stable across the primary phases of the menstrual cycle. A recent study on endurance-trained women by Ekberg et al. (2024) found no significant differences in aerobic capacity, including VO2max and substrate utilization, across the follicular and luteal phases. This finding of stability in maximal aerobic performance is supported by similar research from Docter et al. (2025), who also found no effect on running economy.

This stability appears to extend beyond just aerobic metrics. In the domain of anaerobic and explosive performance, a study by Cabre et al. (2024) on repeated sprint ability and a preliminary study by García-Pinillos et al. (2021b) on jumping and sprinting both concluded that there were no significant variations across the primary menstrual cycle phases. The nuance in this area is highlighted by the work of Dokumacı & Hazır (2019), who found that the very definition of a metric can alter the conclusion; while they found no difference in running economy based on oxygen cost, they found runners were more economical based on caloric cost in the mid-luteal phase. Collectively, this body of evidence illustrates a critical divide: while athletes may genuinely perceive that their performance fluctuates with their cycle, objective laboratory data across both aerobic and anaerobic domains often fails to detect a consistent, underlying physiological cause for performance changes.

The Moderating Role of Athlete Performance Level

While many studies report trivial or no performance effects, this may be masking a more nuanced reality dependent on the athlete's training status. A pivotal randomized crossover study by Isenmann et al. (2024) offers a compelling insight by investigating the role of performance level. The authors found that while there was no overall performance effect when all subjects were grouped together, a more detailed analysis revealed that back squat strength in highly advanced athletes was significantly influenced by cycle phase, a variation not observed in their lower-level counterparts. This finding proposes that an athlete's training status may be a critical moderator, suggesting that the menstrual cycle's impact may only emerge at the elite end of the performance spectrum.

Beyond Performance: The Menstrual Cycle's Influence on Underlying Physiology, Recovery, and Health

The Primacy of Cycle Health: Ovulatory vs. Anovulatory Cycles

A potential explanation for the widespread inconsistency in the literature has been provided by a recent, methodologically robust study from Recacha-Ponce et al. (2025). The research sought to determine if performance differs between athletes with truly ovulatory cycles versus those with underlying menstrual irregularities. Using gold-standard hormonal verification to separate athletes into ovulatory (OMC) and anovulatory/luteal phase deficient (AMC) groups, the results were revelatory. The AMC group showed no significant variation in aerobic performance (VO2max) across their cycle, whereas the OMC group exhibited significant fluctuations. This finding is profound, as it suggests that many previous studies, by failing to verify ovulation, may have inadvertently pooled these two physiologically distinct groups. The high prevalence of menstrual irregularities found in their sample (26%) underscores the severity of this issue, providing a powerful explanation for why decades of research have yielded such conflicting results.

Modulation of Recovery: The Autonomic Nervous System and Sleep

Expanding the scope of influence to include recovery, several studies have investigated the menstrual cycle's effect on the autonomic nervous system (ANS) and sleep architecture. Providing powerful, large-scale evidence from wearable technology, a retrospective study by Sims et al. (2021) analyzed recovery metrics in over 3,800 naturally cycling women. The study revealed a distinct and predictable pattern of ANS modulation: the follicular phase was characterized by higher heart rate variability (HRV) and lower resting heart rate (RHR), indicative of enhanced physiological recovery, while these metrics progressively worsened throughout the luteal phase, signaling increased physiological strain. Further supporting this, a longitudinal study by Sherman et al. (2022) on collegiate rowers found that day-to-day HRV fluctuation- a marker of physiological stress- was significantly greater during the weeks of menstruation. Complementing this, objective long-term sleep monitoring data from Hrozanova et al. (2021) revealed an increase in deep sleep during menstrual bleeding days, suggesting the body attempts to compensate for this increased physiological load with more restorative sleep.

Stability of Key Hormonal and Inflammatory Systems

In line with findings of stable athletic performance, several methodologically robust studies suggest that the underlying physiological systems that support performance are also remarkably stable. Providing a potential mechanistic explanation for this stability, two companion studies by Collomp, Olivier, et al. (2025) and Collomp, Teulier, et al. (2025) investigated a wide array of biomarkers in highly trained athletes. The first study found no significant phase-based changes in key haematological markers related to oxygen-carrying capacity or inflammatory markers. The second study expanded on this, reporting that while reproductive hormones fluctuated as expected, there were no significant changes across the cycle in other major hormonal systems, including cortisol and thyroid-stimulating hormone. This concept of systemic stability is further supported by the IronFEMME project, where Barba-Moreno et al. (2022) found that the acute inflammatory (IL-6) and overall iron-regulatory (hepcidin) responses to exercise were stable across phases.

The Role of Specific Hormones and Cycle Health

While the broader systems may be stable, specific hormonal concentrations and cycle health remain critical factors. Shifting the focus from cycle phases to the role of individual hormones, a study by Collado-Boira et al. (2021) provides compelling evidence for the importance of testosterone. In their study of female ultra-marathon runners, the authors found that athletes with higher baseline testosterone levels experienced significantly less muscle damage and strength loss following the race, suggesting an athlete's individual androgenic profile may be a more powerful predictor of exercise tolerance than cycle phase alone. Furthermore, the distinction between cycle health and cycle phase is crucial. A more detailed analysis from the IronFEMME project by Alfaro-Magallanes et al. (2022) confirmed that resting iron levels were indeed lowest during the early follicular phase, which was associated with a subtly blunted post-exercise hepcidin response- a functional adaptation to maximize iron absorption following menstrual loss. This highlights that direct physiological consequences of the cycle, such as blood loss, can drive mechanistic responses independent of the broader hormonal environment.

A Dynamic and Multi-faceted Injury Risk Profile Across the Menstrual Cycle

Research into the menstrual cycle's influence on injury risk reveals a complex and often contradictory picture. A systematic review by Martínez-Fortuny et al. (2023), for example, synthesized the literature and concluded that the ovulatory phase is the period most consistently associated with increased injury rates, primarily attributing this to peak estrogen levels causing greater joint and ligament laxity. However, this finding is not universally supported. In direct contrast, a primary study by Pournasiri et al. (2023) on knee strength found that both isometric and isokinetic strength were significantly lower during the follicular and luteal phases, leading them to conclude that these periods of relative weakness posed the greatest injury risk.

This “laxity vs. weakness” debate is further nuanced by other mechanistic findings. Dos Santos A Ndrade et al. (2017) identified a significant neuromuscular imbalance—a lower hamstring-to-quadriceps strength ratio—specifically in the follicular phase, a known risk factor for anterior cruciate ligament (ACL) injury. Meanwhile, Forouzandeh Shahraki et al. (2020) found that while shoulder strength peaked during ovulation, proprioception was most impaired in the luteal phase. A prospective longitudinal study by Fort-Vanmeerhaeghe et al. (2025) provided real-world evidence linking the luteal phase directly to a higher incidence of sports injuries, which they correlated with concurrent reports of poorer sleep and greater fatigue. Providing a functional illustration of this impairment, a study by Arslan & Ercan (2025) found that athletes made significantly more motor errors during a dynamic balance test in their luteal phase. This increase in skill execution errors not only represents a performance decrement but also a clear marker of the neuromuscular instability that can precipitate injury. Seeking a potential synthesis, a high-quality laboratory study by Johnson & Shields (2024) used hormonal verification and a perturbed squatting task, finding that female athletes demonstrated the best knee control during the mid-luteal phase, suggesting this period may offer enhanced neuromuscular protection despite the fatigue reported elsewhere.

Athlete Perception, Symptoms, and the Culture of Silence: The Subjective Impact of the Menstrual Cycle

A central theme emerging from the literature is the significant discrepancy between athletes' subjective experiences and the often-inconclusive findings of objective performance data, a paradox highlighted by reviews from Carmichael et al. (2021). Despite this objective uncertainty, survey-based research consistently shows that athletes themselves believe the menstrual cycle is a critical performance factor. A clear majority of elite athletes - from 66% of Olympic and Paralympic hopefuls McNamara et al. (2022) to nearly 70% of professional futsal players Queiroga et al. (2021) - perceive their performance to be affected, with a strong preference to compete during the follicular phase. This was further confirmed in a longitudinal study of elite rowers by Antero et al. (2023), who found that both athletes' self-reported performance and their coaches' evaluations were consistently lower during the menstrual phase.

Further investigation reveals that this perception is driven less by an abstract understanding of hormonal phases and more by the tangible experience of disruptive symptoms. The qualitative work of Brown et al. (2021) provides deep insight, linking the performance impact directly to physical symptoms like pain and psychological factors like reduced motivation. This is quantitatively supported by Roffler et al. (2024), who, in tracking an elite volleyball team, identified stomach cramps, tiredness, and sleep disturbances as the most prevalent complaints peaking almost exclusively during menstruation. The direct impact of such symptoms on training was quantified by Prado et al. (2023), who found that athletes experiencing Premenstrual Syndrome (PMS) reported modifying their training, most commonly by reducing intensity. The importance of symptoms is further underscored by findings from McNamara et al. (2022) and Bruinvels et al. (2016), who both found that the presence of pain or a cycle-related disorder like heavy menstrual bleeding, respectively, significantly increased the likelihood of an athlete reporting a negative performance impact.

Critically, this widespread perception does not necessarily translate into practice for all athletes. A large descriptive study by García-Pinillos et al. (2021a) identified a significant ‘perception-action gap’, where most athletes felt an effect but did not modify their training. The qualitative findings of Brown et al. (2021) offer a powerful explanation for this inaction: a ‘communication taboo’ and a lack of comfort discussing the menstrual cycle with coaches. This creates a challenging environment where, as the review by Meignié et al. (2021) notes, a lack of robust objective guidance from science combines with a culture of silence in practice. This is compounded by other factors, such as the finding by Seddik et al. (2025) that the fatigue experienced during the luteal phase is most pronounced during morning sessions, leaving athletes to manage a very real, symptom-driven performance issue largely on their own.

A Methodological Blueprint for Future Research: Bridging Rigor and Practicality

Given the inconsistent evidence base, a clear consensus is emerging in the literature that the path forward requires a fundamental shift towards more rigorous and standardized research methodologies. Recent systematic reviews, such as those by McNulty et al. (2020), have concluded that the current evidence is severely limited by "low quality" and "pervasive methodological issues" of the primary studies, largely due to a failure to verify the menstrual cycle. In direct response, a new gold standard for research is being established, as outlined in the detailed study protocols for large-scale projects like the 'IronFEMME' study Peinado et al. (2021), the international 'Feminae' project Elliott Sale et al. (2023), and the 'IMPACT' trial Ekenros et al. (2024). These protocols collectively mandate the essential elements of robust design: adequately powered sample sizes, multi-phase testing, and, most critically, objective hormonal verification via blood analysis.

However, recognizing that invasive blood testing is often impractical in applied settings, recent research has focused on validating and implementing more accessible methods. The feasibility of such on-field monitoring was demonstrated by Dupuit et al. (2023), who successfully used a smartphone app to track menstrual status in elite soccer players over a seven-month season. Similarly, a crucial study by Ferrer et al. (2024) established salivary progesterone as a viable, non-invasive monitoring tool. This work, combined with proposals to use wearable technology to longitudinally track objective biomarkers Hunter & Smith (2024), provides a clear path to bridge rigor with practicality. This new standard, when applied in randomized controlled trials like that of Kissow et al. (2022), allows for definitive tests of practical interventions like phase-based training. Finally, these robust designs must also account for powerful confounding variables, as a hormonally verified study by Lei et al. (2017) found that the significant negative impact of high humidity on performance completely masked any effect of the menstrual cycle, highlighting the need to control the environmental context.

Discussion

The vast and often contradictory body of literature on the menstrual cycle's influence on performance suggests that focusing on hormonal phase as a sole predictor is an overly simplistic approach. A more holistic interpretation of the evidence indicates that the trivial physiological effects of a healthy cycle are often masked, modified, or entirely nullified by more powerful, interacting factors. The consistent finding of "trivial" or "inconsistent" objective effects, as highlighted by major reviews (Carmichael et al. 2021; McNulty et al. 2020), should not be misinterpreted as proof that the menstrual cycle is irrelevant. Rather, it is an indictment of the field's historical methodological shortcomings and a call to investigate the factors that truly matter.

One of the most compelling explanations for the conflicting results is the moderating role of athlete performance level. The pivotal finding by Isenmann et al. (2024)- that back squat strength was influenced by cycle phase only in highly advanced athletes- helps contextualize the literature. The consistent "no effect" findings in studies on recreationally active or sub-elite populations (Ekberg et al. 2024; Kissow et al. 2022) may simply reflect that the cycle's impact is negligible in these groups. Conversely, the significant performance impairments detected in national-level athletes (Graja et al. 2022) suggest the cycle's influence may only emerge as a critical, performance-altering factor at the elite margins of sport.

Furthermore, the influence of the menstrual cycle does not occur in a physiological vacuum. Other powerful modulators, such as circadian rhythm and environmental stress, can easily mask or negate the trivial performance variations attributable to phase alone. The finding by Seddik et al. (2025) that luteal phase fatigue was most pronounced in morning sessions offers a plausible explanation for why studies testing at a circadian peak in the afternoon may find no effect. Similarly, the work of Lei et al. (2017) demonstrated that the physiological stress of high humidity was a far more powerful performance determinant than cycle phase. This has profound implications, suggesting that athletes and coaches may gain more from managing context- such as time of day and environment- than from broadly periodizing training around a phase.

Critically, the entire "effect vs. no effect" debate may be an artifact of a fundamental methodological flaw: the failure to distinguish between ovulatory and anovulatory cycles. The transformative findings from Recacha-Ponce et al. (2025)- that performance fluctuates only in hormonally verified ovulatory athletes- suggests that the most important question is not "What phase is the athlete in?" but rather, "Is the athlete's cycle healthy?" This shifts the focus from performance modulation to a more foundational concern for athlete health, underscoring that a regular, ovulatory cycle is the prerequisite for any potential performance fluctuation.

This leads to the final, and perhaps most important, implication. The consistent and widespread athlete perception that the menstrual cycle affects performance, even when objective data is inconclusive, is a critically important finding in itself. The longitudinal data from Antero et al. (2023), showing a clear correlation between

athletes' self-assessments and their coaches' blinded evaluations, validates that this perceived performance dip is observable and consistent. As detailed by qualitative research (Brown et al. 2021; Roffler et al. 2024), this perception is driven by the lived, subjective experience of symptoms. The existence of a 'perception-action gap' (García-Pinillos et al. 2021a) and a 'communication taboo' (Brown et al. 2021) indicates that the primary barrier to optimizing performance is not just physiological, but profoundly cultural. The practical solution, therefore, may not be a universal, phase-based training plan, but rather the implementation of simple tracking systems and the fostering of an open environment where conversations about symptoms are normalized. By addressing the root causes of the negative perception- the symptoms and the silence surrounding them—coaches and support staff can empower athletes to manage their health and, by extension, their performance.

Conclusions

Decades of research into the influence of the menstrual cycle on athletic performance have produced a body of literature that is vast, complex, and markedly inconsistent. This review concludes that a myopic focus on whether performance is better or worse in a given hormonal phase is an overly simplistic approach that has led to a state of scientific ambiguity. The evidence suggests that for most healthy, sub-elite athletes, any direct effect of the menstrual cycle phase on maximal strength or aerobic capacity is likely trivial and easily masked by more powerful factors such as training status, environmental conditions, or circadian rhythm.

However, this does not mean the menstrual cycle is irrelevant. A more nuanced interpretation of the literature reveals two critical areas where the cycle's influence is both significant and actionable.

First, the most crucial factor appears to be cycle health. The distinction between hormonally verified ovulatory cycles and often undetected anovulatory cycles is paramount, as performance and physiological stability appear to differ profoundly between these two groups. This shifts the primary concern for practitioners from phase-based training to a more fundamental goal: ensuring athletes have a healthy, regular, and ovulatory cycle as a prerequisite for optimal adaptation and performance.

Second, while objective performance data is inconsistent, the subjective evidence is clear and compelling. The majority of athletes perceive their performance to be affected, a belief driven by the tangible experience of disruptive symptoms like pain, fatigue, and poor sleep, particularly during the luteal and menstrual phases. These symptoms are linked to measurable physiological changes, including increased autonomic stress and a dynamic, multi-faceted injury risk profile. The existing 'perception-action gap'- whereby athletes feel an effect but do not receive the support to manage it- highlights that the most effective interventions may not be physiological, but rather educational and cultural.

Therefore, the path forward requires a dual approach. For researchers, it demands adherence to a new gold standard of methodological rigor, including hormonal verification, to build a reliable evidence base. For athletes, coaches, and practitioners, the most evidence-based strategy is to move beyond predicting performance and instead focus on an individualized, athlete-centered model that prioritizes monitoring cycle health, managing symptoms, and fostering an environment of open communication.

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REFERENCES

1. Alfaro-Magallanes, V. M., Barba-Moreno, L., Romero-Parra, N., Rael, B., Benito, P. J., Swinkels, D. W., Laarakkers, C. M., Díaz, Á. E., & Peinado, A. B. (2022). Menstrual cycle affects iron homeostasis and hepcidin following interval running exercise in endurance-trained women. European Journal of Applied Physiology, 122(12), 2683–2694. https://doi.org/10.1007/s00421-022-05048-5
2. Antero, J., Golovkine, S., Niffoi, L., Meignié, A., Chassard, T., Delarochelambert, Q., Duclos, M., Maitre, C., Maciejewski, H., Diry, A., & Toussaint, J. F. (2023). Menstrual cycle and hormonal contraceptive phases' effect on elite rowers' training, performance and wellness. Frontiers in Physiology, 14. https://doi.org/10.3389/FPHYS.2023.1110526
3. Arslan, E., & Ercan, S. (2025). The effect of menstrual cycle phase changes on error scores in sportive movements in female athletes. Physician and Sportsmedicine. https://doi.org/10.1080/00913847.2025.2477977
4. Barba-Moreno, L., Alfaro-Magallanes, V. M., de Jonge, X. A. K. J., Díaz, A. E., Cupeiro, R., & Peinado, A. B. (2022). Hepcidin and interleukin-6 responses to endurance exercise over the menstrual cycle. European Journal of Sport Science, 22(2), 218–226. https://doi.org/10.1080/17461391.2020.1853816
5. Brown, N., Knight, C. J., & Forrest, L. J. (2021). Elite female athletes' experiences and perceptions of the menstrual cycle on training and sport performance. Scandinavian Journal of Medicine and Science in Sports, 31(1), 52–69. https://doi.org/10.1111/sms.13818
6. Bruinvels, G., Burden, R., Brown, N., Richards, T., & Pedlar, C. (2016). The Prevalence and Impact of Heavy Menstrual Bleeding (Menorrhagia) in Elite and Non-Elite Athletes. PloS One, 11(2). https://doi.org/10.1371/JOURNAL.PONE.0149881
7. Bruinvels, G., Burden, R. J., McGregor, A. J., Ackerman, K. E., Dooley, M., Richards, T., & Pedlar, C. (2017). Sport, exercise and the menstrual cycle: where is the research? British Journal of Sports Medicine, 51(6), 487–488. https://doi.org/10.1136/BJSPORTS-2016-096279
8. Bruinvels, G., Hackney, A. C., & Pedlar, C. R. (2022). Menstrual Cycle: The Importance of Both the Phases and the Transitions Between Phases on Training and Performance. Sports Medicine, 52(7), 1457–1460. https://doi.org/10.1007/S40279-022-01691-2
9. Cabre, H. E., Ladan, A. N., Moore, S. R., Joniak, K. E., Blue, M. N. M., Pietrosimone, B. G., Hackney, A. C., & Smith-Ryan, A. E. (2024). Effects of Hormonal Contraception and the Menstrual Cycle on Fatigability and Recovery from an Anaerobic Exercise Test. Journal of Strength and Conditioning Research, 38(7), 1256–1265. https://doi.org/10.1519/JSC.0000000000004764
10. Carmichael, M. A., Thomson, R. L., Moran, L. J., & Wycherley, T. P. (2021). The impact of menstrual cycle phase on athletes' performance: a narrative review. International Journal of Environmental Research and Public Health, 18(4), 1–24. https://doi.org/10.3390/ijerph18041667

11. Collado-Boira, E., Baliño, P., Boldó-Roda, A., Martínez-Navarro, I., Hernando, B., Recacha-Ponce, P., Hernando, C., & Muriach, M. (2021). Influence of female sex hormones on ultra-running performance and post-race recovery: Role of testosterone. International Journal of Environmental Research and Public Health, 18(19). https://doi.org/10.3390/ijerph181910403
12. Collomp, K., Olivier, A., Teulier, C., Bonnigal, J., Crépin, N., Buisson, C., Ericsson, M., Duron, E., Favory, E., Zimmermann, M., Amiot, V., & Castanier, C. (2025). Hormonal and metabolic responses across phases of combined oral contraceptive use and menstrual cycle in young elite female athletes. European Journal of Applied Physiology. https://doi.org/10.1007/S00421-025-05745-X
13. Collomp, K., Teulier, C., Castanier, C., Bonnigal, J., Marchand, A., Buisson, C., Ericsson, M., Crépin, N., Duron, E., Favory, E., Zimmermann, M., Amiot, V., & Olivier, A. (2025). Impact of Menstrual Cycle and Oral Contraceptives on Haematological and Inflammatory Biomarkers in Highly Trained Female Athletes. Drug Testing and Analysis. https://doi.org/10.1002/DTA.3859
14. Costello, J. T., Bieuzen, F., & Bleakley, C. M. (2014). Where are all the female participants in Sports and Exercise Medicine research? European Journal of Sport Science, 14(8), 847–851. https://doi.org/10.1080/17461391.2014.911354
15. Docter, H., Taylor, M., Müller, A. L., de Koning, J. J., Sandbakk, Ø. B., Osborne, J. O., & Noordhof, D. A. (2025). Running Economy After a Low- and High-Intensity Training Session in Naturally Menstruating Endurance-Trained Female Athletes: The FENDURA Project. Scandinavian Journal of Medicine & Science in Sports, 35(4), e70050. https://doi.org/10.1111/sms.70050
16. Dokumacı, B., & Hazır, T. (2019). Effects of the Menstrual Cycle on Running Economy: Oxygen Cost Versus Caloric Cost. Research Quarterly for Exercise and Sport, 90(3), 318–326. https://doi.org/10.1080/02701367.2019.1599800
17. Dos Santos A Ndrade, M., Mascarin, N. C., Foster, R., De Jármy Di Bella, Z. I., Vancini, R. L., & Barbosa De Lira, C. A. (2017). Is muscular strength balance influenced by menstrual cycle in female soccer players? Journal of Sports Medicine and Physical Fitness, 57(6), 859–864. https://doi.org/10.23736/S0022-4707.16.06290-3
18. Dupuit, M., Meignié, A., Chassard, T., Blanquet, L., LeHeran, J., Delaunay, T., Bernardeau, E., Toussaint, J. F., Duclos, M., & Antero, J. (2023). On-Field Methodological Approach to Monitor the Menstrual Cycle and Hormonal Phases in Elite Female Athletes. International Journal of Sports Physiology and Performance, 18(10), 1169–1178. https://doi.org/10.1123/IJSPP.2022-0287
19. Ekberg, S., Morseth, B., Larsén, K. B., & Wikström-Frisén, L. (2024). Does the Menstrual Cycle Influence Aerobic Capacity in Endurance-Trained Women? Research Quarterly for Exercise and Sport, 95(3), 609–616. https://doi.org/10.1080/02701367.2023.2291473
20. Ekenros, L., von Rosen, P., Norrbom, J., Holmberg, H. C., Sundberg, C. J., Fridén, C., & Hirschberg, A. L. (2024). Impact of Menstrual cycle-based Periodized training on Aerobic performance, a Clinical Trial study protocol—the IMPACT study. Trials, 25(1). https://doi.org/10.1186/s13063-024-07921-4
21. Elliott Sale, K. J., Flood, T. R., Arent, S. M., Dolan, E., Saunders, B., Hansen, M., Ihalainen, J. K., Mikkonen, R. S., Minahan, C., Thornton, J. S., Ackerman, K. E., Lebrun, C. M., Sale, C., Stellingwerff, T., Swinton, P. A., & Hackney, A. C. (2023). Effect of menstrual cycle and contraceptive pill phase on aspects of exercise physiology and athletic performance in female athletes: protocol for the Feminae international multisite innovative project. BMJ Open Sport & Exercise Medicine, 9(4), e001814. https://doi.org/10.1136/bmjsem-2023-001814
22. Elliott-Sale, K. J., Minahan, C. L., de Jonge, X. A. K. J., Ackerman, K. E., Sipilä, S., Constantini, N. W., Lebrun, C. M., & Hackney, A. C. (2021). Methodological Considerations for Studies in Sport and Exercise Science with Women as Participants: A Working Guide for Standards of Practice for Research on Women. Sports Medicine (Auckland, N.Z.), 51(5), 843–861. https://doi.org/10.1007/S40279-021-01435-8
23. Ferrer, E., Rodas, G., Casals, G., Trilla, A., Balagué-Dobon, L., González, J. R., Ridley, K., White, R., & Burden, R. J. (2024). The use of saliva and blood progesterone to profile the menstrual cycles of youth professional football players. Frontiers in Sports and Active Living, 6, 1430158. https://doi.org/10.3389/fspor.2024.1430158
24. Forouzandeh Shahraki, S., Minoonejad, H., & Moghadas Tabrizi, Y. (2020). Comparison of some intrinsic risk factors of shoulder injury in three phases of menstrual cycle in collegiate female athletes. Physical Therapy in Sport, 43, 195–203. https://doi.org/10.1016/j.ptsp.2020.02.010
25. Fort-Vanmeerhaeghe, A., Pujol-Marzo, M., Milà, R., Campos, B., Nevot-Casas, O., Casadevall-Sayeras, P., & Peña, J. (2025). Injury Risk and Overall Well-Being During the Menstrual Cycle in Elite Adolescent Team Sports Athletes. Healthcare (Switzerland), 13(10). https://doi.org/10.3390/HEALTHCARE13101154
26. García-Pinillos, F., Bujalance-Moreno, P., Jérez-Mayorga, D., Velarde-Sotres, Á., Anaya-Moix, V., Pueyo-Villa, S., & Lago-Fuentes, C. (2021). Training habits of eumenorrheic active women during the different phases of their menstrual cycle: A descriptive study. International Journal of Environmental Research and Public Health, 18(7). https://doi.org/10.3390/ijerph18073662

27. García-Pinillos, F., Bujalance-Moreno, P., Lago-Fuentes, C., Ruiz-Alias, S. A., Domínguez-Azpíroz, I., Mecías-Calvo, M., & Ramirez-Campillo, R. (2021). Effects of the menstrual cycle on jumping, sprinting and force-velocity profiling in resistance-trained women: A preliminary study. International Journal of Environmental Research and Public Health, 18(9). https://doi.org/10.3390/ijerph18094830
28. Goldsmith, E., & Glaister, M. (2020). The effect of the menstrual cycle on running economy. The Journal of Sports Medicine and Physical Fitness, 60(4), 610–617. https://doi.org/10.23736/S0022-4707.20.10229-9
29. Graja, A., Kacem, M., Hammouda, O., Borji, R., Bouzid, M. A., Souissi, N., & Rebai, H. (2022). Physical, Biochemical, and Neuromuscular Responses to Repeated Sprint Exercise in Eumenorrheic Female Handball Players: Effect of Menstrual Cycle Phases. Journal of Strength and Conditioning Research, 36(8), 2268–2276. https://doi.org/10.1519/JSC.0000000000003556
30. Hrozanova, M., Klöckner, C. A., Sandbakk, Ø., Pallesen, S., & Moen, F. (2021). Sex differences in sleep and influence of the menstrual cycle on women's sleep in junior endurance athletes. PloS One, 16(6), e0253376. https://doi.org/10.1371/journal.pone.0253376
31. Hunter, N. N., & Smith, M. A. (2024). How the Menstrual Cycle Can Be Utilized During Sports Training, Performance, and Recovery through Wearable Technology: A Narrative Review for Researchers, Physicians, Coaches, and Athletes. Seminars in Reproductive Medicine. https://doi.org/10.1055/s-0044-1791508
32. Isenmann, E., Held, S., Geisler, S., Flenker, U., Jeffreys, I., & Zinner, C. (2024). The effect of the menstrual cycle phases on back squat performance, jumping ability and psychological state in women according to their level of performance -a randomized three-arm crossover study. BMC Sports Science, Medicine and Rehabilitation, 16(1). https://doi.org/10.1186/S13102-024-01010-4
33. Johnson, K. A., & Shields, R. K. (2024). Influence of the Menstrual Cycle and Training on the Performance of a Perturbed Single-Leg Squatting Task in Female Collegiate Athletes. Orthopaedic Journal of Sports Medicine, 12(6). https://doi.org/10.1177/23259671241251720
34. Kissow, J., Jacobsen, K. J., Gunnarsson, T. P., Jessen, S., & Hostrup, M. (2022). Effects of Follicular and Luteal Phase-Based Menstrual Cycle Resistance Training on Muscle Strength and Mass. Sports Medicine, 52(12), 2813–2819. https://doi.org/10.1007/s40279-022-01679-y
35. Legerlotz, K., & Nobis, T. (2022). Insights in the Effect of Fluctuating Female Hormones on Injury Risk—Challenge and Chance. Frontiers in Physiology, 13. https://doi.org/10.3389/FPHYS.2022.827726
36. Lei, T. H., Stannard, S. R., Perry, B. G., Schlader, Z. J., Cotter, J. D., & Mündel, T. (2017). Influence of menstrual phase and arid vs. humid heat stress on autonomic and behavioural thermoregulation during exercise in trained but unacclimated women. Journal of Physiology, 595(9), 2823–2837. https://doi.org/10.1113/JP273176
37. Martínez-Fortuny, N., Alonso-Calvete, A., Da Cuña-Carrera, I., & Abalo-Núñez, R. (2023). Menstrual Cycle and Sport Injuries: A Systematic Review. International Journal of Environmental Research and Public Health, 20(4). https://doi.org/10.3390/ijerph20043264
38. McNamara, A., Harris, R., & Minahan, C. (2022). That time of the month' ... for the biggest event of your career! Perception of menstrual cycle on performance of Australian athletes training for the 2020 Olympic and Paralympic Games. BMJ Open Sport and Exercise Medicine, 8(2). https://doi.org/10.1136/BMJSEM-2021-001300
39. McNulty, K. L., Elliott-Sale, K. J., Dolan, E., Swinton, P. A., Ansdell, P., Goodall, S., Thomas, K., & Hicks, K. M. (2020). The Effects of Menstrual Cycle Phase on Exercise Performance in Eumenorrheic Women: A Systematic Review and Meta-Analysis. Sports Medicine (Auckland, N.Z.), 50(10), 1813–1827. https://doi.org/10.1007/S40279-020-01319-3
40. Meignié, A., Duclos, M., Carling, C., Orhant, E., Provost, P., Toussaint, J. F., & Antero, J. (2021). The Effects of Menstrual Cycle Phase on Elite Athlete Performance: A Critical and Systematic Review. Frontiers in Physiology, 12. https://doi.org/10.3389/fphys.2021.654585
41. Paul, R. W., Sonnier, J. H., Johnson, E. E., Hall, A. T., Osman, A., Connors, G. M., Freedman, K. B., & Bishop, M. E. (2023). Inequalities in the Evaluation of Male Versus Female Athletes in Sports Medicine Research: A Systematic Review. The American Journal of Sports Medicine, 51(12), 3335–3342. https://doi.org/10.1177/03635465221131281
42. Peinado, A. B., Alfaro-Magallanes, V. M., Romero-Parra, N., Barba-Moreno, L., Rael, B., Maestre-Cascales, C., Rojo-Tirado, M. A., Castro, E. A., Benito, P. J., Ortega-Santos, C. P., Santiago, E., Butragueño, J., García-De-Alcaraz, A., Rojo, J. J., Calderón, F. J., García-Bataller, A., & Cupeiro, R. (2021). Methodological approach of the iron and muscular damage: Female metabolism and menstrual cycle during exercise project (IronFEMME study). International Journal of Environmental Research and Public Health, 18(2), 1–22. https://doi.org/10.3390/ijerph18020735
43. Pournasiri, F., Zarei, M., Mainer-Pardos, E., & Nobari, H. (2023). Isometric and isokinetic strength of lower-limb muscles in female athletes during different phases of menstrual cycle: a causal-comparative study. BMC Women's Health, 23(1). https://doi.org/10.1186/s12905-023-02819-w
44. Prado, R. C. R., Willett, H. N., Takito, M. Y., & Hackney, A. C. (2023). Impact of Premenstrual Syndrome Symptoms on Sport Routines in Nonelite Athlete Participants of Summer Olympic Sports. International Journal of Sports Physiology and Performance, 18(2), 142–147. https://doi.org/10.1123/IJSPP.2022-0218

45. Queiroga, M. R., da Silva, D. F., Ferreira, S. A., Weber, V. M. R., Fernandes, D. Z., Cavazzotto, T. G., Portela, B. S., Tartaruga, M. P., Nascimento, M. A., & Vieira, E. R. (2021). Characterization of Reproductive and Morphological Variables in Female Elite Futsal Players. Frontiers in Psychology, 12. https://doi.org/10.3389/FPSYG.2021.625354
46. Recacha-Ponce, P., Suárez-Alcázar, P., Hernando, C., Salas-Medina, P., Muriach, M., Baliño, P., Guisado-Cuadrado, I., & Collado-Boira, E. (2025). Hormonal balance, anovulatory cycles and luteal phase deficiency: exploring relationships between hematological variables, sex hormones and V̇O2max in athletes. Reproduction & Fertility, 6(2). https://doi.org/10.1530/RAF-24-0119
47. Roffler, A., Fleddermann, M.-T., de Haan, H., Krüger, K., & Zentgraf, K. (2024). Menstrual cycle tracking in professional volleyball athletes. Frontiers in Sports and Active Living, 6, 1408711. https://doi.org/10.3389/fspor.2024.1408711
48. Sawai, A., Tochigi, Y., Kavaliova, N., Zaboronok, A., Warashina, Y., Mathis, B. J., Mesaki, N., Shiraki, H., & Watanabe, K. (2018). MRI reveals menstrually-related muscle edema that negatively affects athletic agility in young women. PLoS ONE, 13(1). https://doi.org/10.1371/journal.pone.0191022
49. Seddik, M., Bouzourraa, M. M., Ceylan, H. İ., Hamaidi, J., Ghouili, H., Chtourou, H., Guelmami, N., Dergaa, I., Muntean, R. I., & Souissi, N. (2025). The effect of time of day and menstrual cycle on physical performance and psychological responses in elite female Tunisian volleyball players. BMC Sports Science, Medicine & Rehabilitation, 17(1), 67. https://doi.org/10.1186/s13102-025-01117-2
50. Sherman, S. R., Holmes, C. J., Demos, A. P., Stone, T., Hornikel, B., MacDonald, H. V., Fedewa, M. V., & Esco, M. R. (2022). Vagally Derived Heart Rate Variability and Training Perturbations With Menses in Female Collegiate Rowers. International Journal of Sports Physiology and Performance, 17(3), 432–439. https://doi.org/10.1123/IJSPP.2021-0005
51. Sims, S. T., Ware, L., & Capodilupo, E. R. (2021). Patterns of endogenous and exogenous ovarian hormone modulation on recovery metrics across the menstrual cycle. BMJ Open Sport and Exercise Medicine, 7(3). https://doi.org/10.1136/BMJSEM-2021-001047
52. Vogel, K., Larsen, B., McLellan, C., & Bird, S. P. (2023). Female Athletes and the Menstrual Cycle in Team Sports: Current State of Play and Considerations for Future Research. Sports (Basel, Switzerland), 12(1). https://doi.org/10.3390/sports12010004