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The Impact of the Menstrual Cycle on Sports Performance: A Narrative Review

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Abstract

Background: The menstrual cycle (MC) plays a fundamental role in female physiology, influencing endurance, strength, and overall athletic performance. Hormonal fluctuations across the menstrual phases impact metabolism, muscle recovery, thermoregulation, cardiovascular function, and psychological well-being. Recognizing these variations is crucial for optimizing training and competition strategies for female athletes.

Objective: This review synthesizes recent scientific findings on the effects of MC phases on athletic performance, specifically examining endurance, strength, neuromuscular function, and perceived exertion.

Methods: A review of peer-reviewed literature was conducted using databases such as PubMed, Scopus, Web of Science, and Google Scholar.

Results: Hormonal fluctuations across the menstrual cycle influence endurance, strength, and perceived performance. The follicular phase supports muscle recovery, neuromuscular efficiency, and cardiovascular function, potentially enhancing performance, though increased ligament laxity may raise injury risk. During ovulation, energy availability improves, but joint laxity increases susceptibility to injury. The luteal phase introduces physiological challenges such as elevated core temperature, cardiovascular strain, and increased perception of effort, which may impair endurance. Despite these complexities, current evidence does not support a one-size-fits-all approach to training modifications based on the menstrual cycle. Instead,

individualized menstrual tracking and adaptive training strategies may offer more effective ways to optimize female athlete performance.
Keywords: menstrual cycle, sport performance, female athletes, menstrual cycle tracking, exercise physiology

Introduction

The menstrual cycle plays a fundamental role in female physiology, influencing a wide range of physiological and psychological factors that can impact sports performance. Typically lasting around 28 days, the cycle comprises four key phases—menstrual, follicular, ovulatory, and luteal—each marked by distinct hormonal fluctuations in estrogen and progesterone. These hormonal shifts affect multiple physiological systems, including metabolism, muscle recovery, thermoregulation, cardiovascular function, and psychological well-being. (Oester et al., 2024) In recent years, increasing research has highlighted the importance of considering these variations when designing training programs and competition schedules for female athletes.(McNulty et al., 2020) This review synthesizes recent scientific findings to examine how different menstrual cycle phases influence endurance, strength, and overall athletic performance.

Methodology

Study Design

This review follows a systematic approach to synthesizing current literature on the impact of the menstrual cycle (MC) on athletic performance. The study design incorporates a qualitative synthesis of peer-reviewed articles, meta-analyses, and empirical studies published in the last two decades. The review focuses on the physiological, neuromuscular, and psychological effects of MC phases on endurance, strength, and overall performance in female athletes.

Data Sources and Search Strategy

A comprehensive literature search was conducted using electronic databases, including PubMed, Scopus, Web of Science, and Google Scholar. The search strategy included

combinations of the following keywords and Medical Subject Headings (MeSH) terms: ("menstrual cycle" OR "hormonal fluctuations" OR "female hormones") AND ("athletic performance" OR "sports performance" OR "exercise performance") AND ("endurance" OR "aerobic capacity" OR "VO2 max" OR "running economy") AND ("strength" OR "muscle power" OR "neuromuscular function") AND ("injury risk" OR "ligament laxity" OR "ACL injury") AND ("psychological factors" OR "perceived exertion" OR "mood fluctuations") AND (("elite athletes" OR "trained female athletes") OR ("recreational athletes" AND NOT "sedentary women")).

Filters were applied to include studies published between 2000 and 2025, with a focus on original research, systematic reviews, and meta-analyses. Reference lists of relevant studies were also examined to identify additional sources.

Ethical Considerations

As this study is a narrative review it did not involve direct participation of human subjects and thus did not require ethical approval. However ethical research practices were upheld by ensuring that all referenced studies adhered to ethical guidelines for human research as indicated by institutional review board approvals in the original studies.

Limitations of Methodology

Potential limitations of this review include variability in menstrual cycle tracking methods across studies which may affect phase classification. Individual differences in hormonal responses that may not be captured in group-level analyses and limited availability of studies on elite athletes as much research focuses on recreationally trained individuals. To mitigate these limitations findings were interpreted with consideration of methodological rigor sample characteristics and the presence of conflicting evidence. Future research recommendations emphasize the need for standardized protocols in menstrual cycle-related sports performance research.

Physiological Changes Across the Menstrual Cycle and Their Possible Impact on Athletic Performance

Each phase of the menstrual cycle creates distinct physiological conditions that can either enhance or hinder athletic performance.

The follicular phase

The follicular phase, which begins on the first day of menstruation and lasts until ovulation, is characterized by rising estrogen levels and relatively low progesterone.(Barbieri, 2014) This

hormonal environment supports various physiological advantages for athletic performance. Estrogen's anti-inflammatory properties help reduce exercise-induced muscle damage and oxidative stress, leading to faster recovery and improved muscular endurance (Enns & Tiidus, 2010; Kendall & Eston, 2002; Lowe & Kararigas, 2020; Pellegrino et al., 2022; Stupka et al., 2000) e. Additionally, estrogen enhances neuromuscular efficiency by improving motor unit recruitment and muscle contractility, which supports strength and power generation, though it may also contribute to increased ligament laxity and injury susceptibility. (Coldron et al., 2021) From a cardiovascular perspective, estrogen promotes vasodilation, increasing oxygen delivery to working muscles and improving aerobic capacity by enhancing mitochondrial efficiency and shifting metabolism toward greater fat oxidation.(Guajardo-Correa et al., 2022; Morselli et al., 2017) Furthermore, estrogen influences thermoregulation by lowering core body temperature and enhancing sweat response, helping athletes tolerate heat stress more effectively, a key advantage in endurance sports.(Charkoudian & Joyner, 2004; Charkoudian & Stachenfeld, 2016; Giersch et al., 2020; Lei et al., 2018; Stephenson & Kolka, 1985) These combined physiological benefits make the follicular phase a period of potential performance optimization for female athletes.

The ovulatory phase

At the midpoint of the menstrual cycle, the ovulatory phase brings a peak in estrogen and a surge in luteinizing hormone (LH).(Barbieri, 2014) Beyond the previously discussed effects of estrogen, LH plays a key role in triggering ovulation and influencing neuromuscular function and metabolic regulation. At this stage, progesterone remains low, which may enhance insulin sensitivity and carbohydrate utilization, potentially supporting energy availability for athletic performance.(Campbell et al., 2001; Devries et al., 2006; Isacco et al., 2012; C. M. Lebrun et al., 2013; Zderic et al., 2001) However, hormonal fluctuations also impact collagen turnover and ligament stiffness, leading to increased joint laxity and flexibility, which may heighten injury risk in high-impact sports like football and rugby.(Shultz et al., 2004, 2005; Smith et al., 2024).

The luteal phase

During the luteal phase of the menstrual cycle, elevated progesterone levels induce significant physiological changes that may influence athletic performance. One of the most notable effects is an increase in core body temperature, which could diminish heat tolerance and impair endurance, particularly in warm conditions. (Marsh & Jenkins, n.d.; Tenaglia et al., 1999) Additionally, cardiovascular strain may heighten as resting heart rate and cardiac output rise,

potentially leading to an increased perception of effort.(C. Lebrun, n.d.; Zengin et al., 2007) Fluid retention and slowed digestion may cause bloating and discomfort, potentially reducing movement efficiency. (Massil & O'brien, 1986; White et al., 2011) Neurologically, disturbances in sleep quality and mood fluctuations can impair motivation, cognitive clarity, and decision-making—critical components of athletic success.(Power et al., 2023; Ronca et al., 2025; Taylor et al., 2024)

Endurance and Strength Performance Across the Menstrual Cycle

The relationship between menstrual cycle (MC) phases and athletic performance in endurance and strength activities remains a critical area of sports science research. A growing body of literature suggests that hormonal fluctuations influence various physiological and psychological factors that may impact performance. However, the degree of impact varies across individuals and exercise modalities.

Endurance Performance Across the Menstrual Cycle

Several studies have explored how different MC phases affect endurance performance, including aerobic capacity, running economy, and recovery. A systematic review and meta-analysis by McNulty et al. (2020) found that endurance-based performance might be slightly lower during the early follicular phase, where estrogen and progesterone levels are at their lowest.(McNulty et al., 2020) Similarly, a study on endurance-trained women indicated that the early follicular phase was associated with poorer sleep quality and slower recovery following high-intensity training, suggesting that hormonal fluctuations may affect endurance recovery dynamics.(Taylor et al., 2024)

Research on elite multisport female athletes suggests that the impact of the menstrual cycle on endurance performance varies significantly between individuals. While some athletes experience noticeable declines, others report little to no change, emphasizing the importance of personalized assessment. (van den Berg & Doyle-Baker, 2025) However, despite these subjective reports, physiological measures like VO_2 max and time to exhaustion show inconsistent patterns across studies.(McNulty et al., 2020)

Strength Performance and Neuromuscular Function

The impact of the MC on strength-related performance, including maximal strength, power, and neuromuscular control, has been widely debated. Isenmann et al. (2024) examined back squat and jumping performance in trained female athletes and found no significant fluctuations in maximal force production across MC phases. However, they noted that at higher performance

levels, small variations in squat performance correlated with cycle phase, suggesting that elite athletes may exhibit greater sensitivity to hormonal fluctuations compared to recreational athletes. (Isenmann et al., 2024)

Research on female rugby league players also reported minimal effects of the MC or hormonal contraceptive use on jump height, peak force, and sprint performance. (Smith et al., 2024) Similarly, a study on professional volleyball players found no significant variations in strength-related performance across MC phases, leading the authors to question the necessity of adjusting training based on the cycle. (Roffler et al., 2024) An investigation into isokinetic knee flexor and extensor strength in female soccer players provided some contrasting evidence. Researchers found that while peak torque remained stable across MC phases, functional hamstring strength was significantly lower during the follicular phase. Authors suggest that while maximal strength may not be affected, stability and injury risk factors could fluctuate, particularly in high-speed, eccentric muscle actions. Given the increased risk of anterior cruciate ligament (ACL) injuries in female athletes, this finding underscores the importance of monitoring neuromuscular control throughout the cycle. (Quigley & Greig, 2025)

Perceived Performance and Psychological Factors

In addition to physiological changes, subjective perceptions of performance and well-being fluctuate throughout the MC. A study by Ihalainen et al. found that 56% of athletes reported a decline in perceived performance during menstruation due to symptoms such as bloating, cramps, and mood swings. While strength and endurance performance metrics often showed trivial or no changes, athletes' perceptions of performance were significantly influenced by menstrual cycle symptoms, particularly in naturally menstruating athletes compared to those using hormonal contraceptives.(Ihalainen et al., 2024)

Similarly, research highlighted mental performance deficits in the early follicular phase, with increased reaction time and decreased cognitive processing speed. (Ihalainen et al., 2024) This could be particularly relevant in team sports or activities requiring rapid decision-making, even if physical performance remains unchanged.

Impact of Hormonal Contraceptives on Athletic Performance

Hormonal contraceptives (HCs), including oral contraceptive pills (OCPs), intrauterine devices (IUDs), and injectables, alter natural hormonal fluctuations by suppressing ovulation and stabilizing estrogen and progesterone levels. This hormonal modulation can influence

metabolism, muscle recovery, and thermoregulation, potentially affecting athletic performance (Elliott-Sale et al., 2020). Some research suggests that OCP users may experience reduced muscle protein synthesis, which could impair strength adaptations and recovery compared to naturally menstruating athletes. Additionally, studies indicate that OCPs may lead to altered neuromuscular efficiency, affecting power output and muscle activation, particularly in high-intensity or strength-based sports (Burrows & Peters, 2007). However, findings on endurance performance remain inconclusive, with some studies reporting improved exercise efficiency due to stabilized hormone levels, while others suggest potential declines in VO_2 max and increased fatigue (McNulty et al., 2020). Furthermore, the influence of HCs on injury risk is a growing area of interest, as some evidence suggests that oral contraceptive users may have a lower risk of anterior cruciate ligament (ACL) injuries due to reduced ligament laxity and collagen turnover (Herzberg et al., 2017). Despite these findings, the impact of hormonal contraceptives remains highly individualized, warranting further research to develop personalized training and recovery strategies for female athletes.

Discussion

The findings of this review suggest that the menstrual cycle (MC) plays a complex role in female athletic performance, influencing endurance, strength, and neuromuscular function through hormonal fluctuations. While physiological studies highlight potential performance advantages in the follicular phase—such as improved muscle recovery, neuromuscular efficiency, and thermoregulation—athletes also face heightened risks of ligament laxity and injury. Conversely, the luteal phase presents physiological challenges, including elevated core temperature, increased cardiovascular strain, and potential declines in endurance due to increased perception of effort. However, the extent of these effects varies widely among individuals, underscoring the need for personalized approaches to training and competition planning.

The influence of the MC on endurance performance remains a topic of debate. While some research suggests a slight decrease in aerobic performance during the early follicular phase due to low estrogen and progesterone levels, other studies report negligible changes in key metrics such as VO_2 max and time to exhaustion. Similarly, strength performance appears to be relatively stable across MC phases, with only minor variations observed in elite athletes. However, neuromuscular control and functional hamstring strength may fluctuate, increasing the risk of injury in sports involving high-speed movements and eccentric contractions.

Psychological and perceptual factors further complicate the relationship between MC phases and athletic performance. Many athletes report experiencing fatigue, mood disturbances, and perceived performance declines during menstruation, despite minimal objective changes in physical capabilities. Cognitive function and reaction time may also be affected, particularly in the early follicular phase, which could impact decision-making and tactical execution in competitive settings. These findings emphasize the importance of considering both physiological and psychological factors when designing training programs for female athletes. Future research should aim to address the inconsistencies in the current literature by utilizing larger sample sizes, standardized methodologies, and individual-specific analyses. Additionally, while hormonal contraceptives are commonly used by female athletes, their impact on performance and injury risk remains an area requiring further investigation. Studies exploring the interaction between MC phases, nutritional strategies, recovery protocols, and training adaptations could provide more comprehensive guidelines for optimizing female athletic performance.

Conclusion

This review highlights the intricate relationship between the menstrual cycle and athletic performance, demonstrating that hormonal fluctuations influence various physiological and psychological factors. While the follicular phase may offer advantages in endurance and neuromuscular efficiency, the luteal phase presents potential challenges related to thermoregulation, cardiovascular function, and perceived exertion. However, the degree of impact is highly individualized, with some athletes experiencing significant variations while others report minimal changes.

Hormonal contraceptives (HCs) alter natural hormonal fluctuations, potentially influencing metabolism, muscle recovery, neuromuscular efficiency, and thermoregulation in female athletes. While some research suggests OCPs may impair strength adaptations and endurance performance, they may also reduce ACL injury risk, highlighting the need for individualized training and further research.

Given these findings, sports scientists, coaches, and athletes should adopt a more personalized approach to training and competition planning, incorporating MC tracking and individualized adjustments where necessary. While objective performance measures often remain stable across the cycle, subjective symptoms and injury risk factors should not be overlooked. Future research should continue to explore the nuanced effects of the MC on female athletic

performance, ultimately working toward evidence-based strategies that support optimal performance and well-being.

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Authors' contributions

Conceptualization: SD, WK, AK, AB;
Methodology: SD, AB, WD;
Software: n/a; check: SD, AB, WK;
Formal analysis: SD, AB, WK, AK;
Investigation: SD, AB, WK, MM, AK;
Resources: MM, AK, RT, KSz;
Data curation: AB, WK, SD, AK, AB;
Writing - rough preparation: SD, WK, AK, ABy;
Writing - review and editing: RT, ABy, KSz, MM;
Visualization, SD, AK, AB, WD;
Supervision: SD, WK, AK, AB, MM;
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References

Barbieri, R. L. (2014). The endocrinology of the menstrual cycle. *Methods in Molecular Biology (Clifton, N.J.)*, *1154*, 169–180. https://doi.org/10.1007/978-1-4939-0659-8_7

Burrows, M., & Peters, C. E. (2007). The influence of oral contraceptives on athletic performance in female athletes. *Sports Medicine*, *37*(7), 557–574. https://doi.org/10.2165/00007256-200737070-00001

Campbell, S. E., Angus, D. J., & Febbraio, M. A. (2001). Glucose kinetics and exercise performance during phases of the menstrual cycle: Effect of glucose ingestion. *American Journal of Physiology - Endocrinology and Metabolism*, *281*(4 44-4), 817–825. https://doi.org/10.1152/AJPENDO.2001.281.4.E817/ASSET/IMAGES/LARGE/H11010541007.JPEG

Charkoudian, N., & Joyner, M. J. (2004). Physiologic considerations for exercise performance in women. *Clinics in Chest Medicine*, *25*(2), 247–255. https://doi.org/10.1016/j.ccm.2004.01.001

Charkoudian, N., & Stachenfeld, N. (2016). Sex hormone effects on autonomic mechanisms of thermoregulation in humans. *Autonomic Neuroscience*, *196*, 75–80. https://doi.org/10.1016/J.AUTNEU.2015.11.004

Coldron, Y., Wilson, A. J., & Coldron, Y. (2021). *Journal of Pelvic, Obstetric and Gynaecological Physiotherapy*. *129*, 9–21. www.positivepause.co.uk

Devries, M. C., Hamadeh, M. J., Phillips, S. M., & Tarnopolsky, M. A. (2006). Menstrual cycle phase and sex influence muscle glycogen utilization and glucose turnover during moderate-intensity endurance exercise. *American Journal of Physiology - Regulatory Integrative and Comparative Physiology*, *291*(4), 1120–1128. https://doi.org/10.1152/AJPREGU.00700.2005/ASSET/IMAGES/LARGE/ZH601006542700 03.JPEG

Elliott-Sale, K. J., McNulty, K. L., Ansdell, P., Goodall, S., Hicks, K. M., Thomas, K., Swinton, P. A., & Dolan, E. (2020). The Effects of Oral Contraceptives on Exercise Performance in Women: A Systematic Review and Meta-analysis. *Sports Medicine (Auckland, N.Z.)*, *50*(10), 1785–1812. https://doi.org/10.1007/S40279-020-01317-5

Enns, D. L., & Tiidus, P. M. (2010). *The Influence of Estrogen on Skeletal Muscle Sex Matters*.

Giersch, G. E. W., Morrissey, M. C., Katch, R. K., Colburn, A. T., Sims, S. T., Stachenfeld, N. S., & Casa, D. J. (2020). Menstrual cycle and thermoregulation during exercise in the heat: A systematic review and meta-analysis. *Journal of Science and Medicine in Sport*, *23*(12), 1134–1140. https://doi.org/10.1016/J.JSAMS.2020.05.014

Guajardo-Correa, E., Silva-Agüero, J. F., Calle, X., Chiong, M., Henríquez, M., García-Rivas, G., Latorre, M., & Parra, V. (2022). Estrogen signaling as a bridge between the nucleus and mitochondria in cardiovascular diseases. *Frontiers in Cell and Developmental Biology*, *10*. https://doi.org/10.3389/FCELL.2022.968373

Herzberg, S. D., Motu'apuaka, M. L., Lambert, W., Fu, R., Brady, J., & Guise, J. M. (2017). The Effect of Menstrual Cycle and Contraceptives on ACL Injuries and Laxity: A Systematic Review and Meta-analysis. *Orthopaedic Journal of Sports Medicine*, *5*(7). https://doi.org/10.1177/2325967117718781

Ihalainen, J. K., Takalo, S., Mjøsund, K., Solli, G. S., Valtonen, M., Kokkonen, M., Hackney, A. C., & Mikkonen, R. S. (2024). Self-Reported Performance and Hormonal-Cycle-Related Symptoms in Competitive Female Athletes. *Women in Sport & Physical Activity Journal*, *32*(1). https://doi.org/10.1123/WSPAJ.2023-0102

Isacco, L., Duch, P., & Boisseau, N. (2012). Influence of hormonal status on substrate utilization at rest and during exercise in the female population. *Sports Medicine*, *42*(4), 327–342. https://doi.org/10.2165/11598900-000000000-00000

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 & Rehabilitation*, *16*(1). https://doi.org/10.1186/S13102-024-01010-4

Kendall, B., & Eston, R. (2002). Exercise-induced muscle damage and the potential protective role of estrogen. *Sports Medicine*, *32*(2), 103–123. https://doi.org/10.2165/00007256-200232020-00003

Lebrun, C. (n.d.). *Effects of menstrual cycle phase on athletic performance*.

Lebrun, C. M., Joyce, S. M., & Constantini, N. W. (2013). Effects of Female Reproductive Hormones on Sports Performance. *Endocrinology of Physical Activity and Sport: Second Edition*, 281–322. https://doi.org/10.1007/978-1-62703-314-5_16

Lei, T. H., Cotter, J. D., Schlader, Z. J., Stannard, S. R., Perry, B. G., Barnes, M. J., & Mündel, T. (2018). On exercise thermoregulation in females: interaction of endogenous and exogenous ovarian hormones. *The Journal of Physiology*, *597*(1), 71. https://doi.org/10.1113/JP276233

Lowe, D. A., & Karagas, G. (2020). Editorial: New Insights into Estrogen/Estrogen Receptor Effects in the Cardiac and Skeletal Muscle. *Frontiers in Endocrinology*, *11*, 141. https://doi.org/10.3389/FENDO.2020.00141

Marsh, S. A., & Jenkins, D. G. (n.d.). *Physiological Responses to the Menstrual Cycle Implications for the Development of Heat Illness in Female Athletes*.

Massil, H., & O'brien, P. M. (1986). Premenstrual syndrome. *British Medical Journal (Clinical Research Ed.)*, *293*(6557), 1289. https://doi.org/10.1136/BMJ.293.6557.1289

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

Morselli, E., Santos, R. S., Criollo, A., Nelson, M. D., Palmer, B. F., & Clegg, D. J. (2017). The effects of oestrogens and their receptors on cardiometabolic health. *Nature Reviews Endocrinology*, *13*(6), 352–364. https://doi.org/10.1038/NRENDO.2017.12

Oester, C., Norris, D., Scott, D., Pedlar, C., Bruinvels, G., & Lovell, R. (2024). Inconsistencies in the perceived impact of the menstrual cycle on sport performance and in the prevalence of menstrual cycle symptoms: A scoping review of the literature. *Journal of Science and Medicine in Sport*, *27*(6), 373–384. https://doi.org/10.1016/J.JSAMS.2024.02.012

Pellegrino, A., Tiidus, P. M., & Vandenboom, R. (2022). Mechanisms of Estrogen Influence on Skeletal Muscle: Mass, Regeneration, and Mitochondrial Function. *Sports Medicine*, *52*(12), 2853–2869. https://doi.org/10.1007/S40279-022-01733-9

Power, C. J., Fox, J. L., Elliott-Sale, K. J., Bender, A. M., Dalbo, V. J., & Scanlan, A. T. (2023). Waking Up to the Issue! Research Inattention and Sex-Related Differences Warrant More Sleep Studies in Female Athletes. *Sports Medicine 2023 54:3*, *54*(3), 565–583. https://doi.org/10.1007/S40279-023-01963-5

Quigley, T., & Greig, M. (2025). The influence of menstrual cycle phase on isokinetic knee flexor and extensor strength in female soccer players: a pilot study. *Research in Sports Medicine (Print)*, *33*(1). https://doi.org/10.1080/15438627.2024.2420085

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*. https://doi.org/10.3389/FSPOR.2024.1408711

Ronca, F., Blodgett, J. M., Bruinvels, G., Lowery, M., Raviraj, M., Sandhar, G., Symeonides, N., Jones, C., Loosemore, M., & Burgess, P. W. (2025). Attentional, anticipatory and spatial cognition fluctuate throughout the menstrual cycle: Potential implications for female sport. *Neuropsychologia*, *206*. https://doi.org/10.1016/J.NEUROPSYCHOLOGIA.2024.108909

Shultz, S. J., Kirk, S. E., Johnson, M. L., Sander, T. C., & Perrin, D. H. (2004). Relationship between Sex Hormones and Anterior Knee Laxity across the Menstrual Cycle. *Medicine and Science in Sports and Exercise*, *36*(7), 1165–1174. https://doi.org/10.1249/01.MSS.0000132270.43579.1A

Shultz, S. J., Sander, T. C., Kirk, S. E., & Perrin, D. H. (2005). Sex differences in knee joint laxity change across the female menstrual cycle. *The Journal of Sports Medicine and Physical Fitness*, *45*(4), 594. https://doi.org/10.1249/00005768-200405001-00719

Smith, E. S., Weakley, J., McKay, A. K. A., McCormick, R., Tee, N., Kuikman, M. A., Harris, R., Minahan, C., Buxton, S., Skinner, J., Ackerman, K. E., Elliott-Sale, K. J., Stellingwerff, T., & Burke, L. M. (2024). Minimal influence of the menstrual cycle or hormonal contraceptives on performance in female rugby league athletes. *European Journal of Sport Science*, *24*(8), 1067–1078. https://doi.org/10.1002/EJSC.12151

Stephenson, L. A., & Kolka, M. A. (1985). Menstrual cycle phase and time of day alter reference signal controlling arm blood flow and sweating. *The American Journal of Physiology*, *249*(2 Pt 2). https://doi.org/10.1152/AJPREGU.1985.249.2.R186

Stupka, N., Lowther, S., Chorneyko, K., Bourgeois, J. M., Hogben, C., Tarnopolsky, M. A., & Bour-Geois, J. M. (2000). Gender differ-ences in muscle inflammation after eccentric exercise. *J Appl Physiol*, *89*, 2325–2332. http://www.jap.org

Taylor, M. Y., Hrozanova, M., Nordengen, L., Sandbakk, Ø., Osborne, J. O., & Noordhof, D. A. (2024). Influence of Menstrual-Cycle Phase on Sleep and Recovery Following High- and Low-Intensity Training in Eumenorrheic Endurance-Trained Women: The Female Endurance Athlete Project. *International Journal of Sports Physiology and Performance*, *19*(12), 1491–1499. https://doi.org/10.1123/IJSPP.2024-0201

Tenaglia, S. A., McLellan, T. M., & Klentrou, P. P. (1999). Influence of menstrual cycle and oral contraceptives on tolerance to uncompensable heat stress. *European Journal of Applied*

Physiology and Occupational Physiology, *80*(2), 76–83. https://doi.org/10.1007/S004210050561

van den Berg, C. A., & Doyle-Baker, P. K. (2025). Are we asking the right questions? Female athletes' perspectives on the menstrual cycle in sport. *Psychology of Sport and Exercise*, *76*. https://doi.org/10.1016/J.PSYCHSPORT.2024.102767

White, C. P., Hitchcock, C. L., Vigna, Y. M., & Prior, J. C. (2011). Fluid Retention over the Menstrual Cycle: 1-Year Data from the Prospective Ovulation Cohort. *Obstetrics and Gynecology International*, *2011*(1), 138451. https://doi.org/10.1155/2011/138451

Zderic, T. W., Coggan, A. R., & Ruby, B. C. (2001). Glucose kinetics and substrate oxidation during exercise in the follicular and luteal phases. *Journal of Applied Physiology*, *90*(2), 447–453. https://doi.org/10.1152/JAPPL.2001.90.2.447/ASSET/IMAGES/LARGE/DG0210463002.JPEG

Zengin, K., Tokac, M., Duzenli, M. A., Soylu, A., Aygul, N., & Ozdemir, K. (2007). Influence of menstrual cycle on cardiac performance. *Maturitas*, *58*(1), 70–74. https://doi.org/10.1016/J.MATURITAS.2007.06.002