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Human Kinetics
BRIEF REVIEW

Menstrual Cycle Effects on Performance Parameters in Female Football Players: A Systematic Review

Kristine D. Rasmussen, Mette S. Bisgaard, and Mette Hansen
Section for Sport Science, Department of Public Health, Aarhus University, Aarhus, Denmark

Purpose: The aim of this systematic review was to investigate the influence of menstrual cycle (MC) phases on performance-determining parameters in female football players. ***Methods:*** A systematic search was conducted in PubMed and SPORTDiscus (last updated January 2026) following PRISMA guidelines. Studies were eligible if they included eumenorrheic female football players and assessed at least one quantitative performance outcome across 2 or more defined MC phases. Outcomes were categorized into aerobic performance (eg, total running distance, Yo-Yo tests), sprint and high-intensity running, and agility and power-related parameters (eg, jumps, change in direction). Methodological quality and MC phase verification were assessed using a modified version of an existing quality tool. Outcomes were synthesized using a structured, domain-based comparison across MC phases. This review was not registered. ***Results:*** Fifteen prospective observational studies (total n = 210) met inclusion criteria. Evidence for MC phase effects on performance was inconsistent. Five studies reported reduced aerobic and/or sprint performance in the early follicular phase compared with the late follicular or mid-luteal phases, while 10 studies found no differences. No consistent effect of MC phase was observed on agility and power-related outcomes. Methodological limitations across studies included small sample sizes, inconsistent MC phase verification, and variability in performance tests. ***Conclusions:*** Current evidence suggests that aerobic and sprint performance may be slightly impaired during the early follicular phase in female football players, but findings remain inconclusive. Standardized protocols and hormonal confirmation of MC phases are needed to clarify the impact of hormonal fluctuations on sport-specific performance.

Keywords: hormonal fluctuations, team sport physiology, female athletes, exercise performance, soccer

Women's football has gained substantial popularity over the past decade[1] and is undergoing increasing professionalization.[2,3] Although training and competitive environments have improved, the women's game still markedly lags behind men's football in terms of resources and support.[4] Furthermore, a rising challenge is the increasing fixture load put on players.[5] Despite this, female players are increasingly expected to perform at a high level.[2,6,7] Since performance is closely linked to individual and team physical capacity,[7] a better understanding of female-specific physiology is essential.

Football is an intermittent, high-intensity sport characterized by frequent changes of movement, direction, and intensity.[2] During a 90-minute match, elite female footballers typically maintain an average heart rate of 87% maximum heart rate, indicating substantial aerobic strain.[7] Aerobic performance supports sustained technical and tactical performance,[2,7] and can be assessed using competition-specific metrics such as total running distance during a match (~10 km on average) or standardized field tests like the Yo-Yo Test, in which female players run between 780 and 1379 m.[2,3] Anaerobic demands are equally critical. High-intensity runs (>15 km·h^{-1}) and sprints (>21 km·h^{-1}) are important differentiators across performance levels.[2] Elite female football players cover 0.2 to 1.7 km at high intensity during a match depending on level of play and measurement method and complete a 30-m sprint in 4.34 to 4.96 seconds.[2] Rapid changes of direction, accelerations, decelerations, and jumping are also performance-determining.[8,9] Female players perform over 1300 activity changes per match[3] and typically jump 28 to 50 cm in countermovement jumps or vertical jumps.[2]

Unlike their male counterparts, female athletes during their menstrual cycle (MC) experience fluctuations in sex hormones which may influence physiological performance parameters.[10–12] A regular MC length is 21 to 35 days (in average 28 d).[13] The MC is regulated by the hypothalamic-pituitary-ovarian axis and is divided into the follicular and luteal phases. The early follicular phase (EF phase, the bleeding phase) is marked by low estrogen and progesterone levels. In the late follicular (LF) phase, estrogen levels rise while progesterone remains low. During ovulation (OV), a surge in estrogen triggers a peak in luteinizing hormone which elicits OV.[14] OV marks the transition to the luteal phase, which in a 28-day MC takes place around day 14.[11] In the early luteal (EL) phase, corpus luteum activity increases estrogen and progesterone secretion, reaching a plateau during the mid-luteal (ML) phase. Both hormone levels subsequently decline during the late luteal (LL) phase.[14] These hormonal fluctuations have been suggested to influence cardiovascular capacity,[15] neuromuscular function, and overall athletic performance,[11] potentially affecting performance outcomes in football-specific tasks such as sprinting, endurance, power, and agility.

Despite growing interest, current evidence on the influence of MC phases on physical performance in female football remains inconclusive. A recent systematic review by Hamed-Hamed et al[6] based on only 9 studies addressed this topic and identified several methodological limitations in the existing literature, including heterogeneous study designs and inconsistent MC phase verification methods.[6] Since the publication of that review, several new studies have been published,[16–23] warranting an updated synthesis of the evidence. Furthermore, we find it highly relevant to perform a quality assessment regarding MC phase verification,[11] as it was

Rasmussen and Bisgaard contributed equally to this work and share first authorship.
Rasmussen https://orcid.org/0009-0005-9192-2928
Bisgaard https://orcid.org/0000-0002-1818-072X
Hansen (mhan@ph.au.dk) is corresponding author, https://orcid.org/0000-0002-9383-8202

not systematically performed in the previous review. An up-to-date review is essential to clarify whether MC-related hormonal fluctuations affect performance in football-specific tasks and guide individualized evidence-based training strategies for female athletes.

Objectives

The aim of this systematic review is to investigate how the phases of the MC influence performance-determining parameters in female football players.

Methods

Design

The systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. No protocol registration was undertaken for this review and no protocol prepared.

Information Sources

To identify eligible papers, an electronic search was conducted in PubMed and SPORTDiscus on September 5, 2024. Reference lists of included studies were screened to identify potentially missed studies. An updated electronic search was subsequently conducted on January 9, 2026, to identify any further articles published between September 2024 and January 2026.

Search Strategy

A broad search strategy was chosen using a Boolean strategy with the following search terms related to MC: "Menstrual Cycle" OR "menstruate" OR "menstruated" OR "menstruates" OR "menstruating" OR "mense" OR "menses" OR "follicular phase" OR "luteal phase" AND terms related to football: ("Soccer" OR "Football") as the only search terms. The specific search strategies used in each database are seen below. No date restriction was applied.

PubMed:

("menstrual cycle"[MeSH Terms] OR ("menstruate"[All Fields] OR "menstruated"[All Fields] OR "menstruates"[All Fields] OR "menstruating"[All Fields] OR "menstruation"[MeSH Terms] OR "menstruation"[All Fields] OR "menstruations"[All Fields] OR ("mense"[All Fields] OR "menstruation"[MeSH Terms] OR "menstruation"[All Fields] OR "menses"[All Fields]))) AND ("football"[MeSH Terms] OR "soccer"[MeSH Terms] OR ("soccer"[MeSH Terms] OR "soccer"[All Fields] OR "soccers"[All Fields]) OR ("football"[MeSH Terms] OR "football"[All Fields] OR "football s"[All Fields] OR "footballer"[All Fields] OR "footballers"[All Fields] OR "footballers"[All Fields] OR "footballs"[All Fields]))

SPORTDiscus:

(menstrual cycle or menses or follicular phase or luteal phase) AND (football or soccer)

Eligibility Criteria

Original articles discussing the influence of MC phases on performance determining parameters in female football players were considered for analysis if they met the following inclusion criteria: (1) included participants being eumenorrheic, defined as a MC between 21 and 35 days; (2) related to quantitative performance parameters (aerobic, sprint, agility, and power) in association football; (3) outcome parameters were measured in ≥2 defined phases within the MC.

Studies were excluded based on the following criteria: (1) not association football, (2) participants used hormonal contraception, (3) did not include a relevant performance parameter, (4) not original research article and/or (5) not written in English.

Study Selection

One author (Rasmussen) carried out the systematic electronic searches in both databases and screened the titles and abstracts of all identified articles. Any duplicates were removed using Covidence Systematic Review, Software (Veritas Health Innovation). Full-text versions of relevant articles were retrieved and independently screened by 3 authors (Rasmussen, Bisgaard, and Hansen). Consensus meetings were used to resolve any conflicts between the authors relating to study eligibility.

Data Items

Eligible outcomes included within the relevant performance parameters:

1. Aerobic performance was total distance covered during a match (in meters per minute) or Yo-Yo intermittent endurance test or intermittent recovery test level 1 (in meters).
2. Sprint variables included amount (bouts per match) and counts (counts per minute) of high-speed running and sprints within a match, a 20- to 40-m sprint (in seconds) or repeated sprint test (in seconds).
3. Agility and power variables included countermovement jumps (in centimeters), squat jumps (in centimeters), leg jump, including both legs, nondominant and dominant leg (in centimeters), V-cut (in seconds), 5-jump test (in meters), accelerations (in counts per minute), decelerations (in counts per minute), 15-m agility run (in meters per second), and 15-m ball dribbling (in meters per second), Illinois Agility Test (in seconds), and repeated sprint test with 180° change of direction halfway (in seconds).

Any measure of performance across ≥2 MC phases within each outcome domain was eligible for inclusion. Data extraction was conducted by the 3 authors (Rasmussen, Bisgaard, and Hansen) and any discrepancies resolved during consensus meetings. We also extracted the following data: (1) characteristics of the study (author, year of publication, country, and aim of study and design), (2) population characteristics (n, age, and tier), (3) MC verification method (method and time of test in MC). Outcomes were synthesized using a structured, domain-based comparison across MC phases. Effect measures were reported as provided in the original studies (eg, mean differences, *P* values, effect sizes).

Study Risk of Bias Assessment

The risk of bias assessment of the studies was assessed by one author (Rasmussen) using a strategy based on the modified version of the quality assessment in McNulty et al[11] and was discussed at consensus meetings between the 3 authors (Rasmussen, Bisgaard, and Hansen).

Results

Study Selection

The search identified 207 titles in the 2 databases. After removal of duplicates (51 references) and screening for relevance based on title and abstract, 18 articles remained. The main reason for exclusion was not including a relevant performance parameter (n = 57), did not include association football (n = 47), did not use a quantitative design (n = 13), and no MC phase comparison (n = 6). The full text of the remaining 18 articles was examined in more detail; 3 were excluded because only abstracts were available. At the end of the screening procedure 15 articles were selected for in-depth reading and analysis. A flowchart of the process is available in Figure 1.

Study Characteristics

This systematic review is based on the results from 15 prospective observational studies, published within the last 11 years, with follow-up periods ranging from 1 MC up to 3 years. The study populations in the included 15 studies varied between 7 and 33 participants, corresponding to a total of 210 participants across all included studies.[8,16–29] Table 1 provides an overview of the 15 included studies, outlining study characteristics, populations, methods of MC verification, outcomes, and individual results.

The age of the football players in the included studies ranged from an average age of 16 years for the youngest population studied[8] to the oldest population with an average age of 28 years.[18] Nine of the included studies were based on players from the top 2 leagues in Italy,[24] France,[16,19,20,22,25] and Germany.[21,26,27] Additionally, 3 studies examined football players from Spain, one from the fifth-tier league,[8] one competing in the first division,[23] and one on the second team of Valencia C.F.[17] All these nations were ranked in the top-10 of UEFA's ranking of women's football nations in 2026.[31] The remaining 3 articles focused on players from countries outside the UEFA rankings, including the best Australian league,[18] national football players from Thailand,[28] and Tunisian players at a high national level.[29]

Risk of Bias in Studies

The quality classification of the 15 included studies is presented in Table 2. Based on the modified quality assessment,

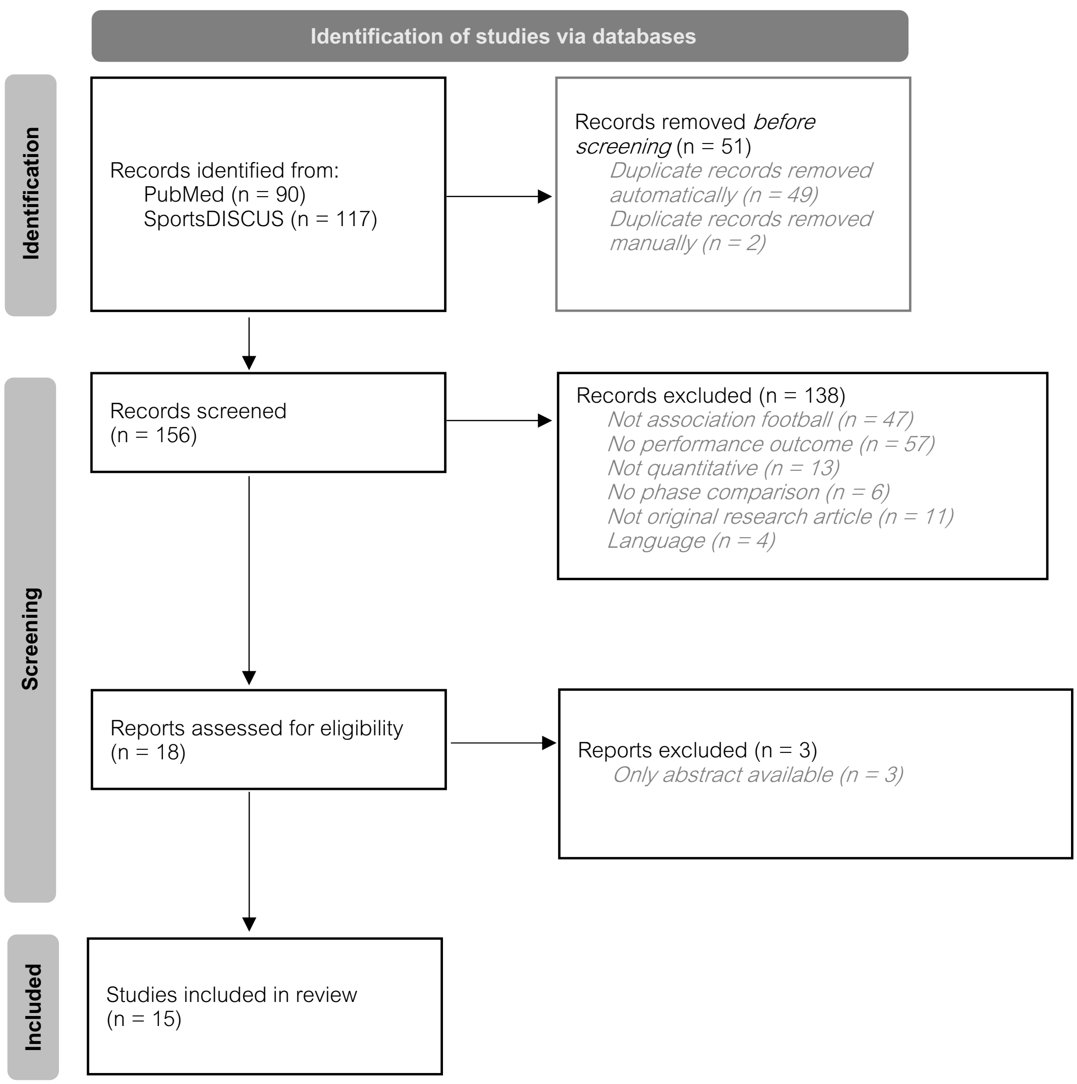

Figure 1 — Flowchart over the search and selection process.

Table 1 Overview of Included Studies on Football-Related Performance Parameters Across MC Phases

Article	Country	N	Age, y	Tier[a]	MC verification method[b] and MC tracking duration	MC length, d	Phases in MC[c]	Performance outcomes	Main results[d]	Study quality[e]
Muñoz Aloy et al[17]	Spain	14	19 (2)	*3*	Calendar; 1 MC	21–35 d (inclusion criteria)	FP_{est}, LF_{est}, LP_{est}	CMJ, SJ	NS	Very low
Badier et al[22]	France	33	—	4/5	Calendar; 6 mo	21–35 d; <7–d variation (inclusion criteria)	Days of bleeding, in-between phase, prebleeding (7 d prior to next bleeding)	DTOT, HSR, MSR, LSR	Higher HSR (≥13 km·h^{-1}) on symptom free days vs symptom days Other NS (DTOT, LSR, MSR)[f]	Very low
Beavan et al[21]	Germany	21	24 (3)	4	Questionnaire; 1 season	—	EF_{est}, OV_{est}, EL_{est}, ML_{est}, LL_{est}	DTOT, ACC, sprint	NS	Very low
Brown et al[18]	Australia	7	28 (6)	*3/4*	Calendar + urinary LH, PdG; up to 4 MC in 1 season	29 (5)	EF_{est}, LF, LP	DTOT, HSR, sprint, peak speed, ACC, DEC	Higher DTOT and HSR in LF vs EF and LP ($P < .05$) Other NS	Low
Bouvier et al[16]	France	11	26 (4)	*4*	Calendar + serum E2, P4; 1 MC	28 (2)	EF, LF, ML	40-m sprint	NS	Moderate
Campa et al[24]	Italy	20	24 (3)	*3*	Calendar; 50 d (≈2 MC)	29 (2)	EF_{est}, OV_{est}	CMJ, 20-m sprint	NS	Low
Igonin et al[19]	France	11	26 (4)	*3*	Calendar + serum E2, P4; 1–2 MC	28 (2)	EF, LF, ML	40-m sprint, agility, ball dribbling, SJ, RST	Sprint velocity lower in EF vs LF and ML ($P < .05$) Other NS	Moderate
Igonin et al[25]	France	8	26 (3)	*3*	Calendar; 3 seasons	30 (3)	EF_{est}, LF_{est}, ML_{est}	DTOT, LSR, MSR, HSR, sprint counts	DTOT, MSR, HSR, sprint count lower in EF vs LF and/or ML ($P < .05$) Other NS	Very low
Juillard et al[20]	France	10	19 (1)	*3*	Calendar; 8 wk	Absent cycle or ≥7–d delay (exclusion criteria)	FP_{est}, LP_{est}	IAT	NS	Very low
Julian et al[27]	Germany	9	19 (4)	*2*	Calendar + serum E2, P4; 8 wk	24–35 d (inclusion criteria)	EF, ML	CMJ, 30-m sprint, YYIET	NS	Low
Julian et al[26]	Germany	15	23 (4)	*3/4*	Calendar + serum E2, P4, LH; 4 mo	24–35 d (inclusion criteria)	EF, ML	DTOT, LSR, MSR, HSR, sprint counts	MSR higher in ML vs EF ($P = .02$) Other NS	Moderate
Romero-Moraleda et al[23]	Spain	15	24 (6)	*3/4*	Calendar + saliva E2, P4 + urinary LH + basal body temperature; ≥1 MC over 5 mo	27 (2)	EF, OV, ML	CMJ	NS	Moderate
Sánchez et al[8]	Spain	12	16 (2)	*2*	Calendar; 1 MC	24–35 d (inclusion criteria)	EF_{est}, FP_{est}, LP_{est}	40-m sprint, V-cut, SJ, leg jump	NS	Very low
Somboonwong et al[28]	Thailand	13	19 (1)	*3*	Basal body temperature; 1 MC	29 (1)	EF_{est}, ML_{est}	RST	NS	Very low
Tounsi et al[29]	Tunisia	11	21 (3)	*2/3*	Calendar + serum P4; 1 MC	25–30 d (inclusion criteria)	EF_{est}, LF_{est}, ML	5JT, RST, YYIR1	NS	Moderate

Abbreviations: 5JT, 5-jump test; ACC, accelerations; CMJ, countermovement jump; DEC, decelerations; DTOT, total distance; E2, estrogen; EF, early follicular; EL, early luteal; FP, follicular phase; HSR, high-speed running; IAT, Illinois Agility Test; LH, luteinizing hormone; LF, late follicular; LL, late luteal; LP, luteal phase; LSR, low speed running; MC, menstrual cycle; ML, mid-luteal; MSR, moderate speed running; NS, nonsignificant; OV, ovulation; P4, progesterone; PdG, pregnanediol glucuronide; RST, repeated sprint test; SJ, squat jump; YYIET, Yo-Yo Intermittent Endurance Test; YYIR1, Yo-Yo Intermittent Recovery Test Level 1. Note: Data are shown as mean (SD). [a]Based on the Participant Classification Framework from McKay et al[30] Italicized numbers represent estimates made by the authors of this review, whereas all other values are those reported in the original studies. [b]MC verification methods include calendar tracking, hormone or saliva assays (E2 and P4), urinary LH, PdG, and basal body temperature. [c]MC phases are annotated according to the phases each study aimed to test. The subscript $_{est}$ indicates that, due to insufficient menstrual-cycle verification, the phase was estimated rather than confirmed. Phase terminology follows McNulty et al,[11] unless otherwise noted. [d]Main results outlines significant findings from the study (NS). [e]Study quality based on the modified assessment tool from McNulty et al.[11] [f]As elaborated in the discussion.

Table 2 Overview of Quality Assessment

Article	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	q11	q12	q13	q14	q15	Sum	Q1[a]	Q2[b]	Study quality[c]
Muñoz Aloy et al[17]	1	1	0	1	1	1	1	1	1	1	1	1	0	0	1	12	No	No	Very low
Badier et al[22]	1	1	1	1	1	1	0	0	0	1	1	1	0	0	1	10	No	No	Very low
Beavan et al[21]	1	1	1	1	1	1	0	0	1	1	1	1	0	0	1	12	No	No	Very low
Bouvier et al[16]	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	13	Yes	No	Low
Brown et al[18]	1	1	1	1	1	1	1	0	1	1	1	1	0	0	1	12	No	Yes	Low
Campa et al[24]	1	1	1	1	1	1	1	1	2	1	1	1	0	1	1	15	No	No	Low
Igonin et al[19]	1	1	1	1	1	1	1	0	2	1	1	1	1	0	1	14	Yes	No	Moderate
Igonin et al[25]	1	1	1	1	1	1	1	0	0	1	1	1	0	0	1	11	No	No	Very low
Juillard et al[20]	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	13	No	No	Very low
Julian et al[27]	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	13	Yes	No	Low
Julian et al[26]	1	1	1	1	1	1	1	0	0	1	1	1	0	0	1	11	Yes	Yes	Moderate
Romero-Moraleda et al[23]	1	1	1	1	1	1	1	1	2	1	1	1	1	0	1	15	No	Yes	Moderate
Sánchez et al[8]	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	12	No	No	Very low
Somboonwong et al[28]	1	1	1	1	1	1	1	0	1	1	1	1	0	0	1	12	No	No	Very low
Tounsi et al[29]	1	1	1	1	1	1	1	1	2	1	1	1	0	0	1	14	Yes	No	Moderate

Note: q1–q15: Items from modified McNulty et al[11] quality assessment tool. Each item scored as 0 = not fulfilled, 1 = fulfilled, with q9 being 0 = not fulfilled, 1 = partly fulfilled, 2 = fully fulfilled.
[a]Q1 indicate whether hormonal confirmation was performed (“Yes”) or not (“No”). [b]Q2 indicate whether urinary ovulation testing was performed (“Yes”) or not (“No”).
[c]Quality = overall study quality, graded as “Very low,” “Low,” “Moderate” or “High.”

27% were graded “moderate,”[19,23,26,29]; 27% were graded “low”[16,18,24,27]; and 46% were graded “very low”[8,17,20–22,25,28]; Therefore, the quality of the evidence from the 15 studies included in this review was primarily classified as “very low,” which implies that “we have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect.”[32]

Sprint Performance and High-Intensity Running

Sprint and high-intensity running were measured in 10 studies, with observation periods ranging from 1 MC to 3 years.[8,16,18,19,22,24–28] Sprint performance was assessed both in competition-specific situations,[18,22,25,26] standardized 20- to 40-m tests,[8,16,19,24,27] and with repeated sprint tests,[19,28] yielding mixed results. Three studies reported improved sprint performance during the LF phase compared with the EF phase.[18,19,25] One study reported significantly more high-speed running (18–25 km·h^{-1}) in the LF phase compared with the EF phase ($P = .009$, Δ 1.2 m min^{-1}, CI 0.3–2.1) and the luteal phase ($P = .006$, Δ 1.1 m min^{-1}, CI 0.3–1.9).[18] Another study found a significantly higher number of sprints (>19 km·h^{-1}) in the LF phase compared with the EF phase ($P < .001$; $d = 0.7$) and the ML phase ($P = .002$; $d = 0.96$).[25] The third study observed a significantly higher speed over the first 10 to 30 m of a 40-m sprint in the LF phase compared with the EF phase ($P < .05$ for all; $d = 0.87$, $d = 0.93$, and $d = 0.82$, respectively) and a significantly higher speed over the first 10 to 20 m of a 40-m sprint in the LF phase compared with the ML phase ($P < .05$ for both; $d = 0.95$ and $d = 0.75$).[19] In addition, Badier et al[22] reported a significant decline in high-speed running (≥13 km·h^{-1}) during symptomatic days. The remaining 6 studies reported no differences between MC phases.[8,16,24,26–28]

Aerobic Performance

Measurements of aerobic performance were conducted in 7 observational studies, with observation periods ranging from 1 MC to 3 years.[18,21,22,25–27,29] Two studies[18,25] found a significant difference in total distance covered during a match across MC phases. One showed that total distance was significantly higher in the LF phase ($P = .045$, Δ 5.0 m min^{-1}, CI 0.1–10.0) and the luteal phase ($P = .007$, Δ 5.7 m min^{-1}, CI 1.4–9.9) compared with the EF phase.[18] The other observed players over a 3-year period also found a significantly higher total distance in the LF phase compared with the EF phase ($P = .0048$; $d = 0.78$), but reported no differences between the LF phase and the ML phase.[25] In the remaining 5 studies, no significant differences were found in total distance[21,22,26] or Yo-Yo tests.[27,29]

Agility and Power

Several of the included studies assessed agility[8,19,20,29] or power[8,17,19,24,27,29] over 1 to 2 MCs. None of the studies reported a significant difference in either of these metrics across the MC, as measured by Illinois Agility Test,[20] V-cut test,[20] a repeated sprint test incorporating 180° change of direction,[29] or 15-m agility run, and 15-m ball dribbling test.[19] Similarly, no significant differences were observed in jump performance across the MC, as assessed by countermovement jump,[17,23,24,27] squat jump,[8,17,19] single-leg (dominant and nondominant legs) and 2-leg jumps,[8] or a 5-jump test.[29]

Discussion

This review aimed to investigate whether different MC phases influence performance-related parameters relevant to football. The main findings indicate that aerobic and sprint performance may be reduced in the EF phase (the bleeding phase) compared with other MC phases. However, most studies did not find a significant difference in performance-related parameters in football across MC phases. Furthermore, most studies included in this systematic review were classified as "low" to "very low" in quality, implying caution in interpretation of the findings.

Hypothetically, the changing levels of estrogen and progesterone during the MC can affect aerobic, agility, power, and sprint performance.[12] First and foremost, estrogen is suggested to have anabolic effects and promotes glycogen sparing and lipid oxidation, which may lead to better aerobic performance.[12] Estrogen is also thought to have neuroexcitatory effects, reducing inhibition and increasing voluntary activation.[11] Therefore, estrogen has the potential to improve performance-related parameters in the LF and ML phases, where estrogen is elevated. On the other hand, progesterone is found to be antiestrogenic,[12] which indicates that the ratio between the hormones also could influence performance. Thus, it may be speculated that any beneficial performance effects of estrogen are more pronounced during the LF phase, when estrogen is high and progesterone is low, compared with the EF or ML phase, where both hormones are low or elevated. This hypothesis is supported in the current review, where 2 studies[18,25] found increased aerobic performance in the LF phase, where estrogen is high and progesterone low, compared with EF phase, where both hormones are low. The remaining 5 studies[21,22,26,27,29] that did not find a significant difference shared several methodological limitations. Some only compared phases with low estrogen and progesterone (ie, the EF phase) to phases with high estrogen and progesterone (ie, the ML phase).[26,27] Others used MC phase verification methods that provides estimates rather than precise phase confirmation,[21,22] or measured progesterone without measuring estrogen, making it impossible to confirm the estrogen peak in the LF phase.[29] Additionally, some studies did not assess performance in the LL phase, where many athletes experience premenstrual syndrome symptoms which may affect performance negatively.[15,33,34] Therefore, it cannot be excluded that reporting of no variation in performance during the MC may be related to lack of confirmation of MC phases and the limited number and timing of the measurements.

Mechanistically, the estrogen-induced increase in voluntary activation could be the explanation behind the improved sprint performance observed in the LF phase versus the EF phase in some studies.[18,19,22,25] However, other explanations could also be in play when explaining observed differences in performance parameters between MC phases, for example, variation in motivation,[20] match variables,[18] and psychological factors.[25] When examining the MC, it is crucial to recognize the significant intraindividual and interindividual variation, seen not only in hormonal fluctuations and concentrations,[35] but also in the lived experience, including the presence or absence of physical symptoms.[22,36] The vast majority of females, including female athletes and footballers, experience some kind of negative physical or psychological symptoms related to their MC at some point.[22,33,34,36] When present, negative symptoms typically occur during the days before the bleeding (the LL phase) and during bleeding (the EF phase).[22,33,34] Surveys have shown that negative symptoms related to the MC may affect physical performance during training or competition.[15,33,34] This is in line with the findings of Badier et al,[22] who reported a significantly higher proportion of symptomatic days during the bleeding phase (ie, EF_{est}, 34.3% [31.4%]) compared with the mid-cycle phase (ie, the days between menstruation and the prebleeding phase; 8.4% [16.2%], $P < .001$) or prebleeding phase (7 d prior to next bleeding, 15.1% [27.5%], $P < .001$). These results were based on a sample of 109 elite athletes across 7 sports (ie, tier 4–5). This raises the question of whether any observed improvements in performance in the LF phase, compared with the EF phase, are due to performance-enhancing effects of estrogen or to performance impairments caused by negative symptoms in the EF phase.

The finding that agility and power were not different across MC phases[8,17,19,23,27,29] could be attributed to the ability of estrogen to reduce musculotendinous stiffness,[19] implying that estrogen might on one hand enhance voluntary activation but on the other hand reduce the elastic energy storage and release involved in agility and power-related actions, such as jumping and change of direction.

Although caution is required when interpreting the results, the findings of the current review nonetheless appear to be largely in line with a previous systematic review on the effects of the MC on exercise performance by McNulty et al,[11] who reported that exercise performance in general seemed to be reduced by a trivial amount during the EF phase compared with all other MC phases.[11] Their review was based on 78 studies including a total of 1193 participants, not only footballers, and compared exercise test performances, both on endurance and strength parameters, across MC phases. It must be noted that the authors advised caution in interpreting their findings, due to the moderate to low quality of studies, variation in study design and methodology, and high variability.

Limitations in the Existing Literature

The quality assessment of studies investigating the MC influence on football-performance-related parameters was primarily rated as "very low," highlighting limitations in the current evidence base and underscoring the need for higher-quality research in this area.

All included studies employed a prospective observational design.[8,18–29] These studies examined the associations between MC phases and performance-related parameters such as sprinting,[8,16,18,19,22,24–28] aerobic performance,[18,21,22,25–27,29] agility,[8,19,20,29] and power.[8,17,19,20,23,24,27,29] However, due to the lack of related blood sampling during the MC in most studies,[8,17,20–22,24,25,28] it was not possible to determine whether fluctuations in sex hormone levels were causally linked to changes in the outcomes in performance-related parameters. Furthermore, changes over time in physical fitness and training status may influence performance outcomes. Other potential confounding factors, such as nutrition, hydration status,[24] sleep quality or duration,[20] and contextual factors[26] may also vary systematically or unsystematically across the MC cycle, thereby affecting results. Contextual factors also may influence football performance regardless of MC phase.[26] In addition, the observation period in most studies was relatively short (1–4 cycles),[8,18–20,24,26–29] with 2 studies running for 5 to 6 months,[22,23] 1 over the course of a season,[21] and 1 study extending over 3 years.[25] This limited duration may not adequately capture the inherent cycle-to-cycle variation within individuals,[13] which is crucial for understanding the nuanced and potentially fluctuating effects of MC phases on performance. Short-term designs risk overinterpreting transient patterns and may fail to reflect consistency or long-term trends relevant for practical applications in football training and match preparation.

The sample sizes in the included studies ranged from 7 to 33 participants, which is typical for this type of research,[10] but limits the statistical power to detect effects of the MC. The participants were football players at a relative uniform level, corresponding to subelite to elite national-level athletes (tiers 3–

4),[30] which restricts the generalizability of the findings to the broader populations of female football players. Additionally, the populations were predominantly White. Moreover, small sample sizes may, combined with low interindividual variability, yield large effect sizes, even when the true differences may have limited practical relevance.[19] The homogeneity and limited size of the study populations represent both a strength and a limitation: while the results are directly applicable to a specific subgroup of female football players, they cannot be generalized beyond this population.[19–24,26,27,29]

MC phase verification in most of the included studies[8,20–22,24,25,27–29] lacked one or more essential steps required to accurately assess cycle length, bleeding patterns, OV, and normal sex hormone levels. As a result, there is a potential risk that anovulatory cycles and luteal phase deficiencies were included in the analyses.[18,25] This concern appears relevant in at least one study,[27] which reported mean luteal phase progesterone concentrations of 6.5 (2.0) nmol·L, well below the minimum threshold of >16 nmol·L recommended by Janse de Jonge et al[10] to confirm OV. Even the studies that applied all recommended verifications methods[10,26] had limitations: hormone levels were assessed in only 2 phases (EF vs ML), thereby missing the estrogen peak typically occurring in the LF.[10] Furthermore, progesterone concentrations in the ML phase ranged from 1.9 to 15.7 ng·mL^{-1} (equivalent to 6–50 nmol·L), suggesting that anovulatory cycles or luteal phase deficiency may still have been present despite adherence to verifications protocols.[10] In contrast, several studies[16–19,25] investigated the LF phase, but only a few studies[16,19] successfully captured the estrogen peak in the LF phase strengthening their MC phase classification.

Measurement methods for performance parameters varied across the studies, with measurements taken either in competition-specific situations[18,21,22,25,26] (ie, total distance, sprint, high-intensity running) or using field tests[8,16,17,19,23,24,27–29] (ie, Yo-Yo test, 20- to 40-m sprint, repeated sprint test, countermovement jumps, squat jumps, V-cut, Illinois Agility Test). Both approaches are useful but influenced by different factors that must be considered when interpreting the results. Competition-specific situations are affected by factors such as playing away versus at home, match outcomes, and the opponent's level,[18,25,26] whereas field tests' applicability depends on how well they replicate the physical demands of football.[7,20] These tests are also influenced by factors that change over time, such as motivation.[20]

Strength and Limitations

We acknowledge several limitations of this systematic review. The review protocol was not prospectively registered on platforms such as PROSPERO or OSF, which may reduce transparency and increase susceptibility to certain forms of bias. In addition, initial title and abstract screening was conducted by a single author, and inclusion was restricted to English language publications, potentially leading to the omission of relevant studies. However, despite these limitations, several methodological strengths should be noted. The literature search strategy was developed and guided by an experienced librarian at The Royal Library of Denmark, supporting a comprehensive and systematic identification of relevant studies. Inclusion and exclusion criteria were predefined through consensus among the 3 authors (Rasmussen, Bisgaard, and Hansen), and the study selection and data extraction procedures were conducted in a structured and transparent manner. The relatively high degree of homogeneity across the included publications further reduces the likelihood that omitted studies would have materially altered the overall conclusions. Finally, the manuscript has been aligned with the PRISMA with PERSIST reporting guidelines.

Practical Applications

Although a few studies in this review reported a slight reduction in aerobic and sprint performance during the EF phase compared with the LF phase, the majority found no significant differences in performance across the MC phases. This underscores the importance of adopting an individual approach to training and performance management in football, rather than applying generalized recommendations based on MC phases. Monitoring athletes' MCs individually and identifying athletes who experience more pronounced performance fluctuations across the MC, whether physiological or psychological, may enable more tailored and effective training strategies.[26] Future research should aim to improve methodological quality through more accurate MC verification, larger sample sizes, and better assessment of causal relationships between hormonal fluctuations, symptom fluctuations, and performance-related parameters in football.

Conclusions

This systematic review examined the potential influence of MC phases on performance-related parameters in football players. While some evidence suggests that aerobic and sprint performance may be diminished during the EF phase, most studies did not report significant performance differences across MC phases. Notably, most included studies were rated as "low" to "very low" in methodological quality, warranting cautious interpretation of the findings and underscoring the need for more rigorous research in this area.

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