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BRIEF REVIEW

Monitoring Readiness to Train and Perform in Female Football: Current Evidence and Recommendations for Practitioners

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Purpose: Monitoring player readiness to train and perform is an important practical concept in football. Despite an abundance of research in this area in the male game, to date, research is limited in female football. The aims of this study were, first, to summarize the current literature on the monitoring of readiness in female football; second, to summarize the current evidence regarding the monitoring of the menstrual cycle and its potential impact on physical preparation and performance in female footballers; and third, to offer practical recommendations based on the current evidence for practitioners working with female football players. ***Conclusions:*** Practitioners should include both objective (eg, heart rate and countermovement jump) and subjective measures (eg, athlete-reported outcome measures) in their monitoring practices. This would allow them to have a better picture of female players' readiness. Practitioners should assess the reliability of their monitoring (objective and subjective) tools before adopting them with their players. The use of athlete-reported outcome measures could play a key role in contexts where technology is not available (eg, in semiprofessional and amateur clubs); however, practitioners need to be aware that many single-item athlete-reported outcome measures instruments have not been properly validated. Finally, tracking the menstrual cycle can identify menstrual dysfunction (eg, infrequent or irregular menstruation) that can indicate a state of low energy availability or an underlying gynecological issue, both of which warrant further investigation by medical practitioners.

Keywords: women's football, mood, stress levels, sleep, muscle soreness, biomarkers

Football is one of the most popular sports in the world, but it has been dominated by male athletes until recently.[1] Women's football is now having an extraordinary rise in popularity and visibility with millions of fans following matches,[2] which was highlighted during the recent 2023 Fédération internationale de football association Women's World Cup, with an estimated 2 billion TV views and a record attendance of almost 2 million, up by more than 600,000 on the previous record.[3] Although this is a great step forward in popularity, research in the area of female football is still behind male football.[4,5] Based on the current evidence, it is known that female football requires a significant amount of physical and mental preparation.[6,7] In particular, female footballers require high levels of cardiovascular endurance, strength, power, speed, and agility to compete at the professional level.[8] Previous research reported that players need to have a well-developed aerobic and anaerobic fitness level to satisfy the demands of the game, specifically, the distance covered during games ranges between approximately 9 to 11.5 km and average heart rates (HRs) are above 85% HR_{max}.[9–11] Considering that the football game model is intermittent, players need to perform accelerations, decelerations, jumps, and high-speed running (HSR) actions, which further enhance the physical and physiological requirements of the game.[6,12,13] These demands are evolving rapidly at the elite level, with a 21% increase in high-speed (≥19 km/h) running observed from the 2015 to the 2019 Fédération internationale de football association Women's World Cups.[14] Moreover, the players need to be able to maintain their energy levels throughout the game, which can last more than 90 minutes and this can play a very important psychological impact, specifically, the players need to possess a variety of skills and mental toughness to keep their playing level throughout the match.[7,15] Because of the combined football matches and training demands (and associated stressors), players need to be able to stay prepared (psychologically and physically) and in a state of physical and mental health throughout the season and tournaments to compete at a high level[16]; therefore, the monitoring of players' readiness is an important task for practitioners.

Readiness and wellness are 2 important concepts in football that help players and coaches understand how prepared players are for upcoming training and games and how well their body is functioning.[17,18] However, these 2 concepts sometimes overlap in the scientific literature and in practice, and so a clear line of demarcation between readiness and wellness is missing.[19] In this paper, we have defined readiness as "the state of being fully prepared to train and perform physically and mentally," which includes both fatigue and health monitoring; therefore, wellness monitoring has been included in the readiness construct. Therefore, readiness represents a state of preparedness (assessed at a specific moment in time) deriving from a combination of stressors (positive or negative).[18–20] Readiness involves assessing a player's physical and mental preparedness,[21] which can consist in the assessment of muscular strength, endurance, HR variability (HRV), and cognitive function.[6,18–20] Moreover, since health is a prerequisite of readiness, it involves tracking various physiological (eg, using saliva and blood tests) and psychological factors such as sleep, muscle soreness, stress levels, and mood, among others.[22]

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More information regarding this topic would help coaches and medical staff making informed decisions about training and recovery schedules and identify potential injury risk factors with female players. Readiness can provide a more complete picture of a player's overall health and performance status,[21] allowing teams to optimize training and recovery plans to help players reach their full potential. However, the amount of research that has investigated readiness in female football is very limited compared to male football; therefore, future research is needed. Another key process to monitoring in women's football is the menstrual cycle, which could affect readiness to train and perform.[23–25] The menstrual cycle is controlled by female hormones that cause regular bleeding (periods). The menstrual is subdivided in phases: menstruation, the follicular phase, ovulation, and the luteal phase. The menstrual cycle is, however, subject to internal (eg, menstrual dysfunction and pregnancy) and external (eg, hormonal contraceptive use) perturbations,[26] and practitioners working in women's football should be aware of them.

It is clear that more evidence derived from female football players is needed to support the selection of parameters to measure (eg, performance, physiological, subjective, cognitive). The readiness and menstrual cycle parameters should have adequate, validity, reliability, and sensitivity before being implemented into a monitoring system (as previously explained in a recently revised conceptual framework[19]). Therefore, the aims of this study were first, to summarize the current literature on the monitoring of readiness in female football; second, to summarize the current evidence regarding the monitoring of the menstrual cycle and its potential impact on physical preparation and performance in female footballers; and third, to offer practical recommendations based on the current evidence for practitioners working with female football players.

Readiness Monitoring

Readiness monitoring tools are often labeled *objective*, those that are externally quantified often via the use of technology (Figure 1), or *subjective*, those that are self-reported given an individual's internal feelings and perceptions.

Objective Measures

Vertical Jump and Peak Power Cycle Tests

Multiple approaches exist to gain insight into a player's readiness status. A commonly used readiness parameter in football is neuromuscular fatigue, which is a reduction in maximal voluntary force induced by exercise and is classified into central or peripheral based on its origin.[27] It is the larger magnitude and slower recovery of peripheral fatigue that primarily explains the recovery of neuromuscular fatigue.[27,28] Readiness research has primarily been carried out on male footballers, but a number of sex-based differences (eg, anthropometric and hormonal) exist that warrant consideration. For example, 1 meta-analysis showed a quicker postmatch recovery time course for female footballers compared to males, with all physical performance measures recovered by 72 hours postmatch,[29] although the low number of studies ($n = 26$ studies, 465 players) included warrants caution.[29] Specifically, fatigue (ie, decrement in performance) was reported for countermovement jump (CMJ) performance (jump height) only up to 24 hours and sprint time at 48 hours for female football players, whereas such capacities are still substantially reduced at 72 hours postmatch in males.[30] Comparing sex differences in recovery time course is complex but could, in part, be explained physiologically by greater muscle oxidative capacity, augmented fatigue resistance

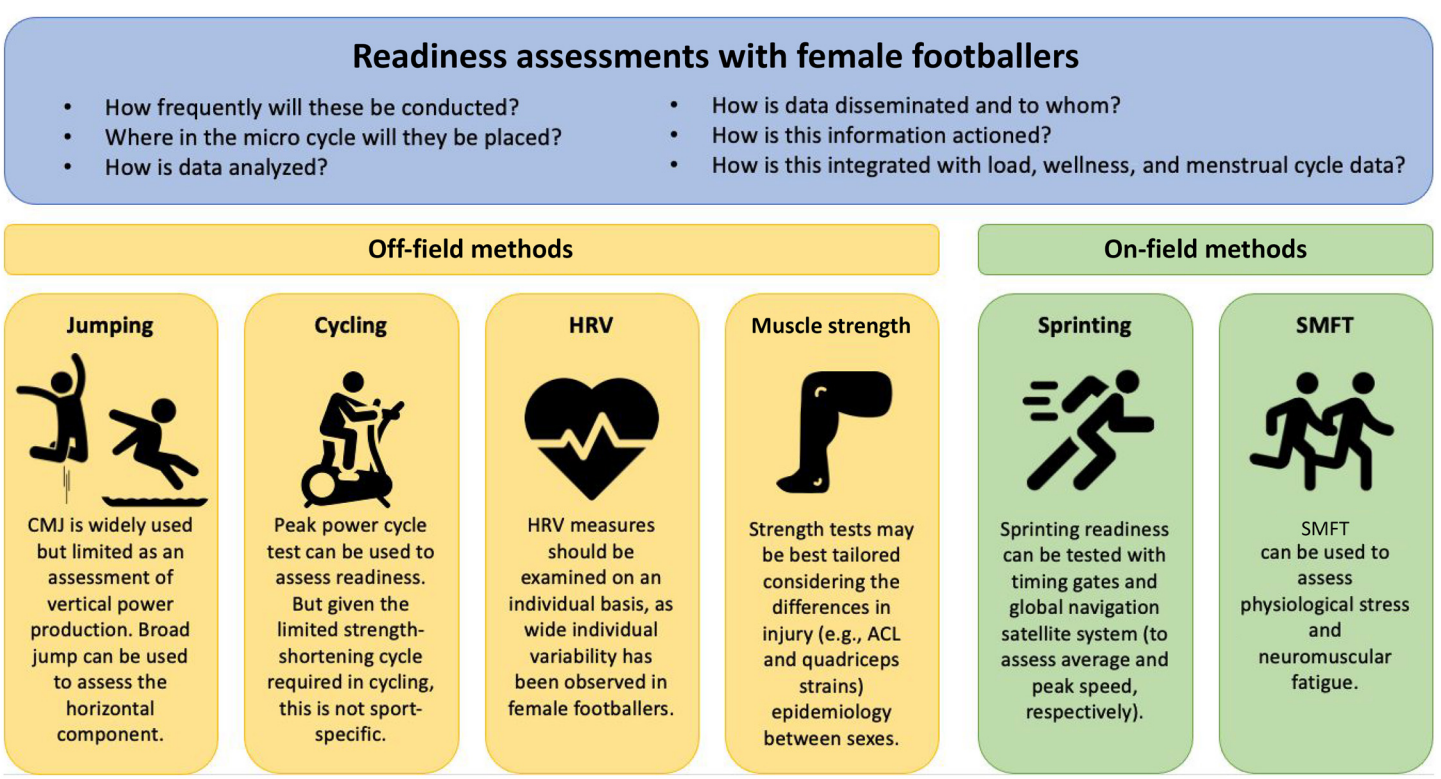

Figure 1 — Key considerations for readiness assessments. CMJ indicates countermovement jump; HRV, heart-rate variability; SMFT, Submaximal Fitness Test; ACL, anterior cruciate ligament.

due to differences in fiber-type proportion,[31] and greater mitochondrial intrinsic respiratory rates,[32] which is sometimes seen in females, combined with a lower intensity nature of match-play in the game compared with the men's game.[29] Therefore, considering readiness data within the specific population of female footballers is important, given the potential difference in recovery time course (although the physiological explanation of this is not clear yet). The body of evidence on female footballers' readiness is currently small, as demonstrated by a recent scoping review of readiness assessments across football codes, which included 31 studies of which only one involved female athletes.[17]

Given the inverse relationship between power output and fatigue, a peak power cycle ergometer test can provide a short, nonfatiguing assessment of readiness.[33] It was shown that maximal cycle ergometer power output declined across a season in female collegiate footballers, in line with the differences in match loads between starters and nonstarters.[33] However, cycling may not reflect football-specific demands, given the minimal contribution from the stretch-shortening cycle required during this type of task.[34] As such, readiness assessments using jumping and running movements have also been explored to assess acute negative physiological and biomechanical training effects.[19] Jump testing has become a particularly popular readiness test in football, due to its simplicity, reliability, specificity to the movement demands, and time efficiency.[35] Specifically, the CMJ is widely implemented, owing to its natural movement pattern for footballers and the lower technical demands compared to other jump tests, such as a drop jump.[35,36] Moreover, reliability of the CMJ in elite female football players has demonstrated good test–retest reliability (coefficient of variation = 3.9% [3.4%–4.3%]).[36] However, it is known that players can often maintain performance (ie, jump height) when fatigued by altering their movement patterns; therefore, sport scientists should preferentially monitor both time-related jump strategy metrics (eg, flight time: contraction time) and outcomes.[35,37] Another jump modality that practitioners could take into consideration is the drop jump test, which assesses explosive leg power and reactive strength index (ie, the ability to quickly and effectively change from an eccentric to a concentric contraction).[38] Drop jump testing could be therefore another test used to assess readiness; however, the literature existing on women's football is very limited. Therefore, we suggest that practitioners preferentially use a CMJ, which has greater scientific support.

Broad Jump and Sprint Tests

An alternative to vertical jump testing is represented by its horizontal equivalent.[6,39] Vertical jumping is an assessment of vertical power production, as opposed to horizontal power production, which is more commonly (although not solely) required in football.[6,39,40] A broad jump may be employed in readiness testing batteries to assess power in a different plane of movement. However, practitioners need to be aware that research in footballers, regardless of sex, in relation to the use of such a test for readiness is limited.[6,41] A more established method to assess readiness is through sprint testing, which is a sport-specific task, can be conducted on-field, and may capture horizontal capacities.[42] Sprint testing can be performed using timing-gates or global navigation satellite system to assess average and peak speed, respectively.[43,44] However, its relevance as a readiness assessment in female footballers may be questioned, given that (as previously mentioned) their sprint performance may already be recovered by 72 hours postmatch.[29] Given the lack of a complete description of the recovery time course in female footballers though,[29] more evidence is needed in such readiness (physical performance) measures.

Submaximal Fitness Assessments and HR

Another on-field option is a submaximal fitness test (SMFT) used to assess chronic (positive or negative) physiological training effects (ie, HR)[45] as well as players' fatigue status (eg, 48–72 h after a match). SMFT have become popular in team sports, with over 100 different protocols published, and the recording of HR in the last 30 or 60 seconds of the test the most utilized outcome measure.[46] The rationale is that a decrement in HR in response to a fixed external demand is related to an increase in aerobic fitness (ie, chronic adaptations).[47] Therefore, the results should be interpreted specifically about aerobic capacity and need to be combined with other assessments to establish the player's status for the more varied physical demands of football (ie, HSR, accelerations, decelerations, jumping). Regarding the monitoring of the players' fatigue, a variation in HR in response to a fixed external demand could represent a status of unreadiness to train; therefore, practitioners could use such information to implement some additional recovery strategies (eg, 72 h after a match). Regarding evidence in women's football, Shushan et al[46] caution about generalizing their findings to females, given their unbalanced data set in relation to sex; 0/21 studies in the reliability meta-analysis and 2/20 studies in the convergent validity meta-analysis included female athletes. Indeed, 1 study exploring intermittent endurance performance and HR response in football players advocated a different timeframe for analysis between the sexes that practitioners may want to utilize: minutes 4 and 6 for female and male players, respectively.[48] During an SMFT, in addition to chronic adaptations, it is also possible to assess fatigue (eg, muscular or biomechanical) by monitoring of accelerometer-derived metrics using global navigation satellite system-embedded accelerometers.[45] Previous research reported that dynamic stress load and fatigue index can be valid metrics for monitoring fatigue-related modifications to movement strategies during an SMFT.[45] However, further research are needed about the reliability of these specific metrics and about their validity to assess readiness in female football players before their implementation.[19,43]

Practitioners could also use HR assessments outside of the training environment as measures of readiness, given they present an indicator of the autonomic nervous system.[47] HRV refers to the variation in time between consecutive R-to-R intervals, which provides information on the parasympathetic and sympathetic contributions to resting and postexercise modulation of HR.[47] Smartphone applications are available to capture such data and have been shown in a previous study with a female college football team to be sensitive to changes in training load.[49] Conversely, another study showed nocturnal HRV indices were not associated with training loads in high-level female football players, which may be due to high individual variability observed.[50] Specifically, the response of HRV parameters in 4 individuals was in contrast to the rest of the team ($n = 30$),[50] highlighting that if practitioners monitor HRV, it should be examined on an individual level, via an individual approach to sleep and recovery interventions in order to promote readiness.

Strength Tests

Another option to assess readiness in footballers is the use of muscle-specific strength testing (eg, isometric or eccentric contractions), such as adductor[51] and hamstring strength tests.[52]

However, such research has focused mainly on males; therefore, more understanding of the validity and sensitiveness of such assessments to evaluate readiness explicitly in female footballers is needed before providing specific recommendations. Moreover, given differences in injury epidemiology exist between sexes in football, different muscle-specific strength tests should be considered. Specifically, quadriceps strains, anterior cruciate ligament ruptures, and ankle syndesmosis injuries were 2.25, 4.59, and 5.36 times more common in women than men, and conversely, hamstring strains and pubalgia cases were 1.93 and 11.10 times more frequent in men,[53] highlighting that muscle-specific assessments could be tailored with this injury epidemiology in mind.

Other Objective Parameters

Measuring different parameters is crucial in understanding the overall health and well-being of female football players.[22] Objectively, these parameters often involve various tests, including saliva and blood tests, which can provide valuable insights into the status of players. Hormones play a vital role in many physiological processes and can affect performance and recovery of female football players. Saliva tests are commonly used to assess hormonal balance such as cortisol and testosterone.[54] Cortisol, often referred to as the stress hormone, can indicate the players' stress levels and their ability to recover from intense training or matches.[29] Monitoring cortisol levels can help coaches, medical, and performance staff assess if players are adequately managing their stress and if adjustments to training loads are necessary. Testosterone, on the other hand, is important for muscle growth and recovery and its level monitoring can help pinpoint any imbalances that may affect readiness and performance.[55,56] Specifically, testosterone concentration (and some other sex hormones) is one of the primary determinant of sex-based differences in athletic and sports performance.[57] Therefore, hormone tests, especially those related to the menstrual cycle, are also critical for female players, specifically, tracking hormones such as estrogen and progesterone helps understand the potential impact of menstrual cycle on performance and recovery (although more high-quality evidence is needed to show what affect performance parameters).[58] Hormone tests can identify irregularities or conditions such as polycystic ovary syndrome,[59] which can affect hormonal balance and overall psychological conditions in female athletes. By monitoring these parameters, coaches, medical, and performance staff can potentially tailor training programs and provide a comprehensive picture of the female player's overall health and physical condition.

In addition, blood tests can be used for monitoring specific markers, such as red and white blood cell counts, liver function, vitamin and mineral levels, and markers of inflammation. Red blood cell counts and measurements of hemoglobin and iron concentration are essential for assessing oxygen-carrying capacity and the player's ability to continuously performing high-intensity runs,[60] which are crucial in elite-level female football, and iron deficiency quite commonly seen for female players.[8,61] Contrary to red blood cells, white blood cells count can indicate the presence of infections or immune system challenges.[62] Liver function tests can help identify any liver-related issues, which might also affect the female players performance and well-being.[63] In addition, analyzing vitamin and mineral levels ensures that the players have the necessary nutrients for optimal performance and recovery, including a special focus on B12-vitamin intake for vegan players. Monitoring markers of inflammation allows medical staff to identify any underlaying issues that may impact readiness (eg, recovery).[64]

Subjective Measures

The use of different subjective perceptual scales play an important role in monitoring and optimizing player performance.[7] Subjective athlete-reported outcome measure (AROM) instruments can be used to assess players' readiness, specifically acute (positive or negative) training effects (eg, fatigue status after a match or a period of training). Practitioners could use multi-item and multidimensional AROM, for instance the Acute Recovery and Stress Scale and the Short Recovery and Stress Scale (both assess recovery and stress) and the Recovery Stress Questionnaire for Athletes.[65,66] Another option is the user of a Hooper Index,[67] which can be incorporated in mobile apps that allow players to self-report their current status on a regular basis chosen by the team medical and/or performance staff. The Hooper Index assesses subjective readiness such as muscle soreness, fatigue, sleep, sleep quality, and mental feeling to perform and can provide valuable insights to the coaches. By analyzing the responses, team medical and/or performance team staff can identify trends or patterns that might indicate potential issues and make informed decisions regarding training and/or match load, recovery strategies, or player selection. Visual Analog Scales (VAS) are also valuable tools as they allow players to rate subjective experiences as pain levels or mood on a continuous line.[68] These scales provide quantitative data, enabling medical and performance staff to monitor injuries, manage pain, and make informed decisions regarding players availability and treatment plans.[69] Furthermore, mental fatigue can play a role (in training and competition); therefore, implementing perceptual scales to assess cognitive functioning is something that practitioners should consider. Scales like cognitive tests, such as testing executive functions (ie, working memory, inhibition, cognitive flexibility[70]) and psychometric scales can be utilized to measure mental fatigue levels, concentration, and decision-making abilities. By evaluating these subjective parameters, coaches and performance staff can adjust schedules, prioritize recovery strategies, and optimize player performance. Incorporating these perceptual scales into the monitoring process in female football provides a comprehensive understanding of a player's physical and mental readiness, perceived effort, subjective experience of training and matches, and mental well-being. This information enables coaches, medical, and performance staff to tailor training programs and recovery strategies specific to each player, optimizing performance and decreasing the likelihood of injuries. Furthermore, when players' mental well-being is at risk due to stressors related to the football environment, it is recommended that they collaborate with other professionals (e.g., psychologists) to help them deal with such factors.[71]

Although what has been just reported, the authors of this paper need to highlight that almost all single-item AROM instruments that can be used to assess players' readiness variation (eg, after periods of training or competitions) have not been properly validated[19]; therefore, it is still unclear if practitioners should use such instruments due to the lack of existing specific evidence for women's football players. Therefore, it is in the authors' opinion that subjective measures are used in conjunction with objective measures to obtain a more holistic view of players' situation.[69,72] Considering both objective and subjective readiness measures, a more comprehensive understanding of the female player's status can be obtained.[18,73]

The Menstrual Cycle

Ovarian hormone monitoring is a key female-specific consideration as estrogen and progesterone have numerous nonreproductive

functions (eg, bone health and metabolism) and effects (eg, physical and psychological symptoms), which are capable of influencing female player health and performance.[23–25,74,75] The most discussed (within sport and the media) ovarian hormone profile is the menstrual cycle, which is likely due to this profile being instigated at puberty and prevailing until the menopause, and as such represents the profile associated with most youth and adult female players. The menstrual cycle is, however, subject to internal (eg, menstrual dysfunction and pregnancy) and external (eg, hormonal contraceptive use) perturbations.[26] Menstrual irregularities, such as oligomenorrhea, anovulation, and amenorrhea, are common in elite athletes[76,77] and need to be identified as early as possible and treated accordingly in order to avoid detriments in health and performance. A large proportion (approximately 50%) of elite female athletes use some type of hormonal contraception.[77] In 2022, Parker et al[78] showed that 28% of elite female football players in the UK's Women's Super League used hormonal contraceptives with combined hormonal contraceptives being the most popular type. Most players can provide their self-reported hormonal profile and can be grouped as naturally menstruating (defined as players who bleed regularly [ie, every 21–35 d] and who do not use hormonal contraceptives); diagnosed or suspected menstrual dysfunction (such as excessively long or short menstrual cycles or absence of menstruation for several consecutive months); or hormonal contraceptive user (providing the type and possibly brand of contraceptive used). This amount of information is, however, superficial and provides a low-level approach to categorizing the ovarian hormonal status of female players. Indeed, in terms of mapping performance and/or health against ovarian hormonal profiles, this approach is almost useless and leads to the overinterpretation of any responses, as the ovarian hormonal profile is predicted and assumed, rather than being established and verified. Table 1 shows how ovarian hormone profiles should be established, from a high- (gold) to a low-quality (bronze) approach.

Consideration also needs to be given to how often these profiles are established (eg, How long the menstrual cycle should be tracked? Every cycle or less frequently?) and who is responsible for tracking and interpreting this information (eg, the team doctor, physiotherapist, nutritionist). These decisions should be based on (1) how long is legitimately needed to establish a particular ovarian hormonal profile and (2) who is qualified and trusted (by the players) to collect and review these data. In addition, a clear pipeline to use these data need to be found before monitoring takes place and consideration needs to be given to who sees these data and what decisions are made on their basis. Data related to a players reproductive functioning should only be collected (1) with their informed consent; (2) when positive changes can be made on the basis of the resultant data; and (3) the systems used to collect these data are valid (ie, a high-quality approach) and as frictionless as possible for the players (ie, fit among their other sporting requirements with as little burden as possible). Ultimately, it is important to recognize that not all players will have a menstrual cycle (ie, they have a different ovarian hormone profile) and those with a menstrual cycle might not be affected by it; remembering that their response to the menstrual cycle can only be established using a robust approach over time and cannot be assumed. Finally, equal consideration and attention needs to be given to players with menstrual dysfunction and to those who use hormonal contraceptives, as they have different ovarian hormone profiles that have the capability of affecting their performance and health.

Practical Recommendations for Training/Practitioners Based on the Existing Knowledge

- CMJ is a test that practitioners could include in their testing battery to assess players' readiness.[36] However, it is known that players can often maintain performance (ie, jump height)

Table 1 Suggested Approach to Establishing the Ovarian Hormone Profile of Female Players

	Gold approach	Silver approach	Bronze approach
Menstrual cycle (known as eumenorrheic athletes)	Cycle length ≤21 and ≥35 d based on bleeding patterns AND ovulation established AND luteal phase deficiency excluded AND no hormonal contraceptive use for a minimum of 3 mo	Cycle length ≤21 and ≥35 d based on bleeding patterns AND ovulation established AND no hormonal contraceptive use for a minimum of 3 mo	Cycle length ≤21 and ≥35 d based on bleeding patterns AND no hormonal contraceptive use for a minimum of 3 mo
Menstrual dysfunction[a]			
Amenorrhea	Absence of menstruation for ≥3 mo in players who have menstruated before		
Anovulation	Players who experience regular menstruation but do not ovulate; ovulation cannot be detected by urinary luteinizing hormone surge or confirmed by hormone concentrations via blood sample analysis		
Oligomenorrhea	Cycle length >35 d		
Luteal phase deficiency	Cycles with less than 16 $nmol \cdot L^{-1}$ of progesterone, when a single luteal phase progesterone measurement (ovulation + 7 d) is taken		
Hormonal contraceptive use			
Oral contraceptive pill Implant Patch Injection Coil	Brand name AND schedule AND endogenous and exogenous hormone concentrations	Brand name AND schedule[b]	Brand name

[a]Menstrual dysfunction should be confirmed by a medical professional. [b]Schedule refers to knowing which point of the hormonal cycle the player is on. For example, pill taking versus pill-free day, patch wearing versus patch-free day, time since injection received, time since implant, and time since coil inserted.

when fatigued by altering their movement patterns, and therefore, sport scientists should preferentially monitor both time-related jump strategy metrics (eg, flight time:contraction time) and outcomes.[35,37] Practitioners should be aware of the limitations related to jump tests (validity, reliability, and sensitivity) for assessing readiness.

- The use of different subjective perceptual scales can play an important role in monitoring and optimizing player readiness.[7] Mobile apps that allow players to self-report their status on a regular basis could be used by the team medical and/or performance staff. (However, practitioners need to be aware of the lack of validation of some of these subjective perceptual scales). By analyzing the responses, team medical and/or performance team staff can identify trends or patterns that might indicate potential issues and make informed decisions regarding training and/or match load, recovery strategies, or player selection.
- Mental fatigue plays a crucial role in performance, and practitioners should look to implement perceptual scales to assess cognitive functioning. Cognitive scales, such as testing executive functions (ie, working memory, inhibition, cognitive flexibility)[70] and psychometric scales can be utilized to measure mental fatigue levels, concentration, and decision-making abilities (although practitioners need to be aware that specific evidence in women's football is sparse). Incorporating these perceptual scales into the monitoring process in female football provides a comprehensive understanding of player's physical and mental readiness, perceived effort, subjective experience of training and matches, and mental well-being.
- We suggest that practitioners include both objective and subjective tests and parameters within their monitoring practices to provide a more comprehensive understanding of female player's readiness. Readiness is best assessed by comparing an individual to their own baseline data across a number of measures, and in conjunction with recent training and match load parameters. When selecting parameters to measure, practitioners must consider the validity, reliability, and sensitivity of the measure. Practitioners could also follow a recently revised conceptual framework, which may help to implement and interpret measures for athlete monitoring.[19,79]
- Practitioners should ensure that menstrual cycle-related questions are incorporated into readiness monitoring. Changes in concentrations of endogenous female sex hormones can potentially affect readiness to perform[31,58]; however, the current evidence on this topic about female football players is very limited; therefore, further research is needed to verify what cycle symptoms actually affect performance. Based on what we know so far, the primary windows for symptoms are during menstruation (the beginning of the follicular phase) and in the 4–5 days prior to the onset of menstruation. Therefore, the menstrual and premenstrual phases are key time windows, which should be monitored, and a proactive approach to symptom management may be warranted.
- Tracking menstrual cycle can also identify menstrual dysfunction (eg, infrequent or irregular menstruation) that can indicate a state of low energy availability or an underlying gynecological issue, both of which warrant further investigation by medical practitioners. Significant interindividual variation in the menstrual cycle means that tracking it is important at an individual level.
- Iron metabolism and concentrations change during a football season, and it is possible to observe an iron deficiency in elite players (as well as women athletes in general). Previous research reported lower erythrocyte iron concentrations at the end of the season.[60] We suggest practitioners consider the implementation of nutritional strategies (with the support of nutrition professionals) throughout the football season.

Current Limitations and Future Directions

This review is not without limitations; first, the authors of this narrative review did their best to summarize the most up to date and relevant evidence around readiness and menstrual cycle monitoring in female football. However, this review is not a systematic review of the existing literature; therefore, the papers selected and discussed could have been subjected to a selection bias. Second, the recommendations for practitioners made in this paper are based on the body of the literature selected and on the authors' personal experience (expert opinions, which are at the bottom of the evidence pyramid),[80] which could be subjected to a form of bias. In the authors' opinion, much original research is needed in women's football, which is currently underrepresented compared to the male counterpart. Finally, some of the recommendations reported can be applied in professional football contexts where practitioners have adequate technology and budgets. However, many of the women's practitioners work with semi-professional and amateur players, who could struggle to have adequate technological and financial support as well as specific knowledge of the differences (eg, hormonal) between men's and women's football players. In amateur contexts, when technology and budgets are limited, practitioners could use subjective monitoring tools (eg, surveys) to gather information about readiness and menstrual cycle to plan training programs and individualize recovery strategies specific to their players, which could increase their performance and reduce the likelihood of injuries.

Conclusions

This narrative review summarized the current literature on the monitoring of readiness in women's football. Moreover, it summarized the current evidence regarding the monitoring and implications of the menstrual cycle and gave some practical recommendations for training practitioners working with female football players. Practitioners should include both objective (eg, countermovement jump and heart rate) and subjective measures (athlete-reported outcome measure [AROM] instruments) in their monitoring practices. This would allow them to have a better picture of a female player's readiness. Practitioners should assess the reliability of their monitoring (objective and subjective) tools before adopting them with their players. The use of AROM instruments could play a key role in contexts where technology is not available (eg, in semiprofessional and amateur clubs); however, practitioners need to be aware that many single-item AROM instruments have not been properly validated. Finally, tracking the menstrual cycle can also identify menstrual dysfunction (eg, infrequent or irregular menstruation) that can indicate a state of low energy availability or an underlying gynecological issue, both of which warrant further investigation by medical practitioners.

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