

Article

Physical-Menstrual Variables as Predictors of Women's Rugby Performance and Well-being

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Abstract: Women's rugby is characterized by an intermittent activity profile that includes high-intensity actions such as sprinting, tackling, scrummaging, and rucking. Therefore, investing training time in the development of strength, power, and overall well-being may contribute to enhanced performance. This study analyzed the effects of different phases of the menstrual cycle on the performance and perceived well-being of female amateur rugby players. The sample consisted of 16 female players (22.13 ± 4.50 years). The variables analyzed included body composition, stretch-shortening cycle (CMJ, CMJ Abalakov, and CMJ unilateral), isometric strength, and state of well-being. Menstrual cycle phases were monitored using the "My FLO menstrual calendar" application. The results showed no significant differences in the stretch-shortening cycle or isometric strength test results across the menstrual cycle phases ($p > .05$). However, total body weight had a significant effect on right/left leg strength ($p = .020$). Regarding perceived well-being, a significant variation was observed during the ovulatory phase ($p = .0226$), with fat mass identified as an influential factor ($p = .172$). A difference in CMJ was also observed between the menstrual and ovulatory phases ($p = .019$). The results suggest that, although strength is not altered by the menstrual cycle, variables such as total body weight and fat mass influence both strength and well-being in female rugby players across the menstrual cycle. These results highlight the importance of individualizing training loads according to body composition profiles and well-being status throughout the menstrual cycle.

Keywords: Menstrual cycle, isometric strength, stretch-shortening cycle.

1. Introduction

Women's rugby has experienced an increase in participation worldwide (Heyward et al., 2020). This sport is characterized by its intermittent nature, with episodes of high intensity, such as sprints, tackles, scrums, rucks, and mauls (Sheppy et al., 2020). Therefore, investing time in developing strength and power can lead to improved performances (Woodhouse et al.,

2021). In addition to possessing the appropriate physical characteristics, it is extremely important for players to achieve and maintain an optimal body composition that enables them to compete at the highest level (Yao et al., 2024). The anthropometric profiles of female rugby players have been extensively studied. A clear example is the study by Escrivá et al. (2021), who reported that forwards present higher total body weight and fat mass levels than defenders,



demonstrating that these parameters are dependent on aspects such as playing position. Similarly, Posthumus et al. (2020) highlighted that the body composition values of forwards are higher than those of defenders, with greater differences in total fat mass compared to other variables such as total lean mass.

Regarding counter-movement jump (CMJ) performance, it has been shown that players with lower total body weight and fat percentage achieve greater height and power levels (Scantlebury et al., 2022; Yao et al., 2024). However, in terms of maximum isometric strength production capacity and body composition values, no significant differences were found in relation to body composition (Scantlebury et al., 2022).

Another important aspect to consider in female athletes is the variability of the menstrual cycle (Hayward et al., 2024), which fluctuates as a result of hormonal changes in oestrogen, progesterone, follicle-stimulating hormone, and luteinising hormone (Carmichael et al., 2021). One of the most significant yet least researched issues to date is the perceived of the menstrual cycle on performance. Findlay et al. (2020) y Hayward et al. (2024) reported that more than 80% of participants in their respective samples believed that the menstrual cycle and its associated symptoms negatively affected their performance. In the study by Juillard et al. (2024), the phases of the menstrual cycle were associated with sleep quality, fatigue, stress, and muscle pain; however, no significant differences were observed between these well-being variables across the different menstrual cycle phases. Rugvedh et al. (2023) stated that sleep can be compromised depending on the phase of the

menstrual cycle, with the ovulatory phase showing the greatest decline in sleep quality. Regarding perceived fatigue, Romero-Moraleda et al. (2025) found no significant differences among professional football players, irrespective of the menstrual cycle phase. With regard to muscle pain, Dam et al. (2022) reported that perceived muscle pain was low, although it was higher during the early follicular phase than during the other phases. Finally, in relation to stress, female athletes tend to experience increased psychological and physiological tension during the premenstrual and menstrual phases, largely due to decreases in energy and cognitive functioning.

Therefore, the main objective of this study was to analyze the relationships between the menstrual cycle, body composition, and perception of well-being in amateur rugby players. It is hypothesized, based on the findings of Yao et al. (2024), that total body mass is directly related to strength production. By contrast Juillard et al. (2024), it is expected that significant will be observed in well-being across the different phases of the menstrual cycle.

2. Materials and Methods

Study Design—Longitudinal, quasi-experimental, intra-subject study without a control group.

Subjects—Sixteen rugby players competing in the senior category of the 1st Regional Women's League. The players' ages ranged from 16 to 29 years (22.13 ± 4.50 years). The sampling method used was non-probabilistic convenience sampling, as the team to which access was available was selected for the study. The sample size is justified by the availability of players at the time of the study. Studies such as those by Muñoz-Aloy et al. (2024) and Romero-

Moraleda et al. (2025) on this topic were also reviewed, and it was found that the sample size fluctuated around the same number of participants. The inclusion criteria for the study were as follows: players had to be actively engaged in both training and competition, participate in all scheduled assessments, and had not experienced any injuries in the month preceding the study. The exclusion criteria comprised the absence of a regular menstrual cycle over the previous six months, as well as confirmed or suspected pregnancy. Prior to data collection, all participants received an information sheet about the study and signed an informed consent form. The study was approved by the ethics committee under code number UCV/2023-2024/121, thus ensuring compliance with the ethical principles established by the 1964 Declaration of Helsinki.

Variables and Instruments—To analyze the independent variable Menstrual Cycle, four phases were considered (luteal, ovulatory, menstrual, and follicular). To do this, the FLO menstrual calendar app was used, which recorded each player's menstrual cycle on a daily basis and which, in studies such as those by Muñoz-Aloy et al. (2024) and Sánchez et al. (2022), confirmed its efficacy for the monitoring of the menstrual cycle.

For body composition analysis, the TANITA BC 418-MA Segmental (Tanita Corporation, Tokyo, Japan) was used, an electrical bioimpedance device with eight electrodes (Łuszczki et al., 2022). The following data were obtained: lean mass, fat mass, percentage of water and weight in kg. In addition, the height in cm reported by the participants was recorded. For the analysis of general well-being or wellness, the Hooper Index Questionnaire (IPC, scale 1-7) was used (Hooper et al., 1995) which assesses general well-being on a scale of 1 (very low) to 7 (very high) using four items: sleep quality, stress level, fatigue, and muscle pain, with the total score obtained by adding up

the four items (Moalla et al., 2016). For the analysis of isometric strength, the Chronojump dynamometer was used to record the Squat Iso Push and Hip Iso Push tests, allowing the maximum peak force in N generated in each attempt to be calculated (Paul & Nassis, 2015; Sinacore et al., 2017). To evaluate stretch-shortening cycle in the CMJ, CMJ Abalakov, and unilateral CMJ vertical jump tests, Optojump was used, which recorded flight time measured in cm (Sella et al., 2021).

Procedure—The protocol was developed over a total of four face-to-face sessions at the Turia River rugby field, with the aim of analysing the influence of the menstrual cycle on the study variables. The sessions were conducted by graduates in physical activity and sports sciences with experience in monitoring and assessing performance in women's football. The sessions always took place in the afternoon from 5:00 p.m. to 8:00 p.m. Because the testing schedule was fixed weekly, the timing of each participant's assessment was not arranged according to her menstrual cycle phase but was instead determined by predetermined testing days. Consequently, the phase corresponding to each player was identified based on her physiological cycle on the specific evaluation day. In each of the evaluations, all players showed their menstrual records obtained through the mobile application 'My Flo Calendar' (García et al., 2022) and the data was recorded. This procedure allowed researches to determine the exact menstrual phase of each participant during every testing session and across the four evaluation days all participants were able to record and represent the four phases of the menstrual cycle. Each player then completed the Hooper Index Questionnaire (IPQ, 1–7 scale) to assess sleep quality, stress, fatigue, and muscle pain, with each item scored from 1 (very low) to 7 (very high), yielding an average score by adding the four scores together (Haddad et al., 2013; Hooper et al., 1995). The variability in menstrual cycle

length was registered her symptoms and cycle progressions in My Flo Calendar application, which estimated the phases according to each player's individual hormonal patterns based on each player's individual patterns. For this reason, phase classification was based on self-reported digital tracking rather than on a fixed or standardised cycle length.

Before starting the measurements, a guided warm-up was performed, consisting of a block of joint mobility, core activation, and strength work in exercises such as squats, side lunges, front lunges, and unilateral isometric glute bridges (Krawczyk et al., 2021; Lum et al., 2021).

After warming up, isometric strength was assessed using the Squat Iso Push and Hip Iso Push, both evaluated with a Chronojump dynamometer (Bemben et al., 1990; Walshe et al., 2023). Each test was performed in three attempts, with a three-minute rest period between each repetition and between tests.

In the Squat ISO push test, the athletes in a seated position had to extend their knees at maximum speed and hold the position for 10 seconds (Demura et al., 2010).

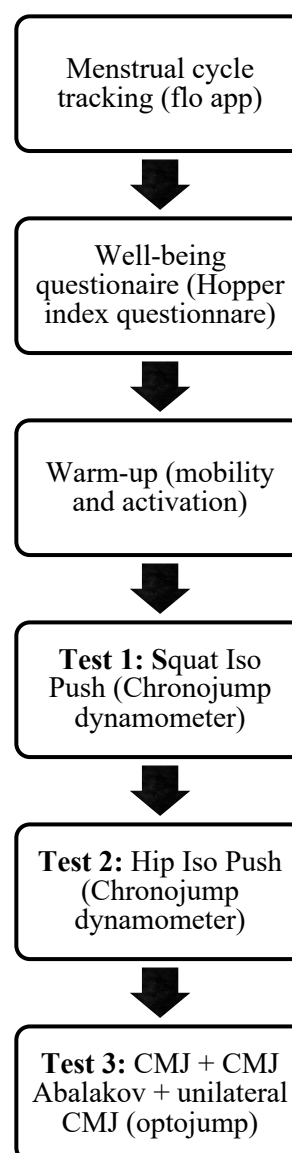
In the Hip ISO push test, participants were placed in a supine position with their knees bent and feet on the platform. The exercise consisted of a maximum-intensity hip extension, with the peak force achieved being recorded (Delgado et al., 2019). In both tests, three attempts were made with a three-minute rest between them, recording the best result in both cases (Contreras et al., 2015).

After completing the isometric tests, the jump tests were carried out. The first test was the CMJ, in which the participants performed a rapid flexion-extension movement of the knees, executing a vertical jump without arm momentum (González et al., 2014). The second test was the Abalakov CMJ, where a counter-movement was performed with approximately 90° knee flexion, with the hands free throughout the movement. After take-off, the legs were fully

extended until landing, with a final flexion to cushion the impact. Finally, the unilateral CMJ was evaluated, where with one leg supported, while the other leg was flexed at 90°, a vertical jump was performed as high as possible, landing on the same leg used for the push-off.

In all three measurements, the athletes were placed between the photoelectric cells of the Optojump system and three attempts were made; in the case of the unilateral CMJ, three with each leg, with 30-second breaks, and the best results were recorded (Julian et al., 2017). Figure 1 illustrates the study protocol.

Figure 1. Assement protocol



Statistical Analysis – Descriptive exploration included Mean (M) and Standard Deviation (SD) for each dependent variable. Secondly, Shapiro-Wilk test for normality for all dependent variables, and Mauchly's W sphericity test for repeated measures ANOVAs, were conducted. Huynh-Feldt's correction was applied in case sphericity assumption was violated. Finally, repeated measures ANOVA were performed using Menstrual Cycle (menstruation, follicular, ovulatory, luteal) as intra-subject factor; CMJ (bipodal), Right Unilateral CMJ, Left Unilateral CMJ, Isometric Squat Strength, Isometric Hip Thrust Strength, and Wellness as dependent variables. Additionally, Total Body Weight (TBW) and Fat Mass (FM) were considered as covariates. Holm's post-hoc test were conducted to compare any significant effect, using estimated marginal means. Confidence interval (CI) was set to 95% and significance was established at $p < .05$. Size effect was reported with η^2_p for repeated measures of ANOVA.

3. Results

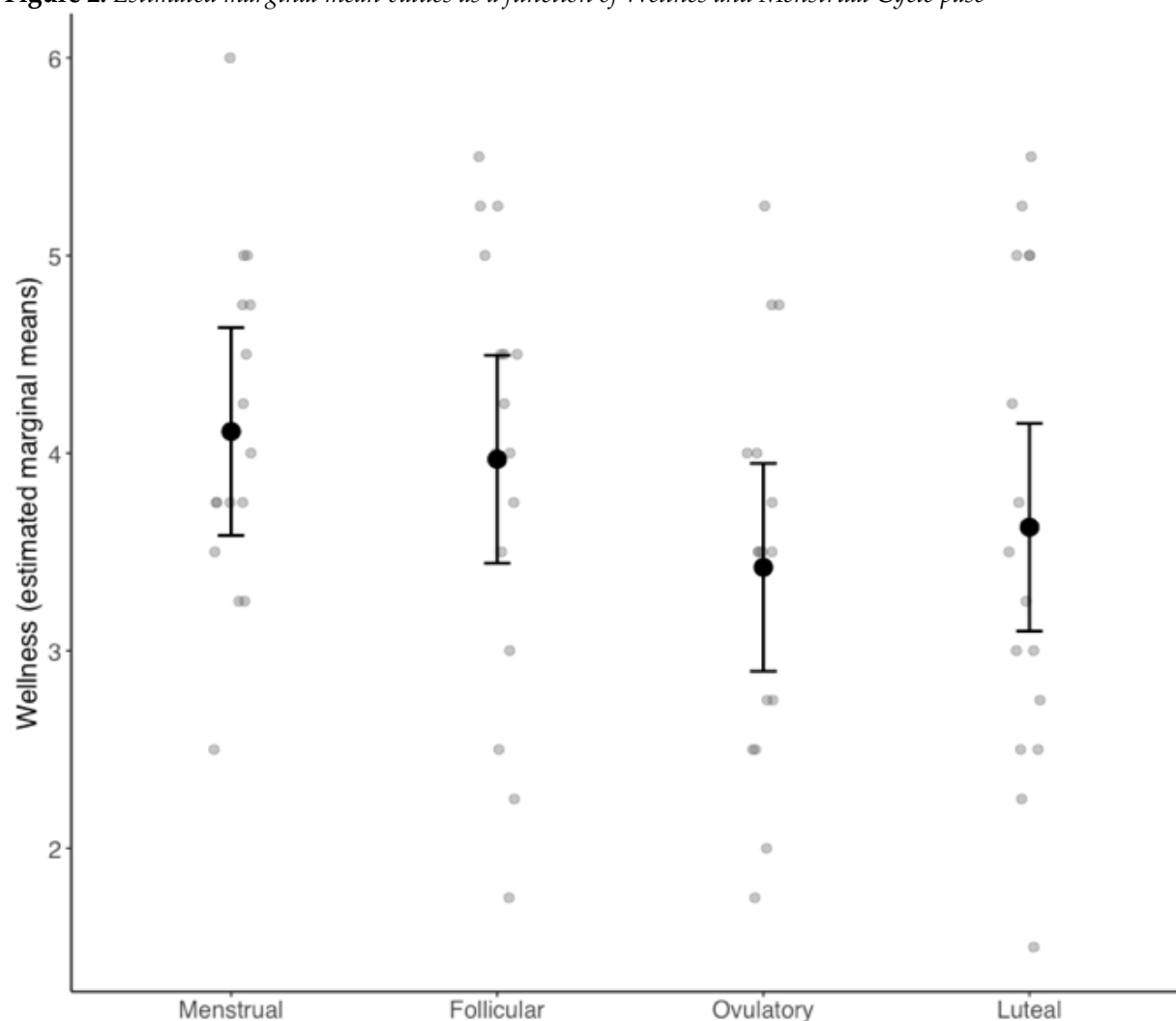
Preliminary Analysis—All variables followed a normal distribution after the Shapiro-Wilk test (all $p > .05$). Sphericity test was only significant ($p < .05$) for Right Unilateral and Left Unilateral CMJ, thus applying corresponding F corrections during the repeated measures of ANOVA conducted for these dependent variables.

CMJ jump (bipodal) —A repeated measures ANOVA was performed with Menstrual Cycle as an intra-subject factor for CMJ (bipodal jump height) as dependent variable, and FM, TBW, and height as covariates. No significant effects were observed ($F > 1$, $p > 0.05$ in all cases).

Right/Left Unilateral CMJ—A repeated measures analysis was performed with Menstrual Cycle $\times$ Right Unilateral CMJ, and Menstrual Cycle $\times$ Left Unilateral CMJ. Covariates included FM and TBW. No significant results were found ($p > .05$).

Strength Analyses—Isometric Strength (Squat and Hip Thrust). Repeated measures ANOVA was performed for both the isometric squat and hip thrust, considering the phase of the Menstrual Cycle as intra-subject as factor, and FM and TBW as covariates. No significant effects ($p > 0.05$) were detected for the phase of the menstrual cycle, when Huynh-Feldt correction was applied.

Wellness—Repeated measures ANOVA for Menstrual Cycle as intra-subject factor, with FM as covariable, revealed a main effect of menstrual cycle phase on Wellness [$F(3,42) = 4.06$, $p = 0.012$, $\eta^2_p = 0.226$], and a significant covariate effect of FM [$F(3,42) = 2.91$, $p = 0.045$, $\eta^2_p = 0.172$]. Estimated marginal means (EMM) were calculated for Menstrual Cycle effect considering FM covariable, with menstruation [$EMM = 4.11$; $SE = 0.223$; $CI\ 95\% (3.63, 4.59)$] and follicular [$EMM = 3.97$; $SE = 0.293$; $CI\ 95\% (3.35, 4.59)$] phases showing higher wellness scores than ovulatory [$EMM = 3.42$; $SE = 0.218$; $CI\ 95\% (2.95, 3.89)$] and luteal [$EMM = 3.63$; $SE = 0.274$; $CI\ 95\% (3.04, 4.21)$] phases (see Figure 2). However, Holm's post-hoc analysis didn't reach significance ($p_{holm} > .05$) for any comparison of the menstrual cycle phases, with the highest difference observed between menstrual and ovulatory phase ($\Delta EMM = 0.688$, $SE = 0.259$, $p_{holm} > .113$).

Figure 2. *Estimated marginal mean values as a function of Wellnes and Menstrual Cycle pase*

Note. This figure demonstrates the change in Wellnes score during the menstruation, follicular, ovulatory and luteal phases of the Menstrual Cycle. Error bars represent standard errors.

4. Discussion

The main objective of this study was to analyse the relationship between the menstrual cycle, body composition and perception of well-being in amateur rugby players. The main findings of this study indicate that the phases of the menstrual cycle do not affect strength expression when performing a counter-movement jump. These results are related to those obtained by Muñoz-Aloy et al. (2024) y Velarde-Sotres et al. (2025) where they indicate that there are no significant differences in neuromuscular performance, regardless of the phase of the menstrual cycle.

Regarding isometric strength in the squat and hip thrust tests, and its relationship

to the menstrual cycle, it was found that there were no significant differences for either test regardless of the phase of the menstrual cycle the player was in. These findings are consistent with studies such as that by Småvik Dasa et al. (2021), reported no significant differences in maximum isometric grip strength across different phases of the menstrual cycle among female athletes. Kuehne et al. (2021) in a study involving 16 women found no differences in maximum isometric strength during the biceps curl exercise between menstrual cycle phases. Romero-Moraleda et al. (2019) found no significant variations in muscle performance in the lower limbs in trained women during different phases of the menstrual cycle. In this regard, to date, there is not much

scientific evidence to show that the menstrual cycle can significantly alter maximum isometric strength in the upper and lower limbs.

Another relationship established in this study is that between well-being and the menstrual cycle. Altogether, the results show a global significant effect of menstrual cycle phase on wellness score, but no individual comparison reached statistical significance between phases after multiple comparison correction, reflecting a global and moderate effect, not concentrated in a unique pair of phases. Carmichael et al. (2021), demonstrated significant differences, observing that menstrual cycle-related symptoms influenced stress perception, fatigue perception, and sleep quality during the luteal phase. These results support the findings of the present study. However, our findings contrast with those reported by Antero et al. (2023), who observed that aspects related to well-being, such as sleep or physical condition, did not differ significantly across the different phases of the menstrual cycle. These discrepancies may arise from methodological and sample-related factor. Prior reviews have highlighted that heterogeneity in study design and participant characteristics can substantially influence the detection of cycle-related changes in perceived well-being (McNulty et al., 2020).

As for the relationship between fat mass, well-being and the menstrual cycle, our findings are in line with other studies such as that of Dam et al. (2022) Those who observed a decline in performance at the beginning of the menstrual cycle, associated with lower psychological well-being, can be explained by hormonal changes. The ovulatory phase has been associated with elevated oestrogen levels, as well as improved mood and a positive perception of well-being. On the other hand, with regard to the influence of fat mass on changes in well-being caused by the menstrual cycle, adipose tissue is considered an active endocrine

organ that modulates circulating sex hormones (oestrogens) and can alter the menstrual cycle through the dysregulation of the hypothalamic-pituitary-gonadal (HPG) axis (Newell-Fugate, 2017). In female athletes, deviations above and, especially, below the optimal fat mass can affect normal gonadotropin secretion and alter the dynamics of the luteal phase, changing the length and regularity of the cycle and affecting athletic performance by altering metabolism, muscle recovery, and neuromuscular function (Cabre et al., 2024; Niering et al., 2024).

It is important to note that this study has some limitations, such as the small number of participants and therefore, reduced statistical power. Furthermore, the menstrual cycle was evaluated using the "FLO menstrual calendar app", taking into account the first day of bleeding to determine the other phases, rather than urine or saliva tests (De Jonge et al., 2019; Romero-Moraleda et al., 2019). Consequently, although this method is commonly used in similar research, there remains a high probability of cycle phase misclassification, which could be minimized though direct hormone measurements. In addition, although the study conditions were kept as consistent as possible, factors such as training load, sleep, nutrition, and hydration were not strictly controlled, and may have had a minor influence on the outcomes. These limitations could be addressed in future research by increasing the number of subjects, conducting assessments over more than one menstrual cycle, and performing more specific hormone assessment tests to more accurately determine the phases of the menstrual cycle.

5. Practical Applications.

Given that no significant variations in strength performance were observed during the different phases of the menstrual cycle, it is recommended to avoid changes in training planning that could lead to

inconsistent adaptations during the most sensitive phases. In this regard, planned strength programmes can remain stable or follow the schedule throughout the menstrual cycle.

Due to variations in each participant's perception depending on the phase of the cycle and their emotional state, it is advisable to adapt and individualise the loads in strength or speed sessions.

TBW was a significant covariate influencing muscle strength. These findings support the need to consider TBW as an individual adjustment parameter for load prescription and strength training planning. In this sense, TBW can act as a predictive covariate that contributes to the individualisation of therapeutic interventions, allowing for the optimisation of exercise dosage or overload, especially in the early stages of the recovery process.

Overall well-being varies significantly depending on the phases of the cycle, an aspect that must be considered when adjusting intensity, volume or including more recovery time (Muñoz-Aloy et al., 2024). A low perception of well-being can alter motivation, exercise technique and motor control, which could lead to an increased risk of injury due to fatigue and even distraction (Dos Anjos et al., 2023; Juillard et al., 2024).

Implementing brief well-being questionnaires during the different phases of the menstrual cycle can help to individualise training programmes, especially for women with lower GM levels, who may perceive training, or themselves, differently. This in turn can reduce adherence to training and even the ability to recover, aspects that would affect physical and psychological performance and well-being.

6. Conclusions

The results of this study suggest that the phase of the menstrual cycle did not meaningfully influence CMJ, strength, or performance in isometric squats. However,

given the methodological limitation, these finding should be interpreted with caution. TBW emerged as a significant covariate in the strength analysis, suggesting that future studies should consider categorising TBW to better understand its effects on strength outcomes. Furthermore, the interaction between menstrual cycle phase and MG appeared to be a relevant predictor of well-being, suggesting a possible role of body composition in shaping well-being perceptions throughout the menstrual cycle. Future research should explore this relationship in greater depth to determine the underlying mechanisms and their potential practical applications.

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