Effects of the menstrual phase on the performance and well-being of female youth soccer players

Efectos de la fase menstrual en el rendimiento y bienestar de mujeres jóvenes futbolistas

Mario Sánchez[1*], Alejandro Rodríguez-Fernández[2], María Villa-Del Bosque[1], Luis Bermejo-Martín[1], Javier Sánchez-Sánchez[1], Rodrigo Ramírez-Campillo[3], José-Gerardo Villa-Vicente[2]

[1] Grupo de Planificación y evaluación del Entrenamiento y Rendimiento Deportivo. Facultad de Educación. Universidad Pontificia de Salamanca, Salamanca, España

[2] Grupo de Investigación VALFIS, Instituto de Biomedicina (IBIOMED). Facultad de Ciencias de la Actividad Física y del Deporte. Universidad de León, España

[3] Exercise and Rehabilitation Sciences Laboratory. School of Physical Therapy. Faculty of Rehabilitation Sciences. Universidad Andres Bello. Chile

* Correspondence: msanchezga@upsa.es

HOW TO CITE THIS ARTICLE:
Sánchez, M., Rodríguez-Fernández, A., Villa-Del Bosque, M., Bermejo-Martín, L., Sánchez-Sánchez, J., Ramírez-Campillo, R., & Villa-Vicente, J.G. (2022). Effects of the menstrual phase on the performance and well-being of female young soccer players. *Cultura, Ciencia y Deporte, 17*(51), 113-129. http://dx.doi.org/10.12800/ccd.v17i51.1610.

Received: 18 October 2020 / Accepted: 23 September 2021

Abstract

The aim of the study was to analyze variations in performance and subjective perception of well-being in youth soccer players between menstrual (FM), follicular (FF) and luteal (FL) phases. Twelve female soccer players participated (age, 16.18 ± 1.68 years; height, 164 ± 7.27 cm; body mass, 61.90 ± 6.37 kg), all with 4 years of competitive experience, and 3.1 ± 1 years with a regular menstrual cycle. The maximum speed in 40-m, ability to change direction (25-m with 5 changes of direction of 45º every 5 m), explosive strength of the lower limbs with dominant, non-dominant, bipodal leg and vertical jump height were evaluated using Squat Jump into each phase, along with the Hooper's subjective well-being questionnaire. No differences between menstrual phases were obtained in any performance outcome, sleep, fatigue, stress, or muscle pain (all p> 0.05). However, a lower (worse) general well-being (p <0.01) was noted during FM and FL compared to FF. Youth female soccer players well-being perception between menstrual phases provides relevant information to take into account by practitioners working with such athletes.

Keywords: menstrual cycle, gender, football, women, menstruation.

Resumen

El objetivo del estudio fue analizar variaciones en rendimiento y percepción subjetiva del bienestar en jóvenes futbolistas entre fase menstrual (FM), folicular (FF) y lútea (FL). Participaron doce mujeres futbolistas (16.18 ± 1.68 años; 164 ± 7.27 cm; 61.90 ± 6.37 kg) con 4 años de experiencia competitiva y 3.1±1 años con ciclo menstrual regular. Se evaluó velocidad máxima en 40-m, habilidad de cambio de dirección (25-m con 5 cambios de dirección de 45º cada 5 m), fuerza explosiva del tren inferior con pierna dominante, no dominante, bipodal y altura de salto vertical mediante Squat Jump en cada fase, junto con el cuestionario de Hooper de bienestar subjetivo. No se obtuvieron diferencias significativas en ninguna variable de rendimiento ni de sueño, fatiga, stress y dolor muscular entre las fases del ciclo menstrual (p>0.05). Sí se obtuvo un estado de bienestar general significativamente peor (p<0.01) en FM y FL respecto a FF. Conocer la percepción subjetiva de bienestar puede ser una herramienta que aporte información relevante a los cuerpos técnicos de equipos femeninos.

Palabras clave: ciclo menstrual, género, futbol, mujer, menstruación.

Introduction

Soccer performance depends on multiple variables of physical, physiological, psychological, social, technical and tactical type (Reina-Gómez & Hernández-Mendo, 2012), providing a complex performance analysis scenario (Carling et al., 2014). Along with these aspects, women's soccer has the added feature of experiencing a menstrual cycle with hormonal changes that can condition performance (Constantini, et al., 2005). Within soccer as a sport predominantly practiced by men, we find more and more women practicing, both in grassroots soccer and in elite soccer (Oyón et al., 2016). According to the International Football Federation (FIFA), 30 million women practiced this sport in 2015 (FIFA, 2015). In 2019, ~60,000 female licenses were registered in Spain, 4,762 more compared to 2018. Despite the fact that there continues to be a clear imbalance between men (93.9% of licenses) and women (6.1% of licenses), it should be noted that the percentage increase in female licenses (7.89%) was higher than that of men (3.14%) between the years 2017 and 2018.

Sport performance between men and women is conditioned by differences at a physiological, biological, social, and cultural level, as well as by a different age of maturation (León, 2000; Ramírez-Balas, 2014). Moreover, women experience variations in their performance due to hormonal changes during their menstrual cycle (Seoane-Prado, 2013) and with modifications in the levels of endogenous sex steroid hormones (Constantini et al., 2005). The fertile and adult age of the menstrual cycle can be a determining factor of possible changes in performance, due to wide variations in the concentration of follicle-stimulating hormone (FSH) and luteinizing hormone (LH), and ovarian hormones such as estrogens and progesterone (Villa-del Bosque, 2016). Information regarding the menstrual cycle and its effects on performance may aid practitioners to adapt training and to better preper athletes for competitions during the different menstrual phases (Bruinvels et al., 2016; Datson et al., 2014).

The literature is contradictory regarding how menstrual phases can influence sports performance (Romero-Moraleda et al., 2019). Not only are there contradictory results, but also some investigations did not find clear differences in performance between the phases of the menstrual cycle (Fridén et al., 2003; Guijarro et al., 2009) while others have shown this aspect as a determining factor of performance (Dokumacı & Hazır, 2019; Julian et al., 2017). Previous studies have shown a significantly better performance in intermittent resistance (14%) (Julian et al., 2017) and in muscular strength (26%) (Pallavi et al., 2017) in the follicular phase (FF) over the luteal phase (FL). On the contrary, a better average power in repeated sprints (2.61%) has been obtained in the FL over the FF (Middleton & Wenger, 2006), together with a worse running economy in FF than in FL (Dokumacı & Hazır, 2019). On the other hand, no significant differences have been obtained in 30-second sprint power (Tsampoukos et al., 2010), 30-m sprint time (Julian et al., 2017), lower body strength under different loads (Romero-Moraleda et al., 2019), time to exhaustion (Matsuda et al., 2020), or VO2max depending on the phase of the menstrual cycle (Dokumacı & Hazır, 2019). Therefore, more research should clarify the effects of the menstrual phases on performance. In addition to effects on physical performance, it seems that menstrual phases affect the perception of energy levels (Cockerill et al., 1994), psychological stress (Oriol, 2006) and the state of well-being (Konovalova, 2013) seeing all of them harmed in FF over FL.

Elite female soccer matches entails running 10.3 km (range 9.7-11.3), 1.32 km at high intensity (range 0.71–1.70) (Krustrup et al., 2005), and 4.8 maximal-intensity actions per minute in each competition (Strauss et al., 2019), representing ~125 total maximal-intensity actions, each with an average duration of 2.3 seconds (range 2.0-2.4). Along with these actions, the players made approximately 700 changes of direction (Upton & Ross, 2011) all of them carried out at high intensity and considered the most influential actions in competition performance (Bangsbo et al., 2006). Speed and change of direction along with acceleration and deceleration are essential attributes for performance in women's football (Yap, 2000), so the training and assessment of these actions will be of vital importance for coaches and coaches. Studies analysing the effects menstrual phases on performance in the aforementioned variables are scarce and contradictory, with differences noted in speed (Paris & Jakeman 1987), although not in jumping 30-m sprint (Julian et al., 2017). Despite the popularity of female soccer, few studies addressed the influence of the menstrual cycle, age and years of sports practice in youth female soccer performance.

Therefore, the objective of this study was to analyze the effects of the different phases of the menstrual cycle on determinant variables of performance and well-being in youth soccer players. Our main hypothesis is that the phases of the menstrual cycle may have a conditioning effect on the performance of the lower body, showing better results in the menstrual phase (FM) and FF, also affecting the perception of well-being in youth soccer players.

Method

Participants

Twelve female soccer players (age, 16.18 ± 1.68 years; height, 164.01 ± 7.27 cm; body mass, 61.90 ± 6.37 kg) who competed in the regional category participated in the study. The inclusion criteria were i) perform three 90-minute sessions together with a weekly competitive game for at least three months prior to the study; ii) minimum experience of at least four years practicing federated football; iii) not having suffered any injury in the four months prior to the study. Athletes with menstrual cycle variation from 24 to 35 days in the last six months were excluded from the study (Lebrun et al., 1995). The athletes and their parents/guardians were informed of the risks and benefits of participating in the study and signed/approved the corresponding informed consent/assent. The experimental design was carried out according to the Declaration of Helsinki.

Experimental design

One week before the start of data collection, the weight and height of the soccer players were recorded. A 100g precision scale (BC-418MA, TANITA®, Arlington Heights, IL) was used to measure weight and a 1mm precision Seca stadiometer (Seca 202, Seca®, Hamburg, Germany) for height. During three training sessions this week, the players performed the performance tests used in the study, requiring maximum effort at least in one repetition, and they completed the well-being questionnaire, in order to become familiar with them. Subsequently, the days to carry out the tests were assigned individually for each player, coinciding with a training day after a rest session and with the second third of the cycle phase. Furthermore, the athletes were instructed to eat a dinner and breakfast rich in carbohydrates, and to be well hydrated the day before the test and during the testing sessions. They were also instructed to have a light snack with ingestion of about 300 ml of water 1 h before the session. On the day assigned for the measurements in each of the phases of the menstrual cycle, the players completed individually (19:00 ± 1h) the well-being perception scales, providing information on the state with which they faced the session. Subsequently and prior to performing the physical performance tests, the players performed a 15-minute warm-up that consisted of five minutes of continuous low intensity running and joint mobility, five minutes of dynamic stretching and five minutes of running races (progressive speed over different distances). After the warm-up, the players performed the different physical performance tests proposed for the study (20:00 ± 1h). After five minutes of passive rest, the tests began, which were carried out outdoors in an area sheltered from rain and air, in the extension of the artificial turf surface of the soccer field where the players performed their training sessions and games, with the usual clothes and footwear for the game. All the participants completed the tests in the afternoon at the same time of day and in similar environmental conditions (4.8 ± 0.83 °C and 71.60 ± 5.07% relative humidity) and without previous fatigue. All data was saved into an Excel sheet (Microsoft Office 2017).

Determination of the phases of the menstrual cycle

The players completed a retrospective initial questionnaire regarding their menstrual cycle in the previous six months (Romero-Parra et al., 2020) as well as the date of the next period and whether they used any hormonal contraceptive and/or medication. Data was obtained using a mobile application (Menstrual Calendar and Cycle®, Period Tracker) that predicts the different menstrual phases. The application calculated possible days of registration taking into account the possible ovulation day (predicted by the app) and the period of menstruation, establishing three phases, FM, FF and luteal phase (FL) for each player (Figure 1) and from which the timing of the performance of the different assessment tests was established. Of the 16 players who completed the study, only 12 were selected (i.e., eumenorrheic athletes).

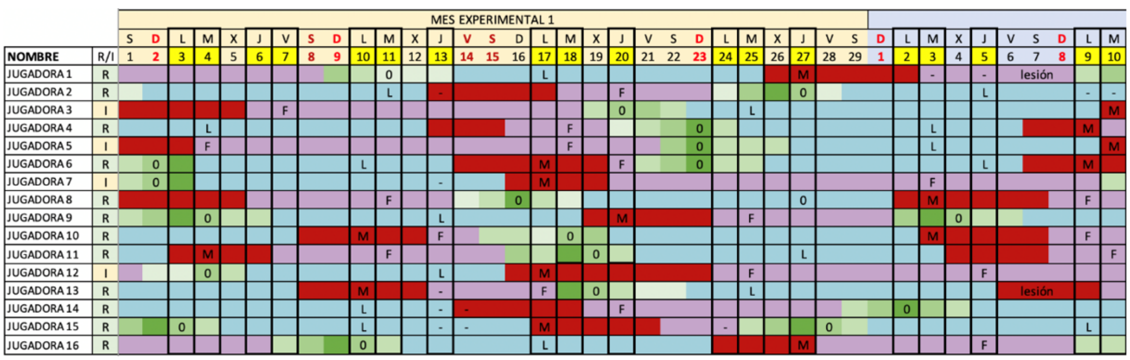

Figure 1. Calendar for the registration of the menstrual cycle of each player obtained from the data of the retrospective questionnaire

Note = Red = menstrual phase days; Pink = follicular phase; Blue = luteal phase; Green (0) = ovulation estimate; R = Regular cycle; I = Irregular cycle; Dark line and yellow background = weekly training; M = test performed in menstrual phase; F = Test performed in follicular phase; L = Test performed in the luteal phase.

Athletic Performance

40-m test. The maximum linear speed was determined by performing two linear sprints of 40 m separated by a passive rest of two minutes (Hernández et al., 2019). The best attempt of the two was selected for analysis. The players began the test standing from a bipedal position, located 0.3 meters from the first photocell. The height of the photocells was 1.40 m, at the height of the soccer players' chest (Cronin et al., 2007).

V-cut. To determine the speed in the change of direction, the V-Cut test was carried out (Gonzalo-Skok et al., 2015). For this, two 25-m sprints were executed, separated by a two-minute passive rest, with four direction changes (one every 5 m) with a 45° departure angle. For valid trials, the players had to pass the foot over the line marked on the ground (by two cones) at each change of direction point. The distance between cones was 0.7 meters. If a trial was not valid, the athlete repeated the trial after five minutes of recovery. The best time of the two repetitions performed was recorded for analysis. WittySEM, Microgate ® (Bolzano, Italy) photocells were used to measure linear speed and performance in direction changes.

Lower body strength. Two maximum horizontal jump tests (Hop Test) and one vertical jump test (Squat Jump) (Logerstedt, Snyder-Mackler, Ritter, Ax, & Godges, 2010) were performed to determine lower body strength. In the horizontal jump test, the Single Hop Test (SHT) was used, assessing the ability to do a maximum monopodal jump with left and right leg, identifying the dominant (D-SHT) and non-dominant (nD-SHT) leg and the Bipodal Hop Test (BHT). A mark was placed on the ground perpendicular to the starting line. The players supported on one leg (SHT) or on two (BHTD), with the foot on the line that marked the exit, executed a maximum horizontal jump receiving with the same leg or with both, respectively. The distance was measured from the starting line to the back of the heel. To count a jump as correct, the position had to be maintained after the jump for at least three seconds without losing balance or supporting the opposite leg in the case of SHT. If these quality criteria were not met in the execution, the jump was repeated after the established recovery time (Troule & Casamichana, 2016). In the vertical jump test, the Squat Jump (SJ) test was used to assess the explosive strength of the lower body (Bosco et al., 2000). From the squat position (knees bent) at 90° and the hands resting on the hips with the trunk and head perpendicular to the ground, the players performed a maximum vertical jump, keeping their knees extended throughout the aerial phase of the jump and landing with the forefoot of the jump. In all the tests, three jumps were made with a recovery of 30 seconds between each one, calculating the distance in cm with the software and selecting the jump with the greatest distance or height reached in the case of the SJ. Jumping performance tests were measured with a Globus Ergo System R. contact platform (Codogne, Italy).

Subjective perception of well-being and fatigue. To know the subjective perception of well-being and fatigue of the players, the scales proposed by Hooper et al. (1995) known as the Hooper Index and whose reliability has been demonstrated in previous studies (Rabbani et al., 2019). This tool is made up of four items (sleep, fatigue, stress, muscle pain) to be evaluated from one to seven, where the value one corresponds to very, very low (very, very good in the case of sleep) and seven with very, very high. The athletes in each item had to assess: i) how they had perceived the quality of sleep the previous night; ii) what was the level of general fatigue they perceived; iii) perception of the level of stress and iv) perception of local muscle pain.

Statistical analysis

Results are presented as mean ± standard deviation (SD). The study of the variables showed a normal distribution according to the Shapiro Wilk test. To analyse the difference between variables as a function of the phase of the menstrual cycle, the mixed analysis test line ANOVA of repeated measures was used. When appropriate, the Bonferroni post hoc adjustment was applied to examine the differences. The coefficient of variation was determined as (SD · mean − 1) × 100 to evaluate the variability of each test (Atkinson & Nevill, 1998). Significant differences were considered when p <0.05. Additionally, the effect size (TE) was calculated through Cohen's d test (Cohen, 1988). The d value was interpreted according to the following ranges <0.1 (very small), from 0.1 to <0.2 (small), 0.2 to <0.5 (moderate), 0.5 to <0.8 (large) and ≥ 0.8 (very large). The Statistical Package for Social Sciences (SPSS, v. 21.0, SPSS, Inc., Chicago, IL, USA) was used for this analysis.

Results

Results are presented as mean ± standard deviation (SD). The study of the variables showed a normal distribution according to the Shapiro Wilk test. To analyse the difference between variables as a function of the phase of the menstrual cycle, the mixed analysis test line ANOVA of repeated measures was used. When appropriate, the Bonferroni post hoc adjustment was applied to examine the differences. The coefficient of variation was determined as (SD · mean − 1) × 100 to evaluate the variability of each test (Atkinson & Nevill, 1998). Significant differences were considered when p <0.05. Additionally, the effect size (TE) was calculated through Cohen's d test (Cohen, 1988). The d value was interpreted according to the following ranges <0.1 (very small), from 0.1 to <0.2 (small), 0.2 to <0.5 (moderate), 0.5 to <0.8 (large) and ≥ 0.8 (very large). The Statistical Package for Social Sciences (SPSS, v. 21.0, SPSS, Inc., Chicago, IL, USA) was used for this analysis.

Table 1 shows the results of the physical condition assessment tests in the different phases of the menstrual cycle. No differences (p> 0.05) were noted for 40-m sprint, V-Cut test, LSHT, RSHT, BHT, or SJ between the different phases of the menstrual cycle. The performance in the V-Cut test presents a large effect size (TE = 0.53) with a better mark (2.7%) during the FF than, in the FM, although without significant differences, observing the tendency to reach higher speed (linear and with changes of direction) and explosive force (vertical and horizontal, except in non-dominant leg).

Table 1. Performance in speed and explosive strength tests according to the phase of the menstrual cycle in youth soccer players

	40-m (s)	**V-Cut** (s)	**nD-SHT** (cm)	**D-SHT** (cm)	**BHT** (cm)	**SJ** (cm)
FM	6.18±0.38 (6.29)	7.27±0.39 (5.36)	159.96±13.66 (8.53)	152.72±11.48 (7.51)	182.03±14.63 (8.03)	27.94±4.49 (16.07)
FF	6.14±0.38 (6.18)	7.08±0.33 (4.66)	159.77±11.79 (7.37)	161.28±16.73 (10.37)	188.46±15.01 (7.96)	28.69±4.35 (15.16)
FL	6.12±0.51 (8.46)	7.19±0.36 (5.01)	161.41±19.96 (12.36)	158.09±16.87 (10.67)	186.36±15.86 (8.51)	27.45±5.43 (19.78)
			% change-TE			
FM vs FF	0.65%-0.11	2.68%-0.53	0.11%-0.01	5.30%-0.60	3.41%-0.43	2.61%-0.17
FM vs FL	0.98%-0.13	1.11%-0.21	0.89%-0.08	3.39%-0.37	2.32%-0.28	1.78%-0.10
FF vs FL	0.32%-0.04	1.52%-0.32	1.01%-0.10	2.01%-0.19	1.12%-0.14	4.51%-0.25

Mean values ± SD (CV). Note = 40-m = speed test time in 40 m; V-Cut = 25 m test time with changes of direction; nD-SHT = Non-dominant leg jump; D-SHT = Dominant leg jump; BHT = Bipodal jump; SJ = Squat Jump; FM = menstrual phase; FF = follicular phase; FL = luteal phase; TE = effect size. CV = coefficient of variation.

Figure 2 shows the results of the subjective perception of well-being scale, not observing significant differences (p> 0.05) between phases, neither in sleep assessment, nor in stress nor in muscle pain. In FM and FL, higher levels of Fatigue were obtained (large TE = 0.52 and 0.54, respectively) with a score of 19.93% higher in FM and FL, compared to FF. In addition, a significantly worse general well-being was obtained (p <0.01) in FM and FL compared to FF (large TE = 1.1 and 0.91, respectively), with a score 6.43% higher in FM and 7.11 % in FL compared to FF. The coefficient of variation (CV) of the general welfare state was 23.65 for FM, 29.35 for FF and 35.01 for FL. In the variables sleep, fatigue, stress and muscle pain, the CV values were: sleep (FM = 3.51; FF = 2.59; FL = 3.30); fatigue (FM = 37.15; FF = 42.69; FL = 39.58); stress (FM = 26.86; FF = 40.35; FL = 39.93); muscle pain (FM = 43.48; FF = 38.56; FL = 67.08).

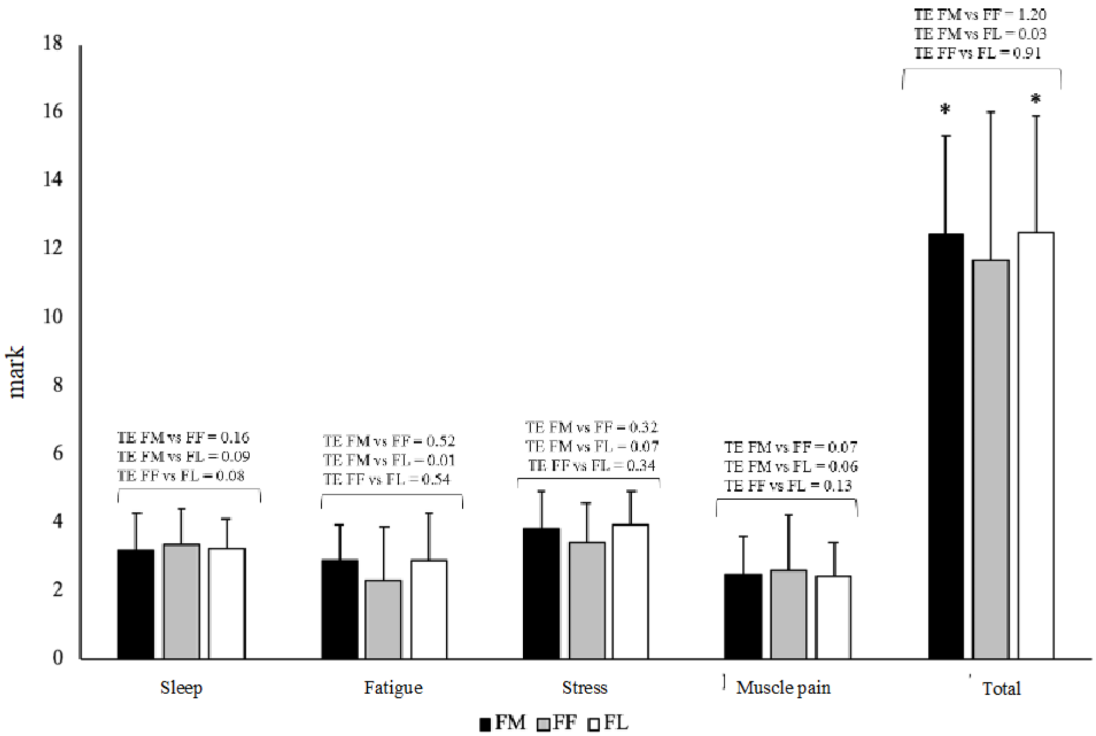

Figure 2. Results of the well-being perception scale in the different phases of the menstrual cycle in youth soccer players

*Note = FM = menstrual phase; FF = follicular phase; FL = luteal phase; TE = effect size. * = indicates significant differences with follicular phase (p <0.01).*

Discussion

The objective of this study was to analyse the effects of the different phases of the menstrual cycle (FM, FL, and FF) on performance determinants such as speed and horizontal and vertical jumping capacity, and well-being in youth soccer players. The data obtained show that the FF of the menstrual cycle of youth soccer players shows a significant ($p < 0.01$) lower perception of fatigue (FM vs FF = 19.93% and TE 1.2; FL vs FF 19.93% and TE 0.91) and general well-being (FM vs FF = 6.43% and TE 0.52; FL vs FF 7.11% and TE 0.54) in the Hooper index, without significant differences ($p > 0.05$) in the performance in speed and explosive strength of the lower body between the three phases of the menstrual cycle. The absence of effects of the menstrual cycle on performance in speed and explosive strength of the lower body, suggests that performance in eumenorrheic women is not affected by the different phases of the menstrual cycle. These results are of great relevance in the design and quantification of the training and competition load since a greater load can be perceived differently depending on the phase of the menstrual cycle and increase the risk of injury. All the participants had a regular menstrual cycle, were active in the same sports category, with only three years of menarche, without medication or use of contraceptives, or diseases or conditions that could affect hormonal balance, and without having suffered previous injuries in the last 4 months, thus justifying the great control of the variables that can affect and influence the contradictory evidence of the results (Julian et al., 2017; Romero-Moraleda et al. 2019).

Sprinting and high intensity actions in soccer matches account for only 8% to 12% of the distance travelled, but these actions are considered the most important for performance along with horizontal (sprint) and vertical (jumping power) in women's soccer (Haugen et al., 2012). The results obtained did not show significant differences ($p < 0.05$) in linear speed (40-m) or in speed with change of direction (V-Cut) as a function of the menstrual cycle. These results are in agreement with previous studies that show that performance in speed determined by a similar test (30-m) is not conditioned by the phase of the menstrual cycle (Villa-del Bosque, 2016; Julian et al., 2017). Hormonal changes caused by the menstrual cycle may not cause changes in sprint performance because naturally isolated 17b-estradiol concentrations with low progesterone have no effect on performance (Tsampoukos et al. 2010). Likewise, Wiecek et al. (2016) showed that hormonal changes in the menstrual cycle have no effect on anaerobic performance, speed, or anaerobic endurance. Julian et al. (2017) in a study with 9 soccer players carried out during early FF (where estrogen is at minimum values) and medium FL (where both estrogen and progesterone reach their highest magnitude), they did not obtain differences in speed (5 -m, 10-m and 30-m), between FF and FL. However, they did show a significant reduction ($p = 0.07$) in performance in aerobic endurance tests during the FL of the menstrual cycle, postulating that it may be due to the regulation of heat, the availability of substrates and metabolism.

The variation in basal body temperature of women during FL is attributed to the increase in progesterone, thus justifying the limitation in the ability to perform prolonged exercise in this phase (Janse de Jonge, 2003; Julian et al., 2017). However, Somboonwong et al. (2015) showed that the increase in core temperature after warming was associated with an improvement in sprinting. The explosive strength performance of the lower body has not shown significant differences depending on the phase of the menstrual cycle, neither in the horizontal nor in the vertical jump. Arazi et al. (2019) report that the muscular strength and endurance and anaerobic power of young women do not vary in the different phases of the menstrual cycle, despite the fact that the levels of LH and FSH change. According to the results of our study, no significant differences (p> 0.05) were observed in any of the jump tests (D-SHT; nD-SHT; BHT; SJ) performed to measure lower body muscle strength. These results may hormonal changes may not cause an effect, and/or the effects of estrogen on muscle strength have been restricted during LF, a consequence of the predominant antagonistic effect of progesterone (Giacomoni et al. 2000; Julian et al., 2017). These results are in agreement with previous studies that show how, in trained women, lower-body muscle strength performance is not affected by the phase of the menstrual cycle (Fridén et al. 2003; Romero-Moraleda et al. 2019). The authors suggest that the individual responses of each athlete should be considered and taken into account if decisions are to be made regarding the phases of the menstrual cycle during training and matches, since this seems to affect the performance of each subject differently.

Performance in eccentric muscular actions will not be affected in the different phases of the cycle, as long as women do not suffer from premenstrual and menstrual symptoms (Lebrun, 1993), justifying that this absence of differences in the cycle could be related to specificity of the exercise they are familiar with (Giacomoni et al., 2000; Martínez-Lagunas et al., 2014; Tsampoukos et al., 2010; Villa-del Bosque, 2016). In fact, physical performance in elite women's soccer is closely related to training status and maximum capabilities (Krustrup et al., 2005; Julian et al., 2017), so maintaining an optimal level during the menstrual cycle is essential for athletic success.

The main finding of this study is that, while no significant differences were obtained in the variables of subjective well-being, sleep, stress, muscle pain and fatigue, the players showed a significantly worse (p <0.01) general well-being state (TE = 1.21 -0.91; very large) in FM and FL compared to FF. The menstrual and premenstrual symptoms such as fluid retention (causing bloating, congestion and discomfort), weight gain, mood swings (irritability, depression, loss of motivation), and dysmenorrhea (Villa-del Bosque, 2016) may be the reasons for the different wellness scores. Konovalova (2013), showed that stress, both psychological and physiological, or changes in mood caused in the premenstrual and menstrual phases, are associated with a decreased level of energy and / or a worse functioning of cognitive processes, being able to also establish an association between these and the menstrual phase (Guijarro et al., 2009). Pallavi et al. (2017) in a study carried out in the three phases of the menstrual cycle with 100 healthy volunteers aged between 18-24 years, showed a higher rate of fatigue during FM, followed by FL and FF, attributed to the psychological component, since bleeding has a negative effect on their performance due to their preconceived anguish; and it can even be related to physical performance, since blood loss can reduce oxygen transport.

This study is not without limitations, the main ones being the small sample size and the absence of evaluation of hormonal changes depending on the phase of the menstrual cycle. An analysis of the concentrations of hormones related to performance in each of the phases of the menstrual cycle could help us to interpret the reasons for the absence of changes in performance as a function of the menstrual cycle. Finally, it is important to point out that there are aspects related to mood that can influence the slowdown of motor responses, so this aspect could be a future line of research.

Conclusions

Soccer players in training with a regular menstrual cycle did not show significant differences in muscle performance in speed and explosive strength of the lower body between the menstrual cycle phases, but in the subjective perception of well-being. Recording data on subjective perception of well-being through scales such as the Hooper Index can be a complementary instrument, which provides relevant information to the technical bodies of women's teams, when it comes to knowing the predisposition towards competition on the part of the players.

References

Arazi, H., Nasiri, S., & Eghbali, E. (2019). Is there a difference toward strength, muscular endurance, anaerobic power and hormonal changes between the three phase of the menstrual cycle of active girls? *Apunts Medicina de l'Esport, 54*(202), 65-72. doi:10.1016/j.apunts.2018.11.001

Atkinson G, & Nevill, A.M. (1998). Statistical methods for assessing measurement error (reliability) in variables relevant to sports medicine. *Sports Medicine, 26*(4), 217# 238. doi:10.2165/00007256-199826040-00002

Bangsbo, J., Mohr, M., & Krustrup, P. (2006). Physical and metabolic demands of training and match-play in the elite football player. *Journal of Sports Sciences, 24*(7), 665-674. doi:10.1080/02640410500482529

Bosco, C., Colli, R., Bonomi, R., von Duvillard, S.P., & Viru, A. (2000). Monitoring strength training: neuromuscular and hormonal profile. *Medicine and Science in Sports and Exercise, 32*(1), 202-208. doi:10.1097 / 00005768-200001000-00030

Bruinvels, G., Burden, R.J., McGregor, A.J., Ackerman K.E., Dooley, M., Richards T., et al. (2016). Sport, exercise and the menstrual cycle: where is the research? *British Journal of Sports Medicine, 51*(6). doi:10.1136 / bjsports-2016-096279.

Carling, C., Wright, C., Nelson, L. J., & Bradley, S. P. (2014). Comment on performance analysis in football: a critical review and implications for future research. *Journal of Sports Science, 32(*1), 2-7. doi:10.1080/02640414.2013.807352

Cockerill, I.M., Wormington, J.A., & Nevill, A.M. (1994). Menstrual-cycle effects on mood and perceptual-motor performance. *Journal of Psychosomatic Research, 38*(7), 763-771. doi:10.1016/0022-3999(94)90029-9.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences. Hillsdale, NJ: Lawrence Earlbaum Associates. doi: 10.4324/9780203771587.

Constantini, N.W., Dubnov, G., & Lebrun, C.M. (2005). The menstrual cycle and sport performance, *Clinical Sports Medicine, 24*(2), 51-82. doi:10.1016/j.csm.2005.01.003

Cronin, J.B., Green, J.P, Levin, G.T., Brughelli, M.E., & Frost, D.M. Effect of starting stance on initial sprint performance. Journal of Strength and Conditioning Research, 21(3), 990-1002. doi:10.1519/R-22536.1

Datson, N., Hulton, A., Andersson, H., Lewis, T., Weston, M., Drust, B., et al. (2014). Applied physiology of female soccer: an update. *Sports Medicine, 44*(9), 1225-1240. doi:10.1007/s40279-014-0199-1

Dokumacı, B, Hazır, T. (2019). Effects of the Menstrual Cycle on Running Economy: Oxygen Cost Versus Caloric Cost. *Research Quarterly for Exercise in Sport, 90*(3), 318#326. doi:10.1080/02701367.2019.1599800

FIFA. (2015). Women's Football. Background information.

Fridén, C., Hirschberg, A.L., & Saartok, T. (2003). Muscle strength and endurance do not significantly vary across 3 phases of the menstrual cycle in moderately active premenopausal women. *Clinical Journal of Sport Medicine, 13*(4), 238-241. doi:10.1097/00042752-200307000-00007

Giacomoni, M., Bernard, T., Gavarry, O., Altare, S., & Falgairette, G. (2000). Influence of the menstrual cycle phase and menstrual symptoms on maximal anaerobic performance. *Medicine and Science in Sports and Exercise, 32*(2), 486-492. doi:10.1097/00005768-200002000-00034

Gonzalo-Skok, O., Tous-Fajardo, J., Suarez-Arrones, L., Arjol-Serrano, J.L., Casajús, J.A., & Méndez-Villanueva, A. (2015). Validity of the V-cut Test for Young Basketball Players. *International Journal of Sports Medicine, 36*(11), 893-899. doi:10.1055/s-0035-1554635.

Guijarro, E., de la Vega, R. y del Valle, S. (2009). Ciclo menstrual, rendimiento y percepción del esfuerzo en jugadoras de fútbol de élite. *Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte*, 9(34), 96-104. ISSN: 1577-0354

Haugen, T. A., Tønnessen, E., & Seiler, S. (2012). Speed and countermovement-jump characteristics of elite female soccer players, 1995-2010. *International Journal of Sports Physiology and Performance, 7*(4), 340-349. doi:10.1123/ijspp.7.4.340

Hernández, D., Martín, V., Villa-del Bosque, M., & Sánchez-Sánchez, J. (2019). Efecto del entrenamiento de pretemporada sobre la condición física de futbolistas jóvenes: análisis por demarcaciones. *Revista Andaluza de Medicina del Deporte, 12*(4), 348-353. doi:10.33155/%20j.ramd.2019.06.003

Hooper, S. L., Mackinnon, L. T., Howard, A. L. F., Gordon, R. D., & Bachmann, A. W. (1995). Markers for monitoring overtraining and recovery. Medicine y Science in Sports y Exercise. 27(1), 106-112. PMID: 7898325

Janse de Jonge, X.A. (2003). Effects of the Menstrual Cycle on Exercise Performance. *Sports Medicine, 33*, 833–851. doi:10.2165/00007256-200333110-00004

Julian, R., Hecksteden, A., Fullagar, H. H., & Meyer, T. (2017). The effects of menstrual cycle phase on physical performance in female soccer players. *Plos One, 12*(3), 1-13. doi:10.1371 / journal. pone.0173951

Konovalova, E. (2013). El ciclo menstrual y el entrenamiento deportivo: una mirada al problema. *Revista U.D.C.A Actualidad & Divulgación Científica, 16*(2), 293-302. doi: 10.31910/rudca.v16.n2.2013.900

Krustrup, P., Mohr, M., Ellingsgaard, H., & Bangsbo, J. (2005). Physical demands during an elite female soccer game: Importance of training status. *Medicine and Science in Sports and Exercise, 37*(7), 1242-1248. doi:10.1249/01.mss.0000170062.73981.94

Lebrun, C.M. (1993). Effect of the different phases of the menstrual cycle and contraceptives on athletic performance. *Sports Medicine, 16*(6), 400–430. doi:10.2165/00007256-199316060-00005.

Lebrun, C.M., McKenzie, D.C., Prior, J.C., Taunton, J.E. (1995). Effects of menstrual cycle phase on athletic performance. *Medicine and Science in Sports and Exercise, 27*(3), 437–44. doi: 10.1249/00005768-199503000-00022.

León, C. (2000). Influencia del sexo en la práctica deportiva. Biología de la mujer deportista. *Arbor CLXV, 165*(650), 249-263. doi:10.3989/arbor.2000.i650.968

Logerstedt, D.S.; Snyder-Mackler, L.; Ritter, R.C.; Axe, M.J., y Godges, J.J. (2010). Knee stability and movement coordination impairments: knee ligament sprains. *Journal of Orthopaedic and Sports Physical Therapy, 40*(4), A1-A37. doi:10.2519/ jospt.2010.0303.

Martínez-Lagunas, V., Niessen, M., & Hartmann, U. (2014). Women's football: Player characteristics and demands of the game. *Journal of Sport and Health Science, 3*(4), 258-272. doi:10.1016/j.jshs.2014.10.001

Matsuda, T., Furuhata, T., Ogata, H., Kamemoto, K., Yamada, M., & Sakamaki-Sunaga, M. (2020). Effects of the Menstrual Cycle on Serum Carnitine and Endurance Performance of Women. *International Journal of Sports Medicine* (ahead of print). doi:10.1055/a-1088-5555

Middleton, L.E., & Wenger, H.A. (2006). Effects of menstrual phase on performance and recovery in intense intermittent activity. *European Journal of Applied Physiology, 96*(1), 53-58. doi:10.1007/s00421-005-0073-9

Oriol, P.A. (2006). La importancia de corrección de los estados psicológicos en el kickboxing femenino. *Educación Física Estudiantil, 6,* 43-51.

Oyón, P., Franco, L., Rubio, F.J., & Valero, A. (2016). Fútbol femenino categorías inferiores. Características antropométricas y fisiológicas. Evolución a lo largo de una temporada. *Archivos de Medicina del Deporte, 33*(1), 24-28. ID: ibc-152179

Pallavi, L. C., Souza, U. J. D., & Shivaprakash, G. (2017). Assessment of musculoskeletal strength and levels of fatigue during different phases of menstrual cycle in young adults. *Journal of Clinical and Diagnostic Research, 11*(2), CC11-CC13. doi: 10.7860/JCDR/2017/24316.9408

Paris, H.C., & Jakeman, P.M. (1987). The effects of menstruation upon repeated maximal print performance. *Journal of Sports Sciences, 1*, 78.

Rabbani, A., Clemente, F. M., Kargarfard, M., & Chamari, K. (2019). Match Fatigue Time-Course Assessment Over Four Days: Usefulness of the Hooper Index and Heart Rate Variability in Professional Soccer Players. *Frontiers in physiology,* 19(*10)*, 109. doi:10.3389/fphys.2019.00109.

Ramírez-Balas, A. (2014). *Efectos de las fases del ciclo menstrual sobre la condición física, parámetros fisiológicos y psicológicos en mujeres jóvenes moderadamente entrenadas*. Tesis Doctoral. Universidad de Extremadura, Extremadura.

Reina-Gómez, A. y Hernández-Mendo, A. (2012). Revisión de indicadores de rendimiento en fútbol. *Revista Iberoamericana de Ciencias de la Actividad Física y el Deporte, 1*(1), 1-14. doi:10.24310/riccafd.2012.v1i1.1990

Romero-Moraleda, B., Del Coso, J., Gutiérrez-Hellín, J., Ruíz-Moreno, C., Grgic, J., & Lara, B. (2019). The Influence of the Menstrual Cycle on Muscle Strength and Power Performance. *Journal of Human Kinetics, 68*(1), 123-133. doi:10.2478/hukin-2019-0061

Romero-Parra, N., Barba-Moreno, L., Rael, B., Alfaro-Magallanes, V. M., Cupeiro, R., Díaz, Á. E., Calderón, F. J.,

& Peinado, A. B. (2020). Influence of the Menstrual Cycle on Blood Markers of Muscle Damage and Inflammation Following Eccentric Exercise. *International journal of environmental research and public health, 17*(5), 1618. doi: 10.3390/ijerph17051618

Seoane-Prado, A. (2013). Influence of menstrual cycle in synchronized swimming flexibility. *AGON, International Journal of Sport Sciences, 3*(2), 53-59. ISSN: 2254-2132

Somboonwong, J., Chutimakul, L., & Sanguanrungsirikul, S. (2015). Core temperature changes and sprint performance of elite female soccer players after a 15-minute warm-up in a hot-humid environment. *Journal of Strength and Conditioning Research, 29*(1), 262-269. doi:10.1097/JSC.0000000000000235.

Strauss, A., Sparks, M., & Pienaar, C. (2019). The Use of GPS Analysis to Quantify the Internal and External Match Demands of Semi-Elite Level Female Soccer Players during a Tournament. *Journal of sports science & medicine, 18*(1), 73–81. PMID: 30787654

Troule, S. & Casamichana, D. (2016). Application of functional test to the detection of asymmetries in soccer players. *Journal of Sport and Health Research. 8*(1), 53-64. ISSN: 1989-6239

Tsampoukos, A., Peckham, E. A., James, R., & Nevill, M. E. (2010). Effect of menstrual cycle phase on sprinting performance. *European Journal of Applied Physiology, 109*(4), 659-667. doi:10.1007/s00421-010-1384-z

Upton, D.E., & Ross, J.W. (2011). Assisted and Resisted Sprint Training: Effects on 13.7 M Speed, Speed with Direction Change, and Peak Power in Division I Female Soccer Athletes. *Journal of Strength and Conditioning Research*, 25, 83-84. doi:10.1097/01.JSC.0000395712.68999.f1

Villa-del Bosque, M. (2016). Influencia del ciclo menstrual en la capacidad anaeróbica en el fútbol femenino. *Papeles Salmantinos de Educación, 20*, 49-67.

Wiecek, M., Szymura, J., Maciejczyk, M., Cempla, J., & Szygula, Z. (2016). Effect of sex and menstrual cycle in women on starting speed, anaerobic endurance and muscle power. *Acta Physiologica Hungarica, 103*(1), 127-132. doi:10.1556/036.103.2016.1.13

Yap, C.W. (2000). Development of speed, agility, and quickness for the female soccer athlete. *Strength and Conditioning Journal, 22*, 1-9. doi:0.1519/1533-4295

Acknowledgment

The authors thank the Club Deportivo Salamanca Femenino (Salamanca, Spain) for their collaboration in conducting this study. In addition, we thank all the athletes who volunteered to participate in the study and those who collaborated with the data collection.