Title: Self-reported menstrual health, symptomatology and perceived effects of the menstrual cycle for elite junior and senior football players.

Purpose: To describe the self-reported menstrual health, symptomatology and perceived effects of the menstrual cycle on athletic performance for national and international Australian football (soccer) players. **Methods:** Players from national and domestic teams were invited to complete an online questionnaire regarding menstrual health, hormonal contraceptive (HC) use, negative symptomatology and perceived disruption of the menstrual cycle to performance. Descriptive statistics and binomial regressions with Odds Ratios (OR) were used to report the relationship of menstrual-related variables with perceived performance disruption. **Results:** 199 players (20.9±5.1y) completed the questionnaire, with 18% of players reported using HCs.1 primary amenorrhea case was detected, whilst 26% of players reported menarche age ≥15y. For non-HC users, prevalence of secondary amenorrhea was 2%, oligomenorrhea 19% and heavy menstrual bleeding 11% . 97% of players reported experiencing physical or affective menstrual symptoms (5±1.3/player). 40% of all players reported menstrual symptoms impacted their ability to work, study, train or compete. Further, 40% of players perceived their training or performance to be disrupted by the menstrual cycle. Increasing number of menstrual symptoms (OR=1.43; 95% CI 1.28-1.62; $p<0.001$), heavy menstrual bleeding (OR=12.73; 95% CI 3.4-82.8; $p<0.001$) and pelvic pain (OR=3.40; 95% CI 1.7-7.2; $p<0.001$) increased the likelihood of perceiving the menstrual cycle to disrupt performance. **Conclusion:** Heavy menstrual bleeding prevalence and HC use was low amongst this cohort of national and international footballers, whilst amenorrhea and oligomenorrhoea were comparable to other football populations. Nearly all players reported menstrual symptoms, and increased symptomatology was associated with greater perceived effects on performance.

Key words: females, women's soccer, hormonal contraceptives, menstrual symptoms, performance

Introduction

The menstrual cycle is highly individual, with inter- and intra-variability in cycle length, phase durations, bleeding patterns, symptoms and conditions[1,2]. Given the extensive training and match schedules of professional football (soccer), players may be in any menstrual phase for any given training or match, and still be expected to perform. Improved understanding of menstrual health, symptomatology and perceptions of how the menstrual cycle affects training and performance is needed to provide support for players. For example, menstrual abnormalities such as oligomenorrhea and amenorrhea are frequently experienced by exercising women[3], however the prevalence of other menstrual abnormalities, such as heavy menstrual bleeding (HMB), also referred to as menorrhagia, remains relatively unknown in athletic populations. Further, menstrual symptoms (e.g., cramps and mood changes) are also commonly experienced, though menstrual symptomatology in relation to athletic performance remains equivocal. Moreover, the number of athletes who perceive a negative impact of the menstrual cycle on performance varies between studies[4], likely due to contextual and methodological differences to capture the athlete's experiences. At present, the menstrual health and perceived effects of the menstrual cycle of elite football players in Australia remains unknown, and warrants an understanding given the potential negative effect of the menstrual cycle on athlete health, wellbeing and performance.

Menstrual abnormalities cover a broad array of conditions, of which oligomenorrhea, amenorrhea and HMB are classified as abnormal uterine bleeding[5]. Oligomenorrhea and amenorrhea, associated with bleeding frequency, can be a consequence of low energy availability (LEA) and/or stress, resulting in functional-hypothalamic-amenorrhea[6]. Athletes experiencing functional-hypothalamic-amenorrhea are at increased risk of bone stress injuries, reduced training adaptations and many other negative health and performance consequences[7]. Often athletes are unaware of therisks that prolonged cycles and absence of menstruation incur, especially given the normalisation of amenorrhea in such populations[8]. In Australia, 9% of recreational to national-level athletes (primarily team and individual land-based sports) reported not having periods, and a further 17% reported irregular periods[9], though reports for football in Australia remain scant. Further, HMB as related to menstrual flow and duration, can result in iron deficiency, anaemia and reduced endurance performance[10], as well as decreased athlete wellbeing[11]. For example, of 33 elite runners with HMB, 67% self-reported a negative effect on their performance, whilst only 42% sought medical help[10]. Given the impact of menstrual dysfunction on athlete health and performance, understanding the prevalence of these conditions in footballers may help guide education strategies.

Menstrual-related symptoms are common, with 74-93% of athletes reporting predominantly negative perceptions of symptoms [9,12-14]. The most common physical symptom amongst athletes is abdominal cramping, whilst psychological symptoms, such mood changes and anxiety are also prevalent[4]. Symptoms frequently occur during the premenstrual and menstrual phases, often associated with progesterone withdrawal[1].This is supported by professional footballers reporting symptoms in the first few days of (59%), and lead up to (17%), menstruation[12]. Physical symptoms are reported as the greatest menstrual related barrier to playing football for amateur footballers[15], whilst 4-13% of players in the English women's professional league reported missing training or matches due to high symptom severity[12,16]. Further, athletes reporting ≥three symptoms are twice as likely to report their performance being affected by their menstrual cycle[13]. Despite the high occurrence and severity of menstrual symptoms, research surrounding menstrual symptoms influence on training and performance is lacking[1].

Athletes often report the menstrual cycle to negatively impact their training and/or performance, though perceptions are mixed. For example, 100% (n=10) of interviewed Women's Super League[16], and 29% (n=12) of surveyed South African national team[17] footballers reported a negative effect. Such findings reveal contextual and methodological differences, necessitating research amongst additional football populations. Of those reporting a negative effect, menstruation, or just prior to menstruation, are perceived as the most disruptive phases[9,16]. This is perhaps unsurprising given the aforementioned prevalence of negative symptoms experienced by athletes. Further, a systematic review and meta-analysis found exercise performance may be trivially reduced during the early follicular phase (menstruation), though the studies were primarily rated as low quality and large variability existed between study findings[18]. In fact, some athletes utilise hormonal contraceptives (HC) to control their cycle to avoid menstruating during competition, amongst various other uses[13]. Prevalence of HC use amongst footballers differs between studies (10% South African[17] vs 28% Women's Super League players)[12] as might the reasons for and types of HCs, potentially highlighting sociocultural differences. Understanding athlete's perceived impact of the menstrual cycle and HC use will aid player care within their specific sporting environments.

To help optimise the health and performance of female football players, specific female considerations, such as the menstrual cycle, require attention. The aim of this study was to describe the 1) menstrual health, 2) menstrual symptomatology and 3) perceived effects of the menstrual cycle for elite football players in Australia.

Methods

Participants

International and national female football players from a Federation's national teams (youth and senior, Tier 3 and 4[20]) and domestic first tier professional league (Tier 3[20]) were invited to participate in the study. A total of 199 players (age 20.9 ± 5.1 years [13-42 years]) from the national teams (n= 127, 19.5 ± 4.5 years) and domestic league (n=72, 23.4 ± 5.3 years) completed the questionnaire (Figure 1).

Methodology

Players in the national team were asked by support staff to complete a menstrual health questionnaire on the National Federation's athlete management system phone application (Smartabase, Fusion Sport, Brisbane, Australia) whilst in camp every three months between March 2022 and February 2023. The data was identifiable by the national team's sports medicine staff only for screening purposes, though was de-identified prior to downloading for the research. For players with multiple responses, only their first response was included in the dataset (Figure 1). The questionnaire was re-created on Jotform (San Francisco, United States) and an online weblink was sent by the research team to the domestic league doctors and high-performance staff to share with their players to anonymously complete during the 2022/23 season. All domestic league player responses were downloaded and merged with the national team dataset. Due to the potential cross-over between players in the national teams and domestic league, repeated responses (responses from the same individual) were identified and removed based on club, age and age of menarche (Figure 1). Ethical approval was provided by the institutional Human Research Ethics Committee (ETH22-7624).

INSERT FIGURE 1 ABOUT HERE

Menstrual health questionnaire

The menstrual health questionnaire was developed based on previous questionnaires [9,21-23] and in consultation with the Federation's national team doctors given no validated questionnaire existed. The questionnaire included 4 sections as follows [number of answers available]:
(1) Age (open ended), first period (yes/no).
(2) Age of menarche, diagnosed menstrual conditions (multiple-choice [7]) and negative menstrual symptoms (multiple-choice [18])[21], HC use (yes/no).
(3a) HC type (single-choice [6]), duration of use (open ended), reason for use (multiple-choice [10]) and side effects (yes/no, and open ended).
(3b) Timing of last period (single-choice [3]), menstrual cycle length (open ended), duration (open ended), HMB (multiple-choice [4]), intermenstrual spotting (yes/no).
(4) Perceived disruption of the menstrual cycle to training and performance (yes/no), timing of perceived disruption (multiple-choice [4]), aspects of performance disrupted (multiple-choice[9]).
Sections 3a and 3b pertained to the previous 3 months, whilst no time-period was specified for the remaining questions.

The survey was setup with logic to ensure players answered relevant questions only. Section (1) of the questionnaire was used to detect primary amenorrhea. All players who answered *Yes* to having had a first period were directed to section (2) of the questionnaire. At the end of section (2), players were asked about HC use in the previous three months, as up to three months is required to re-establish eumenorrhea/a regular cycle following HC-use[2]. Players who answered *Yes* to HC use in the previous three months were directed to section (3a), and those who answered *No* were directed to section (3b). Section (3b) commenced by asking when a player's last period was (<3 months ago, 4-5 months ago, >6 months ago), where only those selected <3 months ago completed the remaining questions in section (3b). All players, except those identified as having primary amenorrhea in section 1, finished the questionnaire by completing section 4.

Questionnaire completion was 100% i.e., no questions were left unanswered by any players. However, invalid responses were received for some open-ended questions, and removed prior to analysis. For example, players were asked their average menstrual cycle length in days (from the start of 1 period until the day before the start of the next), and any response <14 was deemed invalid ie. players reporting in weeks.

In reporting menstrual dysfunction outcomes, it is noted the terminology and definitions that currently exist vary within the literature[4]. The following terminology was used based on the Australian Institute of Sport and American College of Obstetricians and Gynecologists[5]:

- Primary amenorrhea: no period by age 15.
- Secondary amenorrhea: absence of menstruation for three months or more.
- Oligomenorrhea: irregular cycles and menstrual cycle length >35 days.
- HMB (menorrhagia): determined by experiencing two or more of the following[22] (1) pass large blood clots, (2) flood through clothes, (3) bleeding more than 7 days, (4) changing of sanitary items (tampons or pads) every 2 h or 12 sanitary items per day.
- Intermenstrual bleeding (metrorrhagia): spotting between periods.

Statistical Analysis

Data were imported into R Statistical Software (R Core Team 2020) for analysesTo test the effect of HC use on number of symptoms whilst controlling for age a Poisson regression was performed with HC use and age as fixed effects. Overdispersion was detected, thus a quassi-

poisson regression was performed. Normality was checked by via residuals plot. To determine the influence of age, HC use, menstruating days, HMB, intermenstrual spotting, endometriosis, pelvic pain and number of symptoms on perceived training and performance disruption, binomial regressions were performed using the glm function with a binomial family. Linearity of logit was tested for binomial regressions with continuous independent factors by visually inspecting partial residual plots using the crPlots function. To determine the combined effect of individual factors found to have a significant effect on performance disruption, a binomial regression was performed and variation inflation factor (<2.5)[24] checked to ensure no multicollinearity between variables. Linearity of logit was not performed on this regression due to inclusion of categorical fixed effects. Significance was set at $p<0.05$ and 95% confidence intervals were determined for all regression models. Binary data are presented as frequencies and percentages. Count data are presented as means (± standard deviations) for normally distributed data, and medians (interquartile range) for non-normally distributed data, with ranges.

Results

Menstrual characteristics and abnormalities

Table 1 shows the menstrual characteristics of, and menstrual abnormalities experienced by, all players including HC and non-HC users.

INSERT TABLE 1 ABOUT HERE

Menstrual symptomatology

One or more negative menstrual symptom(s) was experienced by 97% (192/198) of players (Figure 2), with no difference between HC and non-HC users ($p=0.919$). Pelvic pain was the most frequently selected symptom (71%, 141/198), followed by mood changes/anxiety (58%, 114/1198) and tiredness/fatigue (56%, 110/198). Forty one percent of players (81/198) experienced pelvic pain every cycle and 30% of players (60/198) some cycles. The median number of symptoms experienced per player was 5 [IQR 3-7], ranging from 0 to 18. Of the 192 players who reported a menstrual symptom, 40% (76/192) reported these symptom(s) interfered with their general ability to work, study, training and/or compete.

INSERT FIGURE 2 ABOUT HERE

Performance disruption

Forty percent of players (79/198) perceived their training and performance to be disrupted by their menstrual cycle. Figure3 shows the timing and aspects of perceived performance disruption . Players most frequently reported “whilst menstruating” as the time of perceived disruption to training and performance (89%, 70/79). Of those who perceived the menstrual cycle to disrupt training and performance, 87% (69/79) reported reduced energy levels as an aspect of performance disruption. Player age, HC use, menstruating days, intermenstrual spotting, and self-reported endometriosis did not affect *perceived training and performance disruption* ($p>0.05$). *Number of symptoms* (OR=1.43; CI 1.28-1.62; $p<0.001$), *pelvic pain* (OR=3.40; CI 1.7-7.2; $p<0.001$) and *heavy menstrual bleeding* (OR=12.73; CI 3.4-82.8; $p<0.001$) all had a significant effect on *perceived training and performance disruption*. When the combined effect was assessed (*perceived training and performance disruption ~ number of symptoms + pelvic pain + heavy menstrual bleeding*), only number of symptoms had a significant effect ($p<0.001$).

INSERT FIGURE 3 ABOUT HERE

Discussion

This study describes the menstrual health, symptomatology and perceived effects of the menstrual cycle on performance for elite junior and senior footballers in Australia. The self-reported prevalence of HC use was relatively low, as was abnormal uterine bleeding Nearly all players experienced at least one menstrual symptom, and a strong association existed between the number of symptoms experienced and perception of the menstrual cycle disrupting performance. Currently, this is the largest menstrual health survey conducted in a single sport for elite athletes and practitioners can use this information to guide menstrual health screening, cycle monitoring and education-focussed strategies.

Hormonal contraceptives are frequently used by athletes to manage menstrual symptoms and period timing[15]. Similar to previous research, key reasons for HC use were reducing period pain, reducing heaviness of bleeding and controlling cycles (e.g., avoiding menstruation during competition), alongside contraception [13,25,26]. A systematic review and meta-analysis found oral contraceptives may slightly reduce exercise performance compared to non-use, although large variability and trivial effects existed across studies[27]. The benefits of menstrual cycle management may outweigh the negative trivial effects of HC use on performance, though HCs may also cause negative side-effects as reported by 30% of HC users in our study. Thus, an individualised approach to HC use is recommended[14,27]. A low prevalence rate of HC use was evident (18%), compared to professional footballers and Australian athletes (28-58%)[12-14,25,28], though higher than South African National Team footballers (10%)[17]. Differences may be attributed to the sport, sociocultural or geographical norms. Similar to other athletic populations[12,14,25,28], oral contraceptive pill was the most common HC type (80%) and combined pill (contains oestrogen and progesterone) was the most common form (75%). Understanding the reasons for HC use, side effects and type may help minimise negative effects and maximise positive effects of HCs amongst footballers.

A low number of self-reported primary amenorrhea (n=1) cases were detected, though 26% of players reported age of menarche ≥15y, suggesting an increased percentage of players previously experienced primary amenorrhea. The mean pooled prevalence of primary amenorrhea in athlete studies is 7%, with 0% reported amongst team sports, including football[4]. Similar proportions (23%) of elite Australian athletes from other football codes also reported age of menarche ≥15y[25]. Further, whilst menstrual cycle length (28 [27-30days]) for non-HC using players was within normal ranges (21-35 days), 19% of non-HC users reported irregular cycles or an average menstrual cycle length >35 days (oligomenorrhea) and 1.5% had secondary amenorrhea (n=3). The oligomenorrhea prevalence is similar to Australian athletes from other football codes (17%, 21/124)[9], UK professional footballers (15%, 8/54)[12], and Olympic and Paralympic athletes (23%, 46/195)[13]. Lower prevalence of secondary amenorrhea existed compared to UK professional players (8%, n=6)[12] though the prevalence of oligomenorrhea was higher (19% vs 11%), which may be attributed to the "snapshot" nature of questionnaires. Indeed whilst a few players reported having had their period in the previous 3 months, "irregular" was selected for menstrual length with comments such as "*sometimes 6 weeks sometimes 12 weeks*". Emphasising the importance of this knowledge is the fact that in athletes, oligomenorrhea and amenorrhea may be a sign and symptom of Relative Energy Deficiency in Sport, where problematic LEA places athletes at risk of many health and performance consequences[7]. The low prevalence of primary and secondary amenorrhea in this population is reassuring, perhaps demonstrating a reduced impact of these conditions in elite football populations compared to other athletic populations. Regardless of case numbers the severity of amenorrhea, and percentage of oligomenorrhea justifies

encouragement of menstrual monitoring and menstrual health education amongst football players.

Heavy menstrual bleeding, associated with increased menstrual flow volume and duration, is a uterine bleeding menstrual abnormality that may negatively impact athletes[22], and remains under-reported in research compared to oligomenorrhea and amenorrhea. The prevalence of HMB amongst non-HC users in our study (11%) was lower than other athletic populations (18-37%)[10,13,26], though differences in HMB definitions/classification criteria exist, and inclusion of HC users in some studies makes direct comparisons challenging. The criteria we used (see *Menstrual health questionnaire* section) was from a large European study[22], and in alignment with a previous athlete HMB study[10]. Had a less strict criteria (one HMB symptom instead of two) been employed, a higher HMB prevalence (41% vs 11%) would've been reported, highlighting the need for standardisation of HMB classification. Heavy menstrual bleeding may negatively affect performance, as perceived by 67% of elite runners with self-reported HMB[10]. For example, HMB is associated with fatigue-related symptoms[9], anaemia and iron deficiency[10]; all of which have been shown to reduce physical performance, particularly endurance performance [10]. Heavy flow can decrease time to exhaustion[29], though no studies of HMB effects on physical performance for athletes exist. Poorer mental quality of life and higher perceived stress[11] are also associated with HMB, stressing the negative impact on athlete wellbeing. Concerns about "flooding through" clothes and "wearing white shorts" can cause distraction and worry amongst athletes [30], adding to potential performance effects, though HMB effects were not assessed in our study. Given the potential negative effects of HMB on athlete psychophysiological health and performance, further research on its effects for football players would be beneficial.

Nearly all players (97%) reported experiencing one or more negative menstrual symptoms. A similar prevalence has been reported in Olympic and Paralympic athletes (93%)[13], though our results are higher than other Australian athletes (83%)[9] and UK professional league footballers (74%)[12], which may be attributed to the larger number of symptoms to select from here (18 vs 9)[12]. Most reported symptoms were pelvic pain (71%), mood changes/anxiety (58%), tiredness and fatigue (56%) and back / thigh pain (51%). The presence of physical, mental, and behavioural symptoms suggests that a multidisciplinary approach to symptom management may be required. We did not assess dysmenorrhea, which is painful menstruation primarily associated with pelvic pain[4]. Instead, we investigated the burden of all menstrual symptoms, given the debilitating nature of some menstrual symptoms not exclusive to pelvic pain, thus providing a holistic indicator of symptoms impact. Athletes may experience positive effects of the menstrual cycle[9], though we did not explore these which may be a limitation. Forty percent of players reported symptoms interfered with their ability to study, work or train/play. Whilst the intensity and frequency of symptoms was not surveyed, the average number of symptoms experienced (5 ±1.3/player) and reported interference to daily living (40%) provides an indication of menstrual symptom burden. As our study is cross-sectional, encouraging players to track symptoms (and severity) longitudinally may be beneficial for further education and management[10].

The menstrual cycle was perceived to disrupt training and performance by 40% of players. The percentage of players perceiving a negative effect of the menstrual cycle on training and performance is mixed in football populations (29-100%)[15-17], likely attributed to sociocultural and competition level differences. Methodological differences also existed between these studies (i.e., questionnaires vs interviews), and had smaller sample sizes (n=15-127) than our study (n=199). The perceived timing of effects is consistent between studies[9]; menstruation is

the most frequently perceived disruptive phase, followed by just prior to menstruation. This may be due to increased menstrual symptoms during these times, which is supported by a higher number of symptoms, including pelvic pain, being associated with an increased likelihood of perceived performance disruption in our study. Heavy menstrual bleeding was also associated with a perceived performance disruption, in alignment with previous elite athlete research[10] and providing further support for "whilst menstruating" being the most disruptive menstrual cycle phase. Similarities exist between our study and previous reports on aspects of performance disruption[16]. Physical impacts of the menstrual cycle on football performance are predominant, however psychological (concentration), tactical (decision making), skill (coordination) and recovery (soreness, ability to recovery) were selected by players within this study (Figure 3), though other perceived performance impacts could exist given a closed-ended question was implemented. Most research has focussed on menstrual phase effects on performance, associated with the idea that hormonal fluctuations affect physical capacities[18,19], though findings are equivocal[18], due to methodological and classification concerns. The mixed research outcomes and player perceptions, including aspects and timing of performance disrupted by the menstrual cycle, suggest an individualised approach to menstrual related management for players.

There are several limitations within this study. A partial response bias likely exists as completion was voluntary for domestic players, so those with menstrual health conditions, or who felt their menstrual cycle affected them, may have been more inclined to participate. In contrast, players without a period (i.e., amenorrhea) may not have deemed the survey relevant to them, thus the prevalence of primary and secondary amenorrhea could be higher. The questionnaire used was not validated, as no validated questionnaire existed and responses were susceptible to recall bias. Lastly, as discussed, large variability exists between studies limiting the generalisability of our findings, thus practitioners are encouraged to conduct their own menstrual health screening.

Practical applications

The low reported rates of primary and secondary amenorrhea should be encouraging for female football practitioners, though it is recognised this study provides a snapshot only. Simple questionnaires such as our own may be implemented to screen player menstrual health and performance effects. The high percentage of players with menstrual symptoms who reported symptom burden and the association between number of symptoms and perceived performance disruption warrants practitioner attention and action where appropriate. Additionally, the organisations involved in this study may use the results to create resources which target commonly reported symptoms.

Conclusion

The presence of severe menstrual dysfunction (amenorrhea) in this cohort was low, though a fifth of players were classified as oligomenorrheic. Similarly, the prevalence of HMB was low, though using a less strict criteria resulted in a much higher prevalence. Less than 20% of elite football players within Australia used HCs, and a third of these players experienced HC side effects. Nearly all players experienced menstrual symptoms, with 40% of players lives negatively affected by these symptoms. Lastly, 40% of the surveyed players perceived the menstrual cycle to disrupt their ability to train and perform.

Acknowledgement

The authors thank the players for completing the questionnaire.

Conflicts of interest

The authors are all employed by the federation and domestic league involved in this study though declare no conflict of interest relevant to this study.

References

1. Bruinvels G, Hackney AC, Pedlar CR. Menstrual Cycle: The Importance of Both the Phases and the Transitions Between Phases on Training and Performance. *Sports Med*. Jul 2022;52(7):1457-1460. doi:10.1007/s40279-022-01691-2
2. Elliott-Sale KJ, Minahan CL, de Jonge X, et al. Methodological Considerations for Studies in Sport and Exercise Science with Women as Participants: A Working Guide for Standards of Practice for Research on Women. *Sports Med*. May 2021;51(5):843-861. doi:10.1007/s40279-021-01435-8
3. De Souza MJ, Toombs RJ, Scheid JL, O'Donnell E, West SL, Williams NI. High prevalence of subtle and severe menstrual disturbances in exercising women: confirmation using daily hormone measures. *Human Reproduction*. 2009;25(2):491-503. doi:10.1093/humrep/dep411
4. Taim BC, C OC, Renard M, Elliott-Sale KJ, Madigan S, Ni Cheilleachair N. The Prevalence of Menstrual Cycle Disorders and Menstrual Cycle-Related Symptoms in Female Athletes: A Systematic Literature Review. *Sports Med*. Oct 2023;53(10):1963-1984. doi:10.1007/s40279-023-01871-8
5. Practice bulletin no. 128: diagnosis of abnormal uterine bleeding in reproductive-aged women. *Obstet Gynecol*. Jul 2012;120(1):197-206. doi:10.1097/AOG.0b013e318262e320
6. Gordon CM, Ackerman KE, Berga SL, et al. Functional Hypothalamic Amenorrhea: An Endocrine Society Clinical Practice Guideline. *The Journal of Clinical Endocrinology & Metabolism*. 2017;102(5):1413-1439. doi:10.1210/jc.2017-00131
7. Mountjoy M, Ackerman KE, Bailey DM, et al. 2023 International Olympic Committee's (IOC) consensus statement on Relative Energy Deficiency in Sport (REDs). *Br J Sports Med*. Sep 2023;57(17):1073-1097. doi:10.1136/bjsports-2023-106994
8. Verhoef SJ, Wielink MC, Achterberg EA, Bongers MY, Goossens SMTA. Absence of menstruation in female athletes: why they do not seek help. *BMC Sports Science, Medicine and Rehabilitation*. 2021/11/23 2021;13(1):146. doi:10.1186/s13102-021-00372-3
9. Armour M, Parry KA, Steel K, Smith CA. Australian female athlete perceptions of the challenges associated with training and competing when menstrual symptoms are present. *International Journal of Sports Science & Coaching*. 2020/06/01 2020;15(3):316-323. doi:10.1177/1747954120916073
10. Bruinvels G, Burden R, Brown N, Richards T, Pedlar C. The Prevalence and Impact of Heavy Menstrual Bleeding (Menorrhagia) in Elite and Non-Elite Athletes. *PLOS ONE*. 2016;11(2):e0149881. doi:10.1371/journal.pone.0149881
11. Vannuccini S, Fondelli F, Clemenza S, Galanti G, Petraglia F. Dysmenorrhea and Heavy Menstrual Bleeding in Elite Female Athletes: Quality of Life and Perceived Stress. *Reprod Sci*. Mar 2020;27(3):888-894. doi:10.1007/s43032-019-00092-7
12. Parker LJ, Elliott-Sale KJ, Hannon MP, Morton JP, Close GL. An audit of hormonal contraceptive use in Women's Super League soccer players; implications on symptomology. *Sci Med Footb*. 2022/04/03 2022;6(2):153-158. doi:10.1080/24733938.2021.1921248
13. McNamara A, Harris R, Minahan C. 'That time of the month' … for the biggest event of your career! Perception of menstrual cycle on performance of Australian athletes training for the 2020 Olympic and Paralympic Games. *BMJ Open Sport & Exercise Medicine*. 2022;8(2):e001300. doi:10.1136/bmjsem-2021-001300

14. Martin D, Sale C, Cooper SB, Elliott-Sale KJ. Period Prevalence and Perceived Side Effects of Hormonal Contraceptive Use and the Menstrual Cycle in Elite Athletes. *Int J Sports Physiol Perform*. Aug 1 2018;13(7):926-932. doi:10.1123/ijspp.2017-0330
15. Pinel CJJ, Mehta R, Okholm Kryger K. The impact and experienced barriers menstruation present to football participation in amateur female footballers. *J Sports Sci*. Sep 13 2022:1-14. doi:10.1080/02640414.2022.2122328
16. Read P, Mehta R, Rosenbloom C, Jobson E, Okholm Kryger K. Elite female football players' perception of the impact of their menstrual cycle stages on their football performance. A semi-structured interview-based study. *Sci Med Footb*. 2021:1-10. doi:10.1080/24733938.2021.2020330
17. Mkumbuzi NS, Dlamini SB, Chibhabha F, Govere FM, Manda-Taylor L. The menstrual cycle and football: The experiences of female African football players. *Sci Med Footb*. 2021;doi:10.1080/24733938.2021.2005252
18. McNulty KL, Elliott-Sale KJ, Dolan E, et al. The Effects of Menstrual Cycle Phase on Exercise Performance in Eumenorrheic Women: A Systematic Review and Meta-Analysis. *Sports Med*. Oct 2020;50(10):1813-1827. doi:10.1007/s40279-020-01319-3
19. Bernstein C, Behringer M. Mechanisms Underlying Menstrual Cycle Effects on Exercise Performance: A Scoping Review. *Women in Sport and Physical Activity Journal*. 04/26 2023;doi:10.1123/wspaj.2022-0026
20. McKay AKA, Stellingwerff T, Smith ES, et al. Defining Training and Performance Caliber: A Participant Classification Framework. *Int J Sports Physiol Perform*. Feb 1 2022;17(2):317-331. doi:10.1123/ijspp.2021-0451
21. Bruinvels G, Goldsmith E, Blagrove R, et al. Prevalence and frequency of menstrual cycle symptoms are associated with availability to train and compete: a study of 6812 exercising women recruited using the Strava exercise app. *Br J Sports Med*. Apr 2021;55(8):438-443. doi:10.1136/bjsports-2020-102792
22. Fraser IS, Mansour D, Breymann C, Hoffman C, Mezzacasa A, Petraglia F. Prevalence of heavy menstrual bleeding and experiences of affected women in a European patient survey. *International Journal of Gynecology & Obstetrics*. 2015;128(3):196-200. doi:https://doi.org/10.1016/j.ijgo.2014.09.027
23. Nnoaham KE, Sivananthan S, Hummelshoj L, et al. MULTI-CENTRE STUDIES OF THE GLOBAL IMPACT OF ENDOMETRIOSIS AND THE PREDICTIVE VALUE OF ASSOCIATED SYMPTOMS. *J Endometr*. 2009;1(1):36-45.
24. Menard S. Applied Logistic Regression Analysis (Quantitative Applications in the Social Sciences). 2nd ed. SAGE Publications, Inc.; 1995. https://methods.sagepub.com/book/applied-logistic-regression-analysis
25. Clarke AC, Bruinvels G, Julian R, Inge P, Pedlar CR, Govus AD. Hormonal Contraceptive Use in Football Codes in Australia. Original Research. *Front Sports Act Living*. 2021-February-25 2021;3doi:10.3389/fspor.2021.634866
26. Oxfeldt M, Dalgaard LB, Jørgensen AA, Hansen M. Hormonal Contraceptive Use, Menstrual Dysfunctions, and Self-Reported Side Effects in Elite Athletes in Denmark. *Int J Sports Physiol Perform*. Sep 21 2020;15(10):1377-1384. doi:10.1123/ijspp.2019-0636
27. Elliott-Sale KJ, McNulty KL, Ansdell P, et al. The Effects of Oral Contraceptives on Exercise Performance in Women: A Systematic Review and Meta-analysis. *Sports Med*. Oct 2020;50(10):1785-1812. doi:10.1007/s40279-020-01317-5

28. Larsen B, Morris K, Quinn K, Osborne M, Minahan C. Practice does not make perfect: A brief view of athletes' knowledge on the menstrual cycle and oral contraceptives. *J Sci Med Sport*. Aug 2020;23(8):690-694. doi:10.1016/j.jsams.2020.02.003
29. de Carvalho G, Papoti M, Rodrigues MCD, Foresti YF, de Oliveira Guirro EC, de Jesus Guirro RR. Interaction predictors of self-perception menstrual symptoms and influence of the menstrual cycle on physical performance of physically active women. *Eur J Appl Physiol*. Mar 2023;123(3):601-607. doi:10.1007/s00421-022-05086-z
30. Findlay RJ, Macrae EHR, Whyte IY, Easton C, Forrest Nee Whyte LJ. How the menstrual cycle and menstruation affect sporting performance: experiences and perceptions of elite female rugby players. *Br J Sports Med*. Sep 2020;54(18):1108-1113. doi:10.1136/bjsports-2019-101486

Table captions

Table 1: Menstrual characteristics, abnormalities and menstrual related conditions for hormonal and non-hormonal contraceptive users

Figure captions

Figure 1: Flow chart of total and included questionnaire responses.

Figure 2: Self-reported menstrual symptoms. % calculated from number of players who selected 1 or more symptom (n=192). All symptoms listed in the questionnaire are included in the figure.
Non-HC users = non-hormonal contraceptive users; HC users = hormonal contraceptive users

Figure 3: Perceived (A) timing and (B) aspects of performance disrupted by the menstrual cycle. % calculated from number of players who perceive disruption to training or performance (n=79).
Non-HC users = non-hormonal contraceptive users; HC users = hormonal contraceptive users