

Australian female athlete perceptions of the challenges associated with training and competing when menstrual symptoms are present

Mike Armour^{1,2}, Kelly A Parry^{1,3}, Kylie Steel⁴  and Caroline A Smith^{1,2}

International Journal of Sports Science & Coaching
2020, Vol. 15(3) 316–323
© The Author(s) 2020
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/1747954120916073
journals.sagepub.com/home/spo


Abstract

Coaches consider various competencies (e.g. conditioning, nutrition, skills and tactics), when planning sessions, though rarely the impact of menstruation on the efficacy of training and competition performance for athletes. Given the impact menstrual symptoms can have on athletes, the management strategies that athletes may use to minimise any potential impact, and the mechanisms that provide barriers to greater coach athlete interaction require investigation and consideration. Therefore, this study aimed to investigate the strategies used by athletes to manage menstrual symptoms and the role coaches played in this process. An anonymous, 36-item questionnaire was developed and hosted on Qualtrics. Descriptive statistics and Chi-square statistics were used to analyse the data. One hundred and twenty-four valid responses from Australian athletes 16–45, with a mean age of 29 years, were received. Period pain (82%) and pre-menstrual symptoms (83%) were commonly reported and contributed to fatigue and to perceived reductions in performance during or just prior to the period (50.0% in training, 58.7% on 'game day'). Contraceptive use was reported by 42% of athletes. Those reporting heavy menstrual bleeding (29.7%) were more likely to report increased fatigue (relative risk 1.6, 95% CI 1.07 to 2.32). Over three-quarters of athletes reported neither they nor their coaches altered training due to the menstrual cycle. Most athletes (76%) did not discuss menstruation with their coaches. Given the perceived negative impact on performance and potential risks with contraceptive usage during adolescence, coaches, trainers and athletes need to have a more open dialogue around the menstrual cycle.

Keywords

Coaching, competition, dysmenorrhea, pre-menstrual syndrome, sport, training

Primary dysmenorrhea (period pain) affects approximately three-quarters of all women during their reproductive life, and is especially common in young women, with around 90% of Australian adolescents experiencing menstrual pain^{1,2} and a worldwide prevalence of 71% in women under 25.³ Apart from pain, women with primary dysmenorrhea also very commonly suffer from other symptoms such as fatigue, bloating, gastrointestinal changes and lower back pain.^{4,5}

Despite the attention in the media around how tracking the menstrual cycle and modifying training based on this is an important factor in many recent high-profile sporting victories,^{6,7} previous self-reported surveys on menstruation and athletic performance are inconclusive on the impact of menstruation,⁸ and we know little about how prevalent modifying training throughout the menstrual cycle is.

The interaction between menstruation and physical activity is complex and changes during the menstrual

Reviewers: Jaunita Weissensteiner (New South Wales Department of Sport, Australia)
Julian Ross (University of Saarland, Germany)

¹NICM Health Research Institute, Western Sydney University, Sydney, Australia

²Translational Health Research Institute (THRI), Western Sydney University, Sydney, Australia

³Centre for Educational Research, Western Sydney University, Sydney, Australia

⁴The MARCS Institute/ School of Science and Health, Western Sydney University, Sydney, Australia

Corresponding author:

Mike Armour, Western Sydney University, Locked Bag 1797, Penrith South, New South Wales 2751, Australia.
Email: m.armour@westernsydney.edu.au

cycle. Many young women in the community report having to reduce or avoid sporting activities during their period itself.³ In contrast, exercise, regardless of intensity, performed three to four times per week throughout the month, may actually reduce period pain symptoms.⁹ There is also evidence to suggest that aspects of physical performance (e.g. endurance) vary across the menstrual cycle,¹⁰ and this may be due to changes in physiological, metabolic, thermoregulatory function that occur during different phases of the menstrual cycle.¹¹ Additionally, there appears to be an association between the phase of the menstrual cycle and likelihood of injury, including stress fractures¹² and anterior cruciate ligament ruptures.¹³ These factors have implications for athletes as it can remove a player from sport for extended periods of time.

Recommended first-line medical treatment for period pain is generally either non-steroidal anti-inflammatories (NSAIDs)¹⁴ or the oral contraceptive pill, especially if contraception is also desired.¹⁵ Most young women in the community manage their period pain with the use of analgesic medication, heat and rest, with contraceptive use being less common.¹⁶ However, these commonly used methods may not be suitable for athletes, as analgesics often do not provide complete pain relief¹⁶ which may impede training or competition, or in the case of heat and rest, may not be suitable or possible for athletes who need to train or perform on those days. While sports coaches are often concerned with the art and science of the pedagogical and planning aspects of learning new skills and tactics,^{17,18} they are generally not exposed to formalized training regarding the specific needs of female athletes related to the management and potential impact of menstruation. This is despite evidence that suggests that coaches who build and maintain supportive relationships with their athletes result in better athlete wellbeing.¹⁹ This is especially concerning given the paucity of female coaches in high performance settings²⁰ who may innately understand the athlete's gender specific needs.

Given the role of the menstrual cycle on reduction in performance and the potential for increased injury in athletes, there is a vital need to understand both how the menstrual cycle impacts athletes, and how they or their coaches/trainers try to mitigate any potentially negative impact.

This study aimed to examine athletes, coaches and trainers' management of the menstrual cycle and menstrual symptoms when competing or training and the impact they perceive it has on their performance. Potential barriers to discussion of menstruation and the menstrual cycle with coaches or trainers will also be explored. This information can be used to determine suitable approaches for coaches, trainers and female

athletes themselves to help minimise the impact (if any) of the menstrual cycle on women's performance.

Methods

Design

An anonymous, 36-item questionnaire was developed by the research team in conjunction with female athletes and senior academics at the New South Wales Institute of Sport (NSWIS). The survey was approved by the Western Sydney University Human Research Ethics Committee, approval number H12596 (approved April 2018). Data gathered from the survey included age, oral contraceptive usage, sources of information on menses, pain and other menstrual symptoms such as heavy bleeding, what parts of training or competition are affected by menstrual symptoms, modification of training based on menses. A copy of the survey tool can be found in the Supplementary Appendix A. In addition, respondents were asked who they talked to regarding their menstruation. The survey tool was piloted with five young women and minor edits were made to the survey wording based on their feedback. The final version was hosted on the Qualtrics platform (Qualtrics Ltd). A cross-sectional online survey was used due to the wide geographical reach required to ensure that respondents from various parts of Australia would be able to be involved. This was the first phase of a two-phase mixed methods study, where respondents in the survey were invited to participate in a series of focus groups, data for which will be published separately.

Subjects

Recruitment was undertaken via advertisements on social media platforms such as Twitter, Facebook and Instagram, in addition to study information being disseminated via email using the authors professional networks including the staff at the New South Wales Institute of Sport, professional clubs associated with Cricket, Australian Rules football and Netball, and coaches associated with multi-level athletes in athletics, rowing, soccer and water-polo throughout Australia. This anonymous survey took respondents approximately 15–20 min to complete and the survey link was active between May and July 2018. Any potentially identifying data in the responses were removed to protect participant confidentiality.

Inclusion and exclusion criteria

People were eligible to participate in this survey if they were currently living in Australia, aged between 16 and

45, had at least one menstrual period, and be an 'Athlete' according to the study definition:

An athlete is someone who engages in strenuous and specialised training for the purpose of **competition** against other peers in the same sport. If you play a team sport the competition would need to be at club level or above.

The criteria for at least one menstrual period was to allow those who were not currently menstruating, either due to amenorrhea or use of menstrual suppression (such as by the oral contraceptive pill) to participate. Respondents were not required to be having regular menstrual periods at the time of the survey, so if there was menstrual suppression used (such as via the contraceptive pill), they could still participate. Team sport was considered at a competitive level where the competition needed to be at club level or above. Athletes, i.e. those who run to keep fit, or played football socially with friends in a park were not considered athletes and thus not eligible for the study. However, those that undertook training for a specific goal that involved competition, even if this was at a local level, e.g. a half-marathon or did CrossFit to compete with other CrossFit athletes were deemed eligible respondents and were designated as recreational athletes. All respondents were also required to be currently competing in their chosen sport.

Statistical analysis

A sample size of a minimum of 100 respondents was calculated based on an estimate of there being approximately 10,000 athlete at a semi-professional or above level (it is unknown exactly how many female athletes there are in Australia), then at 95% confidence and with a 10% margin of error, then 96 respondents would be sufficient. As such, at least 100 athletes were considered to allow sufficient generalisability to the population of female Australian athletes.

Descriptive statistics were presented as **means and standard deviations (for normally distributed data), medians and interquartile ranges (for non-normally distributed data) or number and percentages (for categorical data)**. For **between-group comparisons, either Chi-square or Fishers exact tests were performed using GraphPad Prism version 8.3.0 for Mac (GraphPad Software, San Diego, California USA)**. For **comparisons between levels of expertise, those competing at state, national or international level were considered 'elite' athletes, while those competing at club level or recretionally were considered 'non-elite'**. **Relative risk was calculated from contingency tables.**²¹ Statistical significance was set at $p < 0.05$. Missing data were not replaced.

Results

Responses were collected from 143 respondents. One hundred and twenty-four valid responses were received and 19 respondents were excluded from the analyses; 18 respondents were excluded due to more than 50% of their questionnaire data missing and 1 participant was outside the age range for inclusion.

Overall age ranged from 16 to 45 years, with a **mean age at the time of the survey of 29 (± 7.3) years**. The mean age of menarche for respondents was 13.2 (± 1.81) years. The **most common sport or exercise participated in by the respondents included land-based team sports (43.6%) and land-based individual sport/fitness training (37.9%), with the majority of athletes performing at club level (29.8%) and training 4–7 h per week (41.1%)**. Table 1 outlines the **sporting and menstrual characteristics of the athletes**. The menstrual cycle was regular in most athletes (74.6%). Pre-menstrual symptoms (PMS) such as breast tenderness, headaches, mood swings were commonly (83.2%) reported. Athletes had moderate period pain, most commonly occurring every period, with a mean intensity of 5.3 (± 2.1) as measured by a 0–0 numeric rating scale (NRS). The majority of respondents (66.4%) experienced period pain on the first day of their period, while a minority (8.0%) experienced period pain throughout all of their period. A minority of athletes reported heavy menstrual bleeding (29.7%). **Those reporting heavy menstrual bleeding were more likely (relative risk (RR) = 1.6, 95% CI 1.07 to 2.32, $p = 0.035$) to report fatigue-related symptoms during their period compared to those with normal bleeding**. Twenty-four percent of all athletes reported a diagnosis of anaemia during their reproductive life and 18.8% of athletes were currently using iron supplements with 36.6% having used them at least once in the past. **There was no association between heavy menstrual bleeding and anaemia ($p = 0.79$)**, while those with a history of anaemia were much more likely to use iron supplements (88.2%) than those without (44.3%) ($p < 0.001$). **There was no difference in the prevalence of heavy menstrual bleeding ($p = 0.16$) or of anaemia ($p = 0.68$) between elite and non-elite athletes**.

Sixty-two percent of athletes indicated they engaged in a variety of pharmaceutical and hormonal strategies for menstrual management (Supplementary Table 1). Ibuprofen was the most common analgesic used (44.8%) and over a third of athletes reported using hormonal contraceptives (41.9%). Of those using hormonal contraception, over a third reported bothersome side effects (37.7%), most commonly changes in mood (42.8% of reported side effects). Doctors were the most common person who recommended the use of contraceptives (75.4%). The most common reasons reported

Table 1. Demographic and menstrual characteristics.

Training and sport specifications	<i>n</i> = 124	%
Hours of training per week		
1–3 h	19	15.3
4–7 h	51	41.1
8–12 h	35	28.2
12–20 h	14	11.3
20+ h	5	4.0
Primary sport/activity		
Team sport (land based)	54	43.6
Team sport (water based)	1	0.8
Individual sport/ fitness training (land based)	47	37.9
Individual sport/ fitness training (water based)	3	2.4
Combination	19	15.3
Competition level of sport/activity		
International	20	16.1
National	22	17.7
State	12	9.6
Club	37	29.8
Recreational (e.g. CrossFit, marathon running)	33	26.6
Menstrual cycle		
Regular cycle (21–35 days)	91	73.3
Having periods but not a regular cycle	21	16.9
Not having periods at all	11	8.8
Don't know	1	0.8
Period pain		
Yes, with every period	46	37.1
Yes, with most periods (two of the last three periods)	30	24.2
Yes occasionally (one of the last three periods)	26	21.0
No	22	17.7
Pain incidence ^a		
First day of my period	75	66.4
Just before my period starts	61	54.0
Second day of my period	39	34.5
All of my period	9	8.0
Third day of my period and beyond	4	3.5

^aMultiple responses allowed and may add to more than 100%.

for using hormonal contraceptives was for contraception itself (67.9%) and being able to skip or shift their period (52.8%). In athletes who reported skipping or shifting the period, this occurred regularly, with 46.4% skipping or moved their period most of the time (more than three times in the last six months). The most common reasons for skipping the period were convenience (22.2%) and reducing the impact on sporting events (18.5%). **There was no difference ($p = 0.85$) in the prevalence of use of contraceptives between elite versus non-elite athletes.**

The impact of the menstrual cycle on athlete performance is reported in Table 2. The majority of athletes

reported they or their coaches (77.2%) did not alter training during the different stages of the menstrual cycle. Half of the respondents (50.0%) perceived their training to be negatively affected by their menstrual cycle with marginally more respondents (56.5%) believing their performance on 'game day' or competition day to be negatively affected. **There was no difference between elite and non-elite athletes in terms of perceived negative impact either during training ($p = 0.10$) or on 'game day' ($p = 0.13$).** A minority of respondents reported that their training (6.4%) and performance on 'game day' (<1%) were positively affected by their menstrual cycle. Forty-three percent of the athletes did not notice any difference to their training, while 37.9% did not notice any difference in their performance on game day.

The most common problem encountered during training was feeling more easily fatigued and/or less endurance (70.9%). Similarly, the most common negative impacts reported on game day included energy levels being affected (71.4%) and feeling fatigued more easily (71.4%). Just under one in five athletes' (17.7%) indicated that other areas were affected during training, most commonly feeling distracted or unable to concentrate due to pain (72%). Most of the negative impact was identified as occurring either just prior to (36.3%) or during the period itself (78.8%). Being identified as menstruating was a common concern, with 40% reported concern that they might bleed through their clothes/uniform during training, with almost half of the athletes (49.2%) being worried about bleeding through on game day.

Only eight athletes indicated that aspects of their training were positively affected; four respondents felt stronger or could lift more weight, two felt they were faster in speed activities, one respondent felt like their concentration was better and another felt like their endurance was better.

The majority of respondents (76.3%) said they do not discuss their menstruation with their coach or trainer (Table 3). Only 17 respondents (13.7%) said that they would speak to the coach, trainer or anyone senior on their team. Gender did play a role in the reluctance to speak, with over a quarter of athletes (26.9%) indicating they did not think the coach would understand because they are male. Moreover, many of the athletes did not see the need to talk to their coach since they did not perceive their performance to be affected (26.96%).

Discussion

Most coaches focus on the more traditional art and science aspects of planning and programming in

Table 2. Impact of menstrual cycle on performance.

	<i>n</i>	%
Training affected	<i>n</i> = 124	
Yes – affected negatively	62	50.0
No – I don't notice any difference	54	43.5
Yes – affected positively	8	6.45
Part of cycle affects training ^a	<i>n</i> = 70	
During my period	58	78.8
The day or two before my period	26	36.25
The one to two weeks before my period	8	12.50
Other (please specify)	4	5.00
The week after my period finishes	2	3.75
Parts of training negatively affected ^a	<i>n</i> = 62	
I feel like I fatigue more easily / my endurance is less	44	70.96
My energy levels are different	43	69.35
I'm concerned that I might bleed through my clothes/uniform	22	35.48
I feel I'm not as strong / can't lift as much weight	19	30.64
I do not feel as fast in speed activities	17	27.41
Other (please specify)	11	17.74
I feel less coordinated or more clumsy	5	8.06
I feel vague or I am less able to concentrate on the coach's instructions or tactics during a game	9	14.5
I feel my vision is affected and things seem closer/ further away	1	1.61
Parts of training positively affected ^a	<i>n</i> = 8	
I feel stronger or can lift more weight	4	50
Other (please specify)	3	37.5
I feel like I'm faster in speed activities	2	25
I feel like my concentration is better or I'm able to concentrate better on tactics or coaches instructions	1	12.5
I feel like my endurance is better	1	12.5
Competition day affected	<i>n</i> = 124	
Yes – affected negatively	70	56.45
No – I don't notice any difference	47	37.90
Not applicable (I don't have a competition day)	6	4.83
Yes – affected positively	1	0.80
Parts of performance on competition day is negatively affected ^a	<i>n</i> = 70	
My energy levels are different	50	71.4
I feel like I fatigue more easily / my endurance is less	50	71.4
I'm concerned that I might bleed through my clothes/uniform	31	44.28
I do not feel as fast in speed activities	23	32.85
I feel I'm not as strong/can't lift as much weight	15	21.42
Other	4	5.71
I feel less coordinated or more clumsy	11	15.71
I just feel vague or I feel I am less able to concentrate on the coaches instructions or tactics during a game	10	14.28
I feel my vision is affected and things seem closer/ further away	3	4.28
Altering training during menstrual cycle	<i>n</i> = 123	
No – Neither I nor my coach does	95	77.24
Yes – I do	19	15.45
Yes – My trainer/coach and I plan it together	9	7.32

^aMultiple responses allowed and may add to more than 100%.**Table 3.** Discussion of menstruation.

	<i>n</i>	%
Speak to your coach, trainer or anyone senior on your team about your menstrual cycle	<i>n</i> = 124	
No	93	75
Yes	17	13.70
Not applicable (I don't have a coach or trainer)	14	11.29
Who do you talk to about menses?	<i>n</i> = 16	
I would/do tell any coach/trainer/manager	12	75
Only a female coach/trainer/manager	4	25
Why don't you speak to your coach about menses? ^a	<i>n</i> = 89	
Don't think they would understand because they are male	24	26.96
Didn't see the need to talk to their coach since their performance was not being affected	24	26.96
Don't think they would care	16	17.97
Embarrassed	15	16.85
Don't think they would care because they are male	14	15.73
Embarrassed because they are male	11	12.35
Don't think they would understand	8	8.98
No way to communicate with them easily or discreetly	5	5.61
It's non controllable, they just deal with it	5	5.61
It's not their concern	4	4.49
Perceive that they can't help	3	3.37
Do you speak to anyone else regarding menses	<i>n</i> = 123	
No	74	60.16
Yes	49	39.83

^aMultiple responses allowed and may add to more than 100%.

relation to fitness without consideration of female needs, in addition to strategies related to pedagogy, athlete management, nutrition and skill improvement.^{17,18} As a result, it is possible that female athletes do not engage in training that maximizes their potential, particularly when managing symptom related to their menstrual cycle despite the documented benefits of coaches addressing the wellbeing of their athletes regardless of gender.¹⁸

Menstrual pain and other bothersome secondary symptoms such as breast tenderness, headaches and mood swings were common amongst Australian athletes, with at least half of all athletes reporting a negative impact on performance either during training or during competition. Despite this, very few athletes or coaches altered their training to accommodate these changes and less than half used menstrual suppression to mitigate potential negative impact from menstruation.

There have been a small number of clinical studies conducted on athletes with eumenorrheic cycles. In

these women, the effect of the menstrual cycle on anaerobic performance²² appears to be minimal, while evidence on endurance appears to be equivocal, with one study showing endurance negatively affected during the luteal phase,¹⁰ while another showed no change in endurance.²³ In contrast, athletes in our study commonly reported perceived reductions in performance, especially increased **fatigue and decreased endurance**, in addition to **reductions in strength, speed and agility**. These factors are important for an athlete's performance, as an inability to execute skills and act on tactical decisions because of fatigue can result in reduced levels of performance which translates to the entire team or squad, not just the individual. There is some preliminary clinical evidence to support the perceived negative effects reported by athletes in our study. In women with period pain and/or PMS, which affected a significant proportion of our respondents, **reductions in neuromuscular control and aerobic performance**,⁸ **maximal anaerobic performance**,²² **leg strength and aerobic capacity**²⁴ have been previously observed.

Heavy menstrual bleeding was reported by just under a third of athletes (29.7%) in our study, which is slightly lower than the 36% reported in marathon runners.²⁵ Our self-reported anaemia levels were also slightly lower, with 24% reporting anaemia (vs. 32%) but similar levels of iron supplementation (55.4%). Interestingly, we did not find any correlation between heavy menstrual bleeding and anaemia, but given the higher risk of fatigue-related symptoms in those reporting heavy menstrual bleeding, athletes and coaches should be aware of the increased iron needs in women who may have more frequent or heavier periods.²⁶

Menstrual management options varied amongst athletes, with both the oral contraceptive pill and non-steroidal anti-inflammatories (NSAIDs) being commonly used. Both NSAIDs¹⁴ and the oral contraceptive pill¹⁵ are effective in the treatment of menstrual pain due to primary dysmenorrhea. The rate of contraceptive usage in athletes was slightly higher (41.3%) than those reported in Australian women in the general population of a similar age range (33%)²⁷ but lower than those previously reported for other similarly active populations (49.5–57%).^{28,29} Our findings for the motivation for contraceptive use were similar to those in other physically active populations,²⁸ with athletes reporting the importance of being able to shift or suppress menstruation, both for convenience and specifically due to sports performance. Similar to other research in athletes using contraceptives,²⁹ side effects were relatively common, with over one-third (37.9%) of contraceptive users reporting adverse events that they associated with contraceptive use, mostly related

to mood changes. The long-term use of contraceptives, whether oral or steroidal, on factors such as bone density is still unclear,^{30,31} However, there is evidence that oral contraceptive use during adolescence, when many athletes will begin using this for menstrual management, is related to a decrease in bone density³² and an increased risk of depression.³³ Conversely, there appears to be a potential benefit in reducing ACL injuries with the use of the oral contraceptive pill^{34,35}; however, the quality of the evidence for this is low. Therefore, the relatively high rate of side effects as well as potential risks over the long term must be balanced with the perceived benefits of being able to skip or shift the period and the potential benefit of reducing in ACL injuries.

The concept of needing to endure menstrual pain and symptoms is both common and persistent,^{36,37} and discussions about menstruation, especially with men, are often avoided. Normalisation of menstrual pain often results in women feeling like there is little that can be done to manage pain.³⁸ These factors may contribute to the observation that over three-quarters of athletes reported not discussing their menstrual cycle with their coach or trainer, and a similar number did not alter their training, despite reporting negative impacts on endurance, speed, agility and strength.

The gender of the coach or trainer did appear to be a factor, with athletes reporting that this was a contributing factor in their avoidance of discussing their menstrual cycle with their coaches generally. Given that approximately 85% of coaches in Australia are male,²⁰ the low rate of coaches altering training during the menstrual cycle may be due to the low rates of discussion with coaches, leaving them unaware of the fact that their athletes are being negatively impacted.

This survey has a number of limitations that require acknowledgement. Our recruitment strategy via social media and professional networks may have missed athletes who do not use social media or were not involved in the sporting groups targeted. This may be a factor as to why there were very few respondents who were involved in water-based sports, preventing comparisons between different types of sport. All measures were self-reported; therefore, athletes may potentially have had issues such as anaemia that had not been discussed or diagnosed by a medical practitioner or conversely may have considered they had heavy bleeding while they may not meet the criteria for this. We only required one menstrual cycle to have occurred to be eligible to participate in our study, and one cycle alone may not provide an accurate representation of the impact of menstruation. However, given the average age of menarche in Australia is 12 years and 9 months,¹ the requirement for respondents to be aged

at least 16 to answer the survey, and our respondents' mean age of 29 at the time of the survey and mean age at menarche of 13.2 years, it is unlikely that any respondent had only had one previous menstrual cycle. We did not record the specific type of contraceptive used, which means we are unsure about what percentage were using oral versus steroidal contraceptives. The risks and benefits of different forms of contraception may differ and therefore future research should determine particular sub-types used.

Conclusion

Issues related to menstruation such as PMS symptoms, heavy menstrual bleeding and dysmenorrhea were relatively common amongst athletes. Many athletes used either contraceptives or NSAIDs to manage their symptoms. Despite this, negative impacts during training and on game day performance were very commonly perceived by athletes, especially in those with heavy menstrual bleeding. Only a minority of athletes discussed any menstruation-related issues with their trainers or coaches, and very few altered training due to the menstrual cycle. Given the potential for reduction in perceived performance, especially with heavy bleeding, and potential risks of hormonal contraception, coaches, trainers and athletes need to have a more open dialogue around the menstrual cycle and management strategies which may require additional educational resources or training to accomplish. The use of smartphone apps that collect menstrual cycle data and provide information on potential changes at each phase of the cycle may be an option to assist with this dialogue.

Practical applications

Our findings highlight a critical need that coaches and trainers should be aware of the potential benefits of altering training programs based on the menstrual cycle and of effective management strategies. To achieve this coaches, trainers and athlete's themselves would benefit from evidence-based education on the menstrual cycle, its potential impact on performance, and safe and effective management strategies for athletes, especially those who are still adolescents. The use of an app such as FitrWoman (<https://www.fitrwoman.com>) may facilitate both education and tracking of menstruation and should be considered as a potential tool.

Acknowledgements

Thank you to all those who distributed and completed our survey, especially Dr Kenneth Graham and colleagues at NSWIS as well as those students who helped pilot our survey.

Declaration of conflicting interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: MA, KP and CS: As a medical research institute, NICM Health Research Institute receives research grants and donations from foundations, universities, government agencies and industry. Sponsors and donors provide untied and tied funding for work to advance the vision and mission of the Institute. This study was not specifically supported by donor or sponsor funding to NICM.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Kylie Steel  <https://orcid.org/0000-0001-6521-9044>

Supplemental material

Supplemental material for this article is available online.

References

1. Parker MA, Sneddon AE and Arbon P. The menstrual disorder of teenagers (MDOT) study: determining typical menstrual patterns and menstrual disturbance in a large population-based study of Australian teenagers. *BJOG* 2010; 117: 185–192.
2. Subasinghe AK, Hapoo L, Jayasinghe YL, et al. Prevalence and severity of dysmenorrhoea, and management options reported by young Australian women. *Aust Fam Phys* 2016; 45: 829–834.
3. Armour M, Parry K, Manohar N, et al. The prevalence and academic impact of dysmenorrhea in 21,573 young women: a systematic review and meta-analysis. *J Womens Health (Larchmt)* 2019; 28: 1161–1171.
4. French L. Dysmenorrhea in adolescents: diagnosis and treatment. *Paediatr Drugs* 2008; 10: 1–7.
5. Proctor M and Farquhar C. Diagnosis and management of dysmenorrhoea. *BMJ* 2006; 332: 1134–1138.
6. Saner E. How period tracking can give all female athletes an edge, www.theguardian.com/lifeandstyle/shortcuts/2019/jul/10/how-period-tracking-can-give-all-female-athletes-an-edge. Published 2019. (accessed 2 December 2019).
7. Keeling E. Athletes develop edge on competition with period tracking, www.stuff.co.nz/sport/opinion/117781834/emma-keeling-athletes-develop-edge-on-competition-with-period-tracking?cid=app-iPhone. Published 2019. (accessed 2 December 2019).
8. Lebrun CM. Effect of the different phases of the menstrual cycle and oral contraceptives on athletic performance. *Sports Med* 1993; 16: 400–430.
9. Armour M, Ee CC, Naidoo D, et al. Exercise for dysmenorrhoea. *Cochrane Database Syst Rev* 2019; 9: CD004142.

10. Julian R, Hecksteden A, Fullagar HH, et al. The effects of menstrual cycle phase on physical performance in female soccer players. *PLoS One* 2017; 12: e0173951.
11. Lebrun CM, Joyce SM and Constantini NW. Effects of female reproductive hormones on sports performance. In: Constantini N and Hackney AC (eds) *Endocrinology of Physical Activity and Sport*. New York: Springer Science & Business Media, 2013, pp.281–322.
12. Takeda T, Imoto Y, Nagasawa H, et al. Stress fracture and premenstrual syndrome in Japanese adolescent athletes: a cross-sectional study. *BMJ Open* 2016; 6: e013103.
13. Wojtys EM, Huston LJ, Lindenfeld TN, et al. Association between the menstrual cycle and anterior cruciate ligament injuries in female athletes. *Am J Sports Med* 1998; 26: 614–619.
14. Marjoribanks J, Ayeleke RO, Farquhar C, et al. Nonsteroidal anti-inflammatory drugs for dysmenorrhea. *Cochrane Database Syst Rev*. 2015; 7: CD001751.
15. Wong CL, Farquhar C, Roberts H, et al. Oral contraceptive pill for primary dysmenorrhoea. *Cochrane Database Syst Rev* 2009; 4: CD002120.
16. Armour M, Parry K, Al-Dabbas MA, et al. Self-care strategies and sources of knowledge on menstruation in 12,526 young women with dysmenorrhea: a systematic review and meta-analysis. *PLoS One* 2019; 14: e0220103.
17. Nash CS, Sproule J and Horton P. Sport coaches' perceived role frames and philosophies. *Int J Sports Sci Coach* 2008; 3: 539–554.
18. Becker AJ. It's not what they do, it's how they do it: athlete experiences of great coaching. *Int J Sports Sci Coach* 2009; 4: 93–119.
19. Lafrenière M-AK, Jowett S, Vallerand RJ, et al. Passion for coaching and the quality of the coach–athlete relationship: the mediating role of coaching behaviors. *Psychol Sport Exerc* 2011; 12: 144–152.
20. Holmes T. New Sport Australia boss out to tackle gender inequality in sport governance and coaching. www.abc.net.au/news/2018-11-09/sport-boss-gender-inequality-in-sport-governance-and-coaching/10479876. Published 2018. (accessed 24 June 2019).
21. Graphpad. Interpreting results: relative risk, www.graphpad.com/guides/prism/7/statistics/index.htm?stat_howto_contingency_tables.htm. Published 2017. (accessed 19 March 2020).
22. Giacomoni M, Bernard T, Gavarry O, et al. Influence of the menstrual cycle phase and menstrual symptoms on maximal anaerobic performance. *Med Sci Sports Exerc* 2000; 32: 486–492.
23. Vaiksaar S, Jurimae J, Maestu J, et al. No effect of menstrual cycle phase and oral contraceptive use on endurance performance in rowers. *J Strength Cond Res* 2011; 25: 1571–1578.
24. Chantler I, Mitchell D and Fuller A. Diclofenac potassium attenuates dysmenorrhea and restores exercise performance in women with primary dysmenorrhea. *J Pain* 2009; 10: 191–200.
25. Bruinvels G, Burden R, Brown N, et al. The prevalence and impact of heavy menstrual bleeding (menorrhagia) in elite and non-elite athletes. *PLoS One* 2016; 11: e0149881.
26. Kocaoz S, Cirpan R and Degirmencioglu AZ. The prevalence and impacts heavy menstrual bleeding on anemia, fatigue and quality of life in women of reproductive age. *Pak J Med Sci* 2019; 35: 365–370.
27. Richters J, Grulich AE, de Visser RO, et al. Sex in Australia: contraceptive practices among a representative sample of women. *Aust N Z J Public Health* 2003; 27: 210–216.
28. Schaumberg MA, Emmerton LM, Jenkins DG, et al. Use of oral contraceptives to manipulate menstruation in young, physically active women. *Int J Sports Physiol Perform* 2018; 13: 82–87.
29. Martin D, Sale C, Cooper SB, et al. Period prevalence and perceived side effects of hormonal contraceptive use and the menstrual cycle in elite athletes. *Int J Sports Physiol Perform* 2018; 13: 926–932.
30. Lopez LM, Grimes DA, Schulz KF, et al. Steroidal contraceptives: effect on bone fractures in women. *Cochrane Database Syst Rev* 2014; 6: CD006033.
31. Tremollieres F. Impact of oral contraceptive on bone metabolism. *Best Pract Res Clin Endocrinol Metab* 2013; 27: 47–53.
32. Goshtasebi A, Subotic Brajic T, Scholes D, et al. Adolescent use of combined hormonal contraception and peak bone mineral density accrual: a meta-analysis of international prospective controlled studies. *Clin Endocrinol* 2019; 90: 517–524.
33. Skovlund CW, Mørch LS, Kessing LV, et al. Association of hormonal contraception with depression. *JAMA Psychiatry* 2016; 73: 1154–1162.
34. Samuelson K, Balk EM, Sevetson EL, et al. Limited evidence suggests a protective association between oral contraceptive pill use and anterior cruciate ligament injuries in females: a systematic review. *Sports Health* 2017; 9: 498–510.
35. Herzberg SD, Motu'apuaka ML, Lambert W, et al. The effect of menstrual cycle and contraceptives on ACL injuries and laxity: a systematic review and meta-analysis. *Orthop J Sports Med* 2017; 5. DOI: 10.1177/2325967117718781.
36. Scambler A and Scambler G. Menstrual symptoms, attitudes and consulting behaviour. *Soc Sci Med* 1985; 20: 1065–1068.
37. Brantelid IE, Nilvér H and Alehagen S. Menstruation during a lifespan: a qualitative study of women's experiences. *Health Care Women Int* 2014; 35: 600–616.
38. Armour M, Dahlen HG and Smith CA. More than needles: the importance of explanations and self-care advice in treating primary dysmenorrhea with acupuncture. *Evid Based Complement Alternat Med* 2016; 2016: 1–11.