



The BASES Expert Statement on Conducting and Implementing Female Athlete-Based Research

Produced on behalf of the British Association of Sport and Exercise Sciences by Drs Kirsty Elliott-Sale, Emma Ross FBASES, Richard Burden and Kirsty Hicks.

Introduction

The Tokyo Olympics will be the first Games where there are as many medals available for females as for males and reflects a rise in female participation from 2.2% in Paris 1900 to ~48.8% in Tokyo. The Tokyo Paralympics will feature more female athletes than any previous Games, 4,400 athletes will compete in 537 medal events, with 1,756 places available for women, which is a 17% increase on London 2012. This coupled with increasing global investment, development and media coverage of women's sport, indicates an increased appetite for female sport. Moreover, the unique hormonal fluctuations encountered by female athletes, as a result of the eumenorrhic menstrual cycle (MC) and its perturbations, could significantly impact upon performance and health, showing the clear necessity for high-quality female athlete-focused research.

Although research into female-specific performance started in 1876, surprisingly little is known about the direction or magnitude of the effects of ovarian hormones on performance. There is a dearth of female athlete-specific research (Costello *et al.*, 2014) and poor methodological quality has further compounded our ability to draw evidence-based conclusions/recommendations. To overcome the androcentric (male-centred) physiology research base and to pursue a competitive advantage, more studies are needed that specifically address the performance- and health-related issues associated with the fluctuations in reproductive hormones. Sport scientists can address this by unpicking the combined/individual effects of oestrogen and progesterone on physiological processes, performance and health. This expert statement outlines good practice to follow when conducting and implementing female athlete-based research. We hope that it will reduce some of the poorer practice previously seen in laboratory and applied settings and will allow female athletes to receive the same quality and quantity of research informed practice, to allow them to reach their full potential.

Background and evidence

The MC is a repeating pattern of sex hormone production and secretion, which is subject to large inter- and intra-individual variation. A eumenorrhic cycle lasts 21-35 days. Assuming a

28-day cycle, day one is characterised by a bloody discharge known as menstruation/menses, or colloquially as “a period.” In the simplest terms, the MC can be divided into two phases: the follicular phase, occurring before ovulation; and the luteal phase, occurring after ovulation.

It is worth considering the MC as (at least) three phases with significantly/meaningfully different hormonal profiles: 1) The early follicular days 1-5 (low oestrogen and progesterone); 2) The ovulatory days 14-15 (medium oestrogen, low progesterone); and 3) mid-luteal days 20-22 (high progesterone, high oestrogen).

These phases can be established by (i) asking athletes to indicate when their period starts; (ii) using a urinary ovulation kit; and (iii) adding 7 days from when ovulation occurs; and confirmed by blood samples that are retrospectively analysed for 17- β -oestradiol (most potent type of oestrogen) and progesterone concentrations. Janse de Jonge *et al.* (2019) suggest the luteal phase is verified by a progesterone concentration $>16 \text{ nmol}\cdot\text{L}^{-1}$. We suggest the research community adopts these phases, so we can make direct comparisons between studies.

The late follicular phase has the highest oestrogen levels and would yield the greatest oestrogen to progesterone ratio, but this phase is difficult to determine as there is a lot of variability in the timing of this peak and there are no obvious physical indicators of this phase unlike menstruation and ovulation. As such this phase should be avoided for research purposes in the absence of daily prospective blood sampling.

The MC has many perturbations (i.e. alterations to the usual function). Anovulatory cycles are characterised internally by the absence of an ovulatory peak in 17- β -oestradiol and externally by periods but no ovulation. Amenorrhic cycles are typified internally by downregulated 17- β -oestradiol and progesterone levels and externally by no periods or ovulation. Oligomenorrhoea refers to infrequent periods and results in cycles that are >31 days but otherwise follow the same eumenorrhic hormonal patterns just extended over a longer timeframe. Polymenorrhoea refers to frequent periods and results in cycles that are <21 days but otherwise follow the same eumenorrhic hormonal patterns just truncated over a shorter timeframe.

In an applied setting the MC can easily be tracked using a calendar and ovulation kits; we suggest annotating the start and end of menstruation and when ovulation occurs. If ovulation kits are not available then athletes should look out for another physical signs of ovulation, such as a rise in basal body temperature (taken every morning upon waking) or a white vaginal discharge that is stretchy and slippery and looks like egg whites. Athletes should note any physical/emotional changes as they occur, allowing them to produce their own personalised MC profiles. This is a straightforward concept but collecting data in this way can be a powerful tool; empowering each athlete to understand her cycle and how it relates to any physical and emotional symptoms she may experience. To get the best data, rather than simply instructing athletes to monitor their cycle, athletes need to be invested in these activities, using a system that suits them. They should monitor for >3 months to allow meaningful conclusions about their cycle patterns to be made.

For coaches, monitoring MCs offers the opportunity to understand individual athletes, and their lived experience of the MC. At the very least it can help explain why some days feel better than others; at best it can produce patterns that can be anticipated, exploited or overcome. Coaches must create a space where athletes feel *safe* and *confident* to share their cycle details. *Safe*, in that they will neither be judged on what they report, nor will it be used against them; this information will be treated confidentially. *Confident*, in that their coaches are comfortable discussing MCs and have good enough knowledge of female physiology to be able to use the data impactfully and without risk. The goal is to ensure that all athletes can overcome any cycle-related symptoms, such that their ability to fulfil their potential on any given day is not compromised.

“Hormonal contraceptives” is an umbrella term, which describes a variety of medications that obfuscate the MC, by altering the endogenous hormonal milieu (Elliott-Sale & Hicks, 2018). Nearly half of elite UK-based female athletes use a hormonal contraceptive (Martin *et al.*, 2018) therefore, it is not ecologically valid to only consider eumenorrhic athletes either in research or practice. Most (68%) hormonal contraceptive users take the combined oral contraceptive pill (OCP), which follows a two-phase, 28-day regimen: pill consumption (low endogenous oestrogen and progesterone plus exogenous oestrogen and progestin) for 21 days and pill withdrawal (slight rise in endogenous oestrogen and progesterone and no exogenous oestrogen and progestin) for 7 days. Therefore, there are significantly/meaningfully different ovarian hormonal profiles between OCP users and non-users, making them two distinct groups. OCP use has been associated with less physical/emotional side-effects than non-use (Martin *et al.*, 2018), although this warrants further investigation. As the long-term health implications of chronic hormonal contraceptive use are unknown, female athletes need to receive informed medical advice on contraceptive choices. We need to educate OCP takers about their withdrawal bleed, dispelling the myth that this is a period and a marker of reproductive health. Low energy availability is masked by OCP use because a breakthrough bleed can still occur, even if an athlete is under-fuelling.

There is no consensus on the effects of the ovarian hormones on performance. Such inconsistencies might arise from differences in the definition and quantification of reproductive status and the type of outcome measured. Future research should focus on measuring the concentration of reproductive hormones at the time of performance assessment. Studies on OCPs should employ a homogenous design, studying one type of OCP per group as large variation in endogenous sex hormone concentration were observed when multiple brands were analysed together (Elliott-Sale *et al.*, 2013).

At present there are no fit for purpose, evidence-based guidelines from high quality peer-reviewed papers for practitioners to apply. Practitioners should develop their own

bespoke athlete guidelines based on the data collected from their athletes until such point that the scientific community endorses a substantial body of work, which can be used to inform practice. As every woman’s cycle is different and can change across her lifespan, there might never be a universal blueprint that practitioners can exclusively use to direct training and performance.

Conclusions and recommendations

In order to advance female athlete-based research, and the implementation of this research into practice, we need:

- A cultural shift away from period-based silencing to unrestricted, irreproachable conversations about MCs
- An audit of literature through meta-analyses to evaluate the findings and quality of previous research
- To exercise caution when interpreting published data due to the large inter- and intra- individual variation in reproductive hormone status, resulting in mostly under-powered studies
- MC tracking of characteristics/symptoms and performance measures
- Ovulation kits for verification of ovulatory cycles
- Retrospective blood sample verification of MC phase
- Informed hormonal contraceptive choices. ■



Dr Kirsty Elliott-Sale

Kirsty is an Associate Professor of Female Physiology and Head of the Musculoskeletal Physiology Research Group within the SHAPE Research Centre at Nottingham Trent University.



Dr Emma Ross

Emma is the former Head of Physiology at the English Institute of Sport. She now runs her own business, Thrive Revolution, supporting female athletes and their support teams.



Dr Richard Burden

Richard is Technical Lead for Physiology at the English Institute of Sport. He leads the innovation and delivery of physiology support to British Olympic Sport.



Dr Kirsty Hicks

Kirsty is a Senior Lecturer in the Department of Sport, Exercise and Rehabilitation at Northumbria University. She is a BASES accredited sport and exercise scientist.

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