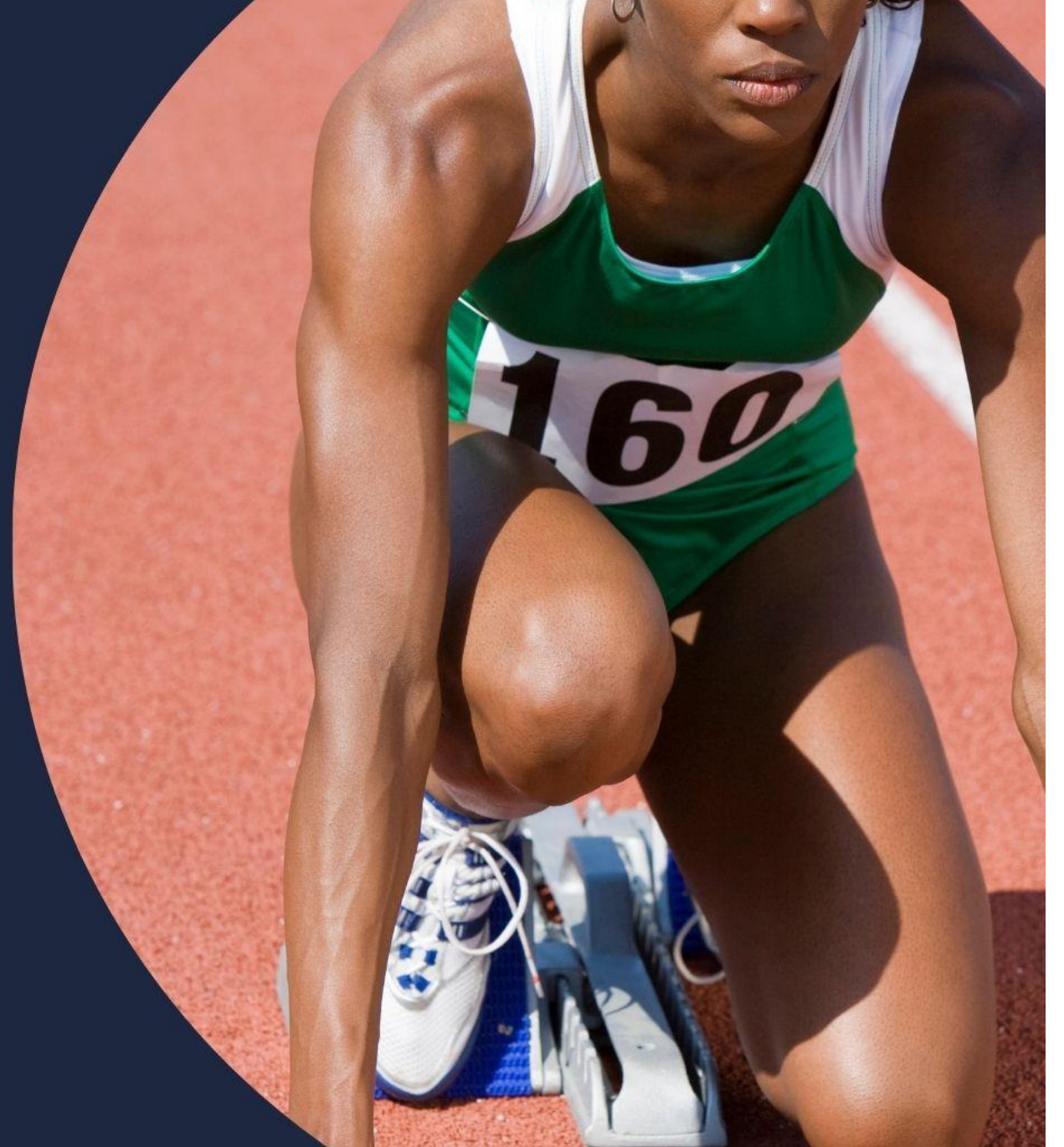


The effects of the menstrual cycle and hormonal contraceptives on athletic performance

What we know, what we don't know, and what we should do now and next!

Prof Kirsty Elliott-Sale





SVENSK FRIIDROTT

**Thank you for
inviting me to your
home!**



**This is my home! Institute
of Sport, Manchester
Metropolitan University**



Cis-gender women

Females as an adjective

Women as a noun

No conflicts of interest to declare

A female athlete with long braids is captured in mid-air, performing a hurdle jump. She is wearing a grey athletic top and shorts. The background is dark, and the floor is a light brown color. A silver hurdle is positioned in the center of the frame. The word 'Practice' is written in white text to the left of the hurdle, and the word 'Research' is written in white text to the right of the hurdle.

Practice

Research



HURDLES TO OVERCOME

- Data are scarce
- Data are low to moderate quality
- No consensus on methodological approaches
- Shortage of specialist knowledge
- Reluctance to consider female-specific issues
- Ignorance of female-specific issues

What we don't know

QUANTITY AND QUALITY

Cowley, E. S., Olenick, A. A., McNulty, K. L., & Ross, E. Z. (2021). "Invisible Sportswomen": The Sex Data Gap in Sport and Exercise Science Research, *Women in Sport and Physical Activity Journal* (published online ahead of print 2021).

"About 5,261 publications and 12,511,386 participants were included in the analyses. Sixty-three percentage of publications included both males and females, 31% included males only, and **6% included females only** ($p < .0001$). When analysing participants included in all journals, a total of 8,253,236 (66%) were male and 4,254,445 (34%) were female ($p < .0001$). Females remain significantly underrepresented within sport and exercise science research."



Menstrual cycle

8% high quality

Sports Medicine
<https://doi.org/10.1007/s40279-020-01319-3>

SYSTEMATIC REVIEW



The Effects of Menstrual Cycle Phase on Exercise Performance in Eumenorrhic Women: A Systematic Review and Meta-Analysis

Kelly Lee McNulty¹ · Kirsty Jayne Elliott-Sale² · Eimear Dolan³ · Paul Alan Swinton⁴ · Paul Ansdell¹ · Stuart Goodall¹ · Kevin Thomas¹ · Kirsty Marie Hicks¹

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Abstract

Background Concentrations of endogenous sex hormones fluctuate across the menstrual cycle (MC), which could have implications for exercise performance in women. At present, data are conflicting, with no consensus on whether exercise performance is affected by MC phase.

Objective To determine the effects of the MC on exercise performance and provide evidence-based, practical, performance recommendations to eumenorrhic women.

Methods This review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Four databases were searched for published experimental studies that investigated the effects of the MC on exercise performance, which included at least one outcome measure taken in two or more defined MC phases. All data were meta-analysed using multilevel models grounded in Bayesian principles. The initial meta-analysis pooled pairwise effect sizes comparing exercise performance during the early follicular phase with all other phases (late follicular, ovulation, early luteal, mid-luteal and late luteal) amalgamated. A more comprehensive analysis was then conducted, comparing exercise performance between all phases with direct and indirect pairwise effect sizes through a network meta-analysis. Results from the network meta-analysis were summarised by calculating the Surface Under the Cumulative Ranking curve (SUCRA). Study quality was assessed using a modified Downs and Black checklist and a strategy based on the recommendations of the Grading of Recommendations Assessment Development and Evaluation (GRADE) working group.

Results Of the 78 included studies, data from 51 studies were eligible for inclusion in the initial pairwise meta-analysis. The three-level hierarchical model indicated a trivial effect for both endurance- and strength-based outcomes, with reduced exercise performance observed in the early follicular phase of the MC, based on the median pooled effect size ($ES_{0.5} = -0.06$ [95% credible interval (CrI): -0.16 to 0.04]). Seventy-three studies had enough data to be included in the network meta-analysis. The largest effect was identified between the early follicular and the late follicular phases of the MC ($ES_{0.5} = -0.14$ [95% CrI: -0.26 to -0.03]). The lowest SUCRA value, which represents the likelihood that exercise performance is poor, or among the poorest, relative to other MC phases, was obtained for the early follicular phase (30%), with values for all other phases ranging between 53 and 55%. The quality of evidence for this review was classified as “low” (42%).

Conclusion The results from this systematic review and meta-analysis indicate that exercise performance might be trivially reduced during the early follicular phase of the MC, compared to all other phases. Due to the trivial effect size, the large between-study variation and the number of poor-quality studies included in this review, general guidelines on exercise performance across the MC cannot be formed; rather, it is recommended that a personalised approach should be taken based on each individual’s response to exercise performance across the MC.

Oral contraceptive pill

17% high quality



The Effects of Oral Contraceptives on Exercise Performance in Women: A Systematic Review and Meta-analysis

Kirsty J. Elliott-Sale¹ · Kelly L. McNulty² · Paul Ansdell² · Stuart Goodall² · Kirsty M. Hicks² · Kevin Thomas² · Paul A. Swinton³ · Eimear Dolan⁴

© The Author(s) 2020

Abstract

Background Oral contraceptive pills (OCPs) are double agents, which downregulate endogenous concentrations of oestradiol and progesterone whilst simultaneously providing daily supplementation of exogenous oestrogen and progestin during the OCP-taking days. This altered hormonal milieu differs significantly from that of eumenorrheic women and might impact exercise performance, due to changes in ovarian hormone-mediated physiological processes.

Objective To explore the effects of OCPs on exercise performance in women and to provide evidence-based performance recommendations to users.

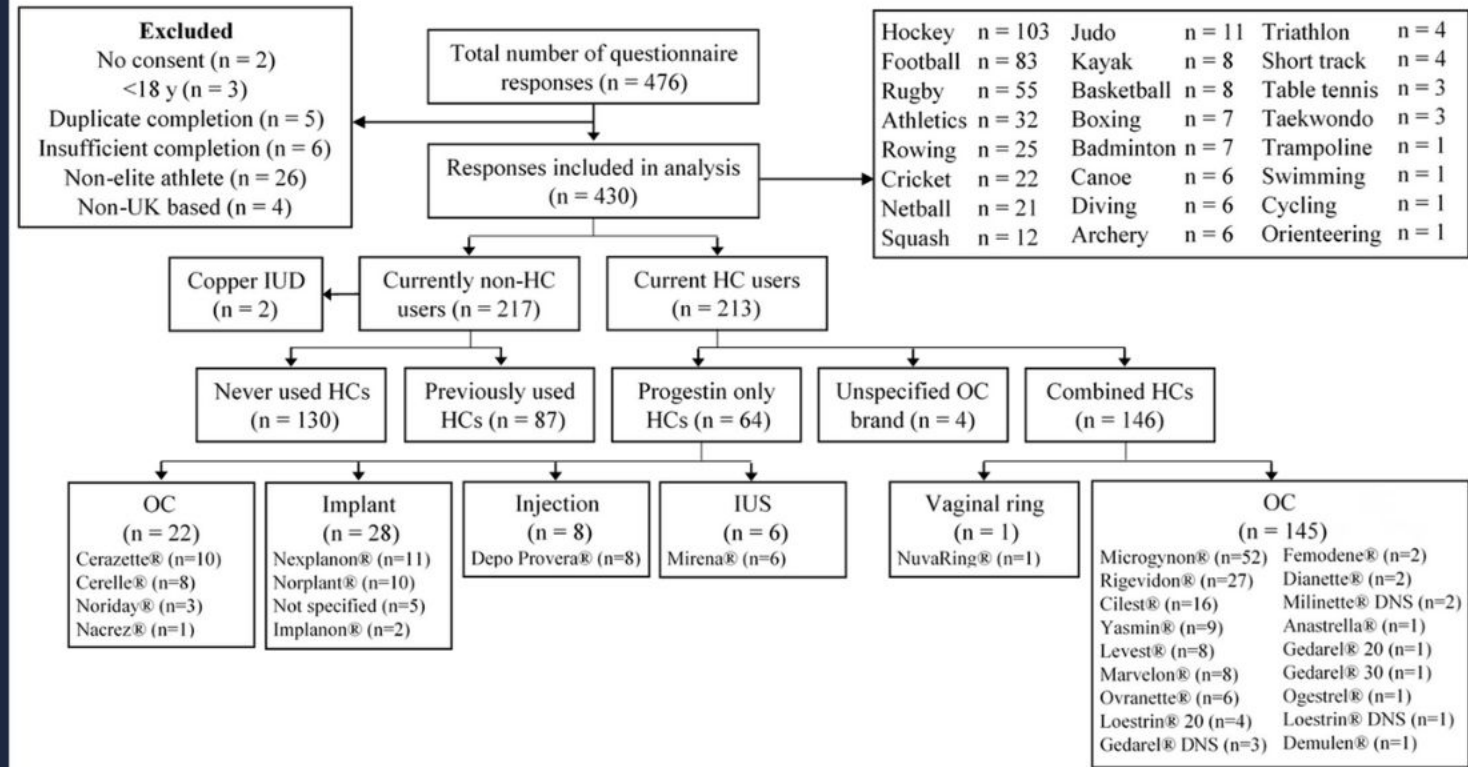
Methods This review complied with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. A between-group analysis was performed, wherein performance of OCP users was compared with naturally menstruating women, and a within-group analysis was conducted, wherein performance during OCP consumption was compared with OCP withdrawal. For the between-group analysis, women were phase matched in two ways: (1) OCP withdrawal versus the early follicular phase of the menstrual cycle and (2) OCP consumption versus all phases of the menstrual cycle except for the early follicular phase. Study quality was assessed using a modified Downs and Black Checklist and a strategy based on the recommendations of the Grading of Recommendations Assessment Development and Evaluation working group. All meta-analyses were conducted within a Bayesian framework to facilitate probabilistic interpretations.

Results 42 studies and 590 participants were included. Most studies (83%) were graded as moderate, low or very low quality, with 17% achieving high quality. For the between-group meta-analysis comparing OCP users with naturally menstruating women, posterior estimates of the pooled effect were used to calculate the probability of at least a small effect ($d \geq 0.2$). Across the two between-group comparison methods, the probability of a small effect on performance favouring habitual OCP users was effectually zero ($p < 0.001$). In contrast, the probability of a small effect on performance favouring naturally menstruating women was moderate under comparison method (1) ($d \geq 0.2$; $p = 0.40$) and small under comparison method (2) ($d \geq 0.2$; $p = 0.19$). Relatively large between-study variance was identified for both between-group comparisons ($\tau_{0.5} = 0.16$ [95% credible interval (CrI) 0.01–0.44] and $\tau_{0.5} = 0.22$ [95% CrI 0.06–0.45]). For the within-group analysis comparing OCP consumption with withdrawal, posterior estimates of the pooled effect size identified almost zero probability of a small effect on performance in either direction ($d \geq 0.2$; $p \leq 0.001$).

Conclusions OCP use might result in slightly inferior exercise performance on average when compared to naturally menstruating women, although any group-level effect is most likely to be trivial. Practically, as effects tended to be trivial and variable across studies, the current evidence does not warrant general guidance on OCP use compared with non-use. Therefore, when exercise performance is a priority, an individualised approach might be more appropriate. The analysis also indicated that exercise performance was consistent across the OCP cycle.

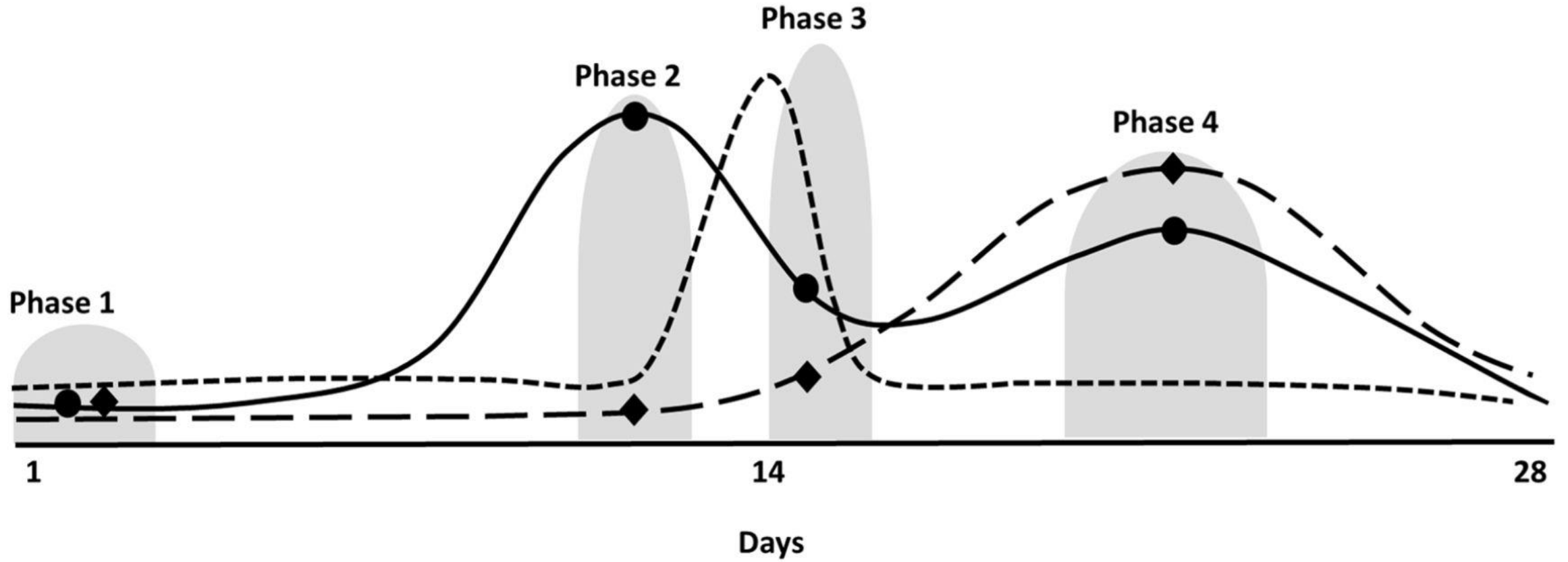
Audience

Martin et al., 2018

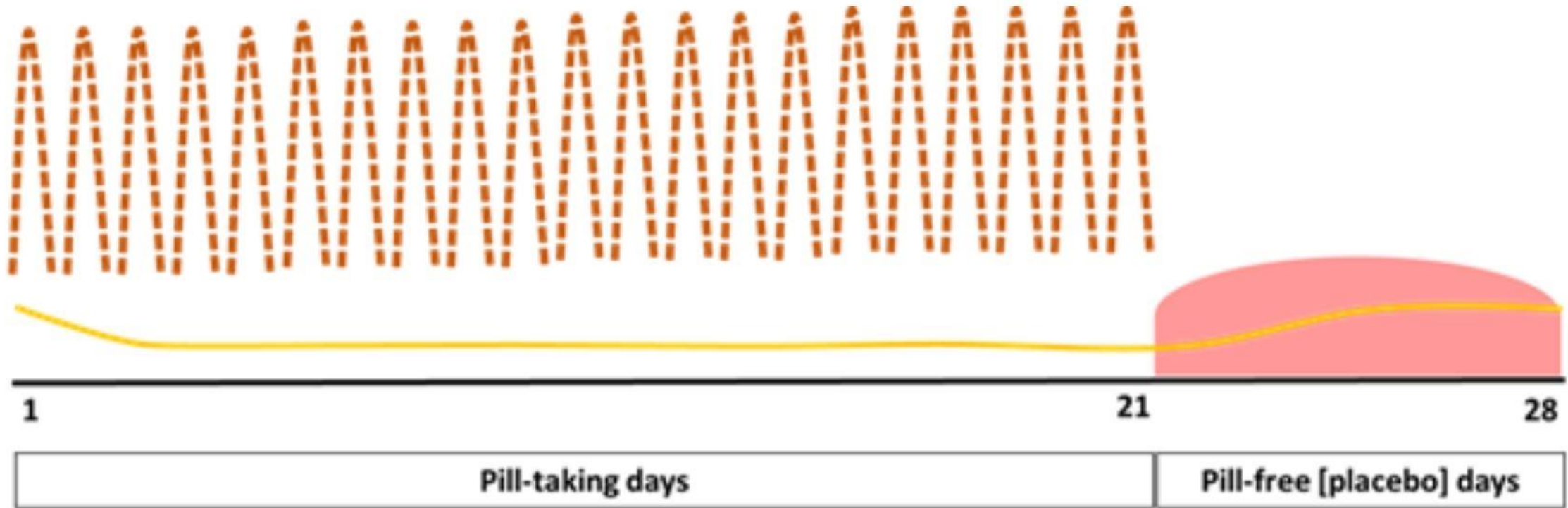


What we should know

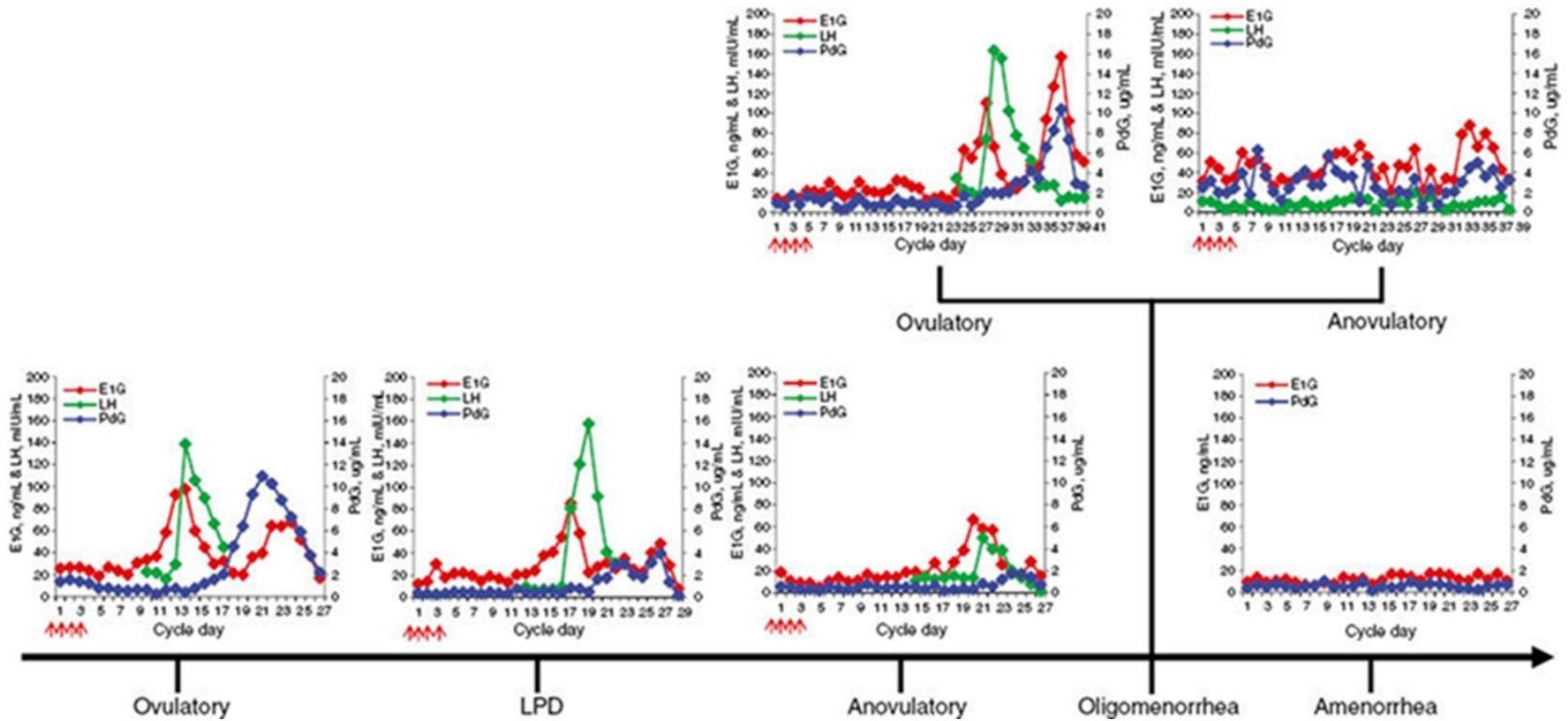
OVARIAN HORMONAL PROFILES



Chronobiology



Pharmacology



Gynecology

What we know [today]

PERFORMANCE



The Effects of Menstrual Cycle Phase on Exercise Performance in Eumenorrhoeic Women: A Systematic Review and Meta-Analysis

Kelly Lee McNulty¹ · Kirsty Jayne Elliott-Sale² · Eimear Dolan³ · Paul Alan Swinton⁴ · Paul Ansdell¹ · Stuart Goodall¹ · Kevin Thomas¹ · Kirsty Marie Hicks¹

Published online: 13 July 2020
© The Author(s) 2020

Abstract

Background Concentrations of endogenous sex hormones fluctuate across the menstrual cycle (MC), which could have implications for exercise performance in women. At present, data are conflicting, with no consensus on whether exercise performance is affected by MC phase.

Objective To determine the effects of the MC on exercise performance and provide evidence-based, practical, performance recommendations to eumenorrhoeic women.

Methods This review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Four databases were searched for published experimental studies that investigated the effects of the MC on exercise performance, which included at least one outcome measure taken in two or more defined MC phases. All data were meta-analysed using multilevel models grounded in Bayesian principles. The initial meta-analysis pooled pairwise effect sizes comparing exercise performance during the early follicular phase with all other phases (late follicular, ovulation, early luteal, mid-luteal and late luteal) amalgamated. A more comprehensive analysis was then conducted, comparing exercise performance between all phases with direct and indirect pairwise effect sizes through a network meta-analysis. Results from the network meta-analysis were summarised by calculating the Surface Under the Cumulative Ranking curve (SUCRA). Study quality was assessed using a modified Downs and Black checklist and a strategy based on the recommendations of the Grading of Recommendations Assessment Development and Evaluation (GRADE) working group.

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Conclusion The results from this systematic review and meta-analysis indicate that exercise performance might be trivially reduced during the early follicular phase of the MC, compared to all other phases. Due to the trivial effect size, the large between-study variation and the number of poor-quality studies included in this review, general guidelines on exercise performance across the MC cannot be formed; rather, it is recommended that a personalised approach should be taken based on each individual's response to exercise performance across the MC.

Kelly Lee McNulty and Kirsty Jayne Elliott-Sale: Joint first authors.

Electronic supplementary material The online version of this article (<https://doi.org/10.1007/s40279-020-01319-3>) contains supplementary material, which is available to authorized users.

Extended author information available on the last page of the article.

Menstrual cycle

The quality of evidence for this review was 8% high; 24% moderate; 42% low and 26% very low.

In women, exercise performance might be reduced by a trivial amount during the early follicular phase of the menstrual cycle when compared with other phases. However, large between-study variance was identified, indicating that research design, participant characteristics and choice of outcome measure might influence any group-level effect.

Practically, the current evidence does not warrant general guidance on modulating exercise across the menstrual cycle. As such, we recommend that a personalised approach should be taken based on each individual's response to exercise performance across the menstrual cycle.



The Effects of Oral Contraceptives on Exercise Performance in Women: A Systematic Review and Meta-analysis

Kirsty J. Elliott-Sale¹ · Kelly L. McNulty² · Paul Ansdell² · Stuart Goodall² · Kirsty M. Hicks² · Kevin Thomas² · Paul A. Swinton¹ · Eimear Dolan⁴

Published online: 14 July 2020
© The Author(s) 2020

Abstract

Background Oral contraceptive pills (OCPs) are double agents, which downregulate endogenous concentrations of oestradiol and progesterone whilst simultaneously providing daily supplementation of exogenous oestrogen and progestin during the OCP-taking days. This altered hormonal milieu differs significantly from that of eumenorrhoeic women and might impact exercise performance, due to changes in ovarian hormone-mediated physiological processes.

Objective To explore the effects of OCPs on exercise performance in women and to provide evidence-based performance recommendations to users.

Methods This review complied with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. A between-group analysis was performed, wherein performance of OCP users was compared with naturally menstruating women, and a within-group analysis was conducted, wherein performance during OCP consumption was compared with OCP withdrawal. For the between-group analysis, women were phase matched in two ways: (1) OCP withdrawal versus the early follicular phase of the menstrual cycle and (2) OCP consumption versus all phases of the menstrual cycle except for the early follicular phase. Study quality was assessed using a modified Downs and Black Checklist and a strategy based on the recommendations of the Grading of Recommendations Assessment Development and Evaluation working group. All meta-analyses were conducted within a Bayesian framework to facilitate probabilistic interpretations.

Results 42 studies and 590 participants were included. Most studies (83%) were graded as moderate, low or very low quality, with 17% achieving high quality. For the between-group meta-analysis comparing OCP users with naturally menstruating women, posterior estimates of the pooled effect were used to calculate the probability of at least a small effect ($d \geq 0.2$). Across the two between-group comparison methods, the probability of a small effect on performance favouring habitual OCP users was effectually zero ($p < 0.001$). In contrast, the probability of a small effect on performance favouring naturally menstruating women was moderate under comparison method (1) ($d \geq 0.2$; $p = 0.40$) and small under comparison method (2) ($d \geq 0.2$; $p = 0.19$). Relatively large between-study variance was identified for both between-group comparisons ($\tau_{0.5} = 0.16$ [95% credible interval (CrI) 0.01–0.44] and $\tau_{0.5} = 0.22$ [95% CrI 0.06–0.45]). For the within-group analysis comparing OCP consumption with withdrawal, posterior estimates of the pooled effect size identified almost zero probability of a small effect on performance in either direction ($d \geq 0.2$; $p \leq 0.001$).

Conclusions OCP use might result in slightly inferior exercise performance on average when compared to naturally menstruating women, although any group-level effect is most likely to be trivial. Practically, as effects tended to be trivial and variable across studies, the current evidence does not warrant general guidance on OCP use compared with non-use. Therefore, when exercise performance is a priority, an individualised approach might be more appropriate. The analysis also indicated that exercise performance was consistent across the OCP cycle.

Joint first authors: Kirsty J. Elliott-Sale and Kelly L. McNulty.

Electronic supplementary material The online version of this article (<https://doi.org/10.1007/s40279-020-01317-5>) contains supplementary material, which is available to authorized users.

Extended author information available on the last page of the article

1 Introduction

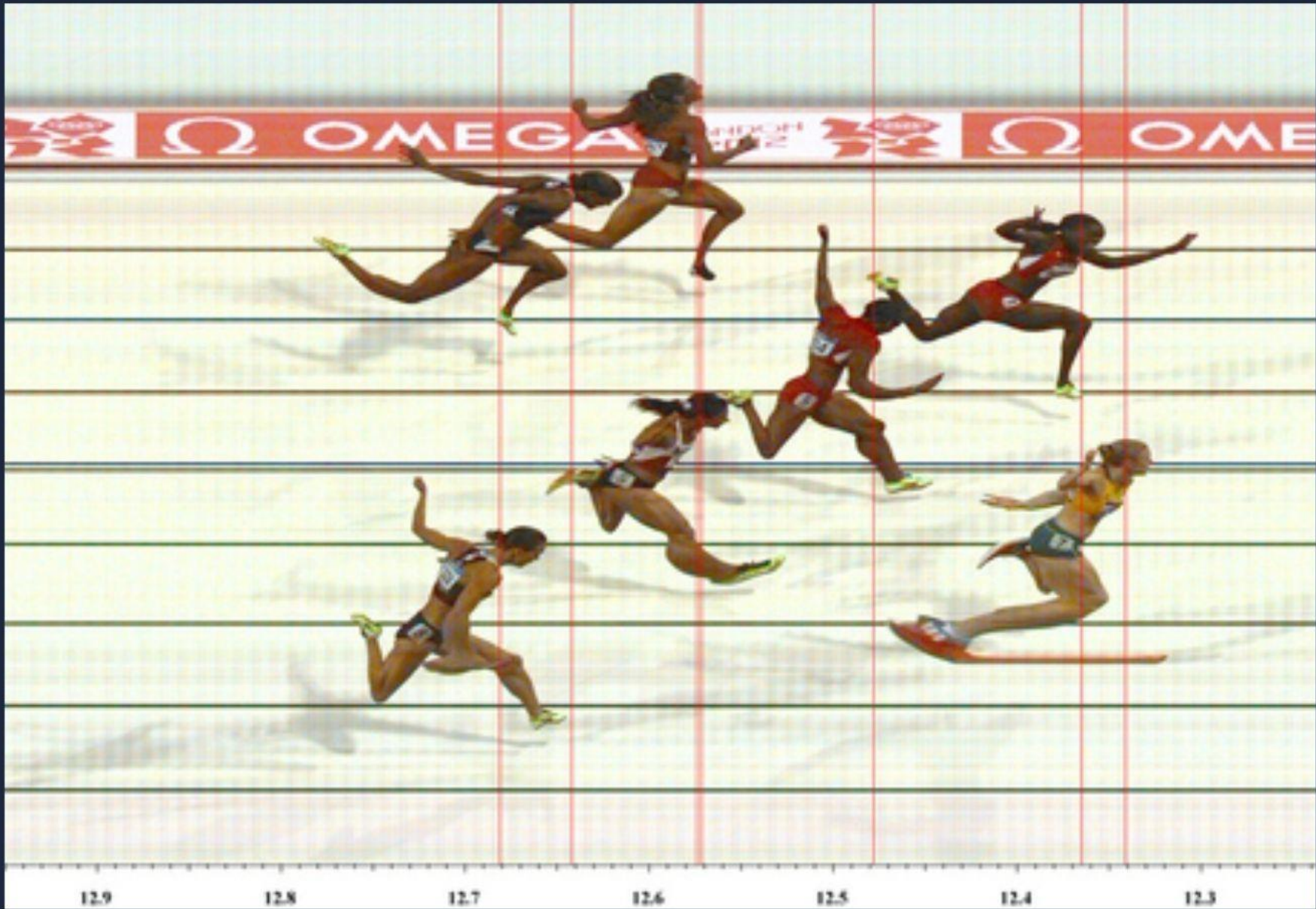
Sex hormones are one of the main determinants of biological sex [1]. During adulthood, levels of testosterone, the predominant male sex hormone, remain consistent in men [2], whilst concentrations of oestrogen and progesterone, the prevailing female sex hormones, undergo circamensal changes

Oral contraceptive pills

83% of the studies were graded as moderate, low or very low quality, with 17% achieving high quality.

Exercise performance appeared relatively consistent across the OCP cycle, suggesting that different guidance is not warranted for OCP-taking days versus non-OCP taking days.

When compared with a natural menstrual cycle, oral contraceptive pill (OCP) use might result in slightly inferior exercise performance, although any group level effect is most likely to be trivial, and as such from a practical perspective, the current evidence does not warrant general guidance on OCP use compared with non-use.



(Photo by Omega via Getty Images)



Interesting!
Priorities...

Article metrics | Last updated: Sun, 5 Sep 2021 15:45:58 Z

The Effects of Oral Contraceptives on Exercise Performance in Women: A Systematic Review and Meta-analysis

Access & Citations

17k
Article Accesses

21
[Web of Science](#)

16
[CrossRef](#)

Citation counts are provided from Web of Science and CrossRef. The counts may vary by service, and are reliant on the availability of their data. Counts will update daily once available.

Online attention



361 tweeters
12 news outlets
186 Mendeley
1 blogs
1 Video uploaders
2 Facebook pages

Altmetric calculates a score based on the online attention an article receives. Each coloured thread in the circle represents a different type of online attention. The number in the centre is the Altmetric score. Social media and mainstream news media are the main sources that calculate the score. Reference managers such as Mendeley are also tracked but do not contribute to the score. Older articles often score higher because they have had more time to get noticed. To account for this, Altmetric has included the context data for other articles of a similar age.

This article is in the 98th percentile (ranked 3,011th) of the 297,274 tracked articles of a similar age in all journals and the 97th percentile (ranked 2nd) of the 37 tracked articles of a similar age in *Sports Medicine*

Article metrics | Last updated: Sun, 5 Sep 2021 15:46:52 Z

The Effects of Menstrual Cycle Phase on Exercise Performance in Eumenorrheic Women: A Systematic Review and Meta-Analysis

Access & Citations

35k
Article Accesses

46
[Web of Science](#)

43
[CrossRef](#)

Citation counts are provided from Web of Science and CrossRef. The counts may vary by service, and are reliant on the availability of their data. Counts will update daily once available.

Online attention



675 tweeters
18 news outlets
375 Mendeley
1 blogs
1 Video uploaders
2 Facebook pages

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Biopsychosocial

What should/can we do next?

RESEARCH

DEFINE POPULATION CONFIRM POPULATION

ADAPT METHODOLOGY

Elliott-Sale KJ, Minahan CL, de Jonge XAKJ, Ackerman KE, Sipilä S, Constantini NW, Lebrun CM, Hackney AC. **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. 2021 May;51(5):843-861.

So much more

Title and abstract reporting; clearly identify your cohort

A priori justification of single sex cohorts

Clear reporting of sex disaggregated data

Perceived novelty

Quotas

Recruitment strategies

Sex differences is not the only pathway

Hagstrom AD, Yuwono N, Warton K, Ford CE. Sex Bias in Cohorts Included in Sports Medicine Research. *Sports Med.* 2021 Aug;51(8):1799-1804.



What should/can we do now?

PRACTICE



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 eumenorrheic 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 eumenorrheic 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. Jansse de Jonge et al. (2019) suggest the luteal phase is verified by a progesterone concentration >16 nmol 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. Amenorrhoeic 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 eumenorrheic 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 eumenorrheic hormonal patterns just truncated over a shorter timeframe.

Bringing together research and practice

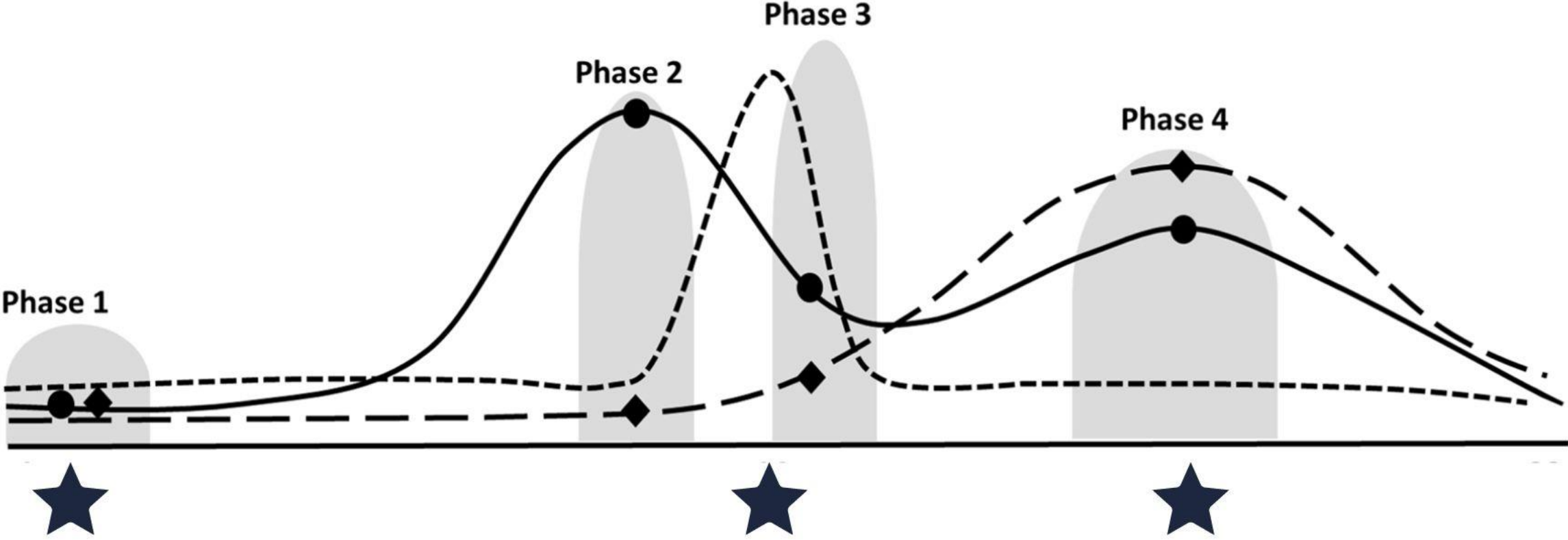
A cultural shift away from period-based silencing to unrestricted, irreproachable conversations about MCs;

To exercise caution when interpreting published data;

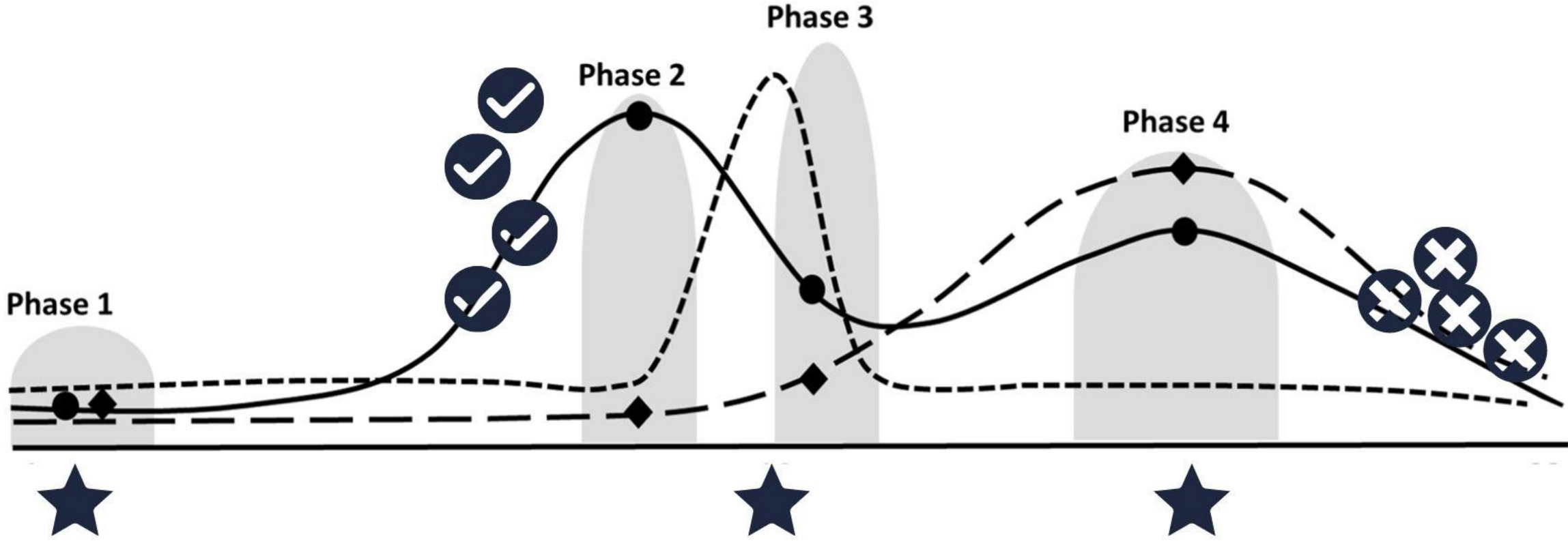
MC tracking of characteristics/symptoms and performance measures;

Informed hormonal contraceptive choices.

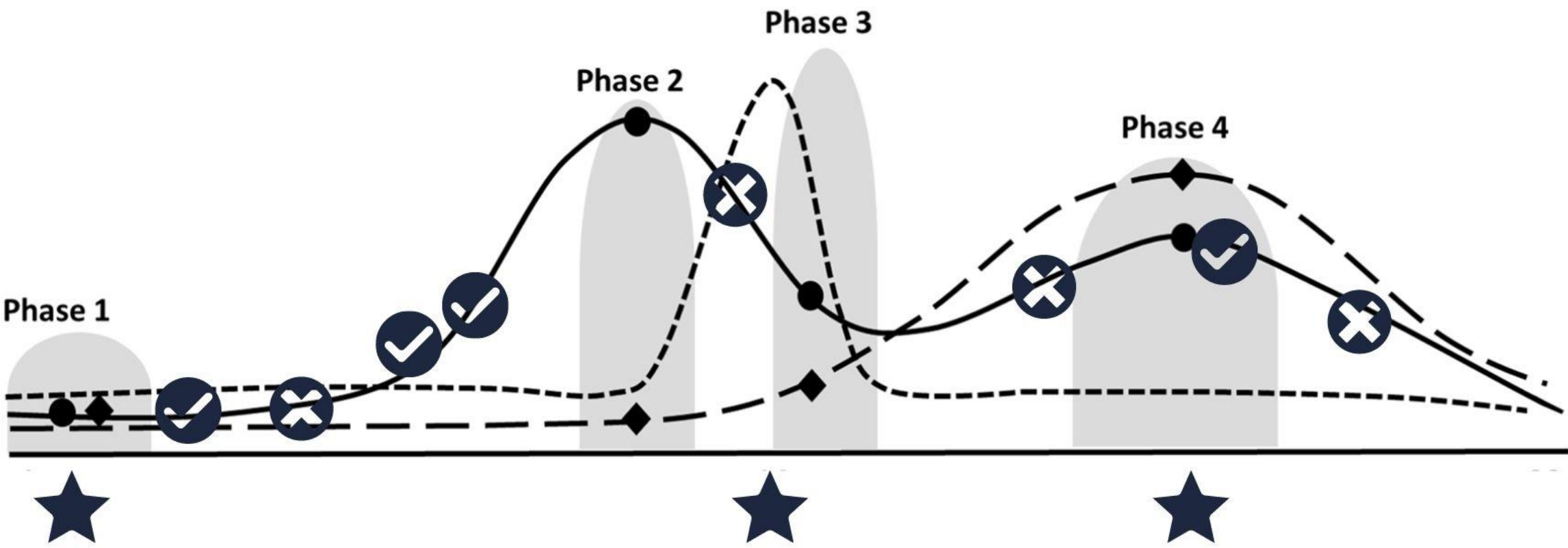
TRACK AND MAP



TRACK AND MAP



TRACK AND MAP



TALK TO ME!

Twitter @ElliottSale

K.Elliott-Sale@MMU.ac.uk

