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The intra- and inter-variability of menstrual cycles in professional female footballers; the use of daily hormone measurements to determine ovulation.

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INTRODUCTION:
Menstrual cycle (MC) variability exists in the general population [1], but it's variability within athletic populations has not been reported. Advances in technology enabling a practical method of assessing daily reproductive hormone concentrations provide an avenue for such research. Accurate determination of ovulation is necessary to identify follicular (FP) and luteal phase (LP) lengths, which are pivotal to assess the impact of the MC on performance and health metrics [2]. Although a range of methods have been proposed to assess ovulation day and subsequent MC variability, agreement between methods remains unknown. Hence, the first aim of this study was to compare three methods of determining ovulation: (1) positive urinary luteinising hormone (LH) test, (2) sustained rise in progesterone above critical difference, and (3) countback regression equation (CRE). The second aim was to assess the variability in MC length, phase length, and concentrations of oestradiol and progesterone for each method.
METHODS:
Eight professional female footballers provided morning saliva samples, daily, for three consecutive MCs; the start of each cycle was characterised by the onset of bleeding. Samples were analysed to measure oestradiol and progesterone concentrations. Each MC was separated into the FP and LP relative to the day of ovulation, using three different methods (as above). To make comparisons between the sub-phases, both the FP and LP were normalised to 14 d each and split into early (first 4 d), mid (middle 6 d), and late (last 4 d). An ANOVA and Tukeys HSD post hoc was used to compare between methods and phases. The significance level was set at $p < 0.05$. All data are expressed as mean ± SD.
RESULTS:
MC length (all cycles) ranged from 16-43 (29.3 ± 5.7) days; the intra-CV (16.3%) was greater than the inter-CV (11.4%). Ovulation determined using method 2 (17.4 ± 3.0 d) was significantly later ($p < 0.001$) than method 1 (13.3 ± 2.0) and 3 (14.1 ± 1.8), thus longer FP and short LP lengths were established when using method 2 ($p < 0.001$). Mean oestradiol and progesterone concentrations were significantly different between sub-phases ($p < 0.001$). For methods 1 and 3, progesterone was highest in the mid-LP. For method 2, progesterone was highest in the early-LP and mid-LP. For all methods, oestradiol was lowest in the early-FP and highest in the late-FP, early-LP, mid-LP, late-LP, and during ovulation.
CONCLUSION:
Day of ovulation was later when determined using a sustained rise in salivary progesterone compared to both the positive urinary LH test and the CRE. Given the importance of identifying when ovulation occurs, the misalignment of methods observed here underlines the need for more research to establish the efficacy of current practice. Furthermore, intra and inter-variability in MC length, phase length, and concentrations of oestradiol and progesterone challenge the narrative for generic MC recommendations in elite sport.
[1] Fehring et al. (2006), [2] Elliott-Sale et al. (2021)

Topic: Physiology

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