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## Match workload in female football players vary across menstrual cycle phases

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### INTRODUCTION:

Sex hormones variations seem to impact work load among female football players. Quantitative measures of load parameters across either the menstrual cycle (MC) or combined oral contraception (OC) phases are scarce. We aimed to quantify the players match load across their MC or OC phases of a French National club through an entire season.

### METHODS:

16 elite football players ( $23.7 \pm 4.4$  years) volunteered to take part in the study. We followed up their match load through GPS data and their cycle phases (menstruation, mid and late follicular, early, mid and late luteal), based on a calendar method and an algorithm for phases estimation [1] for MC ( $n = 12$ ) or according to the pills taking/pause in OC users ( $n = 4$ ) through 24 games of the 2021-2022 season. For each load variable, a mixed model considering the group and individual players effect was performed to explain each variable according to the cycle's phases in MC or OC. We calculated the odds ratio on the fixed parameters of the models to identify an overall effect of the phases on each load variable.

### RESULTS:

Among MC players we found a significantly greater total match load, total distance, total acceleration and average velocity in the mid-cycle (mid and late follicular) in comparison with the beginning and the end of the cycle (menstruation and late luteal) ( $p < 0.05$ ). The gap between the phases with the greatest and the lowest load ranged from (5 to 13%).

### CONCLUSION:

The workload among elite football players vary across menstrual cycle phases, displaying a cyclicity, where higher load values were found in the middle of their cycle, around the fertile period, and lower values in the premenstrual and menstrual phases. We have not identified any significant variation between the hormonal phases among OC users. These findings based on quantitative data of a collective sport suggest the interest of more studies investigating the effect of the menstrual cycle on female athletes' performance.

[1] Soumpasis et al., Real-life insights on menstrual cycles and ovulation using big data, Human Reproduction Open 2020.

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