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Urinary excretion of anabolic steroid hormones during the menstrual cycle in track and field athletes

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## **INTRODUCTION:**

The menstrual cycle (MC) is characterized by fluctuations of the sex steroids estrogen and progesterone. However, the cyclic fluctuations of anabolic steroid hormones such as testosterone and its metabolites, which are secreted from both ovaries and adrenal cortex, and the influence of hormonal oral contraception (OC) are largely unknown in elite female athletes. As the phases of MC might have influence on athletic performance and strength training adaptations (1), a deeper understanding of the secretion and metabolism of anabolic steroid hormones through the MC is needed. The aim of the present study was to investigate the urinary profiles of these hormones during the MC in elite athletes with and without OC (wOC/noOC). **METHODS:** 

22 elite track and field athletes participated in a longitudinal study of MC monitoring in sports. 10 athletes with normal MC (n=18 cycles) and 5 athletes with OC (n=10 cycles) (26±6 y, 172±5 cm, 68±7 kg) were included in the analysis. Intravaginal body temperature was measured daily for 24-h to detect ovulation. Further, athletes collected morning saliva and urine, and capillary EDTA blood prior to training every day or every second day. Urinary steroid hormones were analyzed by GC-MS/MS. Linear mixed models were used to compare Testosterone (T) and the sum of 5 -diol, 5 -diol, 5 -dion, 5 -dion, androsterone and etiocholanolone (SUM) during different phases of MC/noOC (4(7)-phases: menstruation, follicular phase (FP, mid and late), ovulation, and luteal phase (LP, early, mid and late)) and wOC (7-"phases": 28 days/ 7). The average of T and SUM was used for statistical comparison between noOC and wOC using Mann-Whitney-U test. **RESULTS:** 

Neither T nor SUM showed any MC phase dependencies in the 4-phase model. In the 7-phase model, however, T and SUM were significantly higher during ovulation compared to mid LP (T: ovulation: 7.11±6.15 ng/ml; mid LP: 4.08±2.71 ng/ml; 95% CI [0.70 4.69], p=.048; SUM: ovulation: 4856±3049 ng/ml; mid LP: 3342±1858 ng/ml; 95% CI [391 2286], p=.034). Further, steroid hormone concentrations in wOC did not differ between the respective "phases". Mean T concentration was higher in noOC compared wOC (noOC: 4.84±3.71 ng/ml; wOC: 2.55±2.91 ng/ml; 95% CI [-2.67 -1.80], p<.001), while mean SUM did not differ between both groups. CONCLUSION:

In regular menstruating athletes urinary T concentrations and the sum of T-metabolites were about 45 % higher around ovulation compared to the mid luteal phase. This result and findings of higher serum T concentrations around ovulation support the rationale for a periodization of the training according to MC. Results between athletes without and with OC are contradictory concerning T and its metabolites. Hormonal changes in the MC were highly variable and require individual analysis and interpretation. This project was funded with research funds from the Federal Institute for Sports Science based on a decision by the German Bundestag. (1) Alexander et al., 2022, Eur J Sport Sci, 22(7), 1035-45.

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