

## Effect of the menstrual cycle on performance of intermittent, high intensity shuttle running in a hot environment

Cyclic variations in deep body temperature during the menstrual cycle may alter thermoregulatory responses when exercising in the heat and thus affect performance. In hot environmental conditions deep body temperature may be a limiting factor for exercise performance, and therefore during the luteal phase of the cycle, performance may be diminished. However, in moderate environmental conditions menstrual phase has been reported to have no effect on intermittent exercise performance (Lynch and Nimmo, 1998, *European Journal of Applied Physiology*, **78**, 565-572). There is no information regarding the effects of the menstrual cycle and oral contraceptives on games based activity in a hot environment. Thus, the aim of this study was to investigate the effects of menstrual cycle phase and oral contraceptive use on intermittent, high intensity shuttle running in a hot environment (31°C, 23% relative humidity).

Seven normally menstruating women and 8 oral contraceptive users participated in the study. All the subjects were unacclimatised game players (mean  $\pm$  sd) aged  $20.2 \pm 0.8$  years and body mass  $60.8 \pm 4.7$  kg. Two trials were undertaken near the predicted mid-point of the follicular (FT) and luteal (LT) phases of the menstrual cycle and the equivalent days for the oral contraceptive users. Serum progesterone concentrations were later measured for menstrual phase verification. The subjects performed shuttle running over a 20 m distance comprising of repeated cycles of walking, sprinting, cruising ( $\sim 95\% \dot{V}O_2 \text{ max}$ ) jogging ( $\sim 55\% \dot{V}O_2 \text{ max}$ ) and rest, until exhaustion (Nicholas *et al.* 1995, *Journal of Sports Sciences*, **13**, 283-290). Subjects drank water ad libitum. Analysis of data was undertaken using a 2-way and 3-way ANOVA where appropriate.

There were no differences in distance run between menstrual cycle phases or between the normally menstruating and oral contraceptive groups (follicular vs luteal phase;  $5869 \pm 2896$  vs  $6238 \pm 2648$

m. Furthermore, there were no differences in sprint performance (set 1 FT vs LT, normally menstruating  $2.68 \pm 0.08$  vs  $2.73 \pm 0.11$  s, contraceptive users  $2.78 \pm 0.22$  vs  $2.79 \pm 0.19$  s) perceived exertion, heart rate, body mass changes, rectal temperature, fluid intake, plasma volume changes, plasma lactate and ammonia between either phases or between normally menstruating women and oral contraceptive users. However, plasma glucose concentrations were higher in the follicular phase than the luteal, (main effect phase  $P < 0.01$ ). This difference was greatest at the end-point of the exercise when the follicular and luteal plasma glucose concentrations were  $9.56 \pm 3.02$  and  $8.04 \pm 2.69$   $\text{mmol} \cdot \text{l}^{-1}$  respectively (interaction phase –by- time,  $P < 0.01$ ).

These results demonstrate that for unacclimatised games players the performance of intermittent, high intensity shuttle running in the heat is unaffected by menstrual cycle phase nor oral contraceptive use.