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Research article

## Serum Markers of Inflammation and Endothelial Function are Elevated by Hormonal Contraceptive Use but not by Exercise-Associated Menstrual Disorders in Physically Active Young Women

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### ABSTRACT

The purpose of the study was to determine the effects of exercise-associated menstrual disorders and hormonal contraceptives (HC) on systemic inflammatory markers and endothelial function in female athletes. Thirty-nine active women ( $\geq 5$  h of aerobic exercise per wk), aged 18-33 y, participated in this cross-sectional study comparing women with menstrual disorders (MD,  $n = 10$ ;  $0-9$  cycles $\cdot$ y $^{-1}$ ), eumenorrheic women (E,  $n = 13$ ;  $10-13$  cycles $\cdot$ y $^{-1}$ ), and HC users (HC,  $n = 16$ ;  $12$  cycles $\cdot$ y $^{-1}$ ). Fasting serum samples were collected during the early follicular phase (d2-5) for the menstruating women. Tumor necrosis factor- $\alpha$  (TNF $\alpha$ ), interleukin-6 (IL-6), C-reactive protein (CRP), soluble vascular adhesion molecule-1 (sVCAM-1), total cholesterol (TC), high- and low density lipoprotein-cholesterol (HDL-C, LDL-C), triglycerides (TG), reproductive hormones, and cortisol were measured in serum. Estradiol, progesterone, and cortisol were not statistically different between MD and E groups; cortisol was significantly greater in the HC versus E group ( $p = 0.002$ ). TC ( $p = 0.005$ ), LDL-C ( $p = 0.03$ ), and CRP ( $p = 0.05$ ) were increased in the HC versus MD and E groups. TNF- $\alpha$  was significantly higher in the HC ( $p=0.001$ ) compared with the E group. There were no significant group differences in the concentrations of sVCAM-1 or IL-6. TNF- $\alpha$  and cortisol were positively

correlated ( $r=0.31$ ,  $p = 0.058$ ), as were sVCAM-1 and estradiol ( $r = 0.41$ ,  $p = 0.010$ ). In conclusion, HC use, but not exercise-associated menstrual disorders, is associated with increased TNF $\alpha$  and LDL-C.

**Key words:** Cytokines, soluble vascular adhesion molecule, female reproductive disorders

### Key Points

- Serum lipids and markers of inflammation were not altered by exercise-associated oligomenorrhea or amenorrhea.
- Hormonal contraceptive users had elevated total and LDL cholesterol compared with regularly menstruating non-HC users.
- C-reactive protein and tumor necrosis factor- $\alpha$ , but not soluble vascular adhesion molecule-1, were increased in hormonal contraceptive users.
- The long-term effect of these changes on cardiovascular disease is unknown.

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