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Changes in Vitamin D and Hematological Micronutrients and Association with Skeletal Health During Marine Officer Candidates School

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Changes in micronutrients, including vitamin D and iron, have been observed during military training but are often assessed within a single sex and in isolation. The integral role of vitamin D in maintaining calcium homeostasis and musculoskeletal health is well understood, however, whether iron deficiency affects bone metabolism and further, the confluence of both deficiencies in men and women undergoing the same arduous training and how that may affect the skeleton have yet to be studied. **PURPOSE:** To characterize sex-specific hematological and nutritional status of men and women undergoing 10-weeks of Marine Officer Candidates School (OCS), determine interrelationships of biomarkers included, and examine how alterations to status affect skeletal health. **METHODS:** OCS candidates including 251 men (23 ± 3 y, 177.05 ± 6.74 cm) and 52 women (24 ± 3 y, 165.00 ± 5.87 cm) underwent two assessment time points, Pre (T1) and Post (T2). Iron status, including serum total iron, iron saturation and total iron binding capacity (TIBC), was measured via immunoenzymatic assays. Hepcidin was measured via Simple Plex ELLA. 25-hydroxyvitamin D (25(OH)D) was measured via mass spectrometry. Vitamin D and hematological status changes were assessed with two-way mixed-measures ANOVAs. Volumetric bone mineral density, geometry, and bone strength were assessed via pQCT (XCT2000, Stratec, Germany) at the distal metaphysis, mid-diaphysis and proximal diaphysis. Pearson correlation (r) determined associations between hematological parameters. Multiple linear regression analysis was performed with bone parameters as the outcome variable and absolute change and baseline ferritin—a sensitive marker of iron status—and 25(OH)D, age, sex and BMI as explanatory variables. **RESULTS:** Decreased concentrations (main effect of time) of 25(OH)D (8-10%), total iron (20-35%) ferritin (18-37%), iron saturation (18-37%) and hepcidin (14-26%) were observed following training (all $p<.001$). Main effects of sex were observed such that women exhibited greater 25(OH)D ($p=.019$) and total iron binding capacity (TIBC) while men exhibited greater serum iron, ferritin and iron saturation (all $p<.001$). Change in iron saturation ($r= -.125$, $p=.032$) and baseline hepcidin ($r= -.145$, $p=.032$) were significantly correlated with change in 25(OH)D. Regression analysis revealed 25(OH)D significantly predicted between 26.3% of the variation in cortical density and thickness (both $p < .04$) while ferritin results were nonsignificant. **CONCLUSION:** OCS deleteriously affected micronutrient status similarly in men and women, which were weak, but significantly related. **SIGNIFANCE/NOVELTY:** These results suggest an emerging association between vitamin D and iron status with plausible implications for operationally relevant outcomes such as physical work capacity, energy metabolism and stress fracture risk.

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