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Sex-differences in Bone Density, Geometry, and Estimated Strength Adaptations to 10-weeks of Military Officer Training

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Mechanical loading (e.g. physical activity) is associated with changes in bone density and structure; however, few investigations have examined the adaptive bone response to arduous military training in men and women. **PURPOSE** Investigate the effects of military training on volumetric bone density (vBMD), geometry, and strength in men and women who complete Marine Corps Officer Candidates School (OCS). **METHODS** Male and female candidates (n=266) completed a tibial peripheral quantitative computed tomography (pQCT) scan before and after a 10-week physically intensive military training course. Three-dimensional vBMD, geometry, and estimated bone strength were assessed at the 4%, 38%, and 66% sites. Wilcoxon signed-rank tests assessed changes across training. Data are mean±SEM, α=0.05. **RESULTS** Subjects were aged 19-35 yrs- (25.3±0.2) with a BMI 25.5±0.1kg/m^2. At the distal (4%) tibia, increases in total vBMD (pre: 354.5±2.7, post: 356.3±2.7 mg/cm^3), trabecular vBMD (294.3±2.2, 295.6±2.2 mg/cm^3), and estimated compression strength (BSI; 154.7±2.2, 156.2±2.1 mg^2/mm^4) were observed in men (n=222, $p<0.001$). In women (n=39), total vBMD (324.2±5.1, 326.5±5.2 mg/cm^3 $p=0.03$), trabecular vBMD (262.7±4.8, 264.4±2.9 mg/cm^3 $p=0.01$), and BSI (105.9±3.3, 107.4±3.4 mm^3 $p<0.01$) also increased. At the midshaft (38%) tibia, total vBMD (938.1±3.7, 938.9±3.7 mg/cm^3 $p=0.03$), cortical thickness (6.8±0.1, 6.8±0.1 mm, $p<0.01$), periosteal circumference (77.0±0.3, 77.1±0.3 mm $p<0.01$) and estimated bending strength (SSI; 2182.7±25.9, 2193.8±25.1 mm^3 $p=0.02$) increased in men (n=208). In women (n=40), only periosteal circumference increased (70.0±0.6, 70.1±0.6 mm $p=0.05$). At the proximal (66%) tibia, no significant changes ($p>0.05$) were observed in men (n=200). In women (n=38), total vBMD decreased (735.9±9.0, 732.7±8.8 mg/cm^3 $p=0.04$) and periosteal circumference increased (82.5±0.9, 82.8±0.9 mm $p<0.01$) following training. **CONCLUSION** Bone adaptations in response to 10 weeks of military training are slight (≤1.5%), but statistically significant and may be sufficient to improve estimates of bone strength. Changes are further dependent on biological sex and anatomical location.

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