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Bone Mineral Density and Tibial Microarchitecture Changes in Division I Male and Female Cross-Country Runners

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Habitual weight-bearing physical activity can improve bone mineral density (BMD), structure, and strength, but it remains unclear if bone adaptations to prolonged physical training are similar between elite male and female endurance athletes. **Purpose:** To compare the effect of 6 months of sport training on areal BMD (aBMD) and tibial volumetric BMD (vBMD), microarchitecture, and strength between elite male and female distance runners. **Methods:** Twenty-one male (n=12; 19.4±0.5 yr; 21.4±0.4 kg/m^2) and female (n=9; 18.9±0.4 yr; 20.9±0.4 kg/m^2) Division I cross-country runners completed high-resolution peripheral quantitative computed tomography (HR-pQCT; XtremeCTII) scans at 4% (metaphysis) and 30% (diaphysis) of total tibial length and DXA (Lunar iDXA) scans of the total body, lumbar spine, and hip prior to and following the competitive fall season. Generalized linear mixed effects modeling was used to compare changes over time between men and women, adjusting for baseline BMI. Data are presented as estimated marginal mean±SEM, α=0.05. **Results:** At the tibial diaphysis, training increased (main effects of time) cortical area (286.8±5.4, 290.3±4.9 mm^2, p=0.016) and perimeter (77.7±0.6, 78.2±0.6 mm, p=0.007), stiffness (307.2±6.2, 310.8±5.6 kN/mm, p=0.021), and failure load (17.5±0.4, 17.7±0.3 kN, p=0.040). Training also increased (main effect of time) total body aBMD (1.238±0.014, 1.248±0.016 g/cm^2, p=0.001). No significant main effects of time were observed for the tibial metaphysis (4%). Men had lower total and cortical vBMD, but greater cortical area, perimeter, and thickness, stiffness, and failure load than women at the tibial diaphysis (main effects of sex, p≤0.032). Men had greater trabecular area and thickness, stiffness, and failure load than women at the tibial metaphysis (main effects of sex p≤0.003). Men had greater aBMD for the total body, femoral neck, and total hip (main effects of sex p≤0.037). No significant sex*time interaction effects were observed. **Conclusion:** Six months of cross-country training elicited positive bone adaptations for the whole body and at the diaphyseal tibia, which were similar between men and women. Sex-differences in parameters of bone health may also explain differences in risk for bone stress injury between men and women.

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