Male Runners Have Impaired Tibial Cortical Bone Integrity and Strength Compared to Non-athletes

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Female athletes with low energy availability are at risk for impaired bone microarchitecture and strength associated with hypogonadism. Data are lacking for bone outcomes in male athletes. We studied 31 men 16-30 years (n=15 runners with mean (±SD) mileage43±4 miles/week, n=16 non-athlete controls). We assessed distal tibia and radius volumetric BMD (vBMD) and microarchitecture by high resolution peripheral quantitative CT (HRpQCT), estimated bone strength by microfinite element analysis and body composition by DXA. Testosterone, estradiol (by LC-MS) and leptin (by electrochemiluminescence) were measured. Groups did not differ for mean age (24.5±3.6y), BMI (22.2±2.6 kg/m 2), lean mass, or testosterone or estradiol levels. Mean tibial cortical vBMD was lower and porosity higher in athletes than controls ($p<0.01$). In contrast, mean tibial trabecular vBMD and number were higher, and separation lower, in athletes ($p<0.02$). Athletes with BMI ≤ 21 kg/m 2 had lower tibial failure load (bone strength estimate) than those with BMI >21 kg/m 2 ($p=0.007$). Lean mass ($R=0.85$, $p<0.0001$), serum leptin ($R=0.59$, $p=0.046$) and estradiol ($R=0.66$, $p=0.007$), but not testosterone, were associated with tibial failure load in athletes. Athlete and control groups did not differ for HRpQCT variables at the radius. Despite weight-bearing activity, male runners have impaired tibial cortical BMD and microarchitecture, which may increase their risk for bone stress injuries. Lower leptin (reflecting lower fat mass) and estradiol (converted from testosterone in adipose tissue), as well as lean mass, are determinants of lower tibial strength in these athletes, suggesting that low energy availability is a risk factor for impaired bone strength in male runners.

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