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Differences Between Tibia Bone Density and Geometry of Male Collegiate Rowers and Sedentary Males

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RESULTS: Body weight, height and body mass index (BMI) were similar between groups. The functionally adapted group had significantly stronger bones (SSI) (38% higher, p=0.05) that were more robust (total area/length) (0.91 vs 1.1, p = 0.06). However, no differences were found between groups in other bone traits including Ct.Ar (227.8 vs. 269.0 mm2, p=0.11) and cBMD (1156 vs 1166 mg/cm3, p=0.35)). The less adapted group was significantly younger.
CONCLUSIONS: Groups had similar Ct.Ar and cBMD but the athletes with functionally adapted bones "built" a stronger skeleton during development. The athletes increased their bone strength by altering their bone geometry; moment of inertia was 56% larger in the functionally adapted group. Previous studies link reduced bone stiffness relative to body size and slender bones with stress fracture. However, in the current population, the less adapted group was significantly younger and may still be modeling their bones that may increase the robustness of their bones as they continue to develop. Long term follow-up of these athletes is needed.

2615 Board #3 May 29, 1:00 PM - 3:00 PM

Differences in Tibia Bone Strength Between Collegiate Rowers and Sedentary Males

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(No relationships reported)

Increased mechanical loading exerts site-specific positive effects on bone density, geometry and strength across a wide variety of sports. In particular, research shows beneficial effects of weight-bearing sports (e.g. soccer, running, and gymnastics) on tibia bone strength, but little research has examined the effects of rowing at similar sites. While not-weight bearing, increased lower-body peak forces generated during rowing, may result in more robust lower extremity bone structure over time compared to non-athletes.
PURPOSE: To investigate the effects of rowing on tibia bone geometry, volumetric density, and strength differences among male collegiate rowers compared to sedentary controls.
METHODS: Study participants included ten collegiate male rowers with a mean 2.2±0.6 years rowing experience and seven sedentary males from an existing database, all aged 18-23 years. Air-displacement plethysmography was used to obtain measures of body composition (fat mass, kg; fat-free mass, kg) in the rowers. The distal (4%) and midshaft (66%) non-dominant tibia sites were scanned using peripheral quantitative computed tomography (pQCT) to acquire bone outcomes. Total cross-sectional area (ToA), total volumetric density, and bone compressive strength were assessed at the distal (4%) site. Proximal tibia (66%) site outcomes included ToA, cortical thickness, cortical volumetric density, and bending strength.
RESULTS: There were no significant differences between rowers and controls in height (cm; 182.2±6.0 vs.180.3±9.8), or weight (kg; 80.2±6.6 vs. 85.9±18.8), respectively. Rower's mean fat-free mass (kg) was 68.4±7.4 and fat mass.(kg) was 10.8±3.5. Total weekly physical activity (including rowing practice) for rowers was 5.9±0.8 days. Finally, there were no significant differences in bone structure or strength between groups at the tibia 4% or 66% sites.
CONCLUSIONS: Despite high peak forces generated during rowing, tibia volumetric bone density, geometry, and strength were similar between male collegiate rowers and sedentary controls. This lack of differences may be attributed to the relatively short training history among the rowers and anthropometric similarities with sedentary controls. Future research should include larger numbers of rowers and controls to further explore the possible effects of rowing on tibia bone geometry, volumetric density, and strength.

2616 Board #4 May 29, 1:00 PM - 3:00 PM

Bone Characteristics in Collegiate Male Soccer Players Compared to Untrained Controls

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Soccer is a high intensity sport that can generate high mechanical strains on bone. Higher bone mineral density (BMD) has been reported in soccer players, but few studies have focused on hip strength or tibia variables.
PURPOSE: The purpose of this study was to compare bone characteristics in collegiate male soccer players (SP, n=23) and controls (CON, n=23) matched for age and weight. We compared areal BMD (aBMD) and volumetric BMD (vBMD) between dominant (D) and non-dominant (N) legs.
METHODS: DXA was used to assess aBMD (total body, lumbar spine, dual femur) and hip structural analysis (Buckling Ratio, Cross-Sectional Moment of Inertia (CSMI), and Section Modulus (SM)). Dominant (kicking leg) and non-dominant tibiae variables (vBMD, bone mineral content (BMC), area, Bone-Strength Index (BSI), Stress-Strain Index (SSI)) were measured by pQCT.
RESULTS: SP had significantly ($p<0.05$) higher aBMD than CON at all sites except for dominant trochanter. Hip strength (smaller Buckling Ratio with higher SM) was significantly ($p<0.05$) greater in SP. Generally, SP had significantly greater values than CON for pQCT variables (total and trabecular vBMD, total and trabecular BSI 4% tibia; cortical area 38% tibia; total vBMD and cortical thickness 66% tibia), except for lower cortical vBMD at 38% and 66% tibia sites. There were significant side ($p<0.05$) differences; the N side/leg had greater total hip aBMD; total and trabecular BSI at 4% tibia; total BMC, total area, cortical BMC, cortical area, and SSI at 38% tibia.
CONCLUSION: Soccer players had higher aBMD, hip strength (SM), vBMD (4% and 66% sites) and tibia strength (4% site) than controls. Both groups had similar dominance patterns, with the N side/leg having greater BMD, BMC, and strength.

Table 1. Selected Bone Variables (Mean ± SE)

Variables	Side	SP (n=23)	CON (n=23)
Total Hip aBMD (g/cm^2)	D	$1.390 \pm 0.031^{**\dagger}$	$1.150 \pm 0.031^{\dagger}$
	N	$1.395 \pm 0.033^{**}$	1.184 ± 0.033
Hip SM (mm^3)	D	$1111.0 \pm 185.4^{***}$	894.38 ± 153.42
	N	$1118.6 \pm 185.5^{***}$	957.65 ± 247.00
Total vBMD 4% (mg/cm^3)	D	$385.2 \pm 7.0^{**}$	341.7 ± 7.0
	N	$388.2 \pm 7.0^{**}$	344.2 ± 7.0
Total BSI 4% (mg^2/mm^4)	D	$185.5 \pm 6.9^{**\dagger\dagger}$	$147.7 \pm 6.9^{\dagger\dagger}$
	N	$192.8 \pm 7.1^{**}$	150.8 ± 7.1

$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$ SP vs. CON;
$^{\dagger}p < 0.05$; $^{\dagger\dagger}p < 0.01$ D vs. N leg