

Racial Differences in Cortical Bone Mass, Size and Estimated Strength at the Tibial Diaphysis in Early Pubertal Children

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Abstract

Osteoporotic fracture rates differ according to race, with blacks having up to half the rate of whites. The reduced fracture rate in blacks has been suggested to be due to their superior bone mass; however, mass is not the sole determinant of bone strength. Bone strength, and consequent fracture risk, is also influenced by how bone material is distributed or structured. It is likely bone structure also contributes to the lower incidence of fractures in blacks and that racial differences in bone structure have roots in childhood. The aim of this study was to assess the influence of race on pQCT-derived cortical bone mass, size and estimated strength at the tibial diaphysis in early pubertal children. 160 children were recruited, with equal subjects according to race (black, n=80; white, n=80) and sex (female, n=80; male, n=80). Subjects were at sexual maturation stages 2 or 3. Tomographic slices of the tibial diaphysis at 66% proximal from the medial malleolus were acquired using pQCT. Slices were assessed for cortical volumetric BMD (Ct.vBMD), cortical BMC (Ct.BMC), total (Tt.Ar) and cortical (Ct.Ar) area, density weighted maximum (I_{MAX}) and minimum (I_{MIN}) second moments of area, density-weighted polar strength-strain index (SSI_P), and muscle cross-sectional area (mCSA). Group differences were assessed by two-way analysis of covariance, with race (black vs. white) and sex (female vs. male) as independent variables. Covariates included predicted years from peak height velocity (maturity offset), tibial length and mCSA. There were no interactions between race and sex (all $P=0.50-0.98$) or main effect for sex (all $P=0.08-0.45$). Blacks had 15.7% more Ct.BMC, and 10.8-11.8% larger Tt.Ar and Ct.Ar than whites (all $P<0.001$). The greater enhancement of Ct.BMC relative to Ct.Ar resulted in blacks having 3.6% greater Ct.vBMD than whites ($P<0.001$). The combination of increased cortical bone mass, size and density in blacks contributed to enhanced estimated bone strength, with I_{MAX} , I_{MIN} and SSI_P being 20.0%, 34.5% and 25.2% greater in blacks than whites, respectively (all $P<0.001$). These data indicate that early pubertal black children have enhanced bone mass, size and estimated bone strength at the tibial diaphysis versus whites, independent of tibial length and mCSA. They suggest bone structural differences may contribute to observed racial differences in fracture rates and that structural divergence between races develops during childhood.