MUSCLE CROSS-SECTIONAL AREA AND BONE STRENGTH SHARE GENETIC AND ENVIRONMENTAL EFFECTS IN OLDER FEMALE TWINS

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Introduction: Muscle and bone characteristics are known to be associated at the population level. The aims of this study were to estimate to what extent individual differences in cross-sectional area of the lower leg muscles and bending strength of the tibial shaft are influenced by genetic and environmental factors in older women, and to investigate whether the association between these traits is due to common genetic factors or environmental factors.

Methods: Peripheral quantitative computed tomography scans of the lower leg were obtained from 102 monozygotic (MZ) and 113 dizygotic (DZ) 63-76-year-old female twin pairs to estimate section modulus (BSI i.e. bone bending strength index) of the tibial shaft and cross-sectional area of the lower leg muscles (muscle CSA). Quantitative genetic models were used to decompose the phenotypic variances of the BSI and muscle CSA into common and trait-specific additive genetic, shared environmental (shared by the co-twins) and individual environmental (not shared by the co-twins) factors.

Results: The groups of MZ and DZ individuals did not differ in mean age, height, body weight, BSI or muscle CSA. The phenotypic correlation between BSI and muscle CSA was 0.45. The pairwise correlations of the MZ and DZ twins were 0.73 and 0.50 for the BSI and 0.73 and 0.42 for the muscle CSA, respectively. The age-adjusted independent pathway model showed that a genetic factor, common to both traits, accounted for 75% (95% CI: 66-79%) of the variance in the BSI and 16% (8-25%) of the variance in the muscle CSA. In addition, a trait-specific genetic factor accounted for 59% (49-68%) of the variance in the muscle CSA. The traits shared an individual environmental factor in common that accounted for 17% (1-34%) and 7% (1-35%) of the variance in the BSI and muscle CSA, respectively. The remaining variances, 8% (0-28%) for the BSI and 19% (18-28%) for the muscle CSA, were accounted for by trait-specific individual environmental factors.

Conclusions: In older women, genetic factors explained three-fourths of the individual differences in the bending strength of the tibial shaft and in the cross-sectional area of the lower leg muscles. Thus, these two traits are good candidates for linkage analysis. The cross-sectional area of the lower leg muscles was partly influenced by same genes as bone bending strength. In addition, there were such environmental factors which influenced both traits. Therefore, it seems that genetic and environmental factors predispose some older women to both sarcopenia and poor bone strength.

Keywords: Muscle, Bone, Osteoporosis