Peripubertal Estrogen Levels and Physical Activity Affect Young Adult Bone Strength in Women

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Abstract:
Understanding how growing bones adapt to mechanical loading is a fundamental problem in human biology. Exercise-induced changes in bone strength are greater in women who start exercising premenarchally vs. postmenarchally, suggesting that estrogen (E2) may mediate these bone-strain interactions. Here we evaluate the contributions of peripubertal physical activity and estrogen levels to young adult bone strength in subjects from the Penn State Young Women's Health Study (N=84). We hypothesize that women who 1) had higher E2 levels or 2) were more physically active during puberty will have greater adult bone strength. To test this hypothesis, we divided subjects into tertiles of physical activity and of E2 level. We then compared cross-sectional moment of inertia (CSMI) and section modulus (Z) in the femoral narrow neck, intertrochanteric region, and proximal shaft at age 17 (measured using DXA and the HAS algorithm) among these E2 and activity tertiles.
Results indicate that women with the highest E2 levels in the first year after menarche had 11% greater CSMI in the narrow neck and 6-12% greater Z in the narrow neck and intertrochanteric region, vs. women with lower postmenarchal E2 levels. The most physically active women had 16-18% greater femoral CSMI in the narrow neck and intertrochanteric region, and 9-11% greater Z in the narrow neck, vs. less active women. These results support the hypothesis that peripubertal estrogen and physical activity are important determinants of adult bone strength. Physiological factors such as hormone levels may be crucial mediators of human osteogenic responses to exercise.