Six-year longitudinal analysis shows physical activity impacts on lean mass development in adolescence

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The study of physical activity effects on muscle and bone in youth is largely limited to cross-sectional comparisons among athletic and nonathletic groups and short-term intervention studies often less than one year. Critical to the field is the impact of physical activity throughout the developmental years on the musculoskeletal system and especially muscle and bone mass. With the development of a healthy muscle and bone mass, children will be better protected from the chronic diseases of osteoporosis and sarcopenia in middle and old ages.

Unique to the literature is the longitudinal study design of body composition in the development years by Bailey et al. (1). The research design and findings of the study by Baxter-Jones et al. (2) in the Journal of Applied Physiology is one cohort from a series of studies from the University of Saskatchewan. In assessing lean mass development for 6 continuous years in a relatively large sample of boys and girls, the authors were able to provide estimates of lean mass development over a 10-yr period. Further, because of their estimates of biological age as estimated from peak height velocity, the usual confounders of maturation and stature with lean mass development were taken into account. These adjustments are essential because of the effect of physical activity on maturation. Finally, because physical activity was assessed each year over the entire 6-yr period, the authors are in a unique position to study in the natural setting the relationship of physical activity and lean mass adjusted for height velocity.

Unique to this data set was the availability of dual-energy X-ray absorptiometry (DXA) measurements with individual yearly estimates of total lean as well as leg, trunk, and arm lean mass in both boys and girls. The key finding of this longitudinal design is that for both boys and girls lean development is a function of quintile of physical activity. Boys at the upper quintile have 1.9 kg more lean mass development at the sample biological age and height than those at the lowest quintile. For girls, the equivalent comparison between the upper and lower physical activity quintile was 1.2 kg. This effect amounts to a 3–6% difference between upper and lower physical activity groups depending on age and sex.

The assessment of physical activity was carried out by self-report (a 9-item questionnaire) (4). A mean of these items formed a composite score assessed every 6 mo. In this longitudinal analysis there is no random assignment to physical activity level; thus the descriptive longitudinal analysis can only establish group differences in lean development without establishing causal effects. Although limited in its internal validity by the nonrandom assignment to physical activity level, the study has a high external validity in terms of natural setting and representative population of boys and girls.

Previous to this study, the authors extended the effect of physical activity on bone development using DXA and a hip structural analysis to estimate femoral neck strength and size (3). Again, using this longitudinal analysis, significant differences in bone mineral size and strength are found to be associated with higher levels of physical activity in both boys and girls over the 2-yr period around the age of peak height velocity. In addition, the authors have also shown an effect of physical activity and fat mass development in boys but not girls from their DXA data in this longitudinal cohort (6).

The main limitation of these well-designed longitudinal studies is that we cannot prove the difference in physical activity caused difference in lean, bone, and fat development as self-selection of children by physique into more vigorous activities confounds the interpretation of results. However, by accounting for height and peak height velocity, much of the self-selection effect may be removed.

In conclusion, the studies of Baxter-Jones et al. (2), Forwood et al. (3), and Mundt et al. (6) demonstrate pioneering work in the assessment of physical activity on body composition in growing boys and girls. The next generation of studies must focus on the key developmental years, two years before and after peak height velocity, measuring other aspects of bone development, and body composition, better assessed by peripheral quantitative computed tomography (5). In addition, weight-bearing and weight-lifting activities need to be designed in the future physical activity questionnaires to begin to assess dose response from more quantitative assessments. Finally, clinical trials with random assignment of activity need to document both short-term and long-term dose of physical activity on the musculoskeletal system in this critical population of youth.

REFERENCES


