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CORR Insights

CORR Insights®: Does Exercise Influence Pediatric Bone? A Systematic Review

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Where Are We Now?

Bone quality is an important factor when analyzing fracture risk in patients of all ages. Fractures are painful, functionally limiting, and costly, both emotionally and financially, to patients, families, and caregivers. Much attention, therefore, has been focused on improving bone health. Wolff's Law teaches us that bone remodels in response to mechanical stress, and so some loading is healthy—indeed essential—to bone. However, too much load can cause damage, either acutely (as seen with traumatic fractures) or over time (as seen in stress or overuse injuries). Also, bone does not behave identically in all individuals. Population demographics, lifestyles, activity levels, climate, diet, and the interaction of these variables must be considered. Since bone mineral density declines during adulthood, it would be ideal to maximize bone quality in the pediatric population.

Controversy exists, however, regarding the best ways to accomplish this. Exercise is one way to alter bone quality and can result in numerous physical and psychological benefits. However, questions still remain, including: What types of exercise are best? How often and how intensely should one exercise? Can benefits be maintained in both the short- and long-term? Do results of exercise differ by sex? How do nutrition, body habitus, hormone levels, medical comorbidities, and other factors influence the effects of exercise? One single exercise prescription may not apply to everyone. Instead, exercise protocols may need to be individually adjusted to achieve maximum benefit.

In their meta-analysis of previous studies, Specker and colleagues attempt to answer the following questions: (1) Does exercise in childhood consistently increase bone mineral content, bone area, or areal bone mineral density (aBMD)? (2) Do effects of exercise differ depending on pubertal status or sex of the children? (3) Does calcium intake modify the bone response to exercise? After analyzing 22 studies, they conclude that exercise does increase bone mineral content and aBMD, but not bone area.

Where Do We Need To Go?

This meta-analysis pooled data from numerous studies that differed slightly in study design, patient populations and interventions, and outcome measures. Although calcium intake was assessed in some studies, Vitamin D

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levels rarely were included. Specker and colleagues note that few studies have evaluated prepubescent boys. Additionally, most reports analyze bone mineral content and aBMD, but few actually assess the structure and bone area using peripheral quantitative computed tomography. All of this information is needed to truly understand the structure of bone. We are still left wondering if the improvements in bone density actually decrease fracture risk—during youth, young adulthood, or later in life. If so, how can we encourage compliance with exercise and nutritional programs, and should such programs target certain high-risk individuals? If load-bearing exercise improves femoral neck and spine bone density, should we be increasing upper body weight bearing (push-ups, for example) to try to decrease wrist fractures?

How Do We Get There?

Multiple studies in different patient populations support that exercise can improve bone mineral content and density, especially when combined with supplemental calcium [1–7]. Assessing the size and structure of the bones may be accomplished with peripheral quantitative CT scans; however, this technique may be difficult to employ in large groups due to concerns about radiation exposure. Longitudinal studies are needed to determine if the benefits can be maintained in the long-term. It would be interesting to follow participants from previous studies into late adulthood. Ideally, tracking fracture rates would help us understand the long-term benefits of exercise intervention. Such information could best be obtained in large population studies where interventions are performed in large cohorts. Having baseline body composition data (muscle mass, bone quality, percentage of body fat) prior to intervention would better standardize results. Assessing wrist/distal radius bone quality and the affect of upper body load bearing (such as push-ups) should be considered since wrist fractures are common in all ages. Finally, we need to consider why some individuals do not show bone density improvements after exercise. Is there a ceiling effect? Do they already start with sufficient or maximal density? Should exercise protocols be tailored to specific body types? Looking at larger populations, before and after exercise intervention programs, may be the best way to assess these issues.

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