Fat and bone: the difficult duet to measure

A. Pietrobelli

Grasa y hueso: un dueto difícil de medir

Background

Quantifying the main body components is integral to the study of growth, as the assessment of human physical characteristics is important in the anthropological and medical fields (1). The human body consists of over thirty components, sometimes also referred to as compartments, distributed across the main organizational levels: atomic, molecular, cellular and tissue system (2). The sum of all components at each level of body composition is equivalent to total body mass (3). Studies of body composition and various risk factors in growing children should have important implications for preventive medicine (4, 5).

Purpose

There was been uncertainty in the adult body composition literature about whether fat mass (FM) of fat free mass (FFM) is a better predictor of bone mineral content and bone mineral density (6). This issue has recently also been raised in pediatric literature (7). First we will describe and discuss methods for pediatric body composition assessment starting with cutting-edge methods that are primarily available to research centers. Then we will discuss practical and easy to perform methods for estimating body composition in order to establish an individual child's health (8). This could offer to us the possibility of disentangle the relation between fat and bone.

Discussion

According with the literature lean tissue mass is independently associated with total bone mineral content both in boys and girls. It is important to note that total bone mineral content as well as total bone mineral density were more strongly associated with lean tissue mass than FM (7, 9). We will discuss potential mechanisms for the positive association between lean tissue mass and total bone mineral content including a greater mechanical load and increased estrogen production among other factors. Because lean body mass reflects skeletal muscle mass, and bone and skeletal muscle form an operation unit we will look at the notion that skeletal muscle development is linked to skeletal development. Twins studies offer an informative approach to better understanding the basis of the relationship between these correlations, including genetic and environmental influences (10). Another important component is the role of physical activity, which promotes greater bone density in children and adolescents (11). Attention could be put on weight loss among over-weight, obese, and anorectic adolescents; in fact lower bone density was associated with severe weight loss. Particular emphasis will be done on Dual energy X-ray Absorptiometry (DXA) as the reference method for assessing long-term changes in bone density and mineral content (12).

Conclusion

The clinicians should consider the various factors that can influence body composition. It is important to know nutritional factors, energy intake, and composition of the diet, nutrition and hormonal status, food preferences and behavior, and the non influence of non-nutritional factors (5). When these are taken together with an accurate and precise body composition

Pediatric Unit
Verona University Medical School
Verona (Italy)

assessment where FM, FFM and total bone mineral are measured and precisely controlled, it may be possible to have a control of growth process in order to predict adult status. This could reduce the risk factors for various diseases (5, 8).

References

1. Forbes GB. Methods for determining composition of the human body. Pediatrics 1962; 29:477-94.

2. Wang ZM, Pierson RN Jr, Heymsfield SB. The five level model: a new approach to organizing body composition research. Am J Clin Nutr 1992; 56:19-28.

3.   Wang ZM, Heshka S, Pierson RN Jr, Heymsfield SB. Systematic organization of body composition methodology: overview with emphasis on component based methods. Am J Clin Nutr 1995; 61:457-65.

4. Forbes GB. Body composition in infancy, Childhood and adolescence. In: Human Body composition: growth, aging and activity. Ed. Forbes GB. New York: Springer Verlag 1987:125-196.

5. Pietrobelli A, Heo M, Faith MS. Assessment of childhood and adolescents' body composition: a practical guide. In Perspectives in human growth, development and maturation. Eds. Dasgupta P, Hauspie R. Kluwer Academic Publisher, 2001: 67-75.

6. Aloia JF, Vaswani A, Ma R, Flaster E. To what extent is one mass determinant by fat-free or fat mass? Am J Clin Nutr 1995, 61:1110-1114.

7. Pietrobelli A, Faith MS, Wang J, Brambilla P, Chiumello G, Heymsfield SB. Association of lean tissue and fat mass with bone mineral content in children and adolescents. Obes Res 2002; 10:56-60.

8. Sopher A, Shen W, Pietrobelli A. Pediatric body composition methods. In: Human body composition. Eds: Heymsfield SB, Lohman TG, Wang ZM, Going SB. Human Kinetics, 2005: 129-140.

9. Courteix D, Lespessailles E, Loiseau-Peres S, Obert P, Ferry B, Benhamou CL. Lean tissue mass is a better predictor of bone mineral content and density than body weight in prepubertal girls. Rev Rheum 1998; 65:328-36.

10. Maes HHM, Neale M, Eaves LJ. Genetic and environmental factors in relative body weight and human adiposity. Behav Genet 1997; 27:325-51.

11. Branca F. Physical activity, diet, and skeletal health. Public Health Nutr 1999; 2:391-96.

12. Pietrobelli A, Wang ZM, Formica C, Heymsfield SB. Dual energy x-ay absorptiometry: fat distribution errors due to variation in soft tissue hydration. Am J Physiol 1998; 274:860-66.