Rev Paul Pediatr. 2014;**32(3)**:266–272.

REVISTA PAULISTA DE PEDIATRIA

www.spsp.org.br

REVIEW ARTICLE

Factors that influence bone mass of healthy children and adolescents measured by quantitative ultrasound at the hand phalanges: a systematic review☆

Tathyane Krahenbühl*, Ezequiel Moreira Gonçalves, Eduardo Tavares Costa, Antonio de Azevedo Barros Filho

Universidade Estadual de Campinas (UNICAMP), Campinas, SP, Brazil

Received 19 December 2013; accepted 5 March 2014

KEYWORDS
Children;
Adolescent;
Finger phalanges;
Ultrasonography;
Bone development;
Bone density

Abstract
Objective: To analyze the main factors that influence bone mass in children and teenagers assessed by quantitative ultrasound (QUS) of the phalanges.
Data source: A systematic literature review was performed according to the PRISMA method with searches in databases Pubmed/Medline, SciELO and Bireme for the period 2001-2012, in English and Portuguese languages, using the keywords: children, teenagers, adolescent, ultrasound finger phalanges, quantitative ultrasound of phalanges, phalangeal quantitative ultrasound.
Data synthesis: 21 articles were included. Girls had, in QUS, Amplitude Dependent Speed of Sound (AD-SoS) values higher than boys during pubertal development. The values of the parameters of QUS of the phalanges and dual-energy X-ray Absorptiometry (DXA) increased with the increase of the maturational stage. Anthropometric variables such as age, weight, height, body mass index (BMI), lean mass showed positive correlations with the values of QUS of the phalanges. Physical activity has also been shown to be positively associated with increased bone mass. Factors such as ethnicity, genetics, caloric intake and socioeconomic profile have not yet shown a conclusive relationship and need a larger number of studies.
Conclusions: QUS of the phalanges is a method used to evaluate the progressive acquisition of bone mass during growth and maturation of individuals in school phase, by monitoring changes that occur with increasing age and pubertal stage. There were mainly positive influences variables of sex, maturity, height, weight and BMI, with similar data when compared to the gold standard method, the DXA.

DOI refers to: 10.1590/1984-0462201432319
☆Study conducted at Faculdade de Ciências Médicas da Universidade Estadual de Campinas, Campinas, SP, Brazil.
*Corresponding author.
E-mail: tathy04n@gmail.com (T. Krahenbühl).

PALAVRAS-CHAVE
Criança;
Adolescente;
Falanges dos dedos da mão;
Ultrassonografia;
Desenvolvimento ósseo;
Densidade óssea

Fatores que influenciam a massa óssea de crianças e adolescentes saudáveis mensurada pelo ultrassom quantitativo de falanges: revisão sistemática

Resumo
Objetivo: Analisar quais os principais fatores que influenciam na massa óssea de crianças e adolescentes avaliada pelo ultrassom quantitativo (QUS) de falanges.
Fonte de dados: Foi realizada revisão sistemática da literatura, de acordo com o método Prisma, com buscas nas bases de dados do Pubmed/Medline, Bireme e Scielo, referente ao período de 2001 a 2012, nos idiomas inglês e português, utilizando os descritores *children, adolescent, ultrassonography finger phalanges, quantitative ultrasound of phalanges, phalangeal quantitative ultrasound*.
Síntese dos dados: Foram incluídos 21 artigos. As meninas apresentaram no QUS valores de Amplitude Dependent Speed of Sound (AD-SoS) superiores aos meninos durante o desenvolvimento puberal. Os valores dos parâmetros do QUS de falanges aumentaram com o incremento do estádio maturacional, assim como ocorre com o Dual-energy X-ray Absorptiometry (DXA). Variáveis antropométricas, como idade, peso, estatura, índice de massa corporal (IMC) e massa magra, demonstraram correlações positivas com os valores do QUS de falanges. A atividade física também demonstrou estar positivamente relacionada ao aumento da massa óssea. Fatores como etnia, genética, ingestão calórica e perfil socioeconômico ainda não mostraram relação conclusiva e necessitam um número maior de estudos.
Conclusões: O QUS de falanges é um método indicado para avaliar a progressiva aquisição da massa óssea durante o crescimento e a maturação dos indivíduos em fase escolar, por acompanhar as alterações que ocorrem com o aumento da idade e do estádio puberal. Observou-se influência positiva, principalmente das variáveis de sexo, maturação, estatura, peso e IMC, sendo seus dados semelhantes quando comparados ao método padrão-ouro, o DXA.

Introduction

Childhood and adolescence are important phases for the development of peak bone mass, as it is the time when there is a gradual increase in bone tissue, with the predominance of formation in relation to absorption.[1] Several aspects may influence the process of increasing bone mass, such as genetic, hormonal, and nutritional factors, as well as physical activity.[1,2]

There are several methods to measure bone mass in pediatric age ranges, which are different regarding the techniques and assessed anatomical sites, and all present advantages and disadvantages. The method considered to be the gold standard is dual-energy x-ray absorptiometry (DXA),[3] but this method is influenced by changes in bone size during growth and may underestimate bone mineral density (BMD) in small individuals and overestimate it in larger individuals, in addition to not providing information regarding bone quality.[2] In recent years, quantitative ultrasound (QUS) of the phalanges has been widely used as it is an easily accessible, low-cost, non-invasive, non-ionizing, and portable technology,[4-6] which uses the speed of sound as a principle to assess bone mass in the proximal phalanges of the hand, a site sensitive to bone alterations that occur during growth[7-9] and is less influenced by bone size.[9,10]

Understanding the factors that determine the process of acquisition during bone tissue maturation and which techniques can be used to properly assess bone mass allows for the creation of strategies for intervention and prevention of disorders and alterations in that tissue, preventing early onset of osteogenic diseases. However, it is yet to be determined which factors are more important or show more interference during these periods. Thus, this study aimed to analyze the main factors that influence bone mass in children and adolescents assessed by QUS of the phalanges.

Methods

This is a systematic review of the literature on the QUS of the phalanges method in healthy children and adolescents. The Prism Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISM) [11] method was used as a reference.

Initially, it was done an article research in PubMed, Bireme, and SciELO databases, between 2001 and 2012. The search was performed by two authors (TK and EMG) at different times, guided by a librarian, in English and Portuguese. The keywords used for the search were: children, adolescent, ultrasonography finger phalanges, quantitative ultrasound of phalanges, phalangeal quantitative ultrasound, using “and” or “or”.

Based on the analysis of titles and abstracts, 69 articles were identified in the databases, of which 48 were excluded and 21 were included in this study. The inclusion criteria for selecting the articles were: studies with QUS of