Measurement properties of radial and tibial SoS for screening bone health and fragility in 10 to 12 yrs old boys and girls


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INTRODUCTION

Girls and boys with bone fractures reveal usually low bone mineral and bone size and consequently are at risk for osteoporosis from 10-13 yrs. Osteoporosis is however a disease that could have a slow and long progression starting in the period of growth associated with an insufficient acquisition of bone mineral. The screening of bone health around 10-14 yrs of age in girls and 10-16 yrs of age in boys seems to be particularly important in the prevention of osteoporosis because about 40% of peak bone mineral mass is acquired during the four year period surrounding peak height velocity, which is around the 12th and 14th yrs of life in girls and boys, respectively [3-4]. Beyond DXA, other equipments have been applied in both pediatrics and adults to assess bone mineral status, as the quantitative ultrasound (QUS), which quantifies the ultrasound velocity and attenuation parameters at the distal regions of the appendicular skeleton [5-6]. In children and adolescents, the tibia (midshaft) and the radial shaft (tibial) with cortical axial transmission of ultrasound have been the skeletal sites most often assessed by the multilude QUS devices [7-8]. However, poor or inconsistent associations between QUS and DXA both in growing patients with pathology [10-12] as in healthy children [13-14] have been found. Given that bone ultrasound are relatively inexpensive and free of ionizing radiation making them a suitable method for screening bone fragility in large pediatric populations, the main objective of the study was to analyze measurement properties of the BeamMed OmmiSense QUS to screen bone health and fragility.

METHODS

Subjects. 319 non-obese participants, 160 girls and 159 boys drawn from local schools (5th grade) not taking any medication affecting bone.

Speed of Sound (SoS); radial (distal third) and tibial (midshat) SoS evaluated by QUS on the non-dominant limb (Sunlight OmmiSense TM, BeamMed Ltd; Tel Aviv, Israel). radial and tibial SoS coefficients of variation were 0.6% and 0.3%, respectively.

Bone mineral density (BMD); BMD of the whole body less head (WBLH) obtained from a whole body scan (QDR Explorer HR; Hologic, Waltham, MA, USA); reproducibility of the whole body scan was not performed to avoid excessive exposure to radiation.

Body size and body composition: standing height (cm) measured in accordance with the International Society for the Advancement of Kinanthropometry [15]. body mass (kg) evaluated with a weighing-scale (Seca Alpha model 770, Hamburg, Germany) with children in underwear and barefoot; body mass index (BMI) calculated as body mass in kilogramms divided by body height (in meters squared); total fat mass (%) estimated via six Skeletal measurements which include calf and triceps skinfolds [16].

Maturity offset; estimated as the distance years positive or negative of the age from peak height velocity (PHV) using sex-specific prediction equations that include age, body height, sitting height, and body mass [17-18].

Calcium intake; calculated from a semi-quantitative Food Frequency Questionnaire, assessing regular intake of a wide set of a typical Portuguese foods.

Statistical analysis: standardization of all bone variables with previous adjustment of WBLH BMD for body height; validation analysis (radial SoS vs. WBLH BMD; tibial SoS vs. WBLH BMD) conducted by concordance coefficient correlation with differences between the regression and identity lines tested by analyzing the intercepts and slopes; additional use of Kappa statistic to analyze agreement by tertiles, in particular among the first tertile of the two methods, bone height defined as low WBLH BMD measured by DXA (first tertile: 1st SD, 95% CI: 1.1% - (-0.6%) and as past history of fractures evaluated by questionnaire; accuracy of the radial and tibial SoS and of the WBLH BMD to identify participants with past fractures analyzed by logistic regression; statistical significance set at P<0.05; analyses conducted with SPSS (Version 19.0 for Windows; SPSS, Chicago, IL, USA) and MedCalc (MedCalc Software, Mariakerke, Belgium).

RESULTS

** CONCLUSIONS

- Concordance coefficient correlations between WBLH BMD and radial and tibial SoS of 0.129 and 0.038 respectively, with regression lines different from the identity lines.

- Radial and tibial SoS explaining less than 2% of the variability of the WBLH BMD.

- Kappa coefficients near 0 suggests that the equipments ratings were largely different, even in the group of bone fragility [first tertile of WBLH BMD]: 1st SD (5.3%), 95% CI: 1.1% - (-0.6%).

- Cross classification showed that only 41 participants (35.3%) were categorized in the first tertile of radial SoS and 38 participants (33.3%) in the first tertile of tibial SoS, concerning bone fragility identified in the first tertile of DXA measurements.

- Logistic regression adjusted for gender and maturity showed that radial SoS was the only significant variable in predicting OR for identifying participants with past fractures; each SD increase in radial SoS decreased fracture odds ratio in 25.9%.

- The BeamMed OmmiSense QUS provides significant fracture prediction when measured at the radius in youth 10-12 yrs old revealing to be a valuable tool for screening bone fragility despite the absence of agreement with DXA WBLH BMD.

REFERENCES


* Independent Sample T-Test; PHV: peak height velocity; BMD: bone mineral density; SoS: speed of sound

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