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ORIGINAL ARTICLE

Influence of the weight status on hip bone mineral density in young males

Influence du statut pondéral sur la densité minérale osseuse de la hanche chez les jeunes de sexe masculin

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KEYWORDS
Body mass index;
Bone strength;
Lean mass;
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Physical activity

Summary
Objective. — The aim of this study was to explore the effects of being obese or overweight on bone mineral density (BMD) of proximal femur in a group of Lebanese adolescent boys and young men (aged 15 to 30 years).
Material and methods. — This study included 128 adolescent boys and young men (34 obese, 54 overweight and 40 normal-weight). The three groups (obese, overweight and normal-weight) were matched for age. Body composition and proximal femur BMD were assessed by dual-energy X-ray absorptiometry (DXA). DXA scans were analyzed at the femoral neck (FN) by the hip structure analysis (HSA) program. Cross-sectional area (CSA), an index of axial compression strength, and section modulus (Z), an index of bending strength, were measured from hip bone mass scans. Daily calcium intake and physical activity were assessed using questionnaires.
Results. — Body weight, lean mass, fat mass and BMI were significantly higher in obese and overweight subjects in comparison to normal-weight subjects ($P < 0.05$). After adjusting for age, whole body bone mineral content (WB BMC), total hip (TH) BMD, FN BMD, FN CSA and FN Z were significantly higher in obese and overweight subjects in comparison to normal-weight subjects ($P < 0.05$). After adjusting for weight, obese subjects displayed lower WB BMC, FN CSA and FN Z in comparison to normal-weight and overweight subjects ($P < 0.05$). In the whole population, weight, height, lean mass and physical activity were positively correlated to WB BMC, TH BMD, FN BMD, FN CSA and FN Z.
Conclusion. — This study suggests that in obese adolescent boys and young men, WB BMC and indices of axial compression strength and bending strength at the FN are not adapted to the increased body weight.

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MOTS CLÉS
Indice de masse corporelle ;
Résistance osseuse ;
Masse maigre ;
Pic de masse osseuse ;
Activité physique

Résumé
Objectif. — Le but de cette étude était d'explorer l'influence du statut pondéral sur la densité minérale osseuse de la hanche chez un groupe d'adolescents de sexe masculin et de jeunes hommes libanais (âgés de 15 à 30 ans).
Méthodes et sujets. — Au total, 128 sujets de sexe masculin âgés de 15 à 30 ans ont participé à cette étude. Cette population a été divisée en trois groupes en fonction du statut pondéral (34 sujets obèses, 54 sujets en surpoids et 40 sujets normo-pondérés). Les trois groupes (obèse, en surpoids et normo-pondéré) étaient appariés pour l'âge. La composition corporelle du corps entier (CE) et la densité minérale osseuse (DMO) de la hanche ont été évaluées par ostéodensitométrie biphotonique à rayons-X (DXA). Les images DXA au niveau du col fémoral ont été analysées par le logiciel Hip Structure Analysis (HSA). La surface de la section transversale (CSA) et le module de section (Z) du col fémoral ont été mesurés par le logiciel HSA. La consommation calcique journalière et le volume hebdomadaire d'activité physique ont été évalués par des questionnaires.
Résultats. — Le poids, la masse maigre, la masse grasse et l'indice de masse corporelle étaient significativement supérieurs chez les groupes obèse et en surpoids par rapport au groupe normo-pondéré. Après ajustement pour l'âge, le contenu minéral osseux (CMO) CE, la DMO de la hanche totale, la DMO du col fémoral, la surface de la section transversale du col fémoral et le module de section du col fémoral étaient significativement supérieurs chez les groupes obèse et en surpoids par rapport au groupe normo-pondéré. Après ajustement pour le poids, le CMO CE, la surface de la section transversale du col fémoral et le module de section du col fémoral étaient significativement inférieurs chez le groupe obèse par rapport au groupes en surpoids et normo-pondéré. Dans la population entière, le poids, la taille, la masse maigre et le volume hebdomadaire d'activité physique étaient positivement corrélés au CMO CE, à la DMO de la hanche totale, à la DMO du col fémoral, à la surface de la section transversale du col fémoral et au module de section du col fémoral.
Conclusion. — Cette étude suggère que le contenu minéral osseux du corps entier et les indices de résistance en flexion et en compression au niveau du col fémoral ne sont pas adaptés à l'excès de poids chez les adolescents obèses de sexe masculin et les jeunes hommes obèses.

1. Introduction

The incidents of hip fractures in men are rising worldwide [1,2]. Peak bone mineral density (BMD) in men may be the single most important determinant for the prevention of osteoporosis later in life [2,3]. Determinants of peak BMD in men include genetic factors, dietary intakes and exercise... [2,3]. Body weight has been shown to be a strong predictor of BMD in adolescent boys [4—6]. However, the influence of being obese or overweight on hip BMD in young adult men is not completely understood. The hip is a weight-bearing site, which is influenced by mechanical factors such as lean mass and physical activity [3,7—17]. Furthermore, hip bone strength is not only influenced by BMD but also by bone geometry and bone material properties [18—20]. Bone material properties vary little between healthy subjects [21]. The main aim of this study was to explore the effects of being obese and overweight on proximal femur BMD and geometric indices of femoral neck (FN) strength in a group of adolescent boys and young adults. The second aim of this study was to explore the relative importance of age, lean mass, fat mass, daily calcium intake and physical activity on proximal femur BMD and geometric indices of FN strength in the whole population. We hypothesized that obese and overweight subjects have higher BMD and bone strength indices at the hip compared to normal-weight peers and that lean mass and physical activity are positive determinants of BMD and geometric indices of FN strength in the whole population.

2. Material and methods

2.1. Subjects and study design

Hundred and twenty-eight healthy males (aged 15 to 30 years) participated in this study. The participants were non-smokers and had no history of major orthopaedic problems or other disorders known to affect bone metabolism. The participants were divided into three groups: obese ($n = 34$), overweight ($n = 40$), and normal-weight ($n = 54$) using international cutoffs for BMI [22]. These three groups were matched for age. This study did not include extremely obese (BMI > 40 kg/m^2) males or extremely lean (BMI < 16 kg/m^2) males. An informed written consent was obtained from the participants. This study was approved by the University of Balamand Ethics Committee.

2.2. Pubertal status assessment

Tanner pubertal status was determined by self-evaluation [23]. Adolescents were provided with line drawings of the five Tanner stages and were instructed by a research assistant to choose the drawing that best represented their current stage of development. Adolescents completed the form in a private setting.

2.3. Anthropometric measurements

Height (in centimeters) was measured in the upright position to the nearest 1 mm with a Seca standard stadiometer. Body