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ORIGINAL ARTICLE

Effect of distinct impact loading sports on body composition in pre-menarcheal girls

Effet de différents sports d'impact sur la composition corporelle chez des jeunes filles pré-ménarches

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KEYWORDS

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Gymnastique ;
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Summary

Introduction. – The aim of this preliminary work was to explore the effect of distinct impact loading sport and different amount (h/w) of impact activity on body composition of pre-menarcheal girls.

Subjects and methods. – This study included 30 pre-menarcheal girls (aged 8.0–12.9 years) training for at least 1 year in volleyball (VOLLEY, $n = 10$) or artistic gymnastics at high (HGYM, $n = 10$) and low (LGYM, $n = 10$) amount (h/w) of training. Body composition (bone mineral content [BMC], fat-free soft tissue mass [FFST], fat mass [FM], and %FM) was assessed by dual-energy X-ray absorptiometry (DXA) at the total body (TB) and regional (arms, legs, trunk) level as well as specific axial skeleton sites (thoracic and lumbar spine, pelvis).

Results. – After adjusting for body mass and stature, TB composition measurements were all significantly ($P < 0.01$) different in the three groups of pre-menarcheal athletes. VOLLEY had lower BMC and FFST, and greater FM and %FM vs. both HGYM and LGYM. The main difference between LGYM and HGYM was greater %FM in the former. Similar results were found at the regional level (but for similar BMC in the legs) and at lumbar spine and pelvis.

Conclusion. – This study suggests that in pre-menarcheal girls training in impact loading activity, difference in sport type mainly affect %FM, and the amount of impact activity (h/w) has major impact on BMC accrual.

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Résumé

Introduction. – Le but de cette étude préliminaire était d'explorer l'effet de différents sports d'impact et de la quantité d'activité d'impact (h/s) sur la composition corporelle de jeunes filles pré-ménarches.

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DXA ;
Os ;
Masse grasse ;
Masse maigre ;
Prédicteur

Sujets et méthodes. – Nous avons étudié 30 jeunes filles pré-ménarches (âgées de 8,0 à 12,9 ans) après une activité d'au moins une année de volley-ball (VOLLEY, $n = 10$) ou de gymnastique artistique à haute (HGYM, $n = 10$) et faible (LGYM, $n = 10$) quantité (h/s) d'entraînement. La composition corporelle (contenu minéral osseux [BMC], masse non grasse des tissus mous [FFST], masse grasse [FM] et pourcentage de FM [% FM]) a été évaluée par absorptiométrie biphotonique à rayons-X (DXA), soit au corps entier, soit au niveau régionale (membres supérieurs, membres inférieurs, tronc), ainsi que sur des sites spécifiques du squelette axial (rachis thoracique et lombaire, bassin).

Résultats. – Après ajustement pour la masse et la hauteur corporelle, les mesures de la composition corporelle au corps entier étaient toutes significativement ($p < 0,01$) différentes parmi les trois groupes d'athlètes. VOLLEY montrait des valeurs de BMC et FFST plus élevées et de FM et %FM moins élevées que HGYM ou LGYM. La différence principale entre LGYM et HGYM était le %FM plus élevée chez LGYM. Des résultats similaires ont été trouvés au niveau régional (BMC des membres inférieurs exclus) et dans le rachis lombaire et le bassin.

Conclusion. – Cette étude suggère que chez les jeunes filles pré-ménarches, l'activité d'impact de sports différents a un effet en particulier sur le %FM, et que la quantité de l'activité d'impact (h/s) a un effet important sur le BMC.

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1. Introduction

Physical activity involving weight-bearing or jumping is beneficial per se to bone mineral accrual in children [1]. However, there is large evidence that sports involving high impact loading i.e., generated ground reaction forces greater than or equal to three times body weight, tend to produce a better overall osteogenic response than sports without impact loading i.e., generated ground reaction forces = 0 times body weight (review in [2]).

Women's artistic gymnastics and volleyball are Olympic disciplines practiced by millions worldwide, which are characterized by high impact loading (three to six times the body weight; [3,4]) as well as muscle strength requirement. According to cross-sectional studies, both female artistic gymnasts and volleyball players have greater areal bone mineral density (aBMD) and bone mineral content (BMC) in comparison with other athletic and non-athletic populations [5–7]. Female gymnasts and volleyball players often start performing very young, and begin to compete at the lowest levels at about age 7 and 10, respectively. Interestingly, it has been suggested that in subjects who begin training prior to puberty, a greater osteogenic effect may be seen [8,9]. Actually, gymnastics participation in prepubescent girls was associated with increased bone strength and mass vs. controls in several cross-sectional and longitudinal studies, irrespective of large (8–36 h/w [10–13]), or moderate (3–5 h/w [14–18]) participation hours in gymnastics. However, the effect of pre-menarcheal participation in other impact loading sports has been not investigated. Moreover, most investigation of body composition in pre-menarcheal athletes focused on bone characteristics in competitive gymnasts, less interest being paid to gymnasts exposed to lower participation in gymnastics activity and other impact loading sports; further, the athlete's body fat mass (FM) and lean mass were given little consideration. However, an athlete's body composition characteristics, in addition to the loading characteristics of a specific activity, may play a role in explaining the large variation between sports in

bone quality of participants. In fact, FM and muscle mass, together with body mass and stature, show direct or indirect association with aBMD [19].

Therefore, this preliminary study investigated FM, soft tissue fat-free mass (FFST) and BMC in pre-menarcheal, moderately training volleyball players and gymnasts by means of whole-body dual-energy X-ray absorptiometry (DXA) with the aim to first, compare the effect of distinct impact loading sports on bone quality and body composition at a variety of sites and second, determine predictor variables for each BMC measurement. Moreover, the possible role of the amount (h/w) of impact loading activity was evaluated by including a group of high-training gymnasts (HGYM) in the study.

2. Subjects and methods

2.1. Subjects

Thirty pre-menarcheal girls in the age range 8.0–12.9 years training in artistic gymnastic or volleyball for at least 1.0 year participated in this study. Aim and procedures of the study were illustrated to each participant and at least one parent of the latter signed informed consent. All procedures conformed to the Helsinki declaration as revised in 2008. Volleyball players (VOLLEY, $n = 10$) trained twice a week for 1.5 hours and had a competitive match once a week (total training about 5 h/w) with a 3-month stop in summer. Gymnasts ($n = 20$) were subdivided into low-training gymnasts (LGYM) and HGYM. LGYM ($n = 10$) trained twice a week for 2 hours (about 4 h/w) with a 2-month stop in summer; they competed occasionally at the regional level. HGYM ($n = 10$) trained four to five times a week for 3 hours (12–15 h/w) with a 3-week stop in summer; they were involved in competitions at the regional, inter-regional and national level. The physical characteristics of the three groups of participants and the aggregated data are summarized in Table 1.

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