Journal of Clinical Densitometry: Assessment & Management of Musculoskeletal Health, vol. ■, no. ■, 1–7, 2016

1094-6950/■:1–7/$36.00
http://dx.doi.org/10.1016/j.jocd.2016.04.008

Review Article

Handball Practice Enhances Bone Mass in Specific Sites Among Prepubescent Boys

Kawther Missawi,[*,1] *Mohamed Zouch,*[1] *Yosra Chakroun,*[1] *Hamada Chaari,*[1] *Zouhair Tabka,*[1] *and Elyès Bouajina*[2]

[1]*Laboratoire de Physiologie de l'exercice et Physiopathologie: de l'intégré au moléculaire, Biologie, Médecine et Santé, UR12ES06, Faculté de Médecine Ibn Jazar Sousse, Université de Sousse, Sousse, Tunisia; and* [2]*Service de Rhumatologie, CHU Farhat Hached, Faculté de Médecine Ibn Jazar Sousse, Université de Sousse, Sousse, Tunisia*

Abstract

This investigation's purpose is to focus on the effects of practicing handball for at least 2 yr on bone acquisition among prepubescent boys. One hundred prepubescent boys aged 10.68 ± 0.85 yr were divided into 2 groups: 50 handball players (HP group) and 50 controls (C group). Bone mineral density (BMD), bone mineral content (BMC), and bone area (BA) were evaluated by using dual-photon X-ray absorptiometry on the whole body, lumbar spine (L2–L4), legs, arms, femoral necks, hips and radiuses. Results showed greater values of BMD in both right and left femoral neck and total hip in handball players than in controls. In addition, handball players had higher values of legs and right total hip BMC than controls without any obvious variation of BA measurement in all sites between groups. All results of the paired *t*-test displayed an obviously marked variation of bone mass parameters between the left and right sides in the trained group without any marked variation among controls. Data showed an increased BMD of the supporting sites between the left and the right leg among handball players. However, "BMC" results exhibited higher values in the right than in the left total hip, and in the right total radius than in the left correspondent site. In addition, differences in the "BA" measurements were observed in the left total hip and in the right arm. Specific bone sites are markedly stimulated by handball training in prepubescent boys.

Key Words: Bone area; bone mass; handball; prepubescent boys.

Introduction

Bone mass acquisition is widely influenced by ground impacts and locomotion induced by many physical activities *(1)*. Physical exercise is recommended to improve bone in young children and to decrease bone loss in elderly men and women *(2)*. Sports with impact have been suggested to obtain a high peak bone mass, reducing the risk of osteoporotic fractures later in life *(3,4)*. Therefore, the osteogenic effects of mechanical stress induced by impact sports are site specific *(5)*. Mechanical stimulations are beneficial to increase bone mineral density (BMD), bone mineral content (BMC), and bone area (BA) of weight-bearing and non-weight-bearing bones in the young and in adults *(6)*. In many studies, sports like gymnastics and soccer increase BMD and BMC in weight-bearing bones, particularly at the femoral neck among athletes compared to controls *(7,8)*. Other sports such as basketball and volleyball have many beneficial effects on bone mass acquisition among children. According to these data, recently, Zribi et al found that basketball practice was related to high BMC and BA in the whole body, upper and lower extremities, trochanter, total hip, and whole right and left radiuses ($p < 0.001$) in trained prepubescent boys compared to their matched controls *(9)*. Likewise, Chaari et al

Received 01/22/16; Revised 04/2/16; Accepted 04/7/16.
*Address correspondence to: Kawther Missawi, PhD, Laboratoire de Physiologie de l'exercice et Physiopathologie : de l'intégré au moléculaire, Biologie, Médecine et Santé, UR12ES06, Faculté de Médecine Ibn Jazar Sousse, Université de Sousse, 4002 Sousse, Tunisia. E-mail: kawther.missawi@hotmail.fr

showed that 18 mo of volleyball training in prepubescent boys increase BMC in the whole body, lumbar spine, and femoral neck of the dominant leg among the high-level training group. Chaari et al also reported a BA expansion in the radius and weight-bearing sites in the high-level training group, and in the legs and whole radiuses in the low-level group *(10)*. On the contrary, it was mentioned that physical activity in water may not be the best sport to allow an improvement of bone density. Therefore, moving in a low-gravity environment could explain why swimming might abolish the osteogenic effect of sport *(11)*.

Handball, a sport widely practiced worldwide, includes a great number of impacts and maneuvers. This impact sport involves a number of different actions such as rapid directional changes, starts, stops, jumps, and so on *(12)*. Indeed, handball training increases the BMD of the femoral neck, forearm *(13,14)*, lumbar spine, and total body among sportive adolescent girls compared with controls *(14)*. Moreover, practicing handball over 8 mo of competitive season in adult females increases the BMC of the whole body (+1.64%), upper limbs (+4.95%), and lower limbs (+1.7%) in comparison with controls *(15)*.

In our knowledge, there are no data comparing the impact of practicing handball on the BMD and BMC of weight-bearing and non-weight-bearing bones among prepubescent boys. Therefore, the aim of the present study was to verify whether handball is able to increase the BMD, BMC, and the BA of weight-bearing and non-weight-bearing bones among prepubescent boys in comparison with controls.

Materials and Methods

Population

One hundred voluntary prepubescent boys, aged 9–12 yr and recruited from sport schools and clubs in the Tunisian Sahel region, were divided into 2 groups. The sportive group was composed of 50 handball players who practiced handball for at least 2 yr in addition to physical education at school. They completed 3–6 h of training plus 1 match/week during the school year. The other 50 subjects were assigned to the control group. The subjects in the control group participated only in the physical education curriculum at school (2 weekly sessions of 50 min each).

In general, handball training sessions lasted for 1 h and 30 min, including about 15–20 min of warm-up, low-intensity games, and stretching exercises; 15–25 min of technical exercises (passing actions, dribbling, blocking, and running with fast accelerations); and there are 20–30 min of match practice, in relation with the aim of the training session and 10 min of active recovery.

Boys who have chronic diseases that might affect bone metabolism were automatically excluded from the study. The present study was approved by the Independent Ethics Committee of Farhat Hached Hospital in Sousse (Tunisia). All subjects and their parents were asked to sign informed consent forms.

Anthropometric Measurements

Height was measured to the nearest 0.001 m using a wall-mounted stadiometer (model S-220; Seca, Hanover, MD) and weight was assessed to the nearest 0.1 kg using a Seca electronic weighing scale (model #770, Seca). Body mass index (BMI) was calculated as follows: BMI = Weight/Height^2.

Calcium Intake

The dietary calcium intake of each boy was measured using the Bilnut program (version 2.01 1990; SCDA Nutrisoft, Cerelles, France), a method of recording food for 3 consecutive days.

Bone Measurements

The BMD (in gram per square centimeter), BMC (in gram), and BA (in square centimeter) of the whole body (WB), lumbar spine (L2–L4), legs, right and left radiuses, fat mass (FM, in kilogram), and lean body mass (LBM, in kilogram) were measured by dual-energy X-ray absorptiometry (Lunar Prodigy, model DXPA 2004, Software version 3.6; Madison, WI) in the Rheumatology Department of Sousse University Hospital.

Physical Activity Parameters

VO_2 Max

The physical ability of children was assessed by indirect calculation of the maximal oxygen uptake (VO_2 max) through the 20-m shuttle run test of Leger et al *(16)*.

Basal Physical Activity Level (PAL)

The level of daily PAL during a typical day without handball training was estimated by Bratteby et al's questionnaire *(17)*.

Peak Power of the Lower Limbs

The peak power of the lower limbs was measured by horizontal jump by using a dual decameter, and by squat jump and counter movement jump by using the Sargent test *(18)*.

Pubertal Status

The pubertal status of the 2 groups was determined and recorded using the self-report public hair and genital stage described by Tanner *(19)*.

Statistical Analysis

Anthropometric data, age, dietary calcium intake, LBM, FM, and physical activity data were analyzed by unpaired samples Student *t*-test. The analyses of covariance entering LBM as covariate were performed to compare the BMD, BMC, and BA between the 2 groups. Differences of bone parameters between the right and the left weight-