HONG KONG SPORTS INSTITUTE
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RESEARCH HIGHLIGHTS

Bone Mineral Density of Hong Kong Athletes in Different Sports

Sarah S.N. Hui, Frankie P.L. Siu, Lisa Tarquini
Sport Nutrition Monitoring Centre, Hong Kong Sports Institute

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Introduction

Bone mineral density (BMD) can identify osteoporosis and determine the risk for fractures [1]. BMD depends on the influence of endocrine and mechanical factors [2-3]. Cross-sectional studies showed that athletes who participate in different types of exercise have different BMD [4-5]. Power or combat athletes, and team sport athletes have greater BMD than endurance trained athletes, and ballet dancers [5]. Endurance trained athletes are prone to having low BMD which increases the risk for stress fractures and overt fractures [6]. Early identification of low BMD is preferable. There is a paucity of data about BMD in Hong Kong athletes. The aim of this study was to measure the BMD of Hong Kong national athletes in different sports and to investigate the differences between them.

Methodology

One hundred and forty seven subjects aged 18 years old or above were enrolled in this study. All athletes competed at national or international level and trained for at least 15 hours or more per week. Every participant filled in a health and training questionnaire regarding their training regimen and medication. None of the subjects were taking medications or drugs that could affect bone and muscle metabolism. Body weight was measured by an electronic weighing scale. Body fat percentage and BMD were measured by a bone densitometer (Horizon™ DXA system, Hologic Inc., MA, USA) using dual-energy x-ray absorptiometry. The same experienced investigator completed and analyzed all scans using standard analysis protocols. Sports were grouped into either a high or low impact category according to Kohrt and colleagues [7] suggestion. The high impact group consisted of sports that take advantage of body mass impacting the ground to generate gravitational loading which is athletics, cricket, gymnastics, karatedo, rugby, squash, tennis, and triathlon. The low impact group consisted of sports that involve little or no impact with the ground which is cycling, rowing, swimming, and windsurfing.

Statistical Analysis

Results are expressed as Mean ± Standard Deviation (Mean ± SD). Age, body weight, body fat percentage and BMD difference between high and low impact group were determined by Independent Samples Test and Univariate Analysis of Variance. The significance level was set at 0.05.

Results

The BMD of different sports are reported in Table 1. Rugby athletes had the highest BMD among all disciplines in both genders (Male: BMD 1.447 ± 0.099 g/cm^2, Female: 1.310 ± 0.096 g/cm^2). They were followed by squash (1.361 ± 0.060 g/cm^2) and athletics (1.254 ± 0.085 g/cm^2) in male, squash (1.262 ± 0.078 g/cm^2) and tennis (1.253 ± 0.058 g/cm^2) in female. In male athletes, triathletes had the lowest BMD (1.128 ± 0.064 g/cm^2) among all disciplines, followed by rowers (1.161 ± 0.064 g/cm^2) and windsurfers (1.179 ± 0.062 g/cm^2). In female athletes, rowers had the lowest BMD (1.087 ± 0.067 g/cm^2), followed by swimmers (1.167 ± 0.053 g/cm^2) and cyclist (1.176 ± 0.112g/cm^2). Table 2 reports the age, anthropometric characteristics and BMD of high impact and low impact groups. There was a significant difference in age and body weight between two groups of male athletes ($P < 0.05$). There was no significant difference in body fat percentage between groups. The high impact group had a significantly higher BMD value than the low impact group after correcting age and weight in both genders ($P < 0.05$). In both genders, all high impact sports except triathlon had BMD higher than three typical non-weight bearing and low impact sports, cycling, rowing and swimming.

Table 1. Bone mineral density (BMD) of different sports (Mean ± Standard Deviation (SD))

Sport		BMD (g/cm^2)	
		Male	Female
Athletics	n	3	4
	Mean ± SD	1.254 ± 0.085	1.252 ± 0.080
Cricket	n	7	0
	Mean ± SD	1.238 ± 0.041	-
Cycling	n	1	2
	Mean ± SD	-	1.176 ± 0.112
Gymnastics	n	0	3
	Mean ± SD	-	1.247 ± 0.059
Karatedo	n	6	6
	Mean ± SD	1.222 ± 0.120	1.200 ± 0.075
Rowing	n	21	7
	Mean ± SD	1.161 ± 0.064	1.087 ± 0.067
Rugby	n	20	12
	Mean ± SD	1.447 ± 0.099	1.310 ± 0.096

Table 1. Bone mineral density (BMD) of different sports (Mean ± Standard Deviation (SD)) (cont'd)

Sport		BMD (g/cm^2)	
		Male	Female
Squash	n	9	6
	Mean ± SD	1.361 ± 0.060	1.262 ± 0.078
Swimming	n	3	7
	Mean ± SD	1.196 ± 1.123	1.167 ± 0.053
Tennis	n	5	4
	Mean ± SD	1.243 ± 0.082	1.253 ± 0.058
Triathlon	n	5	1
	Mean ± SD	1.128 ± 0.064	-
Windsurfing	n	11	4
	Mean ± SD	1.179 ± 0.062	1.201 ± 0.077

Table 2. Age, anthropometric characteristics and BMD of high impact and low impact groups (mean ± SD)

		High Impact		Low Impact		
		n	Mean ± SD	n	Mean ± SD	P value
Age (years)	Male	55	24.8 ± 4.0	36	22.6 ± 4.6	0.020*
	Female	36	25.8 ± 4.6	20	23.5 ± 3.5	0.052
Weight (kg)	Male	55	74.6 ± 11.5	36	70.1 ± 6.0	0.017*
	Female	36	55.7 ± 8.5	20	59.1 ± 5.2	0.068
Body fat (%)	Male	55	19.9 ± 3.3	36	19.1 ± 2.0	0.158
	Female	36	25.1 ± 3.9	20	25.7 ± 3.7	0.603
BMD (g/cm^2)	Male	55	1.324 ± 0.138	36	1.169 ± 0.067	0.000†
	Female	36	1.260 ± 0.089	20	1.147 ± 0.078	0.012†

* Significant difference between high impact and low impact groups, P value < 0.05

† Significant difference between high impact and low impact groups after correcting age and weight, P value < 0.05

Discussion

Our results concur with those of previous cross-sectional studies [4,5,8]. For weight bearing sports, gravitational forces exert a passive mechanical effect which contributes to the development and maintenance of bone mass [4]. A study in mice have demonstrated that high impact, irregular and multiplanar loads are more effective at increasing bone mass than the lower impact, repetitive, uniplanar loads [9]. Triathlon as a typical endurance sport which generates repetitive forces and little variation is not as effective as other high impact sports in increasing bone mass. Beyond the effects of mechanical load and gravitational forces, energy availability (EA) will affect bone health [10]. Energy availability is defined as the amount of energy consumed minus the amount of energy used during exercise divided by fat-free mass [11], thus EA is the pool of energy that is available to fuel a wide array of physiological functions including bone formation. Triathletes usually control energy intake so as to maintain lower body fat levels and achieve a better power-to-weight ratio. They may have low EA and it may suppress the production of reproductive and growth factors which results in decreased bone formation. Low impact sports which have weight concern like lightweight rowing had the lowest BMD among all sports. Endurance sport and non-weight bearing sports especially those with weight concern are encouraged to be screened and maintain awareness of potential poor bone health.

Reference

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