

Nutrition, Physical Activity and Bone Mineral Density of Hong Kong Elite Athletes

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Introduction

Nutrition and physical activity play important roles in bone acquisition and bone health.¹⁻⁴ However, there is a paucity of information on nutritional status and bone mineral density of adult athletes in Hong Kong. A study in 2010 found that adolescent athletes in Hong Kong have more nutritious diets, better bone mineral density and physiological profiles (i.e. higher lean body mass, lower body fatness) than non-athletic age-matched counterparts.⁵

Purpose

To investigate the nutritional status, physical activity level and bone mineral density of adult elite athletes in Hong Kong, and to compare these characteristics with age-matched sedentary controls.

Methodology

Fifty-eight (M=34, F=24) elite athletes (athletes), aged 18 to 35 years old, recruited from the Hong Kong Sports Institute (HKSI), and 98 (M=41, F=57) sedentary (less than 2 hours of physical activity per week) age-matched controls were recruited from the local community for this study. The athlete subjects were chosen from cycling, fencing, karatedo, rowing, squash, triathlon, badminton, judo and windsurfing teams between the years of 2009 to 2010. A 3-day self-reported food record and questionnaire on physical activity were collected. Physical characteristics, including body weight, height were measured. The lean body mass (LBM), fat mass, bone mineral density at lumbar spine (BMD-Lumbar) and of whole body (BMD-WB) were measured by dual energy x-ray absorptiometry (DXA) instrument (Hologic Explorer, USA). All records and questionnaires were reviewed by a dietitian. Dietary analysis was performed using the Food Processor (ESHA Research, USA Version 10.6.3).

Results and Discussion

Nutrition

On average, athletes consumed 800kcal/d more than the controls. Based on the macronutrients recommendation from the United States⁶ (Carbohydrate (CHO): 45-65%; Protein: 10-35%; Fat: 20-35% of the daily total energy intake (TEI)), athletes were able to meet all recommendations. Controls were able to meet recommendations for CHO and protein but had excessive fat intake. Average daily intakes of energy and nutrients are found in Table 1.

Athletes' average daily calcium consumption was 788mg, almost reaching China's Recommended Nutrient Intake (RNI) of 800mg per day, whereas the control group was 535mg per day, much lower than RNI⁷. Phosphorus intake in both groups reached RNI of 700mg per day.⁷ The mean dietary vitamin D intake in the athlete group and control group were 1.2µg and 0.7µg respectively, both groups were below RNI of 5µg.⁷ However, we have not taken into account the influence of sunlight exposure which contribute to the synthesis of 25-hydroxyvitamin D [25(OH)D]. Athletes who engaged in outdoor sports should have higher synthesis of 25(OH)D than sedentary controls with less than 2 hours of physical activity per week. Magnesium (Mg) is another nutrient which is involved with bone health. The average daily Mg intake of athletes and controls, 211mg and 170mg respectively, which were both below RNI of 350mg.⁷ However, athletes' average Mg intake was significantly higher than the controls' (p<0.05). In general, the nutrients intake pertaining to bone health in the athletes' group is more satisfactory when compared to the control group (See Table 1).

Table 1 Average daily intakes of energy and selected nutrients related to bone health

	Energy (kcal)	CHO (g)	% CHO of TEI	Protein (g)	% Protein of TEI	Fat (g)	% fat of TEI	Calcium (mg)	Magnesium (mg)	Phosphorus (mg)	Vitamin D (µg)
Athletes (n = 28)	2856 ±845**	370 ±142**	51 ±9%**	112 ±34**	16±3%	101 ±36*	32 ±7%**	788 ±386**	211±105*	1012±389	1.2±1.2*
Controls (n = 52)	2036 ±480	230±71	45±7%	88±26	17±3%	82 ±22	36 ±5%	535 ±250	170±58	890±307	0.7±0.85

CHO = carbohydrate TEI = total energy intake
* p<0.05, compared with control ** p<0.01, compared with control

Physical Activity

Physical activity, especially weight bearing activity, is important to bone health.^{2,3} The majority of athletes (81%) started sports-specific training at the average age of 15.2 years old. The athletes received an average of 21.6 hours of sports-specific training per week with an additional of 4.1 hours of weight training per week. In combining sports-specific and weight training, athlete trained an average of 3.7 hours per day.

Body composition and BMD

The results of physiological characteristics of athletes and controls were presented in Table 2. Female athletes were significantly taller and heavier than female controls (p<0.01). Athletes have significantly lower body fat percentage and significantly higher LBM, BMD-Lumbar and BMD-WB than the controls in both genders (the corresponding p values are listed in Table 2).

Table 2 Subjects' body composition and BMD

	Males		Female	
	Athletes (n = 34)	Control (n = 41)	Athletes (n = 24)	Control (n = 57)
Height (cm)	175.2±4.8	173.0±5.9	164.7±4.1**	159.0±6.2
Weight (kg)	69.0±6.7	68.1±9.0	57.2±3.6**	50.6±7.2
LBM (kg)	60.1±5.3**	54.6±4.7	44.8±4.1**	36.4±5.0
Body fat (%)	11.5±2.3**	18.3±5.8	20.8±4.1**	26.9±4.4
BMD-WB (g/cm ²)	1.26±0.12*	1.20±0.09	1.20±0.10**	1.13±0.07
BMD-Lumbar (g/cm ²)	1.07±0.16*	0.99±0.13	1.03±0.08**	0.95±0.11

* p<0.05, compared with control ** p<0.01, compared with control

Conclusion

Athletes generally have better dietary intake than controls. Dietary intakes of the nutrients related to bone health (i.e. calcium, phosphorous, Vitamin D, and magnesium) were all found to be higher in the athletes' group and most of these nutrient intakes met China's Recommended Nutrient Intake (RNI). Athletes' bone mineral density at lumbar and whole body, and lean body mass were higher than controls, whereas their body fat percentage was lower than the controls. In summary, Hong Kong elite athletes have better dietary intake and higher physical activity than the age-matched sedentary subjects. These two factors maybe conducive to bone health.

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