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ORIGINAL ARTICLE

Practice of martial arts and bone mineral density in adolescents of both sexes



Igor Hideki Ito^{a,*}, Alessandra Madia Mantovani^a, Ricardo Ribeiro Agostinete^b, Paulo Costa Junior^b, Edner Fernando Zanuto^b, Diego Giulliano Destro Christofaro^b, Luis Pedro Ribeiro^c, Rômulo Araújo Fernandes^b

^a Instituto de Biociências, Universidade Estadual Paulista “Júlio de Mesquita Filho” (Unesp), Rio Claro, SP, Brazil

^b Universidade Estadual Paulista “Júlio de Mesquita Filho” (Unesp), Presidente Prudente, SP, Brazil

^c Universidade do Algarve, Faro, Portugal

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KEYWORDS

Martial arts;
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Abstract

Objective: The purpose of this study was to analyze the relationship between martial arts practice (judo, karate and kung-fu) and bone mineral density in adolescents.

Methods: The study was composed of 138 (48 martial arts practitioners and 90 non-practitioners) adolescents of both sexes, with an average age of 12.6 years. Bone mineral density was measured using Dual-Energy X-ray Absorptiometry in arms, legs, spine, trunk, pelvis and total. Weekly training load and previous time of engagement in the sport modality were reported by the coach. Partial correlation tested the association between weekly training load and bone mineral density, controlled by sex, chronological age, previous practice and somatic maturation. Analysis of covariance was used to compare bone mineral density values according to control and martial arts groups, controlled by sex, chronological age, previous practice and somatic maturation. Significant relationships between bone mineral density and muscle mass were inserted into a multivariate model and the slopes of the models were compared using the Student *t* test (control versus martial art).

Results: Adolescents engaged in judo practice presented higher values of bone mineral density than the control individuals (p -value=0.042; Medium Effect size [Eta-squared=0.063]), while the relationship between quantity of weekly training and bone mineral density was significant among adolescents engaged in judo (arms [$r=0.308$] and legs [$r=0.223$]) and kung-fu (arms [$r=0.248$] and spine [$r=0.228$]).

Conclusions: Different modalities of martial arts are related to higher bone mineral density in different body regions among adolescents.

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* Corresponding author.

E-mail: hidekincubus@yahoo.com.br (I.H. Ito).

PALAVRAS-CHAVE

Artes marciais;
Densidade mineral
óssea;
Adolescentes

Prática de artes marciais e densidade mineral óssea em adolescentes de ambos os sexos**Resumo**

Objetivo: O objetivo desse estudo foi analisar a relação entre a prática de artes marciais (judô, karatê e kung-fu) e a densidade mineral óssea em adolescentes.

Métodos: O estudo foi composto por 138 adolescentes (48 praticantes de artes marciais e 90 não praticantes) de ambos os sexos, com idade média de 12,6 anos. A densidade mineral óssea foi medida usando absorptometria radiológica de dupla energia em braços, pernas, coluna, tronco, pelve e total. A carga de treinamento semanal e o tempo anterior de envolvimento na modalidade esportiva foram relatados pelo treinador. A correlação parcial testou a associação entre a carga semanal de treinamento e a densidade mineral óssea, controlada para sexo, idade cronológica, prática anterior e maturação somática. A análise de covariância foi utilizada para comparar os valores de densidade mineral óssea de acordo com os grupos controle e de artes marciais, controlados para sexo, idade cronológica, prática anterior e maturação somática. Associações significativas entre a densidade mineral óssea e a massa muscular foram inseridas em um modelo multivariado e as inclinações dos modelos foram comparadas usando o teste *t* de Student (controle versus arte marcial).

Resultados: Os adolescentes envolvidos na prática de judô apresentaram valores maiores de densidade mineral óssea do que os indivíduos do grupo controle ($p=0,042$; tamanho de efeito médio [$\eta^2=0,063$]), enquanto a relação entre a quantidade de treinos semanais e a densidade mineral óssea foi significativa entre os adolescentes praticantes de judô (braços [$r=0,308$] e pernas [$r=0,223$]) e kung-fu (braços [$r=0,248$] e coluna [$r=0,228$]).

Conclusões: Diferentes modalidades de artes marciais estão relacionadas com maior densidade mineral óssea em diferentes regiões do corpo em adolescentes.

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Introduction

During adulthood, bone health is affected by physical inactivity and aging, since both affect bone structure and can lead to osteoporosis and fractures.¹ Therefore, physical exercise is widely advocated for the prevention of fractures and osteoporosis through increases in bone mineral density (BMD) and reduction in age-related bone loss.² In adulthood, physical exercise produces low increments in bone mass² and, thus, childhood and adolescence appear to be the most significant periods in which to improve BMD^{2,3} and, hence, prevent outcomes such as osteoporosis in adulthood.

During childhood and adolescence growth hormone contributes to bone mass gain and the concentration of this hormone in the blood is increased by physical exercise.⁴ Furthermore, the strength and geometry of bone are substantially affected by the higher continuous muscle contractions observed in sport activities.⁵ Therefore, the practice of physical activity is recommended and some studies have reported improvement in BMD in many modalities⁶⁻⁸ such as soccer,⁹ volleyball¹⁰ and badminton;¹¹ but this event is less reported in martial arts.¹²

Martial arts include high-magnitude forces through muscle pulling on the bone, ground reaction forces intensified by the absence of footwear to attenuate impact shocks and high-impact loading of the skeleton due to repeated falls on the ground.¹³ The American College of Sports Medicine¹⁴ recognizes the beneficial effect of sports practice on bone mass gain during human growth, but the same statement

identifies that, although martial arts have aspects related to BMD gain, the findings are mainly based on elite athletes,⁶ and it is not clear if this relationship occurs in children and adolescents.¹⁵ Moreover, the absence of control by important variables related to bone mass gain during childhood and adolescence (fat free mass [FFM] and biological maturation) constitutes a limitation in studies analyzing the relationship between sport practice and BMD in Pediatric populations.¹⁶

Therefore, the aims of this study were (i) to verify the relationship between widely performed martial arts (judo, karate and kung-fu) and BMD in adolescents, as well as (ii) to identify whether this relationship is independent of biological maturation and FFM. We hypothesized that martial arts practice would be related to higher BMD in adolescents of both sexes.

Method

This cross-sectional study was composed of 138 adolescents of both sexes (ages ranging from 11 to 14 years) and was carried out in the "Laboratory for the Investigation of Exercise" (LIVE) of the Department of Physical Education, Universidade Estadual Paulista "Júlio de Mesquita Filho" (UNESP), in the city of Presidente Prudente, Brazil. The cohort study "Practice of different sport modalities and bone mass gain in adolescents: cohort of 9 months" was

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