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Original article

Influence of different sports on fat mass and lean mass in growing girls

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Abstract

Purpose: The aim of this study was to analyze and compare the effects of different sports (swimming, football, basketball, and handball) on fat mass and lean mass in prepubertal and pubertal girls.

Methods: Two hundred girls (10.6 ± 1.5 years old, Tanner stages I–III) participated in the study and were divided into 5 groups: 40 swimmers, 40 football players, 40 basketball players, 40 handball players, and 40 controls. Fat and lean masses at whole body, arms, trunk, and legs were measured using dual-energy X-ray absorptiometry (DXA). Pubertal status was determined using Tanner test. Effects of different sports on fat and lean masses were assessed through analysis of covariance with height as covariates. Analyses were performed separately in 2 groups depending on the Tanner stage (prepubertal and pubertal).

Results: The girls of the control group had less lean mass and more fat mass compared to the girls who play sports ($p < 0.05$). There were differences in body fat between sports. The swimmers and football players had less body fat ($p < 0.05$). On the other hand, handball players showed the highest values in lean mass ($p < 0.05$).

Conclusion: Impact sports (football, basketball, and handball) and low-impact sports (swimming) provide an appropriate development of lean mass in growing girls. We can conclude that people practicing sports at early ages ensure a lower fat mass and higher lean mass compared to those who do not practice. These results may be useful as a preventive method of adult obesity.

Keywords: Body composition; DXA; Female players; Physical activity; Sports

1. Introduction

In the last few years, there has been an alarming increase in overweight and obesity among young people.[1] Among other reasons, this is because of low levels of habitual physical activity and associated negative health outcomes among young people, especially females.[2] Physical inactivity is a risk factor for many diseases such as type 2 diabetes, cardiovascular diseases, high blood lipid, arthritis, asthma, and cancer.[3] Obesity in childhood is closely related to adult obesity,[4] because these children have twice the risk of developing obesity in later life than those who are not obese.[5] Studies such as Boreham et al.[6] show that physical activity during childhood prevents obesity in later life. For these reasons, the prevention of obesity in childhood is an international priority given the impact it has on chronic diseases, general health, development, and well-being.[7]

The direct relationship between physical activity and body composition results in sport having a positive effect on body composition.[8] Physical activity has an influence on muscle mass as a result of increased energy expenditure and helps maintain lean mass, bone mineral density, and body weight.[9] It is known that sport is an important factor that regulates body mass of children, which is associated with lower obesity.[8] Exercise practiced continuously and regularly produces changes in body composition.[3] Physically active people have a lower percentage of fat than people who do not exercise.[10]

For these reasons, health institutions are increasing their interest in assessing body composition of schoolchildren.[4] During the study of body composition, health problems can be identified in relation to body fat, lean mass (excluding bone mass), or muscle mass and changes associated with different types of exercise can be compared.[11] This measurement of body

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composition can be performed through indirect techniques, such as the dual-energy X-ray absorptiometry (DXA). This has become an important tool for evaluating and monitoring obesity and related diseases.[12] It is recognized as an accurate and precise method to measure body composition[13] and it is useful to quantify fat mass and fat-free mass in separate segments or total body.[14] Several reviews claim its theoretical and empirical validity to estimate fat mass and fat-free mass.[15,16]

Moreover, the type of sport has some influence on the development of body composition. Each sport has a different player profile, as each sport has different physical requirements.[17] Most studies are focused on the analysis of high-performance[18] or a particular sport.[19–21] Therefore, studies focused on children's health and proper growth through sport and its various forms are needed. The present study was planned to fill the gap in the literature.

All the sports of this research have their own special features. Football is considered as a resistance sport that generates different levels of intermittent activity at variable intensities,[22] which involves mainly the lower body. On the other hand, the movements that basketball players perform during the games are multiple and differ in terms of intensity, distance, and duration.[23] Movements such as consecutive jumps, changes of direction, several sorts of accelerations and quick counterattacks (short runs) are usually very powerful.[24] However, swimming allows an improvement of the aerobic capacity, flexibility, strength, coordination, and muscle tone of the whole body.[25] Finally, handball is a dynamic sport, with a high aerobic demand, characterized by runs, jumps, throws, passes, and blocks.[26] According to Hatzimanouil and Oxizoglou,[27] handball is a sport that requires certain skills such as speed, agility, reaction speed, speed strength, resistance, strength, and coordination. During game tasks such as pushes and blocks, a great power and strength are required for the limbs and the trunk.[28,29]

To study the body composition of child athletes is important not only to detect young talent but also to track their optimal development.[30] This can be helpful to reconsider teaching and training programs in different contexts (school, training, and performance). Thus, the objective of the study is to analyze and compare the effects of different sports (swimming, football, basketball, and handball) on fat and lean masses in prepubertal and pubertal girls. The hypothesis, in which this research is based on, was that sport practice reduces girls' fat mass and improves their lean mass. The results of the study will show the influence that a particular sport has on the body composition development of growing girls.

2. Materials and methods

2.1. Participants

Healthy prepubertal (Tanner stage I) and pubertal (Tanner stages II–III) female children from different schools and football clubs of Toledo, Ciudad Real, and Madrid (Spain) were recruited for the study. In total, 200 girls aged 9–13 years (10.6 ± 1.5 years) were divided into 5 groups (swimming, football, basketball, handball, and control groups) according to their sport activity patterns. The characteristics of each group and descriptive statistics are presented in Table 1. Once the sample was recruited, the participants underwent a series of tests to assess the degree of sexual development and body composition (fat mass and lean mass).

All the girls practicing sport were recruited from sport clubs, whereas all the control group participants were recruited from schools. According to the answers given during a personal

Table 1
Descriptive characteristics of 5 groups of prepubertal and pubertal girls.

	Swimming	Football	Basketball	Handball	Control
Prepubertal					
n	20	20	20	20	20
Age (year)	9.16 ± 0.69	9.63 ± 0.98	10.36 ± 0.51[a,b]	9.86 ± 0.64	10.01 ± 0.52[a]
Height (cm)	135.03 ± 6.19	141.20 ± 9.84	151.18 ± 10.74[a,b,d,e]	142.04 ± 8.24	141.15 ± 6.32
Body mass (kg)	29.01 ± 4.38	35.73 ± 8.74	43.04 ± 9.34[a]	37.50 ± 8.69[a]	38.44 ± 8.79[a]
BMI (kg/m^2)	15.85 ± 1.66	17.67 ± 2.60	18.74 ± 2.98[a]	18.52 ± 3.86	19.12 ± 3.38[a]
Years of training	4.68 ± 2.00	3.85 ± 1.81	3.37 ± 1.52	3.35 ± 1.35	0
Weekly training hours	3.83 ± 1.89	3.00 ± 0.00	2.88 ± 0.39	3.05 ± 0.22	0
Total BMC (g)	973.68 ± 115.32	1171.74 ± 186.41[a]	1302.71 ± 286.73[a,e]	1133.46 ± 183.35	1122.66 ± 151.60
Total BMD (g/cm^2)	0.78 ± 0.06	0.86 ± 0.07[a]	0.87 ± 0.09[a]	0.84 ± 0.06	0.82 ± 0.06
Pubertal					
n	20	20	20	20	20
Age (year)	12.20 ± 0.62	12.31 ± 0.60	13.05 ± 0.34[a,b,e]	12.69 ± 0.86	12.10 ± 0.72
Height (cm)	154.55 ± 8.41	153.85 ± 6.25	163.12 ± 8.27[a,b,e]	159.96 ± 8.14	155.76 ± 8.32
Body mass (kg)	49.06 ± 11.24	45.61 ± 9.95	56.85 ± 13.20[b,e]	52.66 ± 11.21	46.39 ± 11.27
BMI (kg/m^2)	20.34 ± 3.13	19.13 ± 3.40	21.11 ± 3.51	20.35 ± 2.73	18.91 ± 3.24
Years of training	4.08 ± 2.36	4.45 ± 1.70	4.35 ± 1.42	3.90 ± 1.77	0
Weekly training hours	4.44 ± 2.71	3.55 ± 0.76	3.09 ± 0.19	4.20 ± 2.78	0
Total BMC (g)	1458.32 ± 271.96	1488.10 ± 233.64[e]	1761.62 ± 409.35[a,e]	1784.40 ± 410.98[a,b,e]	1207.70 ± 131.84
Total BMD (g/cm^2)	0.93 ± 0.08[e]	0.95 ± 0.08[e]	1.00 ± 0.13[e]	1.01 ± 0.12[e]	0.83 ± 0.04

Notes: Data adjusted by height. Differences concerning the mentioned group at [a]swimming, [b]football, [c]basketball, [d]handball, [e]control, $p < 0.05$.
Abbreviations: BMC = bone mineral content; BMD = bone mineral density; BMI = body mass index.