

## Changes in Body Composition After 6 Months of Training in Pubertal Swimmers

Cambios en la Composición Corporal Después de  
6 Meses de Entrenamiento en Nadadores Púberes

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**SUMMARY:** This study assessed the differences in body composition after 6 months of training in pubertal boys and girl swimmers and in pubertal boys and girls without sport practice. The swimming group was composed of 20 pubertal swimmers: 10 boys (SB) (age: 13.5±1.5 years; Tanner stage: 3.6±0.5) and 10 girls (SG) (age: 11.3±0.7 years; Tanner stage: 3.4±0.5), with an average training experience of 4±1.3 and 3±0.5 years, respectively. The control group was composed of 20 pubertal participants without sport practice: 10 boys (CB) (age: 13.6±1.2 years; Tanner stage: 3.5±0.5) and 10 girls (CG) (age: 11.2±0.8 years; Tanner stage: 3.5±0.5). The following anthropometric measurements were carried out in two assessment periods (pre- and post-test): height, weight and skinfold thickness (biceps, triceps, subscapular and suprailiac). The sum of 4 skinfolds allowed calculating the percentage of fat mass according to sex and maturational status equations. The Pared-Samples T test was used to analyze the differences between the two assessment periods (pre- and post-test). Between the pre- and post-test, the percentage of fat mass was significantly lower in SB (p= 0.014) and SG (p= 0.016), and significantly higher in CG (p= 0.007). In conclusion, a decrease in the percentage of fat mass was observed in pubertal boys and girls swimmers after 6 months of training compared with the control group, and those results seem to be associated with the swimming training, specifically the high training volume.

**KEY WORDS:** Morphology; Body composition; Pubertal athletes; Swimming.

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### INTRODUCTION

The external morphology refers to the study of bones, muscles and adipose tissue during growth and development (Fragoso & Vieira, 2011), where the body composition is generally expressed as the percentage of fat mass and fat-free mass considering the two compartments model (Claessens *et al.*, 2000; Malina, 2007; Lohman *et al.*, 2008; Malin & Geithner, 2011; Slater *et al.*, 2013). The regular monitoring of body composition in sports is an important indicator of the health and physical development of the adolescent athletes (Lohman *et al.*; Slater *et al.*), namely detecting eating disorders, overtraining, illness or to relate body composition to performance. In addition, the evaluation of external morphology is inherent in the identification, selection and development of young talent athletes (Malina & Beunen, 2008), for example, the identification of essential elements of the body composition for the demands of the sport (Rossi *et al.*, 2014). Currently there are available several methods for the assessment of

body composition in adolescent athletes (Claessens *et al.*; Malina *et al.*, 2004; Malina, 2007; Malina & Geithner; Lohman *et al.*; Slater *et al.*), however due to the low time required, low cost and practical aspects, the anthropometry is one of the most used methods for the evaluation of the external morphology of various populations of adolescents, including young athletes (Claessens *et al.*; Malina, 2007; Lohman *et al.*; Slater *et al.*). In young athletes, low levels of fat are generally observed (Malina, 2009; Malina & Geithner, 2011), including lower adiposity measured through skinfolds, lower body mass index (BMI) and lower percentage of fat mass (Strong *et al.*, 2005), influenced by the type of sport practiced (Malina & Geithner; Slater *et al.*). There is a scarcity of studies that evaluate the changes in body composition associated with training in young boy and girl athletes. Thus, the aim of the study was to analyze the differences in body composition after 6 months of training in pubertal boy and girl swimmers.

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## MATERIAL AND METHOD

**Participants.** The sample consisted in 40 young participants divided into two groups. The swimming group was composed by 20 pubertal swimmers, of which 10 boys (SB) (age:  $13.5 \pm 1.5$  years; Tanner stage:  $3.6 \pm 0.5$ ) and 10 girls (SG) (age:  $11.3 \pm 0.7$  years; Tanner stage:  $3.4 \pm 0.5$ ) with an average of training experience of  $4 \pm 1.3$  years and  $3 \pm 0.5$  years, respectively. The control group was composed of 20 pubertal participants without sport practice, 10 boys (CB) (age:  $13.6 \pm 1.2$  years; Tanner stage:  $3.5 \pm 0.5$ ) and 10 girls (CG) (age:  $11.2 \pm 0.8$  years; Tanner stage:  $3.5 \pm 0.5$ ). All participants volunteered and signed an informed assent, while the parents or guardians signed an informed consent (Winter & Cobb, 2008), for participation in the study, after being informed about the objectives and procedures involved. The study was approved by the Scientific Committee of the University of Madeira and the Sport Sciences School of Rio Maior, Polytechnic Institute of Santarém.

**Procedures.** The data collection was performed at the Laboratory for Research in Sports of the Sport Sciences School of Rio Maior – Polytechnic Institute of Santarém. The study was a quasi-experimental design with non-equivalent groups. The time between the two assessment periods was similar in both groups, namely  $181 \pm 11$  days in the swimming group and  $178 \pm 8$  days in the control group. The pubertal boy and girl swimmers had  $6 \pm 1$  and  $5 \pm 1$  training session per week, respectively. The weekly training volume was  $24800 \pm 9150$  and  $14800 \pm 3650$  meters for boy and girl swimmers, respectively, with approximately 95% of aerobic training and 5% of anaerobic training. The protocols proposed by the International Society for the Advancement of Kinanthropometry (ISAK) were used for the anthropometric evaluation (Fragoso & Vieira; Slater *et al.*). The assessment of biological maturation of the participants, through self-rating (Baxter-Jones *et al.*, 2005; Baxter-Jones & Sherar, 2007; Malina & Beunen), was done based on the developmental stages of pubic hair described by Tanner (1962), using the schematic illustrations and descriptive criteria for each stage (adapted from Malina *et al.*).

**Anthropometrical Measurements.** In the two assessment periods, the participants were evaluated at the same time of the day and all measurements were performed by the same researcher (Hume & Marfell-Jones, 2008; Slater *et al.*), with experience in the anthropometric evaluation of young people. The variables were evaluated three times in a rotation system and all measurements did not exceed the tolerance limit set by ISAK (Fragoso & Vieira). Special attention was given to the preparation of the material and environmental conditions in order to promote a calm and reserved space to the

measurements of the young participants (Eston *et al.*, 2009). The anthropometric measurements were as follows: height (stadiometer Seca, Hamburg, Germany), weight (Tanita BC558 Tetrapolar, Japan) and skinfold thickness (biceps, triceps, subscapular and suprailiac) (Slim Guide, Canada). Skinfold callipers had a constant closing compression of 10 g·mm<sup>-2</sup> throughout the range of measurements (Stewart *et al.*, 2011). The percentage of fat mass was calculated through the equations:

Pubertal boys equation: Fat mass (%) =  $18.7 \log_{10}(\text{BIC} + \text{TRI} + \text{SBS} + \text{SIL}) - 11.91$

Pubertal girls equation: Fat mass (%) =  $23.94 \log_{10}(\text{BIC} + \text{TRI} + \text{SBS} + \text{SIL}) - 18.89$

using the sum of 4 skinfolds (biceps, triceps, subscapular and suprailiac) according to sex and maturational status (Deurenberg *et al.*, 1990).

**Statistical Analysis.** Descriptive data are presented as mean  $\pm$  standard deviation. Statistical analysis was performed in the Statistical Package for Social Sciences (SPSS) version 17.0, and the level of significance was set at 5%. The Shapiro-Wilks test was used to analyse the normality of the data distribution, while Levene's test was used to analyse the homogeneity of variances. The Pared-Samples T test was used to analyze the differences between the two assessment periods (pre- and post-test).

## RESULTS

Table I presents the morphological characteristics of the participants in the two assessment periods. Between the pre- and post-test, height differed significantly in all the subgroups ( $p < 0.001$ ), weight differed significantly in the SB and SG ( $p = 0.005$ ) and the CG ( $p = 0.005$ ), and the BMI differed significantly in the CG ( $p = 0.044$ ).

Table II shows the results of the skinfold thickness and the percentage of fat mass in the two assessment periods. The SB presented significantly lower biceps ( $p = 0.008$ ), triceps ( $p = 0.043$ ) and suprailiac ( $p = 0.013$ ) skinfolds. The SG showed significantly lower biceps ( $p = 0.028$ ) and suprailiac ( $p = 0.020$ ) skinfolds. The CG presented significantly higher biceps ( $p = 0.005$ ), subscapular ( $p = 0.016$ ) and suprailiac ( $p = 0.005$ ) skinfolds. Between the pre- and post-test, the percentage of fat mass was significantly lower in SB ( $p = 0.014$ ) and SG ( $p = 0.016$ ), and significantly higher in CG ( $p = 0.007$ ).

Table I. Morphological characteristics of the participants in the two assessment periods.

Variable	Subgroups	Pre	Post	t	p
Height (cm)	SB	166.9±8.5	170.4±7.9	-10.692	<0.001
	SG	152.7±5.4	155.1±5.1	-8.287	<0.001
	CB	163.6±6.8	166.3±6.9	-13.294	<0.001
	CG	150.0±6.8	152.2±6.9	-13.531	<0.001
Weight (kg)	SB	56.8±10.3	59.5±10.0	-3.680	0.005
	SG	46.4±6.8	48.4±7.4	-3.756	0.005
	CB	67.3±14.7	68.9±13.6	-2.161	0.059
	CG	41.1±7.2	43.2±7.7	-5.509	<0.001
BMI (kg·m <sup>-2</sup> )	SB	20.3±2.6	20.4±2.4	-0.553	0.594
	SG	19.8±2.3	20.1±2.3	-0.960	0.362
	CB	25.1±5.2	24.9±4.6	0.221	0.830
	CG	18.2±2.2	18.5±2.3	-2.343	0.044

Note. BMI= body mass index; cm= centimeter; kg= kilogram; m= meter; SB= boy swimmers; SG= girl swimmers; CB= boys without sport practice; CG= girls without sport practice.

Table II. Skinfold thickness and fat mass (%) of the participants in the two assessment periods.

Variable	Subgroups	Pre	Post	t	p
Biceps (mm)	SB	6.5±3.2	4.8±2.1	3.431	0.008
	SG	8.5±2.8	7.2±2.3	2.623	0.028
	CB	12.2±5.6	12.6±5.7	-0.612	0.555
	CG	6.8±4.2	8.6±4.5	-3.674	0.005
Triceps (mm)	SB	11.5±3.9	9.6±3.4	2.349	0.043
	SG	14.2±4.1	12.6±2.9	1.953	0.083
	CB	19.5±6.4	18.3±6.7	1.406	0.193
	CG	12.9±6.0	13.6±6.2	-1.481	0.173
Subscapular (mm)	SB	8.8±3.8	7.6±2.5	1.385	0.200
	SG	10.7±5.3	8.7±3.4	2.236	0.052
	CB	19.8±8.4	19.9±8.0	-0.133	0.897
	CG	8.5±4.2	10.4±5.1	-2.967	0.016
Suprailiac (mm)	SB	10.4±4.9	7.9±4.2	3.101	0.013
	SG	13.3±5.3	10.0±5.5	2.810	0.020
	CB	23.0±7.6	21.8±8.5	0.950	0.367
	CG	9.3±5.4	11.3±6.8	-3.721	0.005
Fat mass (%)	SB	16.9±3.3	15.2±2.9	3.045	0.014
	SG	20.5±3.6	18.6±3.1	2.957	0.016
	CB	22.6±3.2	22.3±3.2	-0.431	0.676
	CG	17.9±4.5	19.4±4.9	-3.434	0.007

Note. mm= millimeter; %= percentage; SB= boy swimmers; SG= girl swimmers; CB= boys without sport practice; CG= girls without sport practice.

## DISCUSSION

This research presented the body composition before and after 6 months of training in pubertal boys and girls swimmers. The main finding of this study was that the percentage of fat mass was significantly lower in the post-test in SB and SG, and it might be due to the training volume that the pubertal athletes had completed. Those results were

consistent with the findings of other authors that observed a lower adiposity and lower percentage of fat mass in young athletes (Strong *et al.*; Malina, 2009; Malina & Geithner; Slater *et al.*). The sport and physical activity are seen as important for long-term benefits in body composition (Janz *et al.*, 2009). One limitation of this study was that we did

not control effectively the nutritional patterns and that could also affect the body composition. However, the participants reported no great changes in their nutritional during the study.

On the other hand, in the control group the CB showed no changes after the 6 months in the skinfold thickness and percentage of fat mass, however the CG showed a significantly higher percentage of fat mass, suggesting sex differences on growth and maturation of body composition, namely the increases in muscle mass and bone tissue in boys and an increase in adipose tissue in girls, especially during puberty (Malina *et al.*; Baxter-Jones & Sherar; Baxter-Jones, 2008; Beunen & Malina).

With respect to the morphological characteristics, a significantly higher height and weight (except for the CB), has been found in all the subgroups that corroborates the values observed in typical growth curves for height and

weight (Malina *et al.*; Baxter-Jones & Sherar; Baxter-Jones), and were similar between the swimming and control groups (Beunen & Malina). The morphological characteristics were similar to other studies of young boys (Schneider & Meyer, 2005; Wells *et al.*, 2006) and girls (Schneider & Meyer, 2005; Wells *et al.*, 2006; Erlandson *et al.*, 2008) swimmers.

In conclusion, a decrease in the percentage of fat mass was observed in pubertal boy and girl swimmers after 6 months of training compared with the control group, and those results seem to be associated with the swimming training, specifically the high training volume. A higher percentage of fat mass is commonly inversely correlated with performance, thus is important for the coaches to evaluate the body composition of the young athletes throughout the season. Future studies should evaluate the relationship between morphological variables and the swimming performance.

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**RODRIGUES-FERREIRA, M. A.; VENCESBRITO, A. M.; MENDES, J.; FERNANDES, R. & FERNANDO, C.** Las modificaciones en la composición corporal después de 6 meses de entrenamiento en nadadores púberes. *Int. J. Morphol.*, 33(1):350-354, 2015.

**RESUMEN:** Este estudio evaluó las diferencias en la composición corporal después de 6 meses de entrenamiento en niños y niñas púberes nadadores y en los niños y niñas púberes sin la práctica del deporte. El grupo de natación fue compuesta por 20 nadadores púberes: 10 niños (SB) (edad: 13,5±1,5 años; Tanner etapa: 3,6±0,5) y 10 niñas (SG) (edad: 11,3±0,7 años; estadio de Tanner: 3,4 ± 0,5), con una media de experiencia de entrenamiento de 4±1,3 y 3±0,5 años, respectivamente. El grupo de control estaba compuesto por 20 participantes púberes sin la práctica del deporte: 10 niños (CB) (edad: 13,6±1,2 años; Tanner etapa: 3,5±0,5) y 10 niñas (CG) (edad: 11,2±0,8 años; etapa Tanner: 3,5±0,5). Las siguientes mediciones antropométricas se realizaron en dos períodos de evaluación (pre y post-prueba): altura, peso y pliegues cutáneos (bíceps, tríceps, subescapular y suprailíaco). La suma de 4 pliegues cutáneos permitió calcular el porcentaje de masa grasa según las ecuaciones apropiado al estado de maduración e sexo. Se utilizó la técnica estadística T para muestras pareadas para analizar las diferencias entre los dos períodos de evaluación (pre y post- prueba). Entre la pre y post- prueba, el porcentaje de masa grasa fue significativamente menor en el SB (p= 0,014) y SG (p= M0,016), y significativamente mayor en CG (p= 0,007). En conclusión, se observó una disminución en el porcentaje de masa grasa en los niños y niñas púberes nadadores después de 6 meses de entrenamiento en comparación con el grupo control, y esos resultados parecen estar asociados con el entrenamiento de natación, en especial el alto volumen de entrenamiento.

**PALABRAS CLAVE:** Morfología; Composición corporal; Atletas en la pubertad; Natación.

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