Evaluation of Body Composition in Competitive Male Marathon Runners

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Keywords: Multi-frequency BIA, Phase Angle, Marathon Runner.

Abstract: The marathon is a long-distance running event with an official distance of 42.195 km. Different anthropometric variables were related to endurance running performance such as weight, body fat, the sum of skin-fold thickness and circumferences of limbs. Aim of this study was to compare antropometric measurements, multifrequency (MF) BIA and phase angle between competitive marathon runners and sedentary adult individuals. Fifty-seven subjects were studied, 28 Marathon runners and 29 Control subjects. Anthropometry variables and skinfold thicknesses were determined according to standard procedure. MF BIA was performed using a multi-frequency analyzer. Biolectrical impedance index (BI index) and MF BIA ratios were calculated for the whole body. Competitive marathon runners had lower body weight and BMI compared to control subjects. There was a significant decrease of arm and forearm circumferences in the marathon runners, with no difference between groups with respect to thigh circumference and calf circumference; they also exhibited lower skinfold thicknesses. Mean MF BIA ratios and phase angle were increased in the marathon group for the whole-body than control group. The use of simple methods, that are properly applied, can provide useful information for the study of body composition. In particular, the combination of anthropometry and BIA can provide a series of information that concerns both muscle mass and fat mass of the body.

1 INTRODUCTION

Running is a popular sport discipline which can be performed over several different distances, the marathon being a event over 42.195 km.

It it well known that endurance performances are associated with a variety of variables such as gender, length and duration of performance, ambient conditions, etc. Diet and body composition may also significative affect training and physical performance (Burke LM 2007, De Garay 1974; Etheridge 2008; Giampietro M. 2009; Maughan RS 2007; Gibala 2007; Sawka 2007). Endurance running performance was related to different anthropometric variables such as body mass, body height, body mass index, body fat, the sum of skin-fold thickness, single skin-fold thicknesses at the upper and lower body, length of legs and circumferences of limbs (Timothy 1988; Knechille 2011; Costill DL 1970; Pollok ML 1977). Much less is known about the use in endurance athletes of bioelectrical impedance analysis (BIA), another widely used bedside method for assessing body composition. In particular, impedance ratios (IR) and phase angle (PhA) are raw BIA variables (see *Methods* section) of interest because they may be related to muscle quality, being proxy of body cell mass, the ratio between extracellular and intracellular water, cell integrity, etc.

The objective of the present paper was to compare antropometric measurements, IR and PhA in marathon runners and sedentary adult individuals.

2 MATERIALS AND METHODS

In this cross-sectional study fifty-seven healthy subjects were studied: twenty-eight marathon runners (personal best marathon time in the last year <195 min) and 29 control subjects with sedentary lifestyle and aerobic physical activity <60 min/week (and no significant resistance training).

Marra, M., Gregorio, A., Alicante, P., Vincenzo, O., Sammarco, R., Speranza, E., Cioffi, I. and Scalfi, L.
Evaluation of Body Composition in Competitive Male Marathon Runners.
DOI: 10.5220/0007232301580160
In *Proceedings of the 6th International Congress on Sport Sciences Research and Technology Support (icSPORTS 2018)*, pages 158-160
ISBN: 978-989-758-325-4

Anthropometry: according to standard procedures, the following anthropometric variables were measured: weight, height, circumferences (arm, forearm, thigh, etc.), skinfold thicknesses (upper limb, trunk, lower limb) (Timothy 1988; Knechille 2011; Costill DL 1970; Pollok ML 1977).

Bioelectrical impedance analysis. Multifrequency (MF) BIA was performed using a multi-frequency analyzer (Human IM Touch, DS Medica, Milano, Italia) on both the dominant and non dominant sides of the body. Impedance (Z) was measured at 5, 10, 50, 100 and 250 kHz injecting an alternating current of 0.5 mA. Biolectrical impedance index (BI index) was obtained at different frequencies by dividing the square of height by Z at different frequencies. IRs was calculated as the ratios between Z at high frequencies (50-100-250 kHz) and Z at low frequency (5 kHz). Finally, PhA at 50 kHz was also considered.

3 RESULTS

Marathon runners had lower body weight and BMI compared to control subjects (Table 1).

Table 1: Anthropometric measurements of 28 marathon runners and 29 controls.

		Marathon Runners (n.28)		Controls (n.29)	
		m	SD	m	SD
Age	y	39.4	9.5	41.1	9.3
Height	cm	174	5.6	176	6.5
Weight	kg	70.0*	8.5	77.7	5.8
BMI	kg/m²	22.9*	2.3	24.8	0.8

They exhibited (Table 2) a significant decrease of arm circumference, with no difference between groups emerged with respect to thigh and calf circumference. The marathon runners also had lower skinfold thicknesses (triceps, biceps, subscapular, suprailiac, thigh and calf), showing a definite decrease in subcutaneous fat. BI index was lower in the marathon runners, but the differences compared to control subjects disappeared after adjusting for body weight.

In the marathon runners impedance was higher and BI indexes lower at each of the frequencies considered (Table 3). In addition, a decrease of IR and increase of PhA emerged.

Table 2: Circumferences and skinfold thickness in of 28 marathon runners and 29 controls.

	Marathon Runners (n. 29)		**Controls (n. 28)**	
	mean	SD	mean	SD
Circumferences (cm)				
Arms	28.0*	2.7	31.2	2.5
Waist	82.4*	7.8	86.8	5.8
Thigh	51.4	2.9	51.8	4.5
Calf	38.1	8.9	37.3	2.6
Skinfold (mm)				
Bicipital	3.7*	1.6	4.8	1.3
Tricipital	7.5*	2.8	10.8	3.3
Iliac	6.2*	2.8	12.2	5.1
Subscapular	10.4*	3.1	14.0	2.3

* p< 0.05 vs. controls

Table 3: Impedance, BI-Index, Phase Angle and Multi-frequencies ratio in of 28 marathoners and 29 control.

	Marathon Runners (n. 28)		**Controls (n. 29)**		
	Mean	SD	mean	SD	p
Impedance (ohm)					
5 kHz	586	53	533	54	0,001
10 kHz	566	52	518	53	0,001
50 kHz	495	47	456	48	0,003
100 kHz	462	45	429	46	0,007
250 kHz	427	43	399	42	0,019
BI-Index (cm²/ohm)					
5 kHz	52,2	6,1	59,4	8,6	0,001
10 kHz	53,9	6,4	61,1	8,9	0,001
kHz	61,9	7,2	69,5	10,2	0,002
100 kHz	66,3	7,8	74,0	11,1	0,004
250 kHz	71,7	8,9	79,4	11,7	0,008
Phase Angle (°)	7,9	0,8	7,2	0,8	0,006
Multifrequency ratio					
5 kHz/50 kHz	119	2,2	117	2,6	0,036
5 kHz/100 kHz	127	3,2	124	3,8	0,009
10 kHz/50 kHz	115	1,9	114	2,0	0,148
10 kHz/100 kHz	123	2,5	121	3,1	0,019

Multi_frequencies ratio x 100

4 DISCUSSION

The use of simple methods, when properly applied, can provide useful information for evaluating body composition in endurance athletes. In particular, the combination of anthropometry and BIA gives a number of information that concerns both muscle mass and fat mass of the body (Rodriguez NR 2009; Sprugnarosa A. 1971).

The results of the present study clearly showed a significant difference between groups in IR and PhA, suggesting in marathon runners both lower ratio between extracellular and intracellular water and greater body cell mass.

Further studies areneeded to ascertain whether the measurement of IR and phase angle (raw BIA variables) may really help assessing muscle quality in athletes and its changes with training.

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