Resting Energy Expenditure and Body Composition of an Elite Water Polo Team

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1 OBJECTIVES

In the field of sport, it could be useful to evaluate the changes in body composition and energy consumption that may occur mainly in elite athletes. (NIH Consensus Statement 1996, Gudivaka R 1999)
Bioelectrical impedance is a non-invasive and rapid method for the evaluation of body water, since both in literature and in scientific evidence a close correlation was found between the variation of the distribution of water in the various body compartments (Marra M 2005, Marra M 2009) and changes in muscle strength and hence the performance-sports competitions.
On the other hand, the assessment of resting energy expenditure in athletes could define more accurately the dietary requirements of athletes.
Water polo is a dynamic and intermittent team sport, requiring a high anaerobic effort. In the pool, players swim from an extreme to the other of the swimming-pool and perform high-intensity actions, such as jumping, wrestling and sprinting.
The aim of this study was to evaluate resting energy expenditure and body composition in an elite water polo team national first league and to compare them with a control group.

2 METHODS

We studied an elite water polo team formed by 10 male players (23.8±6.1 years, weight 89±5.2 kg, height 185±3 cm, BMI 25.9±1.9 kg/m^2) and 16 controls (25.8±8.8 years, weight 82.2±6.3 kg, height 179±5 cm, BMI 25.7±2.3 kg/m^2)
Data were collected during the championship 2013-2014; body weight, resting energy expenditure, segmental bioelectrical impedance analysis (BIA), hand grip muscle strength (Jamar dynamometer) were measured early in the morning following standard procedures. No special advice has been given as far as food and water intake.
Height was measured to the nearest 0.1cm with a stadiometer and body weight to the nearest 0.1 kg on a balance beam scale with the subject barefoot and wearing only light undergarments.
REE was measured by indirect calorimetry using a canopy system (V max29; Sensormedics, Anaheim, California) at an ambient temperature of 23 C-25C. The instrument was checked by burning ethanol, and oxygen and carbon dioxide analyzers were calibrated using nitrogen and standardized gases (mixtures of nitrogen, carbon dioxide, and oxygen). Subjects were fasting (12-14 hours) and lying down on a bed in a quiet environment. Females were in the postmenstrual phase. After a 15-minute adaptation period, oxygen consumption and carbon dioxide production were determined for 45 minutes. The inter-day coefficient of variation (as determined in 6 obese individuals on subsequent days) was always less than 3%. Energy expenditure was then calculated employing the abbreviated Weir formula, neglecting protein oxidation *(Weir)*
Bia parameters (resistance, reactance and phase angle) were measured at 50 kHz (Human IM Plus II - DS Medica srl, Milan, Italy) in the post-absorptive state, at ambient temperature of 22–24°C, after voiding and after being in the supine position for 20 min. with use of disposable pregelled adhesive electrodes supplied with the instrument (validated by DS Medica srl, Milan, Italy).
Body composition (Fat Free Mass: FFM, Fat Mass: FAT) was evaluated by BIA while phase angle (PA) was use to estimate the body water distribution between the intra/extracellular spaces in total body and limb (arms and legs).
The statistical analysis was performed using software SPSS vers. 18. All data are presented as means ± standard deviations (SD) and the statistical significance level is defined as $p < 0.05$. One-way ANOVA was used to compare data between groups.

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3 RESULTS

In table 1 are reported the individual characteristics of the 28 participants.

Table 1: Individual characteristics in elite water polo players and in control group.

		Water Polo (n. 12)			Control Group (n. 16)		
Age	*years*	23.8	±	6.1	25.8	±	8.8
Height	*cm*	185*	±	3	179	±	5
Weight	*kg*	89.0	±	5.2	82.2	±	6.3
BMI	*kg/m²*	25.7	±	1.9	25.7	±	2.3

**p < 0.05 vs Controls*

REE measured and corrected for FFM (REE /FFM kcal/kg/d) was significantly (p<0.05) higher than control group (REE: 2255±297 vs 1936±256 kcal/d; REE/FFM 31.3± 4.2 vs 29.3±1.9 kcal/kg). (Table 2) FFM resulted (p< 0.05) higher in water polo team than control group (FFM: 74.4±4.1 vs 65.9±7.2 kg) whereas FAT mass resulted lower (p<0.05) in water polo team than control group (FAT 14.6±2.8 vs 16.3±4.1 kg; 16.3±2.6 vs 19.9±5.1 %).

Table 2: Body composition and Resting Energy Expenditure in elite water polo players and in control group.

		Water Polo (n. 12)			Control Group (n. 16)		
FFM	*kg*	74.4*	±	4.1	65.9	±	7.2
FAT	*kg*	14.6*	±	2.8	16.3	±	4.1
FAT	*%*	16.3*	±	2.6	19.9	±	5.1
REE	*kcal/die*	2255*	±	297	1936	±	256
RQ		0.845	±	0.05	0.857	±	0.07
REE/FFM	*kcal/kg*	31.3*	±	4.2	29.3	±	1.9

*p<0.05 vs Control group

Phase angle was significantly (p<0.05) higher in water polo team than control group (PA: total 8.1±0.6 vs 6.8±0.6 degrees; legs 9.3±0.5 vs 6.7±1.0 degrees; arms 6.2±0.6 vs 5.5±0.5 degrees).(Table 3) Mean Hand grip maximal strength (48.2 ±2.9 kg) was correlated (r= 0.762; p= 0.01) with FFM but not with phase angle (r= 0.762; p= 0.01)

Table 3: Total and segmental (arm and leg) phase angle in elite water polo players and in control group.

		Water Polo (n. 12)			Control Group (n. 16)		
Phase Angle							
Total	°	8.1*	±	0.6	6.8	±	0.6
Arms	°	6.2*	±	0.6	5.5	±	0.5
Legs	°	9.3*	±	0.5	6.7	±	1.0

**p < 0.05 vs Controls*

4 DISCUSSION

In conclusion this study highlights how the BIA analysis and in particular the phase angle can be used to track changes in athletes, mainly in long-term competitions or championships. (Silva 2010, Silva 2011). This preliminary study indicates a clear modification both in body water distribution (total and limb), both body composition (FFM and FAT) and REE in absolute values also after correction with FFM. Further studies are necessary to evaluate the effect of body water distribution on athletes' metabolism

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