Body Composition and Physical Fitness in Elite Water Polo Athletes

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Abstract: Elite water polo athletes participate in several high-intensity bouts undergoing heavy training programs. An optimal athletic performance is a result of many factors, including changes in body composition (BC) during the sport season. Aim of this study was to evaluate the relation between BC and physical fitness in an elite water polo team national first league. Ten water polo men athletes (17-26 years) were studied. Data were collected during the regular season of the 2018/2019 Italian Men's Water Polo First League. BIA parameters, resistance (R) and phase angle (PhA) were measured at 50 kHz and BC was evaluated. The physical fitness tests performed were hand grip strength (HGS), long jump (LJ) and squat jump (SJ). Our study showed that LJ, SJ and HGS were positively related to FFM (Fat-Free Mass) and LJ was also positively related to whole-body phase angle but not to upper- or lower-limbs. This preliminary study underlines a close correlation between physical fitness and FFM.

1 INTRODUCTION

Elite water polo athletes undergo heavy training programs throughout the year, especially to prepare major competitions.

They participate in several high-intensity bouts separated by lower-intensity efforts, suggesting that high levels of strength and aerobic and anaerobic capacity are necessary for successful participation in elite water polo leagues (Botonis, 2018; Keiner, 2018; Melchiorri, 2018; Galy, 2014; Smith, 1998).

An optimal athletic performance is a result of many factors, including changes in body composition (BC) during the sport season (Brocherie, 2014).

Bioimpedance Analysis (BIA) is a non-invasive method to assess BC. BIA parameters (resistance, reactance and phase angle), are commonly used to evaluate cellular function and hydration status. Interest in the application of PhA in athletes as index of skeletal muscle property, especially body water distribution in the whole-body and/or limbs, has growing, but data are not yet constant. In healthy subjects, the PhA ranges from 5 degrees to 7 degrees (Barbosa-Silva, 2005) and in well-trained athletes it may reach 8.5 degrees (Marra, 2011).

Physical fitness can be defined as “a set of attributes that people have or achieve that relates to the ability to perform physical activity.” This is the definition used in both the Surgeon General’s Report on Physical Activity and Health (Kolimechkov, 2017) and the Institute of Medicine (IOM) report. (HHS).

Physical fitness tests are simple to manage, require minimal equipment, have a low cost and could be used on a large number of participants in short time (Plowman, 2013).

BC and physical fitness are components of nutritional status closely related to each other. In scientific evidences, a close correlation between changes in body fluids distribution and changes in muscle strength and, therefore, in athletic performance was found (Mascherini, 2015; Marra, 2016; Carrasco-Marginet, 2017; Mundstock, 2018).

The recording of both muscular strength level and fitness indices of elite male water polo players appears to be of great scientific interest in order to provide practical applications regarding the strength level and fitness profile of water polo players.

The purpose of the present study was to evaluate the relation between selected physical fitness tests and BC in an elite water polo team national first league.

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2 METHODS

Ten male water polo athletes (age 21.5±3.2 years, weight 83.9±6.8 kg, stature 183±8 cm, BMI 25.3±1.6 kg/m²) participated in the study. Data were collected during the regular season of the 2018/2019 Italian Men's Water Polo First League (competitive period). Athletes were tested in the morning (9.00 a.m.) by the same operator, following standard procedures. Weight was measured to the nearest 0.1 kg using a platform beam scale and stature to the nearest 0.5 cm using a stadiometer (Seca 709; Seca, Hamburg, Germany). BMI was then calculated as weight (kg) / stature² (m²).

With respect to BIA, impedance (Z) and phase angle were measured at 50 kHz (HUMAN IM-TOUCH, DS Medica, Milano). BC (fat-free mass FFM, and fat mass FM) was determined using Kushner equation.

The selected physical fitness tests were made according to standardized procedures. Hand Grip Strength (HGS), was performed with a Jamar handle dynamometer (Patterson Medical, Canada) and the best of three measures was used for analysis. An isometric long jump (LJ) test was used to assess the explosive strength capabilities of the leg musculature. Players performed 1 maximal bilateral anterior jump with arm swing. Jump distance was measured from the starting line to the point at which the heel contacted the ground on landing. The squat jump (SJ) was performed to estimate explosive leg power. The athletes performed three single jumps without arm swing recorded with an OptoJump device (MicroGate, Italy) and the highest of three jumps was used for analysis (0.1 cm). Only 8 water polo athletes performed the physical fitness tests.

Statistical Analysis.
Results are expressed as mean±standard deviation. For statistical analysis (SPSS. 19.0 vers., Chicago, USA), simple linear correlation was used to assess the association between variables. Statistical significance was pre-determined as $p<0.05$.

3 RESULTS

Individual characteristics (age, weight, stature and BMI), BC (assessed by BIA) and phase angle (both whole-body and limbs) of water polo athletes are reported in Table 1. Regarding BIA phase angle, upper-limbs values were particularly higher to those of a group of healthy non-athletes subjects studied by our group (data not yet published) whereas whole-body and lower-limbs values were similar. Data of physical fitness tests are showed in Table 2. A linear correlation was found between fitness tests and FFM (LJ: R=0.601; SJ: R=0.577; and HGS: R=0.847) (Figure 1). LJ was also positively related to whole-body phase angle (R=0.703) (Figure 2) but not to upper- or lower-limbs.

Table 1: Individual characteristics, body composition and phase angle of water polo athletes.

		Water Polo Players (n = 10)
Age	yrs	21.5±3.2
Weight	kg	83.9±6.8
Stature	cm	183±8
Body mass index	(kg/m^2)	25.3±1.6
Fat mass	kg	20.7±6.6
Fat mass	%	24.4±6.7
Fat-free mass	kg	63.2±5.3
Phase angle		
Whole body	degrees	7.36±0.52
Upper limbs	degrees	6.92±0.46
Lower limbs	degrees	7.83±0.63

mean±standard deviation

Table 2: Physical fitness tests performed by water polo players.

		Water Polo Players (n = 8)
HGS mean	kg	47.8±5.5
SJ	cm	28.3±6.0
LJ	cm	216±39

mean±standard deviation; HGS=hand grip strength; SJ=squat jump; LJ=long jump

4 DISCUSSION

This data showed that a relatively %FM was quite elevated for professional athletes, mainly because fat may give some benefit on performance in water compared to lean mass. HGS measures the

maximum isometric force that can be generated mainly from the arm (Castro-Pinero et al., 2010) and it is an acceptable index of overall muscle strength. In an italian population (20-29 years), mean HGS was 44.77±6.68 kg for males and 27.70±4.35 kg for females (Montalcini et al., 2012). In our study mean HGS was not particularly higher than healthy non-athletes.

LJ and SJ are widely performed to assess the explosive-elastic strength of the lower limbs muscles. In a not yet published study by our group, an Italian population (20-30 years) of 85 males, exhibited mean LJ was 1.68±3.2 m and mean SJ was 25.6±7.4 cm. Data of our study showed higher values for these fitness tests, especially for LJ.

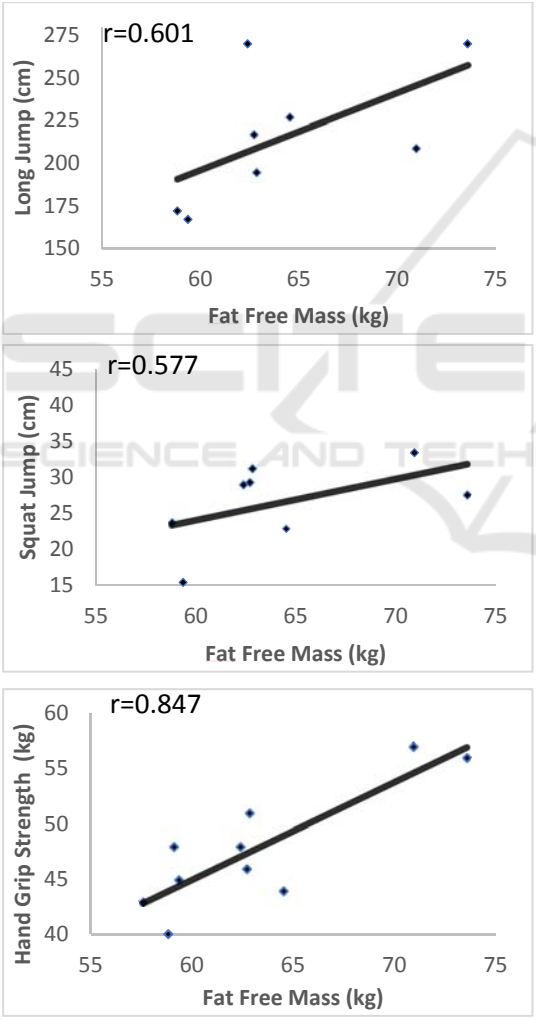

Figure 1: Linear correlation between physical fitness tests and FFM.

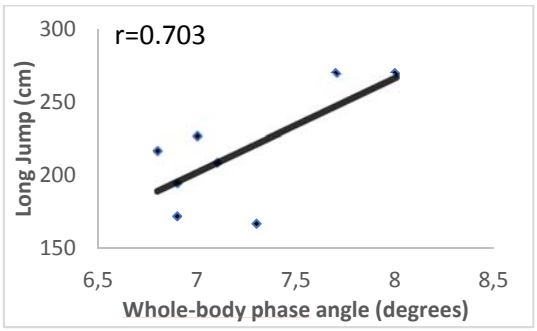

Figure 2: Linear correlation between whole-body phase angle and HGS.

The results of the presents study clearly confirmed a close correlation between fitness tests (LJ, SJ and HGS) and the amount of FFM whereas unexpectedly whole-body but not limbs PhA resulted directly related to LJ.

Limit of the study was the low number of participants. For the future it would be necessary to evaluate a large sample of athletes also in order to better clarify the correlation between fitness tests, performance and BC. Additionally, it would be advisable to apply other physical tests more representative of the physical condition of water polo athletes and repeat the evaluations for more moments throughout the season.

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