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The Relationship among Somatotype Structures, Body Compositions and Estimated Oxygen Capacities of Elite Male Handball Players

İrfan MARANGOZ[1]
Sevde Mavi VAR[2]

[1,2] *Ahi Evran University, School of Physical Education and Sports, Kırşehir, Turkey*
[1] *Email: imarangoz@ahievran.edu.tr Tel: 506 632 21 00*
[2] *Email: sevde.mavivar@ahievran.edu.tr Tel: 554 450 00 16*

(Corresponding Author)

Abstract

This study aims to analyze the relationship among somatotype structures, body compositions and estimated oxygen capacities of elite male handball players in Ahi Evran University Handball Team in 2017-2018 Turkish Men's Handball First Division. It was conducted on elite male handball players (n=15) aged between 18 and 30 who voluntarily participated in the study. Their arithmetic means and standard deviations are 22.06±3.80 years of age, 186.00±7.62 cm height, 88.66±10.69 kg weight, and BMI 25.65±3.08 kg/m2, aerobic power (VO2 max.) 41.39±3.86 (ml/kg/min), and 13.10%±1.70% body fat. They had endomorph and mesomorph (4.43 – 3.96 – 2.14) in terms of somatotype properties. A highly negative significant correlation was found between VO2 max and body fat % (r= -.702, p<0.01), between VO2 max and endomorph value (r= -.702, p<0.01), and between VO2 max and mesomorph value (r= -.703, p<0.01), while a highly positive significant correlation was found between VO2 max and ectomorph value (r= .609, p<0.05). In conclusion, it can be stated that differences in body fat data may result from players' somatotypes categories, intensity of training, duration of training, measurements by different researchers, measurements in different periods of the season, and use of different formulas in the calculation of measurement values.

Keywords: Elite male handball players, Somatotypes, Body composition, VO_2max.

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1. Introduction

The studies on anthropometric properties around the globe aim to identify suitable body profiles for different sports types (Çakıroğlu *et al.*, 2002; Barış *et al.*, 2003). Physical and physiological suitability are of vital importance in order to display a successful performance in sports. Unless the physical and physiological properties of an athlete is suitable, it is not possible for him/her to reach a satisfactory level of performance. However, physical suitability is not the only criterion for a high performance. Height, weight, body composition, aerobic and anaerobic power, strength, speed and flexibility are among factors that influence performance in sports activities (Kalyon, 1990). In addition to aerobic and anaerobic endurance, strength, cardiorespiratory, flexibility, balance, muscle and coordination, a handball player also needs to have determination, high speed and agility skills (Aktuğ *et al.*, 2018). Similar to other sports, recent scientific and technological developments have also remarkably increased the performance of handball players (Yildirim and Özdemir, 2010) and the popularity of handball as a competitive sport as well (Eler and Bereket, 2001).

2. Materials and Methods

This study was conducted on elite male handball players (n=15) aged between 18 and 30 in Ahi Evran University Handball Team in 2017-2018 Turkish Men's Handball First Division. Their arithmetic means and standard deviations are 22.06±3.80 years of age, 186.00±7.62 cm height, 88.66±10.69 kg weight, and BMI 25.65±3.08 kg/m2, aerobic power (VO2 max.) 41.39±3.86 (ml/kg/min), and 13.10%±1.70% body fat. They had endomorph and mesomorph (4.43 – 3.96 – 2.14) in terms of somatotype properties.

2.1. Data Collection Tools

The somatotypes, body compositions and aerobic properties the participants were measured.

2.2. Determination of Somatotypes

Body weight, height, biceps and calf circumference during flexion, humerus and femur breadth, triceps, subscapular, suprailiac and calf skinfold are used to calculate somatotypes. Somatotype values are calculated using the following formulas (Ross and Marfell-Jones, 1991; Carter, 2002). They were calculated in SOMATOTURK Calculation Program (Marangoz and Özbalcı, 2017).

2.2.1. Calculation of Endomorph

A = triceps + subscapular + suprailiac
B= (170.18 / height) (Adjustment coefficient for height)
Adjusted sum X = A.B
Endomorph= - 0.7182 + 0.1451 (X) - 0.00068 (X2) + 0.0000014 (X3)

2.2.2. Calculation of Mesomorph

Mesomorph = (0.858 HB + 0.601 FB +0.188 CAG + 0.161 CCG) - (0.131 H) + 4.5
HB: Humerus breadth (cm)
FB: Femur breadth (cm)
CAG: Arm circumference during flexion – Triceps skinfold /10
CCG: Maximal calf circumference – Calf skinfold /10
H: Height (cm)

2.2.3. Calculation of Ectomorph

Height and weight are calculated in cm and kg, respectively. Height is divided by cube root of weight to calculate HWR (HWR=height/cube root of weight). Ectomorph is calculated based on HWR value using one of the formulas below:

IF HWR ≥ 40.75, Ectomorph = 0.732× HWR– 28.58
IF 38.25 < HWR < 40.75, Ectomorph = 0.463× HWR– 17.63
IF HWR ≤ 38.25, Ectomorph = 0.1

2.3. Body Composition

Tanita BC-601 Segmental, Japan, a bioelectric impedance analyzer, was used to calculate body composition values (body fat%, weight and body mass index, BMI) of the handball players who participated in the study.

2.4. Determination of Aerobic Strength (VO_2 Max)

A 12-minute running test was developed by Cooper in order to calculate an individual's aerobic capacity. It consists of a 12-minute field test developed by Balke in previous years. Cooper test is one of the most widely used field tests, and athletes are required to run as long distance as possible in 12 minutes (Banıbrata, 2013). Thus, this test was used to measure aerobic strength. Max VO_2 values of the handball players were calculated using the Formula (1) below:

Estimated VO_2max = Distance Covered – 504.9 / 44.73   (1)

2.5. Statistical Analysis

After the data were analyzed using SPSS 22 software program, the descriptive statistical analysis was used to analyze running distances and the relationship among somatotype structures of elite male handball players, their body compositions and estimated oxygen capacities.

3. Findings

Table-1. Average and standard deviations of the elite male handball players' demographic variables

	N	x±sd
Age (years)	15	22,06±3,80
Weight (kg)	15	88,66±10,69
Height (cm)	15	186,00±7,62
BMI (kg/m^2)	15	25,65±3,08
VO_2 max. (ml/kg/min)	15	41,39±3,86
Body Fat %	15	13,10±1,70
Endomorph Value	15	4,43±1,24
Mesomorph Value	15	3,96±1,15
Ectomorph Value	15	2,14±,995

(±) (Mean and standard deviation)

Table-2. The relationship among somatotype structures of elite male handball players, their body compositions and estimated oxygen capacities

		Years of Age	Weight	Height	BMI	VO_2 max	Body Fat %	Endomorph	Mesomorph
Weight	r	.133							
Height	r	.438	.504						
BMI	r	-.109	.770**	-.017					
VO_2 max	r	.157	-.537*	.020	-.584*				
Body Fat %	r	-.304	.518*	-.222	.783**	-.702**			
Endomorph	r	-.346	.417	-.324	.737**	-.702**	.986***		
Mesomorph	r	-.514*	.464	-.255	.680**	-.703**	.749**	.742**	
Ectomorph	r	.281	-.590*	.259	-.942***	.609*	-.805***	-.805***	-.750**

$^{***}p<0.001$, $^{**}p<0.01$, $^{*}p<0.05$

The relationship between somatotype structures of elite male handball players and their body compositions and estimated oxygen capacities is given in Table 2 (correlation-Pearson). The analysis indicates:
a moderate negative significant correlation (r=-.514, p<0.05) between years of age and mesomorph value,
a highly positive significant correlation (r=.770, p<0.01) between weight and BMI,
a moderate negative significant correlation (r=-.537, p<0.05) between weight and VO_2 max,
a moderate positive significant correlation (r=.518, p<0.05) between weight and body fat%,
a moderate negative significant correlation (r=-.590, p<0.05) between weight and ectomorph value,
a moderate negative significant correlation (r=-.584, p<0.05) between BMI and VO_2 max,
a highly positive significant correlation (r=.783, p<0.01) between BMI and body fat%,
a highly positive significant correlation (r=.737, p<0.01) between BMI and endomorph value,
a highly positive significant correlation (r=.680, p<0.01) between BMI and mesomorph value,
a highly negative significant correlation (r=-.942, p<0.001) between BMI and ectomorph value,
a highly negative significant correlation (r=-.702, p<0.01) between VO_2 max and body fat%,
a highly negative significant correlation (r=-.702, p<0.01) between VO_2 max and endomorph value,
a highly negative significant correlation (r=-.703, p<0.01) between VO_2 max and mesomorph value,
a highly positive significant correlation (r=.609, p<0.05) between VO_2 max and ectomorph value,
a very highly positive significant correlation (r=.986, p<0.001) between body fat% and endomorph value,
a very highly positive significant correlation (r=.749, p<0.001) between body fat% and mesomorph value,
a very highly negative significant correlation (r=-.805, p<0.001) between body fat% and ectomorph value,
a very highly positive significant correlation (r=.742, p<0.01) between endomorph and mesomorph values,
a very highly negative significant correlation (r=-.805, p<0.001) between endomorph and ectomorph values,
a very highly negative significant correlation (r=-.750, p<0.001) between mesomorph and ectomorph values,

4. Discussion

Anthropometric properties are closely related to the physical activities of an organism and decisive factors that influence an athlete's success. An individual's oxygen consumption in unit time is directly proportional to his/her aerobic capacity. Aerobic strength is the most important factor that affects performance in endurance sports. There is a strong dependence between maximal aerobic capacity and the ability to making an intense effort (Sinirkavak *et al.*, 2004). Regular and gradually increasing controlled training can remarkably increase an individual's maximum energy consumption (Akgün, 1994).

Sinirkavak *et al.* (2004) state that VO_2max values of male handball players are 32.41±1.87 (ml/kg/min) and found a negative correlation (r= -0.52) between body fat percentage and maximal oxygen consumption per kilogram, which overlaps the finding (r=-.702) in this study.

The amount of calories burned and oxygen consumption in a given activity will be insufficient if the amount of body fat is excessive, thus leading to a lower cardiovascular endurance and a decreasing performance (Muratlı, 2003). A high amount of fatty tissues and a low amount of fat-free muscle in a body negatively influence performance in all sports containing anaerobic and aerobic training (Falk *et al.*, 1996). Mobilization and hydrolysis of fat provide energy during a highly intense exercise (Wolfe, 1998; Smith *et al.*, 2000).

When the body structures of handball players are observed, it can be noted that they are tall, have long arms and legs, and their body weight help them optimally use their relative strength. In addition, they also have an above-average body weight, while their body fat percentage is below average (Yildirim, 1997). Handball requires physical strength because it is a dynamic sport. Even though technical and tactical details play an important role in handball, physical properties of players are more important. Fast breaks which often occur during a handball match require a certain agility to dribble and sprint. Shooting strength and physical properties bear utmost importance in vertical and stride jump shots, shots while falling, shot in bending sideways and body feints (Taşkıran, 1997; Taşucu, 2002).

In the literature review, average body fat percentages of elite male handball players are given as 11.37% by Zorba *et al.* (1999) as 12.4% by Taşkıran and Varol (1995) as 12.84% by Vurgun *et al.* (2001) as 14.15% by Eler and Bereket (2001) as 15.71% by Gökdemir (1997) as 16.77% by Yildirim and Özdemir (2010) and as 18.74% by Sevim (1990). Tillaar and Ettema (2004) and Loftin *et al.* (1996) state body fat percentages as 16.7% and 18.9%, respectively. It is evident that findings in the literature are similar to those of this study.

In conclusion, differences in body fat data in the literature may result from handball players' somatotypes categories, intensity of training, duration of training, measurements by different researchers, measurements in different periods of the season, and use of different formulas in the calculation of measurement values. Additionally, a strongly negative correlation is observed between maximal oxygen consumption and body fat percentage. We suggest that somatotypes structures of all players (all 13 categories of Endomorph, Mesomorph and Ectomorph including central ones) performing in individual and team sports be taken into account in the determination of maximal oxygen consumption capacity.

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