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Physical characteristics of handball elite male players

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Abstract

Introduction: The current handball performance, both nationally and internationally, has obvious progress in terms of the dynamics of the game in all phases of its development in attack and defense, characterized by the speed and complexity of development throughout the game. Anthropometric parameters and physical tests have been identified as fundamental to determining the success of handball performance. Examining fitness profiles could be of great importance for the optimal preparation of training plans and the orthopedic care of high-performance handball players. *Materials and methods*: Seven athletes from the handball club SCM Politehnica Timişoara, aged between 21 and 35, participated in this study. The tests conducted were aimed at evaluating the following parameters: body composition, strength of the lower and upper limbs and speed endurance. *Results*: The results obtained in body composition show an average value for weight of 90.14 ± 8.35kg, for BF 15.55 ± 2.79% and for BMI 25.32 ± 0.98 kg/m^2. In dynamometric tests, the mean values were obtained for VJ height of 27.85 ± 6.02 cm, for CMJ height the value of 28.07 ± 2.74 cm and for SJ height the value of 27.42 ± 2.67 cm. The mean value for the maximum oxygen consumption VO$_2$max was 49.32 ± 2.32 ml / kg / min, and for the total distance traveled was obtained, 1714.28 ± 208.7 m. *Conclusions*: Analyzing the data obtained and by comparison with international average reference values, it can be concluded that a specific physical training regime based on the level and position of the player on the field is needed to improve the technical procedures during the match and prevent injuries.

***Key words**: handball players, body composition, fitness, physical characteristics*

Rezumat

Introducere: Handbalul de performanță actual, atât pe plan național cât și pe plan internațional, cunoaște progrese evidente în ceea ce privește dinamica jocului în toate fazele desfășurării sale în atac și în apărare, caracterizate prin rapiditatea și complexitatea desfășurării pe toată durata jocului. Testele fizice și caracteristicile antropometrice constituie ca fiind factori fundamentali pentru succesul performanței în jocul de handbal. Examinarea profilurilor de fitness ar putea avea o mare importanță pentru construirea optimă a regimurilor de antrenament și îngrijirea ortopedică a jucătorilor de handbal de performanță. *Materiale și metode*: În cadrul acestei cercetari au participat șapte sportivi de la clubul de handbal SCM Politehnica Timișoara, cu vârsta cuprinsă intre 21 – 35 ani. Prin intermediul testelor s-a urmărit evaluarea următorilor parametrii: compoziția corporală, forța membrelor inferioare și superioare și rezistența în regim de viteză. *Rezultate și discuții*: În urma măsurătorilor de compoziție corporală s-au obținut valorile medii pentru greutate 90,14 ± 8,35 kg, pentru BF 15,55 ±2,79%, și pentru BMI 25,32 ± 0,98 kg/m^2. La testele dinamometrice, au fost obținute valorile medii pentru înălțimea saltului VJ de 27,85 ± 6,02 cm, pentru înălțimea saltului CMJ valoarea de 28,07 ± 2,74 cm și pentru înălțimea saltului SJ valoarea de 27,42 ± 2,67 cm. Valoarea medie pentru consumul maxim de oxigen VO$_2$max 49,32 ± 2,32 ml/kg/min, iar pentru distanța totală parcursă s-a obținut 1714,28 ± 208,7 m.*Concluzii*: Analizând datele obținute și prin comparare cu valorile medii de referință internaționale, se poate concluziona că este necesar un regim de pregătire fizică specifică bazat pe nivelul și poziția jucătorului în teren pentru îmbunătățirea procedeelor tehnice din timpul meciului și pentru a preveni accidentările.

***Cuvinte cheie**: jucători de handbal, compoziție corporală, fitness, caracteristici fizice*

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Introduction

The current handball performance, both nationally and internationally, has obvious progress in terms of the dynamics of the game in all phases of its development in attack and defense, characterized by the speed and complexity of development throughout the game. Evaluating and monitoring of body composition is a key issue in sports due to its link with performance and prevention of the risk of injuries. Body mass can affect the speed, endurance and strength, while body fat can affect the strength and agility of an athlete. Higher body mass is often an advantage in handball, where speed is the key.

Handball is classified as a high-intensity contact sport that requires a high level of aerobic and anaerobic fitness (Hermassi et.al., 2017). Several studies have been reported on the anthropometric characteristics and high levels of strength, power, and throwing speed of high-performance handball players, which, in addition to technical and tactical skills, are essential factors for competitive success (Hermassi et.al. 2017, Gorostiaga et.al. 2006, Karcher & Buchheit 2014, Wagner et.al. 2014).

Few studies have compared the anthropometric and physical characteristics of handball players of different levels and different playing positions. Examining fitness could be of great importance for the optimal preparation of the training regime to improve the handball performance and orthopedic care of the players. Determining the strengths and weaknesses of players can be a valuable tool in identifying a talent, assigning game positions, and optimizing the design of endurance and conditioning training programs (Karcher & Buchheit 2014, Schwesig et.al. 2017). Several studies have reported significant differences in playing positions for various physical and anthropometric characteristics (Schwesig et.al. 2017, Granados et.al. 2008).

Anthropometric parameters and physical tests have been identified as fundamental to determining the success of handball performance (Karcher & Buchheit 2014, Schwesig et.al. 2017). A study has shown that body composition also has an influence on performance, namely, a larger hand size creates better ball control, or a larger arm span creates a higher level of space occupancy in defensive and offensive actions (Karcher & Buchheit 2014). Granados et al. (Granados et.al. 2008) showed that higher fat-free body mass values led to higher performance, mainly due to increased muscle strength. Another study evaluated motor skills as decisive factors for performance, showing that motor skills in the upper limbs could be essential for performance (Wagner et.al. 2014).

Few studies have collectively assessed fitness, anthropometric profile, muscle strength, and throwing speed in handball players (Granados et.al. 2008, Zapartidis et.al. 2009).

Examining fitness profiles could be of great importance for the optimal construction of training plans and the orthopedic care of high-performance handball players. It is true that modern handball involves short, high-intensity exercises (Rannou et.al. 2001), in addition to well-developed aerobic fitness, speed, and strength (Valamatos et.al. 2007). In fact, the ability to repeat high-intensity intermittent actions throughout the game seems to be important to handball players (Povoas et.al. 2012, Souhail et.al. 2010).

Competence in a handball team, usually attributed to a combination of technical and tactical skills, is analyzed by completing evaluation sheets during matches or by retrospective analysis of video recordings (Ohnjec et.al., 2008). Therefore, it is difficult to get an objective measure of the efficiency of each player in a match. Despite its disadvantages, coaches rely heavily on the individual contributions of each player in terms of team performance (Ohnjec et.al., 2008, Trinini & Dizdar 2000).

In general, athletes on the best performing teams have a higher height and lower body fat than athletes on lower performing teams. Gorostiaga et al. (Gorostiaga et.al. 2005) found that elite handball players are heavier and have a higher level of fat-free body mass than amateur handball players, and concluded that this seems to be an advantage. Of course, anthropometric measurements, in terms of the upper body, limb lengths contribute to a large extent to individual performance. These measures are important for better execution of throws (the longer the range, the greater the strength of the technical gesture) or for defensive actions (eg blocking).

Massuca and Fragoso (Massuca et.al., 2011) also concluded that the best athletes are taller, heavier, and have a higher body mass content without fat, lower body fat, and better socio-economic status.

From all the studies analyzed, it can be deduced that the higher the quality level of handball players, the higher the height and body mass, and the lower the percentage of adipose tissue. Although there is a degree of heterogeneity in the results, both height and weight appear to increase with age. Senior players should be oriented toward defensive positions. When it comes to pivots, coaches need to consider, in addition to body height, robustness. For goalkeepers, body height is very important, however, the criterion of solidity is also important. In the case of extremes, body height is not a decisive factor, shorter players can occupy this position, but a lower weight is favorable for this position.

Recent studies have shown that professional handball players have a higher average strength of the upper limbs (+ 22%) and lower limbs (+ 16%) compared to amateur players. A positive correlation was also established between the speed of the ball in the throw and 1RM (1 maximum repetition). The strength and power of the upper and lower limbs are very important in the game of handball, to increase performance and prevent decreased performance during the game (Gorostiaga et.al., 2005, Chelly et.al. 2006).

The height of the jump is also an important factor, both for the attack phase and for the defense. In defense, the jump is important to block the opposing offensive player during the throw, and in the attack to reach a high upright position to throw over the rival defensive players' block or to have more time to throw (an increase in time flight) to mimic or react to the goalkeeper's movements. The height of the jump in the game of handball is often measured during a counter-movement jump CMJ or vertical jump VJ. The endurance of handball players is determined by measuring the maximum oxygen consumption VO_2max, the maximum aerobic speed (VMA), and the total distance covered while running on the treadmill or during specific shuttle or sprint tests.

One limitation of these studies was that these parameters were measured under standardized conditions that do not reflect or reflect a small extent the situation during the game.

The aim of this study was to evaluate the fitness profile of Romanian handball elite male players and compare it with the international level.

Materials and methods

Seven athletes from the handball club SCM Politehnica Timişoara, aged between 21 and 35, participated in this study. The tests conducted were aimed at evaluating the following parameters: body composition, the strength of the lower and upper limbs and speed endurance.

The body composition was measured using the Bodymetrix adipometer. The Bodymetrix adipometer is an instrument that allows an accurate analysis of the body's composition through ultrasound technology.

This adipometer analyzes body composition and provides information on weight, body mass index (BMI), and body fat index (body fat BF). During the strength test was assessed 1RM for bench press.

Dynamometric tests were performed to determine the muscle profile by which the height was determined during jumps using the OptoGait system. OptoGait is an innovative system for motion analysis and functional assessment of athletes. OptoGait is an optical detection system made up of a transmission bar and a reception bar. Each contains 96 LEDs that communicate on an infrared frequency with the same number of LEDs on the opposite bar. Once positioned on the floor, the system detects interruptions in communication between the two bars caused by the athlete's movement and calculates the duration and position.

During a run, walk or series of jump tests, the contact and flight time can be measured with an accuracy of 1 thousandth of a second and the position of the intermittent LEDs with a spatial resolution of 1,041 cm.

Based on this basic data, the dedicated software measures in real time a series of crucial data for the analysis of the movement. Three jump tests were carried out in this study: vertical jumps (VJ), squat jumps (SJ) and countermovement jumps (CMJ).

The maximum amount of oxygen VO_2max, and the total distance traveled during the test were determined in the Yo-Yo endurance test. The Yo-Yo test is a type of shuttle test used to measure athletic performance. This test provides a great opportunity to estimate a subject's ability to sustain high-intensity efforts in the game.

Results

Table I. Descriptive statistics of the studied handball players' characteristics

Variables	Mean	Standard deviation
Age (years)	29.28	5.58
Weight (kg)	90.14	8.35
Body Fat (%)	15.55	2.79
Body mass index (kg/m^2)	25.32	0.98
Bench press 1RM (kg)	91.5	12.48
Height VJ (cm)	28.07	2.74
Height SJ (cm)	27.42	2.67
Height CMJ (cm)	27.85	4.02
VO2max (ml/kg/min)	49.32	2.32
Total distance Yo-Yo (m)	1722.8	161.83

The results obtained in body composition show an average value for weight of 90.14 ± 8.35kg, for BF 15.55 ± 2.79% and for BMI 25.32 ± 0.98 kg/m^2. Following the strength test, the mean value for 1RM bench press of 91.5 ± 21.32 kg was obtained.

During the dynamometric tests, the mean values were obtained for VJ height of 27.85 ± 6.02 cm, for CMJ height the value of 28.07 ± 2.74 cm and for SJ height the value of 27.42 ± 2.67 cm.

The mean values for the maximum oxygen consumption VO_2max 49,32 ± 2,32 ml / kg / min, and for the total distance traveled 1714 were obtained, 28 ± 208.7 m.

Discussions

In our paper the recorded values are close to the reference values, except for BF where it is noted a slightly above average value. The reported international average values are the following: for weight 93 kg, for BF 12.3% and for BMI 25.9 kg/m^2 (Martinez-Rodriguez et.al. 2020).

Similar other studies, our results for bench press 1RM was 92 kg (Martinez-Rodriguez et.al. 2020).

In the literature, the average values for height in the case of CMJ and SJ jumps are 47 cm and 42 cm, respectively (Martinez-Rodriguez et.al. 2020).

Compared to the obtained test results, a significant difference was found compared to the reference values.

During the game, the handball players need a high aerobic capacity to recover during the low intensity phases to ensure the game is at a high level in the high intensity phases. Wagner et al (Wagner et.al. 2016) reported that during a handball game, the athlete needs a maximum amount of VO_2max oxygen of 55-60 [ml / kg / min].

In the case of the maximum amount of oxygen VO_2max, values below the reference level were recorded.

Conclusions

Analyzing the data obtained, and by comparison4 with international average reference values, it can be concluded that a specific physical training regime based on the level and position of the player on the field is needed to improve the technical procedures during the match and prevent injuries.

Following the physical evaluation of the parameters, the training of performance handball players can be customized.

The training of performance handball players must include exercises aimed at the ability to perform specific high-intensity actions throughout the game and to recover as quickly as possible during less intense periods.

The limitation of this study was that the tested players have different positions on the field and were selected from a single team. A more in-depth study of groups of athletes nationwide with similar positions on the field would lead to better accuracy of results.

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