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PHYSICAL PROFILE DIFFERENCES BETWEEN THE PLAYERS OF THE FIRST TWO MEN'S HANDBALL LEAGUES IN ROMANIA

P.F. TROFIN[1,2] C. HONCERIU[1,2] A.R. TANASĂ[1]

Abstract: *The purpose of this research is to create a physical profile of the handball player. The results of 133 handball players from the first two leagues of Romania were analyzed. The players in the first league are taller, heavier, but without significant differences from those in the second league in body fat or muscle mass. The developed explosive force (SJ, CMJ and FJ) indicated close values. Spine mobility is superior to second league players. The maximum oxygen consumption is higher in the first league players (56.24±0.53 ml/kg/min). The results indicated the need for superior anthropometric characteristics for the first men's handball league, but also physical characteristics that would give players a great capacity for effort.*

Key words: *handball, physical profile, performance, evaluation, effort capacity.*

1. Introduction

Currently, the game of handball is a sport characterized by a sustained effort, divided into motor actions involving acceleration, deceleration, sprints, changes of direction, throws, jumps, direct contact with the opponent, etc. Changes in regulations and competitive structure in recent years have led to a transformation of physical requirements for players. Determining exactly the rigors of the current game is impossible, given that we are analyzing a complex, dynamic and constantly changing sporting activity in order to maintain the growth of human performance in performance sports.

The research directs its action towards the specific requirements of sports disciplines, because the definition of

[1]"Alexandru Ioan Cuza" University of Iaşi, Faculty of Physical Education and Sports
[2]The Centre of Interdisciplinary Research in Human Motricity Sciences

particular characteristics can determine a beneficial effect for sports selection and training. Often, researchers turn their attention to a single characteristic of the analyzed subjects [2]. A frequently studied aspect in handball is the morphological profile of performance athletes. Differences were analyzed between athletes who have different levels of performance, which can provide important information for shaping a morphological profile [3, 4, 5]. Regarding the analysis of body composition, which plays an important role in achieving performance, some studies have focused on the use of estimation formulas [6, 7], [4], [8, 9]. Being a contact sport, muscle mass plays an important role in creating a physical profile of the handball player [4], [10, 11].

The game involves a special physical engagement, both by aerobic and anaerobic effort [12, 13].

The profile of a handball player is defined by a series of factors such as technical skills, psychological characteristics, social interaction ability, cognitive ability, etc.

The essence of sports training is the official game, in which athletes show their level and reflect the true profile they have. For the official game, technical-tactical analysis sheets or the interpretation of its video recordings can be used [14, 15, 16].

Psychological characteristics and mental abilities play a significant role in sports performance [17]. Motivation and constant pursuit of sports goals make the difference in achieving sports success [18, 19, 20].

Another factor that contributes to shaping the sports profile of handball players is the socio-economic status, being shown that a good level of it determines a directly proportional performance [21].

2. Objectives

The research aims to draw the general lines of the physical profile of professional male handball players in the first two leagues of Romania.

At the same time, we want to analyze the differences arising between male handball players of the two mentioned categories.

3. Material and Methods

The research aimed at outlining the anthropometric characteristics and the physical potential for 133 players from the first two men's handball leagues of Romania. From the first league came 83 players (25 ± 4.28 years, 95.09 ± 14.16 kg, 20.69 ± 5.25% body fat, 38.10 ± 3.98% muscle mass), and from the second 50 (20.55 ± 2.91 years, 86.6 ± 10.48 kg, 20.67 ± 5.39% body fat, 39.20 ± 3.51% muscle mass).

Establishing the physical profile of our group of athletes required the application of a battery of tests in order to quantify each individual motor capacity.

Body composition was determined using an Omron BF511 body analyzer. They were determined (body mass, body mass index - BMI, body fat, muscle mass, basal metabolic rate (RMB) and visceral fat level). The analyzer required the introduction of data, including height, which was measured with a metal square and a professional Bosch GLM80 telemeter, near a wall.

Reaction speed was assessed using Treaction Co software[22], which ran on a laptop to which a three-pedal foot keyboard was connected. The keyboard was placed on the athlete's thighs; he pressed the keys corresponding to the red circles that appeared randomly on the screen.

The running speed was assessed by recording the travel times of 5, 10, 20 and 30 m. The timing was done using an automatic infrared gate system (TrackTronix). The measurement error of the device being very small, determined a high accuracy of the measurement. The final result was the better of two attempts.

Agility was assessed using 2 tests: 505 and 1001. The last is similar to the first, except that the momentum is 10 m and the travel time of 10 m round trip is counted.

The handgrip strength represents the sum of the values obtained for a maximum isometric tightening of two dynamometers, for a period of 4-6 s, standing.

The explosive force of the lower limbs was determined by means of the Squat Jump (SJ), Counter Movement Jump (CMJ) and Free Jump (FJ) tests. The device used for measurement was Just Jump. In addition, a repeated jump test was performed to determine an explosive lower limb power factor (FPEMI). The test involved the execution of 4 jumps (4x) related and characterized by short contact time with the ground, as well as the highest possible height of each execution.

Lactacid anaerobic capacity was evaluated by the test 8x10 + 10m, which involved a maximum effort in the form of repeated sprints of 20m, back and forth, totalling a number of 8 lengths. The test estimates the anaerobic capacity of athletes by calculating an index as a percentage (%), but also by indicating the total time of effort, in the form of seconds (s)[23].

The mobility of the vertical column was determined using a flexiometer from a sitting position (sit and reach test).

For the maximum oxygen consumption we applied the VamEval field test, following which the maximum aerobic speed is determined, implicitly the maximum aerobic consumption [24].

The physical tests were applied in sports halls, on the parquet surface. The evaluation period of each team was the one before the preparation period for the start of the competition season.

4. Results and Discussions

The physical evaluation of the athletes was followed by the centralization of the results, the verification of their correctness and the statistical processing. Statistical analysis of the data was performed using Graph Pad Prism 6. The numerical values of the tests are expressed as the mean and standard deviation. The differences between the two groups were analyzed for each test using the t Student test.

Table 1 summarizes the results synthesized statistically and defines the physical profile of the two categories of athletes analyzed.

Table 1

Handball players' results on physical tests
(mean ± standard deviation)

Parameter	First league	Second league	Difference (t)
Height (cm)	190.1 ± 6.63	185.6 ± 7.09	t=3.50***
Body weight (kg)	95.09 ± 14.16	86.6 ± 10.48	t=3.58***
BMI (kg/m^2)	26.25 ± 3.03	25.07 ± 2.22	t=2,32*
Body fat (%)	20.69 ± 5.25	20.67 ± 5.39	ns
Muscle mass (%)	38.10 ± 3.98	39.20 ± 3.51	ns
BMR (kcal)	1982 ± 203.9	1860 ± 139.6	t=3.46***
Visceral fat (1-30)	7.20 ± 2.17	6.04 ± 2.10	t=2.77**
TReaction_sup_DOM (ms)	282.2 ± 177.6	249.6 ± 176.3	ns
TReaction_sup_NonDOM (ms)	280.4 ± 166.4	257.4 ± 181.8	ns
5 m (s)	1.09 ± 0.06	1.13 ± 0.09	ns
10 m (s)	1.85 ± 0.09	1.88 ± 0.08	ns
20 m (s)	3.19 ± 0.19	3.21 ± 0.14	ns
30 m (s)	4.44 ± 0.44	4.47 ± 0.17	ns
505 (s)	2.44 ± 0,16	2.38 ± 0,13	ns
1001 (s)	4.07 ± 0.54	4.04 ± 0.28	ns
Handgrip strength (kg)	112.2 ± 13.75	75.95 ± 49.53	t=6.25****
SJ (cm)	42.19 ± 5.86	41.76 ± 4.76	ns
CMJ (cm)	44.23 ± 5.09	43.79± 4.49	ns
FJ (cm)	50.14 ± 5.85	51.29± 5.76	ns
4x	1.91 ± 0,41	1.85 ± 0,37	ns
8x10+10m (s)	30.20 ± 1.96	29.82 ± 1.96	ns
8x10+10m (%)	5.95 ± 2.82	6.38 ± 2.56	ns
Sit and reach (cm)	9.88 ± 7.42	19.48 ± 15.06	t=4.85****
vO2max (ml/kg/min)	56.24 ± 4.88	52.77± 4.86	t=3.91***

The obtained results (table 1) can create an image on the physical potential that the professional handball players from the first two leagues of Romania would have. The third column of values expresses the differences between the two groups of athletes, as well as their degree of significance ($p < 0.05$). We observe important differences between anthropometric parameters (height, body mass, BMI), but also between those characteristic of body composition (BMR and visceral fat). Reaction speed, movement speed and agility do not differ between the two categories of athletes.

Force is a quality that differentiates the groups only in the isometric sector, where the strength of the palm flexors is higher in first league players.

Anaerobic capacity does not differ significantly (5.95 ± 2.82% vs. 6.38 ± 2.56%).

Players in the second league have greater flexibility of the spine (19.48 ± 15.06 cm).

The maximum oxygen consumption is the parameter at which the difference materializes significantly in favour of the first league players (56.24 ± 4.88 ml/kg/min).

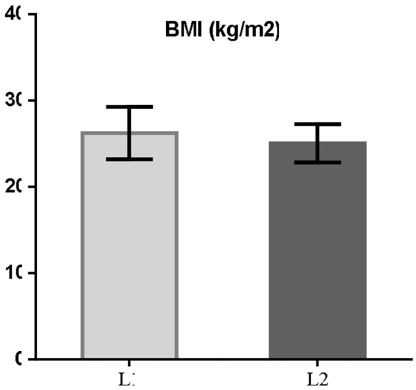

Fig. 1. *Body mass index of handball players in the first two leagues*

The body mass index includes in its calculation formula the height and the body mass. At both parameters there are significant differences between the groups of athletes. Hence the significant difference in BMI, a synthesis parameter, often used to determine the health of the population.

The statistical analysis led to the fact that the value of 26.25 ± 3.03 kg/m^{2}of the first league players is significantly higher than that of the second league players 25.07 ± 2.22 kg/m^2 (fig. 2). This difference may be related to significant differences in height and body weight ($p < 0.05$). It should be noted that the difference in the case of BMI has a lower degree of significance than in the case of its constituent elements. In addition to these differences, there are also those from BMR, as well as visceral fat.

Reported to the norms imposed by the WHO, our athletes fall into the normal category (≤25 kg/m^2) and overweight (25-30 kg/m^2).

A 2013 study looked at a group of 39 handball players (25.51 ± 2.36 years old). Of these, 17 had normal body mass (23.54 ± 1.55 kg/m^2), and 22 were over it (27.03 ± 1.65 kg/m^2). It was shown in the same study that the BMI value is inversely proportional to the performance of athletes and hence the need for high attention to the body mass of performance athletes [25].

Another study presented for a group of 15 professional beach handball players, with participation in the national team of Spain (25.0 ± 5.19 years, 188 ± 7.73 cm, 90.1 ± 13.4 kg), a BMI of 25.4 ± 2.50 kg/m^2[26]. Another recent study indicated a BMI of 26.13 ± 2.45 kg/m^2 for national team players [27].

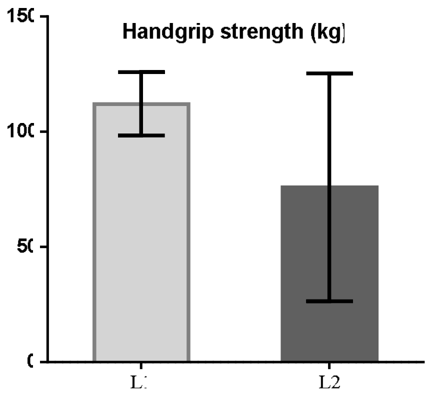

Fig. 2. *The strength of the hand flexors of handball players in the first two leagues*

The two groups analyzed differ significantly in terms of the total strength of the palm flexors (t = 6.25, p <0.0001), the first registering a value of 112.2 ± 13.75 kg, and the second league players 75.95 ± 49.53 kg (fig. 2).

The strength of the palm flexors has been studied in the literature, it being an important parameter in sports games, in order to obtain considerable results. A group of 24 professional beach handball players (25.5 ± 4.7 years, 183.0 ± 6.4 cm and 81.3 ± 7.6 kg) recorded a value of 51.6 ± 9.2 kg for the dominant upper limb. In the same study it was also shown that the handgrip strength correlates with height and body mass [28].

The strength of the palm flexors is also important because it correlates with the acceleration of the ball in the case of throws from 6 m[29].

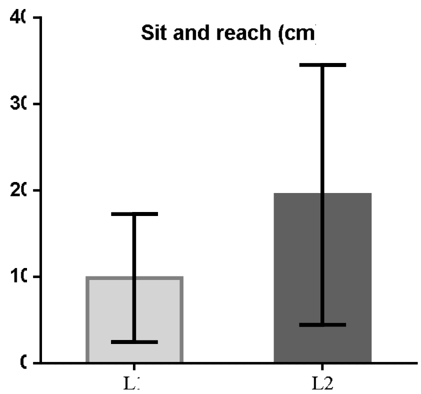

Fig. 3. *The backbone of handball players in the first two leagues*

The flexibility of the spine (fig. 3) is 9.88 ± 7.42 cm in the first league players and 19.48 ± 15.06 cm in the second league, the difference being significant (t = 4.85, p <0.0001). It is possible that anthropometric differences cause this gap.

A study that looked at a group of 16 handball players from some American colleges reported a value of 28.50 ± 2.72 cm for spine mobility. Following the application of an experimental design, it increased to 31.90 ± 2.89 cm[30].

Also from the area of handball practiced in colleges, mobility values were determined for a group of 15 players (15-20 years) of 31.27 ± 5.60 cm[31].

A group of amateur players (21.8 ± 1.3 years, 169.6 ± 2 cm, 60.7 ± 7 kg) recorded a mobility of the spine of 6.43 ± 8.58 cm, much lower level than those presented previously [32].

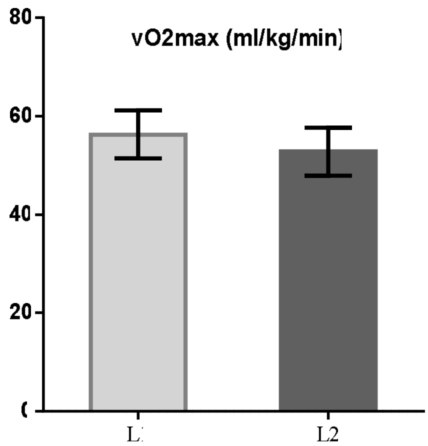

Fig. 4. *Maximum oxygen consumption of handball players in the first two leagues*

The maximum aerobic power of our batches, expressed by the maximum oxygen consumption, reached the value of 56.24 ± 4.88 ml/kg/min in the first league group, and in the second 52.77 ± 4.86 ml/kg/min. The difference between the two groups is significant (t = 3.91, p <0.001), resulting in a higher aerobic level of first league players and a greater disposition towards effort.

Being a frequently evaluated parameter, the maximum oxygen consumption was 46.6 ± 5.1 ml/kg/min for a group of 10 players from the German first league (192 ± 8 cm, 96 ± 6 kg). The test was performed at the beginning of the COVID-19 pandemic period in 2020. They followed a home preparation program and after that, vO2max increased to 49.4 ± 7.0 ml/kg/min, but not enough to have a significant effect (p = 0.12)[33]. Hence the fact that specific training on a surface of sports games is the best method of aerobic accumulation available at this time.

A study of 24 players of the Slovenian national team (23.17 ± 5.1 years, 188 ± 6.7 cm, 89.0 ± 9.3 kg) estimated a maximum oxygen consumption of 51.54 ± 5.98 ml/kg/min. The extremes recorded the highest value of 53.22 ± 5.13 ml/kg/min [34].

5. Conclusions

The results indicated the need for superior anthropometric characteristics for the first men's handball league, but also physical characteristics that would give players a high capacity for effort.

There are differences between the professional handball players from the first two leagues of Romania at the level of anthropometry, the players of the first league being taller, heavier and with higher energy needs for the body.

The reaction and travel speeds are close for the two categories, the same being recorded in the case of agility and explosive force. The strength of the palm flexors indicates a better isometric level in the first league players, fact determined by the connections of this parameter with the sports performances in handball.

The study shows that second league players have better joint mobility of the spine.

Effort capacity shows differences only in the aerobic sector, where first league players have a significant advantage.

Knowing the physical profile required for a level of performance can improve the process of selection and sports training.

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