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# MORPHOLOGICAL DIFFERENCES BETWEEN PLAYING POSITIONS IN ELITE MALE HANDBALL PLAYERS

MORFOLOŠKE RAZLIKE IZMEĐU IGRAČKIH POZICIJA KOD VRHUNSKIH RUKOMETAŠA

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SUMMARY

This study presents morphological characteristics of 37 elite Croatian junior and senior national male handball players. A set of 27 anthropometric measures were carried out on 9 wing attack players, 6 pivots, 5 goalkeepers and 17 back court players. The body fat percentage and the BMI were calculated. ANOVA showed statistically significant differences between wing attackers and other playing positions in variables of body height, body mass, biltareral measures of leg and arm length, abdomen skinfold, circumference of right extended upperarm, circumference of right flexed upperarm, bilateral measures of forearm circumference, circumference of right upperleg, bilateral measures of lower leg circumference and abdominal circumference. Morphological characteristics can influence the ability of players to respond better to the requirements of the certain position in the game.

*Key words:* morphology, handbal, playing position

SAŽETAK

U ovom radu predstavljene su morfološke karakteristike 37 vrhunskih hrvatskih juniorskih i seniorskih rukometaša. Mjerenja su provedena putem seta od 27 antropometrijskih mjera, izmjerenih na 9 krilnih igrača, 6 pivota, 5 golmana i 17 vanjskih igrača. Postotak masti ITM (Indeks tjelesne mase) su izračunati. Univarijatna analiza varijance (ANOVA) pokazala je statistički značajne razlike između krila i igrača sa ostalih pozicija u igri u varijablama tjelesne visine, tjelesne mase, obostrano u mjerama dužine ruke i noge, kožnom naboru trbuha, opsegu desne ispružene nadlaktice, ospegu desne savijene nadlaktice, obostrano u mjerama opsega podlaktice i potkoljenice, opsegu desne natkoljenice i opsegu trbuha. Morfološke karakterisitke mogu utjecati na bolji odgovor igrača obzirom na zahtjeve pojedine igračke pozicije.

*Ključne riječi:* morfologija, rukomet, igračka pozicija

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## INTRODUCTION

Handball is an Olimpic sport and also one of the most popular team sports in the world (19). Kinesiologist, sport scientists and sport coaches describe it as a strenous body contact team sport which in its structure has elementary movements such as running, jumping, sprinting, arm throwing, hitting, blocking and pushing with interactive contact with oponents during the game (3,5,6). Succes in team sport, in this case handball, depends on numerous external and internal factors (12). Antropological characteristics of a player and morphological characteristics in particular, have an important role on top performance and results (3,8,9,11,12,14). For coaches, diagnostics of morphological characteristics imply having valuable data considering athlete's body status and structure during different stages of periodization, and therefore plays an immence role in top handball teams.

Main morphological characteristics for various handball player subgroups were an interest of study for many researchers (2,12,13,14). Some studies compared anthropometric and physiological characteristics of handball players of different levels (4,6). On the other hand, some researchers investigated anthropometric characteristics as descriptive characteristics of the subjects (5,6,7,10,18).

Handball as a complex team sport differentiates four main playing positions: goalkeeper (defence), back court player, wing attack player and circle runner or pivot (offence). During the game the player on each position has certain tehnical and tactical requirements which are consequential to field zones and phases of the game1. Previous researches state that players on different position differ significantly from each other in some morphological parameters, especially in body height and subcutaneous fat (2,12,13,14). Observed differences were in body height measures between backs and wings (2,12,13,14) and in body fat between goalkeepers and the other players in team (2,13,14).

Hypothesis was made on previous research made by Šibila and Pori in 2009. who analysed morphological characteristics of Slovenian junior and senior national handball team players. They assumed the existence of different morphological characterisitcs between playing positions, therefore we wanted to investigate whether there are any differences in top male handball players (in this case Croatian national junior handball team and senior top team) and which morphological characteristics differ players on different playing position.

## METHODS

The sample included 37 elite male handball players, 22 players of Croatian junior national handball team and 15 players of senior top team in Croatia (out of which 6 players were senior national representatives, 5 players were occasional members of senior national representation and 4 players were members of first league club in Croatia). There were 9 wing attackers, 17 back court players, 6 pivots and 5 goalkeepers.

The study was approved by the Ethics Committee of the Faculty of Kinesiology, University of Zagreb, Croatia. The players were fully informed of all the experimental procedures prior to giving their written consent of participation.

According to the instructions of the International Biological Program the following anthropological measures were taken: body height, body mass, arm span, leg length, arm length, shoulder width, skinfolds of back, upper arm, thigh, chest, shank, suprailiocristal and abdomen and circumferences of upper arm (extended and flexed), forearm, upper leg, lower leg and abdomen. Measures of legs length, arm length, circumferences of upper arm (extended and flexed), forearm, lower leg were taken bilaterally (L – left side; R – right side) and upper leg only R -right side. The percentage of body fat (body fat %) in the male handball players was determined by Jackson and Pollock anthropometric method. BMI was also calculated.

The statistical package Statistica for Windows 7.0 was used for statistical analysis. Basic descriptive parameters of anthropological variables were calculated: mean (X), standard deviation (SD), minimum and maximum value of the results registered (MIN, MAX). The differences between team positions (wing attackers, back court players, pivots and goalkeepers) were analyzed by analysis of variance (ANOVA). The statistical significance was set at $p < 0,05$.

## RESULTS

The results of the basic descriptive analysis and the basic parameters of the univariate analyses of variance (ANOVA) are presented in Table 1.

Table 1. Descriptive statistics and results of ANOVA for morphological variables
Tablica 1. Deskriptivni parametri i rezultati ANOVE za morfološke varijable

| | Valid N | Mean | Minimum | Maximum | Std.Dev. | p |
|---|---|---|---|---|---|---|
| Body height (cm) | 37 | 189,32 | 177,30 | 198,70 | 5,92 | 0,00 |
| Body mass (kg) | 37 | 89,44 | 66,87 | 110,76 | 10,32 | 0,00 |
| Body fat % | 37 | 14,69 | 7,70 | 28,91 | 4,48 | 0,24 |
| BMI | 37 | 24,90 | 20,28 | 29,46 | 2,01 | 0,09 |
| Arm span (cm) | 37 | 191,61 | 181,10 | 207,70 | 6,68 | 0,27 |
| Leg length L(cm) | 37 | 108,28 | 102,00 | 116,60 | 3,92 | 0,02 |
| Leg length R (cm) | 37 | 108,34 | 102,00 | 116,70 | 3,99 | 0,02 |
| Arm length L(cm) | 37 | 83,11 | 76,80 | 89,70 | 3,21 | 0,03 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Arm length R(cm) | 37 | 83,12 | 76,70 | 92,00 | 3,34 | 0,02 |
| Shoulder width (cm) | 37 | 42,24 | 37,60 | 47,50 | 2,41 | 0,08 |
| Spread fist width L(cm) | 37 | 23,46 | 20,90 | 31,20 | 1,62 | 0,36 |
| Spread fist width R(cm) | 37 | 23,29 | 21,00 | 31,40 | 1,73 | 0,58 |
| Skinfold back (mm) | 37 | 12,33 | 6,50 | 20,70 | 3,41 | 0,69 |
| Skinfold upperarm (mm) | 37 | 10,27 | 4,20 | 17,53 | 2,94 | 0,36 |
| Skinfold thigh (mm) | 37 | 16,03 | 6,40 | 28,80 | 6,13 | 0,48 |
| Skinfold chest (mm) | 37 | 7,83 | 3,90 | 17,20 | 3,26 | 0,27 |
| Skinfold shank (mm) | 37 | 8,45 | 4,20 | 19,67 | 3,06 | 0,29 |
| Skinfold suprailliocristal (mm) | 37 | 10,40 | 4,73 | 24,53 | 4,44 | 0,16 |
| Skinfold abdomen (mm) | 37 | 16,47 | 5,90 | 42,80 | 7,89 | 0,04 |
| Circ. Upperarm ext. L(cm) | 37 | 33,32 | 27,70 | 39,60 | 2,29 | 0,11 |
| Circ. Upperarm ext. R(cm) | 37 | 33,72 | 29,00 | 40,20 | 2,45 | 0,02 |
| Circ. Upperarm flex. L(cm) | 37 | 35,67 | 31,00 | 40,00 | 2,08 | 0,52 |
| Circ. Upperarm flex. R(cm) | 37 | 36,00 | 30,20 | 41,00 | 2,21 | 0,01 |
| Circ. Forearm L(cm) | 37 | 29,49 | 25,70 | 32,80 | 1,59 | 0,02 |
| Circ. Forearm R(cm) | 37 | 30,32 | 25,10 | 33,70 | 1,63 | 0,00 |
| Circ. Upper leg R(cm) | 37 | 62,90 | 53,10 | 72,40 | 4,02 | 0,03 |
| Circ. Lower leg L(cm) | 37 | 40,95 | 36,40 | 46,10 | 2,53 | 0,01 |
| Circ. Lower leg R(cm) | 37 | 41,05 | 36,00 | 46,10 | 2,26 | 0,00 |
| Circ. Abdomen (cm) | 37 | 90,45 | 81,00 | 108,40 | 6,03 | 0,03 |

Differences between positions were furthermore examined by the post-hoc analysis of the variance shown in Table 2.

Table 2. Mean values and post hoc analyses of variance for morphological variables of four groups of handball players.
Tablica 2. Aritmetičke sredine i post hoc analiza varijance morfoloških varijabli četiri grupe rukometaša.

| | GOAL | WING | BACK | PIVOT | W-G | W-B | W-P |
|---|---|---|---|---|---|---|---|
| **Body height (cm)** | 191,70±2,33 | 181,84±2,96 | 192,14±4,75 | 190,55±5,20 | * | * | * |
| **Body mass (kg)** | 92,88±11,36 | 78,72±5,05 | 91,71±8,52 | 96,21±9,94 | ** | * | * |
| **Body fat %** | 18,21±4,11 | 13,33±3,69 | 14,18±3,49 | 15,27±7,27 | | | |
| **BMI** | 25,24±2,68 | 23,82±1,70 | 24,81±1,76 | 26,45±1,96 | | | |
| **Arm span (cm)** | 194,26±5,68 | 184,61±3,47 | 193,25±6,03 | 195,23±6,34 | | | |
| **Leg length L(cm)** | 109,08±1,72 | 104,88±1,97 | 109,45±4,44 | 109,43±3,38 | | ** | |
| **Leg length R (cm)** | 108,94±1,63 | 104,92±1,99 | 109,54±4,41 | 109,57±3,95 | | ** | |
| **Arm length L(cm)** | 83,34±2,82 | 80,50±2,01 | 83,92±3,17 | 84,55±3,50 | | ** | |
| **Arm length R(cm)** | 83,22±2,67 | 80,22±1,97 | 84,01±3,36 | 84,83±3,33 | | ** | ** |
| **Shoulder width (cm)** | 43,82±1,87 | 40,70±1,71 | 42,28±2,47 | 43,13±2,66 | | | |
| **Spread fist width L(cm)** | 23,04±1,23 | 22,76±0,95 | 23,85±2,01 | 23,80±1,20 | | | |
| **Spread fist width R(cm)** | 23,30±1,49 | 22,60±0,93 | 23,60±2,20 | 23,45±1,33 | | | |
| **Skinfold back (mm)** | 13,95±4,26 | 11,62±2,81 | 12,29±3,42 | 12,15±3,96 | | | |
| **Skinfold upperarm (mm)** | 12,10±1,48 | 9,15±2,97 | 10,25±3,17 | 10,47±2,89 | | | |
| **Skinfold thigh (mm)** | 17,68±5,80 | 14,77±6,55 | 15,14±5,99 | 19,04±6,39 | | | |
| **Skinfold chest (mm)** | 10,23±5,02 | 6,63±2,17 | 7,88±3,35 | 7,47±2,08 | | | |
| **Skinfold shank (mm)** | 8,17±2,17 | 7,16±2,47 | 8,57±3,49 | 10,28±2,75 | | | |
| **Skinfold suprailliocristal (mm)** | 13,32±4,55 | 9,28±3,35 | 9,35±3,74 | 12,59±6,51 | | | |
| **Skinfold abdomen (mm)** | 24,92±6,83 | 12,94±3,90 | 15,37±6,18 | 17,86±12,80 | ** | | |
| **Circ. Upperarm ext. L(cm)** | 33,10±1,77 | 32,22±2,53 | 33,32±1,83 | 35,13±2,87 | | | |
| **Circ. Upperarm ext. R(cm)** | 33,16±1,60 | 32,39±2,21 | 33,72±1,96 | 36,20±3,16 | | | ** |
| **Circ. Upperarm flex. L(cm)** | 35,52±2,35 | 34,81±2,37 | 35,98±1,92 | 36,22±1,98 | | | |
| **Circ. Upperarm flex. R(cm)** | 35,50±2,00 | 34,49±2,11 | 36,24±1,82 | 38,02±2,16 | | | ** |
| **Circ. Forearm L(cm)** | 29,28±1,96 | 28,20±1,48 | 30,00±1,31 | 30,15±1,33 | | ** | |
| **Circ. Forearm R(cm)** | 30,20±1,65 | 28,64±1,64 | 30,85±1,01 | 31,43±1,37 | | * | * |
| **Circ. Upper leg R(cm)** | 64,26±4,71 | 59,74±3,65 | 63,31±3,33 | 65,33±3,74 | | | ** |
| **Circ. Lower leg L(cm)** | 40,58±2,71 | 38,71±1,61 | 41,77±2,29 | 42,28±2,39 | | ** | ** |
| **Circ. Lower leg R(cm)** | 40,30±2,81 | 39,07±1,47 | 42,04±1,77 | 41,88±2,28 | | * | |
| **Circ. Abdomen (cm)** | 93,46±7,54 | 85,84±3,53 | 90,76±4,91 | 93,98±7,50 | | | ** |

Thorough post hoc analysis showed the statistically significant differences between the wing attack players and the goalkeepers in the variables of body height ($p<0,01$), body mass ($p<0,05$) and abdomen skinfold ($p<0,05$).

Between wings and backs, statistically signifficant differences were found in the variables of longitudinal dimensionality and body volume. Differences were found in the variables of body height ($p<0,01$) and bilaterally in the measures of leg length and arm length ($p<0,05$). Further differences between wing attackers and back court players were found in the variables of body mass ($p<0,05$), right forearm circumference ($p<0,01$), left forearm circumference ($p<0,05$), right lower leg circumference ($p<0,01$), and left lower leg circumference ($p<0,05$).

Statistically signifficant differences between wing attack players and pivot players were found in the variables of body height ($p<0,01$), body mass ($p<0,01$) and right arm length ($p<0,05$). Further differences between wings and pivots were found in body volume measures including: extended right upperarm circumference ($p<0,05$), flexed right upperarm circumference ($p<0,05$), right forearm circumference ($p<0,01$), right upperleg circumference ($p<0,05$), left lower leg circumference ($p<0,05$), and abdomen circumference ($p<0,05$).

## DISCUSSION

In this study the main purpose was to obtain which of 27 morphological measures differs handball players on four different positions.

The results indicate significant differences in 15 different anthropometric variables between different playing positions. All differences were found between wings and other playing positions. Significant differences were found between wing attack players and back court players in variables of body height, body mass, leg and arm length, circumference forearm and lower leg. In above mentioned measures, wing attack players have lower values than the backs. Play demands of a back court player are very complex and consist of a lot of ball possession during the game together with responsibility for organizing and closing actions by scoring or assisting. Furthermore, in phases of offense, very often backs perform goal shooting from a certain distance over and through opponents' defence wall generally by interference from players of opposing team. During the phases of defence back court players perform extremely powerful contacts with opponents. The significant longitudinal body dimensionality manifested in the body height, larger qualitative body mass and consequently bigger forearm girth are very important for matching desirable game demands (12). Game demands of the wing attack players require quick movements from the defence to the attack phase of play, quick movements thru adverse defence, very often participating in counterattacks or preventing them and therefore covering the biggest part of the field (1,12,15). Differences in forearm girth may be explained by shooting demands of wings which do not always include powerfull ball throws at the goal, since sometimes they shoot from a very close range, having a much wider shooting pallete.

Differences between goalkeepers and wings were found in the measures of body height, body mass and abdomen skinfold. The goalkeepers have specific technical and tactical play demands. They act in limited space and do not have high energy demands. Actions which they perform in game are quick and explosive implementations of simple movements. Bigger longitudinal and transversal skeletal dimensionality enables goalkeepers to successfully cover the most part of goal area. Differences in abdomen skinfold may be explained by goalkeepers' decreased aerobic endurance demands during the game. On the other hand, wing attack players cover the greatest total distance during matches and therefore note lowest skinfold value (15).

Differences between the wings and the pivots were found in the measures of longitudinal and transversal skeletal dimensionality. Their grounds may be found in modern model of handball play. Game demands have changed in sense of tactical efficiency, tempo and game attractiveness, especially for pivots who are now more engaged during the attack and defence phase of play than they used to14. Tactical demands such as “quick” center18 engage physiological process in the body and reduction of body fat. Moreover a high quantity of muscle mass is necessary for pivots to sustain constant contact with the opponent players. Differences between back court players, pivots and goalkeepers were not found in space of morphological characteristics. It is assumed that this is due to a modern concept of handball, where players´ versatility in sense of playing on different positions is a required necessity. On the other hand there might be differences between above-mentioned playing positions in other characteristics of anthropological status.

## CONCLUSION

This study confirmed the existance of statistically significant morphological differences between male handball players according to their playing positions. The differences in morphological measures were manifested between wing attack players and players on the other positions (backs, pivots and goalkeepers). Differences among wing attack players and back court players were found in variables of longitudinal skeletal dimensions and circular measures of the body. Differences between wing attack players and goalkeepers were found in body height, body mass and abdominal skinfold, while pivots had higher values than wing attack players in measures of body height, body mass, right arm length, circumferences of extent and flexed upper arm both on right side, right forearm, right upper leg, left lower leg and abdominal circumference.

Good knowledge about general and specific demands in game and knowing morphological characteristics of players for each position are crucial to coaches in orienting players to certain positions. For wing attack player abilities such as agility, high-speed in counterattacks and ability of repetition are very important, for that body height and body mass can be one of the crucial factors. The tallest and strongest players should be

oriented to back court player position which considers extremely powerful contacts with opponents all-round the court. Pivots should be robust with higher body mass and values in upper extremities. For goalkeepers vital tasks are saving the goal and due to that mission they need to be tall, robust but also quick and flexible.

During training process and using specific kinesiological activities one may influence on the reduction of body fat and the increase in the measures of circumferences. Morphological characteristics can influence the ability of players to respond to the requirements of the certain position in the game. Values of the obtained results in this study are at the orienting players to certain playing positions according to their morphological profile. Observed from one side one may find a relatively small number of entities and furthermore an unequal number of the examinees for each position as a limiting factors of this study, but one the other side the sample was formed of top junior and senior male players who consisted a representative sample.

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