Comparative Analysis of Morphological Characteristics of Goalkeepers in Football and Handball

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ABSTRACT

The goal of this research was to determine differences between top football and handball goalkeepers in morphological characteristics. The sample consisted of 10-13 handball and 7-10 football top senior goalkeepers. Morphological characteristics were assessed using a battery of 12 anthropometrical variables – 4 variables for the assessment of longitudinal skeletal dimensionality, 4 for subcutaneous adipose tissue, and 4 for body voluminosity. The standard central and dispersion parameters were calculated for all the variables. The significance of differences between football and handball goalkeepers in the measured morphological characteristics were determined by t-test for independent samples. It was determined that the handball and football goalkeepers differ in the following variables: arm span (ALRR), back skinfold (ANL), upper arm skinfold (ANNAD), abdomen skinfold (ANT), right thigh circumference (AVONATD), waist circumference (AVOT), and body mass (AVTT). The football goalkeepers had lower values in longitudinal skeletal dimensionality, subcutaneous adipose tissue and body voluminosity.

Key words: *Football Goalkeepers, Handball Goalkeepers, Morphological Characteristics, Differences.*

Introduction

In the contemporary training experts increasingly use testing of relevant dimensions that can be quantified. With the view towards optimising training, the current state of athletes' relevant abilities, characteristics and skills as well as the specific demands of particular sport and different players' positions should be taken into consideration.

Top football and handball goalkeepers should master the goalkeeping technique and specific goalkeeping movements that are used during the training and the competition and that are performed in a fast, correct, explosive and accurate manner. Football and handball goalkeeping techniques consist of the technique with the ball and the technique without the ball.

Beside the specific goalkeeping technique, football goalkeepers often use and should therefore master the elementary technique of field players. The specific football goalkeeping technique and movements comprise: The basic stance of the football goalkeeper, positioning of the goalkeeper, saving low balls, saving medium height balls, saving high balls, saving by rolling down, rolling the ball out, kicking the ball from the hand, diving on low balls, single leg jump high balls saving, diverting high balls, punching the ball with both hands, drop-kicking the ball, diving on medium height and high balls, diverting high balls by diving sideways, punching the ball with one hand, throwing the ball out sideways and drop-kicking the ball, diving into opponent's legs, diverting low and medium height balls by rolling down, throwing the ball out overhead[1].

The coach should be familiar with the model values of top athletes in the given sport in order to conduct proper selection and to design and implement training plan and programme. To better understand and design the training plan and programme coaches should also know which movement structures the goalkeepers perform during the training and the competition.

Specific handball goalkeeping movements comprise: The basic stance of the handball goalkeeper, positioning of the goalkeeper in front of the goal line and within the goal perimeter (semicircle, parallel and vertical positioning), jumps of the handball goalkeeper, saving low balls by lunging and positioning of the leg and the arm in front of the ball flight path, saving the low balls by sliding step and positioning of the leg and the arm above the foot in front of the ball flight path, saving medium height balls by arm, saving medium height balls by arm and leg while standing on one leg, saving medium height balls by arm and leg with both legs in the air - split in the air, jump saving of high balls with both arms, jump saving of high balls with one arm, saving low angles from wing positions, saving medium height angles from wing positions, saving high angles from wing positions, saving shot angles from backcourt positions by catching, saving shot angles from backcourt positions by amortisation, saving shot angles from backcourt positions by bouncing the ball using the arm only, saving shot angles from backcourt positions by bouncing the ball using the leg only, saving shot angles from backcourt positions by bouncing the ball using the arm and the leg, saving the penalty line shot angles from the goal line in the basic stance, saving the penalty line shot angles by positioning in front of the goal line. In order to perform specific goalkeeping movements the flexibility and the speed of the movement of handball goalkeepers must be well-developed and their longitudinal skeletal dimensionality must be above the average in comparison to normal population.

Football and handball research has been primarily focused on field players, neglecting goalkeepers. Morphological characteristics and specific tasks of goalkeepers during the match vary and there are significantly fewer goalkeepers than the field players. This is why goalkeepers have usually been excluded from the sample of subjects. Data obtained by testing allows an educated coach to determine the level of different preparedness components for one goalkeeper or for the group of goalkeepers, which further helps to define the goals of the training process

and to design the plan and programme of the training in each sports preparation cycle.

Verheijen[2] and Bangsbo[3] previous research studies have included insufficient analysis of football and handball goalkeepers' body build indicators. According to Drust Reilly and Rienzi[4] and Sporiš[5], football goalkeepers are on average taller and heavier than field players. When compared to field players, football goalkeepers on average cover less distance, mostly walking, skipping and sprinting and they perform specific goalkeeping movements, like rolling, jumping, saving balls with hands, throwing the ball out with the hand etc.

Barišić[6] studied the importance of several anthropometrical characteristics in football. According to football experts there are two types of players in football: the goalkeeper and the field player. Goalkeepers have a high level of simple movement speed, reaction speed, explosive power, flexibility, movement frequency, coordination, anaerobic alactate capacity, and longitudinal skeletal dimensionality. Gil, S., Gil, J. and Ruiz[7] studied physical and anthropometric characteristics of young football players in relation to their respective positions on the field. Players aged 17.31 (±2.64), in the range between 14 and 21 years of age, were classified in the following groups: goalkeepers (n=29), forwards, midfielders and defenders. The results indicate that the goalkeepers are the tallest and the heaviest players in the field. The goalkeepers also had the lowest values of skinfold measures and aerobic capacity. Šentija, Matković, Vuleta, Tomljanović and Džaja[8] defined morphological characteristics of top Croatian handball players (goalkeepers, wingmen, pivots, and backcourts) based on 6 anthropometrical parameters. In the sample of 20 members of the senior male national team the authors found the highest level of subcutaneous adipose tissue with goalkeepers, while the lowest

level was found with the wingmen. Sporiš, Vuleta and Milanović[9] found different preparedness profiles with handball players playing different positions. Wingmen are the shortest players. Pivots are taller and heavier than backcourt players (0.01 significance level), while backcourt players are taller than wingmen (0.01 significance level). Goalkeepers have higher percentage of subcutaneous adipose tissue than backcourt players (0.01 significance level).

Material and Methods

The purpose of this study was to determine differences between top football and handball goalkeepers in several morphological characteristics. The basic hypothesis was set and tested at 5% significance level.

The sample of subjects comprised 7-10 football goalkeepers and 10-13 handball goalkeepers, depending on the tested anthropometrical variable. The age span was 17-40 for handball goalkeepers and 19-31 for football goalkeepers.

The sample of variables comprised 12 morphological tests that measured the following dimensions: 4 variables for the assessment of the longitudinal skeletal dimensionality (body height - ALVT, right leg length - ALDND, left leg length - ALDNL and arm span - ALRR), 4 variables for the subcutaneous adipose tissue (back skinfold - ANL, upper arm skinfold - ANNAD, thigh skinfold - ANNAT and abdomen skinfold - ANT) and 4 variables for the body voluminosity and mass (thigh circumference - AVONAT, calf circumference - AVOPOT, waist circumference - AVOT and body mass - AVTT). All the morphological variables were measured once, with the exception of the skinfolds, of which three subsequent measurements were taken.

TABLE 1
CENTRAL AND DISPERSION PARAMETERS OF VARIABLES FOR THE ASSESSMENT OF MORPHOLOGICAL CHARACTERISTICS OF FOOTBALL GOALKEEPERS (LONGITUDINAL SKELETAL DIMENSIONALITY, SUBCUTANEOUS ADIPOSE TISSUE AND BODY VOLUMINOSITY AND MASS)

Variables	N	M	Min	Max	Range	SD	Skew	Kurt
ALVT	10	188.87	181.60	195.70	14.10	4.36	0.08	-0.60
ALDND	10	107.66	99.10	112.60	13.50	3.69	-1.31	2.86
ALDNL	10	107.94	99.10	113.20	14.10	3.70	-1.44	3.71
ALRR	10	191.52	183.30	200.30	17.00	4.74	0.38	0.71
ANL	10	10.01	7.20	13.90	6.70	2.34	0.73	-0.73
ANNAD	10	8.74	5.67	11.73	6.06	1.83	-0.04	-0.30
ANNAT	10	13.87	7.67	23.57	15.90	5.08	0.65	-0.01
ANT	10	12.60	7.10	26.00	18.90	5.97	1.28	1.72
AVONATD	10	60.55	57.00	65.20	8.20	2.90	0.12	-1.47
AVOPOTD	10	39.73	34.60	43.60	9.00	2.70	-0.41	0.09
AVOT	7	82.98	61.25	93.00	31.75	10.10	-2.06	5.09
AVTT	10	87.39	75.80	96.50	20.70	7.44	-0.41	-1.24

Data was analysed using the software package Statistica, version 7.0. Standard central parameters (arithmetic mean - M) and dispersion parameters (standard deviation - SD; range - R; minimum - MIN; maximum - MAX; skewness - SKEW and kurtosis - KURT) were calculated for all the variables. T-test for independent samples with 0.05 statistical significance level was used to test differences between the two groups of goalkeepers.

Results and Discussion

Morphological characteristics of football and handball goalkeepers
Morphological characteristics of football goalkeepers
Table 1 shows central and dispersion parameters of variables for the assessment of football goalkeepers' morphological characteristics. All tests for longitudinal skeletal dimensionality and for body voluminosity and mass have adequate metric characteristics. All of the variables are normally distributed and

have adequate dispersion of results from the arithmetic means. The interval between the minimum and the maximum result in most cases includes more than three standard deviation values.

On the basis of the average values and minimum and maximum results in morphological measures a preliminary interpretation of the results suggests that football goalkeepers tend to be of the mesomorphic body type. They are tall athletes (M = 188.87 cm) with adequate body weight (M = 87.39 kg) and relatively low values of subcutaneous adipose tissue.

Morphological characteristics of handball goalkeepers
Table 2 shows central and dispersion parameters of variables for the assessment of handball goalkeepers' morphological characteristics. All tests for longitudinal skeletal dimensionality and for body voluminosity and mass have acceptable metric characteristics and are normally distributed. The interval between the minimum and the maximum result in most cases includes more than three standard deviation values, ranging between 3 and 3.37, which means that the dispersion of results from the arithmetic means is slightly higher than with the football goalkeepers.

TABLE 2
CENTRAL AND DISPERSION PARAMETERS OF VARIABLES FOR THE ASSESSMENT OF MORPHOLOGICAL CHARACTERISTICS OF HANDBALL GOALKEEPERS (LONGITUDINAL SKELETAL DIMENSIONALITY, SUBCUTANEOUS ADIPOSE TISSUE AND BODY VOLUMINOSITY AND MASS)

Variables	N	M	Min	Max	Range	SD	Skew	Kurt
ALVT	13	192.32	181.70	201.30	19.60	5.26	-0.51	0.48
ALDND	10	110.15	106.10	117.20	11.10	3.55	0.85	0.01
ALDNL	10	110.27	106.10	117.10	11.00	3.38	0.86	0.22
ALRR	10	196.73	187.80	206.80	19.00	6.34	0.43	-0.80
ANL	13	14.66	10.07	30.33	20.26	5.80	1.87	3.81
ANNAD	13	11.80	6.00	17.00	11.00	2.73	-0.13	1.23
ANNAT	13	17.61	9.47	26.93	17.46	5.78	0.50	-0.76
ANT	13	26.98	5.30	47.00	41.70	10.48	-0.16	0.72
AVONATD	12	65.44	59.90	71.80	11.90	4.30	0.19	-1.27
AVOPOTD	12	41.12	38.00	45.70	7.70	2.63	0.17	-1.35
AVOT	12	95.45	86.20	103.40	17.20	5.69	-0.26	-0.76
AVTT	13	98.39	82.11	111.80	29.69	9.88	-0.48	-1.06

Handball goalkeepers are very tall athletes (M = 192.32 cm). Their average body weight is 98.39 kg and they have relatively high percentage of the subcutaneous adipose tissue. Handball goalkeepers are corpulent athletes of the mesomorphic somatotype with a slight tendency towards the endomorphic body type. A preliminary interpretation of the results in the Table 1 and Table 2 suggests that the football goalkeepers are slightly shorter, weigh less and have lower percentage of subcutaneous adipose tissue than the handball goalkeepers. Further data analysis will show statistical significance of the differences.

Comparative analysis of variables for the assessment of morphological characteristics of football and handball goalkeepers
T-test for small independent samples at 99% significance level was used to test the null hypothesis regarding differences in several morphological characteristics between top football and handball goalkeepers. Specific differences between football and handball goalkeepers with respect to body build indicators were determined.

The data showed in Table 3 suggest that in longitudinal skeletal dimensionality measures there are practically no statistically significant differences between football and handball goalkeepers. Out of four variables, a statistically significant difference was determined only in the variable *arm span* (ALRR) at the 95% significance level. Table shows that the average height of handball goalkeepers is 192.32 cm and that they are taller than football goalkeepers by approximately 4 cm, which could indirectly affect statistically significant differences in the variable *arm span*.

Football goalkeepers have a significantly lower percentage of subcutaneous adipose tissue than handball goalkeepers. Statistically significant differences were found in 3 out of 4 measured skinfold variables: upper arm (ANNAD), abdomen (ANT) and back (ANL). Football goalkeepers have a lower percentage of subcutaneous adipose tissue due to the fact that they need to be more explosive (faster and of better jumping ability) than handball goalkeepers and that they need to have better aerobic capacity. They cover significantly longer distances on the field during trainings and matches than handball goalkeepers.

Furthermore, the results suggest that football goalkeepers have lower body circumference values than handball goalkeepers. These differences are statistically significant at the 99% significance level in 3 out of 4 measured variables. Statistically significant differences were calculated in the following variables: right thigh circumference (AVONATD), waist circumference (AVOT) and body weight (mass) (AVTT). In conclusion, the results indicate that handball goalkeepers are more corpulent than football goalkeepers.

In order to guard the space in front of the handball goal (300 x 200 cm), which is, when compared to the football goal (7.32 x 2.44 m) much smaller, and to close that space to prevent the opponent attackers from scoring, handball goalkeepers must have higher measures of the longitudinal skeletal dimensionality and body voluminosity than their team mates in the field. This paper has proven that they have, when compared to football goalkeepers, higher values of the body mass, which is partly due to the higher percentage of the subcutaneous adipose tissue. When compared to football goalkeepers, handball goalkeepers more frequently utilise actions in a confined space, anticipate the situation and react by proper positioning.

TABLE 3
DATA SHOWING DIFFERENCES BETWEEN TOP FOOTBALL AND HANDBALL GOALKEEPERS IN VARIABLES FOR THE ASSESSMENT OF MORPHOLOGICAL CHARACTERISTICS.

Variables	goalkeepers	N	M	SD	df	p-
ALVT	F	10	188.87	4.36	21	0.11
	H	13	192.32	5.26		
ALDND	F	10	107.66	3.69	18	0.14
	H	10	110.15	3.55		
ALDNL	F	10	107.94	3.70	18	0.16
	H	10	110.27	3.38		
*ALRR	F	10	191.52	4.74	18	0.05
	H	10	196.73	6.34		
*ANL	F	10	10.01	2.34	21	0.03
	H	13	14.66	5.80		
**ANNAD	F	10	8.74	1.83	21	0.01
	H	13	11.80	2.73		
ANNAT	F	10	13.87	5.08	21	0.12
	H	13	17.61	5.78		
**ANT	F	10	12.60	5.97	21	0.00
	H	13	26.98	10.48		
**AVONATD	F	10	60.55	2.90	20	0.01
	H	12	65.44	4.30		
AVOPOTD	F	10	39.73	2.70	20	0.24
	H	12	41.12	2.63		
**AVOT	F	7	82.98	10.10	17	0.00
	H	12	95.45	5.69		
**AVTT	F	10	87.39	7.44	21	0.01
	H	13	98.39	9.88		

F - football goalkeepers   H - handball goalkeepers
* indicates p-value lower than 0.05   **indicates p-value lower than 0.01

On the other hand, when compared to handball goalkeepers, football goalkeepers move more frequently in front of the goal and cover longer distances. Increased body weight would slow them down in their saving actions, such as jumping, running out, punching or catching the ball, and especially landing after diving.

Conclusion

The purpose of this research was to determine differences between top football and handball goalkeepers in morphological characteristics. The sample of subjects comprised 10-13 handball goalkeepers and 7-10 football goalkeepers. T-test for independent samples was used to determine statistically significant differences between handball and football goalkeepers in the following variables: arm span (ALRR), back skinfold (ANL), upper arm skinfold (ANNAD), abdomen skinfold (ANT), right thigh circumference (AVONATD), waist circumference (AVOT), and body weight (mass) (AVTT). Results suggest that top handball goalkeepers are taller (longitudinal skeletal dimensionality) and more corpulent (body voluminosity and mass) and that they have a higher percentage of the subcutaneous adipose tissue. The reason for this can be found in selection procedures for the position of a goalkeeper and specific TE-TA actions of top football and handball goalkeepers during trainings and matches.

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RAZLIKE IZMEĐU FUDBALSKIH I RUKOMETNIH GOLMANA U MORFOLOŠKIM KARAKTERISTIKAMA

S A Ž E T A K

Cilj je ovog istraživanja utvrditi razlike među vrhunskim fudbalskim i rukometnim golmanima u morfološkim karakteristikama. Uzorak ispitanika čini 10-13 rukometnih i 7-10 fudbalskih seniorskih golmana hrvatskih nacionalnih selekcija ili prvoligaških klubova. Morfološke karakteristike procjenjivane su baterijom od 12 antropometrijskih varijabla – 4 varijable za procjenu longitudinalne dimenzionalnosti skeleta, 4 varijable za procjenu potkožnog masnog tkiva te 4 mjere za procjenu voluminoznosti tijela. Izračunati su standardni centralni i disperzivni parametri morfoloških varijabla. Značajnost razlika između fudbalskih i rukometnih golmana u mjerenim morfološkim karakteristikama utvrđena je t – testom za nezavisne uzorke. Utvrđeno je kako se rukometni i nogometni vratari razlikuju u sljedećim varijablama: raspon ruku (ALRR), kožni nabor leđa (ANL), kožni nabor nadlaktice (ANNAD), kožni nabor na trbuhu (ANT), opseg natkoljenice desne (AVONATD), opseg trbuha (AVOT) i težina tijela (AVTT). Vrhunski fudbalski golmani imaju manju longitudinalnu dimenzionalnost skeleta, imaju manje potkožnog masnog tkiva te manju voluminoznost tijela od rukometnih golmana.

Ključne riječi: Nogometni vratari, rukometni vratari, morfološka obilježja, razlike.