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Cranial Limbs as a Predictor of Precision in Handball

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Abstract

The paper aims to examine how the dimensions of the cranial limbs, arm length and dimensions of the hand, affect the accuracy and strength of the ball throwing in handball. The sample of examinees consists of 75 handball players of the Premier League (30 examinees) and the First League of Republic of Srpska (45 examinees), aged between 17 and 37. To estimate the cranial extremities of handball players, we used a set of five variables (length of hands, wrist diameter, planimetric parameter of the fist, arm span and arm length) and for the assessment of precision and power of ball throwing we used three variables (precision from seven meters from the stand variable, precision from nine meters from the jump and throwing the ball from the seating position). Regression analysis showed that a planimetric parameter of the hand variable has a large influence on the accuracy of handball, with a statistical significance of $p = .000$, while the length of the arm reaches borderline statistical significance with the strength of throw at the level of $p = .06$. The results clearly show us that anthropometric measures of cranial extremity significantly affects the accuracy and power of throwing the ball at the level of statistical significance of $p < .01$. The greatest impact was reached by the measures of arm length and planimetric parameter of the hand.

Keywords: Handball, handball players, precision, specific motor skills.

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1. Introduction

We may say that handball game has experienced a transformation and that from passive play, during the period when the game was based mainly on positional attacks and exhausting circling of the ball around zone defense, it transitioned into the modern, highly active game of modern handball, where the emphasis of the game is focused on the fast attacks (Czerwinski, J. 2000), the attacks on the disorganized play and positional attacks with a lot of fast movement, sharp passes and strong duel games. Defense adapted to such a structure of attack, where the reaction of the defender was replaced by action and maximum aggression. In such a constellation of defense and attack, attack players are finding fewer opportunities and space to create a favorable position for the shot.

It usually indicates a shot from greater distances or with contact play, which directly affects the very quality of impact, and success in implementation. Precision and power of throw are getting greater and greater importance in the outcome of the game. By analyzing the success depending on the actions which were used on XX World Championship for Men (Valdevit, Z. 2009), the author concluded that the players achieved the highest efficiency by kicking of penalty shots, 71%, while the efficiency of the throw while in the game percentage was about 60%.

These data tell us that in practice there is still much room for upgrading and improving of the precision in the handball game. Since the very aim of the game sorts shooting among the most important elements of handball game that determine the success of the score, it is no coincidence that more and more authors base their research on the factors affecting the quality of shooting. A positive impact of motor skills on the speed of the ball, especially the explosive strength, confirmed the investigation (Rogulj, N. et al 2007; Foretić, N. et al, 2005). Previous studies have shown that the technique of shooting, throw of the ball (Zvonarek, N, Vuleta, D and Hraski, Ž. 1997), as well as the movement of the hand with a ball during the shoot (Jovanović, B., Đukić, M. 2007) have high correlation with efficiency of the ball throw. This study aims to determine whether and to what extent anthropometric dimensions of cranial limbs affect the accuracy and the strength of the throw of the ball.

Materials and Methods

The sample of examinees in this study consists of 75 handball players, members of the men's clubs of B & H Premier League (30 examinees) and the First League of Republic of Srpska (45 examinees), aged between 17 and 37, engaged in systematic training for at least two years without long pauses.

Table 1. Average height and age of examinee

	N	Minimum	Maximum	Mean
ATV	75	170	205	186,51
AGE	75	17	37	22,33

To estimate the precision, the subjects were throwing the ball at right triangles whose legs had a length of 50 cm and were placed within the frame of the goal in the upper and lower corners of the goal. Each examinee had two attempts per corner, a total of eight attempts per test. Shooting was done by a handball ball, size 3, at a distance of 7 meters from standing position from the ground (SMP7M) and 9 meters from the jump (SMP9M). The test of throwing the ball from a seated position was used to estimate the power of the throw (SMBLS).

To estimate the dimensions of the cranial limbs, variables of arm length (ADR), wrist diameter (ADRZ), the length of the hand (ADŠ), planimetric parameter of the hand (APLP) and arm span (ARS) were used. In order to determine the statistical significance, all data is processed on the univariate level, basic descriptive parameters were calculated, and then the regression analysis was applied on multivariate level and relevant parameters were defined. For the dependent variables, precision tests were taken from seven and nine meters and the test of throwing the ball from the seating position. Data were analyzed using the SPSS / 20 packages.

Results

Table 2 shows the basic statistical parameters of anthropometric measures and criterion variables and precision of handball players. By analyzing the discrimination of the measurements or normality of the distribution of results, by variables, it can be stated that they move within the limits of the normal distribution of results, which enables the application of more complex multivariate of data processing method.

Table 2: Results of descriptive statistics

	N	Min	Max	Mean	Std. Dev.	Skewness	Kurtosis
ADR	75	71,00	88,00	79,44	4,03	,254	-,567
ADRZ	75	5,00	8,00	6,56	,64	,085	-,220
ADŠ	75	17,00	22,00	19,66	1,21	-,075	-,469
APLP	75	19,00	26,00	22,70	1,55	-,331	-,589
ARS	75	169,00	206,00	189,18	8,32	-,043	-,620
SMBLS	75	14,00	35,00	24,30	4,10	,113	,177
SMP7M	75	,00	8,00	3,96	1,65	-,228	,098
SMP9M	75	,00	7,00	2,36	1,53	,528	-,189

By inspection of results (Table 2), we note that the four variables have a negative (hipokurtic) asymmetry, which means that the number of the better the results is higher, and four variables have a positive (epikurtic) asymmetry which tells us that these variables have a larger number of weaker results. If we observe the normality of distribution of results over the value of kurtosis, it can be observed that six of the eight are variables with a negative sign and that the results tend to be rambly, and that two variables that had a positive sign indicate that the distribution is leptokurtic, which means that in these variables there are more average results. By analyzing the dispersion parameter variables, it is observed that the group of examinees expressed the greatest homogeneity in variables ADRZ, ADŠ, SMP9M, APLP and SMP7M (0.64 - 1.65) and the lowest homogeneity of the results of the group of examinees showed the variables ADR, SMBLS and ARS (4.03 - 8.32).

The results of regression analysis (Table 3, 4 and 5) clearly show us that anthropometric measures of cranial limbs significantly affects the accuracy and power of the throw of the ball at the level of statistical significance of $p < .01$. The greatest impact was realized by the measure of the arm length and planimetric parameter of the hand.

Regression analysis of the SMBLS criterion variable (Table 3), we came to the conclusion that multiple correlation coefficient is $R = .50$, which indicates the degree of correlation with the system of the predictor set at the multivariate level. This connection is at the level of statistical significance $Q = 0.01$.

On the basis of five anthropometric space variables, 25% of common variance of criterion variable is explained. The remaining 75% in explaining the common variability can be attributed to some other anthropometric characteristics of the examinees that were not the subject of this research and other dimensions of the anthropological area, which were not the subject of these investigations.

Table 3: Regression analysis of throwing the ball from sitting position variables (SMBLS)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.499[a]	.249	.195	3.685

a. Predictors: (Constant), ARS, APLP, ADRZ, ADŠ, ADR

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	310.814	5	62.163	4.577	.001[b]
Residual	937.132	69	13.582		
Total	1247.947	74			

a. Dependent Variable: SMBLS

b. Predictors: (Constant), ARS, APLP, ADRZ, ADŠ, ADR

Coefficients[a]

Model	B	Std. Error	Beta	t	Sig.
ADR	.430	.229	.423	1.879	.064
ADRZ	.150	.830	.023	.181	.857
ADŠ	.265	.467	.078	.568	.572
APLP	.502	.292	.191	1.722	.090
ARS	-.031	.114	-.063	-.271	.787

a. Dependent Variable: SMBLS

Results of partial regression coefficients (Beta) and its significance on the univariate level, indicate that statistically significant relationship with the criterion variable have predictor variables in the area of border significance, arm length ADR (BETA) = .42, which is significant at the level of $p = 0.06$ and planimetric parameter of hands APLP (BETA) = .19 which is significant at the level of $p = 0.09$.

By regression analysis SMP7M criterion variables (Table 4) and SMP9M (Table 5) we have come to the fact that a complete system of the predictor set of anthropometric measures on the multivariate level, with this the criterion variables shows statistical significance at the level of Q = 00:00.

Table 4: Regression analysis of precision with seven meters from the stand variable (SMP7M)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.602[a]	.363	.317	1.408

a. Predictors: (Constant), ARS, APLP, ADRZ, ADŠ, ADR

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	77.860	5	15.572	7.854	.000[b]
Residual	136.807	69	1.983		
Total	214.667	74			

a. Dependent Variable: SMP7M

b. Predictors: (Constant), ARS, APLP, ADRZ, ADŠ, ADR

Coefficients[a]

Model	B	Std. Error	Beta	t	Sig.
ADR	.158	.087	.374	1.805	.075
ADRZ	.307	.317	.116	.970	.336
ADŠ	-.085	.178	-.061	-.479	.633
APLP	.592	.111	.541	5.310	.000
ARS	-.051	.044	-.249	-1.167	.247

a. Dependent Variable: SMP7M

In relation to the precision from seven meters from the ground, predictor variables use 36%, and compared to the precision from nine meters from the jump they use 38% of the total variability of criterion variable. It should be noted that only one variable from the system of predictor set of variables, planimetric parameter of the hand, on the univariate level, significantly affects both of the criterion variables that had dealt with the precision of the ball throw.

The partial regression coefficient for this precision variable from seven meters from the stand is .54, and for the precision from nine meters from the jump it is .56 and statistically it has a significance on the level of p = .00. The results indicate that the arm length predictor variable affects the precision from seven meters criterion variable, in the area of border significance of p = .07, while the length of the hand variable has a statistically significant effect p = .05 on the precision from nine meters criterion variable.

Table 5: Regression analysis of precision from nine meters variable (SMP9M)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.613[a]	.376	.330	1.160

a. Predictors: (Constant), ARS, APLP, ADRZ, ADŠ, ADR

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	55.866	5	11.173	8.300	.000[b]
Residual	92.881	69	1.346		
Total	148.747	74			

a. Dependent Variable: SMP9M

b. Predictors: (Constant), ARS, APLP, ADRZ, ADŠ, ADR

Coefficients[a]

Model	B	Std. Error	Beta	t	Sig.
ADR	.106	.072	.303	1.478	.144
ADRZ	.323	.261	.146	1.237	.220
ADŠ	-.296	.147	-.253	-2.012	.048
APLP	.508	.092	.558	5.526	.000
ARS	-.011	.036	-.065	-.305	.761

a. Dependent Variable: SMP9M

Discussion

Shot efficiency depends on the technique (mechanics) of the shot, constitution of the player, physical predisposition, psychological characteristics and shot selection (Mikić, B., Alic-Partić, M. 2002).

This research was based on elements of the constitution of players, namely the impact of cranial limbs on the efficiency, or force and precision of the shots. Obtained information is related to the strength of the throw of the ball and are primarily conditions by the length of the arm. Basically, each ball throw is based on biomechanical frame, depending on the type of the chosen shot.

Throws in handball, and many movements in the game, as well as throws in an everyday life, is not conducted by individual segments, but the kinetic chains. The consequence of using the kinetic chains, or a large number of joints in the throwing of the ball, is increasing of the speed of movement of its open end, in our case, our hand. In this way, the ends of the kinetic chains develop significantly higher speeds than those which can be developed by any other segment of our body's individually (Jarić, S. 1997).

Ball speed depends on the length of the route in which the body has an effect on the ball during the throwing movement; it depends on the amount of the involved musculature, as well as the speed and consistency of contraction and relaxation of muscles that are used in the release of the ball. Therefore, the player who operates the ball with strength for a longer period will give it a greater amount of kinetic energy. It is obvious that players with longer lever or the players who achieve greater amplitude of throwing movement will be able to accomplish a longer traveling of the ball. It is this conclusion that confirms the result obtained from this research, that the players, who had longer cranial limbs, achieved significant results in the length of the throwing of the ball. Throwing of the ball in handball is characterized as an open successive kinetic chain.

In the basic throws from the ground, that produces the maximum speed of the ball, the longest kinetic chain is engaged and it begins with a foothold, it is transmitted through the hip and torso, and ends with the longest lever of the arm and the throwing movement of the hand. It is very important to emphasize that in successive schemes of kinetic chain, the movement begins at a joint of one end of the kinetic chain, and then the adjacent joints start joining, until the entire chain is in motion.

In the handball jargon, as well as professional, this scheme is called "whip" technique of throwing the ball, because, like in the movement of a whip, in the direction of the movement, the segments with the backing are the first to move, then the adjacent segments, until in the end the last segment moves, which is, in our case, the hand with the ball. On the other side, when throwing the ball from the jump, the kinetic chain is rather short, the force is acting on the short path, and the impact of the ground reaction is smaller than when you throw the ball from the ground. The aim of using this method of throwing the ball, in addition to achieving the maximum possible speed of the throw, is also achieving specially accurate movement. In the basics of every throw of the ball, an important element is the quality of holding the ball. In order to get the ball have thrown towards the goal with quality and at high speed, it must have a considerable level of contact with the hand.

Conclusions

Holding of the ball is the specificity of the handball, and dimensions of the hand (length of hand and planimetric parameter of the hand) directly affect the quality of holding the ball. The results showed that the planimetric parameter of the hand to an exceptional extent determine the quality of the throwing of the ball, which influences the final result of the precision of the shot. This parameter is the distance from the tip of the thumb to the tip of the little finger when the hand is open, and preferably that distance is in the form of a straight line. The players are able to improve this hand parameter by training and it should be insisted on during the training process, because it directly or indirectly affects the efficiency of technical and tactical actions.

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