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MORPHOLOGICAL CHARACTERISTICS ASTHE PREDICTORS OF SITUATIONAL SUCCESSFUL IN THE WATER POLO

Summary:

At the sample of 39 water polo players, aged 12 years (± 6 months), the research was conducted to determine the impact of morphological characteristics on the situational performance in the water polo. In this paper, a set of 12 anthropometric measures as a predictor set of variables was applied, while the criterion variables were situational motor tests; swimming speed at 25 meters with and without a ball, vertical jump from the water and side swimming 8 times 2.5 meters. On the basis of the obtained results it was concluded that the morphological characteristics significantly influenced the performance of situational motoric tasks in water polo, depending on the test from 39% to as much as 71%. The most significant applied variables from the morphological space of water polo players were variables; the volume of the thorax, the height of the body, the width of the hand and the foot with a positive effect, while the weight of the body and the subcutaneous fatty tissue were aggravating factors for the performance of situational motoric tasks for the 12-year-old water polo players.

Key words: *water polo, morphological characteristics, situational motoric, regression:*

1. INTRODUCTION

As an integral part of the anthropological status of man there are morphological characteristics whose significance in water polo is confirmed in the previous research (Aleksandrović&sar. 2015, Kondrič&sar. 2012, Tsecouras&sar. 2005, Uljević&Spasić 2009). Situational performance assessed through the application of situational motoric tests is a very important source of information especially for trainers, as it provides the response to the effects of the training process. Water polo as a sport discipline has a very long tradition. The first water polo match was played in Crystal Palace in London in 1874, while water polo was included in the Summer Olympics program since 1900, which, together with football, placed it in the oldest team sports disciplines of modern summer Olympics (Snayder, 2008). From the first water polo match (1874) to the present day, water polo rules have changed and made water polo very popular sports discipline and, therefore, demanding in terms of psycho-physical load for water polo players. The studies in the past 15-20 years (Lozovina&Pavičić, 2004, Uljević&Spasić 2009) found that the constitution of water polo players has changed significantly compared to the previous period, which is especially important to know when selecting children for water polo, positioning players in water polo. In addition to the fact that morphological space and situational efficiency have been investigated by many authors, similar research has to be carried out on different age categories and populations because the dynamics of water polo games, the constitution of water polo players from different countries, as well as the specificity of the training process again indicate interesting results.

Water polo is Montenegrin sport with the highest number of trophies. In addition to the fact that Montenegro has more than half a million inhabitants and is one of the smallest European countries, the Montenegrin senior team has excellent results at the biggest competitions (the champions of Europe 2008, the world champions 2009 and 2018, the world's champions in 2013, fourth place at the Olympic Games 2008, 2012, 2016). Also, the junior national team of Montenegro won the European championship in 2017. These results imply the need for maximum involvement of the professional and scientific public, especially in younger selections, in order to contribute to the preservation of the water polo tradition in Montenegro. Also, the need for surveys, where the sample of respondents is Montenegrin water polo players, is also necessary due to the fact that very few of the previous researchesare related to water polo in Montenegro.

In accordance with the above, the aim of this paper is to determine the impact of morphological characteristics on situational performance for young water polo players.

2. METHOD OF WORK

2.1. Sample respondents

The sample of respondents included 39 water polo players aged 12 years (± 6 months), participants of water polo school VK Budva and VK Jadran from Montenegro. The sample included respondents who had been training water polo for at least 18 months, had a good medical condition during the testing period. Respondents voluntarily participated in all stages of measurement and testing, with the consent of parents and trainers.

2.2. Variables sample

Measuring instruments included a set of 12 anthropometric measures and a battery of 4 situational motoric tasks

The morphological space is covered with the following variables:

- Longitudinal dimension – body height (VIST), arm span (RASR) and arm length (DUŽR),
- Transverse dimensionality –shoulder width (ŠIRR), foot width (ŠIRS) and width of the hand (ŠIRŠ)
- Subcutaneous fat –triceps skinfold(KNND),subscapular skinfold (KNNL) and abdominal skinfold (KNNT),
- Volume and body mass–body weight(TEŽT), triceps volume (ONAD), chest volume (OGRK)

Measurement of morphological characteristics was carried out according to the recommendations of the International Biological Program *(Lohman, Roche and Martorell, 1988).*

Situational motoric variables:

- Speed of swimming at 25 meters water polo crawl without a ball (P25BL),
- Swimming speed of 25 meters water polo crawl with ball (P25SL),
- Vertical jump from water (VERSK) and
- Lateral swimming 8 times 2.5 meters (B8X2.5)

The situational motoric tests applied in this study were applied in similar studies, where it was established that they adequately assess the situation of motor efficiency of water polo players (Kondrič et al., 2012; Platanou, 2006; VaramentiiPlatanou, 2009; Donevisar., 2009 Bampouras and Marrin, 2009).

2.3. Data processing methods

In order to obtain the basic statistical parameters, the collected data are processed at the level of descriptive statistics, where the arithmetic mean (Mean), Minimum and Maximum Result (Min./Max.), Standard deviation (Std. Dev.), Standard error of the arithmetic mean (Std. Error), variance (Variance), skew (Skew) and kurtosis (Kurt).
In order to determine the influence of the predictor set of morphological variables to the criterion variables of situational motoric problems in water polo, the regression analysis was applied. All data is processed in the statistical program Statistics SPSS 20.0.

3. THE RESULTS AND DISCUSSION

By analyzing the values of skews (Skew) and kurtosis (Kurt) for all applied variables, a normal distribution of results can be established, which provides a good premise for the quality application of results in further statistical processing. Respondents were on average higher (Mean - 160.46) compared to the same age in similar studies (Aleksandrovic&sar 2015), where the average height was 156.99cm. It is characteristic that in comparison with the results of the research Aleksandrovic&sar, in 2015, the body weight was almost identical to 50.99 kg compared to 51.79 kg in this study. It is characteristic to point out that the results in the test of swimming speed of 25 meters water polo crawl (Mean - 16.40) were considerably better than the results of the research Aleksandrovic&sar. (2015), where the average speed of swimming was 18.09. The test procedure in both cases was the same, where the respondents started from the water on the sign of the measurer, swimming in a 25 meter section of water polo crawl.

Table No1 Basic statistical parameters of morphological and situational-motoric variables

Variable	N	Min	Max	Mean	Std. Dev	Variance	Skew	Kurt
VIST	39	151.00	175.30	160.46	6.47	41.97	.68	-.13
RASR	39	148.20	174.20	161.21	6.73	45.32	.22	-.60
DUŽR	39	61.00	72.00	67.19	2.91	8.48	-.23	-.62
ŠIRR	39	31.00	39.30	34.60	2.26	5.12	.55	-.40
ŠIRŠ	39	7.00	10.00	8.26	.75	.57	.61	-.11
ŠIRS	39	8.30	11.00	9.55	.69	.48	-.04	-.69
KNND	39	5.80	21.10	11.96	3.98	15.85	.44	-.60
KNNL	39	5.00	18.10	8.92	3.68	13.59	1.15	.08
KNNT	39	3.80	26.00	11.60	6.17	38.09	.58	-.73
TEŽT	39	38.00	75.00	51.79	10.01	100.33	.63	-.23
ONAD	39	21.00	32.00	26.10	3.16	9.98	.26	-.99
OGRK	39	67.50	96.50	82.73	6.96	48.51	.28	-.36
P25BL	39	14.08	21.10	16.40	1.59	2.55	.74	.70
P25SL	39	14.50	23.40	17.95	1.99	4.00	.67	.97
VERSK	39	10.00	41.00	23.74	7.49	56.24	.22	-.64
B8X2,5	39	9.47	15.55	13.33	1.61	2.61	-.60	-.36

Variable *-variables,* ***N****-number of respondents,* ***Min****-minimum score,* ***Max****-maximum score,* ***Mean****-arithmetic mean,* ***Std. Dev****-standard deviation,* ***Variance****- variance,* ***Skew****-skew,* ***Kurt****-kurtosis,* ***VIST****-height of the body,* ***RASR****-arm span,* ***DUŽR****-arm length,* ***ŠIRR****-width of the shoulders,* ***ŠIRŠ****-width of the hands,* ***ŠIRŠ****-width of the feet,* ***KNND****-triceps skinfold ,*
KNNL*-* subscapular skinfold, ***KNNT****-* abdominal skinfold, ***TEŽT****--body weight,* ***ONAD*** *upper arm volume,* ***OGRK****-chest volume,* ***P25BL****-swimming 25 meters without a ball,* ***P25SL*** *swimming 25 meters with a ball,* ***VERSK*** *-vertical jump from the water,* ***B8X2,5****-side swimming 8 times 2.5 meters.*

By the regression analysis of the applied set of morphological variables to the criterion variable of swimming speeds of 25 meters without a ball, it is concluded that there is a statistically significant influence of the predictor on the criterion (Tables 2, 3 and 4). The coefficient of multiple correlation (R = .817) indicates a high degree of connection between the predictor and the criterion. Also, by analyzing the corrected determination coefficient (Adjusted R Square = .515), it can be concluded that the swimming speed of a water polo crawl at 25 meters without a ball is about 52% dependent on the applied set of morphological variables, while the remaining 48% depends on some other anthropological abilities and characteristics which were not the subject of this research. Given that this is a relatively small sample of the respondents, as a coefficient of determination, the value of the corrected coefficient (Adjusted R Square) of the determination was analyzed. The Adjusted R Square indicator in relation to R Square gives a more realistic estimate of the actual value of the coefficient of determination in the population; therefore its application is more logical in the work with smaller samples (Tabachnick&Fidell, 2013).

Table No 2 Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.817[a]	.668	.515	1.11264

Table No3 ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	64.746	12	5.396	4.358	.001[b]
	Residual	32.187	26	1.238		
	Total	96.934	38			

By analyzing the individual effects of the predictor on the criterion, it was noted that only the variable volume of the chest had a statistically significant influence on the predictor P25BL (sig = .036). The negative sign of the Beta (-626) coefficient for the OGRK variant indicates that respondents with a larger chest volume needed less time to swim a 25-meter section of the water polo crawl, or that they achieved a better result.

Table No 4Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	42.438	11.980		3.542	.002
	VIST	.056	.118	.229	.478	.637
	RASR	-.126	.117	-.531	-1.076	.292
	DUŽR	.091	.187	.166	.487	.630
	ŠIRR	-.158	.126	-.225	-1.258	.219
	ŠIRŠ	-.266	.398	-.126	-.668	.510
	ŠIRS	-.651	.469	-.284	-1.390	.176
	KNND	-.197	.102	-.490	-1.922	.066
	KNNL	.253	.178	.584	1.423	.167
	KNNT	.155	.097	.600	1.607	.120
	TEŽT	.109	.110	.686	.992	.330
	ONAD	-.095	.228	-.188	-.417	.680
	OGRK	**-.144**	**.065**	**-.626**	**-2.210**	**.036**

Similar results were obtained when analyzing the influence of the predictor on the criterion variable of the swimming speed of 25 meters water polo crawl with a ball (P25SL). High level of connectivity (R = .749) is also evident, but somewhat lower level of influence of the predictor on the criterion (Adjusted R Square = .358).

Table No 5 Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.749[a]	.561	.358	1.60188

Table No 6 ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	85.278	12	7.107	2.769	.014[b]
	Residual	66.716	26	2.566		
	Total	151.995	38			

The individual effect from the predictor set of variables on the criterion variable P25SL was achieved by the variables of the abdominal skinfold (KNNT) with a positive sign (Beta = .968) and the variable chest volume (OGRK) with a negative Beta coefficient (-.987). Due to the inverse scaling of the analyzed value of the results, it was found that a better result when swimming at 25 meters with a ball water polo crawl were achieved by respondents with a larger volume of the chest, while worse was the result of respondents with higher subcutaneous fat tissue in the abdomen area.

Table No 7 Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	56.371	17.248		3.268	.003
	VIST	.045	.170	.147	.267	.792
	RASR	-.089	.168	-.299	-.527	.603
	DUŽR	-.086	.269	-.125	-.320	.752
	ŠIRR	-.059	.181	-.067	-.326	.747
	ŠIRŠ	-.881	.573	-.333	-1.538	.136
	ŠIRS	.161	.675	.056	.239	.813
	KNND	-.208	.147	-.413	-1.409	.171
	KNNL	.117	.256	.216	.458	.651
	KNNT	**.314**	**.139**	**.968**	**2.257**	**.033**
	TEŽT	.160	.159	.803	1.010	.322
	ONAD	-.167	.329	-.263	-.507	.617
	OGRK	**-.290**	**.094**	**-.987**	**-3.097**	**.005**

The regression analysis of the criterion of variable vertical jump from water (VERSK) and the predictor set of morphological variables indicates a statistically significant association and impact (Sig = .000) of the predictor on the criterion. The applied system of morphological variables is responsible for approximately 71% (Adjusted R Square = .711) for the realization of a vertical jump from the water.

Table No 8 Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.896[a]	.802	.711	4.03282

Table No 9 ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1714.581	12	142.882	8.785	.000[b]
	Residual	422.855	26	16.264		
	Total	2137.436	38			

Of the 12 applied predictor variables, 4 variables individually produced a statistically significant effect; body height, hand width, foot width and body weight (VIST, ŠIRŠ, ŠIRS, TEŽT). Carrying out the conclusion of the partial impact, and taking into account the inverse scaling of the obtained results, it can be concluded that the vertical jump from the water was better performed by the higher respondents, with a larger diameter of the hand and the feet, as well as less weight respondents. Considering the movement of the vertical jump from the water, where it is necessary to strongly tackle the hands and feet on the water, the obtained results are logical. Due to the larger diameter of the foot and the hand, the force acting on the water during the retraction breaks into a larger surface, which creates a better base for retraction during a vertical jump. Respondents who had greater weight also needed more power to perform the task that placed them in an unfavorable position compared to the less weight respondents.

Table No 10 Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-200.944	43.422		-4.628	.000
	VIST	**.914**	**.428**	**.790**	**2.138**	**.042**
	RASR	-.079	.424	-.070	-.185	.855
	DUŽR	.422	.677	.164	.623	.539
	ŠIRR	.297	.456	.090	.650	.522
	ŠIRŠ	**4.354**	**1.442**	**.438**	**3.019**	**.006**
	ŠIRS	**3.324**	**1.698**	**.308**	**1.957**	**.001**
	KNND	.068	.371	.036	.183	.856
	KNNL	-.968	.645	-.476	-1.501	.145
	KNNT	.427	.350	.352	1.221	.233
	TEŽT	**-1.226**	**.400**	**-1.637**	**-3.068**	**.005**
	ONAD	1.068	.828	.450	1.290	.209
	OGRK	.275	.235	.256	1.170	.253

The obtained results of the regression analysis of the predictor set of 12 morphological variables on the criterion of lateral swimming 8 times 2.5 meters indicate statistically significant influence and connection (Sig. = .010). Corrected coefficient of determination (Adjusted R Square = .385) indicates that the performance of the situational motoric task 8 times 2.5 meters lateral, is with about 39% conditioned by the applied set of morphological variables.

Table No 11 Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.761[a]	.579	.385	1.26910

Table No 12 ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	57.601	12	4.800	2.980	.010[b]
	Residual	41.876	26	1.611		
	Total	99.477	38			

By partial analysis of the impact of the predictor on the criterion, it was established that no variable individually had a statistically significant impact. The obtained result suggests the conclusion that the predictor set only as a whole has an impact and successfully predicts with about 39% the performance of the situational motoric task of lateral swimming 8 times 2.5 meters in water polo.

Table No 13 Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	44.999	13.665		3.293	.003
	VIST	-.018	.135	-.072	-.134	.895
	RASR	-.078	.133	-.326	-.588	.562
	DUŽR	-.062	.213	-.112	-.291	.773
	ŠIRR	-.295	.144	-.413	-2.053	.150
	ŠIRŠ	-.253	.454	-.118	-.556	.583
	ŠIRS	-.461	.534	-.198	-.862	.396
	KNND	.028	.117	.069	.239	.813
	KNNL	-.046	.203	-.104	-.225	.824
	KNNT	.080	.110	.306	.728	.473
	TEŽT	.149	.126	.923	1.186	.246
	ONAD	-.283	.261	-.553	-1.087	.287
	OGRK	.043	.074	.184	.578	.569

4. CONCLUSION

A survey conducted on a sample of 39 water polo players, aged 12 years (± 6 months), aimed to determine the impact of morphological characteristics on situational performance in young water polo players. The morphological space with 12 variables was analyzed, as well as the situational motoric of water polo players with a battery of 4 tests used in previous studies with similar problems. Using the regression analysis, a statistically significant influence of the predictor set of morphological variables on situational motor assays was determined; swimming speed at 25 meters water polo crawl with and without a ball (P25BL and P25SL), vertical jump from water (VERSK) and side swimming 8 times 2.5 meters (B8X2.5). Corrected determining coefficients in all four analyzed cases were at a statistically significant level and it can be concluded that morphological characteristics significantly influence the efficiency of the realization of situational motoric tasks. By analyzing the individual effects of applied variables on the analyzed criterion variables, it is concluded that the volume of the chest, body height, width of the hand and foot have a positive effect on performing situational motoric

tasks, while subcutaneous fat tissue in the area of the abdomen, as well as increased body weight, present aggravating factors in situational efficiency for young water polo players.

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