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Original scientific paper

CHARACTERISTICS OF MORPHOLOGICAL AND MOTORIC PARAMETERS IN THE SHORT-DISTANCE DISCIPLINES OF THE YOUNG SWIMMERS

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Abstract

A total of 29 variables were used in the research. For this purpose, samples of 15 variables for the evaluation of anthropometric dimensions, 10 variables for the evaluation of general motoric skills, as well as 4 variables for the evaluation of specific motoric skills were used. Significant correlations are presented between the body height variable and seven other variables at a very high probability level. Body height has achieved a very high correlation with leg length r = .77, which means that body height significantly affects the length of the limbs. Also the length of the arm has achieved a high correlation with the height of the body r = .53, which is considered an important feature in swimmers. Body height has also shown a correlation with the circumference measured in the research, especially with that of the chest r = .56, this correlation has been observed by other researchers, in previous research from the sport of swimming. Thigh circumference and arm circumference have achieved a high and significant correlation r = .65, which indicates the proportional limb development in young swimmers. Unlike anthropometric ambiance, the basic motoric ambiance has only four statistically significant correlations. The variables of hand tapping and sanding long jump have achieved a correlation r = .498 with 99% probability level. Also, the upper limbs tapping variable shows a statistically significant correlation with the lower limbs tapping variable r = 33 as well as the dynamometer variable r = 35 at the 95% probability level. This implies that the explosive force of the lower limbs to a considerable extent exhibits connection with tapping as the main characteristic of alternating limb movements, a phenomenon extremely important in the sport of swimming. A very high correlation is being noted at the 99% probability level in all variables of the short swimming disciplines. The highest correlation, r = 87, was shown between the variables 50 meters freestyle and that of 50 meters breaststroke. Regarding the correlation of sports motoric variables with anthropometric ones, it is noticed that the flexibility test variable, the flamingo test, has a special meaning in almost all specific motoric variables. It shows a high correlation coefficient r = 45 with the breaststroke variable, r = 45 with the freestyle variable and r = 40 with the backstroke variable, all at the 99% probability level, while with the butterfly variable it showed a correlation at the 95% probability level at r = 35.

Keywords: anthropometric, motoric skills, specific motoric, swimming disciplines, correlations

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INTRODUCTION

According to its character, swimming belongs to the sport with mono-structural cyclic movements, which means the movement of the swimmer's body in the water, which is accomplished by the movements, which are repeated in space and interval of the body position in the water, the impact of water on the body and others. We can distinguish everything in the sport of swimming such as clothing or environment, but I would single out the position of the body in the water as the most important, which is considered a specific feature of the sport of swimming - horizontal position (Mehdi Jashari 2001)[2].

We can say that swimming is a sport of endurance skills, because cyclic movements are repeated at a pace for a long period of time. In the training process we also distinguish: general and specific sustainability.

- the position of the swimmer's body in the water; reduction of the frontal surface of the body in water; behavior of the body in a hydrodynamic position or by increasing the ability to swim, the resistance of body mobility over water can be reduced (Kolmogorov et al. 1997)[3],
- body shape; the movement of the swimmer causes the pressure to accumulate in the water in front of it, which consequently has frontal resistance; that pressure occurs where the body is curved, for example: head, shoulders, waist, skin folds and others. (Colwin, 1992)[4],
- swimming speeds; the speed of swimming affects the increase of resistance so that with its increase the resistance increases by the square (Colwin, 1992)[5].

RESEARCH METHODS

Samples of entities

Sample of entities consists of approximately 40 swimmers from the Republic of North Macedonia, swimmers from clubs such as: SC "Delfin" - Skopje, SC "Beta", Swimming and Water Polo Club "Orion", who were in it the same level of competition. It is expected that all swimmers will be in good health and physically fit to undergo anthropometric, motor and specific-motor measurements in order to accomplish the sports tests.

[2] Mehdi Jashari 2001
[3] Kologorov et al. 1997
[4] Colwin, 1992
[5] Clowin, 1992

Samples of variables

A total of 29 variables will be used in this research. For this purpose, we shall use a system of 15 variables for the evaluation of anthropometric dimensions, 10 variables for the evaluation of general motor skills and 4 variables for the evaluation of specific motor skills.

Analysis of correlation coefficients

Table 1. Correlations of anthropometric space variables

	Masa e trupit	Lartesia e trupit	Gjatesia e krahut	Gjatesia e kembes	Gjatesia e shputes	Gjatesia e shuplakes	Perimetri i kofshes	Perimetri i kercirit	Perimetri i krahut	Perimetri i gjoksit	Indi dhjamor i krahut	Indi dhjamor i shpines	Indi dhjamor i barkujt	Indi dhjamor i kercirit	BMI
Masa e trupit	1														
Lartesia e trupit	.347*	1													
Gjatesia e krahut	.131	.536**	1												
Gjatesia e kembes	.389*	.771**	.463**	1											
Gjatesia e shputes	.284	.621**	.315*	.594**	1										
Gjatesia e shuplakes	.509**	-.050	.081	.190	.152	1									
Perimetri i kofshes	.239	.403**	.341*	.392*	.242	.418**	1								
Perimetri i kercirit	.204	.371*	.270	.332*	.302	.392*	.449**	1							
Perimetri i krahut	.431**	.483**	.425**	.384*	.219	.571**	.657**	.574**	1						
Perimetri i gjoksit	.411**	.567**	.287	.583**	.307	.489**	.581**	.474**	.850**	1					
Indi dhjamor i krahut	-.015	.281	.346*	.237	-.129	.143	.281	.295	.455**	.408**	1				
Indi dhjamor i shpines	-.033	-.007	.113	-.012	.139	-.011	.005	-.138	.064	-.022	.157	1			
Indi dhjamor i barkujt	.167	.034	.254	.024	-.121	.093	-.068	-.073	.259	.174	.124	.390*	1		
Indi dhjamor i kercirit	.080	-.046	.005	-.103	.002	-.096	-.040	-.311	.073	-.026	.099	.567**	.415**	1	
BMI	.251	-.567**	-.062	-.402*	-.429**	.443**	-.023	-.003	.027	-.170	-.080	-.049	.091	-.031	1

Table No.2 shows the correlations of anthropometric space. All correlations marked with an asterisk (*) show statistically significant correlations at the 95% probability level, while all correlations marked with two asterisks (**) show statistically significant correlations at the 99% probability level.

Significant correlations are observed between the body height variable with seven other variables at a very high level. The height of the body has accrued a very high correlation with the length of the leg r = .77, which means that the height significantly affects the length of the limbs of the body. Also, the length of the arm has accrued a high correlation with the height of the body r = .53, which is considered an important feature in swimmers.

Body height has also shown a correlation with the circumference measured in the research, especially with that of the chest r = .56, this correlation has been observed in other previous studies, by researchers in the sport of swimming.

Thigh circumference and arm circumference have accrued a high and significant correlation r = .65, which indicates the proportional limb development in young swimmers.

Table 2. Correlations of basic motor space variables

	Sit and Reach	Flamingo test	jump three-step	Shoulder flexibility	Run 10m	Run 20m	long jump from the place	Dinamometer	Foot touch	Hand touch
Sit and Reach	1									
Flamingo test	.039	1								
jump three-step	.074	-.157	1							
Shoulder flexibility	.047	.262	-.138	1						
Run 10m	.210	.018	-.300	.185	1					
Run 20m	-.226	.281	.000	-.067	-.090	1				
long jump from the place	-.209	.059	.285	-.130	-.268	.153	1			
Dinamometer	.033	-.086	.244	-.157	-.221	-.138	.164	1		
Foot touch	.128	-.056	.104	-.224	-.097	-.087	-.067	.168	1	
Hand touch	.184	-.011	-.292	.094	.141	.040	-.498**	-.355*	-.330*	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table No.2 shows the correlations of the basic motor space at two probability levels. Unlike anthropometric space, basic motor space has only four statistically significant correlations. The variables of hand tapping and long jump from the spot have accrued a correlation r = .498 with 99% probability level. Also the manual tapping variable shows a statistically significant correlation with the foot tapping variable r = 33 and the dynamometer variable r = 35 at the 95% probability level. This suggests that the explosive force of the lower limbs exhibits connection to a considerable extent with tapping as the main characteristic of alternating limb movements, a phenomenon that is extremely important in the sport of swimming.

Table 3. Specific motor space correlations

	Free style 50 meters	Backstroke 50 meters	Breaststroke 50 meters	Butterfly 50 meters
Free style 50 meters	1			
Backstroke 50 meters	.828**	1		
Breaststroke 50 meters	.876**	.771**	1	
Butterfly 50 meters	.748**	.770**	.759**	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table No. 4 presents the correlations of the major short distance swimming disciplines in young men and women. A very high correlation is seen at the 99% probability level in all variables. The highest correlation, r = 87, was shown between the variables 50 meters freestyle and that of 50 meters breaststroke. Given the nature of conditioning and physiological abilities, which largely depend on the same energy sources, because it is about the same length of grading, a connection between these disciplines can also be considered natural.

Table 4. Cross-correlations of the three spaces included in the research

Correlations

	Masa e trupit	Lartesia e trupit	Gjatesia e krahut	Gjatesia e kembes	Gjatesia e shputes	Gjatesia e shuplakes	Perimetri i kofshes	Perimetri i kercirit	Perimetri i krahut	Perimetri i gjoksit	Indi dhjamor i krahut	Indi dhjamor i shpines	Indi dhjamor i barkujt	Indi dhjamor i kercirit	BMI	Sit and Reach	Flamingo test	Kercim trehapsh	Fleksibiliteti i shpatullave	Vrapim 10m	Vrapim 20m	Kercim se gjati nga vendi	Dinamometer	Taping me kembe	Taping me dore	Kraul 50 metra	Shpin 50 metra	Bretkos 50 metra	De r
Masa e trupit	1																												
Lartesia e trupit	.347*	1																											
Gjatesia e krahut	.131	.536**	1																										
Gjatesia e kembes	.389*	.771**	.463**	1																									
Gjatesia e shputes	.284	.621**	.315*	.594**	1																								
Gjatesia e shuplakes	.509**	-.050	.081	.190	.152	1																							
Perimetri i kofshes	.239	.403**	.341*	.392*	.242	.418**	1																						
Perimetri i kercirit	.204	.371*	.270	.332*	.302	.392*	.449**	1																					
Perimetri i krahut	.431**	.483**	.425**	.384*	.219	.571**	.657**	.574**	1																				
Perimetri i gjoksit	.411**	.567**	.287	.583**	.307	.489**	.581**	.474**	.850**	1																			
Indi dhjamor i krahut	-.015	.281	.346*	.237	-.129	.143	.281	.295	.455**	.408**	1																		
Indi dhjamor i shpines	-.033	-.007	.113	-.012	.139	-.011	.005	-.138	.064	-.022	.157	1																	
Indi dhjamor i barkujt	.167	.034	.254	.024	-.121	.093	-.068	-.073	.259	.174	.124	.390*	1																
Indi dhjamor i kercirit	.080	-.046	.005	-.103	.002	-.096	-.040	-.311	.073	-.026	.099	.567**	.415**	1															
BMI	.251	-.567**	-.062	-.402*	-.429**	.443**	-.023	-.003	.027	-.170	-.080	-.049	.091	-.031	1														
Sit and Reach	.108	.255	.291	.204	.142	-.102	.283	.097	.175	.216	-.202	-.014	.163	.119	-.181	1													
Flamingo test	.178	.310	.073	.357*	.063	.077	.145	.050	.206	.339*	.271	-.137	-.065	-.189	-.181	.039	1												
Kercim trehapsh	.226	.116	.138	.060	-.010	.029	-.077	.014	.222	.265	.281	.074	.272	.114	.053	.074	-.157	1											
Fleksibiliteti i shpatullave	.068	.174	.158	.136	.131	-.006	-.037	.236	.001	-.063	.139	.096	.017	-.077	.001	.047	.262	-.138	1										
Vrapim 10m	-.122	-.143	-.079	-.072	.077	-.153	-.016	-.147	-.283	-.251	-.419**	-.085	.021	.017	-.025	.210	.018	-.300	.185	1									
Vrapim 20m	.034	-.040	-.012	.151	-.083	.295	.157	.095	.103	.187	.082	-.091	-.265	-.259	.236	-.226	.281	.000	-.067	-.090	1								
Kercim se gjati nga vendi	.100	.182	-.089	.303	.233	.089	.012	-.078	.141	.198	.215	.068	-.094	-.009	-.262	-.209	.059	.285	-.130	-.268	.153	1							
Dinamometer	-.104	.169	.030	.118	.062	.139	.208	.181	.411**	.407**	.241	-.031	.115	.013	-.189	.033	-.086	.244	-.157	-.221	-.138	.164	1						
Taping me kembe	-.128	-.133	-.023	-.296	-.183	-.019	.012	-.011	.088	-.010	-.001	-.364*	.014	-.243	-.002	.128	-.056	.104	-.224	-.097	-.087	-.067	.168	1					
Taping me dore	-.190	.009	.097	.014	.136	-.064	.060	.059	-.219	-.193	-.223	.216	-.113	.123	-.036	.184	-.011	-.292	.094	.141	.040	-.498**	-.355*	-.330*	1				
Kraul 50 metra	.153	.206	.134	.175	.176	-.139	.025	-.019	-.182	-.110	-.047	-.263	-.249	-.243	-.032	-.118	.452**	-.144	.008	-.015	.085	-.010	-.286	-.072	.059	1			
Shpin 50 metra	.002	.113	-.096	.114	.028	-.213	-.011	.020	-.301	-.155	-.096	-.200	-.343*	-.208	-.136	-.201	.404**	-.340*	.047	.140	.177	-.123	-.359*	-.194	.143	.828**	1		
Bretkos 50 metra	.250	.201	-.025	.164	.151	-.127	-.078	-.043	-.117	-.040	-.042	-.178	-.174	-.037	.016	-.252	.457**	-.051	.129	.003	.086	.054	-.239	-.182	.009	.876**	.771**	1	
Delfin 50 metra	.145	.109	-.152	.083	.152	-.173	-.146	-.069	-.323*	-.239	-.111	-.170	-.274	-.208	-.028	-.304	.358*	-.189	.162	.001	.093	.193	-.437**	-.128	-.060	.748**	.770**	.759**	

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table No.4 shows all the correlations of the three spaces (cross-correlations) included in the research. It is worth noting that the dynamometer variable has shown a statistically significant correlation at the 95% probability level with the variables, which measure arm circumference r = 41 and chest circumference r = 40. This suggests that the force expressed by the palm of the hand to a certain extent indicates a connection with the circumference of the arm and chest, which from the physiological aspect of body building is also understood as normal. The arm adipose tissue variable and the 10-meter running variable also showed statistically significant correlations, however, as the sample selected in the research includes very subtle age, where the differences in subcutaneous adipose tissue parameters are from one person to another very large, given here the differences in age and gender, we cannot consider that this association may present any relevant impact on the results of certain swimming disciplines.

Regarding the correlation of sports motor variables with anthropometric ones, it is noticed that the flexibility test variable, flamingo test, has a special meaning in almost all specific motor variables. It shows a high correlation coefficient r = 45 with the breaststroke variable, r = 45 with the freestyle variable and with the backstroke variable r = 40, all at the 99% probability level, while with the butterfly variable it showed a correlation at the 95-probability level %, r = 35.
The dynamometer variable shows the correlation with the specific motor variable, the 50 meters butterfly discipline at r = 48. The strength of the palm of the hand, probably plays an important role in this attractive discipline of swimming.
Regression coefficient analyzes
Regression analysis of basic motor variables

Table 5. Model Summary[b]

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**Durbin-Watson**
1	.452[a]	.204	.183	.91152	2.096

a. Predictors: (Constant), Flamingo test
b. Dependent Variable: Freestyle 50 meters

Table No.5 shows the impact of the predictive variable of motor space on the criterion variable of 50 meters freestyle. This influence, R square = 20.4 means the explicable part of the variability of the 50 meters freestyle discipline variable from the predictive equilibrium variable, the flamingo test.

It should be emphasized that during the calculation of the regression analysis the "Stepwise" method was used, which means that all those predictive variables were eliminated, which did not show an impact on the selected model.

Table 6. ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	8.096	1	8.096	9.745	.003[b]
	Residual	31.573	38	.831		
	Total	39.669	39			

a. Dependent Variable: Freestyle 50 meters

b. Predictors: (Constant), Flamingo test

Table No. 6, through the F-Test implies that the significant influence of the criterion variable from the predictive variable is statistically significant sig. 003.

Table No.7 describes that with the increase of one unit of measurement of the balance test 8 through the non-standardized coefficient B = .248 (once more contact with the floor, which means poorer performance), the swimming time at a 50-meter distance increases by 0.28 seconds meters in freestyle. So, the more contact with the floor, i.e. the weaker the balance of the lower extremities, the slower the swimming time.

Regression analysis of specific motor variables

Table 7. Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1.	.908[b]	.825	.815	.43356

a. Predictors: (Constant), Breaststroke 50 meters

b. Predictors: (Constant), Breaststroke 50 meters, Backstroke 50 meters

c. Dependent Variable: Freestyle 50 meters

Table 8. Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	29.803	.665		44.82	0
	Flamingo test	.248	.079	.452	3.122	.003

a Dependent Variable: Freestyle 50 meters

Table 9. ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	32.714	2	16.357	87.018	.000[c]
	Residual	6.955	37	.188		
	Total	39.669	39			

a. Dependent Variable: Freestyle 50 meters

b. Predictors: (Constant): Breaststroke 50 meters, Backstroke 50 meters

Table 10. Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	-1.635	2.545		-.643	.524
Breaststroke 50 meters	.617	.114	.585	5.413	.000
Backstroke 50 meters	.370	.106	.377	3.486	.001

a. Dependent Variable: Freestyle 50 meters

Table No. 7 presents the effect of predictive variables of specific motor space on the criterion variable 50 meters freestyle. The value of R square = 82.5 explains the level of variability of the 50 meters freestyle variable before the predictive variables, 50 meters breaststroke and 50 meters backstroke.

Table No. 9 describes the statistically significant impact on the criterion variable from the predictive variables through the F-Test at sig. 00.

Table No. 10 presents the impact of each variable on the 50 meters freestyle variable criterion through the standardized coefficient beta = .58 for the 50 meters breaststroke variable and beta = .37 for the 50 meters backstroke variable. The regression analysis coefficient is positive, which

means that as the time of the breaststroke and backstroke disciplines increases, so does the swimming time in the freestyle discipline. This influence is greater than the breaststroke discipline.

CONCLUSION

This research shows that some positive effects have been presented in relation to the main disciplines of short distance swimming in special spaces. It is especially worth noting the correlation relationships of other swimming disciplines in the 50 meters freestyle criterion discipline. Their impact calculated through regression analysis is very significant, especially of the breaststroke and freestyle disciplines at a distance of 50 meters, while the butterfly discipline at 50 meters did not turn out to have a significant impact. It should be noted that the balance variable has an effect on swimming time in 50 meters freestyle discipline.

The non-influence of anthropometric variables on the space of motor-basic variables and that of motor-specific space is justified by the fact of sensitivity of highly oscillating dimensions in relation to the calendar and biological age of the research entity.

Since in modern times the planned training process with young people is subject to a certain criterion of organizing specific training in swimming, the findings in this research can significantly contribute to their success.

The results of this research can also serve trainers to a great extent in the selection of young swimmers, who require not only great dedication, but also a dignified professionalism.

References

[1]. Colwin CM (1992). Swimming into the 21st Century. Champaign Illinois: Leisure Press

[2]. Colwin, Cecil M. (2004.) *Plivanje za 21. stoljeće*. Zagreb. Gopal

[3]. Counselman, E.J. (1978). Nauka o plivanju, Sportska knjiga, Beograd

[4]. Guzman, R. (2006). Plivanje 128 vježbi. Zagreb: Gopal

[5]. James E. Counsilman (1967) The Science of Swimming

[6]. Mehdi (2013). Kako ispraviti lordotično loše držanje i ukloniti bol u donjem dijelu leđa. / on line /. S mreže skinuto 27. svibnja 2015. godine. s: www.stronglifts.com/lordosis-why-it-causes-lower-back-pain-how-to-fix-it

[7]. Szabo, I. (2000). Metodičke vježbe usavršavanja tehnika plivanja. (Diplomski rad) Zagreb: Fakultet za fizičku kulturu Sveučilišta u Zagrebu.

[8]. Trivun, M. (2013). Plivanje, Fakultet fizičkog vaspitanja i sporta, Univerzitet u Istočnom Sarajevu, 102-118

[9]. Volšanček, B. (1979). Utjecaj antropometrijskih i motoričkih dimenzija na rezultat u plivanju. Doktorska disertacija, FFK sveučilišta u Zagrebu.

[10]. Zaciorsky, V. M.; Safarjan, J. G. (1972): Untersuchung von Faktoren zur Bestimmung der maximalen Geschwindigkeit im Freistilschwimmen. Theorie und Praxis der Körperkultur, 21, 695-709.

[11]. Zahrojević, A. I Matković, I. (1975.) *Naučimo da plivamo.* Beograd. Partizan

[12]. Enver N. Tahiraj (2020). Fjalor i sportit. Prishtinë

[13]. Sergei V. Kolmogorov, Olga A. Rumyantseva, Brian J. Gordon, and Jane M. Cappaert (1997) Hydrodynamic Characteristics of Competitive Swimmers of Different Genders and Performance Levels in Journal of Applied Biomechanics