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Relations between Anthropometric Characteristics and Motor Abilities of 14 – 15U Female Swimmers on 50m Result for each Technique

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A B S T R A C T

In aim of correlation between antropometric characteristics, motor abilities and results of swimming 50m in all swimming techniques, a group of 22 swimmers (girls) of Serbian national team, aged 14-15, underwent some anthropometric measurements as well as some motor abilities. Observed longitudinal dimensions were: body height, body mass, arm span and torax circumference and observed motor abilities were: body strength (arms, legs, stomach) and flexibility (trunk and arms). Regression analisys showed that arm span corellated with 50m butterfly and free style score as well as strenght of body and legs corellated with 50m backstroke and free style score. Other measures didn´t corelatted significantly on this sample. Study results confirms importance of arm span and some segments of body strenhgt of swimmers (girls) for successful swimm on 50m in butterfly, backstroke and freestyle techniques in the age 14-15 years.

Key words: *anthropometric characteristics, motor-abilities, swimming, 50m frestyle, butterfly, backstroke, breaststroke*

Introduction

Swimming is monostrucutral sport activity, with polystructural parts start, turns and finishing. Swimming performance depends on the power developed by both the upper and the lower limbs, especially in short distance events. Quallity of performance in swimming depends of more factros from several domains such as the anthropometrics (Geladas et al., 2005) hydrodynamics (Kjendlie & Stallman, 2008), kinematics (Barbosa et al., 2010), energetics (Denadai et al., 2000) and others. Good swimming result depends of morphological characteristics, motor and functional abilities (Volčanšek, 2002). Anthropometrical characteristics are very important for successfull swimming performance (Zaciorsky & Safarjan, 1972; Schramm, 1987; Wilke, 1992). Anthropometrics are highly related with young swimmers' performance (Lätt et al., 2010). Offen anthropometry is used for selecting talented swimmers (grls and boys). The use of anthropometry and physical testing is prevalent in many talent identification and talent development programmes including those of the Federation Internationale De Natation (FINA). But, monitoring anthropometry alone, is not best suited for young swimmers. General and specific motor abilities are also very important for good swimming performance. Flexibility is very important for good and efficient strokes (Schramm, 1987) with big amplitude. It could be found that important factors also are the coordinative and technical abilities (Sharp et al., 1982) and the complex speed abilities, which are energy generator the isokinetic pulling force of the arms (Costill et al., 1980), the power of the start (Thayer & Hay, 1984; Rudolph, 1997) and the clean speed shortly after the start (Wirtz et al., 1996). Good coordination between strokes and kick affects swimming performance, too. Strong swimmers can produce stronger strokes and make better performance. Speed can improve stroke frequency as well as starting performance. This study examine the relations between few antropometric characteristics and motor abilities on 50m result for each technique.

Methods

The research measurements took place in Novi Sad. Best 22 swimmers (girls) of Serbian national team, aged 14-15, participated in this study. All of them were in good health and good season form. All swimmers received a complete explanation of the purpose and the procedures of the study and gave their informed consent. Anthropometric measurements were taken three times by the same person. We measured body height and body weight, arm span and chest circumference. Body height and arm span was measured to the nearest 0.1cm using a Martin's anthropometer, body weight was measured to 0.05 kg using a standard beam balance and chest circumference were measured with a non-elastic tape at the level of the middle of the sternum (breast-bone), with the tape passing under the arms. Body mass index (BMI; $kg \cdot m^{-2}$) was also calculated. Pushups are measured on next way. Swimmers are in pushup position with only the hands and the toes touching the floor in the starting position. Lower the chest down towards the floor, always to the same level each time, either till chest touches the ground. They should work as many push ups as possible until exhaustion. For vertical jump test it is necessary to stay side on to a wall and reaches up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded. Then it is necessary to stands away from the wall, and leaps vertically as high as possible using both arms and legs to assist in projecting the body upwards. The difference in distance between the standing reach height and the jump height is the score. The best of three attempts is recorded Sit-up test

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starts from lying position on the floor with knees bent at approximately right angles, with feet flat on the ground and hands on thighs, rising with flat back until with hands touches tops of knees. Pulling with neck or head isn't allowed. After that return to the starting position. It is necessary to do as much as possible sit ups in one minute. Sit-and-Rich test involves sitting on the floor with legs stretched out straight ahead. Shoes should be removed. The soles of the feet are placed flat against the box. Both knees should be locked and pressed flat to the floor - the tester may assist by holding them down. With the palms facing downwards, and the hands on top of each other or side by side, the subject reaches forward along the measuring line as far as possible. Ensure that the hands remain at the same level, not one reaching further forward than the other. After some practice reaches, the subject reaches out and holds that position for at one-two seconds while the distance is recorded. Shoulder flexibility was tested in following way. In the standing position with cord that has a fixed handle on one end and a sliding handle on the other. Then, holding the two handles of the cord, cord passes, from in front of the body, over the head and as far back as possible. This movement must be made with extended arms, and it is important to keep arms from fanning out more than is physically necessary to complete the movement. After a practice trial, the best score of three trials is recorded. Higher scores indicate better performance. Measurements were recorded by another person, who did not collaborate in any other way with the measurer. Swimming tests took two days. First day every swimmer swum butterfly and backstroke style and following day they swum breast stroke and free style. The performance of swimmers, expressed in time in seconds on 50 metres (short course) freestyle, backstroke, breaststroke and butterfly was electronically obtained at the local competition, following the FINA procedure. Statistical Package for Social Sciences (SPSS) software (version 19) was used for data analysis. Data were analyzed using descriptive statistics of minimum, maximum, mean, standard deviation, skewness and kurtosis. Regression analyze was use to estimate the effects of independent variables on dependent variable.

Results

Table 1 shows the central and dispersion statistics of anthropometric characteristic and motor skills. The sample was composed of 22 girls. The analysis of the table clearly shows that the distribution of results in all assessed variables does not deviate significantly from the normal distribution.

Table 1. Descriptive Statistics of Anthropometric Characteristic and Motor Skills

variable	Min	Max	Mean	Std. Dev
Body height	132.9	173.5	153.941	9.2556
Body weight	29.5	53.9	42.364	6.6391
Arm span	141.5	176.1	159.255	9.2890
Chest circumference	63.0	81.5	73.736	4.6769
Pushups	8	29	18.41	6.337
Jumps	131	213	173.41	17.443
Sit-Ups	17	30	22.23	3.221
Sit-and-Rich	18	40	31.23	5.806
Shoulder flexibility	29	76	53.50	15.146

A review of the results Table 2 shows that there is a statistically significant effect of the system of predictor variables on the criterion variable 50m backstroke (p=0.011). Multiple correlation coefficient is R=0.719, which means that the corresponding coefficient of determination R^2=0.516 or 51.6% of the common variability of the system of predictor variables and the criterion variable. There is also a statistically significant effect of the system of predictor variables on the criterion variable 50m freestyle (p=0.024). Multiple correlation coefficient is R=0.682, which means that the corresponding coefficient of determination R^2=0.465 or 46.5% of the common variability of the system of predictor variables and the criterion variable. There is no statistically significant effect of the system of predictor variables on criterion variables 50m butterfly (p=0.144) and 50m breaststroke (p=0.580). At the univariate level, statistically significant effect on the 50m butterfly had predictor variable Arm span (p=0.018), and the same variable had statistically significant effect on the 50m freestyle (p=0.024). None of the predictor variable has no statistically significant effect on the criterion variable 50m backstroke and 50m breaststroke.

Table 2. Regression Analysis Of Anthropometric Characteristics On Different Swimming Techniques

	50m butterfly		50m backstroke		50m breaststroke		50m freestyle	
variable	β	p	β	p	β	p	β	p
Body height	.968	.058	-.187	.647	-.540	.323	.317	.461
Body weight	.961	.144	.114	.832	.504	.482	.727	.208
Arm span	-1.476	.018	-.893	.077	.305	.634	-1.234	.024
Chest circumference	-.598	.236	.414	.327	-.564	.315	-.404	.362
R	.564		.719		.384		.682	
R^2	.318		.516		.148		.465	
F	1.978		4.539		.737		3.694	
P	.144		.011		.580		.024	

Results of regression analysis Table 3 show that there is a statistically significant effect of the system of predictor variables on the criterion variable 50m backstroke (p=0.008). Multiple correlation coefficient is R=0.772, which means that the corresponding coefficient of determination R^2=0.597 or 59.7% of the common variability of the system of predictor variables and the criterion variable. There is also a statistically significant effect of the system of predictor variables on the criterion variable 50m freestyle (p=0.006). Multiple correlation coefficient is R=0.778, which means that the corresponding coefficient of

determination R^2=0.606 or 60.6% of the common variability of the system of predictor variables and the criterion variable. There is no statistically significant effect of the system of predictor variables on criterion variables 50m butterfly (p=0.460) and 50m breaststroke (p=0.523). None of the individual predictor variables haven't a statistically significant impact on the criterion variable 50m butterfly and 50m breaststroke, and statistically significant effect on the 50m backstroke have predictor variables Pushups (p=0.014) and Jumps (p=0.002), and on the 50m freestyle variables Jumps (p=0.003) and Sit-Ups (p=0.016).

Table 3. Regression Analysis of Motor Skills on Different Swimming Techniques

	50m butterfly		50m backstroke		50m breaststroke		50m freestyle	
variable	β	p	β	p	β	p	β	p
Pushups	.062	.795	.467	.014	-.060	.805	.314	.080
Jumps	-.183	.448	-.613	.002	-.296	.232	-.595	.003
Sit-Ups	-.519	.068	-.259	.197	.106	.697	-.511	.016
Sit-and-Rich	.284	.340	-.084	.694	-.075	.801	.397	.074
Shoulder flexibility	.082	.778	-.112	.596	-.258	.383	.140	.502
R	.484		.772		.462		.778	
R^2	.234		.597		.214		.606	
F	.979		4.735		.870		4.919	
P	.460		.008		.523		.006	

Discussion

The aim of this study was to examine relations between some antropometric characteristics and motor abilities of 14–15U female swimmers on 50m result for each technique. On this sample, it was found that arm span affect 50m butterfly and freestyle performance on girls. Arm span is directly conected with stroke lenght. Swimmers with greater arm span have longer stroke. Swimmer which swim with longer stroke can produce greater propulsive force, and in that way enable greater swimming speed, better performance. Arm span is very suitable for selection in swimming. Arm span is one of the best performance predictors (Lätt et al., 2010). If swimmer uses big arme span, when swimm as long as possiblle with long strokes (dependes of distance), he has big advantage.

All four analyzed anthropometric characteristics affects girls swimming performance on 50m backstroke and frestyle. It is necessary for swimmers to have big longitudinal dimensions, because of stroke length and bigger swimming surface. With long arms swimmers can swimm with longer strokes and with long legs body rotation could be smaller and hidrodinamic position (called stream line position) also could be better. Big swimming surface allows swimmer to take good hidrodinamic position, which decreases water resistance while swimmers body moving through water.

On this sample, all analyzed motor skills affected grls swimming performance on 50m backstroke and freestyle. It is well known that body strength (pushups, jumps and sit-ups) affects streamline position, which decreses water resistance. Streanline position, is active body position of swimmer, when most of trunk muscules are active.

Push ups as measure of arm strenthg, affects 50m backstroke performance on girls. In backstroke, arms produces most of energy for swimming. Jumps as measure of legs strength also affects swimming performance in 50m backstroke of girls. Strong legs helps swimmers to take streamline position and to have strong start from starting block as well as good and fast turns and accomplish better performance.

Sit ups and jumps affects swimming performance od 50m frestyle. Strong abdominal muscules helps swimmer to take good streamline position as well to swim with 6-beat kicks per cycle. Strong legs are important for swimming performance on 50m freestyle for girls also for good starting and good and fast turns.

In this age, for girls is important to lear to use length of upper limbs and to swim with long strokes. Also it is important to strengthen abdominal muscles (stream line position) and upper and lower limbs (stream line position and generating propulsive power). From the other side, it is important to select girls with long longitudinal charasteristics, especially big arm span for most of swimming techniques. Also, it is important for grils swimmers to have strong body, arms and legs.

R E F E R E N C E S

Barbosa, T. M., Costa, M., Marinho, D., Coelho, J., Moreira, M., & Silva, A. J. (2010). Modeling the links between young swimmer's performance: energetic and biomechanical profiles. *Pediatr. Exerc. Sci., 22*, 379–391.

Costill, D. L.; Sharp, R.; Troup, J. P. (1980). Muscle strength: contributions to sprint swimming. *Swimming World, 21*, 29-34.

Denadai, B., Greco, C., & Teixeira, M. (2000). Blood lactate response and critical speed in swimmers aged 10-12 years of different standards. *J Sports Sci., 10*, 779–784.

FINA: Federation Internationale De Natation. (2014). Talent Identification programmes, Available online: http://www.fina.org/ (accessed on 7 January 2015).

Geladas, N. D., Nassis, G. P., & Pavlicevic, S. (2005). Somatic and physical traits affecting sprint swimming performance in young swimmers. *Int. J. Sports Med., 26*,139–144.

Kjendlie, P. L., & Stallman, R. K. (2008). Drag characteristics of competitive swimming children and adults. *J Appl Biomech., 24*(1), 35–42.

Lätt, E., Jürimäe, J., Mäestu, J., Purge, P., Rämson, R., Haljaste, K., Keskinen, K. L., Rodriguez, F. A., & Jürimäe, T. (2010). Physiological, biomechanical and anthropometrical predictors of sprint swimming performance in adolescent swimmers. *J Sports Sci Med., 9*, 398–404.

Mathur, D. N., & Salokun, S. O. (1985). Body composition of successful Nigerian female athletes. *J Sports Med, 25*, 27-21.

Rudolph, K. (1997). Zur Rennstruktur im Schwimmen. Deutsche Schwimmtrainer-Vereinigunge. V., *Schwimmen-Lernen und optimieren, 13*, 182-212.

Sharp, R., Troup, J. P., & Costill, D. L. (1982). Relationship between power and sprint freestyle swimming. *Medicine and Science of Sport and Exercise, 14*, 53-56.

Schramm, E. (1987). *Sportschwimmen*. Berlin: Sportverlag.

Thayer, A. L., & Hay, J. G. (1984). Motivating start and turn improvement. *Swimming technique, 20*, 17-20.

Volčanšek, B. (2002). *Bit plivanja*. Kinezиološki fakultet: Zagreb

Wirtz, W.; Wilke, K.; Klauck, J.; & Langnickel, B. (1996). A method to analyze kinematic parameters during crawl sprint swimming. Biomechanics and Medicine in Swimming VII (Troup, J. P.; Hollander, A. P., Strass, D., Trappe, S. W., Cappaert, J. M., Trappe, T. A., Eds.), *London, E. & F. Spon*, 70-75.

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.

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