THE CONNECTION OF MOTOR SKILLS AND SWIMMING KNOWLEDGE WITH THE RESULT OF SWIMMING THE 100-METER FREESTYLE

Original Scientific Article

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Abstract: On a sample of 31 first-year students of the Faculty of Security Sciences, a research was conducted with the aim of determining the connection of motor skills and swimming knowledge based on the result of swimming the 100-meter freestyle. The results of regression analysis showed that a successful the 100-meter freestyle swimming can be predicted through the observed predictor system, where from the set of applied variables only the variable score in swimming techniques (OPLI), individually had a statistically significant impact on the results of swimming 100-meter freestyle. The positive impact of swimming knowledge in this research can be explained by a rational and good technique in performing movements, which allowed students to change the position, direction and speed of movement, to master the flow of water with greater efficiency and lower energy consumption.

Keywords: motor skills, swimming knowledge, connection, freestyle swimming

INTRODUCTION

Within the system of complex tasks during rescue on water surfaces, in addition to motor skills, motor knowledge is very important, which is manifested in such situations, where swimming knowledge plays a very important role in saving human lives. Considering that the students of the Faculty of Security Studies (as future security officers), in addition to other entities in the social system, will carry out activities in the protection and rescue system, they need to master swimming skills in addition to other motor skills and knowledge, that

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is, to be able to respond in the best possible way (according to the given situation) in the aquatic environment. According to Mitrović and Vucković (2016), police officers of various lines of work at the Ministry of the Interior of Republic of Serbia, in addition to other protection and rescue bodies, were involved in the action of protection and rescue in flooded settlements and they performed tasks related to the protection of life and property, rescue and evacuation of injured citizens on manipulative surfaces, delivery of water, food, medicine, personal hygiene items and clothing. After a detailed analysis of experiences from the participation of police officers in these activities, it was noted that a number of police officers did not have an appropriate training to perform specific protection and rescue tasks (a number of police officers did not know how to swim or operate motorboats, a significant number of police officers did not receive training in rescuing drowning people and did not have sufficient knowledge of providing first and immediate assistance to injured persons). Based on the above and in connection with the educational need to work in the field of security, classes in swimming, diving and rescuing drowning people were conducted at the City Olympic Pool in Banja Luka with first-year students of the Faculty of Security Studies, during the first semester, as part of the subject Sports Skills in Security in order to fully train them to solve tasks in the aquatic environment. 15 classes were held and the exam consisted of the 100-meter freestyle swimming and assessing the correctness of swimming techniques (front crawl, backstroke and breaststroke) and the oral part of the exam. Since swimming speed is used as a parameter for assessing swimming skills, during the semester, a swimming speed in the 100-meter freestyle course was tested, while for other techniques the level of acquisition of swimming knowledge was tested. The norms for swimming 100 meters with grades from 6 to 10 were taken from the textbook Special Physical Education I - basic level (from the tables for assessing motor skills) for students at the Academy of Criminalistics and Police Studies in Belgrade (Blagojevic, Vučković and Dopsaj 2012).

Swimming is a specific physical activity which belongs to the category of motor knowledge that people do not acquire by birth, but must learn it during their lifetime. Since it takes place in an aquatic environment which greatly affects the character of certain movements, it is necessary for a person (one who wants to swim) to get used to the new environment and the forces that appear in it (Marković, 2017). It can be said that sport swimming is one of the cyclic sports in which relatively simple movements dominate, which are periodically repeated during a performance of a certain swimming style (Madić, Okičić & Aleksandrović, 2007), which is why it can be defined as a set of coordinated movements, which allow a person to stay on the water surface and to move back and forth on the surface in a horizontal position, without the use of aids (Marković, 2017). Swimming is considered one of the basic sports because the swimmer strengthens the muscles of the whole body while moving in the aquatic environment, which affects the morphological, motor, functional, psychological and intellectual development of the personality, where the main goal is to swim over a distance in the shortest possible time (Ahmetović, 1994).

Bearing in mind the fact that knowledge of the impact of certain anthropological abilities on efficiency in performing specific tasks, is the starting point for quality the programming and implementation of teaching and training process; most studies addressing the connection of successful swimming with knowledge and motor skills very were conducted among swimmers, while a small number of studies were conducted among in the student population (Šilić, Zupčević, Brekalo and Crnjac, 2010; Budimir, Breslauer and Bokor, 2010; Mirvić, 2011; Beganović, 2011; Tošić, Trivun, Vuković, Panić, 2012; Trivun, Tošić and Vuković, 2015; ; Trivun, Vukić, Sabljo, 2017), the research problem was aimed at determining the relationship between motor skills and swimming knowledge with the results during the 100-meter freestyle swim among students of the Faculty of Security Sciences. In accordance with the defined research problem, the authors wanted to determine the motor skills which influenced the time of mastering the mentioned distance and how much the knowledge of swimming influenced the final result. As a result, this paper seeks to address the efficiency of swimming, estimated by the time it takes for students to master the 100-meter freestyle distance. The object of this research is to determine in the student population the connection between the motor skills and swimming knowledge applied and the result of swimming 100-meter freestyle, as a specific activity that students as future security officers should master.

RESEARCH METHODS

Determination of motor skills was performed in the Athletic Hall of the Faculty of Physical Education and Sports, University of Banja Luka. The assessment of swimming technique and the swimming test were performed at the City Olympic Swimming Pool in Banja Luka, while Cooper's 12-minute run test was conducted on the athletics track at the Borac football club. The testing was conducted by teachers of Special Physical Education, the Faculty of Security Studies in Banja Luka, in accordance with standard procedures.

Sample of respondents

The sample consisted of 31 first-year students of the Faculty of Security Studies, University of Banja Luka, male, aged 19 years (± 6 months). During the regular classes in the subject Sports Skills in Safety, all respondents attended 15 swimming lessons.

Variable sample

The sample of variables in this study was divided into predictor variables (independent variable) and criterion system variables (dependent variable). The predictor variables consisted of seven variables used to assess motor skills and

one variable to assess swimming knowledge, while the criterion variable was used to assess the result of the 100-meter freestyle swim. The following tests were used to assess basic motor skills: long jump (MSDM) - used to assess the explosive power of the lower extremities; maximum number of push-ups in 10 seconds (MSKL) - used to assess the dynamic strength of the arms and shoulder girdle; maximum number of torso lifts in 30 seconds (MPTR) - used to assess dynamic torso strength, mobility stick (MOKP) - used to assess whole body coordination, forward roll- backward roll - running (MKNZ) - used to assess agility; hand tapping (MTAP) - used to assess the frequency of hand movements and the Cooper 12-minute run test (MKUP) - was used to assess aerobic endurance, while the variable knowledge of swimming (OPLI) was used to assess motor skills, which consisted of three swimming styles (crawl, backstroke and breaststroke). The criterion variable consisted of the result in mastering the 100-meter freestyle distance, expressed through the achieved swim time for the 100-meter distance (VPLI). The variables used to assess motor skills have the necessary metric characteristics, with a detailed description, the method of performance, measurement conditions and assessment norms specified in the Rulebook on candidate selection procedure for admission to the Faculty of Security Studies (Rulebook on enrollment in studies at the Faculty of Security Studies, Number: 27 / 3.183 / 2/20 dated 24 February 2020, Faculty of Security Studies, University of Banja Luka).

Conditions and organization of measurements

The level of motor skills was determined during regular morning classes. Swimming stroke was assessed as part of the first colloquium by assessing swimming knowledge (start, swimming strokes and turns), within each of the listed swimming strokes (crawl, backstroke and breaststroke). The 100-meter freestyle swimming test was used to assess swimming efficiency, where the results were expressed in grades and swim time in seconds. The respondents were tested by swimming a continuous 100 meters, starting in the water without diving off the starting block, in order to neutralize the difference in the advantage that would be achieved by students who use a better starting block technique.

Data processing methods

All data obtained in this study were processed using the software program SPSS Statistics 17 (Hair, Anderson, Tatham & Black, 1998). The basic parameters of descriptive statistics were calculated for all variables: arithmetic mean, standard deviation, minimum and maximum result, while the Kolmogorov-Smirnov test was used to determine the correctness of the distribution of the results obtained. Correlation analysis was used to determine the correlation between the predictor variables and the criterion variable, while regression analysis was used to determine the impact of motor skills and knowledge of

swimming on the successful completion of the 100- meter freestyle distance, whereby the level of statistical significance was determined to be ≤ 0.05.

INTERPRETATION OF RESULTS

Table 1 shows the results of the basic descriptive parameters of the monitored variables for all respondents. The results are well grouped and there are no significant deviations from the mean values of the results achieved. The values of the Kolmogorov-Smirnov test indicate that all variables have a correct distribution of the results achieved. The range of grades based on swim time ranged from 5.00 to 10.00 with a mean value of 7.38 and a deviation of 1.47.

Table 1 Descriptive parameters of predictor and criterion variables

Model	Variables	Number of respondents	Minimum score	Maximum score	Arithmetic mean	Standard deviation	Significance of K-S test
1	MSDM	31	222.00	290.00	249.00	16.31	0.60
	MSKL	31	8.00	18.00	15.38	1.81	0.09
	MPTR	31	28.00	39.00	33.03	2.76	0.49
	MOKP	31	3.82	6.43	4.99	0.62	0.89
	MKNZ	31	4.92	6.19	5.44	0.36	0.50
	MTAP	31	44.00	67.00	54.32	4.57	0.57
	MKUP	31	1950.00	3200.00	2749.35	274.41	0.74
	OPLI	31	6.00	10.00	7.7032	0.89	0.68
	VRPL	31	74.98	144.12	110.32	16.94	0.87
	OVPL	31	5.00	10.00	7.38	1.47	0.28

Key: MSDM - long jump, MSKL – number of push-ups in 10 seconds, MPTR – number of torso lifts in 30 seconds, MOKP– mobility stick, MKNZ – forward-roll-backward roll-running, MTAP – hand tapping, MKUP – Cooper 12-minutes run test, OPLI – swimming stroke assessment, VRPLL – a swim time, OVPL – grade based on the swim time achieved.

Table 2 shows the results of Pearson's correlation coefficient between the achieved result of the 100-meter freestyle and the observed variables used to assess motor skills and swimming knowledge. Statistically significant correlation at the level of p = 0.01 with the criterion variable was achieved only by the variable OPLI, while statistically significant correlation at the level of p = 0.05 was achieved by the variables MKNZ and MSKL. Other variables used to assess motor skills did not achieve a statistically significant correlation with the 100-meter freestyle swim time.

Table 2 Results of Pearson's correlation coefficient between the criterion variable and the observed variables used to assess motor skills and motor knowledge

Variables		MSDM	MSKL	MPTR	MOKP	MKNZ	MTAP	MKUP	OPLI
VRLP (TIME)	Correlation coefficient	-0.13	0.37*	0.06	-0.10	0.45*	-0.16	0.14	-0.87**

** Correlation significant at the level of 0.01 * Correlation significant at the level of 0.05

Table 3 shows the parameters of regression analysis of motor skills and swimming knowledge with the achieved result of the swimming 100-meter freestyle. Based on the obtained results, it can be concluded that the set of predictor variables used to assess motor skills and the variable used to assess swimming knowledge are significant in predicting the achieved result of swimming the 100-meter freestyle. The coefficient of multiple correlation indicates a very high agreement of the dependent variable with the independent variables, while the coefficient of multiple determination shows that 80% of the total variability of the criterion variable VRPL can be explained by the impact of combined predictor variables and the variable used to assess swimming knowledge, while the remaining 20%, in the explanation of the common variability, can be attributed to some other anthropological characteristics and abilities, which were not the subject of this research.

Table 3 Regression parameters of criterion variables and variables used to assess motor skills and motor knowledge

Coefficient of correlation	Coefficient of determination	Standard estimation error	F test	Level of statistical significance
0.89	0.80	8.73	11.53	0.00

a. Dependent variable: VRPL b. Predictors: OPLI, MPTR, MKNZ, MKUP, MOKP, MSDM, MTAP, MSKL

Table 4 shows the values of the Beta coefficients that provide information on the individual impact of the predictor variables used to assess motor skills and the variables used to assess swimming knowledge, the time required to swim over the 100-meter distance. It can be seen from the table that, individually observed, only the variable used to assess swimming strokes (OPLI), has a statistically significant impact on the achieved result of swimming the 100-meter freestyle, when subtracting the variable explained by all other variables in the model. Based on the above, it can be concluded that students with better swimming strokes achieved a better result of swimming the 100-meter freestyle.

Table 4 Regression coefficients of criterion variables and variables used to assess motor abilities and motor knowledge

Model		Non - standardized coefficients		Standardized coefficients	T	Level of Significance
		B	Standard error	Beta		
1	(Constant)	216.41	59.23		3.65	0.00
	MSDM	-0.01	0.10	-0.01	-0.10	0.91
	MSKL	-0.39	1.17	-0.04	-0.34	0.73
	MPTR	0.31	0.69	0.05	0.45	0.65
	MOKP	-2.78	3.02	-0.10	-0.92	0.36
	MKNZ	9.69	4.89	0.20	1.98	0.06
	MTAP	-0.33	0.41	-0.08	-0.80	0.42
	MKUP	-0.01	0.10	-0.06	-0.64	0.52
	OPLI	-15.25	2.24	-0.80	-6.80	0.00

a. Dependent variable: VRPL

DISCUSSION

For security officers, swimming as a motor skill is not crucial, but from the aspect of personal and professional needs as motor knowledge, it is necessary for a successful performance of official duties and tasks (Mitrović and Vucković, 2016). Based on the achieved results, it can be said that this research was conducted among a homogeneous population, because the results at the level of the entire sample are well grouped. Based on the obtained correlation coefficients, it can be observed that the connections between the two treated areas are the most pronounced in the variables that treat specific motor skills through swimming knowledge, and in motor skills that treat movement coordination and the arm and shoulder girdle strength. This connection between the variables used to assess motor skills and swimming knowledge and the criterion variable is expected, because when swimming 100 meters, certain actions need to be performed as quickly as possible with certain strength in terms of overcoming resistance, with the maximum coordination of spatial and temporal elements. According to the results of regression analysis, it can be concluded that only the variable used to assess swimming knowledge (OPLI) significantly affects the efficiency of swimming the 100-meter freestyle. The positive impact of swimming stroke in this research can be explained by rational and good technique in performing strokes, which contributes to greater swimming speed and increases energy efficiency. It is known that swimming speed directly depends on the position of the body in the water and the work of the arms and legs, because the propulsion of the body through water is difficult due to the higher density of water. This fact is confirmed by Šiljeg, Leko and Sindik (Šiljeg, Leko and Sindik 2016), who argue that swimming is a sport that takes place in a medium which is about 780 times denser than air, which causes greater friction and greater resistance when the body moves through water. In order

to move efficiently through water, the swimmer should bring the body to a horizontal position, in order to reduce the force of frontal resistance (which is created during movement through water) and achieve the greatest thrust force on the entire body surface. Considering that all the respondents used the front crawl to swim over the mentioned distance, the explanation of the obtained results can be found in the kinematics and dynamics of the front crawl stroke. The front crawl stroke is almost universally used, which is performed with the simultaneous work of the arms and legs, whereby the arms move through the air after each new stroke, while the legs move under the water at a fast pace. The body is in a horizontal position while the back and head are partly above the surface, so the water line passes over the forehead and shoulder girdle. The arm movements provide the force of traction, where the arm movements determine the speed, rhythm and pace of swimming. Uniform and fast movement is achieved by continuous strokes alternately with both arms, where the work of the arms can be observed through the phase of the propulsive part of the stroke which is performed in the water and the phase of the propulsive part of the stroke which is performed by moving the arms through the air. Regarding the impact of swimming stroke on the achieved result in swimming, similar results were obtained by Volčanšek (Volčanšek, 1979), who concluded, using regression analysis among the population of students of the Faculty of Kinesiology in Zagreb, that the predictive system of assessing a swimming stroke can predict 57% variance of the swimming speed in the 500-meter course test and Grcić-Zupčević and Leko (Grcić-Zupčević & Leko, 2004), whose study confirmed that a grade awarded for starts, turns and swimming stroke, explains 62% of the total variance of a successful 100 meters swimming. Insight into the obtained results can determine a significant correlation between swimming knowledge and swimming skills, where swimming knowledge significantly contributes to the prediction the criterion variable.

Based on the results of swimming achieved by our respondents, it is evident that the range of the swimming results achieved in the 100-meter freestyle, ranged from 74.98 to 144.12 seconds, with an average time of 110.32 seconds and a standard deviation of 16.94 seconds. If we show the results of the achieved time through the average swim speed expressed in meters per second, we will see that the students at the Faculty of Security Studies swam over the mentioned distance at an average speed of 0.90 meters per second. Considering a swimming stroke, the role of arms in moving the body in the water surface using traction force is indicated, where the strength of arms and shoulder girdle is pronounced, while rotation significantly contributes to swimming efficiency in small pools, where agility and explosive leg strength when the swimmer pushes away from the wall are pronounced. In addition to this, the role of energy potentials of the organism is very important for the efficiency of the application of a swimming stroke. The obtained results are confirmed by the research conducted by Volčanšek (Volčanšek, 1996), who states that swimming speed and energy consumption are closely related to the laws of water, where they determine propulsion, body position in the water, energy consumption, but also the

structure of the space of swimmers' motor skills, where strength, speed, flexibility and coordination dominate. This is supported by the research conducted by Trivun, Panić and Nemeth (Trivun, Panić, Nemeth, 2018), who cite Lokken's study (1998) which found a very significant impact of strength on the result in crawl stroke. According to his research, the impact of power on the 100-meter crawl amounts to 74% and 72% on the 200-meter crawl stroke.

The fact that the space of motor skills did not achieve the expected connection with the swimming speed can be attributed to the specifics of the sample of respondents, which differs greatly from the sample of top swimmers. Similar results were obtained by Trivun (Trivun, 2011), who conducted a study on a sample of 50 male students, aged 22 (26 undergraduate students enrolled in the 2007/2008 school year and 24 undergraduate students enrolled in the 2009/2010 school year, in the second year of at the Faculty of Physical Education and Sports, University of East Sarajevo), with the aim of comparing the results achieved in swimming over the 100-meter crawl stroke between the group of respondents who underwent condensed teaching in relation to performance in swimming and the group of respondents who had practical swimming lessons during the entire semester. An insight into the achieved results shows that for the respondents enrolled in 2007/2008, on the initial measurement, the results ranged from 68.52 to 158.02 seconds with a mean value of 125.12 seconds and a standard deviation of 19.83 seconds, while in the same group of respondents on the final measurement the results ranged from 68.02 to 149.01 seconds with a mean value of 111.51 seconds and a standard deviation of 16.95 seconds. Among the respondents enrolled in the 2009/2010 school year, the range of results on the initial measurement ranged from 87.93 to 222.96 seconds with a mean value of 132.88 seconds and a standard deviation from the mean value of 34.23 seconds, while the results on the final measurement ranged from 83.94 to 191.16 seconds with the s mean value of the achieved results amounting to 124.10 seconds and a standard deviation from the mean of the results of 29.80 seconds. The obtained results favor the continuous type of swimming lessons in 2007/2008 in relation to the condensed practical classes in 2009/2010.

If we compare the results achieved by our respondents with the results of the students at the Faculty of Physical Education and Sports, University of East Sarajevo, we can conclude that the students at the Faculty of Security Studies achieved better results than the students enrolled in 2009/2010 at the Faculty of Physical Education and Sports in East Sarajevo after both measurements and better results than the students enrolled in 2007/2008 after the initial measurement and almost identical results with the same group of students after the final measurement.

CONCLUSION

Given that motor skills and motor knowledge play a significant role in performing security tasks (which are manifested in such situations), where

swimming knowledge, as a need of future security officers, represents one of the main activities in solving complex rescue tasks on water surfaces, a study was conducted in order to determine the connection of certain motor skills and swimming knowledge with the result of swimming the 100-meter freestyle among the students at the Faculty of Security Studies. The results of regression analysis indicate that the system of basic motor skills and swimming knowledge applied has a significant impact on the result in swimming in the studied student population, which means that a success in swimming 100 meters can be predicted through the predictor system applied. Observed individually, only the variable used to assess swimming knowledge (OPLI) had a statistically significant impact on the result of the 100-meter freestyle, which could be expected because all movements in swimming (arm movements, leg movements, breathing techniques) require a certain level of the acquisition of swimming techniques. The obtained results indicate that students at the Faculty of Security Studies need to improve swimming strokes and develop all parameters of specific motor skills, where all movements involved in swimming activity must be well and properly practiced in order to increase swimming efficiency. Finally, it should be borne in mind that swimming, in addition to the safety aspect in the fight against drowning, occupies a significant place in teaching and extracurricular activities of students at the Faculty of Security Studies, where swimming lessons are used as a means to develop motor skills, which has a positive impact on students' health as future security officers. In order to achieve even better results, the number of swimming lessons should be increased, which is currently only possible if classes are organized in a different way.

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