INFLUENCE OF FLEXIBILITY ON SWIMMING RESULTS WITH STUDENTS OF SPORT AND PHYSICAL EDUCATION

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Abstract

Based on the sample of 70 students, on the third year of Faculty of sports and physical education, University of Nis, we applied 6 variables to assess flexibility (predictor system) and 3 variables to assess swimming results (criteria variables). The aim was to determine influence of flexibility on swimming results in 50 m swimming techniques crawl, backstroke and breaststroke. In order to determine flexibility effect on students we applied regression analysis. According to results obtained we can conclude that no significant effect of flexibility on swimming results in examined group of students was found. On the other hand, there is a positive bond between flexibility and achieved results. It is considered that the main reason for such bad result is insufficient adopting of proper quality swimming technique among students. The recommendation is that in practice we should increase the number of practical swimming classes among the students of the Faculty of Sport and Physical Education as well as to perform homogenization of the groups according to the degree of adoption of swimming technique.

Key words*: students, flexibility, results, swimming, influence*

Introduction

The swimming implies the ability to maintain the body in water and ability to move through the water with the proper movement of arms, legs and body (Madić & al., 2007). A sport swimming belongs to a group of cyclic type of mono-structural sports (Malacko & Rađo, 2004). Swimming techniques are types of cyclic swimmer's movements during swimming determined by competition rules. In sport's swimming there are four swimming techniques: crawl, breaststroke, backstroke and butterfly (Kapus & al., 2002). Efficiency in any sport activity, including swimming depends on 5 basic factors as follows; 1. performing movement properly (sports technique); 2. energetic capacity 3. Muscle contraction capability; 4. joint mobility and 5. tactics (Milišić, 2003). Joint mobility refers to flexibility. It defines as ability of a man to perform a movement with greatest possible amplitude (Malacko & Rađo, 2004). Optimal flexibility enables proper movement performance in swimming avoiding additional energy consumption to overcome the resistance of the ligaments and tendons that are parts of the joints used for movement. Researching influence and relations of flexibility and other motor skills on the swimming results was conducted by many authors. One of them, Volčanšek (1979), in his research indicates about flexibility significance in swimming results. The author considers that the success in swimming will be possible for swimmers who, besides good coordination abilities, fast frequency motion, success in solving new motor tasks, also have greater flexibility in the shoulder joint. Okičić (1996) in his research concludes that swimmers of younger age category, who have greater flexibility of the shoulder joint, knee and ankle joint, achieve better results, which can help in selection of young swimmers, which is also confirmed in research Madić & al. (2002). Also, the swimmers junior and senior of international level are characterized by a high degree of flexibility that has a significant correlation with success in (Colman & al., 1992; Rama & al., 2006). Relations and flexibility effects, together with other motor skills, on the swimming results of student's population were also researched by Pivač & Rađo (1996) and Vidović (2000, 2004) and many others. The purpose of this research was to determine flexibility effect on the swimming results 50 m techniques crawl, breaststroke and backstroke of Faculty of Sport and Physical Education students.

Methods

The sample of respondents consisted of 70 students in third year of Faculty of Sports and Physical Education, Nis. The participants had two classes per week of their regular subject "Swimming". Testing was performed on the last practical class; at the end of second semester of attending the "Swimming" class. The sample of variables consisted of 6 variables for assessment of flexibility as a system of predictor variables, and three variables for assessment of results in swimming as criteria variables. Six measuring instruments was used for flexibility assesment: twist (FISK), a forward bend on the bench (FPRK) a forward bend in straddle (FPRR), plantar foot flexion (FPFS), dorsal foot flexion (FDFS) and arms retroflexion (FRFR). The first 3 tests were taken from the research of Metikoš & al.(1989), and the remaining three from Šoše &Rađo (1998). Three measuring instruments were used for evaluation of swimming results: the swimming result for 50 m crawl (PK50), swimming result for 50 m backstroke (PL50) and swimming result for 50 m breaststroke (PP50).

The measuring was performed in the gym and the pool of the Sports Center "Čair" in Niš. All measuring were conducted at the end of the third year of studies that consisted, among other things, of theoretical and practical classes of swimming. Practical class was organized as one swimming class once a week 90 min long. All the results obtained were processed in the program *Statistica 6.0.* The basic parameters of descriptive statistics were calculated for all variables AS-arithmetic mean, R- span, MAX maximum result, Min-minimum result; SD standard deviation. Results distribution symmetry was evaluated based on the values of Skewness (Skew) and results distribution uniformity based on the values of kurtosis (Kurt).

By using the Kolmogorov-Smirnov test it was determined whether the distribution of results in applied variables has a statistically relevant variation from the normal distribution (max D and K-S test). Correlation between applied variables was determined by coefficients of linear correlation presented in intercorrelation variable matrix. In order to determine effect of entire predictor variable system on criteria variables, regression analysis was applied and following statistic parameters were calculated: multiple correlation coefficients (R), determination coefficient, (R2), F-test result (F), statistical relevance (p). For determining the influence of each individual variable in regression analysis we calculated: partial correlation coefficients (Part-R), Correlation coefficients (R), standardized coefficients of partial regression (Beta), t-test results (t) and statistical relevance (p). For statistical relevance we used the relevance level up to 0.05 ($p \leq 0.05$).

Results

Table 1. presents the values of descriptive statistics basic parameters, the values of Skewness, Kurtosis and Kolmogorov-Smirnov test. The values of Kolmogorov-Smirnov test indicate that in all applied variables, result distribution do not have statistically relevant variations from normal distribution, since the greatest difference between the relative and the theoretical cumulative frequency in each variable (max D) is lower than the constant (K-S test) 0.16. This enables using the obtained results for further analysis.

Table 2 presents the results of inter-correlation matrix of applied variables, and all statistically relevant variables were marked with **bold**. There is statistically relevant and high correlation among all 3 variables for swimming results evaluation. There is also a statistically relevant correlation among certain variables for evaluation of flexibility. There is no statistically relevant correlation between the variables for evaluation of flexibility as a predictor system and the variables for evaluation of swimming results, except in variables FRFR and PL50 (-0.35). The negative sign in this case represents a positive correlation considering the fact that these two variables are inversely scaled. Results of regression analysis in table 3 indicate there is no statistically relevant influence of entire predictor variable system for flexibility assessment on criteria variable swimming result 50 m with crawl (p= 0.59). This is also confirmed by low values of multiple correlation coefficient (R= 0.26) and determination coefficient (R2 = 0.07). Individually, out of each applied predictor variables, the statistically relevant influence onto the criterion variable has the predictor variable FRFR (p= 0.05). Since the entire system of predictor variables has no statistically relevant influence onto the criterion variable, then the influence of predictor variable FRFR is considered to be random. Regression analysis results in Table 4. Indicate that there is no statistically relevant influence of predictor system of variables for evaluation of flexibility onto the 50 m results with backstroke technique (p= 0.11). This is also confirmed by low values of multiple correlation coefficient (R= 0.38) and determination coefficient (R^2 = 0.15). Individually, out of each applied predictor variables, the statistically relevant influence onto the criterion variable has the predictor variable FRFR (p= 0.00). Since the entire system of predictor variables has no statistically relevant influence onto the criterion variable, then the influence of predictor variable FRFR is considered to be random. Regression analysis results in Table 5. Are indicating that there is no statistically relevant influence of the entire system of predictor variables for evaluation of flexibility onto the criterion variable *swimming result 50 m breaststroke* (p= 0.75). This is also confirmed by low values of multiple correlation coefficient (R= 0.23) and determination coefficient (R2 = 0.05).

Table 1. *Results of descriptive statistics*

Variable	AS	SD	Min	Max	Span	Skew	Kurt	max D
PK50	44,50	7,79	30,64	70,1	39,46	0,81	1,54	0,08
PL50	61,69	11,37	40,00	98,6	58,60	0,93	1,02	0,09
PP50	64,36	11,29	46,00	92,4	46,40	0,54	-0,36	0,09
FISK	80,90	14,52	42,00	110,0	68,00	-0,39	-0,34	0,15
FPRK	40,24	7,29	15,00	54,0	39,00	-0,58	1,02	0,08
FPRR	73,96	11,41	48,00	112,0	64,00	0,84	2,13	0,11
FPFS	46,23	6,82	25,00	60,0	35,00	-0,19	0,53	0,10
FDFS	20,41	4,72	10,00	29,0	19,00	-0,26	-0,29	0,09
FRFR	24,26	9,73	6,00	47,0	41,00	0,10	-0,59	0,07
								K-S test = 0.16

Table 2. *Inter-correlation matrix of applied variables*

Variable	PK50	PL50	PP50	FISK	FPRK	FPRR	FPFS	FDFS	FRFR
PK50	1.00	**0.71**	**0.60**	-0.04	0.09	0.04	0.05	0.04	-0.21
PL50	**0.71**	1.00	**0.64**	0.07	0.02	-0.04	-0.10	0.12	**-0.35**
PP50	**0.60**	**0.64**	1.00	0.07	0.07	0.08	0.07	0.15	-0.10
FISK	-0.04	0.07	0.07	1.00	**-0.33**	**-0.26**	**-0.36**	-0.05	-0.14
FPRK	0.09	0.02	0.07	**-0.33**	1.00	**0.61**	**0.28**	**0.25**	0.21
FPRR	0.04	-0.04	0.08	**-0.26**	0.61	1.00	**0.31**	0.13	**0.33**
FPFS	0.05	-0.10	0.07	**-0.36**	**0.28**	**0.31**	1.00	0.11	0.13
FDFS	0.04	0.12	0.15	-0.05	**0.25**	0.13	0.11	1.00	-0.10
FRFR	-0.21	**-0.35**	-0.10	-0.14	0.21	**0.33**	0.13	-0.10	1.00

Table 3. *Regression analysis for 50 m crawl Swimming result (PK50) variable*

Variable	R	Part-R	Beta	t (63)	p
FISK	-0.04	-0.01	-0.01	-0.08	0.94
FPRK	0.09	0.08	0.10	0.62	0.54
FPRR	0.04	0.04	0.06	0.35	0.73
FPFS	0.05	0.04	0.04	0.30	0.77
FDFS	0.04	-0.02	-0.02	-0.18	0.86
FRFR	-0.21	-0.25	-0.26	-2.01	0.05
R = 0.26, **R^2** = 0.07, **F**(6.63) = 0.78, **p** = 0.59					

Tabela 4. *Regression analysis for 50 m backstroke Swimming result (PL50) variable*

Variable	R	Part-R	Beta	t (63)	p
FISK	0.07	0.04	0.04	0.30	0.76
FPRK	0.02	0.06	0.08	0.49	0.63
FPRR	-0.04	0.05	0.07	0.43	0.67
FPFS	-0.10	-0.08	-0.08	-0.65	0.52
FDFS	0.12	0.07	0.07	0.57	0.57
FRFR	-0.35	-0.35	-0.37	-2.93	0.00
R = 0.38, **R^2** = 0.15, **F**(6.63) =1.82, **p** = 0.11					

Tabela 5. *Regression analysis for 50 m breaststroke Swimming result (PP50) variable*

Variable	R	Part-R	Beta	t (63)	p
FISK	0.07	0.11	0.12	0.91	0.37
FPRK	0.07	0.03	0.04	0.22	0.83
FPRR	0.08	0.07	0.08	0.52	0.60
FPFS	0.07	0.08	0.08	0.60	0.55
FDFS	0.15	0.11	0.12	0.89	0.37
FRFR	-0.10	-0.11	-0.12	-0.88	0.38
R = 0.23, **R^2** = 0.05, **F**(6.63) = 0.58, **p** = 0.75					

Discussion and conclusion

The obtained results indicate that there is no relevant influence of predictor system of variables for evaluation of flexibility onto the predictor variables (swimming results for 50 m crawl, backstroke and breaststroke) in students that took part in this research. The results obtained in this way are similar to the ones obtained in the one researching relation of motor skills with styled forms of movements in swimming the techniques crawl, back and breast (Vidović, 2000; 2004).

The author determined, as well, that the flexibility is not in relevant correlation with breaststroke swimming technique, while the correlation of flexibility and swimming technique crawl is statistically relevant, but of low values. Pivač & Rađo (1996) determined that flexibility has a relevant influence on students' degree of success in acquiring the swimming techniques. Unlike our own, the results of many other researches confirmed the influence of flexibility onto the swimming results, primary in population of swimmers, but in students as well.

The reason we obtained this type of results in this research is inadequately acquired and mastered swimming technique, indicated by the swimming results themselves that are below the expected (Table 1). If the swimming technique is not properly acquired the influence of flexibility and other motor skills onto the swimming efficacy is reduced and limited (Okičić et al., 2007). It is obvious that one 90 minutes long swimming class per week is not enough for the students to acquire and master the swimming techniques properly. In general it can be concluded that in students of third year of Faculty of Sport and Physical Education in Nis the existence of relevant influence of the flexibility onto the swimming results (techniques crawl, backstroke and breaststroke) wasn't determined. We believe that the number of practical swimming classes where the swimming techniques would be practiced and mastered should be increased. There is also an issue of higher criteria when it comes to selection of future students of Faculty of Sport and Physical Education that should be introduced by making swimming norms more strict. Redefining of the teaching process in swimming exercises towards homogenization of the groups was also suggested.

Literature

Colman, D., Daly, D., Desmet, S., & Persin, U. (1992). Relation between physical characteristics and endulation in the breaststroke. In. D. MacLaren, T. Reilly, & A. Lees. (Eds.), *Biomechanics and Medicine in Swimming – Swimming Science VI* (pp. 365-370). London: E & FN Spon.

Kapus, V., Štrumbelj, B., Kapus, J., Jurak, G., Pincolič Šajber, D., Vute, R., Kapus, M., & Čermak, V. (2002). *Plavanje, učenje.* [Swimming, learning. In Slovenian.]. Ljubljana: Fakulteta za šport, Inštitut za šport.

Madić, D., Okičić, T., & Aleksandrović, M. (2007). *Plivanje*. [Swimming. In Serbian.]. Niš: SIA.

Madić, D., Pivač, M., & Aleksandrović, M. (2002). Relacije morfoloških karakteristika i motoričkih sposobnosti sa uspehom nekih tehnika plivanja. [Relations of morphological characteristics and motor abilities with the success in some swimming techniques. In Serbian.]. In: S. Vučković (Ed.), *Proceedings of VIth national scientific event with international participation „FIS communications 2001*" (pp. 129-132). Niš: Filozofski fakultet.

Malacko, J., & Rađo, I. (2004). *Tehnologija sporta i sportskog treniniga.* [Technology of sport and sports training. In Bosnian.]. Sarajevo: Fakultet sporta i tjelesnog odgoja.

Metikoš, D., Prot, F., Hofman, E., Pintar, Ž.,& Oreb, G. (1989). *Mjerenje bazičnih motoričkih dimenzija sportaša.* [Measuring of basic motor dimensions of sportsmen. In Croatian.].Zagreb: Fakultet za fizičku kulturu.

Milišić, B. (2003). *Upravljanje treningom.* [Training management. In Serbian.]. Beograd: Publikum.

Okičić, T. (1996). Uticaj fleksibilnosti na rezultate u plivanju. [Influence of flexibility on swimming results. In Serbian.]. In: S. Vučković (Ed.), *Proceedings of VIth national scientific event with international participation „FIS communications 2001*" (pp. 202-204). Niš: Filozofski fakultet.

Okičić, T., Ahmetović, Z., Madić, D., Dopsaj, M., & Aleksandrović, M. (2007). *Plivanje-praktikum.* [Swimming-practicum. In Serbian.]. Niš: SIA.

Pivač, I., & Rađo, I. (1996). Uticaj bazično-motoričkih sposobnosti na uspešnost u savladavanju sportskih tehnika plivanja. [Influence of basic motor abilities on efficiency in sport swimming techniques learning. In Serbian.]. In: N. Živanović (Ed.), *Proceedings of scientific event with international participation „FIS communications 1995*" (pp. 155-158). Niš: Filozofski fakultet.

Rama, L., Santos, J., Gomes, P., & Alves, F. (2006). Determinant factors related to performance in young swimmers. *Portuhuese Journal of Sports Sciences*, *6*(2), 246-249.

Šoše, H., & Rađo, I. (1998). *Mjerenje u kineziologiji.* [Measuring in kinesiology. In Bosnian.]. Sarajevo: Fakultet za fizičku kulturu.

Vidović, N. (2000). Kanoničke relacije nekih morfoloških i motoričkih karakteristika sa stilizovanim oblicima kretanja u plivanju tehnikom kraul. [Canonical relations of some morphological and motor characteristics with stylize forms of moving in swimming free style. In Bosnian.]. *Homo Sporticus*, *1*(1), 23-27.

Vidović, N. (2004). Kanonički odnosi morfoloških i motoričkih karakteristika sa stilizovanim oblicima kretanja u plivanju prsnom tehnikom. [Canonical relations of some morphological and motor characteristics with stylize forms of moving in breaststroke swimming. In Bosnian.]. *Homo Sporticus*, *1*(1), 15-18.

Volčanšek, B. (1979). *Uticaj antropometrijskih i motoričkih dimenzija na rezultate u plivanju.* [Influence of morphological and motor dimension son swimming results In Croatian.]. (Dissertation). Zagreb: Fakultet za fizičku kulturu.

UTJECAJ GIBLJIVOSTI NA PLIVAČKE REZULTATE KOD STUDENATA TJELESNOG ODGOJA

Sažetak

Na uzorku od 70 studenata treće godine Fakulteta sporta i fizičkog vaspitanja Univerziteta u Nišu, primjenjeno je 6 varijabli za procjenu fleksibilnosti (prediktorski sistem) i 3 varijable za procjenu rezultata u plivanju (kriterijske varijable). Cilj je bio da se utvrdi utjecaj fleksibilnosti na rezultate u plivanju na 50 metara tehnikama kraul, leđno i prsno kod studenata. Za utvrđivanje utjecaja fleksibilnosti na rezultate u plivanju korištena je regresiona analiza. Na osnovu dobivenih rezultata može se zaključiti da nije utvrđen značajan utjecaj fleksibilnosti na rezultate plivanja kod ispitivane grupe studenata. S druge strane, kod plivača takmičara postoji pozitivna veza između fleksibilnosti i ostvarenih rezultata. Smatra se da su glavni razlozi ovako dobivenih rezultata nedovoljno pravilno i kvalitetno usvojene plivačke tehnike od strane studenata. Preporuka je da se u praksi poveća broj praktičnih sati plivanja kod studenata Fakulteta sporta i fizičkog vaspitanja kao i da se izvrši homogenizacija grupa prema stepenu usvojenosti plivačkih tehnika.

Ključne riječi: *studenti, fleksibilnost, rezultati, plivanje, utjecaj*

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