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THE RELATION BETWEEN ESTIMATED MOTOR SKILLS WITH FUNCTIONAL MOVEMENT SCREENING AND PERFORMANCE OF GYMNASTIC ELEMENTS ON THE FLOOR ROUTINE AND THE VAULT

Abstract:

The aim of this research was to verify the FMS (Functional Movement Screening) method as a predictor of success in performing gymnastic elements on the floor routine and vault, on a selected sample composed of 36 male subjects aged 20 - 22 years, students of Faculty of Physical Education and Sport, University of Banja Luka. A battery of 11 motor skills tests was assessed: 7 at floor routine (side-to-side and front-to-back cartwheel, roundoff, front and back handspring, forward and backward flip) and 4 on vault (squat through on the vault and straddle vault with pre-flight, front handspring on vault, roundoff vault) together with FMS results all results received normal distribution and a relatively low average FMS value (14.313), which according to many authors is near the limit of the risk of injury (14). The overall results of the correlation analysis indicated statistically significant relationship between FMS and variables PRENAZ (0.049) and SALNAZ (0.038) at significance level of 0.05, while the applied regression analysis gave general information on the prediction model that showed statistical significance of 0.03 with the predictor variable FMS at the level of significance 0.05. Observing the values of the determination coefficients R2, it was established that the FMS method can predict the performance of the selected gymnastic elements on the floor routine and the vault as an integral model, explaining about 96% of the common variability with a criterion, representing a significant statistical value.
Key words: *gymnastics, FMS, floor routine, vault, prediction.*

INTRODUCTION

An integral part of every learning or training process is testing, form of checking level of knowledge or the achieved level of motor or other abilities. Tests in the narrowest sense are divided into laboratory and field tests. Both groups of tests have their characteristics with certain advantages and disadvantages, but often due to the complexity of the organization and / or number of respondents, the authors decides to use field tests. One of the field tests is functional testing or FMS (Functional Motion Screening) which presents a diagnostic method for assessing the performance of the loco motor system of an individual with an emphasis on assessing the stability and mobility of individual parts of the system as a risk factor of injury (Cook (2004), Cook et al. 2006), Myers (2001). FMS is a diagnostic procedure that is applied

in practice quickly and easily, using little space and accessories to quantify the performance of the movement through the measurement and evaluation of functional patterns of movement. This diagnostic method has been used more and more often in recent years as a result of an increase in awareness of the importance of preventive programs, with a significant number of trainers starting to use FMS technology in initial testing as a risk assessment tool for sports injuries but also for predicting success in other fieldsof movement (Milanović et al., 2011). The FMS method allows detection of causes and locations of reduced flexibility suggesting the selection of appropriate corrective exercises that will lead to the departure from the risk area of injury and increase the efficiency of performing individual exercises in training or recreational programs (Kiesel, Butler and Plisky (2008, 2014); Chapman, Laymon and Arnold (2013), Lockie and al. (2013, 2014), and Lloyd et al., 2014). On the other hand, in the process of learning gymnastic elements at certain time intervals, it is necessary to quantify the acquired knowledge as well as to determine the further course of the training. Therefore, there is a need for instruments that can give a prediction of the success of certain gymnastic elements in order to improve and individualize the process itself. According to various previous studies, morphological characteristics and motor skills have a dominant influence on the success in the performance of elements of sports gymnastics (Petković 1989, Tabaković 2000, Gaverdovskiy 2002, Saisoev 2010, Hadjiev, Andonov, Dobrev & Petrov, 2011, Petković et al. Fuluria et al., 2017, Jovanović et al., 2018), so this research is focused on determining the prediction characteristics of the FMS method on the success of the performance of sports gymnastics on the ground and the leap.

Methodology

The aim of this exploratory research was to determine the relations between FMS method and performance of technical elements on the floor routine and the vault. The sample consisted of 36 male subjects, students of Faculty of Physical Education and Sport in Banja Luka, aged 20 to 22. The subjects regularly attended "Sport Gymnastic 1" classes where they acquired knowledge and elements on the floor routine and the vault, and after which the testing of specific skills with FMS method and knowledge estimation was conducted by a committee of experts. Predictor variables are presented through a set of tests: 1.Deep Squat; 2. Hurdle Step; 3. In-LineLunge; 4. Shoulder Mobility; 5.ActiveStraight-Leg Raise; 6.Trunk Stability Push-up; 7.Rotary Stability. Used test are considered to cover the area of performance of the apparatus elements which were standardized by Sparling 2003, Cook 2004, Cook andal. 2006. In further analysis, the sum score calculated for each respondent was used individually on the existing FMS scale.

Table 1. Criteria for assessing the performance of FMS tests

1	During the movement, there is pain and the respondent is not able to perform the given movement.
2	During the movement, a certain degree of restriction and compensation on the move has been observed.
3	During the movement, all the completeness is correct and fully meets all the required criteria.

The sample of criterion variables on the floor routine consisted of the following elements: side-to-side cartwheel (PRSTBO), front-to-back cartwheel (PRSTČE), roundoff (RONDAT), front handspring (PRENAP), back handspring (PRENAZ), forward flip (SALNAP), and backward flip (SALNAZ). Criterion variables of the vault consisted of the following elements: squat through on the vault with pre-flight (ZGRLET), straddle vault with pre-flight (RAZLET), front handspring vault (PRNAPR), and roundoff vault (PRERON). The level of success in performance of the elements was evaluated by a three-member committee of

experts who awarded each performance grades from 1 to 5 (Table 2) using the criteria taken from Petković et al. (2016). In addition to basic descriptive parameters, all variables were also subjected to correlative and regressive analysis in order to determine the existence of relations, which was done in the statistical software SPSS 22.

Table 2. Criteria for performance grades

1	insufficiently	The student is unable to perform an element
2	enough	The student performs the element with great technical and aesthetic errors
3	good	Student performs element with medium technical and aesthetic errors
4	very good	Student performs element with less technical and aesthetic errors
5	perfect	A student performs an element without technical and aesthetic errors

RESULTS AND DISCUSSION

At the beginning of the analysis, the descriptive indicators for all variables were calculated and it can be said that the data of curvature and flattening is in normal distribution, as well as the data of the arithmetic mean of the used variables (Table 3). It is important to highlight the value of the arithmetic mean of the FMS variable - 14,313. Namely, numerous authors have studied, on different samples, which is the minimum normative value of achievement in FMS testing that has been proven to be associated with the great possibility of injury and found that it was 14 (Agresta, Slobodinsky and Tucker (2014); Schneiders, Davidsson , Hörman and Sullivan (2011), Peate et al. (2007), Letafatkar et al (2014); Perry and Koehle, 2013; Loudon et al., 2014; Kiesel, Plisky and Voight, 2007. Thus, by observing the obtained data of the average FMS values, it can be said that the respondents showed relatively low values and that a certain number of subjects are in the risk zone of the injury.

Table 3. Descriptive statistics

	MIN.	MAX.	AM	SD	S	SD	K	SD
PRSTBO	1	5	3.313	1.493	-0.477	0.564	-1.196	1.091
PRSTČE	1	5	3.063	1.389	-0.297	0.564	-1.275	1.091
RONDAT	1	5	3.063	1.436	0.185	0.564	-1.355	1.091
PRENAP	1	5	3.000	1.592	-0.227	0.564	-1.628	1.091
PRENAZ	1	5	2.750	1.770	0.185	0.564	-1.925	1.091
SALNAP	1	5	3.000	1.633	-0.105	0.564	-1.635	1.091
SALNAZ	1	5	3.000	1.751	-0.085	0.564	-1.823	1.091
ZGRLET	1	5	3.500	1.461	-0.587	0.564	-1.104	1.091
RAZLET	1	5	3.313	1.401	-0.307	0.564	-1.136	1.091
PREMET	1	5	3.125	1.746	-0.217	0.564	-1.896	1.091
PRERON	1	5	3.250	1.653	-0.354	0.564	-1.634	1.091
FMS	10	19	14.313	2.701	0.363	0.564	-0.921	1.091

Legend: AM-arithmetic mean, MIN-minimum, MAX-maximum, SD-standard deviation; S-skjunis; K-kurtosis

In order to better understand the obtained results of the evaluation of the functionality of the loco motor system, the distribution of results were performed (Table 4). On the basis of the distribution obtained, one third of the respondents are in the injuries risk area, showing a low score of 8-14 points on FMS testing (Chorba, Chorba, Bouillon, Overmyer and Landis, (2010); Kiesel, Butler and Plisky, (2008, 2014); Raleigh et al. (2010)).

Table 4. Frequency distribution of FMS testing

	BI	KBI	PKBI
8 -10	1	1	2,7
10-12	5	6	16,6
12 - 14	6	12	33,3
14 - 16	14	26	72,1
16 -18	8	34	94,1
18 - 21	2	36	100.0

Legend: BI-number of respondents, KBI-cumulative number of respondents, PKBI-percentage cumulative number of respondents

Observing the data in Table 5 which contains the results of the correlation analysis, a statistically significant correlation of the predictor variable FMS with the criterion variables PRENAZ (0.049) and SALNAZ (0.038) at the significance level of 0.05 can be noted. The negative sign of all correlation values should be mentioned, indicating the influence of the low level of the acquired values of mobility testing on the performance of the gymnastic elements on the ground and the leap.

Table 5. Correlation matrix

		FMS
PRSTBO	PC	-0.224
	Sig.	0.404
PRSTČE	PC	-0.041
	Sig.	0.880
RONDAT	PC	-0.246
	Sig.	0.358
PRENAP	PC	-0.388
	Sig.	0.138
PRENAZ	PC	-0.498
	Sig.	0.049*
SALNAP	PC	-0.484
	Sig.	0.058
SALNAZ	PC	-0.521
	Sig.	0.038*
ZGRLET	PC	-0.296
	Sig.	0.266
RAZLET	PC	-0.309
	Sig.	0.244
PREMET	PC	-0.419
	Sig.	0.107
PRERON	PC	-0.392
	Sig.	0.133

Legend: PC-Person correlation; Sig. - Significance; *. Significance at level 0.05

In the further analysis of the results achieved, a regression analysis was performed using the general data shown in Table 6. Data of the prediction model showed statistical significance of 0.03 with the predictor variable FMS at the significance level of 0.05. Observing the values of the determination coefficients R^2, it can be said that the FMS method can predict the performance of the selected gymnastic elements on the floor routine and the vault as an integral model, explaining about 96% of the common variability with a criterion, representing a significant statistical value.

Table 6. Results of general regression analysis

Model	R	R^2	Adj. R^2	SE	S^2	df1	df2	F	Sig.
1	0.978	0.957	0.840	1.08193	104.755	11	4	8.135	0.03

Legend: R-coefficient of multiple correlation, R2-coefficient of determination, Adj. R2-adjusted determination coefficient; SE-standard error; S^2-Suma squared; df 1/2 -degrees of freedom; F-determination factor; Sig. – significance

Analyzing the ratio of the predictor model at the individual level of the variables that compose it, with the FMS criterion (Table 7), it can be said that the values of the Beta coefficients indicate the possibility of a prediction only in the case of the observed model as a complete system or in the case where the predicate model consists only of variables PRSTČE, SALNAZ and ZGRLET, which showed a statistically significant relationship at the significance level 0.01. A smaller number of statistically significant partial regression coefficients obtained in the framework of the regression analysis leads to the conclusion that the prediction of the success of the performance of gymnastic elements on the floor routine and vault by the FMS method can be performed, on this sample, using only as a complete system, or in order to better predict the performance of individual variables should use a variety of variations of the variables themselves or a different choice when entering data in statistical operations. In addition to simpler elements, more complex acrobatic elements have been applied to both apparatus, and the authors consider that the very low average score on FMS testing in combination with the performance of more complex gymnastic elements has led to the results that are showing the possibility of using the FMS method only as predictive variables for the system of gymnastic elements. Namely, it is known that flexibility and mobility in the joints of the hands, shoulders and hooks are important for the elements used in order to achieve high amplitude and technically correct performance of the elements themselves, which is in contrast to the obtained assessment of the mobility of the joint-bone system of the subjects by FMS testing.

Table 7. Summary of results of standardized beta coefficients

Variable/Model	1	2	3	4	5	6	7	8	9
PRENAZ	0.857								
RAZLET	0.758	0.777							
PREMET	0.736	0.737	0.752						
PRERON	0.702	0.700	0.734	0.879					
RONDAT	0.589	0.564	0.517	0.539	0.497				
SALNAP	0.777	0.635	0.413	0.408	0.332	0.321			
PRENAP	0.725	0.494	0.240	0.174	0.143	0.131	0.229		
PRSTBO	0.270	0.133	0.101	0.080	0.060	0.042	0.059	0.108	
PRSTČE	0.365	0.118	0.064	0.045	0.030	0.010	0.011	0.012	**0.000**
SALNAZ	0.145	0.011	0.003	0.001	0.000	0.000	0.000	0.000	**0.000**
ZGRLET	0.118	0.078	0.014	0.008	0.002	0.001	0.000	0.000	**0.000**

Legend: dependent variable – FMS

CONCLUSION

The aim of this research was to verify the FMS method as a predictor of success in the performance of gymnastic elements on the floor routine and vault on the selected sample consisting of 36 male respondents from the Faculty of Physical Education and Sport at the University of Banja Luka, aged 20-22. On the sample of 11 variables on the floor routine and vault and the FMS testing, normal distribution was obtained and a relatively low average FMS value (14.313), which according to many authors is near the limit of the risk of injury (14). As Distribution of frequency of FMS results is shoving that it can be concluded that 33% of subjects is in the injuryrisk zone. Further analysis correlated statistically significant links between FMS and variables PRENAZ (0.049) and SALNAZ (0.038) at significance level of 0.05, while the applied regression analysis gave general information of the prediction model that showed statistical significance 0.03 with the predictor variable FMS at the level of significance 0.05. Observing the values of the determination coefficients R^2, it was established that the FMS method can predict the performance of the selected gymnastic elements on the floor routine and vault as acomplete system, explaining about 96% of the common variability with a criterion, representing a significant statistical value. By analyzing the ratio of the predictor model at the individual level of the variable, it can be said that the values of the Beta coefficients indicate the possibility of a prediction only in the case of the observed model as a complete systemor in the case that the predicate model consist only the variables PRSTČE, SALNAZ and ZGRLET,a statistically significant relationship on the significance level 0.01. A smaller number of statistically significant partial regression coefficients obtained in the framework of the regression analysis leads to the conclusion that the prediction of the success of the performance of gymnastic elements on the floor routine and vault by the FMS method on this sample can be performed using only a complete system of gymnastic elements, that is, in order to better predict success individual variables should use a different choice of variables themselves, or a different choice when entering data in statistical operations.

By considering the results obtained, it can be concluded that, although the respondents showed a relatively low average result on FMS testing, this method on a given sample and with the selected system of elements on the floor routine and vault, can be used to predict the success of performing them as a single entity. In further work with respondents, it is necessary to suggest and choose the right individual work programs that would improve mobility in the joint-bone system reduce the risk of injury and contribute to better performance of the selected tasks. In this way, they could have a better basis for functional movement which then positively influences through a better functional performance on the better functionality of the acquired skill that makes the basis of the FMS approach theory.

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