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THE CONTRIBUTION OF MOTOR SKILLS IN PREDICTIING THE SUCCESS OF PERFORMING THE BASIC ELEMENTS OF ALPINE SKIING

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Original research:

Abstract

The aim of this study is to determine how a set of motor abilities variables contribute in predicting the success of the execution of the basic elements of alpine skiing. A sample of 40 students of the Faculty of Sports and Physical Education aged 20-23 and the level of their motor skills as well as the success of performing the basic elements of alpine skiing are the subject study. The criterion variable was a cumulative assessment of the performance of the alpine skiing elements, and the predictor variables were three tests for six general motor skills. The predictive contribution of motor ability variables in relation to the criterion variable was examined by Regression analysis. A high general predictive contribution of the applied set of predictor variables (motor abilities) to the criterion system of variables of the basic elements of alpine skiing of 54% of the explained common variability was determined, which is statistically significant at the level of $p < 0.001$. A statistically significant partial predictive contribution was not determined for any motor ability variable. It is obvious that only optimal, common, synergistic manifestation of motor abilities can have a significant impact on the assessment of performance elements of alpine skiing. The results of this research can be the basis for the construction of an adequate Test Battery (measuring instruments), on the basis of which adequate information necessary in the process of planning and programming certain transformation processes in the ski school can be obtained.

Keywords: motor skills, alpine skiing, predictive contribution

Introduction

Skiing is one of the activities that take place in special environmental conditions, and success in the Alpine disciplines primarily depends on the level of acquired specific motor skills (Franjko 2007), but also from the level of motor and functional abilities (speed, strength, coordination, balance, and aerobic and anaerobic endurance). According to Cigrovski and Matković (2003), skiing as a sport puts great physical and mental demands on the skier, demanding from him an exceptional agility, coordination, strength and endurance, because in competitive skiing today the winner is decided by only hundreds of seconds. Inadequate motor preparation of skiers results in irrationality in performance (Schmidt & Wrisberg 2000). According to Metikoš et al. 2003, one of the most important abilities for successful execution of complex alpine movements is coordination. The activities of ski instructors (students) are very similar to the activities of alpine skiers, and we can assume that the ski quality of ski instructors reckon on similar anthropological structures as the quality of alpine skiers (Franjko et al. 2006). However, the overall skiing quality of ski instructors is also significantly influenced by material conditions, motivation to "work on yourself", available time, health status, etc., which belongs to the sphere of disturbing factors whose influence should be minimized. In this study, those motor abilities that have a proven positive effect on the result in alpine skiing are highlighted. Among them, coordination, explosive and repetitive strength stand out as the motor skills that contribute the most to the success of competitors in alpine skiing. It should be noted that some motor skills are more involved than others in the successful performance of elements of alpine skiing techniques (Dolenec and Žvan, 2001; Emeterio and González-Badillo, 2010; Neumayr et al., 2003). Also, studies have shown that the same motor skills do not equally affect the performance in competitive skiers as well as the effectiveness of skiing learning at recreational skiers (Cigrovski, Matkovic and Matkovic, 2008a, 2008b; Cigrovski, Bilic, Prlenda and Martincevic, 2010; Gross et al., 2010; Maffiuletti, Jordan, Spring, Impellizzeri and Bizzini, 2009; Oreb, Vlašić, Cigrovski, Prlenda and Radman, 2011). However, in early ages of life it is

necessary to develop all motor skills, not just those that are closely related to success in alpine skiing. The approach in which all motor skills are developed during the sensitive phases of the life of young alpine skiers will create good preconditions for later specialization in alpine skiing, i.e. in certain disciplines of alpine skiing. It is necessary to include elements of basic sports in the curriculum of alpine skiers, such as: gymnastics, athletics or swimming, and various team sports such as football, basketball, volleyball, hockey or water polo. The aim of this study is to determine the influence of some motor skills on the success in performing the basic elements of alpine skiing on the students of the Faculty of Sports and Physical Education.

Methods

The study was conducted on a sample of 40 students of the Faculty of Sports and Physical Education, University of Sarajevo, male, aged 23 to 26 years. All subjects in this study were clinically healthy and without marked locomotor and morphological impairments. The subjects were students of the fifth (V) year of master studies at the Faculty of Sports and Physical Education. The sample of variables for assessing motor abilities in this study consists of a set of 18 tests, which hypothetically cover explosive and repetitive strength, speed, coordination, balance, and flexibility. The success of performing elements of alpine skiing technique was independently assessed by 5 experienced ski instructors. The criterion variable in this study is the expert assessment (1-5) of the performance of the basic elements of alpine skiing: **STARN** - Straight run, **TRSNG** - traversing, **UPTRN** - uphill turn, **SNPGH-** the snowplough, **SNPGT** - snoplough turns, **SNPGHC**- snowplough curve, **SLSID** - sliding sideways, **STTUR** - stem turns, **SHPLT** - short parallel turns. After determining the satisfactory level of agreement of the evaluators of the technique of elements of alpine skiing, Factor analysis - the method of the first main component and Regression analysis were used to determine the general and partial contribution of motor skills in predicting the success of performing elements of alpine skiing in semi-latent and latent space.

Table 1. Central and dispersion parameters of motor ability variables

Variables	N	Min	Maxi	Mean	SD	Variance	Skew	Kurt
LOJUPI	40	163.00	272.00	199.85	23.58	556.13	.517	.895
HIJUPI	40	19.00	57.00	39.06	8.55	73.10	.057	-.362
TRJUPI	40	439.00	757.00	579.46	71.79	5154.67	.162	-.067
SQUOLE	40	2.00	48.00	12.28	8.64	74.73	2.165	6.804
SIJUOT	40	7.00	152.00	50.36	35.00	1225.28	1.185	1.106
CRUNCH	40	25.00	110.00	54.33	22.59	510.38	1.127	.666
TAPPHA	40	32.00	54.00	42.56	5.22	27.25	-.036	.195
TAPPLE	40	24.00	43.00	29.25	3.48	12.14	1.661	5.333
INCTWT	40	12.00	31.00	25.13	3.65	13.37	-2.040	6.117
STEASI	40	9.90	14.30	11.68	1.06	1.13	.388	-.385
RUNNTR	40	25.40	35.50	30.09	2.59	6.73	-.204	-.560
AGWIST	40	15.80	27.20	19.54	2.98	8.91	1.080	.635
FORBEN	40	3.00	24.00	12.98	5.37	28.92	.003	-.538
SEFOBE	40	65.00	127.00	94.24	13.42	180.24	.354	.291
ROBSID	40	151.00	202.00	176.12	12.99	168.90	-.122	-.797
FLAMTE	40	5.20	135.00	32.57	24.67	608.99	2.385	7.508
LONGBAL	40	4.70	51.50	20.91	11.18	125.10	1.336	1.821
BALATRA	40	4.40	145.30	30.06	23.13	535.18	3.491	16.140

Notes: LOJUPI – long jump pit, HIJUPI – high jump pit, TRJUPI – triple jump pit, SQONLE – squats on one leg, SIJUOTB- side jumps over the bench, CRUNCH – crunch, TAPPHA – tapping hand, TAPPLE – tapping leg, INCTWT – incline, twist, touch, STEASI – steps aside, RUNNTR – running track, AGWIST – agility with a stick, FORBEN – deep forward bend, SEFOBE – seated forward bend, ROBSID – rope by side, FLAMTE – flamingo test, LONGBAL – longitudinal balance, BALATRA – balance transverse

Table 2. Central and dispersion parameters of evaluation of elements of alpine skiing technique

Elements of alpine skiing technique	N	Min	Max	Mean	SD	Variance	Skew	Kurtos
STARN	40	1.00	5.00	3.512	1.051	1.106	-.237	-.579
TRSNG	40	1.00	5.00	3.365	1.066	1.138	-.151	-.818
UPTRN	40	2.00	5.00	3.365	.968	.938	.053	-.944
SNPGH	40	1.00	5.00	3.365	1.066	1.138	-.151	-.818
SNPGT	40	1.00	5.00	3.439	1.141	1.302	-.426	-.695
SNPGC	40	2.00	5.00	3.512	1.003	1.006	-.269	-1.000
SLSID	40	1.00	5.00	3.317	.985	.972	-.035	-.386
STTUR	40	1.00	5.00	3.463	.977	.955	-.230	-.210
SHPLT	40	1.00	5.00	3.365	1.066	1.138	-.151	-.818

Notes: STARN – straight run, TRSNG – traversing, UPTRN – uphill turn, SNPGH-the snowplough, SNPGT – snowplough turns, SNPGC – snowplough curve, SLSID- sliding sideways, STTUR – stem turns, SHPLT- short parallel turns.

Table 3 Regression of the model of motor abilities in relation to the evaluation of alpine skiing techniques

Model	R	R^2	Adjusted R^2	SE
1	.741	.549	.470	.728

Table 4 ANOVA - statistical regression significance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	40.594	11	3.690	6.959	.000
	Residual	33.406	63	.530		
	Total	74.000	74			

Results and discussion

Table 5. Partial contributions of motor abilities in predicting the success of performing elements of alpine skiing technique

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
LOJUPI	-.014	.019	-.332	-.721	.974
HIJUPI	.008	.040	.077	.211	.479
TRJUPI	.007	.007	.476	.970	.835
SQUOLE	.057	.036	.489	1.604	.343
SIJUOT	-.013	.012	-.462	-1.072	.124
CRUNCH	.001	.013	.025	.087	.296
TAPPHA	-.014	.070	-.072	-.200	.931
TAPPLE	-.091	.088	-.314	-1.029	.843
INCTWT	.089	.073	.320	1.205	.315
STEASI	-.245	.324	-.268	-.755	.241
RUNNTR	.213	.140	.549	1.520	.459
AGWIST	-.109	.092	-.322	-1.181	.143
FORBEN	-.033	.058	-.173	-.562	.251
SEFOBE	.015	.025	.204	.621	.580
ROBSID	-.016	.026	-.206	-.618	.541
FLAMTE	-.004	.009	-.092	-.425	.543
LONGBAL	-.017	.021	-.199	-.784	.675
BALATRA	.023	.011	.522	2.036	.442

Notes: LOJUPI – long jump pit, HIJUPI – high jump pit, TRJUPI – triple jump pit, SQONLE – squats on one leg, SIJUOTB- side jumps over the bench, CRUNCH – crunch, TAPPHA – tapping hand, TAPPLE – tapping leg, INCTWT – incline, twist, touch, STEASI – steps aside, RUNNTR – running track, AGWIST – agility with a stick, FORBEN – deep forward bend, SEFOBE – seated forward bend, ROBSID – rope by side, FLAMTE – flamingo test, LONGBAL – longitudinal balance, BALATRA – balance transverse.

Prior to conducting the Regression Analysis, measures of the central tendency, variability and form of distribution of the analyzed variables were determined (Tables 1 and 2).

Factor analysis as well as correlation coefficients confirmed a satisfactory level of agreement between the evaluators of the technique of performing elements of alpine skiing. The general contribution of the analyzed set of variables of motor abilities is high, with the value of multiple

correlation R = .741 and a total of 54% of the explained common variability, while the remaining 46% belongs to uniqueness, or other abilities and characteristics of respondents not included in this study. (Table 3). The regression influence of motor abilities on the first main component from the basic elements of alpine skiing in the semi-latent space (criterion variable) is at the level of statistical significance of $p < .001$. (Table 4).

The high general multiple correlation, the percentage of common variability of the predictor system of variables with the criterion variable (skiing) and no number of valid partial regression coefficients obtained within the presented regression analysis (Table 5), leads to the conclusion that the prediction (forecast) of the predictor set which influence the criterion variable can be executed only with the help of a complete system of predictor variables. This result could be explained by the fact that skiing is a very complex sport that requires a fairly high degree of development of motor skills. In this study, the elements of alpine skiing were broken down into parts and did not have a complexity close to the requirements of alpine skiing techniques. Due to such circumstances, there was no isolation of individual (partial) predictor variables that would have a unique statistically significant impact on the criterion variable (skiing). Nevertheless, by analyzing the absolute values of the standardized beta coefficients, the tests of the analyzed model of motor abilities could be ranked according to their contribution to the prediction of the success of performing the elements of alpine skiing technique. These are coordination with two tests (Envelope test, beta = .549 and Agility stick, beta = -. 322); repetitive strength with two tests (Squats on 1 leg, beta = .489 and Side jumps over the bench, beta = -.462); Explosive power with two tests (Standing triple jump, beta = .476 and standing long jump beta = -. 332) and 1 segmental body velocity test (Foot taping beta = -. 322).

For the purpose of more detailed analyzes, a regression analysis of motor characteristics and the first main components of the basic elements of apple skiing, in the latent space,

Table 6 Matrix of the set of isolated factors by the method of the first main component

	Component					
	1	2	3	4	5	6
LOJUPI	.935					
HIJUPI	.921					
TRJUPI	.943					
SQUOLE		.834				
SIJUOT		.894				
CRUNCH		.661				
TAPPHA			.707			
TAPPLE			.801			
INCTWT			.800			
STEASI				.799		
RUNNTR				.837		
AGWIST				.799		
FORBEN					.809	
SEFOBE					.898	
ROBSID					.839	
FLAMTE						.511
LONGBAL						.838
BALATRA						.767

Notes: LOJUPI – long jump pit, HIJUPI – high jump pit, TRJUPI – triple jump pit, SQONLE – squats on one leg, SIJUOTB- side jumps over the bench, CRUNCH – crunch, TAPPHA – tapping hand, TAPPLE – tapping leg, INCTWT – incline, twist, touch, STEASI – steps aside, RUNNTR – running track, AGWIST – agility with a stick, FORBEN – deep forward bend, SEFOBE – seated forward bend, ROBSID – rope by side, FLAMTE – flamingo test, LONGBAL – longitudinal balance, BALATRA – balance transverse.

was performed. The assembly matrix (Table 6) provides insight into the involvement of individual variables in isolated latent dimensions. Six latent dimensions were isolated by factor analysis using the first principal component method. The first main component or the first isolated factor is defined as the explosive power. The second main component or the second isolated factor is defined as the repetitive power. The third main component or the third isolated factor is defined as the segmental velocity. The fourth main component or the fourth isolated factor is defined as the coordination. The fifth main component or the fifth isolated factor is defined as the flexibility. The sixth main component or sixth isolated factor is defined as the balance.

Regression analysis of the first main component of the basic elements of alpine skiing (criterion) provides sufficient information on the influence of applied variables (isolated factors) of motor abilities on the performance of basic elements of alpine skiing. The correlation of the predictor with the criterion is high and amounts to (R = .73), which is at the level of statistical significance 0.01, where 53% of the total common variance is explained. The remaining 47% in the explanation of the common variability may be attributed to some other factors (motor and functional abilities, morphological characteristics, conative and cognitive components, motivational component, measurement conditions, etc.). Based on the table (Table 3) it is noted that the first and sixth factors from the area of motor abilities had a statistically significant impact on the first main component from the area of the basic elements of alpine skiing. The explosive power and balance showed a statistically significant effect on the criterion variable. Success in learning and mastering the basic elements of alpine skiing requires the possession of certain strength components. (Kazazović, 2003). This research has confirmed that, explosive power has been singled out as a primarily significant ability. Precisely the role of explosive power can be explained by the way or procedure of performing the characters of snowplow turns and basic ski turns, which were performed in a series of several consecutive turns. When performing the basic elements of alpine skiing, the body of the skier goes through certain phases of positions, where it is necessary to maintain a balanced position. Ultimately, it can be said that for beginners but also for experienced skiers, skiing is a constant struggle to maintain balance. During skiing, the influence of various forces (inertia, centrifugal force, etc.) is constant, and the skier must constantly be ready to perform compensatory movements in order to maintain balance. The ski elements that were used in this research proved to be elements with a complex structure, and for their performance it is quite logical that the respondents must have a higher level of balance, which is confirmed by the results of this research.

Ultimately, it is impossible to say that some motor ability does not affect the realization of specific motor skills such as the basic elements of alpine skiing. The results point to the fact that people with a higher level of general motor skills are more successful in learning and mastering the basic elements of alpine skiing. Such persons showed greater knowledge and learned all skiing techniques better. Considering that the sample of respondents in this study, as previously mentioned, was 40 students of the Faculty of Sports and Physical Education who had previously taken similar tests and raised their abilities to a higher level, it can be assumed that they had abilities from previous numerus trainings. It can be said that the adopted level of motor abilities with this sample of respondents was far above the level of knowledge of a non-selective sample.

Conclusion

Significance and general contribution of the applied set of variables of motor abilities in the prediction of the criterion system of variables of the basic elements of alpine skiing shows a statistically significant predictive potential. Multiple correlation (RO) = .74, with the amount of explanation of the common variability of 54%, is at the level of statistical significance of $p < 001$. It is obvious that success in performing the basic elements of alpine skiing is generally enhanced by all variables of motor skills. The prediction of success can be performed globally only with the help of a whole set of predictor variables, among which the unique statistically significant partial influence of individual motor abilities did not stand out. Nevertheless, by analyzing the absolute values of the standardized beta coefficients, the tests of the analyzed model of motor abilities can be ranked according to their contribution to the prediction of the success of performing the elements of alpine skiing technique. Those are, two coordination tests („Envelope"(zig-zag run) test, beta = .549 and stick mobility test, beta = -. 322); two repetitive strength tests (Squats on one leg (single-leg squats), beta = .489 and Lateral jumps over the bench, beta = -.462); two explosive power tests (Standing triple jump, beta = .476 and Standing long jump, beta = -. 332) and one segmental body velocity test („Foot taping" test, beta = -. 322). It can be concluded that respondents who have a higher level of developed motor skills, have a greater opportunity to more successfully perform all nine applied elements of alpine skiing. The results of this research also point to the fact that in the process of physical preparation, before going to the ski trail, an important stage is the process of transformation of motor skills. The theoretical significance of this paper is reflected in the elucidation of the relations and the influence of motor abilities on the success of performing the basic elements of alpine skiing. The results of this study can be the basis for the construction of an adequate Test Battery (measuring

instruments), on the basis of which they can get adequate information necessary in the process of planning and programming of certain transformation processes in the ski school.

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