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IN MEMORIAM

Assistant Professor Emir PAŠALIĆ, PhD
01.06.1970. – 27.09.2010.

This morning, in the midst of summer,
The snow came down, heavy and wet.
Gardens are crying in horror.
I am just a silent witness, for miracles no longer surprise me.
Through the shop window I watch people pass by, worried and mute.
Where will they end up, oh God, You know it all!
This is not my blasphemy - I have received a gift, not a punishment, I have got the upper hand, not the curse.
Morning will bring people, I can tell.
Someone must have died tonight.
My soul is ready, as the spool and paper in front of me.
Silence, and longing.
Whom have You snatched from this town tonight?
Whose name are we going to cry?

When I received the sad news of your passing away, dear Emir, these verses came to me and I too felt as if the snow had come down in the middle of summer, heavy and wet, and as if we became those gardens in horror, muted by pain, and this sudden loss.

Ten years ago, when we met here, you were working on your final exams, hurrying to get your degree. You wanted to achieve more each day; you were running towards your goals. I recognized your passion for success, affirmation and accomplishment, your need to do better than your teacher, as you used to call me. And you did it.

Everything you strived for, everything you wanted to learn, I have given you without any reserves, I did it believing in you. Your eyes showed all the gratitude, and your actions gave the best gifts in return. You achieved a lot, and I was happy for I was your teacher, content to see you become a successful young man, acknowledged and appreciated here and abroad. Even more pleasure came to me when I saw you with your students, how they appreciated you, and to whom you were a good teacher, the one who wanted to see them do better than you.
No matter how hard I try, the words are small and incapable of saying all I want to say right now.
The silence says more.
Today I am silent, and just a few days ago we spoke about everything, we planned, facing the future and talking about life, never about death. But suddenly it came between us. It came to show us all how tiny we are in our joys, sorrows, hopes and dreams, trusts and mistrusts, to show us how big it is - once it stands between us.

Emir was so LARGE that he gathered all the good people under his calm eyes; he was so BRIGHT that he exposed every lie and every illusion; he was so WARM that he melted every heart and so KIND that he planted a seed of love in every heart, awaking respect and making room for eternal memory.

Therefore:
He who breaks
His own little world
His own tiny self
Shall become the bright light of the Universe.

He who disappears in us
Nameless swarm
Shall live eternally
For one death is hundreds of lives.

When we, who remain in this world, ask God to give him the gardens of heaven, we also say this:

"God, show mercy for his sins and be generous for his good deeds!"

Dean of the Faculty of Sport and Physical Education
Professor Izet Rađo, PhD

Romana Caput-Jogunica[1], Sanja Ćurković[1] and Sergio De Privitellio[2]

Latent structure of pre-school children's body power

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Original scientific paper

Abstract
The aim of the study was to determine the latent structure of the group of motor manifestations, which are under control and dominant influence of the mechanism of energy regulation. The measurements were performed on a sample of 180 boys and girls from four kindergartens in Rijeka. The battery consists of 24 motor measurements with the following characteristics; suitable for the motor knowledge and abilities of the pre-school children, the complexity of conducting the tests was as low as possible and small amount of necessary equipment to carry out the tests. Seven factors were extracted using the GK criterion. According to the hypothesis some of the extracted factors have confirmed its existence, such as factor of explosive power, dynamic power and static endurance. It is necessary to make some modification of some measure instruments for static endurance as well as to test its on larger sample. This experimental study is contribution to a very small number of studies in Croatia on the sample of preschools children. The conclusions of this study are contributing to the results of the different former studies concerning the anthropological characteristics of the children at the age of 5 and 6. In the end, it is important to emphasize the complexity of this experimental study with the key terms, preschool children and measurement process of power, as well as at the same time the necessity of effective collaboration with parents, principal and kindergarten teachers, physical education teachers, doctors and pedagogues, who have also taken part in this experimental study.

Key words: **pre-school children, new measurements, strength, latent structure**

Sažetak
Latentna struktura relativne snage djece predškolske dobi utvrđena je primjenom novokonstruirane baterije mjernih instrumenata relativne tjelesne snage. Izmjereno je ukupno 180 djece iz četiri vrtića u Rijeci. Primjenjena je baterija od 24 mjerna instrumenta koja su primjerena motoričkim znanjima i sposobnostima predškolaca, jednostavnog izvođenja i uz vrlo mali broj pomagala i rekvizita. Uz primjenu GK kriterija izolirano je 7 faktora. Na osnovu rezultata potvrđena je opstojnost prema akcionom tipu snage faktora eksplozivne snage, faktora dinamičke snage i statičke izdržljivosti. Mjerne instrumente relativne statičke snage potrebno je doraditi i testirati na većem uzorku ispitanika. Provedeno eksperimentalno istraživanje predstavlja doprinos malobrojnim istraživanjima provedenim na uzorku djece predškolske dobi u Hrvatskoj. Zaključci ovog istraživanja pridonose dosadašnjim spoznajama o antropološkim obilježjima djece u dobi od 5. i 6. godina. Kompleksnost istraživanja prostora snage na uzorku predškolcima ističe potrebu kvalitetne suradnje voditelja mjernog postupka, roditelja djece uključenih u mjerni postupak, ravnatelja i odgojitelja u vrtićima u kojem se istraživanje izvodilo te kineziologa, pedagoga i liječnika koji su također bili uključeni u ovo istraživanje.

Ključne riječi: **predškolci, novi mjerni instrumenti, tjelesna snaga, latentna struktura**

Introduction

According to Malina (2004), children show considerable increase in performance in skills between 5 and 8 years of age (running speed and shuttle run) and a steady, more gradual increase in performance in others from 5 years of age through childhood (e.g. jumping, throwing and strength). Motor performance depends on muscular strength and it improves linearly with age from early childhood. Different studies (Rajtmajer 1990, Živčić and Hraski 1995., Bala, 1999. 2003., Mišigoj-Duraković 1999., Malina 2004, Trajkovski Višić, 2004, Živčić et al. 2008, De Privitellio 2006 and 2009) have confirmed the following; 1. Muscular strength increases gradually during early childhood and 2. Gender differences in average strength are small but consistently favour boys for running, jumping and throwing. Popović et al. (2006) determined the trend of the development of pre-school children motor abilities on the sample of 609 boys and 587 girls. The results of seven motor tests with regard to children's gender and age (age groups defined at six-month intervals) were analyzed. The trend of the development of motor abilities is of the same intensity regarding the sex and has the progressive development regarding the age. The results point at the uniqueness and interconnectedness of motor abilities, i.e. the influence on the one ability has a direct impact on the development of other abilities (7). Planinšec (2001) established the relation between motor dimensions and cognitive abilities in boys and girls of 5. 5 years of age. General cognitive and motor abilities were estimated on the sample of 189 girls and 203 boys applying RAZKOL tests. The connection between cognitive abilities and dynamic strength, balance and speed of simple movements has been found in girls while in boys the relation between cognitive abilities and dynamic strength did not show statistically significant results. In addition, the same author has established the motor types of 6-year-old boys (6). On the sample of 242 boys 28 motor tests were measured intended to estimate the coordination of the whole body, arms and shoulder area, agility, explosive power, dynamic power, movement frequency and balance. The analysis of the results confirmed the existence of general motor ability characterized by information and energetic movement components, and on the basis of which three groups of motor types of boys were obtained based on Ward's method application. The first type was characterized by better results in the overall motor space, especially in

movement speed, agility, dynamic power and arm coordination. The second type achieves the average results of motor efficiency, and the third lower motor efficiency especially in dynamic power, whole body coordination, agility, arm coordination and balance.
In Croatia there is a small amount of studies on the sample of pre-school children. In addition, we can notice the lack of studies which provide analysis and structure of pre-school body power. The reasons for this can be explained by the following facts: 1. The lack of adequate and effective organisation as well as co-operation between different subjects responsible for sports programmes in kindergarten, 2. A small number of reliable and valid motor tests which are suitable for pre-school children, 3. A small percentage of kindergartens with adequate sports infrastructure (gym, playground, etc.) as well as 4. Unsatisfactory proportion of kindergarten teachers with regard to high number of pre-school children in one group. There are just a few and unsystematic investigations of power segment in pre-school children. The purpose of the research is to determine the latent structure of the group of motor manifestations, which are under control and dominant influence of the mechanism for the regulation of excitation duration.

Methods

Subjects

Measurements were carried out on 180 pre-school children, aged 5, participants in extracurricular sports program which has been organized in four kindergartens in Rijeka. The tested children were participants in the classes of the four kindergartens in Rijeka and regularly attended extracurricular sports program during school year 2008/2009.

Variables

The applied variables were selected mainly from the gymnastics school programme carried out with the aim to determine the latent structure of the motor manifestations which are under control and dominant influence of the mechanism for regulation of excitation duration. Its manifestation characteristics are explosive, dynamic and static way of performance. The whole battery of 24 motor measurements (Table 1) has the following characteristics; they were suitable for the assessment and motor knowledge of the pre-school children, the complexity of conducting the tests was a low as possible and a small number of necessary instruments (tools) carrying out the tests. The results in the tests for measuring the explosive power is number of centimetres or seconds depend of the task and for measuring the dynamic power is the number of repetitions per 30 seconds. For each static way of performance we recorded for how long a child held the correct position in seconds.

Table 1. Abbreviations and descriptions of the tests applied in the muscle activity measurement

Topological groups	Tests of explosive power	Tests of dynamic power	Tests of static endurance
Hand and arm area	MFEBLD - Throwing the tennis ball from the standing position	MRAZGP – chins, supinated grip, pull up until your chin reaches the bar	MSAIVZ – hold on by the chin up on the bar
	MFEBMD - Seated medicinal ball throwing from the chest	MRASUS push ups, with back support	MSAUPP – hold on with forward support by hands, and by feet on the wall (position hand stand)
	MFEBML - Throwing 1 kg medicinal ball from lying on back	MRASUK push ups, on the knees	MSAIUZ – push up hold with back support
Trunk		MRAMPT- sit ups, 30 seconds	MSAIVPZ – pull up hang
		MRAMPN – lying on the back, raise the legs	MSAIZZ – extension, hold arms below the chin
		MRAZAK – extensions	MSAIZS – seating position, back support by hand, rise up and hold the legs up the floor
Legs	MFESVM standing jump up (Sargent test)	MRAČUČ – squats	MSAIZC – half – squat – hold
	MFE20V sprint	MRASTEP- rise up on the step bench	MSAIZU – standing on the toes, hold as high as possible
	MFESDM Standing long jump	MRABPO – side jumps	MSAIZN – in the prone position, lift up and hold extend legs

Data processing methods

The basic descriptive statistics was computed. The parameters of central tendencies (mean value), range and standard deviation, results of distribution (SKEW and KURT), multiple correlation (SMC) for each measurement which were measured three times, reliability (Cronbach Alpha) and coefficients between the items (F) with the first measurement main items were estimated. The exploratory factor analysis was carried by an orthoblique rotation and the number of factors defined by the GK criterion. The confirmatory factor analysis was provided by ML method and by the program LISREL 8.5.

Results and Discussion

Characteristics of the applied tests

The basic descriptive statistics was computed. The mean value and standard deviation for the all applied tests were calculated and presented in the Table 2. According to the results in the Table we can conclude referring to the sensitivity and applicability of the tests applied. One of the criteria of the sensitivity of the tests is the range of the results: the measure was derived from the difference between the maximum and minimum results. The wide range of results on the entire sample of the tests suggests a very good sensitivity. It is important to emphasize that for some tests

such as MRAMPT - curl up, MSAIVZ – hold on by the chin up on the bar and MSAIZN – in the prone position, lift up and hold extended legs the minimum time was zero which was presented in the column of minimum results. Further analysis of the results could explain the reasons of that. Distribution of the results does not substantially deviate from the normal Gauss distribution, which satisfies the condition of the suitability of the exercise to the testees, since their differentiation is both in the zone of low and high results.

Table 2. Basic descriptive statistics

VARIABLES/ unit of measure	X	SD	Min.	MaX.	Skew.	Kurt.
MFEBLD cm	744.61	326.17	156.67	2283.33	1.27	2.84
MFEBMD cm	191.48	43.54	83.33	303.33	0.26	-0.24
MFEBML cm	95.38	39.11	28.33	231.67	0.81	0.73
MFESVM cm	15.49	4.41	5.00	28.33	0.48	0.22
MFE20V s	5.25	0.58	4	7.8	0.90	1.56
MFESDM cm	100.23	17.60	51.67	139.67	-0.13	-0.44
MRAZGP r	9.67	4.89	1	30	0.86	1.00
MRASUS r	12.22	4.95	2	27	0.46	-0.10
MRASUK r	18.29	8.95	1	49	0.90	0.49
MRAMPT r	13.01	3.55	0	22	-0.41	0.45
MRAMPN r	13.97	2.92	5	22	0.00	0.46
MRAZAK r	21.39	5.69	3	36	-0.37	0.17
MRACUC r	23.48	3.75	12	32	-0.36	0.20
MRASTEP r	13.52	2.59	5	20	-0.46	0.85
MRABPO r	16.58	6.27	5	32	0.28	-0.78
MSAIVZ s	11.31	9.54	0	48	1.98	4.20
MSAUPP s	41.64	22.93	8.41	202	2.35	12.47
MSAIUZ s	30.24	20.65	4	223	4.85	41.85
MSAIVPZ s	23.13	16.97	1	104	1.91	5.10
MSAIZZ s	38.13	20.47	7.64	120.19	1.13	1.37
MSAIZS s	36.16	24.53	5	187	2.48	9.84
MSAIZC s	52.91	33.52	9	180.21	1.36	2.24
MSAIZU s	76.63	44.64	15.09	336	1.72	5.98
MSAIZN s	48.64	97.16	0	794	5.87	37.56

cm r – repetition s - second

Results of the exploratory factor analysis

The eigenvalue of the principal components is presented in Table 3. The principal components exhausted 61.289 % of the entire system deviation while the rest of 38.711% can be considered as en error component. According to the applied Guttman-Kaiser criterion, 7 characteristics roots where principal component is made up of all applied tests. The first factor explains 25.61 % of the total variability, the second 9,24%, while the seven factor is the lowest 4,28%.

Table 3. Eigen value of the factors defined by GK criterion

Factor	Eigen Value	% Variance	Cumulative %
1	6.148	25.616	25.616
2	2.220	9.249	34.865
3	1.516	6.315	41.180
4	1.396	5.817	46.997
5	1.234	5.141	52.138
6	1.168	4.866	57.004
7	1.028	4.285	61.289
8	.938	3.906	65.196

The first orthobligue factor predominantly determines the tests of the explosive strength. According to the tables 4 the pattern of orthoblique factor the highest value have the all tests where kids have to throw different kinds of ball on different positions; MBEMBL - throwing 1 kg medicinal ball from lying on back, MFEBLD – throwing the tennis ball from standing position, MFEBMD – seated medicine ball, as well as the test for explosive strength such as MFE20V - sprint, MFESDM – standing long jump, MFESVM – standing jump up and one test for dynamic power MRAMPT – sit ups /30 sec.

Considering the projection of measure instruments in the structure of orthobligue factor (Table 5), the significant projection has the measurements for dynamic power MRABPO – side jumps, MRAZAK – extensions, MRACUC – squats, MRAMPN – lying on the back, rise up the legs, MRASTEP – rise up on the step bench, MRAZGP – chins, MRASUK – push ups on the knees and two measurements for static endurance MSAIZVP – pull up hang and MSAIZZ – extension, hold arms below the chin. Respecting the higher projections of the above mentioned measurements on the fourth orthobligue factor, we may conclude that performing these measure instruments for relative body strength significantly depends on the initial level of power with the purpose to achieve better speed and performance as well as self-confidence and sense of safety performance.

The *first orthoblique factor* could be interpreted as the factor of *explosive power*.

The second orthoblique factor is determined by the tests of static endurance: MSAIZC – half- squat-hold, MSAUPP – hold on with forward support by hands and MSAIUZ – push up hold with back support and test MSAIVPZ – pull up hang which has significant but lower projection on this factor. The common feature for all these tests is the same action type of strength. Therefore, this factor can be interpreted as the factor of the *static endurance.* Two tests of static endurance define the third orthoblique factor: MSAIZN – in the prone position, lift up and hold extended legs and MSAIZU – standing on the toes, hold as high as possible. The others tests of static endurance have the lower projection in the Table 5, with the structure of orthoblique factor, while in the Table 4, of pattern orthoblique factors doesn't have any significant projection.

The common characteristic of these tests is probably the cause of the complexity and balance of the tests taking into account the position of the body during the performance and the necessity of activation of large muscle groups with the purpose to hold the right position as long as possible. In our opinion the third factor can be interpreted as the *dual factor of static endurance.*

The *fourth orthoblique factor* is explained by the homogenous block of tests concerning the action type of strength; MRAMPN – lying on the back, rise up the legs, MRAZK – extensions, MRABPO – side jumps, MRACUC – squats, MRASTEP – rise up on the step bench, MRAZGP – chins by supinated grip, MRASUS – push ups with back support and MRASUK – push ups on the knees. The *fourth factor* could be termed as the factor of *dynamic power.*

Only one test of static endurance dominantly explains the fifth orthoblique factor: MSAIZS – extension, hold arms below the chin. The test MSAIZZ – extension, hold arms below the chin has significant but lower projection.

With reservations, this factor could be interpreted as the *single factor of the static endurance*.

Sixth and seventh orthoblique factors explained less then 4,86% of the total variability. Because of lower projections of sixth and seventh orthoblique factors, these factors are difficult to explain comprehensibly.

Table 4. The pattern of orthoblique factor.

Variables	F1	F2	F3	F4	F5	F6	F7
MFEBML	**.811**	-.120	-.030	-.028	-.025	**.041**	.069
MFEBLD	**.769**	**.055**	-.061	.144	-.004	-.025	.104
MFEBMD	**.765**	**-.054**	.108	.021	.153	.013	.047
MFE20V	**-.592**	**-.061**	.181	.081	.144	.145	.184
MFESDM	**.543**	.011	-.171	-.287	-.038	**-.079**	.036
MFESVM	**.456**	.045	.172	-.165	-.117	**-.050**	-.145
MRAMPT	**.286**	.228	.102	-.286	.054	.155	-.155
MSAIZC	-.062	**.700**	.192	.030	.049	-.067	-.044
MSAUPP	-.004	**.398**	-.038	**-.093**	.015	**.044**	.227
MSAIUZ	.004	**.293**	-.089	**.066**	-.061	-.034	-.005
MSAIZN	-.042	-.019	**.812**	**.080**	.040	.001	-.020
MSAIZU	.023	-.011	**.315**	-.106	-.187	-.078	.225
MRAMPN	-.054	.006	.064	**-.612**	-.068	.071	-.015
MRAZAK	.107	.018	-.166	**-.606**	.037	.044	**.318**
MRABPO	.245	-.130	-.095	**-.603**	.099	-.103	.078
MRACUC	-.037	-.070	.006	**-.583**	-.127	-.190	-.074
MRASTEP	.199	.081	.044	**-.468**	.093	-.020	.034
MRAZGP	-.028	.183	.077	**-.414**	.118	-.265	.047
MRASUS	.078	**.332**	-.019	**-.334**	-.241	.016	-.160
MRASUK	.206	.061	.112	**-.220**	-.148	.077	-.082
MSAIZS	-.044	-.002	-.006	.046	**-.737**	.002	.055
MSAIVZ	.036	.002	.027	.013	-.005	**-.818**	-.043
MSAIVPZ	.054	**.331**	-.049	-.114	.018	**-.371**	**.367**
MSAIZZ	**.225**	.199	.183	-.026	-.238	-.072	**.542**

Table 5. The structure of orthoblique factor.

Variables	F1	F2	F3	F4	F5	F6	F7
XMFEBML	.807	.041	-.037	-.392	-.092	-.032	.110
MFEBMD	**.728**	.057	.079	-.330	.066	-.035	.096
MFEBLD	**.720**	.177	-.082	-.253	-.081	-.104	.167
MFESDM	**.702**	.207	-.133	-.559	-.146	-.204	.117
MFE20V	**-.661**	-.214	.160	.401	.237	.217	.094
MFESVM	.551	.196	.203	-.442	-.233	-.124	-.074
MSAIZC	.046	**.690**	.225	-.148	-.124	-.199	.076
MSAUPP	.128	**.443**	.001	-.197	-.084	-.104	.290
MSAIUZ	.036	**.292**	-.073	-.017	-.110	-.095	.043
MSAIZN	-.099	-.010	**.796**	.005	-.025	.037	-.022
MSAIZU	.119	.137	**.352**	-.223	-.252	-.162	.255
MRABPO	**.523**	.079	-.034	**-.686**	-.008	-.221	.142
MRAZAK	**.426**	.218	-.084	**-.652**	-.065	-.146	.368
MRACUC	**.264**	.135	.093	**-.601**	-.231	-.289	-.004
MRAMPN	**.247**	.156	.154	**-.592**	-.166	-.052	.020
MRASTEP	.436	.230	.100	**-.583**	-.037	-.146	.104
MRAZGP	**.223**	.331	.131	**-.494**	-.033	-.381	.156
MRASUS	**.317**	.456	.070	**-.482**	-.376	-.133	-.073
MRAMPT	**.433**	.289	.144	**-.447**	-.071	.053	-.099
MRASUK	**.327**	.165	.159	**-.355**	-.226	-.004	-.048
MSAIZS	.025	.151	.069	-.062	**-.723**	-.084	.057
MSAIVZ	.107	.186	.022	-.169	-.109	**-.812**	.110
MSAIVPZ	**.234**	.506	-.012	-.320	-.127	**-.539**	.501
MSAIZZ	**.351**	.415	.231	-.312	-.350	-.272	**.614**

Table 6. Correlation of orthoblique factors with the GK criterion.

F	1	2	3	4	5	6	7
1	1.00						
2	.18	1.00					
3	-.00	.06	1.00				
4	**-.49**	**-.26**	-.13	1.00			
5	-.11	**-.22**	-.11	**.17**	1.00		
6	-.09	**-.22**	.00	**.20**	.12	1.0	
7	.08	.16	.01	-.08	-.01	-.18	1.00

The correlation of orthoblique factors (Table 6) are within the range between .00 and .49 and have a positive and negative sign. The highest correlation is between the first and fourth factor, which suggests the complexity of the motor space for pre-school children, where the dynamic power expression depends of explosive power and vice versa. When we analyzed the correlation between the all isolated factors we can say that a range of various regulation mechanisms takes part in the realization of children's movements.

Conclusion

At the first level of factor analysis of measurement of children's power it is possible to predict the existence of primary factors of power divided according the way of performance into explosive power, dynamic power and static endurance.

The isolated factors are interpreted as; 1. Factor of explosive power, 2. Factor of static endurance, 3. Dual factor of static endurance, 4. Factor of dynamic power, 5. Single factor of static endurance. These results as well as the results of the studies which have been provided on the sample of pre-school children in Croatia can be a useful frame for monitoring process and methods for evaluation of children's achievements and expected results for 5-6 aged children.

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Correlation between fitness profile and situation efficiency in soccer

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Abstract
The main purpose of this study is to determine relation between Fitness profile and situation efficiency in soccer. For the purpose of this study 11 soccer players of Dinamo Zagreb, Soccer Club in the 2008/2009 season were tested. Firstly, the soccer's' basic morphological characteristics were measured: height (cm), weight (kg) and subcutaneous fat tissue (%). The VO2max test measured the following variables: average maximum oxygen intake (mL kg-1min-1), maximum heart rate frequency (b min-1) and maximum running speed (km h-1). Situational efficiency was determined by Prozone. Significant correlation was determine between overall number of passed balls and successfully passed balls (r=0,99), overall number of passed balls and unsuccessfully passed balls (r=0,79), unsuccessfully and successfully passed balls (r=0,71), average sprint length and maximum speed (r=0,83), number of sprint runs and unsuccessfully passed balls (r=0,63), total distance covered during the second half and number of sprint runs (r=0,62), total distance covered in sprint run and unsuccessfully passed balls (r=0,67), total distance covered in sprint run and number of sprint runs (r=0,91), height and weight (r=0,71), average maximum oxygen intake and total distance covered in sprint run (r=0,61), maximum running speed and number of sprint runs (r=0,76). These data only proves the complexity of success in soccer and the need for further research and improvement in the training processes, as well as the game of soccer. A greater variety of functional and motoric variables should be applied in future research and their correlation with various indicators of situational efficiency of soccer players should be analyzed as well.

Key words: **Soccer, fitness profile, situation efficiency**

Sažetak
Osnovni cilj ove studije je da utvrdi odnos između fitnes profila i stanja efikasnosti u nogometu. Za potrebe ovog istraživanja testirano je 11 nogometaša, Nogometnog kluba Dinamo Zagreb, u sezoni 2008/2009. Kao prvo, kod nogometaša su mjerene osnovne morfološke karakteristike: visina (cm), težina (mm) i potkožnog masnog tkiva (%). Testom VO2mak mijerene su slijedeće varijable: Prosječni maksimalni unos kiseonika (ml kg-1min-1), maksimalna frekvencija srca (B min-1) i maksimalna brzina trčanja (km h-1). Stanje efikasnosti je bilo određeno od Prozone. Značajna korelacija utvrđena je između ukupnog broja dodanih lopti i uspješno dodanih lopti (R = 0,99), ukupan broj dodanih lopti i neuspiješno dodanih lopti (R = 0,79), neuspiješno i uspiješno dodanih lopti (R = 0,71), prosiječna dužina sprinta i maksimalna brzina (R = 0,83), kao i broj šprintova kod bezuspiješno dodanih lopti (R = 0,63), ukupna pređena razdaljina u drugom poluvremenu i broj šprintova (R = 0,62), ukupna pređena razdaljina u šprintu i bezuspiješno dodanih lopti (R = 0,67), ukupna pređena razdaljina u šprintu i i ostvareni broj šprintova (R = 0,91), visina i težina (R = 0,71), prosiječan maksimalan unos kiseonika i ukupno pređena razdaljina u šprintu (R = 0,61), maksimalna brzina trčanja i broj šprintova (R = 0,76). Ovi podaci samo dokazuje složenost uspijeha u nogometu i potrebu za daljim istraživanjem kao i napredak u procesu obuke nogometne igre. Veću raznovrsnost funkcionalnih i motoričkih varijabli treba da se primijeni u budućim istraživanjima i njihova povezanost sa raznim pokazateljima stanja efikasnosti nogometaša i takva treba da budu analizirana, kao dobra.

Ključne riječi: **Nogomet, fitness profil, situaciona efikasnost**

Introduction

Soccer is one of the most widespread and most profitable sports today (Al-Hazzaa, Almuzaini, Al-Refeaee, et al., 2001; Ali A, Farrally, 1991; Aziz, Chia, The., 2000; Bangsbo, Nørregaard, Thørøe, 1991; Bunc, Psotta, 2001). One of the reasons why soccer is so popular is that a player must not have outstanding abilities in all areas (technical, tactical, biomechanical, physiological and mental), but must have a reasonable level in all areas. Throughout the history of soccer affects the lives of people of different social status around the world. Soccer belongs to a group of polystructural activities where the main objective to achieve more goals than the opponent. One of the most important researches are related to the effectiveness of situational parameters (Casajus, , 2001; Di Salvo, , Collins, Neill, and Cardinale, 2006; Franks, Goodman, and Miller, 1983; Helgerud, Engen, Wisløff, Hoff, 2001; Heller, Proch´azka, Bunc, et al., 1992; Hoff, Helgerud, 2004; Hoff, Wisloff, Engen, Kemi, Helgerud, 2002; Hughes and Franks, 1997; Kemi, Hoff, Engen et al., 2003). The majority of team sports face the problem of identifying and interpreting actions and events taking place in the soccer field. The notation analysis is an effective way of resolving this problem (Hughes and Franks, 1997). It primarily focuses on the movement analysis, technical and tactical estimation and statistical content. This is why the notation analysis is a technique of analysis of various performance aspects via the process of continuous event registration (Hughes and Frank, 1997). It has been proved that soccer coaches are less than 45% precise in their analyses of the events taking place within the 45-minute span of a soccer game (Franks, Goodman, and Miller, 1983). In order to obtain appropriate feedback, instruments of objective measurement are absolutely necessary. Such studies have become of importance in planning and programming of the training process because they provide the best feedback from the coaches so they can improve the quality of training and thus the quality of players will occur. Centre events of every soccer matches are eleven soccer players, specifically ten players and one goalkeeper. Each player works as an individual and as such has its own characteristics and abilities that in certain situations during the competitive activities come to play and this will result in unique technical - tactical actions of the individual. If we look soccer as activity there is a need for an answer to the question: what is the connection between the success of soccer players

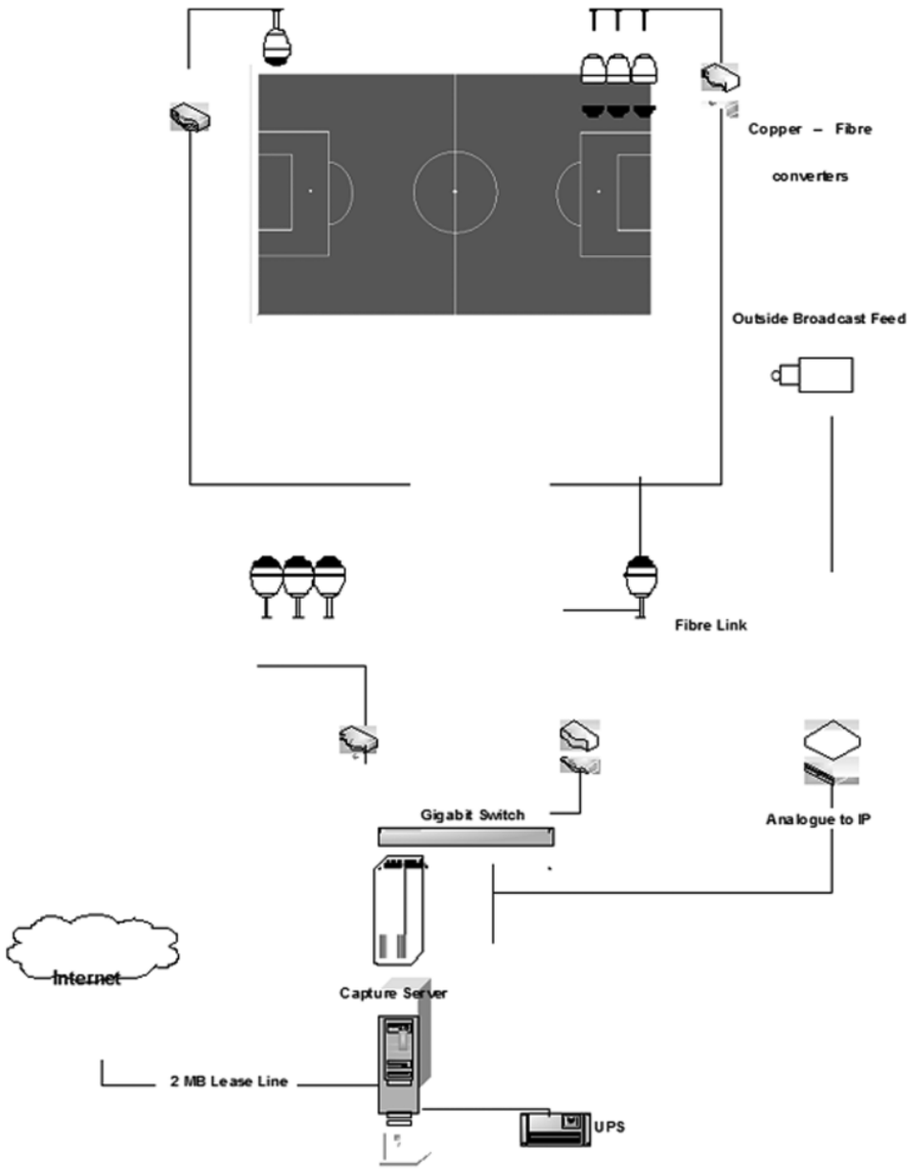
during competitive activity with its functional and motor abilities? In order to try to answer this question we need to collect data through the diagnostic procedures and to determine the actual characteristics and abilities of players. Aerobic capacity significantly affects the technical performance and tactical decisions. Helgerud and colleagues (2001) showed that an increase in maximal oxygen (for 5 ml / kg / min) and running economy (7%), significantly affects players performance during the game. To be successful in soccer, endurance and strength are of great importance, but what a top player must own, with a good basic level of skills and sense of timing. Improvement of aerobic endurance in soccer for 30% has only meaning if the player is ability to manifest in accordance with situational requirements. During 90 min top players run 10-12 miles average intensity in the vicinity of lactate threshold, while goalkeeper run 4 kilometers. Danish study confirms previous observations, the players run 5-10% more in the first half than in the second, but aerobically prepared players can be spared this decline in their performance (Bangsbo, Nørregaard, Thørøe, 1991). However, no correlation was observed between individual VO_{2max} and lactate threshold and decrease in performance during the match performance. Also some studies show a significant correlation between VO_{2max} and the first and second halves of matches, and sprints performed by the players (Kemi Hoff, Engen, et al. 2003; Krustrup, Mohr, Bangsbo, 2005; Reilly, Bangsbo, and Franks, 2000; Rienzi, Drust, Reilly, Carter and Martin. 2000; Smaros, 1980). The results of previous investigations indicate the efficiency of developing various types of endurance and strength in soccer transformation the influence of different procedures. Interval training with 90-95% of maximum heart rate for 4 x 4 min may increase the admission of oxygen to 10-30%. Such a shift is possible if additional training is conducted for a period of 8-10 weeks (Helgerud et al. 2001; Helgrud and Hoff, 2004). There is evidence of differences in the physiological demands against the attacker, or central midfielders and defenders, based on the assumption that the central position demands the highest performance in soccer. Several studies have confirmed the assumptions that the central players have a higher VO_{2max} than the other players. So the main purpose of this study is to determine relation between Fitness profile and situation efficiency in soccer.

Methods

The test group consisted of 11 soccer players of Dinamo Zagreb Soccer Club in the 2008/2009 season of the Croatian First League. The data was gathered at two locations. The first set of data was gathered by the Sports Diagnostic Centre of the Faculty of Kinesiology, University of Zagreb, during the precontest period. Firstly, the soccer's' basic morphological characteristics were measured: height (cm), weight (kg) and subcutaneous fat tissue (%). Then they were subjected to a test with aim to assess their energy capacity on the treadmill. The test measured the following variables: average maximum oxygen intake (mL $kg^{-1}min^{-1}$), maximum heart rate frequency (b min^{-1}) and maximum running speed (km h^{-1}). One minute incremental maximal exercise tests on a motor-driven trademill (Run Race, Technogym, Italy) with 1.5% inclination. Portable breath-by-breath gas analysis system (Quark k4 b2, Cosmed, Italy) was used for respiratory gas exchange monitoring. Heart rate was monitored using a heart rate monitor (Polar Vantage NV, Polar, Finland). The maximal exercise test was interrupted when plateauing of oxygen consumption was noted or when subject perceived volitional fatigue. AT was assessed by a nonlinear increase in carbon dioxide to oxygen consumption ratio (V-slope method). For this purpose, four spiroergometric parameters were calculated and analyzed (VO_{2max}, HR_{max} – maximal heart rate, MRS_{AT} - maximal running speed, , HR_{AT} - heart rate at anaerobic threshold). Situational efficiency was determined by Prozone. Founded in 1998, ProZone are the leaders in providing match analysis products and services to sports organisations through delivering "best practice" performance insights. Our aim is to empower people involved in team-based sports through the provision of performance-affecting information. ProZone have several technologies and software that enable the capture of match information and the subsequent delivery of performance analysis. Data is captured from either standard video or via a set of cameras installed within a stadium, which offer a 'whole' vision of the field. The information captured supports analysis for individuals and teams from a single match or across multiple matches. Hence users are able to investigate trends and create benchmarks (objective accountability) for comparative performance analysis. ProZone core analysis systems (ProZone3 and MatchViewer) have been independently validated by numerous researchers and practitioners to ensure that the output data is both accurate and reliable (Di Salvo, Collins, Mc Neill and Cardinale, 2006). Since our inception, ProZone have worked alongside over 150 worldwide clubs, institutions, leagues, federations and governing bodies, and developed analysis systems that encompass all levels of the game; from grass roots to elite performance level. Moreover, the ProZone systems encompass all areas of the modern day coaching process, including real-time analysis post-match evaluation, scouting services and trend analysis. Importantly, all ProZone systems have been designed alongside some of the leading lights in the game meaning that the product range is 'coach-driven' and easy to use (Figure, 1, Figure, 2 and Figure, 3).

Figure 1. ProZone and the Coaching Process.

Figure 2. ProZone's Digital Capture System.



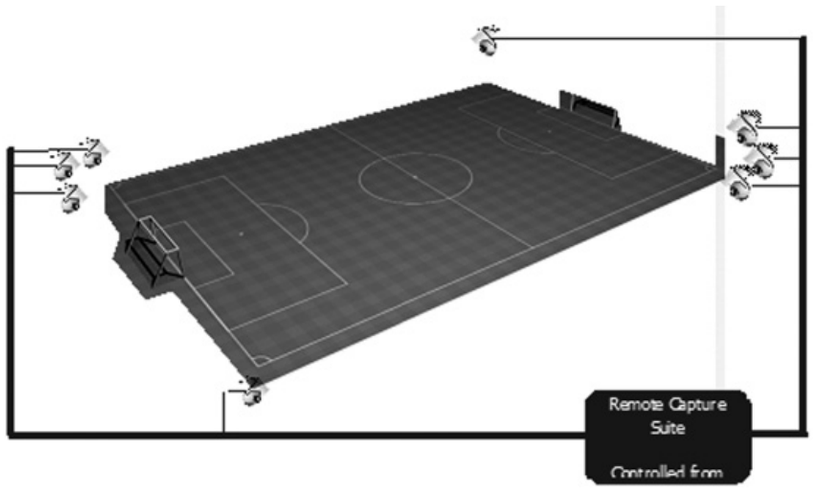


Figure 3. ProZone Camera Configuration with the Stadium.

It is ProZone's vision that analysis be used effectively within the feedback environment so we can help researchers and practitioners make better informed decisions. In addition to the provision of objective data, therefore, ProZone endeavour to deliver insights to those committed to enhancing performance. This could be in the form of simple benchmarking information (e.g. averages for comparative analysis), or more in depth trend analysis (e.g. identifying key performance indicators that lead to successful performance). For ProZone to accurately recreate the movements of football players during matches, an installation of specialised capture equipment must be undertaken at the stadium. The installation is normally permanent ('fixed'), although on occasions temporary installations have been performed. 8-12 camera sensors are located at all 4 corners of the stadium as depicted below. This unique camera configuration is vital for the following reasons;

1. **multiple angles;** for tracking players and also feedback sessions
2. **increases accuracy**; minimises distance between camera and players
3. **eliminates errors;** no blind spots when one camera's line of sight is blocked (e.g. by players crossing)
4. **resilience;** every area of pitch covered with minimum of two cameras, typically four

The digital stadium infrastructure means that ProZone are able to access the cameras remotely without the need for operation intervention during the game. The movements of every player are captured every 25th / second and a combination of automatic and manual tracking procedures are used to recreate these movements. The ProZone3 product is a complete reproduction of a 90 minute game. The data generated from this software provides an unrivalled range of physical and technical data, presented in a multiple formats including stats, maps multi-video, graphs and 2D game animation. When combined, this information provides the user with a comprehensive coaching tool that facilitates the analysis of every movement, action and interaction of each player for both teams. MatchInsight is a software licence that gives users the ability to self-code matches and produce MatchViewer analysis in the same format as if ProZone were providing a service to a customer.

Manager enables the user to insert the fixture details (match date, stadium, teams, players, officials, positions etc) and also house all the match information about all the games analysed, while Events is the actual programme that a user will use to code a match and produce the data that will automatically appear within the MatchViewer product upon completion.

The Events software guides the user through a sequential coding process, which involves inputting the Event (i.e. a shot, cross, header, pass etc), the Player(s) (maximum of 2 players per event) and Pitch Position (x/y coordinate). The data within MatchViewer is actually automatically calculated from the sequential coding process (i.e. the user cannot make subjective decisions on whether a pass was 'successful' or 'unsuccessful'; this is calculated mechanically by the nature of next event in sequence).

PlayBack is a software licence that provides real-time analysis of performance. Designed for 'live' use, PlayBack allows for half-time feedback (statistics and video) as well as in-game viewing and action replays (with slow motion, zoom and grab functionalities). With numerous drawing tools and presentational overlays, PlayBack can also be used as a coach-specific media player at any time during the week to facilitate post-match feedback or scouting analysis.

The statistical Package for Social Sciences SPSS (v13.0, SPSS Inc., Chicago, IL) was used for statistical analyses. Descriptive statistics (mean ± SD and range) were calculated for all experimental data. Kolmogorov-Smirnov test was used for testing normality of distribution. Statistical power, effect size and CV were calculated using the GPOWER software (Erdfelder, Faul and A. Buchner, 1996). Statistical analysis was performed using Person product-movement correlation coefficient. P values ≤ 0.05 were consider being statistically significant. The reliability of the test was determined using the reliability analysis (alpha) and by inter-class correlation coefficient (ICC).

Results

Table 1. Anthropometric and functional characteristics

	Age (years)	**Height** (cm)	**Weight** (kg)	**Subcutaneous fat tissue** (%)	**Average maximum oxygen intake** (mL kg^{-1}min^{-1})	**Maximum heart rate frequency** (b min^{-1})	**Maximum running speed** (km h^{-1})
J.T.	20,8	185,9	78,5	5,82	57,7	204	19
M.B.	19,3	184,6	76,5	4,99	64,7	189	19
M.Ma.	22,1	188,0	78,7	6,26	62,6	197	19,5
I.V.	24,7	187,5	82,7	5,1	62,6	202	20,5
B.B.	29,7	178,6	81,2	9,59	61,3	194	18,5
M.Mi.	28,4	174,6	67,8	5,17	68	204	20
I.B.	30,1	188,9	84,5	6,96	60,2	185	18
M.Ch.	25,3	181,6	78,6	6,71	54,1	181	18,5
C.Sa.	27,3	187,8	84,8	7,63	53,2	206	18,5
S.E.	27,3	176,4	77,8	7,19	55	193	17
A.T.	25,1	186,2	81	7,5	57,5	204	21

All the variables had normal distribution. Statistically significant correlations ($p<0.05$) have been established between the following variables: overall number of passed balls and successfully passed balls (r=0,99), overall number of passed balls and unsuccessfully passed balls (r=0,79), unsuccessfully and successfully passed balls (r=0,71), average sprint length and maximum speed (r=0,83), number of sprint runs and unsuccessfully passed balls (r=0,63), total distance covered during the second half and number of sprint runs (r=0,62), total distance covered in sprint run and unsuccessfully passed balls (r=0,67), total distance covered in sprint run and number of sprint runs (r=0,91), height and weight (r=0,71), average maximum oxygen intake and total distance covered in sprint run (r=0,61), maximum running speed and number of sprint runs (r=0,76). Analyzed tests had high values of reliability coefficients alpha, rage form 0,78 to 0,89. All analyzed test had high values of ICC rage from 0,89 to 0,97. Effect size for correlation coefficient was large (r = 0.50) as the values of statistical power (power = 0.95).

Table 2. Descriptive statistics of the indicators of situational efficiency and anthropometric and functional characteristics

	M ± SD	Min	Max	Range
Average sprint speed	2,07 ± 0,18	1,80	2,30	0,50
Average sprint length (m)	7,01 ± 1,87	5,10	11,90	6,80
Number of sprint runs	32,27 ± 11,14	11,00	51,50	40,50
Covered distance in the first half (m)	4774,45 ± 2406,77	0,00	6341,00	6341,00
Covered distance in the second half (m)	4571,1 ± 868,68	3223,33	5765,75	2542,42
Covered sprint distance (m)	244,87 ± 109,47	130,50	479,28	348,78

Discussion and conclusion

The values of morphological characteristics obtained in this study are in accordance with other studies in some European, while the average maximum oxygen intake slightly lower than in those investigations (Bunc and Pssota, 2001; Casajus, 2001; Ekblom, 1986; Heller et al., 1992).). All the variables of the situational efficiency have high reliability coefficients except for the variable of the maximum running speed which has a lower reliability coefficient (Cr α = 0,79), but is still satisfactory. This means that all the mentioned variables represent accurate indicators of the situational efficiency of the soccer players. The coefficient of variation, as an indicator of the dispersion of results, is significantly low for the variable: average sprint speed (8,7%). This is due to the high quality of the selected test group. The other indicators point out greater dispersion, which is due to the players' various positions in the match, their technical-tactical tasks and their different levels of quality. The relative values of maximal oxygen from the players in the field are according to research of Stolen et al. (2005). Correlation indicates that players with better functional abilities are capable of doing more sprint runs. In other words, they can play in a soccer match with higher level of intensity and have a shorter period of recovery after such an activity, which only supports the recent research that indicates that the maximum oxygen intake (VO_{2max}) has a positive correlation with the covered distance in a soccer match (Bangsbo, 1991; Smaros, 1980). Since the correlation is statistically significant, we can conclude that the linear increase of oxygen consumption follows the linear increase in running speed. Percent body fat was correlated with age (r = 0.58) as expected, with aged we have increasing in the percentage of body fat. The correlation of the variable of the number of sprint runs and the variable of distance covered in the second half (r=0,62) and the variable of the covered distance in sprint run (r=0,94) is understandable because the players with more covered distance in general, especially with more covered distance in sprint run, do more sprint runs during a soccer match (O´Donoghue, 2001; Ohashi, Tagari, Isokawa, Suzuki, 1988; Reilly and Thomas, 1976; Tiryaki, Tuncel, Yamaner, et al. 1997; Wisloff, , Helgerud, and Hoff, 1998; Wislow, Helgerud, Hoff, 1998; Withers, Maricic, Waisilewski, Kelly, 1982). As a soccer player needs to cover a certain distance in order to reach high running speed, the correlation between the variables of average sprint run and maximum speed (r=0,83) is logical. The correlation of the variable of the number of sprint runs and the variable of maximum running speed (r=0,76) as well as the correlation of the variable of average maximum oxygen intake and covered distance in sprint run (r=0,61) indicate that players with better functional abilities are capable of doing more sprint runs. In other words, they can play in a soccer match with more intensity and have a shorter period of recovery after such an activity, which only supports the recent research that indicates that the maximum oxygen intake (VO_{2max}) has a positive correlation with the covered distance in a soccer match (Bangsbo, 1991; Smaros, 1980). A correlation between the sprint run number and maximum running speed was also established, as well as that between the covered distance in sprint run during a game and maximum oxygen intake. Thus, we can conclude that soccer players with better functional abilities cover a greater distance in sprint runs (Bangsbo, 1991; Smaros, 1980). It is obvious that the morphological characteristics and functional abilities are not the only key to the success of players. The success of players determines the number of other capabilities, technical characteristics and tactical knowledge. The high level of functional ability is a prerequisite for the success of players, but without optimal levels of other key components for success in soccer does not have the complete soccer player. These data only proves the complexity of success in soccer and the need for further research and improvement in the training processes, as well as the game of soccer. A greater variety of functional and motoric variables should be applied in future research and their correlation with various indicators of situational efficiency of soccer players should be analyzed as well. This is why it represents an excellent means of determining the concrete behavior in a game. It is also an excellent additional test of morphological, motoric and functional abilities of soccer players helping to identify the good and bad sides of soccer training and improvements of sports performance that have to be carried out in the training process.

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Submaximal concentric contraction method application in judokas
maximal strength development

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Original scientific paper

Abstract
Maximal strength represent important success factor in judo. Aim of this research is to determine the efficiency of the submaximal contraction method at maximal strength development in judokas.
This research included Bosnia and Herzegovina's 20 top level judokas (24, 25±3, 19 yrs; 176, 35±9, 24 cm; 81, 48±18, 28 kg). Judo experience years ranged from 7 to 18. Maximal strength was tested.
At each measured test, with the exeptance of chin-ups, examinees achieved better results at final testing. Motor variables statistically derived between two measurements were: standing long jump $p<0.001$, bench press $p<0.001$, snatch and clean $p<0.001$, chin-ups $p<0.01$ and squat $p<0.001$.
We can summarize that by the application of the submaximal concentric contraction method the observed judokas significantly improved their performance.

Key words: **bench press, snatch and clean, squat, top level athletes**

Sažetak
Maksimalna snaga je bitan faktor uspjeha u judou. Namjera ovog istraživanja je bila da se utvrdi efekasnost metode submaksimalne kontrakcije u razvoju maksimalne snage judista.
U ovom istraživanju je učestvovalo 20 vrhunskih džudista (24,25±3,19 god; 176,35±9,24 cm; 81,48±18,28 kg) Bosne i Hercegovine. Trenažno iskustvo svih ispitanika je u rasponu 7 do 18 godina treniranja. Testirala se maksimalna snaga.
U svim izmjerenim testovima, osim u zgibovima, sportisti su na finalnom merenju imali bolje rezultate. Sledeće motoričke varijable su se statistički izdiferencirale između dva mjerenja: skok u dalj iz mjesta $p<0.001$, benč pres $p<0.001$, zatim nabačaj na grudi $p<0.001$, zgibovi $p<0.01$ i čučanj $p<0.001$.
Može se sumirati da su posmatrani judisti Bosne i Hercegovine primjenom metode submaksimalne koncetrične kontrakcije znatno poboljšali svoje performanse.

Ključne riječi: **benč pres, nabačaj na grudi, čučanj, elitni sportisti**

Introduction

In the physical preparation of judokas strength training is very important. It is considered that amongst the different types of strength, most important is the ability to mobilize maximal energy in the time, ability to perform maximal number of resisted contractions, and the ability to produce maximal muscle strength (Sertic and Lindi, 2003). No doubt that the human strength, defined as the ability to overcome different resistance is the one of the most important and most investigated human motor dimensions. During last 30 years large number of scientific and practical research, books and other publication were published in relation to the definition, diagnostics and strength development. Sport science has several strength training method classifications. Markovic and Perusko (2003) explain two types of method and 4 basic strength training methods group within:

1. Functional method: (a) method of maximal effort; (b) method of explosive dynamic effort and (c) reactive method.
2. Structural method: method of repetition.

Besides mentioned types authors mentioned: supramaximal method, pyramidal method and method of strength endurance.
The aim of this research was to establish the efficiency of the submaximal contraction method at the development of the maximal strength in judokas.

Methods

Examinees

This investigation included Bosnia and Herzegovina 20 top level judokas (24,25±3,19 yrs; 176,35±9,24 cm; 81,48±18,28 kg). Judo experience years ranged from 7 to 18. Trainings lasted for two hours and five times a week. Besides judo training all examinees had additional strength and conditioning training during years as well in preparation and in competition period (max 5 hours per week). Investigation was performed at the beginning of the preparation period in 2009.

Testing procedure

Testing was performed between 10.00 and 13.00 two day prior to beginning and end of the experimental training treatment. Period of rest between tests lasted for 5'. All the examinees undergo 15' warm-up consisting of 5' run, calisthenics, 10 squats, 10 heel up repetitions, 10 abdominal crunches, and back extensions. Warm – up ended by 2' active stretching (15'' each large muscle group). Examinees were instructed to avoid any kind of large physical efforts two days prior to testing, as to keep the usual nutrition regime.

Maximal strength tests

Explosive strength of the leg extensors was tested by the application of the standing long jump test. As the measure of the dynamical force we used 1RM squat, bench press and snatch and clean.

During squat and bench press we used Wilson et al. (1993) warm up procedure. It consisted of 10 repetitions at 30% with 2' rest, 7 reps at 50% with 2'rest, 4 reps at 70% with 3' rest, 1 rep at 90% with 3' rest. (% of 1RM was determined by Eppley's scale). Upon last set, the load increased at 100% based at the examinees feedback, so that the 1RM was determined by 3 trials the most. Examinees had 4' rest between trials. Squat technique required that examinees post a barbell at m.trapezius, squat parallel, while position of the grate trohanter of the femur has to be knee leveled. Examinee than stands up with load up to full knee extension. Bench – press position is a standard supination, where examinee touches the mid chest with weights and lifts them up vertically to full elbow extension. Spotting was not allowed.

Testing method for the snatch and clean differed, considering the nature of the movement, and in relation to squat and bench press. Warm up consisted of gradual increase of the load prior to 1RM test: 2 x 5 reps at 60% with 2' rest, 3 reps at 80% with 3' rest, 1 rep at 90% with 4'rest. Upon last set the load increased at 100% based at the examinees feedback, so that the 1RM was determined by 3 trials the most. Examinees had 4' rest between trials. Successful trial considered the one in which the examinee managed to hold the load in fixed position for 5 seconds at least.

Experimental treatment

Training treatment of the examinees besides standard trainings was based at the strength development. Examinees worked 3 times a week (6 weeks total) per 90' at the strength development of the large muscle groups (Table 1).

Table 1. Weekly training program

	SCHEDULE		
	08:30-10:00	11:00-13:00	19:30-21:00
Monday	Training A	Rest	Training D
Tuesday	Training B	Rest	Training D
Wednesday	Training A	Rest	Training D
Thursday	Training B	Rest	Training D
Friday	Training A	Training D	Training D
Saturday	Rest	Training D	Rest
Sunday	Rest	Rest	Rest

Training A, strength development training
Training B, jogging
Training D, judo training

Method of submaximal concentric contraction was applied. Load used in this method (table 2) vary from 90% to 100%. Mostly used training represented „flat" pyramid: 1 set of 3 repetitions at 90%; 1 set of 1 repetition at 95%; 1 set of 1 repetition at 97,5%; 1 set of 1 repetition at 100%; 1 set of 1 repetition with load larger than 100% for 1 kg (effort to set new personal record).

Table 2. Submaximal concentric contraction method

Tempo	Intensity –load	Repetitions	Sets	Rest interval (min)	No of exercises per training	No of training per week
Explosive	90/95/97/100	3/1/1/1/+1	5	3-5	3-4	2-3

Data processing

Data were processed using the Statistical Package for Social Science (SPSS). Differences between two measurements were calculated by the use of Paired-Samples T Test.

Results

The indicators of the maximal strength in judokas before and after treatment are shown in Table 3.

Table 3. Effects of the six-week long training treatment at maximal strength of judokas (N=20)

Variables	Initial	Final	t	p
Standing LJ (cm)	253,10±8,11	255,60±8,38	-4,54	0,000
Bench press (kg)	112,85±20,35	119,40±19,29	-6,38	0,000
Clean (kg)	106,75±16,40	111,55±16,13	-11,09	0,000
Chin-ups (rep.)	27,65±8,24	26,05±7,68	3,10	0,006
Squat (kg)	130,60±20,76	138,50±19,06	-7,07	0,000

At each measured test, with the exemptance of chin-ups, examinees achieved better results at final testing. Motor variables statistically derived between two measurements were: *standing long jump* $p<0.001$, *bench press* $p<0.001$, *snatch and clean* $p<0.001$, *chin-ups* $p<0.01$ and *squat* $p<0.001$.

Discussion

Based at the fact that the squat jumps performance depends on muscle contractile abilities, it can be presumed that the ability to show maximal strength through eccentric – concentric cycle (SSC) is more important in judo than maximal strength through concentric movement only as was in our investigation.

Facts on the ordinary exercises such as bench press snatch and clean and squat were not largely depicted in the judo referent literature. The results of some investigations on bench press and squat differed top level judokas (A team) from reserve (B and C team) (Thomas et al., 1989; Fagerlund and Häkkinen, 1991; Heyward, 1997; Franchini et al., 2005). This investigation shows that attention must be paid to the development of maximal strength in our judokas. We should always use those weight exercises that in a basis are similar to the movement as in judo technique. Of course we can not neglect other muscle groups but the emphasis should be at those mostly used in judo.

Muscle endurance of the upper torso (assessed by chin ups) decreased during the treatment with submaximal concentric contraction used in development of maximal strength. Considering that during the experiment less time was paid to the rope climbing as in previous stage of the preparation, there is a possibility that it produced result decrement in chin ups test a final measurement.

Significant increase of the judo result is the result of the application of the new methods in strength development, because it is of most importance for the judo to overcome large outer resistance, and to develop grate force and perform large work in shortest time.

Only well shaped weight training, taking in consideration athletes condition, can be efficient mean for achievement of the goal, elite physical condition of the athlete (Pasalić and Radjo, 2003).

Conclusion

In the conclusion we can summarize that by the application of the sub maximal concentric contraction method the observed judokas significantly improved their performance.
This investigation showed that this method can be of practical importance in a view of maximal strength improvement in judokas. It is necessary to have further investigations in order to determine the effect of this method application during the period of year and real existing competition performance in judo.

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Influence of morphological characteristics and motoric abilities
on the success of performing elements of volleyball in the high school student population

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Original scientific paper

Abstract
In terms of organization of sport and physical education lessons, volleyball can be considered the most popular for realization. The reasons for this organizational popularity lie in the fact that for the performance of educational contents of volleyball, very little material and technical equipment are needed, the game is easily applicable for the male and female population, and there is no contact between members of opposite teams so there is a small possibility of injury of participants. On this organizational level (lessons) it is also possible to oppose teams of different sexes, teams of different knowledge and motorical readiness or teams of different social statuses and which will not significantly affect the quality or result of the competition. On this occasion, a significant difference between opposite population does not have to be expressed, which again indicates on high organizational quality.
Sample examinees are defined by the male population of vocational high schools in Sarajevo, between the ages of 16-18. Variables of a predicator area consist of 12 morphological and 24 motoric variables, and the sample variables of the criterion area of 3 variables/elements of volleyball. The aim of this research is to determine the effect of morphological characteristics and motoric abilities on the performance of situational motoric elements of volleyball in terms of organization of sport and physical education. In this research, with the use of regression analysis the determined is a) influence of the morphological area on variables of the situational motorical area does not exist, like individually in the manifest area the same is represented by the first main component and b) the influence of variables from the motorical area on all situational- motorical variables in volleyball (manifest area) is achieved, just like those three elements derived the first main component.

Key words: **morphological characteristics, motorical abilities, high school population, volleyball, situational-motoric abilities**

Sažetak
U smislu organizacije nastave sporta i tjelesnog odgoja, odbojku možemo smatrati veoma popularnom za realizaciju. Razlozi za tu organizacijsku popularnost leže i u činjenici da je za izvedbu obrazovnog sadržaja potrebno vrlo malo materijalnih i tehničkih uslova i opreme, igra je lako primjenjiva za mušku i žensku populaciju, te nema kontakta između pripadnika suprotnih ekipa tako da je mala mogućnost ozljede sudionika. Na ovom organizacijskom nivou (nastava) također je moguće da se suprotstave timovi različitih spolova, timovi različitih znanja i motoričke spremnosti ili timovi različitih društvenih statusa, a što neće značajno utjecati kvalitetu ili rezultat takmičenja, što opet ukazuje na visoku organizacijsku kvalitetu. Uzorak ispitanika u istraživanju definisan je kao populacija učenika muškog spola srednje stručne škole u Sarajevu, starosti od 16-18 god. Uzorak prediktorskih varijabli sastoji se od 12 morfoloških i 24 motoričke varijable, a uzorak kriterijskih varijabli od 3 varijable/elementa odbojkaške igre. Cilj ovog istraživanja bio je utvrditi uticaj morfoloških karakteristika i motoričkih sposobnosti na uspješnost izvođenja situaciono motoričkih elemenata odbojkaške igre realizovane u nastavi sporta i tjelesnog odgoja. Uz primjenu regresijske analize utvrđeno je a) da ne postoji uticaj morfološkog prostora na varijable situaciono motoričkog prostora, kako pojedinačno u manifestnom prostoru tako predstavljene i putem prve glavne komponente i b) da je ostvaren uticaj varijabli motoričkog prostora na svaku od situaciono - motoričkih varijabli odbojkaške igre (manifestni prostor) kao i na od ta tri elemena izvedenu prvu glavnu komponentu

Ključne riječi: **morfološke karakteristike, motoričke sposobnosti, srednješkolska populacija, odbojkaška igra, situaciono-motoričke sposobnosti**

Introduction

In terms of organization of sport and physical education lessons, volleyball can be considered the most popular for realization. The reasons for this organizational popularity lie in the fact that for the performance of educational contents of volleyball, very little material and technical equipment are needed, the game is easily applicable for the male and female population, and there is no contact between members of opposite teams so there is a small possibility of injury of participants. In this light we can also observe the non occurrence and development of violence among participants of other teams, which is how Brackenridge, Fasting, Kirby and Leahu (2008) state, the frequent occurrence on realization of sport activities. On this organizational level (lessons) it is also possible to oppose teams of different sexes, teams of different knowledge and motorical readiness or teams of different social statuses (for ex.: competition in non educational organization of work) and which will not significantly affect the quality or result of the competition, regardless of the research data conducted by Kovač, Leskošek and Strel (2007), for which is determined that the higher level of motorical abilities present in students of technical schools rather than in students from, for ex. Specialized schools, relatively the difference in social statuses will not be expressed. On this occasion, a significant difference between opposite population does not have to be expressed, which again indicates on high organizational quality. In the light of general-worldly popularity, we can say that volleyball by itself falls under four sport games which in this area (European continent) are usually represented on TV screens or in sport magazines (football-soccer, basketball, volleyball, handball). The given popularity contributes and continuous effort of structure

and association that follows development of volleyball, to improve and change of rules accelerates mutually, and thus, furthermore, interests as the mass increases, in the way that media structures do, for volleyball competitions - Kock and Tilp (2009). That presence of media turns the attention of the general public, and also the high school population, to volleyball. Turning this popularity into practical life and into lessons of sport and physical education of students, we can notice the initiation of greater representation of volleyball, from the pedagogues where, if we state the fact that for the concrete performance of educational contents of this game, very little space is needed (for ex.: volleyball in appliance by a smaller number of students in a team or volleyball 2 on 2 players or similar) like sport equipment (one volleyball) Šoše and Tomić (1998) then the practical part comes in the placement of things into "its place". In the following context the interest of researchers for specific rules, interactions and order of effects that happen in volleyball, should not be unusual. Research is particularly interesting when in context of the whole structure also introduce individual educational content which Najšteter (1997) and Findak (2001) advocate and which should be realized within lessons, but in the area since 1999, regardless of the large number of initiatives of both governmental and nongovernmental organizations, according to Hardman (2008) there is no practical progress.Therefore, a large number of researches have been done regarding analysis of correct relations and influences within morphological/situational-motoric and motorical-situtional-motoric areas of volleyball and which have also shown a corresponding influence in terms of the research area (predicator/criterion). Thus, for ex.: Mekić (2001) on a sample of 110 basketball players of a municipal and regional rank proved that basic-motorical abilities affect the shooting of the ball into the basket, and the same author (2002) determines the corresponding high and significant degree of influences of basic motorical abilities on the preciseness of passing the ball in basketball. In the game of volleyball Marković (2002) on a sample of 100 handball players found a significant connection between basic-motorical and situational- motorical abilities. Miletić, Sekulić and Wolf-Cvitak (2004) have conducted research on 55 gymnasts, stated that a connection between motoric abilities and performance of nine different jumps without devices in rhythmical gymnastics, does exist. Vlašić, Oreb and Furjan-Mandić (2007) determined that a statistically significant connection of predicator morphological-motoric area with criterion specific situational motoric elements (folk dances) exists, and Guzel, Colakou, Karacn, Akyuz, Aslanolu (2008) determined that a difference between morphological characteristics and motorical abilities of volleyball and football players exists in terms that height and weight that are considerably expressed in volleyball players than in football players. The obtained results from previous research, both in volleyball as in other sports, suggests that for the aim in this research could be determined by testing influences of morphological and motoric abilities on performance of situational-motorical elements of volleyball, which are realized in the lessons of sport and physical education, which would contribute and individualize educational content and adapt lessons to students of vocational schools – Brettschneider and Naul (2004) determines that socio-economic statuses of families, educational level of parents and aspiration of an individual have a significant influence on the motorical status of adolescents.

Methods of processing data

Processing of data obtained was done by the software package SPSS 12.0 for Windows. At a multivariate level for determining the relation, a regression analysis was used, which represents an extremely suitable mathematical-statistical procedure in cases where it is necessary to determine a relationship between two sets of different variables.

Sample Examinees

Sample examinees are defined by the male population of vocational high schools in Sarajevo, between the ages of 16-18. The survey included only those students, who during the process of testing and measuring were completely healthy. The total number of examinees in the sample consists of 151 students. All examinees had suitable conditions of regular attendance in the lessons of sport and physical education, which represented one of the fundamental requirements for conducting this research. The sample can not be selected by any criteria for entry into high school.

Sample Variables

The selection and definition of the investigated areas (morphological, motoric, situational motoric) in this order were made on the basis of standardized and empirically verified methods of measurement and testing, based on which came to specific information about the characteristics of the surveyed examinees.

Sample of predictor variables is defined as follows:

Variables for assessment of morphological characteristics:
1. Body height (VISTJ)
2. Leg length (DUZNG)
3. Arm length (DUZRK)
4. Hand width (SIRSA)
5. Wrist diameter (DIRZG)
6. Elbow diameter (DILAK)
7. Body mass (MASTJ)
8. Upper arm radius (OBNDL)
9. Middle thorax radius (OBGRU)
10. Upper arm skinfold (NBNDL)
11. Back skinfold (NBLED)
12. Abdominal skinfold (NBTRB)

Variables for assessment of motoric abilities:

Variables for assessment of coordination
1. Coordination with a bat (MKTKK3)
2. Slalom with three medicine balls (MK0S3M)
3. Figure eight with ducking (MAGOSS)

Variables for assessment of explosive strength
1. Throwing a medicine ball out of a back laying position (MESBML)
2. Standing long jump (MESSD)
3. Running 20M (MBR20M)

Variables for assessment of movement frequency
1. Foot tapping (MBFTAN)
2. Foot tapping against a wall (MBFTAZ)
3. Hand tapping (MBFTAR)

Variables for assessment of repetitive strength
1. Push-ups on a loom (MRASKR)
2. Raising body out of a lying position (MRSPTL)
3. Deep squats with weights (MRLDCT)

Variables for assessment of balance

1. Standing on one leg longitudinally on a bench with open eyes(MBAU1O)
2. Standing on one leg across from the bench with closed eyes(MBAU1Z)
3. Standing on one leg longitudinally on a bench for balance with closed eyes(MBAP1Z)

Variables for assessment of precision

1. Targeting with a long stick(MPCDŠ)
2. Targeting a vertical target by foot (MPGVCN)
3. Targeting a horizontal target by hand (MPGHCR)

Variables for assessment of flexibility

1. Flex with a bat (MFLISK)
2. Leg lift while laying facedown (MFLZLG)
3. Deep forward bend on a bench (MFLDPK)

Variables for assessment of speed

1. Running 20M out of a high start (MBR20M)
2. Running 20M out of a flying start (MBR20MLS)
3. Running 50M out of a high start (MBR50MVS)

Sample of criterion variables (situational-motorical) defined as follows:

Variables for assessment of volleyball

1. Hitting aim over a net from primary position(OOGCPMOS)
2. Block "hammer" circular shape (OOOČK)
3. Serve (OOSR)

Results and Discussion

Influence of morphological on situational-motorical area

On the volleyball variables OOGCPMOS (.485), OOOCK (.309) and OOSR (.671) there is no influence of the predicator-morphological variables, considering the previously determined level of significance of $P < .05$, and it is not on a statistically significant level. In accordance to this it can be stated that the morphological area does not have an effect on the given variable of volleyball in the manifest area and it is not necessary to go into a detailed analysis of these relations. It is believed that one of the causes for the lack of correlation can be defined by the level of performance values of situational motoric tests, in which the performance of the morphological area of the studied area did not play an important role. The following could have been the cause to the loss of variability and have an effect on the loss of relations between the predicator and criterion area. One of the reasons that could affect the lack of correlation may result from inadequate and insufficient acquisition of basic techniques, which is like such depends less on the predicator variable. There is a possibility that the elimination of these causes could arrive to the appearance of correlation of the predicator with the criterion area. On the game of volleyball, represented by the first main component that is performed on three elements of volleyball (OOGCPMOS, OOOCK, OOSR) there is no influence of the predicator variables, considering the previously determined level of significance of $P < .05$, on a statistically significant level (in this case is .415). In accordance to this it can be stated that the morphological area does not have an effect on the first main component of volleyball and it is not necessary to go into a more detailed analysis of these relations. The cause for the lack of correlation can be defined by a set of situational motoric tests, by which the performance of the morphological area of the studied population did not have a significant affect. There is a possibility that by complicating the tests it could come to the appearance of correlation of the predicator with the criterion area.

Effects of motorical area on situational-motoric area

Examining the regression analysis of the criterion variable OOGCPMOS (Table 1.) we can determine the existence of statistically significant correlation, and the relation of the predicator and criterion variable provides sufficient information about the applied effects of motoric variables on the success of performance on the treated criterion variables. Correlation of the predicator with criterion variable is R=.52, with an explanation of about 27% of common variability with the criterion. The correlation is registered on a significance level to .05. Examination of the effects of individual motoric variables (Table 3.) it canbe seen that there was a logical and expected correlation between the predicator and criterion variables by the following: variable relation of explosive strength MESSD – standing long jump, which is logical and where explosiveness is necessary for the performance of a serve and strength and speed of serving a ball, variable correlation MRASKR – push-ups on a loom which represent strength of the upper extremities in this case is necessary for a greater number of serving repetition along with retention of quality of the derived technique, variable relation of balance MBAU1Z- Standing on one leg across from the bench with closed eyes which is necessary when stretching examinees during the performance of the technique itself, and relation two of three variables that represent speed of the motoric area MBR20MVS and MBR20MLS and considering the needed arm speed when performing a serve in volleyball. Therefore, proper stretching and maintaining a balanced position in preparation for a serve, in order to obtain the length in swing time, followed by rapid arm movements, causes the strength of the served ball along with attainment of correct precision for hitting the desired target (squares) in the field.

Table 1. OOGCPMOS (Volleyball - Hitting aim over a net from primary position)

Model	R	R Square	Adjusted R Square
1	.522	.272	.133

Table 2. ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	163.480	24	6.812	1.961	.009
	Residual	437.606	126	3.473		
	Total	601.086	150			

Table 3. Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
1		B	Std. Error	Beta		
	MESSD	.024	.010	.273	2.344	.021
	MRASKR	-.102	.037	-.307	-2.775	.006
	MBAU1Z	-.325	.138	-.226	-2.363	.020
	MBR20MVS	-3.060	1.260	-.268	-2.429	.017
	MBR20MLS	3.945	1.497	.316	2.636	.009

Analyzing the obtained tables of the regression analysis in the manifest area for the criterion variable OOOCK (Table 4.) we notice certain information about the effects of the applied motoric variables on the performance success on the treated criterion variables. Relation of the predicator variable with the criterion variable is R= .50 and explanation is about 25% of common variability with the criterion. Such correlation is significant on a level of .01. Examination of individual effects of motorical variables (Table 6.) could be seen that four variables of the predicator area have influence (level of significance .00 to .05) on criterion variable according to the following: MKTKK3- coordination with a bat, MBFTAZ- foot tapping against a wall, MBAP1Z- standing on one leg longitudinally on a bench for balance with closed eyes and MBR20MLS- running 20M out of a flying start. In this placed relation of variables is expected considering that for the performance of lower blocking in volleyball, participants need to have proper coordination between lower and upper extremities, frequency of movement of speed for which the greater number of blockage in a shorter period of time, then they must maintain proper balance manipulating the body within a marked area (a circle in which blocking is preformed) and of coarse at the same time have proper speed, in the way the body will promptly be set up "under the ball". These facts indicate the possibility of poor adoption of the lower blocking technique in volleyball – hammer, in students of vocational schools, considering that among others motorical characteristics of balance came to the fore, suggesting the possibility that the blockage of the ball is constantly found at the border of falling out of the circle and in this way, loss of control on the ball while trying to "catch it" participants/students have especially used this motoric characteristic, which in combination with speed enabled the successful completion of the test.

Table 4. OOOCK (Volleyball - Blocking "hammer" in circular shape)

Model	R	R Square	Adjusted R Square
1	.509	.259	.118

Table 5. ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3773.008	24	157.209	1.835	.017
	Residual	10794.700	126	85.672		
	Total	14567.709	150			

Table 6. Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
1		B	Std. Error	Beta		
	MKTKK3	2.232	.869	.253	2.569	.011
	MBFTAZ	.577	.285	.207	2.028	.045
	MBAP1Z	-3.455	1.700	-.183	-2.032	.044
	MBR20MLS	18.302	7.433	.297	2.462	.015

Review of the regression analysis of the criterion variable OOSR (Table 7. 8. and 9.), provides information on eight correlating variables with the criterion variable. Relation of the predicator with criterion variable is R= .60 and explains 37% of common variability with the criterion. The above relations are significant on a level of .00, along with an interesting fact that all the variables are practically double representatives of a certain area, reverently they correlate by two to three variables of one area. For instance MBFTAN- foot tapping and MBFTAR- hand tapping represent speed frequency of movement, MRASKR- push-ups on a loom and MRSPTL- raising body out of a lying position represent variables for the assessment of strength, MBAP1Z- standing on one leg longitudinally on a bench for balance with closed eyes and MBAU1O- standing on one leg longitudinally on a bench with open eyes represent variables for assessment of balance and MPGVCN- targeting a vertical target by foot and MPGHCR- targeting a horizontal target by hand represent variables for assessment of precision. Considering that the test is measured out of 12 attempts (6 attempts one half and 6 attempts second half of the court) for its complete performance proper strength of the upper extremities and body is needed, so where the abdominal muscles stretch 12 times upwards and backwards with explosive contraction after that, and on preparation for execution and performance of a serve. In the position for performing a serve, on tensing the muscles it is important to maintain the proper stance/position of equilibrium which manifests in the presence of the variable of balance along with maintenance of precision, which in the upper extremities is especially evident at change of serving area (6 attempts in one half of the court and 6 attempts in the second half of the court. Precision is also important in estimating the validity of a serve, considering that the ball has to fall in the marked area or touch the border line of the area. Therefore, the presence of the following variables allows faster hand movement, maintaining hand speed and body balance and attaining proper precise parabolas when performing a serve in volleyball and what is shown in this analysis.

Table 7. OOSR (Volleyball - Serve)

Model	R	R Square	Adjusted R Square
1	.609	.370	.250

Table 8. ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	248.106	24	10.338	3.087	.000
	Residual	421.934	126	3.349		
	Total	670.040	150			

Table 9. Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
1		B	Std. Error	Beta		
	MBFTAN	.318	.087	.378	3.680	.000
	MBFTAR	-.111	.058	-.181	-1.912	.058
	MRASKR	.072	.036	.207	2.007	.047
	MRSPTL	-.073	.031	-.238	-2.356	.020
	MBAP1Z	-.648	.336	-.160	-1.928	.056
	MBAU1O	.011	.005	.219	2.263	.025
	MPGVCN	-.026	.009	-.237	-2.824	.006
	MPGHCR	.029	.008	.291	3.425	.001

Insight into the regression analysis of the **first main component** in volleyball with mutual correlation from .62 (Table 10.), shows high multiple correlation and coefficient determinations (.38). This relation is registered and significant on a level of .00. Analysis of the influence on individual variables (Table 12.) can be concluded that out of eight variables with a statistically significant influence have been registered by two variable representatives out of three latent areas: MBR20MLS and MBR50MVS – speed from participants, MBFTAN and MBFTAR – speed frequency of movement and MBAP1Z and MBAU1O- balance that has statistically significant influence on the first main component of volleyball. From the following it can be concluded that speed balanced characteristics had a dominate influence on achieving better results in the game of volleyball. Areas that represent variables MKTKK3- coordination and MPGHCR- precision are in combination with the previously mentioned speed balanced characteristics gave suitable contribution to achieve quality results in performing elements of volleyball.

Table 10. Volleyball-First main component of sport games

Model	R	R Square	Adjusted R Square
1	.621	.386	.269

Table 11. ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	57.935	24	2.414	3.304	.000
	Residual	92.065	126	.731		
	Total	150.000	150			

Table 12. Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
1		B	Std. Error	Beta		
	MKTKK3	.176	.080	.196	2.188	.031
	MBFTAN	.140	.040	.352	3.467	.001
	MBFTAR	-.057	.027	-.196	-2.103	.037
	MBAP1Z	-.470	.157	-.245	-2.993	.003
	MBAU1O	.005	.002	.190	1.982	.050
	MPGHCR	.012	.004	.251	2.989	.003
	MBR20MLS	1.894	.686	.303	2.759	.007
	MBR50MVS	-.679	.328	-.286	-2.070	.041

Conclusion

The influence of morphological and motorical abilities on the performance of situational-motorical elements of volleyball was analyzed by application of regression analysis on 151 examinees- students from vocational high schools. On the control sample 12 morphological and 24 motorical variables (predicator area) were analyzed versus 3 situational- motorical variables, or criterion area. The set aim in the research suggested that an influence of morphological characteristics and motorical abilities on the performance of situational-motorical elements of basketball existed. In this research, with the use of regression analysis the determined is a) influence of the morphological area on variables of the situational motorical area does not exist, like individually in the manifest area the same is represented by the first main component and b) the influence of variables from the motorical area on all situational- motorical variables in volleyball (manifest area) is achieved, just like those three elements derived the first main component. We can conclude that for realization of situational- motorical elements, like as success in volleyball- which can be indirectly assessed by the attained effects on the first main component, speed characteristics are primarily necessary, followed by balance and coordination. With this research it has been determined that the quality of performing situational-motorical tasks is greater when the level motorical abilities is in participants is greater. Finally, with the obtained results of this research, the influence of motorical abilities on performance of situational-motorical elements in volleyball, in part, presently for the relation of motorical/situational-motorical areas is determined and the set aim of the research is confirmed.

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Effects of combined aerobic, aqua aerobic and swimming program
to some morphologic characteristics and motoric abilities in elderly women

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Abstract
Research has been done on the sample of 20 elderly women (n= 20, mean age=67.0±5.9 yrs; mean height) 1,63 ± 0,12m; mean weight) 75,3 ±15kg) who had been involved in experimental combined twenty-weeks training program, twice a week, for 60 minutes. Research goal was to state the effects of combined aerobic, aqua aerobic and swimming program to some morphologic characteristics at the beginning and at the end of the program, as well as based on significance of changes tested by T-test for reliant samples, it could be seen that the program caused certain changes in some morphological variables. It comes about body weight (p= ,001), waist size (p= .000) and size of thorax at inhaling (p= .000). Test results point that statistically important changes occurred in motoric space at testing speed of making individual move by arm (p= .000), coordination in space (p=.000), flexibility in banding forward (p=.000), as well as speed in 50 meters distance swimming (p=.000). Applied training-exercising program which included the said movement activities proved to be efficient, because it was confirmed that it positively affects some morphological characteristics and improvement of capability, mobility, coordination and flexibility in senior age women.

Keywords: **women, elderly age, aerobic, aqua aerobic, swimming, morphologic characteristics and motoric abilities**

Sažetak
Ispitivanje je rađeno na uzorku od 20 žena starije životne dobi (n= 20, mean age= 67.0±5.9 yrs.; mean height= 1.63±0.12m; mean weight= 75.3±15kg) koje su bile uključene u eksperimentalni kombinovani program vježbanja u periodu od 20 sedmica, dva puta sedmično po 60 minuta. Cilj istraživanja bio je utvrditi efekte kombinovanih programa aerobica, aqua aerobica i plivanja, na neke morfološke karakteristike i motoričke sposobnosti kod žena u starijoj životnoj dobi. Na osnovu aritmetičkih sredina rezultata na početku i na kraju programa, kao i na osnovu značajnosti promjena testiranih T-testom za zavisne uzorke, može se vidjeti da je program izazvao određene promjene u nekim morfološkim varijablama. Radi se o tjelesnoj težini (p= .001), obimu struka (p= .000) i obimu grudnog koša pri udisaju (p= .000). Rezultati testova ukazuju da je došlo do statistički značajnih promjena u motoričkom prostoru pri testiranju brzine izvođenja pojedinačnih pokreta rukom (p= .000), koordinaciju u prostoru (p= .000), fleksibilnost u pretklonu (p= .000), kao i brzine plivanja na 50 metara (p= .000). Primjenjeni program vježbanja, koji je obuhvatio spomenute kretne aktivnosti, pokazao se efikasnim, jer je potvrđeno da pozitivno djeluje na neke morfološke karakteristike i poboljšanje spretnosti, okretnosti, koordinacije i fleksibilnosti u poznim godinama kod žena.

Ključne riječi: **žene, starija životna dob, aerobic, aqua aerobic, plivanje, morfološke karakteristike i motoričke sposobnosti**

Introduction

New theories on phases of human life include ageing as overall development of human being and a king of challenge that instigates knowledge on improvement of health and psychological benefit with elderly people (Spencer, Ruthus, 2000). Ageing leaves traces on motoric functions, and it is more frequently manifested in decrease of both strength and muscular mass. This leads to damage of mobility and activities in everyday life (Murata, 2009). The age of 65 is taken in the most of developed countries as reference value for elderly age which is marked by a number of changes both in functioning of organism as well as in socio-economic relations. Arising changes are significantly reflected in movement activities and they affect motoric abilities. Strength, endurance, muscular mass and bones density are significantly reduced, and quantity of sub-dermal adipose tissue increases (Adams et al., 1999). Researches proved that loss of muscular strength and muscular mass are one of the most visible and notable changes that take place with elderly people. In addition, progressive destruction of nerve system as result of aging process has significant effect on structure and function of nerve-muscular system and work of muscles themselves (Bellew, 2002). During the process of ageing, changes in bone-joint system take place, as well as in skeleton muscles, blood, cardiovascular system and basal metabolism (Andrijasević, 1996). Some authors believe that physical training should be done from early youth to late old age. Every man should build up the healthy basis for active getting old with the preservation of functional ability and health improvement in late ages (Torlaković et al., 2010). This is one of very important factors having favorable impact on bone density level, and later, on preservation, postponing, emersion and extent of osteoporosis. It also reduces possible fracture risks, particularly with women following menopause (Khan, 2001). On the basis of some researches treating this issue, it was found out that during ageing process, reduction of motoric units takes place resulting in loss of muscular fibers of type I and type II. Also, reduction of horizontal cross-section of muscular tissue takes place, particularly on type II muscular tissue which results in reduction of mass and strength of muscles (Adamo et al., 2006). Presently, exercises for increase of strength through aerobic component and flexibility component are important part of recommended training-exercising program for preserving and improvement of health and prevention of chronic diseases with adults and elderly people (Misigoj Duraković et al., 2008). In some researches, dealing with such population (Barbarose et al., 2002), it was proved that strength training has positive effect on

development of flexibility with elderly women. While researching use of swimming, aerobic and dancing programs three times a week for 30 to 60 minutes, it was concluded that the said activities had positive effects on reducing of breast and colon cancer (Lee, 2003).

While analyzing effects of the program, which is implemented in elderly population (Freigenbaum, 1999; Fleg, 2005), it was concluded that elderly people are population that can have major benefit from regular and moderate physical activity. It is interesting that data prove that elderly people, who regularly exercise, have stronger immunity system than those who do not exercise although they are younger (Ogawa et al., 2005). Therefore, it can be stated that maintenance of vital functions of organism at optimum level is a precondition for health and consequently for good mood, feeling of efficiency, optimism and quality of life (Andrijasević, 2007). Goal of this article is to establish effects of combined aerobic, aqua aerobic and swimming program to morphological characteristics and motoric abilities of the women in elderly age.

Methods

Sample of examinees

Research has been done on the sample of 20 women included in experimental training program (n= 20, mean age=67,0±5,9 yrs.; mean height= 1,63±0.12m; mean weight= 75.3±15kg). Criteria was that before the beginning of program, all participants should have medical check based on which physician could provide his/her professional opinion and agreement that they can be included in combined training program of aerobic character and moderate intensity.

Sample of variables

In research, a modified battery of tests (Kurelić et al., 1975; Mikić, 1999; Radjo, 1997) has been applied for evaluation of some morphological characteristics, some motoric abilities and successfulness in swimming (Table 1).

Table 1. Sample of variables

Variable	Test	Measured capacity	Measuring unit
ATT	Absolute body weight	Volume of the body	kg
OBS	Scope of waist	Volume of the body	cm
ONK	Scope of thigh	Volume of the body	cm
ONL	Scope of upper arm	Volume of the body	cm
OGKI	Scope of thorax - exhalation	Volume of the body	cm
OGKU	Scope of thorax - breath	Volume of the body	cm
TPR	Arm/hand plate tapping - 20 repetit.	Assessment speed of alternate movement	seconds
DOH	Forward/flexibility front bench bent	Assessment of flexibility	cm
KOR	Movement/mobility	Co-ordination assessment body movement	seconds
SP50M	Swim 50 meters freestyle	Success in swimming	seconds

Method of results processing

T-test for reliant sample (differences are significant at p< ,05000) has been used for analysis of results of initial and final testing.

Methodology of exercising program

Overall program has been accomplished in the Olympics Pool Sarajevo in the morning hours. The activities were performed over the period of twenty weeks, twice a week, for 60 minutes. Aerobic program was been implemented in the sports hall with adequate ground-base and tools, aqua aerobic exercises in slightly sloppy, 110 cm deep pool, and swimming program in 25x50 meters long and 220 cm deep pool. Training has been performed in groups of 10 attendants with professional leading and supervision by sports and physical training teachers. The attendants have not been requested to change their regime and way of cuisine.

Candidates have been instructed and advised as follows:

- Not to start swimming and exercising program if they did not feel ready and healthy
- Not to swim if hungry or with full bally
- The last meal should be at least two hours prior to any activity
- While changing from training aerobic in pool they should make an adequate break and adapt organism for further activity as to avoid unwanted consequences
- Immediately get out of water in case of spasm, stretch muscles in question and relax

Table 2. Implementation of program contents per weeks

Program/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL HOURS
Swiming	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**10**
Aqua aerobic	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	**10**
Fitness		*			*			*			*			*			*				3
Aerobic low	*			*			*			*			*			*			*		3,5
Step aerobic			*			*			*			*			*			*		*	**3,5**
Pilates			*			*			*			*			*			*		*	**3,5**
Dancing	*			*			*				*		*			*					3
Streching		*			*			*		*				*			*		*		3,5

Table 3. Division of lesson per stages

Stage of the lesson	Introductory-preparatory	The main "A"	The main "B"	Completion
Duration	5-10 %	40-45%	40-45%	5-10%

Each lesson of the program consists of four stages. Warming exercises 5-10 minutes, aerobic type exercises on the ground 20-25 minutes, then 20-25 minutes of aerobic type training in water (free style swimming or aqua aerobic) and 5-10 minutes of relaxing and soothing of organism. During each lesson, introductory-preparatory, and main "A" stage has been done on the ground, and main "B" phase has been done in water (table 2 and 3).

Results and Discussion

On the basis of arithmetic mid result at the beginning and at the end of program, as well as on the basis of importance of changes tested by T-test for reliant samples, it could be seen that the program caused certain changes in some morphological variables. It comes about body weight (ATT p= .001), waste size (OBS p= .000) and size of thorax at inhalation (OGKU p= .000). Test results show that statistically significant changes in motoric space occurred. This refers to speed of making individual moves by arm (TPR p= .000), coordination while making complex moves (KOR p= .000) and flexibility in bending forward (DOH p= .000). All test participants during final testing have swam 50- meters section faster than at the beginning of the program (SP50M p= .000). Program did not have significant effect on size of upper leg, lower leg and thorax at exhale (table 4.)

Table 4. Importance of morphological characteristic under effect of program

					Std.Dv.			
	Mean	Std.Dv.	N	Diff.	Diff.	t	df	p
ATT 1	76,65	8,845						
ATT 2	75,3	8,633	20	1,350	1,565	3,857	19	**,001**
OBS 1	96,55	9,472						
OBS 2	94,35	9,421	20	2,200	2,041	4,818	19	**,000**
ONK 1	56,4	3,633						
ONK 2	56,1	3,582	20	,300	1,128	1,188	19	,249
ONL 1	31,45	2,723						
ONL 2	31,25	2,572	20	,200	,9514	,940	19	,358
OGKI 1	99,55	5,986						
OGKI 2	99,65	5,94	20	-,100	,4472	-1,00	19	,329
OGKU 1	103,2	5,618						
OGKU 2	104	5,666	20	-,750	,9104	-3,683	19	**,001**
TPR 1	12,7	1,809						
TPR 2	10,7	1,625	20	2,000	,8583	10,419	19	**,000**
DOH 1	37,95	13,1						
DOH 2	25,45	11,17	20	12,50	7,337	7,618	19	**,000**
KOR 1	51,85	14,57						
KOR 2	45,8	10,75	20	6,050	4,882	5,541	19	**,000**
SP50M 1	115,7	35,59						
SP50M 2	107	34,43	20	8,700	3,743	10,394	19	**,000**

As it could be seen, the results of the research (Figure 1 and 2), use of aerobic programs that were used in this research show that exercises in water, combined with other aerobic programs, can effect change in mass of the body. Test participant reduced their body weight by 1,3 kg, in average. As result of reduction of body weight, waste size has been also been reduced by 2,2 cm in average (figure 1 and 2). These data partially confirm the results of similar research (Hoeger et al., 1999; Michaud et al., 1995) by which it was proved that use of program of similar characteristics, but higher frequency of lessons, has significant effect on body fat in untrained healthy test participants.

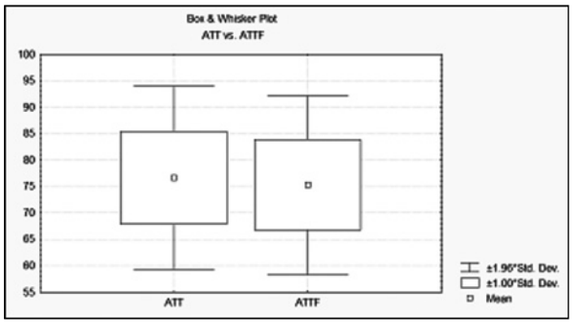

Figure 1. Absolute body weight (Initial vs. Finall)

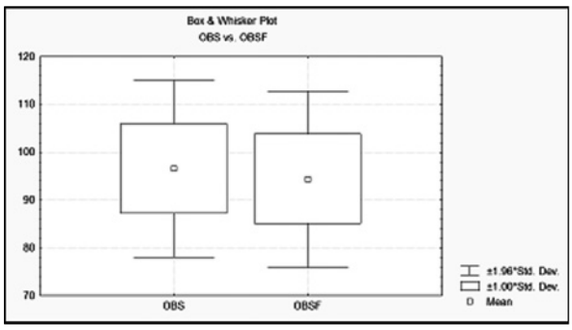

Figure 2. Scope of waist (Initial vs. Finall)

Also, under the influence of aerobic training, changes occurred also in solid increase of size of thorax at inhaling (figure 3). On the basis of these data one could say that aerobic training program had positive effect on lung ventilation, so that test participant had somewhat larger size of thorax in final testing (average of 0,75 cm) rather than at the initial measuring.

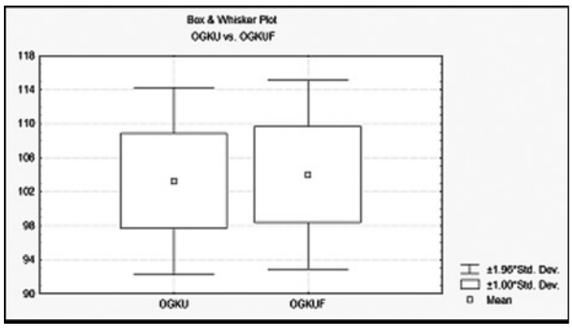

Figure 3. Scope of thorax – breath (Initial vs. Finall)

Results of "hand tapping" test show that in final testing, test participants significantly improved nerve-muscular contractions and had, in average, 2 seconds faster frequency of individual arms movements (Figure 4).

It is important to emphasize improvement in flexibility in bending in all test participants, which confirms results of earlier researches, which tested effects of training in water in elderly women (Colado et al., 2009; Bocalini et al., 2008; Ruoti et al., 1994; Hoeger et al., 1992). As result of the program, test participants improved their flexibility in bending by 12,2 cm. This data proves that program caused significant positive effects to enhancement of this motoric ability (Figure 5).

By use of "slalom with three balls" test one could see that all test participants significantly improved coordination while making complex moves (Figure 6). Average improvement in time that is needed for carrying out of this test was about 4,8 seconds. These data show that program instigated significant, positive changes regarding coordination, which can have strong effect to preservation of health and quality of life of elderly women, thus confirming results of similar researches (Deley at al., 2007; Tsourlou et al., 2006) on effects of physical training on elderly persons.

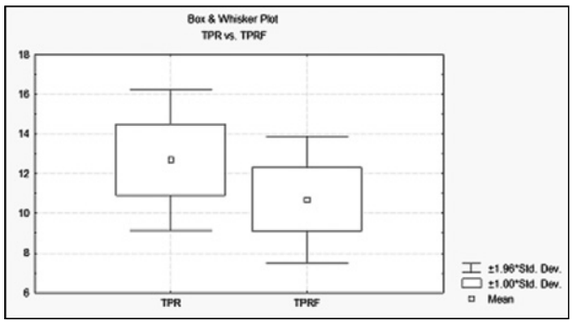

Figure 4. Arm/hand plate tapping – 20 repetit. (Initial vs. Finall)

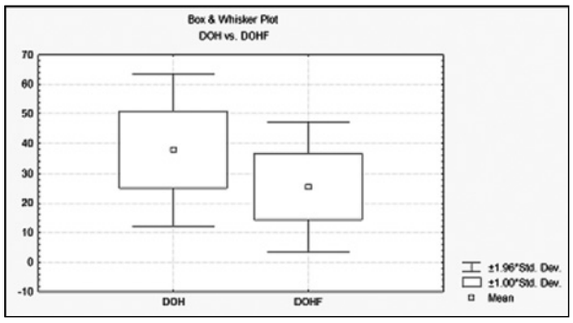

Figure 5. Forward/flexibility front bench bent (Initial vs. Finall)

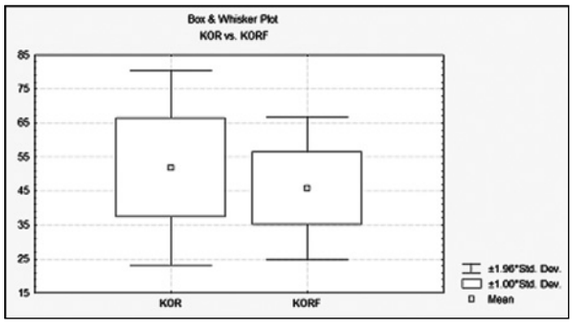

Figure 6. Swim 50 meters freestyle (Initial vs. Finall)

On the basis o arithmetical mid results at the beginning and at the end of program as well as on the basis of changes tested at univariant level (Figure 7), it is evident that swimming program pro-

duced, apart from partial effects, also significant global effects. All test participants significantly improved time they needed to cross 50 meters section swimming free style (average improvement was 8,7 seconds). Such result in enhancement of swimming speed was expected, because it comes about untrained persons who were additionally trained in technique of movement in water. Indeed, such kind of combined training had impact on strengthening of muscles of the whole body, improvement of aerobic endurance, which results in improvement of time and skillfulness in swimming.

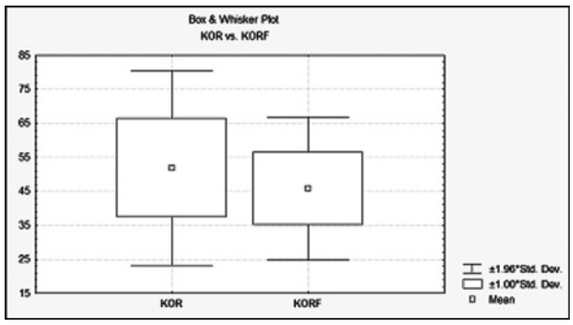

Figure 7. Movement/mobility (Initial vs. Finall)

Conclusion

From medical and kinesiologic point of view, the fact has already been known that swimming and training in water are listed as the most appropriate movement activities. In the research, we applied experimental program of versatile and moderate training of aerobic character for 20 weeks period. As it could be seen from comparison of similar researches so far, any person during the youth should start creating grounds for healthy active ageing with maintaining functional abilities and promotion of health in the old age. Combined program of body training applied in the research, which included the said movement activities proved to be efficient, because it was proved that it positively affects improvement of skillfulness, agility, coordination and flexibility in elderly age of the women. Results of implemented program showed that with appropriate stimulations under impact of swimming, aqua aerobic and aerobic program one could have positive outcome to some morphological characteristics with this population. Having in mind significant positive effects of aerobic training, probably the best recommendation for old persons is just combination of strength trainings and activities in various aerobic programs that increases endurance. Just these abilities allow them more quality lives and more efficient performance of everyday activities. As mentioned during discussion, this experimental program has proved, to some extent, results and conclusions of the authors of similar researches on effects of training to morphological abilities of elderly persons. It is confirmation that physical activity, as the way of life, is believed to be the most natural method and the most significant prevention factor for achieving and maintaining women's health in all its aspects. Therefore, the conclusion is that regular and moderate training in elderly age can increase quality of life and independence from other peoples' care. Finally, it can be concluded that combined program of exercises of aqua aerobic, aerobic and swimming significantly impact improvement and maintenance of adequate level of motoric abilities with elderly women, which indeed allows this population more quality life. Program can be used for education and animation of this population, so that they could take over personal responsibility and care for their health. In that way, by regular and moderate activities ageing processes and their negative effects are slowed down.

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Evaluation of knee muscles isokinetic evaluation between
professional and amateur athletes first year students of the faculty of sport and physical education

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Original scientific paper

Abstract
The purpose of this study was to evaluate the isokinetic dynamometer with maximum torque, total work, reciprocity between agonist / antagonist of the knee joint between professional and amateur athletes of students of the Faculty of Sport and Physical Education. Test strength of dynamic stabilizing knee was performed on the Biodex device 3 on the angular velocities 60 and 180 degrees / sec. The sample represented 42 athletes (22 professional athletes and amateur athletes 20). The data may represent the parameters for the function of dynamic stabilizing knee muscles among athletes students of the Faculty of Sport and Physical Education in Sarajevo. Compared to other categories, professional athletes presented significantly higher values for total work and maximum torque of knee flexor angular velocity 60 ° / s. The results showed that a reciprocal relationship between muscle groups (agonists antagonisa) is lower than the reference value expected for both categories, thus presented a preponderance of the extensor muscles of the flexors dynamic knee stabilizers. Muscular imbalance between flexors and extensors, which may be present, may be caused by overloading and trauma to the muscle-ligament structures of the knee joint. It is necessary to establish normal relations of reciprocal muscle agonists and antagonists of dynamic knee stabilizers. This scientific study can be useful as a basis for comparison for future studies to assess muscle isokinetičkih knee stabilizer with students from the Faculty of Sport and Physical Education.

Key words: **maximum torque, total work, reciprocal relationship**

Sažetak
Svrha ovog istraživanja bila je pomoću izokinetičkog dinamometra ocijeniti maksimalni moment sile, ukupni rad, recipročni odnos agonist/antagonist zgloba koljena između profesionalnih i sportaša amatera studenata Fakulteta sporta i tjelesnog odgoja. Test jačine dinamičkih stabilizatora koljena izveden je na aparatu Biodex 3 na ugaonim brzinama 60 i 180 °/sec. Uzorak ispitanika je predstavljao 42 sportaša (22 profesionalna sportaš i 20 sportaša amatera). Podaci mogu predstavljati parametre za funkciju mišića dinamičkih stabilizatora koljena među sportašima studentima Fakulteta sporta i tjelesnog odgoja u Sarajevu. U odnosu na druge kategorije, profesionalni sportaši prezentirali znatno veće vrijednosti za ukupni rad i maksimalni moment sile fleksora koljena na ugaonoj brzini 60 °/s. Rezultati su pokazali da recipročni odnos mišićnih grupa (agonista/antagonisa) je niži od referentne vrijednosti očekivanih za obje kategorije, na taj način prezentirana je nadmoć mišića ekstenzora nad mišićima fleksorima dinamičkim stabilizatorima koljena. Mišićna nejednakost između ekstenzora i fleksora koja može biti prisutna, može biti prouzrokovana preopterećenjem i povredama na mišićno-ligamentnim strukturama zgloba koljena. Potrebno je uspostavljanje normalnog recipročnog odnosa mišića agonista i antagonista dinamičkih stabilizatora koljena. Ova naučna studija može biti korisni kao osnova za usporedbu budućih studija s ciljem procjene mišića isokinetičkih stabilizatora koljena kod studenata Fakulteta sporta i tjelesnog odgoja.

Ključne riječi: **maksimalni moment, ukupni rad, recipročni odnos**

Introduction

As one of the most important motor skills in sport is referred to the vertical jump. Authors Thissen-Milder M, Mayhew JL (1990) discussed the possibility of a jump as an important factor for most athletes in sports, because jump is part of the attack and defense movements in all sports games. The vertical jump is characterized as a ballistic movement, which consists of rapid eccentric muscle activity following by maximal concentric actions. Performing this motor movements require a high capacity to develop muscle strength and dynamic stabilizers of the knee. The main function of extensors, muscle dynamic knee stabilizer based on the requirements of the sport are impulsive phase of the jump and landing phase (A Panni, Biedert RM, Maffulli N, Tartarone M, Romanini E. 2002).

The demands of certain sports games on the knee joint may be related to the high incidence of injury in that joint (Richards DP, Ajemian SV, Wiley P, Zernicke RF. 1996).

Sport results in practice impose a growing burden on the knee joint which can cause imbalances in muscle strength antagonist dynamic knee stabilizers. These muscle imbalances can cause injury of athletes, such as products with high levels of stress in tissues (Oberg B, Moller M, Gillquist J, Ekstrand J. 1986). Since it is also necessary to set the parameters for the function of muscles related to wrist in athletes. Isokinetic dynamometer provides fast and reliable quantification of variables related to muscle performance at different angular velocities, including the maximum torque, total work, reciprocity between agonist and antagonist muscles and fatigue index (Perrin DH, Robertson RJ, Ray RL. 1987). Isokinetic assessment allows the identification of muscle strength deficit between the bilateral muscle groups and between reciprocal muscle groups (agonist and antagonist) (Siqueira CM, Pellegrini FR, Fontana MF, Greve JM. 2002).

There are several studies that used isokinetic dynamometer at different populations of respondents (Kazazović et al 2008). However, there is little information about the measurements used for athletes in team sports, especially the research of the lower extremities (Kazazović et al 2009).

Therefore, the purpose of this study was to evaluate the differences of dynamic muscle strength of knee stabilizer in the first year students of the Faculty of Sport and Physical Education students between the categories of professional athletes and amateur athletes, as well as to determine the differences in the volume of training.

Methods

Sample

Forty-two students from the Faculty of Sport and Physical Education: twenty-two professional athletes, aged 20 years (± 1.38), body mass 84.1 (± 8.9), height 1.84 (± 0.07), and twenty athletes age 19.6 years (± 0.96), weight 96.4 (± 7.7), height 1.83 (± 0.09). All subjects gave written consent to participate in the isokinetic tests.

Instruments

Isokinetic dynamometer Biodex System 3 Pro ® was used to assess the maximum muscle strength of the dynamic stabilizer knee, peak torque, total work, reciprocity between agonist / antagonist in the angular velocities 60 ° / sec and 180 degrees / sec. Isokinetic dynamometer provides a continuous resistance along the size of the movement.

Procedures

The maximum peak torque in the extensor muscles and knee flexors was measured for both legs over dinamometera isokinetic (Biodex System 3) the angular velocities, 60 and 180 ° / s. These angular velocities are used by many researchers to measure the effect of dynamic knee stabilizer (Kellis, Gerodimos, Kellis, Manou 2001; Dauty, Poriton-Josse, Rochcongar 2003; Ergun, Islegen, Taskiran 2004; Kazazović, Radja, Dervisevic, Smith 2007). The study was conducted at the Institute of Sport in School Sport and Physical Education in Sarajevo. Before the initial test subjects spent two hours getting acquainted with the instruments for testing and training protocols and have had a period of preparation that consisted of warming up exercise and stretching the muscles of the lower extremities, and 5 to 10 minute warm up on a bicycle ergometer. The power dynamic knee stabilizer was tested in a sitting position on the Biodex chair, where the participants fixed belt around her stomach and thighs to stabilize the thigh of the lower limb. Respondents were instructed to keep their hands comfortably on your chest so that the isolated muscle movements flash and knee extensors. Setting tibialnog pads, dynamometer seat height and angle were recorded in order to maintain the reliability and reproducibility during the test. Before beginning the test, the subjects do the first three submaximal repetitions to familiarize them with the direct execution of the test. During the test had verbal encouragement. During the performance of the test, athletes have performed up to five repetitions of flexion and extension at speeds of 60 ° / sec. and five repetitions at 180 degrees / sec. Each athlete received a verbal stimulation during the test.

Methods of data processing

Data collected were analyzed by testing the statistical software package SPSS 12.0 and presented in the tables. To determine the significance of the differences between the dynamic stabilizer of experimental and control groups under the influence of training was used Paired - Samples T - test. Statistical significance at level $p < 0,05$ was set for all analysis.

Results

The result of this study showed statistically significant differences ($p < 0.01$) between professional athletes and student athletes amateur when it comes to variable volume of weekly workout. Total time spent in the training cycle shows no statistically significant differences ($p > 0,05$). Values are presented in Table 1.

Table 1. Characteristics of training (average ± standard deviation)

	Amateur athletes	Professional athletes	p-Value
Total time (years)	5.11 ± 1.78	5.78 ± 1.51	>0.05
Training hours / week	14.4 ± 6.23	26.4 ± 7.36	<0.01

Results show that there are significant differences values found bilaterally and reciprocally for both legs of the values found at different angular velocities (60 ° / s and 180 ° / s). The values of maximum torque and total work were higher at low angular velocity and lower at higher angular velocity. Was not shown a strong association between the dominant and nondominant side, indicating that the maximal dynamic muscle strength of knee stabilizer for any of the tested muscle groups does not affect the dominance between the groups (Table 2).

Table 2 - Torque (Nm) and total muscle extensors and flexors of knee angular velocities 60, and 180 ° / s and the comparison between the right and left athletes and professional athletes amateur students of the Faculty of Sport and Physical Education in Sarajevo

Angular velocity	Professional athletes		Amateur athletes			Professional athletes	Amateur athletes		
		Left leg	Left leg	t	p	Right leg	Right leg	t	p
Ekstenzori 60°/s	Maksimalni moment sile	248,82 ± 53	185,60 ± 43	7,233	,000	241,03 ± 48	187,57 ± 47	5,402	,000
	Ukupni rad	1003,05 ± 182	798,23 ± 149	5,371	,000	974,45 ± 171	758,85 ± 163	4,295	,000
Ekstenzori 180°/s	Maksimalni moment sile	156,33 ± 29	128,15 ± 28	4,297	,000	154,72 ± 26	124,73 ± 230	4,919	,000
	Ukupni rad	706,97 ± 121	699,94 ± 111	4,713	,000	573,86 ± 126	581,38 ± 115	3,806	,000
Fleksori 60°/s	Maksimalni moment sile	131,77 ± 31	107,68 ± 25	3,707	,001	133,85 ± 32	117,29 ± 27	2,932	,006
	Ukupni rad	650,37 ± 143	515,66 ± 121	4,281	,000	676,39 ± 157	555,20 ± 140	3,775	,001
Fleksori 180°/s	Maksimalni moment sile	106,23 ± 27	81,63 ± 25	4,221	,000	103,83 ± 24	85,38 ± 20	6,681	,001
	Ukupni rad	494,57 ± 139	397,68 ± 111	3,271	,001	516,19 ± 143	434,26 ± 119	2,768	,008

Reciprocal relationship between muscle agonists and antagonists of dynamic stabilizing knee right and left legs of student athletes and professional athletes amateurs presented in (Table 3). Statistically significant differences were recorded for the intramuscular ratio between these two groups.

Table 3 Comparison between the ratio of reciprocal muscle groups of muscles on both legs for both the angular velocity in athletes, professional and amateur athletes.

Angular velocity	Professional athletes					Amateur athletes				
	Left leg	Right leg	r	t	p	Left leg	Right leg	r	t	p
60°/s	55,06 ± 3,0	55,98 ± 6,0	0,490	-1,211	,192	54,33 ± 4,8	55,74 ± 7,2	0,512	-,742	,782
180°/s	66,35 ± 12,9	67,02 ± 8,1	0,683	-,466	,602	63,44 ± 9,4	64,43 ± 9,1	0,643	-,893	,432

So that the data of this study set the parameters of dynamic stabilizing knee strength obtained with the isokinetic dynamometer with students from the Faculty of Sport and Physical Education in Sarajevo professional athletes and amateur athletes, and they can be used as a reference for future comparisons. In both groups, the maximum torque of dynamic knee stabilizer is of greater value than those from the normative data for the population of non-athletes received from manufacturers of instruments isokinetic (Biodex 3) used in this study. In the case of team sports (since the majority of students engaged in team sports), these results may explain the large amount of jumps that require these sports.
This study analyzes differences in variables dynamic stabilizer knee strength between two different categories of athletes (professional athletes and amateur athletes). The results of this analysis pointed out significant differences of maximum torque and total work of knee extensors and flexors, between professional athletes and amateur athletes.
Another factor that may point to significant differences in knee flexors between professional athletes and amateur athletes can be no change in the methodology of training, because professional athletes are exposed to a specific work, ie. exercises that have a direct impact on the knee flexors. In addition, many athletes, as part of this study declared that they had already once had injuries to the knee joint (professional athletes = 31.4%, and amateur athletes = 17.2%). So there is a possibility das athletes to compensate for muscle development strategy of dynamic knee stabilizers giving priority flexors.
We also found a significant difference in the maximum flexor strength at 60 degrees / s between the dominant and non-dominant leg in professional athletes, the dominant leg has higher results than the non-dominant. Such a deficit was found in some studies as a risk factor for injuries of the knee joint (Oberg, et al.,1986; Siqueira, et al., 2002).
Standard, reciprocal relationship (agonist / antagonist) was calculated as the ratio between the results of the value of the maximum torque flexors and a maximum torque knee extensor muscles. Variables reciprocal relationship (agonist / antagonist) to assess the athletes in this study represent a lower value than anticipated in both categories. Relationship agonists and antagonists indicates the superiority of the extensor muscles or deficit in flexors, which can be a muscle imbalance of dynamic stabilizing knee.
This test was performed to estimate the parameters of dynamic stabilizing knee strength (maximum torque, total work, the reciprocal relationship between muscle groups) (Oberg, et al., 1986; Zakas, et al.,1995). Therefore, this measure achieved through isokinetic evaluation can be very effective in detecting muscular-skeletal changes, important for preventive measures, the implementation of specific training programs for each athlete and to enhance sports performance (Siqueira, et al., 2002).

Discussion

There are few studies isokinetic performance that can be found in the sports literature (Kazazović, et al., 2009). However, despite the large prevalence of lower limb injuries in sport and the importance of jumps in the acquisition of high-level performance in sports, there are few studies that explore the dynamic stabilizers of the knee such populations (Tabakovic, et al., 2009).

Conclusion

Data obtained from this survey will allow obtaining the parameters with isokinetic dynamometer for dynamic knee stabilizers in students of professional athletes and amateur athletes. The results of this study show that significant differences appear between the extensor and flexor muscles of dynamic stabilizing knee, but no differences in muscle reciprocal relationship agonist and antagonist muscles in both legs, with the student athletes and professional athletes amateur. Active participation in training at the appropriate time through the training frequency (6 times a week with professional athletes) can provide an important role to assist in developing a level of maximum torque and total work. Reciprocal relationship between muscle agonists and antagonists in these muscle groups does not show the presence of differences between the two groups. However, because all have limits of experimental testing, the coaches are aware of the individual design of power for players who have asymmetry of bilateral and reciprocal muscle group dynamic knee stabilizers. In the case of asymmetry, the proper treatment of its removal should be mandatory part of the exercise of power.

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Structural analysis of the situational efficiency in the kickboxing disciplines full contact and low kick

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Abstract
Main purpose is determination of the latent dimensions of fight that are derived from the specific situational conditions, ie Kickboxing competitions, on sample of 78 examinees, participants on the Balkan's championship in kickboxing from Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Macedonia, Montenegro and Serbia, aged from 18 to 33 years, that took place in Tesanj (BiH) in 2007. On the championship, in each category participated one competitor who is the winner of the national championship at the country he represents. Given variables were esimated by three competent assessors with the special protocol. All fights were recorded with two digital cameras covering from two angles. Fourteen latent dimensions have been determined with the component factor analysis together with the 76.32% of complete explained variability.

Key words: **Structural analysis, kickboxing, full contact**

Sažetak
S ciljem utvrđivanja latentnih dimenzija borbe koji proizilaze iz specifično situacionih uslova tj. Kickboxing takmičenja, na uzorku od 78 ispitanika, učesnika Balkanskog prvenstva u Kickboxingu iz Albanije, Bosne i Hercegovine, Bugarske, Hrvatske, Makedonije, Crne Gore i Srbije, uzrasne dobi 18 do 33 godine, koje se održalo u Tešnju (BiH) 2007 godine. Na takmičenju su učestvovali u svakoj kategoriji po jedan takmičar koji je pobjednik nacionalnog prvenstva u zemlji za koju se takmiči. Zadate varijable su procjenjivala tri kompetentna procjenjivača uz poseban protokol. Sve borbe su snimljene sa dvije digitalne kamere iz dva ugla. Komponentnom faktorskom analizom je utvrđeno četrnaest latentnih dimenzija uz 76.32 % ukupno objašnjenog varijabiliteta.

Ključne riječi: **Strukturalna analiza, kik box, ful kontakt**

Introduction

Regarding the clasification of sports, taking into account their complexity, kickboxing belongs to the group of polystructural acyclic sports, which means that it is not possible to predict the solutions or they are highly compoundly structured, ie in which structure dominates the direct conflict and symbolic destruction of the opponent (Malacko 1986). These are the reasons why kickboxer has to be in dispose of comprehensive and purposeful repertoire of motoric activities, automated in training and refinement process with high efficiency and operationalisation on the competition (Kapo, 1999). Consequently, kickboxing is characterised by: continuous change of movement structure in the undetermined conditions, with variable work intensity and load duration. Kickboxing structure consists of: attack, defense, counterattack, and offensive interceptic form of fight, which depends on technical-tactical abilities of kickboxer, that are in the immediate connection with the motoric preparedness (Kapo et al., 2004). Last twenty years were marked by the expansion of researches about situational efficiency in combat sports (Kajmović et al., 2004; Kajmović 2003; Radjo, 1999; Huremović, 2002; Marić, 1996; Kuleš, 1985), while the practice showed quite a disharmony in techniques-tactics, trained until perfection that are being improved in the trainig process and the techniques used during the competition ie real fight by the same competitor. The goal of this research is to determine the specific activities in situational conditions of performing the sport's techniques-tactics, ie during the competitive activity.

Methods

Data processing methods

For the determination of the latent dimensions of success in kickboxing disciplines Full Contact and Low Kick has been used the component factor analysis.

Examinee sample

Examinee sample for this research consists of 78 top competitors in kickboxing discpilines- Full Contact and Low Kick, and only semifinalists and finalists are taken into account, 17 in Full Contact and 15 in Low Kick, all of them males from all weight categories from XIII Amateur Balkan's Championship in Kickboxing that took place in Tesanj (BiH) on 1st and 2nd of September in 2007. This competition is enlisted in the oficial championship calendar of World Kickboxing Federation-WAKO (World Association of Kickboxing Organisations).

Variables sample

Variables sample consists of 37 tehnical elements (Variables taken from: Kapo (2006) Structural analysis and model of top

K-1 fighters super heavy category. Dissertation. Faculty of Sports and Physical Education, Sarajevo), that are presented in kickboxing disciplines during 17 fights in Full Contact and 15 fights in Low Kick:

- Technical characteristics of punches and kicks in kickboxing by disciplines: Full Contact and Low Kick

Methods for situational-motoric variables assessment

Real (situational) qualities of expressed motoric and sports techniques-tactics are the most objective in the authentic conditions of performance during the competitions or by applying the situational and motoric tasks. Therefore, the observation technique is used for this research. In the observation technique, for the registration of the basic data about examinees and their activities, we used appropriate mensural instruments that needed a special protocol (observation list), whose shape and structure formulation were based on the problems, subjects and goals of research. Observation for this research has been executed with the help of the technical aids (DVD snapshots and DVD players) for the sake of higher objectivity in the process of gathering data by competent persons.

Variables for the registration of punches application during competition activity		
1	LIJDIRGL	Left direct to the head
2	LIJDIRST	Left direct to the abdomen
3	DESDIRGL	Right direct to the head
4	DESDIRST	Right direct to the abdomen
5	LIJKROGL	Left cross to the head
6	LIJKROST	Left cross to the abdomen
7	DESKROGL	Right cross to the head
8	DESKROST	Right cross to the abdomen
9	LIJAPEGL	Left uppercut to the head
10	LIJAPEST	Left uppercut to the abdomen
11	DESAPEGL	Right uppercut to the head
12	DESAPEST	Right uppercut to the abdomen
13	DESRUKOKR	Right punch from turn
Variables for the registration of kicks application during competition activity		
14	LIJNNAPR	Left kick forward
15	DESNNAPR	Right kick forward
16	LIJBNAPR	Left side kick forward
17	DESBNAPR	Right side kick forward
18	LIJKAKAT	Left kakato geri
19	DESKAKAT	Right kakato geri
20	LIJNKRUD	Left low rotary kick
21	DESNKRUD	Right low rotary kick
22	LIJUDNOGTJ	Left kick to the body
23	DESUDNOGTJ	Right kick to the body
24	LIJVKRUD	Left high rotary kick
25	DESVKRUD	Right high rotary kick
26	LIJUSGER	Left kick backward ushiro geri
27	DESUSIRG	Right kick backward ushiro geri
28	DESUSMAV	Right ushiro mavashi geri
Variables for the registration of defence techniques application during competition activity		
29	LIJBLRRU	Left hand block from punches
30	DESBLRRU	Right hand block from punches
31	LIJBLRNU	Left hand block from kicks
32	DESBLRNU	Right hand block from kicks
33	LIJBLNNU	Left foot block from kicks
34	DESBLNNU	Right foot block from kicks
35	ESKIVAZEL	Evasion to the left
36	ESKIVAZED	Evasion to the right
37	IZMICANJ	dodging

Results and Discussion

Eigenvalues are inherent values of correlation matrix. From the total number of isolated latent dimensions, 14 are significant together with **76.32%** of complete explained variability, which is relatively a large amount (Table 1). This testifies about the good conceived and implemented experiment, because otherwise the variables (as well as the latent dimensions) would be unrelated. In order of easier interpretation, the principal component is rotated into the Varimax position (Varimax normalised). This way we get the significantly clearer situation through which we can see how the variables are grouped (Table 2).

Table 1. Eigenvalues Extraction: Principal components

		% total	Cumul.	Cumul.
	Eigenval	Variance	Eigenval	%
1	5,02	13,21	5,02	13,21
2	3,04	8,00	8,06	21,21
3	2,90	7,64	10,96	28,85
4	2,62	6,88	13,58	35,74
5	2,23	5,86	15,81	41,60
6	1,98	5,22	17,79	46,82
7	1,88	4,95	19,67	51,77
8	1,67	4,40	21,34	56,17
9	1,51	3,97	22,85	60,14
10	1,48	3,88	24,33	64,02
11	1,31	3,44	25,63	67,46
12	1,20	3,17	26,84	70,63
13	1,11	2,92	27,95	73,55
14	1,05	2,77	29,00	76,32

Table 2. Varimax position of the technical variables

		Factor	Factor	Factor	Factor	Factor	Factor	Factor	Factor	Factor	Factor	Factor	Factor	Factor	Factor
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
LIJDIRGL	VAR01	**0,81**	0,16	0,03	0,24	0,02	-0,01	-0,07	0,09	0,03	0,07	-0,13	-0,01	0,24	-0,09
LIJDIRST	VAR02	0,07	-0,07	-0,02	0,25	**0,75**	0,13	-0,13	0,02	-0,07	0,09	-0,02	-0,26	-0,17	-0,03
DESDIRGL	VAR03	0,29	0,34	0,17	0,09	-0,14	-0,10	-0,15	0,01	**0,63**	0,05	-0,03	0,10	0,09	0,00
DESDIRST	VAR04	-0,05	0,11	-0,15	**0,80**	0,08	0,03	0,04	-0,01	-0,03	-0,13	0,19	0,14	-0,08	0,02
LIJKROGL	VAR05	0,32	**0,58**	0,07	-0,10	-0,03	0,02	0,02	0,11	0,04	0,46	0,10	0,17	0,33	-0,03
LIJKROST	VAR06	0,14	0,29	-0,17	-0,22	**0,53**	0,07	0,00	-0,04	-0,25	0,38	0,23	0,08	0,09	0,16
DESKROGL	VAR07	0,06	0,26	0,17	0,00	-0,27	-0,01	0,01	-0,01	0,35	0,31	0,03	0,00	**0,41**	-0,25
DESKROST	VAR08	-0,17	0,15	0,02	-0,09	**0,78**	-0,14	0,03	0,06	0,09	-0,10	0,03	-0,01	0,07	0,11
LIJAPEGL	VAR09	0,15	0,07	0,24	-0,20	-0,08	0,08	-0,03	0,21	**0,58**	0,09	0,26	0,09	0,10	-0,01
LIJAPEST	VAR10	0,12	0,00	-0,06	-0,09	0,21	-0,03	-0,03	-0,10	**0,68**	-0,10	-0,08	-0,29	0,34	0,18
DESAPEGL	VAR11	-0,14	0,12	**0,42**	-0,09	0,06	0,05	0,05	0,32	0,26	0,07	0,03	0,37	0,33	-0,19
DESAPEST	VAR12	0,03	-0,09	0,09	-0,01	-0,05	0,02	-0,04	0,05	0,16	-0,06	-0,12	-0,15	**0,86**	-0,01
DESRUKOKR	VAR13	0,09	-0,06	0,07	0,04	0,05	-0,07	0,05	-0,03	0,05	**0,84**	0,00	0,02	-0,09	0,04
LIJNNAPR	VAR14	0,08	0,00	0,11	**0,75**	-0,15	-0,01	-0,20	-0,01	0,04	0,25	-0,07	-0,29	0,12	-0,01
DESNNAPR	VAR15	-0,10	-0,01	0,16	0,10	0,00	-0,05	0,04	-0,02	-0,01	0,03	**-0,84**	-0,01	0,09	-0,03
LIJBNAPR	VAR16	-0,05	0,15	-0,11	-0,02	-0,18	0,10	**-0,85**	-0,06	0,14	0,05	0,09	-0,15	0,09	0,03
DESBNAPR	VAR17	0,02	0,14	0,00	0,05	-0,21	0,01	0,05	**0,83**	0,00	0,02	0,02	-0,35	0,10	0,03
LIJKAKAT	VAR18	0,08	-0,18	-0,08	0,11	0,25	0,00	**-0,79**	0,16	0,07	-0,12	-0,01	0,15	-0,15	0,04
DESKAKAT	VAR19	0,03	-0,05	0,02	-0,03	0,31	0,03	-0,11	**0,83**	0,09	-0,06	0,03	0,19	-0,06	-0,07
LIJNKRUD	VAR20	**0,76**	0,04	-0,01	-0,11	0,01	0,15	-0,06	-0,06	0,34	0,04	0,10	0,00	-0,08	0,14
DESNKRUD	VAR21	**0,77**	0,15	0,19	-0,04	-0,16	-0,03	0,03	0,00	0,14	-0,11	0,03	-0,30	-0,12	0,09
LIJUDNOGTJ	VAR22	-0,13	**0,50**	0,06	0,09	0,19	-0,19	-0,21	0,34	0,38	-0,01	0,05	0,16	-0,01	-0,19
DESUDNOGTJ	VAR23	0,23	0,23	0,18	**0,59**	0,11	-0,17	0,21	0,15	-0,18	-0,03	-0,18	0,06	-0,10	-0,24
LIJVKRUD	VAR24	-0,07	0,29	0,02	-0,15	0,24	-0,27	**-0,51**	-0,03	-0,35	0,01	0,03	-0,21	0,07	-0,19
DESVKRUD	VAR25	-0,09	0,03	0,00	0,18	-0,07	**-0,71**	-0,03	-0,01	-0,14	0,07	0,00	0,03	0,02	-0,48
LIJUSGER	VAR26	0,02	0,15	-0,08	0,02	0,17	0,05	-0,06	0,04	0,01	-0,05	0,07	**-0,82**	0,16	-0,01
DESUSIRG	VAR27	-0,05	-0,03	-0,10	0,03	-0,09	0,01	0,02	0,01	-0,04	-0,05	0,03	0,00	0,04	**-0,88**
DESUSMAV	VAR28	-0,07	-0,02	-0,10	-0,06	0,05	**-0,84**	0,05	-0,03	0,10	0,01	0,04	0,02	-0,01	0,15
LIJBLRRU	VAR29	0,04	0,02	**0,86**	0,03	0,01	0,11	0,09	-0,05	0,20	0,11	0,02	0,02	0,00	0,03
DESBLRRU	VAR30	0,10	-0,01	**0,92**	-0,07	-0,04	-0,01	0,10	0,07	0,04	0,06	0,01	0,00	0,01	0,06
LIJBLRNU	VAR31	-0,14	0,25	0,29	0,34	-0,15	0,05	-0,01	**0,47**	-0,19	-0,03	0,01	0,30	0,26	0,24
DESBLRNU	VAR32	0,15	0,31	**0,55**	0,20	-0,07	0,00	-0,16	0,06	-0,16	-0,16	-0,29	0,15	0,12	0,06
LIJBLNNU	VAR33	**0,65**	-0,04	0,06	0,04	0,02	0,13	0,15	-0,06	-0,11	0,33	0,16	0,23	0,05	-0,02
DESBLNNU	VAR34	0,03	0,18	-0,14	-0,17	-0,06	0,11	0,05	-0,03	-0,04	-0,04	**-0,75**	0,07	-0,04	0,06
ESKIVAZEL	VAR35	0,03	**0,67**	0,32	0,09	0,03	0,00	-0,06	0,04	0,31	-0,10	-0,02	-0,13	-0,12	0,03
ESKIVAZED	VAR36	0,02	**0,64**	-0,02	0,29	0,13	0,25	0,03	0,03	-0,02	0,06	-0,12	-0,14	-0,06	0,04
IZMICANJ	VAR37	0,37	**0,71**	-0,12	-0,02	0,02	-0,26	0,01	0,01	0,02	-0,20	-0,19	-0,14	0,12	0,03
	Expl.Var	2,88	2,82	2,67	2,19	2,12	1,64	1,92	1,96	2,22	1,72	1,80	1,72	1,88	1,45
	Prp.Totl	0,08	0,07	0,07	0,06	0,06	0,04	0,05	0,05	0,06	0,05	0,05	0,05	0,05	0,04

First factor is saturated with the variables LIJDIRGL (0.81), LIJNKRUD (0.76), DESNKRUD (0.77), LIJBLNNU (0.65) and statistically important (although not primary for this dimension) variables LIJKROGL (0.32) and IZMICANJ (0.37). According to this it is all about **left hand and foot activities, in principle those closer to the opponent**. As the left hand and the left foot are closer to the opponent, competitors fight and prepare for punches and kicks with the dominant right hand ie right foot. With this reasearch we showed the significance of the left hand and foot in kickboxing disciplines Full Contact and Low Kick, as well as the statistical significance, which is big as shown.

Second factor is saturated dominantly with the variables LIJKROGL (0.58), LIJUDNOGTJ (0.50), ESKIVAZEL (0.67), ESKIVAZED (0.64), IZMICANJ (0.71), as well as DESBLRNU (0.31), DESDIRGL (0.34) and LIJKROST (0.29). It seems that this is the factor that describes **the rotational activities in space** which goal is defensive activity with purpose of infliction the DESDIRGL (0.34) (right direct to the head). Taking all this into consideration we may say that **the body balance is the dominant part of the second factor.**

Third factor is projected mostly by the variables DESAPEGL (0.42), LIJBLRRU (0.86), DESBLRRU (0.92), DESBLRNU (0.55), and somewhat by the ESKIVAZEL (0.32). These are **the specific defense actvities** ie hand and foot blocks enhanced with an evasion for the efficiency.

Fourth factor is described with the variables: DESDIRST (0.80), LIJNNAPR (0.75), DESUDNOGTJ (0.59) and somewhat with the LIJBLRNU (0.34). This is obviously **the specific offensive activity.** This factor, from the tactical position, is used against the taller opponents, and consists mainly of strong punches and kicks to the body so that opponent would lower his guard and expose his vital head points.

Fifth factor is described with the LIJDIRST (0.75), LIJKROST (0.53), DESKROST (0.78), and significantly with the DESKAKAT (0.31). This structure presents **the offense enactment to the center body (abdomen)** with hand techniques, that are, as well as in the previous factor, used against taller opponents, but unlike the previous factor it is about offense enactment to the abdomen region. Complex technical element DESKAKAT (0.31) confirms the fact that the participants and competitors were referent in the technical-tactical sense, meaning that they are probably the competitors coming from the Tae Kwon Do sport where the foot techniques are dominant.

Sixth factor is defined by the variables DESVKRUD (-0.71), DESUSMAV (-0.84) that clearly present **the offense activities by big trajectories with lower, right extremities**. From biomechanical point of view this structure is highly effective because it has high velocity of kicks at the expense of circumferential velocity, but it is extremely hard to perform and that is why it is in the negative relation. It is highly possible, from the tactical point of view, if the DESUSMAV (-0.84) is used for feinting the opponent or breaking his guard after which should be continued with the DESVKRUD (-0.71).

Seventh factor is saturated mostly with the variables LIJBNAPR (-0.85), LIJKAKAT (-0.79), LIJVKRUD (-0.51) which present **the offense activities with the left extremities** that are likely developing the struggle and are done in the combinations.

Eight factor is saturated with the variables DESBNAPR (0.83), DESKAKAT (0.83), LIJBLRNU (0.47), and significantly with the DESAPEGL (0.32) and LIJUDNOGTJ (0.34). This set describes the specific combination of activities, probably blocks, punches and kicks. These are mostly the situations where you must receive the kick and block in order to be able to give one aferwards. **This is probably the agressive offense tactic.**

Ninth factor is described with the variables DESDIRGL (0.63), LIJAPEGL (0.58), LIJAPEST (0.68), and even to a lesser extent, but significantly with the variables DESKROGL (0.35), LIJNKRUD (0.34), LIJUDNOGTJ (0.38), LIJVKRUD (-0.35) and ESKIVAZEL (0.31). These are wide arched kick activities used against the closed possitions of the opponent as well as against shorter fighters.

Tenth factor is defined by the dominant variable DESRUKOKR (0.84), and secondary by the variables LIJKROGL (0.46), LIJKROST (0.38), DESKROGL (0.31) and LIJBLNNU (0.33). This dimension in principle presents the rotary kicks with lower range used in melee.

Eleventh factor is described with the variables DESNNAPR (-0.84) and DESBLNNU (-0.75), that clearly present **the specific combination of defense and attack from the right side of the body.** Movement structure of both kicks and punches enables defense and offense enactment – kick and punch are preceded by the block.

Twelfth factor is defined by the variables LIJUSGER (-0.82), and lesser by the variables DESAPEGL (0.37) and DESBNAPR (-0.35). It seems to present **the specific offense enactment with the goal of provoking the opponent, breaking his guard** or enabling the counterattack.

Thirteenth factor is saturated with the variables DESAPEST (0.86) and DESKROGL (0.41), and lesser with the LIJKROGL (0.33), LIJAPEST (0.34) and DESAPEGL (0.33). The best description of this factor could be sumsumed under **the specific attack with the right hand** but with the logical support from the left hand – specific actions that are manifested by the boxing elements and obviously applied in kicks and punches series.

Fourteenth factor is saturated with the variables DESUSIRG (-0.88) and lesser but significantly with the variable DESVKRUD (-0.48). It seems to present **the specific attack with the right foot** with the potential opening of the opponent.

Component factor analysis picturesquely shows how the real fight imposes special actions that had not been learned sistematically in the training process, and describes in details the structure of the competitive fight. All gathered results show the necessity of implementing further researches in the competitive kickboxing discipline in order to improve the trainig process.

Conclusion

Varimax position of the technical variables presents 14 ways of enactment and probably even the 14 combinations, maybe even those which had not been learned in the training process as school examples of the technical-tactical enactment but are the product of the specific situational conditions. From all this we can conclude that they need to be learned in the training process, because, by the results of this research, they gave the great importance and they structured the hierarchy of application in the situational efficiency. This could be a quality data source for trainers to construct the programs and preparations for the situational efficiency.

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The influence of basic motor abilities of the situation motor skills football players age 13-15 year

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Original scientific paper

Abstract
The aim is to determine the impact of basic motor abilities in motor skills of situational players ages 13-15. Age, which produces large changes in the body and can cause various phenomena. The sample of respondents in this study were children whose age distribution players ages 14, 13 ± 0.93 years. All respondents were members of a youth academy FC Krajina Cazin and members of the cadet selection. From this and take a sample of 120 subjects. Subjects were taken from the school football FC Krajina - Cazin, FC Jedinstvo - Bihać and FC Krajišnik - Velika Kladuša. For the assessment of basic motor skills applied to 17 tests the following skills: explosive power, speed, coordination, repetitive strength, flexibility and balance. The tests are standardized and published in the publications (Gredelj i sur.1975) of situational variables and motor skills as criteria (11). The method of processing data that was used In the paper scientific research paper regeresiona analysis, and based on whose statistics can be given to the conclusion that the situational-motoric abilities in a common motor base that is defined primarily coordination, explosive power, motion and its frequency, precision and equilibrium or balance on the basis of which we can see that each situational ability, but accuracy can significantly predict the size of which indicate multiple connections, the reliability of regression coefficients of risk factors and the importance of F-tests.

Key words: **basic motor skills, situation motor skills, influence, football players**

Sažetak
Cilj rada je utvrditi uticaj bazično motoričkih sposobnosti na situaciono motoričke sposobnosti nogometaša uzrasta 13-15 god. Dob koja proizvodi velike promjene u organizmu i koji mogu izazvati i različite fenomene. Uzorak ispitanika u ovom istraživanju su djeca nogometaši čija je uzrasna dob 14, 13 ±0,93 godina. Svi ispitanici su pripadnici omladinske škole FK Krajina Cazin i članovi kadetskih selekcija. Iz toga je i uzet uzorak od 120 ispitanika. Ispitanici su uzeti iz škole nogometa FK Krajina – Cazin, NK Jedinstvo – Bihać i NK Krajišnik – Velika Kladuša. Za procjenu bazično motoričkih sposobnosti primjenjeno je 17 testova slijedečih sposobnosti :eksplozivna snaga, brzina, koordinacija, repetativna snaga, fleksibilnost i ravnoteža. Testovi su standardizirani i objavljeni u publikacijama (Gredelj i sur.1975) i varijable situaciono motoričkih sposobnosti kao kriteriji(11). Metoda obrade podataka koja je korištena uovom naučno istraživačkom rau je regeresiona analiza, a osnovu čijih statističkih pokazatelja može se dati i zaključak da situaciono-motoričke sposobnosti imaju zajedničku motoričku osnovu koja je definisana prije svega koordinacijom, eksplozivnom snagom, pokretom i njegovom frekvencijom, preciznošću i ravnotežom ili balansom na osnovu ćega možemo uočiti da svaku situacionu sposobnost, osim preciznosti možemo značajno predvidjeti na što nam ukazuju veličine multipli veza, koeficijenti pouzdanosti regresijskih faktora i podatak o značaju F-testova.

Ključne riječi: **bazično motoričke sposobnosti, situaciono motoričke sposobnosti, uticaj, nogometaši**

Introduction

In the constant quest for knowledge and success in the football game is a series of factors (Boženko, 1978.) to be provided. The first factor to the success of the physical characteristics and functional abilities (Elsner, B. (1997). Individuals ability to perform exercise is the foundation, and the movement effect. Therefore, what athletes need is the ability to control this goal to come to a successful effect. Motor skills that are the basis of objective, are largely genetic or inherited abilities. (Jeleskovic, 2008). All this is true provided that the health of athletes who possess the capacity to fulfill the demands of modern football. In modern football all players activities in the game and outside can be estimated on the basis of runing distances at different pace and based on the number of performed technical and tactical elements (Verheijen, R. 1997). Football is one of the most widespread, popular and profitable sports industry today, (Bangsbo, Norregaard, thorou, 1991),. reasons as to why there are many. However, one reason why football is so popular is that the player should have proficiency in all areas (technical, tactical, biomechanical, physiological and psychological), but must have a reasonable level of competence in all areas so that his performance was in the best level. Modern training should go to a specific purpose (Michels, R. 2001) (for each training need improvement of technical and tactical resources), and within that, to implement activities that will focus on the development of at least one motor skills. This tells us that our planning and programming must be meaningful, that we should know what is in the equation specification influence of certain motor skills as other parameters of performance in football, are appropriate in relation to other abilities. (Bunce, Psotta, 2001) This opens the possibility to determine how much attention should be paid, in quantitative and qualitative level, individual abilities, and that the more primary need to develop at this age, so that performance was at the widest level in the continued construction of young players.The subject of this scientific work is an anthropological satatus players with special emphasis on basic motor skills and motor skills of situational players ages 13-15., Ie, the problem of this paper is the impact of basic motor skills in situational motor skills. A large number of researchers addressed this issue and proved a lot in this area, but what might

be interesting in this paper is a sample of respondents and characteristics of age, can still offer new and interesting facts. Age, which produces large changes in the body and can cause various phenomena. The aim is to determine the impact of basic motor abilities in motor skills of situational players ages 13-15. and based on the results to try to define priorities in working with this age category.

Methods

The sample of respondents in this study were children whose age distribution players ages 14, 13 ± 0.93 years. All respondents were members of a youth academy FC Krajina Cazin and members of the cadet selection. From this and take a sample of 120 subjects. Subjects were taken from the school football FC Krajina - Cazin, FC Jedinstvo - Bihać and FC Krajišnik - Velika Kladuša. The sample of variables of this study are the variables of basic motor skills (Mikić, B.1999) as predictors (17) and situational variables of motor abilities as a criteria (11). Basic motor skills: Variables to estimate the speed, MFE20V - run the 20 meters - high start, MBFTAN - tapping foot, MBFTAZ - tapping your foot on the wall; Variables for assessment of explosive strength, MFESDM - long jump with place, MFESVM - high jump with place, MFETRO - triple the place; Variables to assess the repetionary strength, MRESKL - push-ups (withdrawal of troops), MRCDTŠ - withdrawal of troops from lying; Variables to assess the balance, MBAU1O - standing on one leg on the bench for longitudinal balance, MBAU2O - standing on two legs on the bench for longitudinal balance with open eyes, MBAP2Z - cross standing on a low bench with two legs eyes closed; Variables to assess the coordination, MKLSNL - slalom leg with two balls, MAGKUS - steps to the side, MKTOZ - agility in the air; Variables to assess the flexibility, MFLPRK – bend on the bench, MFLPRR – bend with legs widely spread, MFLBOS – side split. Situational motor skills: The variables to estimate the speed of running the ball, SNBUPP - running speed with changes in direction at a right angle, SNBV20 - of keeping the ball speed at 20 meters from the start in place; Variables to assess the playing ball, SNKOST - refusal of the wall horizontally about 20 seconds, SNKSLA - running speed in slalom; Variables to assess the accuracy of shooting the ball, SNPPNV - precision foot straightforward - target vertical, SNPEGH - precision head (elevation) - target horizontal; Variables to assess the impact forces, SNESNO - power kicking, SNESGL - power rubble head; Variables to estimate the speed curve runs, SNBTPO - speed run by a semi-circle, SNBTPP - run with the change of direction at a right angle, SNBTSL - slalom run. Time and measurement was in accordance with football cells that had been placed in a circle. Was taken into the care of the rest that was adequate and long enough not to distort the work for the next test. Testing is always carried out the same group of timekeepers, experts-professor of sport and physical education, and the job of management and oversight of the main role is carried out by the authors of the paper. Dates of testing were 1030h to 1530h during the day.

Data processing methods

Certain predictive values were evaluated by regression analysis (Dizdar, 2006) The data were processed by SPSS 13.0. Level of significance was set at $p < 0,05$.

Results

Table 1. Regression analysis of basic motor skills and motor skills of situational

$RO = 0.73,\ RO^2 = 0.54,\ F_{(13, 100)} = 6.98,\ p < 0.00,$ Std.Error of estimate: 0.69								
		Part-R	β	βe	B	Be	t(101)	p-level
	Intercpt				- 5,27	3,41	- 1,53	0,12
1.	MFESDM	- 0,06	- 0,07	0,10	0,00	0,02	- 0,71	0,46
2.	MFETRO	0,01	0,01	0,11	0,00	0,00	0,08	0,91
3.	MFESVM	0,02	0,02	0,07	0,00	0,01	0,20	0,83
4.	MFE20V	0,34	0,36	0,10	1,40	0,36	3,74	0,00
5.	MBFTAZ	- 0,08	- 0,06	0,08	- 0,04	0,05	- 0,85	0,38
6.	MBFTAN	- 0,04	- 0,04	0,08	- 0,03	0,04	- 0,43	0,65
7.	MKLSNL	0,23	0,22	0,09	0,08	0,04	2,29	0,03
8.	MAGKUS	0,01	0,01	0,08	0,01	0,13	0,06	0,94
9.	MKTOZ	0,13	0,11	0,09	0,25	0,19	1,29	0,19
10.	MRESKL	- 0,17	- 0,17	0,10	- 0,01	0,01	- 1,70	0,08
11.	MRCDTŠ	- 0,04	- 0,04	0,11	0,00	0,01	- 0,37	0,71
12.	MFLPRK	0,10	0,08	0,08	0,02	0,02	0,94	0,33
13.	MFLPRR	- 0,27	- 0,29	0,11	- 0,05	0,01	- 2,84	0,01
14.	MFLBOS	0,02	0,02	0,08	0,00	0,01	0,22	0,81
15.	MBAU2O	0,01	0,01	0,07	0,00	0,04	0,06	0,94
16.	MBAP2Z	0,04	0,03	0,07	0,04	0,08	0,40	0,67
17.	MBAU1O	0,03	0,02	0,07	0,02	0,07	0,26	0,78

In this study, all predictor variables to assess motor skills include the manifest variables for the assessment of motor skills: speed, coordination, explosive and repetative strength, flexibility and balance as the last. The first regression analysis predictor system which consists of basic-basic motor skills, which examines the most important skills in the best way to define the first criterion variable.

When assessing the table number 1 we see that a complete system of predictor variables are statistically significant and very significant impact on the criterion variable. Multiple correlation coefficient RO = 0.73.

Multiple correlation tests were performed F test. The error is at the 0.01 level. The whole prediction system has a very significant multiple correlation coefficient with the first criteria variable consisting of situational-motor skills. When analyzing the individual coefficients of multiple correlation were the highest of the following variables: Variable MFE20V - running at 20 meters from the start of high (0.36). MKLSNL variable - slalom leg with two balls (0.22). MFLPRR variable - bend with legs widely spread (- 0 , 29).

Multiple correlation, which is RO = 0.73, and quite high in predictor set of variables and criterion gives us the full right to say, situational-motoric abilities of football players are basically floor-motor skills, or training in the subjects of this age.

Discussion

Although football is a team sport, every football player operates separately and each has its specifics. In order to reach results, and that we have found of which depends on its success we must determine what are the specifics that would lead him to achieve the desired, and it is to achieve an optimal level that would enable them to excellence. Situational motor skills such as precision shooting the ball, ball handling, speed players with guiding a ball, power blows to the head and the ball and running speed with rapid changes of direction with the ball and without the basic facilities at the football game. On the basis of parameters that we specified and that reprezant results of this scientific work is the fact that the football game, or that the performance of the treated sample depends on the coordination and coordination skills. Based on the preceding considerations can be given to the conclusion that the situational-motoric abilities in a common motor base that is defined primarily coordination, explosive power, motion and its frequency, precision and balance, or balance. In other words, the football players who have better coordination, explosive power, have a better platform for performance at higher levels and achieve better results. For success football player is not crucial only basic motor skills, but also a host of other skills such as, technical characteristics, tactical knowledge, skills, etc. that are the condition for the success of players. These partial data only proves the complexity of the road to success in football and the need for further research and improvements in the training process, training in football. A greater variety of motor variables to be applied in future research, and their correlation with various indicators of situational efficiency in terms of football games in order to get the results arising from real situations that are interlaced during one match. Comparing the results with results of other researchers (Gabrijelić, Mekic, Talovic (2001) in his works in the best way to demonstrate the very substantial and significant multiple correlation coefficients of the latent dimensions of speed, coordination and flexibility. The population was also composed of children of various ages. Multiple correlation by many authors was satisfactory because they obtained a rather large coefficients for example.: multiple correlation explosive power with the criteria variable.

Previous research conducted mainly in the area of tests and in latent space. Predictor systems that are composed in part of the situational-motor variables also showed significant multiple correlation coefficient of explosive energy with criterion variables situational-motor skills.

The authors (Molnar, Popovic & Smajić, 2007), or in their works can be found information about the connection between situational-motor abilities of football players with physical disabilities. There are only a few analysis based on the correction ratio. In these analysis has shown that the efficiency in the performance of situational-motor tasks depends on the functioning mechanisms of the highest. These are situational-motor skills are defined as special agility, coordination legs, football motor information and special football precision (Mikic, Talovic & Radjo, 2003). All of them are dependent on general motor factors.

Conclusion

The overall success of this research in the football game of the respondents are most dependent on coordination and coordination abilities. Based on the preceding considerations can be given to the conclusion that the situational-motoric abilities in a common motor base that is defined primarily coordination, explosive power, motion and its frequency, precision and balance, or balance. Therefore, we can see that each situational ability except precision, but accuracy can significantly predict which indicate the size of multiple connections, the reliability of regression coefficients of risk factors and significance of F-tests.

What is characteristic of this and similar studies, in terms of implementation, application of the results obtained is the fact that coaches, sports officials who work with this age and younger, must know what are the priorities in their work, or what should pay more attention “Any seed is received only when the time during the year”, so that each child age related specificity of genetic influences on individual basic motor skills, that can be crucial to the success of the individual.

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Postural differences between girls who practice and who do not practice rhythmic gymnastics

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Original scientific paper

Abstract
The aim of this study was to detect differences in some postural characteristics that occur
under the influence outside of school physical education among the girls involved in rhythmic gymnastics, and those who are not involved in extracurricular sports activities, and are in early adolescence at the start of puberty. Sample for this study were 100 female students, third and fourth graders, who were divided into two groups. The first group included the students who are actively engaged in rhythmic gymnastics for at least two years (N = 50), and the second group consisted of the students who do not practice any sports (N = 50). The assessment of postural characteristics was analyzed based on a modified method of body posture assessment according to Wolanjski N. (1975). Applicable variables are as follows: the head posture (ADTDG), the shoulder posture (ADTDR), the posture of shoulder blades (ADTDL), the shape of the thorax (ADTGK), vertebral column (ADTKS), the abdomen posture (ADTDS), the shape of the legs (ADTON), feet in line (ADTSS), the overall assessment of body posture - a method per Wolanjski (ADTMW). Also, the height of the body (AVIS) and the body weight (ATEZ) of the students were measured, therefore the body size index was determined (INDEX). Discriminative analysis and T-test results show statistically significant differences in postural characteristics between girls who practice rhythmic gymnastics and schoolgirls who do not. These differences are in favor of gymnasts, as they have better body posture and lower levels of deformities in relation to the schoolgirls of the same age who are not involved in regular training.

Key words: **posture, rhythmic gymnastics, schoolgirls**

Sažetak
Cilj ovog rada bio je otkriti razlike u nekim posturalnim karakteristikama koje nastaju pod utjecajem izvanškolskog tjelesnog vježbanja između djevojčica koje se bave ritmičkom gimnastikom i onih koje se ne bave izvanškolskim sportskim aktivnostima, a nalaze se u ranoj adolescentskoj dobi na samom početku puberteta. Uzorka ispitanika za potrebe ovog istraživanja činilo je 100 učenica 3. i 4. razreda osnovne škole podjeljenih u dvije subskupine. Prvu skupinu su činle učenice koje se aktivno bave ritmičkom gimnastikom najmanje dvije godine (N=50), a drugu grupu učenice koje se ne bave aktivno sportom (N=50). Procjena posturalnih karakteristika izvršena je na osnovu modifikovane metode procjene držanja tijela. Primjenjene su slijedeće varijable: držanje glave (ADTDG), držanje ramena (ADTDR), držanje lopatica (ADTDL), oblik grudnog koša (ADTGK), kičmeni stub (ADTKS), držanje trbuha (ADTDS), oblik nogu (ADTON), svod stopala (ADTSS), ukupna procjena držanja tijela - metoda prema Wolanjski (ADTMW). Također je izmjerena visina tijela (AVIS), težina tijela (ATEZ) ispitanika, te je određen indeks tjelesne građe (INDEX). Diskriminativnom analizom i T- testom dobijene su statistički značajne razlike u posturalnim karakteristikama između grupe ritmičarki i školarki. Te razlike idu u korist ritmičarki, odnosno one imaju bolje držanje tijela i manji nivo deformiteta u odnosu na učenice istog uzrasta koje nisu uključene u redovni trenažni proces.

Ključne riječi: **posture, ritmička gimnastika, djevojčice**

Introduction

The child is not a small man and is significantly different in the anthropological and biological characteristics compared to an adult. One of the most important goals of kinesiology is to allow proper growth and development of children through appropriate kinesiology treatments. The time period in a child's life when it starts school to adolescence (6-10 yr.) is known as a period of middle childhood. Basic changes and leading activities of children in this age are related to a new motivation – the start of school and learning through new, enhanced, expanded and deepened understanding that brings greater responsibility for a child towards school and other obligations, as well as the joy of achievement. With starting school, the movement of a child significantly decreases. How important and significant is regular physical exercise at this early period of growth and development of the young body and whether it is justified by the need to increase the hours of physical exercise through the introduction of extra-curricular activities that will positively affect child's growth and development in this period? These are some of the important issues that deserve special attention of experts as well as scientific evidence.

Children this age very easily and quickly, easier and quicker than ever before or later in life, solve new motor tasks, regardless of what it specifically relates to, quickly improve their motor skills and perfectly adapt them to different conditions. The working capacity of the child in this period can be maintained for a relatively long time, longer than is usually assumed, provided that the physical exercise is in proportion to age and individual abilities of the child. Hardman (2008) as well as many other authors, emphasizes that this age is the most important- a crucial period in relations to the future of sports activities and that the missed exercise time can never be compensated.

At this period of growth and development, with their own specific personalities of mental and physical life, girls have desires towards the beauty and harmony. They are attracted by music and movement in rhythm. A rhythmic gymnastics develops the sense and the ability to consciously experience and express the beauty, and furthermore has a very positive influence on all physiological functions of the body (Ivančević, 1976). It is a complex educational process primarily directed towards health, beauty and ef-

fectiveness, which includes both straightening the body and body care, cultivation of movement with the development of music talent and creative imagination. All this enriches and improves personality, provides joy, pleasure and satisfaction. By doing a variety of physical exercises, the entire apparatus for movement gets trained and develops the meaning and sense of posture, brings the ability to understand and experience the beauty through the movement and music (Hume et al., 1993). The main goal of this study was to identify the differences in postural characteristics that occur under the influence of physical exercise outside of school between the girls in early adolescence at the start of puberty.

Methods

Sample of the examined

Sample for this study were 100 schoolgirls, third and fourth graders, who were divided into two groups. The first group was built of the students who are actively engaged in rhythmic gymnastics for at least two years (N = 50). A second group included the students who do not practice any sports (N = 50). Thus, the sample of respondents for this study case consists of girls aged eight to ten years. This age is the very beginning or the period just before the rapid growth and development of the typical adolescent age, being that the beginning and duration of puberty varies individually.

Sample of the variables

The assessments of postural characteristics were analyzed based on a modified method of assessing posture according to Wolanjski (1975). Applicable variables are as follows: the head posture (ADTDG), the shoulder posture (ADTDR), the posture of shoulder blades (ADTDL), shape of the thorax (ADTGK), vertebral column (ADTKS), the abdomen posture (ADTDS), the shape of the legs (ADTON), feet in line (ADTSS), the overall assessment of body posture - a method per Wolanjski (ADTM). Also, the height of the body (AVIS) and the body weight (ATEZ) of the students were measured, therefore the body size index was determined (INDEX).

Data analyzes methods

In all applied variables, the results of respondents were analyzed with standard descriptive procedures for single and multiple levels. At the single level, the differences were tested for each variable by using T-test for independent samples. On the multiple levels, the discriminative analysis was used in order to determine the difference between the two groups.

Results and Discussion

The analysis of differences between the group of rhythmic gymnasts' girls and the group of schoolgirls underwent T-test for independent samples. By looking at Table 1, it is clear that there are significant differences between most variables, at the level of significance
p = 0.00. Variables that do not show a statistically significant difference between these two groups were body weight, the head posture and the shape of the chest.

The body height is a basic parameter of the level and pace of the body size development. In this study, the girls who are engaged in rhythmic gymnastics are on an average 4 cm taller than the girls who are not involved in extracurricular activities; these differences are at the level of statistical significance (p = 0.04). It is clear that the growth in height in this period of development is not consistent. In the past 10 years in rhythmic gymnastics, there was a change in the morphological type of top ranked gymnasts. The top ranked gymnasts on the world stage are on an average 170 cm high, slender, with long arms and spindle-shaped muscle, with lower measures of the transverse dimensions and a small percentage of adipose tissue (Aleksander, 1991). However, in this research, the difference in height between gymnasts and schoolgirls can not be attributed to selection in rhythmic gymnastics, because the tested girls who are engaged in rhythmic gymnastics are the beginners and not selected competitors. Body weight is also a basic parameter of the level and pace of the body size development, but it belongs to the so-called dynamic-changing dimension, because it is susceptible to environmental influences and can demonstrate large variations, even during the day. In the variables for assessing body weight (ATEZ), there are no statistically significant differences between these two groups of girls.

However, girls differ in body mass index (INDEX), which is used to estimate fat ratio and lean body mass. This tells us that gymnasts in relation to the schoolgirls have a lower percentage of body fat. We may conclude that engaging in rhythmic gymnastics causes positive changes in the structure and composition of the body. Special attention should be paid to the statistically significant differences in the variables to evaluate spinal posture (ADTKS). Rhythmic gymnastics training increases the mobility of the spinal column, but through the exercises, it strengthens back muscles which have a positive effect on the spinal column posture (Bogić, 1995). The skeleton, particularly spine and feet, requires attention during schooling: straightening of the spine, gentle girls' muscles, improper position when sitting at the school desk, can easily lead to early change (deformations) that must be corrected with exercises. Flexibility of the spine hides two opposites. The first characteristic is positive, because the flexibility itself allows the most varied movements. And our efforts should go into that phase when ossification is not yet complete, but we also should not forget to maintain proper strength and to strengthen active and passive stabilizers of the spine (muscles, joints and ligaments).

From the set of variables to assess the body posture, variable for assessing head posture (ADTGK) and variable for assessing the chest shape (ADTGK) came into view, which showed no statistically significant difference between these two groups of girls. For schoolgirls, the least endangered status is the chest and head posture. The past body posture researches of preschool children also show that the chest posture is the least vulnerable (Hadžikadunić, 2005).

In order to determine the global quantitative differences found between the two groups, the discriminative analysis was applied. The discriminative analysis is a method that considers the size of some quantitative variables and their mutual relations. Discriminative model is a special type of a factor analysis in which the isolated orthogonal vectors in the space of manifest variables are best placed to separate the groups in the space of variables (Rađo and Wolf 2002).

Var.	Mean G1:1	Mean G2:2	t-value	df	p	Valid N G1:1	Valid N G2:2	Std.Dev. G1:1	Std.Dev. G2:2	F-ratio variancs	p variancs
ATEZ	39.06	38.94	0.06	98	0.94	50	50	9.93	8.83	1.26	0.42
AVIS	1.46	1.42	2.01	98	**0.04**	50	50	0.12	0.07	2.69	0.00
INDEX	18.05	19.15	-1.93	98	**0.05**	50	50	2.49	3.17	1.63	0.09
ADTDG	0.02	0.03	-0.38	98	0.70	50	50	0.10	0.16	2.51	0.00
ADTDR	0	0.27	-4.10	98	**0.00**	50	50	0.00	0.47	0.00	1.00
ADTDL	0.62	0.29	3.67	98	**0.00**	50	50	0.46	0.44	1.08	0.80
ADTDS	0.17	0.71	-4.81	98	**0.00**	50	50	0.30	0.74	6.17	0.00
ADTGK	0.20	0.23	-0.33	98	0.74	50	50	0.39	0.51	1.68	0.07
ADTKS	0.08	0.3	-2.59	98	**0.01**	50	50	0.27	0.53	3.80	0.00
ADTON	0.08	0.3	-3.33	98	**0.00**	50	50	0.19	0.43	5.36	0.00
ADTSS	0.3	0.88	-5.45	98	**0.00**	50	50	0.46	0.59	1.65	0.08
ADTMN	1.47	3.01	-5.22	98	**0.00**	50	50	0.94	1.86	3.93	0.00

Table 1. T-test differences

The criterion for the strength of applied discriminative variables was so-called Wilks' Lambda. In the analysis of the results in Table 2, it is shown that the discriminative function was obtained, which significantly differs gymnasts from schoolgirls on the basis of postural characteristics, indicating a high discriminative value that is confirmed by the canonical correlation coefficient of .678 (Table 2). It is clear that the rhythmic gymnastics program for girls 8-10 years of age has its positive effects in terms of proper posture, growth and development of the young body.

Reviewing the results in Table 3, it is shown that the largest contributions to discriminative function give the following variables: ATEZ-body weight, AVIS- body height, and INDEX-body mass index. Morphological status was described by three basic anthropometric factors: longitudinal dimension, mass and volume of the body and subcutaneous adipose tissue.

Based on the results in Table 4 (The structure of the discriminative functions), it can be seen that the highest correlation with discriminative function or variable that differentiates the maximum value of the results between the two groups (gymnasts and schoolgirls) has a test for assessing arch of the foot (**ADTSS**). Deformities of the feet have a decisive influence on the functional state of the locomotors apparatus especially on the lower extremities. In children this age, the foot deformities are very common and for most of these phenomena, the reason is insufficient attention devoted to the format and nurturing the feet from early childhood. The foot bears the heaviest load in the static and the dynamic function of the locomotors apparatus. Flatfoot deformity is very common and is manifested by the loss of normal, physiological arches of the feet. It can be congenital or acquired. From the acquired causes, the most common ones are the reduced amount of the foot muscles use, the weak muscles of the legs, and the excessive obesity lifestyle. Through rhythmic gymnastics training, a special attention is devoted to feet exercises, so it is quite logical that the biggest difference between gymnasts and schoolgirls appeared at the variable for assessing the arch of the foot.

The following variables are: the entire posture (**ADTMNW**), the abdomen posture (**ADTDS**) and the blades posture (**ADTDL**). In the analysis of the distance group of centroids (Table 5), it can be seen that the results of the gymnasts are on the negative side of the discriminative function (in the assessment of body posture, lower score indicates better body posture), and the results of schoolgirls are on the positive side of the discriminative function.

Table 2. Isolated discriminative function

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	,852	100,0	100,0	,678

Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	,540	56,988	11	,000

Table 3. Standardized discriminative coefficient

Variable	Function 1
ATEZ	-2,556
AVIS	1,185
INDEX	1,522
ADTDG	-,001
ADTDR	,483
ADTDL	-,398
ADTDS	,307
ADTGK	-,300
ADTKS	,189
ADTON	,182
ADTSS	,461
ATEZ	-2,556

Table 4. Structure of discriminative function

Variable	Function 1
ADTSS	,596
ADTMN	,572
ADTDS	,527
ADTDR	,449
ADTDL	-,402
ADTON	,365
ADTKS	,283
AVIS	-,221
INDEX	,211
ADTDG	,042
ADTGK	,036
ATEZ	-,007

Table 5. Centroid Group

Group	Function 1
1,00	-,914
2,00	,914

Conclusion

Proper body posture is the basic prerequisite of good health, normal growth and development of a person in general, so it is very important to apply the proper body posture at an early age (Hadžikadunić & Balta, 2000). Deformities that occurr in childhood can have enormous consequences, which can cause permanent damage to the body. During the sensitive period of growth and development of the young body, it is of great importance to be involved in physical activity that will affect the proper growth and development. Poor body posture prevails among a large number of people, children, especially school youth. Therefore it is necessary to conduct decisive measures against poor body posture from an early age. Long-term static stress, mainly in a sitting position, in the development of the young body, has a tendency to create an imbalance between the physiological strength, as well as the function of certain body muscles. This indicates to be the first step in the formation of poor body posture.

It is necessary to act on the active part of the locomotors apparatus to be properly selected, based on the appropriate age and regular exercises. It is crucial for the development of movement to go along with the emotional development in children's lives. Rhythmic gymnastics best suits psycho-physical development of young female body. This study demonstrated, that rhythmic gymnastics program for girls 8-10 years of age, has positive effects on proper body posture, growth and development of the young body. With all this, the fact is that the health of each child contributes to the society advancement as a whole. The need to increase the number of physical and health education classes from the very beginning of schooling and the introduction of extra-curricular physical activities is justified.

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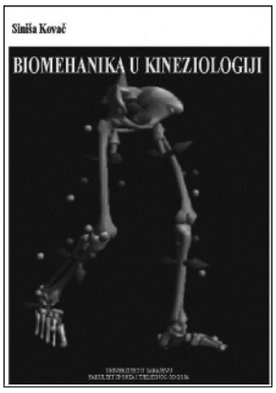

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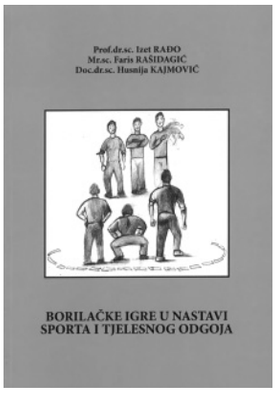

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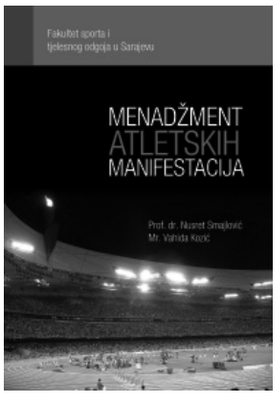

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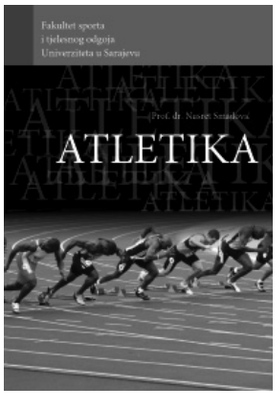

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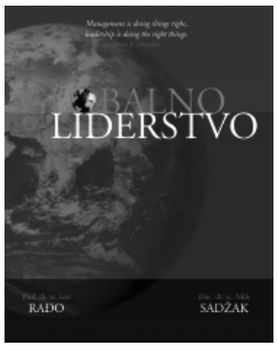

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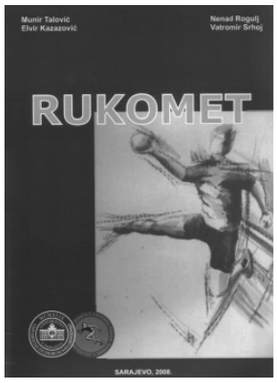

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