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## PRE-COMPETITIVE ANXIETY IN SOCCER PLAYERS

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### **Abstract**

72 senior soccer players filled out a CSAI-2 questionnaire for assessing somatic and cognitive anxiety level and direction, as well as self-confidence, immediately before the match. The first group was made up of soccer players (N=36) who played a first league match, and the second group was made up of soccer players (N=36) who played a second league match. Variance analysis did not show any statistically important differences in the somatic anxiety component between soccer players of different levels of competition. First league soccer players had a statistically higher level of cognitive anxiety, while second league soccer players had a significantly higher level of self-confidence. The results of direction of somatic and cognitive anxiety, as well as self-confidence, significantly differ between the soccer players of different levels of competition. It is obvious that the uncertainty of a match result influences the rise of somatic and cognitive anxiety level, although it is not necessarily reflected negatively on the players' success and concentration. Further research should follow state anxiety in more than one instance, i.e., matches during the whole competition season.

**Keywords:** CSAI-2, self-confidence, somatic and cognitive anxiety.

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### **INTRODUCTION**

Anxiety is one of the most common components influencing sports performance, with different intensity individual levels of experience. In general psychology it designates those anxious psychomotor (bodily) states in which a person feels as if he/she is going to „explode“.

Anxiety (fear, worry) is a painful state of helplessness and insecurity. It is a state of tension, worry, expectance of some terrible event. An anxious person is not aware of the source of uncomfortable state and tension. An anxious reaction is an attempt of liberating anxiety and tension through body. This is the reason why anxiety is accompanied by symptoms of voluntary muscles overload, higher activity of the autonomic nervous system, intensified manifestation of certain organs or certain body systems.

Normal anxiety has a motivational and adaptive function, stimulates deliberation, planning, caution, and prevents repeated exposures to uncomfortable or painful situations. One can control this kind of anxiety.

Pathological anxiety occurs outside dangerous or threatening situations, lasts long after the occurrence of stress or danger, interferes with a person's function and can bizarrely change one's way of thinking and acting. One cannot control pathological anxiety.

The division of anxiety into two components is commonly accepted: cognitive anxiety (worry, nervousness) and somatic anxiety (e.g. the degree of physical activation perception).

Emotional states, besides through emotions, are expressed through cognitive, behavioural and physiological components. Anxiety is characterized by simultaneous presence of symptoms in all areas, and their mutual interaction.

The cognitive component of anxiety includes thoughts, beliefs, interpretations and attributions related to a certain situation and its anticipated results. The behavioural component includes motor reactions which usually include action initiation, avoidance or escape. The physiological component includes a person's bodily reactions. The somatic symptoms of anxiety can be divided

into several groups: cardiovascular (palpitations, tachycardia, high blood pressure, redness or paleness), respiratory (the feeling of suffocation and need for air, shortness of breath), skin changes (red blots, skin temperature changes, paresthesia), muscularity (tremor, muscle tension, muscle cramps), gastrointestinal (diarrhoea, sickness, abdominal pain) and other symptoms (headache, chest pain, insomnia, nightmares, vertigo, dizziness, frequent urination, fatigue).

From a sport-related point of view, there is no athlete who has never felt anxious during his/her career. Even great sport stars, with a great number of performances in front of a large audience, admit that they feel nervous few days prior, as well as immediately before the performance. Sprint world record holder, „the elusive“ Usain Bolt, admits that he feels nervous prior to great competitions, even though other competitors are several meters behind him during a race. Physiological changes that everyone experiences when exposed to a certain pressure, due to expected or unexpected situations, are some of the signs of anxiety, such as: throat dryness, abdominal muscles cramps, perspiration, heart palpitations, shaky voice, trembling etc. The best way to increase sport success is to accept the fact that anxiety exists, but also to keep it at optimum level – positive anxiety. The most suitable state of optimum anxiety for sport success is not too high, but also not too low.

The research showed that the capability of high anxiety confrontation is related to competitive success, especially in elite sport. In concordance with that, numerous research studies have investigated sport anxiety, mostly using the Competitive State Anxiety Inventory-2 (CSAI-2, Martens et al., 1990).

In 2007, Shojaei and Hoji Ghasem conducted a research on the definition of motivation in chosen Iranian soccer players. Sixty one senior soccer players, U-19 and U-23, were included into the research, filling out the sport attitudes questionnaire. The research results showed that the success achieving motivation of the chosen players is twice as strong as their failure avoidance motivation. Also, it has been proven that failure avoidance motivation was higher in seniors than in young players, meaning that seniors were more sensitive to coach's comments. Asci, Caglar and Dogu (2007) conducted a research with the aim of determining soccer referees' performance concentra-

tion, by comparing it related to the league of a referee. Two hundred and thirteen soccer referees were included into the research, which showed that soccer referees' performance concentration was good, no matter the league. Besides physical fitness, the game of soccer demands players' psychological readiness. Spielberger (1966) considers that every player experiences a certain situation in his own way with different way of reaction, i.e., anxiety level. Martens (1977) defines competitive anxiety as a way in which an individual perceives a threat in certain situations. The research was conducted on a sample of 51 second Turkish soccer league players. The conclusion of the research was that there was a significant correlation between competitive anxiety and soccer players' motivational tendency.

Koruc et al. (2007) conducted a research dealing with competitive anxiety and concentration level of 119 soccer players from two second league and three first league teams. The research revealed a negative correlation between self-confidence and concentration level. When an athlete's self-confidence becomes low, his/her concentration level increases.

The aim of this research was to examine the relation between pre-competitive state anxiety, self-confidence and sport success in Croatian first and second league soccer players.

## METHODS

A sample of 72 soccer players of Croatian first and second league was used in this research, with equal ratio of examinees, 36 first league and 36 second league players.

The competitive state anxiety questionnaire (CSAI-2) was chosen because of its adequacy for specific sport research and because of the fact that it had successfully helped athletes with high levels of anxiety in competitive situations. It consists of 17 items in 3 subscales: cognitive anxiety, somatic anxiety and competitive self-confidence. The examinees filled the questionnaire one hour prior to the match.

The CSAI-2 questionnaire consisted of 17 statements estimated using a 4-point Likert scale: 1. Completely untrue, 2. Mostly untrue, 3. Mostly true, 4. Completely true.

From the total number of 17 items, 7 items estimated the somatic component of anxiety, 5 items estimated the cognitive component and 5 estimat-

Table 1 Descriptive indicators of 1st league soccer players (N=36)

Variables	M	Min	Max	SD	Skew	Kurt	KS
CSAISOM	12.39	9.00	19.00	2.68	0.85	0.41	0.20
CSAICOG	11.17	5.00	17.00	3.35	-0.29	-0.60	0.14
CSAICON	13.94	9.00	18.00	2.51	-0.43	-0.59	0.16
DIRSOM	2.39	-6.00	9.00	3.96	0.12	0.00	0.16
DIRCOG	-1.06	-10.00	8.00	5.63	-0.10	-1.08	0.15
DIRCON	6.50	-5.00	13.00	4.60	-1.04	1.06	0.20
MATIMPOR	9.50	8.00	10.00	0.71	-1.12	0.12	0.27
WINCHANC	6.61	4.00	10.00	1.69	0.70	0.02	0.19

MaxD=0.27

M – mean; MIN – minimum result; MAX – maximum result; SD – standard deviation; SKEW – measure of distribution asymmetry; KURT – measure of distribution shape. KS – coefficient of the Kolmogorov-Smirnov test

Table 2 Descriptive indicators of 2nd league players (N=36)

Variables	M	Min	Max	SD	Skew	Kurt	KS
CSAISOM	12.83	7.00	18.00	3.55	-0.48	-0.85	0.12
CSAICOG	9.28	7.00	12.00	1.53	0.59	-0.10	0.23
CSAICON	17.17	14.00	20.00	1.76	-0.36	-1.05	0.23
DIRSOM	8.22	-1.00	16.00	5.14	-0.51	-0.87	0.19
DIRCOG	2.50	-5.00	10.00	4.48	0.04	-1.27	0.21
DIRCON	10.83	5.00	15.00	2.83	-0.53	-0.11	0.19
MATIMPOR	8.17	3.00	10.00	2.04	-1.01	0.84	0.26
WINCHANC	6.50	1.00	9.00	2.15	-0.82	0.89	0.14

MaxD=0.27

M – mean; MIN – minimum result; MAX – maximum result; SD – standard deviation; SKEW – measure of distribution asymmetry; KURT – measure of distribution shape. KS – coefficient of the Kolmogorov-Smirnov test

□

ed self-confidence. The results of the items belonging to the same anxiety component were added in a way that 17 items made 3 variables (anxiety components): CSAI SOM – somatic component, CSAI COG – cognitive component, CSAI CON – self-confidence.

The possible result span in the somatic component of anxiety was from 7 to 28, and in the cognitive and self-confidence component from 5 to 20. In every item (statement) the examinees evaluated anxiety direction or „directional perception“ (Jones and Swain, in Kais, 2005). They answered in a following manner:

„For my play it is:...” The chosen numbers were at the scale from -3 (very negative), 0 (irrelevant) to +3 (very positive). In this case, the results of the same components were added so that the somatic direction variable („DIRSOM“) could range from -21 to +21, and the cognitive („DIRCOG“) and self-confidence („DIRCON“) from -15 to +15.

Besides the listed, the examinees chose the numbers (percentages) for the following state-

ments: This game is („IMPORTANCE“ variable): *Completely irrelevant* to *Extremely important*, 1-10; In this match my team's chances to win are („CHANCE“ variable): (10% to 100%).

This percentage scale was „transformed“ during data input into a 10-point Likert scale, in such a manner that an answer “10%” was marked 1, “30%” was marked 3, etc. After the match, the players estimated their play in a following manner: In relation to my possibilities I played this match („PLAYQ“ variable): *poor* to *excellent*, grades 1-10.

In accordance with the aim of the research, data analysis was conducted, using the STATISTICA 7.0 software. The basic descriptive indicators of variables were calculated (mean, standard deviation, minimum and maximum values, coefficients of skewness and kurtosis). Kolmogorov-Smirnov test determined the distribution normality in all the tested variables. The univariate analysis of variance determined the differences between the soccer players of different competition levels.

## RESULTS AND DISCUSSION

Insight into the results displayed in Table 1 leads towards the conclusion that all the variables do not deviate from normal distribution. The MATIMPOR variable shows KS test threshold values, but it does not deviate significantly from normal distribution. The threshold values of the mentioned variable in 1st league soccer players arise from the fact that they played maybe the most important visiting match of the first part of the competition season.

Soccer players of the 2nd league on average had low level of somatic and cognitive anxiety, and relatively high level of self-confidence.

The examinees considered somatic anxiety as something with a slightly positive influence on their play, while cognitive anxiety was perceived as something with a slightly negative influence. Self-confidence had a moderate positive influence on their play.

The match played was extremely important to the 1st league players (grade 9.50 on the 1 to 10 scale), and they considered that their chances to win had been relatively high (around 70%), which was already mentioned and explained.

Insight into the results displayed in Table 2 leads towards the conclusion that all the variables do not deviate from normal distribution. The MATIMPOR variable shows somewhat higher KS test values.

Second league players on average had a relatively low level of somatic and cognitive anxiety, and a very high level of self-confidence (near to the maximum value of 20).

The examinees usually considered somatic anxiety as something having a moderately positive influence on their play, while cognitive anxiety was considered as something having a mildly positive influence on their play. Self-confidence had a very positive influence on their play.

Second league players considered the game played very important (ranged 8.17 on 1-10 scale), and that they had a relatively high chance of winning (around 65%).

Table 3 shows the results of variance analysis for two groups of soccer players. The first group (N=36) consisted of players competing in First Croatian Soccer League, while the second group consisted of those competing in Second Croatian Soccer League. Variance analysis did not show any statistically significant differences in the somatic

component of anxiety between players of different levels of competition. The first league players had a statistically significant higher level of cognitive anxiety, while second league players had a significantly higher level of self-confidence. The results of direction of somatic and cognitive anxiety, as well as self-confidence, significantly differ in players of a different level of competition. It is obvious that the uncertainty of a match result influences the increase of somatic and cognitive anxiety levels, although it does not necessarily have a negative influence on players' success and concentration, since the obtained values are relatively low, especially in second league players. The results are congruent with the previous findings (Woodman and Hardy, 2003), which found a negative linear correlation between cognitive anxiety and sports performance, reverse correlation between somatic anxiety and performance and a positive linear correlation of self-confidence and sports performance. Table 3 shows that the second league players had a more positive view of somatic anxiety and self-confidence, compared to the first league players. Based on the obtained results, it can be concluded that a somewhat higher level of somatic anxiety had a positive influence on the players' readiness for the match, while the increase of cognitive anxiety could impede with the players' concentration during the match. It is probable that the extreme importance of the match influenced the results for the first league players. Further research should follow state anxiety in more than one instance, i.e., matches during the whole season.

Table 3 Variance analysis for the groups of soccer players

Variables	1st League (N=36)		2ndLeague (N=36)		F-test	p
	M	SD	M	SD		
CSAISOM	12.39	2.68	12.83	3.55	0.18	0.67
CSAICOG	11.17	3.35	9.28	1.53	4.75	0.03
CSAICON	13.94	2.51	17.17	1.76	19.26	0.00
DIRSOM	2.39	3.96	8.22	5.14	14.55	0.00
DIRCOG	-1.06	5.63	2.50	4.48	4.39	0.04
DIRSAM	6.50	4.60	10.83	2.83	11.56	0.00
MATIMPOR	9.50	0.71	8.17	2.04	6.89	0.01
WINCHANC	6.61	1.69	6.50	2.15	0.02	0.86

M – mean; SD – standard deviation; F – coefficient of one-way analysis of variance; p – level of statistical significance of the F coefficients..

## CONCLUSION

The research was conducted with a primary aim of determining the relations between the intensity of pre-competitive state anxiety, self-confidence and sport success of players of Croatian first and second soccer league.

The conclusion, based on the results of this research, is that there were significant differences in certain anxiety components in soccer players of different levels of competition. The results of direction of somatic and cognitive anxiety, as well as self-confidence, significantly differed in soccer players of different levels of competition. Based on the obtained results, the conclusion is that a somewhat increased level of somatic anxiety had a positive influence on the players' readiness for the

match, while increase in cognitive anxiety could impede with the players' concentration during the play. The extreme importance of the match surely had an impact on the obtained results in the first league players. Future research should follow state anxiety in more than one instance, i.e., match during the whole season. Further on, future research should direct the attention towards the relation of anxiety and different playing positions within the team. It can be concluded that worry and fear related to the cognitive state anxiety are basic obstacles to the sport achievement. Lower cognitive state anxiety results in better sports achievement. Also, an increase in somatic anxiety indicators is related to better sports achievement.

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## ПРЕДНАТРЕВАРУВАЧКА АНКСИОЗНОСТ КАЈ ФУДБАЛЕРИ

УДК:796.332.093.427:159.942.4  
(Оригинален научен труд)

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### **Абстракт**

72 фудбалери сениори непосредно пред натпревар пополниа прашалник CSAI-2 за проценување на соматската и когнитивната анксиозност и самодовербата. Првата група ја сочинуваа фудбалери (N=36) кои играат во првата лига, а другата група ја сочинуваа фудбалери (N=36) кои играат во втората лига. Анализата на варијансата не се добиени статистички значајни разлики во соматската компонента на анксиозноста меѓу фудбалерите кои се натпреваруваат во различен ранг на натпревари. Фудбалерите од првата лига имаат статистички значајно поголемо ниво на когнитивна анксиозност, додека фудбалерите од втора лига имаат поголемо ниво на самодоверба. Резултатите на соматската и когнитивната насоченост како и самодовербата значајно се разликуваат меѓу фудбалерите од различно ниво на натпревари. Очигледно дека неизвесниот резултат на натпреварот влијае на зголемување на нивото на соматската и когнитивната анксиозност, иако тоа не мора негативно да се одрази на успешноста и концентрација на играчите. Во идните истражувања би требало да се следи состојбата на анксиозност во повеќе наврати, односно натпревари во текот на целата натпреварувачка сезона.

**Клучни зборови:** CSAI-2, самодоверба, соматска и когнитивна анксиозност

## AGE AND POSITIONAL DIFFERENCES IN PSYCHOLOGICAL COPING SKILLS OF YOUNG FEMALE VOLLEYBALL PLAYERS

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(Original scientific paper)

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### **Abstract**

*With the aim of determining age and positional differences in psychological coping skills, 180 youth and junior female volleyball players, whose mean age was  $15.91 \pm 1.78$ , filled out the Athletic Coping Skills Inventory-28 (Smith, Schutz, Smoll & Ptacek, 1995). Because of its poor reliability, the concentration scale was left out from further analyses. All other scales of the questionnaire have acceptable homogeneity, reliability and sensitivity. There were no statistically significant age and positional differences in coping skills found by independent samples T-test and One-way ANOVA. The results obtained indicate that levels of psychological coping skills do not change as the playing experience of female volleyball players increases, and that some other dimensions of anthropological status (primarily anthropometric characteristics) cause positional differences among young female volleyball players.*

**Key words:** ACSI-28, metric characteristics, t-test, One-way ANOVA

### **INTRODUCTION**

Morris (2000) states that elite athletes must constantly be under a high level of pressure, and it is therefore not surprising that psychological characteristics often distinguish successful elite athletes from those less successful. Athletic coping is the overarching concept that includes other psychological skills (Mahoney, Gabriel and Perkins, 1995). Coping with adversity is the ability to remain emotionally stable and positive during sport performance or competition no matter the situation (Weinberg and Gould, 2011), and to utilize other psychological skills and coping strategies. A number of multidimensional or one-dimensional instruments for measuring athletes' psychological characteristics are used in the area of sport psychology, and the *Athletic Coping Skills Inventory-28 (ACSI-28 hereinafter)* (Smith, Schutz, Smoll and Ptacek, 1995) was developed as a research instrument, measuring psychological coping skills. This questionnaire is a revised version of the *Survey of Athletic Experience* (Smith, Smoll and Ptacek, 1990) questionnaire, constructed with the purpose of predicting coping with athletic injuries. The revised version of the questionnaire measures

seven out of the eight original dimensions, and the structure of the questionnaire had been determined by confirmatory factor analysis. ACSI-28 measures psychological characteristics important for predicting the enhancement of sports performance, and the results of all seven scales can be summed into a general measure of psychological coping skills. The authors state that ACSI-28 measures a multifacet construct and that each scale of the questionnaire can be used as a specific measure. Satisfactory metric characteristics have been determined for the questionnaire. Many research studies have been conducted by using this short and economic questionnaire in order to determine its metric characteristics. By testing the construct validity of the questionnaire, significant correlations were found to general self-esteem (Smoll, Smith, Barnett & Everett, 1993), as well as to a scale or subscales such as the scale of *worry* in the *Sport Anxiety Scale* (constructed by Smith, Smoll & Schutz, 1990) and to different measures of sports performance. Smith & Christiansen (1995), on a sample of professional baseball players, found that the results of the questionnaire, though representing an indirect measure of athletic success, signif-

icantly predict athletes' survival in professional baseball, while psychological coping skills measured by ACSI-28 were a more significant predictor of pitchers' efficacy than physical skills. Crocker, Kowalski & Graham (1998) state that ACSI-28 is not conceptually derived from any theory, and wonder if the questionnaire measures *coping* skills instead of targeted psychological skills, and that the items might have been selected for particular scales – dimensions without specific regard to previous research findings and contemporary theory. Weinberg & Forlenza (2012) state that certain critiques in literature are aimed at the procedure of development of the ACSI-28 questionnaire: they argue it is necessary to perform a procedure of confirmatory factor analysis on an independent subject sample, and not to repeat different analyses on data obtained on one sample; determination of construct validity should also include measures of psychological skills which are not measured by self-reporting procedures because all self-reporting measures have similar limitations. In spite of the mentioned limitations, the ACSI-28 instrument is considered a quality instrument for measuring psychological characteristics of athletes. The aim of this paper was to determine age and positional differences in psychological coping skills on a sample of young female volleyball players.

## METHODS

The subject sample included 180 female youth and junior volleyball players of clubs from all parts of Croatia, who were members of the teams competing in the 2011 Croatian Championship, and whose mean age was  $15.91 \pm 1.78$ . The largest group of subjects included players whose teams had entered the final tournament of the Croatian Championship for their age category. Besides them, the research also included the members of the teams which had not qualified for the final tournament of the Croatian Championship. The measurement of the subjects' psychological skills was performed by applying the *Athletic Coping Skills Inventory-28* (ACSI-28), constructed by Smith, Schutz, Smoll & Ptacek (1995). The inventory consists of 28 five-point Likert-type items, and measures 7 dimensions – facets: *coping with adversity* (abbreviation of variable COPE) which is used to measure athletes' way of coping with difficulties during performance (tendency to

remain positive and enthusiastic, to stay calm and controlled and to bounce back quickly from mistakes); *Peaking under Pressure* (abbreviation PEAK) which is used to measure athletes' ability to perform well under pressure; *Goal-Setting & Mental Preparation* (abbreviation GOAL) which is used to measure athletes' ability to set and work towards specific performance goals and to plan and mentally prepare themselves for performances; *Concentration* (abbreviation CONC) which is used to measure athletes' ability to be able to focus on the task at hand, to be able to maintain this ability to focus, and not to be easily distracted; *Freedom from Worry* (abbreviation FREE) which is used to measure athletes' ability not to put extra pressure on themselves by worrying about performing poorly or making mistakes, and not to be concerned with what other people will think about them if they do happen to make a mistake; *Confidence & Motivation* (abbreviation CONF) which is used to measure self-confidence and positive motivation of athletes who consistently give 100% and work hard to improve their skills; and *Coachability* (abbreviation COACH) which is used to measure the extent to which athletes are able to be open and learn from instruction, and to accept constructive criticism without taking it personally and becoming upset. As this inventory has not been used previously on a sample of Croatian athletes, it needed to be validated on this sample. The validation procedure started with the translation of the questionnaire, after which three volleyball experts agreed upon each item. Then the questionnaire was applied on a small sample of young volleyball players of both genders, primarily with the purpose of testing the content validity of its items. An item which had been marked by the subjects as less understandable or insufficiently applicable to volleyball was discussed again by the expert team. Besides measuring the psychological skills, other significant data about young volleyball players were also collected: year of birth and playing position (role) most frequently played in one's team. For the most part, the measurement of psychological skills by ACSI-28 was conducted through group testing during the final tournaments of the Croatian Championship for youth and junior players, just before playing the first match in the tournament. The remaining subjects, players from the teams which had not qualified for the final



Table 1 Means and metric characteristics of the ACSI-28 scales

VARIABLE	ITEMS	M	SD	CRONBACH'S ALPHA	% VAR	D * (K-S test)	MIN	MAX	SKEW	KURT
PEAK	4	2.92	0.85	0.76	58.36	0.08	1.00	5.00	-0.01	-0.23
FREE	3	3.13	0.87	0.71	62.99	0.11*	1.00	5.00	-0.03	-0.38
COPE	4	3.39	0.70	0.67	51.29	0.10	1.50	5.00	-0.22	-0.09
CONC	4	3.47	0.64	0.57	46.02	0.09	1.75	4.75	-0.01	-0.26
GOAL	4	2.80	0.85	0.76	58.63	0.11*	1.00	5.00	0.05	-0.48
CONF	4	3.72	0.66	0.69	53.04	0.10*	1.50	5.00	-0.28	0.44
COACH	4	3.85	0.71	0.70	53.33	0.13*	2.00	5.00	-0.67	-0.24

M – mean; SD – standard deviation; CRONBACH'S ALPHA – coefficient of internal consistency; % VAR – percentage of the explained variance; D (K-S test) – coefficient of the Kolmogorov-Smirnov test; \* - the level of significance of the K-S test coefficient; MIN – minimum result; MAX – maximum result; SKEW – measure of distribution asymmetry; KURT – measure of distribution shape.

Table 2 Correlations of the ACSI-28 scales

VARIABLE	PEAK	FREE	COPE	GOAL	CONF	COACH
PEAK	1.00	-0.04	0.31***	0.30***	0.32***	0.12
FREE	-0.04	1.00	-0.36***	0.10	-0.17*	-0.24**
COPE	0.31***	-0.36***	1.00	0.19*	0.56***	0.32***
GOAL	0.30***	0.10	0.19*	1.00	0.55***	0.13
CONF	0.32***	-0.17*	0.56***	0.55***	1.00	0.30***
COACH	0.12	-0.24**	0.32***	0.13	0.30***	1.00

\* - statistically significant coefficient of correlation at the level of  $p < .05$ ; \*\* - statistically significant coefficient of correlation at the level of  $p < .01$ ; \*\*\* - statistically significant coefficient of correlation at the level of  $p < .001$ .

tournament of the Croatian Championship, were measured later in their clubs. For validation of the scales of the translated ACSI-28 questionnaire of psychological skills, basic metric characteristics were determined: homogeneity (by using principal components analysis with oblique rotation); reliability (by calculating the Cronbach's alpha coefficient); and sensitivity (by calculating the Kolmogorov-Smirnov test of distribution normality, as well as the coefficients of skewness and kurtosis). In case a low level of reliability or unsatisfactory homogeneity had been established in some scale, item analysis was performed for that scale with the purpose of improving its metric characteristics. In order to be able to compare the results of scales with a different number of items, the result of each scale was calculated by summing each item within the scale and then dividing that sum with the number of items in that scale. Coefficients of the independent samples T-test were calculated to determine possible differences in psychological coping skills between the subjects according to age, and differences in the level of psychological coping skills between the subjects with different player roles were tested by One-way ANOVA.

## RESULTS AND DISCUSSION

Given that the ACSI-28 questionnaire has not been validated earlier in Croatia, the validation of the instrument was performed and the results of validation of each scale on a sample of young female volleyball players are presented in Table 1.

Only the *freedom from worry* scale required an additional item analysis, and after the analysis had been performed, one item was discarded so the scale contains the total of three items. Therefore, all validated scales of the questionnaire, except for the *freedom from worry* scale, consist of 4 items. All scales have good homogeneity because items in all the scales were projected on a single latent component, and the variance explained by these components varies between 46.02% for the *concentration* scale and 62.99% for the *freedom from worry* scale. Scales' reliability of the internal consistency type (Cronbach's alpha) ranged between the satisfactory level of 0.76 for the *peaking under pressure* and *goal setting/mental preparation* scales and the unacceptable level of 0.57 for the *concentration* scale. Similar reliability levels were also found by the authors Smith et al. (1995) when they constructed the scales, but they did not find any Cronbach's alpha coefficients of reliability

Table 3 Differences of the ACSI-28 results according to the age of the examinees

VARIABLE	FEMALE YOUTH PLAYERS (N=105)		FEMALE JUNIOR PLAYERS (N=75)		AGE DIFFERENCES	
	M	SD	M	SD	t-test	p
PEAK	2.83	0.89	3.03	0.77	1.59	0.11
FREE	3.23	0.89	2.98	0.83	1.88	0.06
COPE	3.38	0.72	3.40	0.68	0.13	0.90
GOAL	2.83	0.84	2.77	0.87	0.41	0.68
CONF	3.70	0.64	3.75	0.68	0.56	0.58
COACH	3.85	0.73	3.86	0.70	0.04	0.97

M – mean; SD – standard deviation; t-test – coefficient of the independent samples t-test; p – level of statistical significance.

Table 4 Differences of the ACSI-28 results according to the playing position of the examinees

PLAYER ROLE		VARIABLE					
		PEAK		FREE		COPE	
		M	SD	M	SD	M	SD
Setter	(N=32)	2.79	0.84	3.15	0.95	3.51	0.72
Opposite player	(N=27)	2.89	0.74	3.05	0.87	3.43	0.74
Passer-hitter	(N=54)	2.84	0.84	3.11	0.87	3.31	0.75
Middle blocker	(N=37)	3.02	0.79	3.05	0.89	3.49	0.65
Libero player	(N=30)	3.08	1.01	3.30	0.81	3.25	0.63
ANOVA		F		F		F	
		0.73		0.43		0.93	
		p		p		p	
		0.57		0.79		0.45	
PLAYER ROLE		VARIABLE					
		GOAL		CONF		COACH	
		M	SD	M	SD	M	SD
Setter	(N=32)	2.73	0.98	3.74	0.65	3.86	0.76
Opposite player	(N=27)	2.81	0.79	3.64	0.68	3.80	0.83
Passer-hitter	(N=54)	2.81	0.88	3.68	0.73	3.81	0.65
Middle blocker	(N=37)	2.91	0.85	3.79	0.64	3.92	0.64
Libero player	(N=30)	2.74	0.75	3.77	0.54	3.89	0.78
ANOVA		F		F		F	
		0.24		0.31		0.18	
		p		p		p	
		0.92		0.87		0.95	

M – mean; SD – standard deviation; F – coefficient of one-way analysis of variance; p – level of statistical significance of the F coefficients.

lower than 0.60. During the construction of the questionnaire, it was established that, among all the scales, the *concentration* scale had the lowest coefficient of internal consistency (0.62). Since factor loadings of all items of this scale were 0.64 or higher, and only one latent component was extracted, it was not possible to perform further selection of items. Tennenbaum, Kamata & Hayashi (2007) state that many researchers recommend 0.70 as a minimum criterion value for a measure to be considered internally consistent,

though they do not recommend this criterion as a magic number. Some authors (Nunnally & Bernstein, 1994; Abell, Springer & Kamata, 2009; Milavia, 2013) argue that levels of consistency lower than 0.70 are also acceptable if the measuring performed by an instrument with low consistency is not the basis for decision making which would have consequences for a person, if the data is analyzed and interpreted at a group level, and in early phases of research. In simple terms, items of the *concentration* scale measure manifest behav-

iors which do not provide a sufficient reliability level of the measuring, and there is no way to improve the reliability of this scale. Therefore, it has been decided that this scale would be excluded from further procedures of statistical data analysis, so the *concentration* scale was not further used in this research. Even though the results of the Kolmogorov-Smirnov test show that distributions of 4 out of the 7 variables differ with statistical significance from normal distribution, the sensitivity of the scales is considered to be good because all coefficients of skewness and kurtosis fall within  $\pm 1.00$ , and ranges of the results (the smallest scale range is between 2.00 and 5.00) spread through 3 or more measuring units of the scale. It has been concluded that the validated measuring scales (except for the *concentration* scale) have good metric characteristics, and the use of parametric statistical data analysis procedures of their results is therefore justified. The means obtained on the scales of psychological coping skills on this subject sample vary between moderate 2.80 (*goal setting/mental preparation* scale) and moderately high 3.85 (*coachability* scale). The obtained results show that the technique of goal setting is least used by young female volleyball players with the aim of coping with adversity. This scale consists of three items which measure the usage of goal setting and only one item which refers to creating a mental plan for playing the match. By ranging the means of items of this scale only, by far the lowest result (2.45) was achieved precisely on this item of *mental preparation*. After goal setting, female volleyball players also do not “look forward to” playing under pressure, and do not cope with game pressure in a desirable way. *Coachability* (3.85) and *confidence* (3.72) were found to be positively most expressed coping skills. The volleyball players are open for coach’s instructions, they are ready to listen and accept constructive criticism. They are also confident, believe in their playing abilities, and are intrinsically motivated for training and improvement in volleyball. By comparing the findings of the present research on a sample of young female volleyball players with the female part of the sample used to construct the ACSI-28 questionnaire (Smith et al., 1995), comprised of female high school athletes from different sports, it is noticeable that the ranging structures of means are almost identical in both studies. In the original

research, the lowest results were also found in the measure of *goal setting/mental preparation*, and the highest results were found in the measures of *coachability* and *confidence*. As the majority of the subject sample of the present research also includes female high school students, it can be concluded that young female athletes, regardless of the culture and their chosen sport, cope with difficulties and problem situations in sport in a very similar way. The analysis of age and positional differences might allow further and better interpretation of these findings as well.

The correlations between the measures of psychological coping skills are presented in Table 2. The correlations among the scales of psychological coping skills are mostly positive, except to the measure of *freedom from worry* whose correlations are mostly negative because the items of the scale are negatively oriented. The measures of *confidence/motivation* and *coping with adversity* express the highest correlation to the other variables, which indicates their highest level of importance and their “central” place among the measures of psychological coping skills. Considering the correlations found between the measures of psychological coping skills, further investigation of their relations is recommended because some of the measures might have a common latent basis. Moreover, due to the correlations found between the variables, it is recommended for future research to apply multivariate statistical procedures in order to determine the partial contribution of each variable while excluding the contribution of other variables which are related to that one.

There were no significant differences in the measures of psychological coping skills between the players of youth and junior age category. Coefficient of difference of only one measure of psychological coping skills (the measure of *freedom from worry*) is very close to the level of statistical significance. The measure of *freedom from worry* is very similar in terms of content to the measure of *cognitive state anxiety* in the CSAI-2 questionnaire of athletic psychological skills. Milavič, Jurko & Grgantov (2013) found significant differences between youth and junior female volleyball players in cognitive state anxiety, but also in somatic state anxiety and self-confidence. The authors considered the lower level of somatic and cognitive anxiety and a higher level of self-

confidence in juniors as opposed to youth players to be expected and explained it by greater experience of junior players and their generally higher level of technical-tactical skills as a consequence of a longer period of training and competing. In their opinion, junior players' better performance of volleyball elements in training sessions probably has a positive effect on their self-confidence level, and thereby on decreasing cognitive and somatic state anxiety in matches, while a greater number of matches played probably contributes to a less expressed cognitive and somatic anxiety. The findings of the present research differ from the findings of Milaviæ et al. (2013) as no significant differences were found in self-confidence, and merely a tendency to differentiate was found according to the measure of *freedom from worry*. The inconsistency of differences in these two studies might be interpreted based on the differences between metric characteristics of scales of the two questionnaires by which different findings had been obtained. Namely, each of the three scales of the CSAI-2 questionnaire (cognitive and somatic state anxiety, and self-confidence) consists of 9 items, Cronbach's alpha coefficient of reliability of each scale is 0.84 or higher and each scale measures only one psychological construct. As opposed to this, all scales of the validated questionnaire have only 4 or 3 items each, the levels of the Cronbach's alpha coefficient of reliability vary between 0.67 and 0.76, and two of the scales measure two different psychological constructs (*goal setting/mental preparation* scale and *confidence/achievement motivation* scale). Even though more reliable measures are not necessarily more valid as well (Vaughn, Lee & Kamata, 2013), differences of metric characteristics of scales should be considered as a possible source of inconsistency of the obtained results. It is recommended to repeat the research by using the ACSI-28 questionnaire on a larger subject sample, but also to investigate the relations between the measures of the ACSI-28 and the CSAI-2 in order to accurately determine the relations between different measures of psychological characteristics.

Given the fact that no significant differences were found between female volleyball players of different age groups in this research, the players can be considered members of the same population. Therefore, the next step in statistical analysis,

the One-way ANOVA, was applied on the overall sample of female volleyball players. Differences in the level of psychological coping skills between the groups of subjects with different player roles within their teams were tested by analysis of variance.

There were no significant differences found in the level of psychological coping skills between the players with different player roles in their teams, in spite of the differences in characteristics of tasks they perform during a match or a training session. Players in positions of *setters* organize every attack with great performance precision expected; two "positions" of players who perform serve reception (*liberos* and *passer-hitters*) demand great performance precision of this volleyball element, while *opposite players* in attack "win" crucial points by spiking. The obtained results indicate that players in different playing positions in volleyball have equal levels of psychological coping skills. It might be assumed that positional differences are caused by some other factors and not by a level of psychological coping skills. As in the present research, there were also no differences found in the earlier research by Milaviæ et al. (2013) in the level of psychological characteristics (*cognitive* and *somatic state anxiety*, and *self-confidence*), measured by the CSAI-2 questionnaire, between youth players, and then junior players, playing in different positions. Positional differences have been established in scientific literature, but those differences are a consequence of differences in anthropometric characteristics (Gualdi-Russo and Zaccagni, 2001; Trajkoviæ et al., 2011), and in some motor abilities (Duncan et al., 2006; Marques et al., 2009). The findings of the present research, and the review of the scientific literature, indicate that the most frequently used variables for player specialization of young female volleyball players are anthropometric variables, followed by variables of functional-motor abilities, and to the smallest extent, variables of psychological characteristics. Further research is recommended which should include a longitudinal study of positional differences between young female volleyball players, and which would use all three sets of measures: anthropometric, psychological and functional-motor measures.

## CONCLUSION

Translation and validation of the Athletic Coping Skills Inventory-28 (ACSI-28) was conducted in the present research on a sample of young Croatian female volleyball players. Good homogeneity, reliability and sensitivity was obtained for all scales of the questionnaire, except for the *concentration* scale, which creates the necessary prerequisite for good assessment of the psychological coping skills level. The *concentration* scale did not meet the required level of reliability and it was excluded from further statistical analysis procedures.

The obtained results indicate that the level of psychological coping skills does not change with the increase of playing experience. The findings are not congruent with the findings of previous studies (Milavić et al., 2013; Milavić, 2013) which have found differences in some psychological character-

istics (anxiety, self-confidence and concentration) between youth and junior female players. A detailed comparison of measures from different questionnaires used is recommended with the aim of precisely determining the differences between female players of different age groups.

There were no positional differences found in female players by using the analysis of variance. Thus, it can be concluded that positional differences cannot be well explained based only on psychological coping skills. Taking into consideration the findings of both this and previous research studies, it is evident that positional differences among young female volleyball players in this subject sample are mostly caused by other dimensions of the anthropological status (anthropometric characteristics, motor abilities, technical-tactical skills, etc.)

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## ГОДИШНИТЕ И ПОЗИЦИСКИТЕ РАЗЛИКИ ВО ПСИХОЛОШКИТЕ ВЕШТИНИ КАЈ МЛАДИТЕ ОДБОЈКАРКИ

УДК:796.325.012.2:572.087.1

(Оригинален научен труд)

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### Абстракт

Со цел да се утврдат возрастните и позициските разлики во психолошките вештини реализирано е истражувањето на примерок од 108 млади одбојкарки со просечна возраст од  $15.91 \pm 1.78$ . Испитаниците пополнива пришалник за проценување на психолошките вештини под името Inventory-28 (Smith, Schutz, Smoll i Ptacek, 1995). Поради слабите мерни карактеристики подskalата концентрација е изоставена од понатамошната анализа. Сите останати скали од пришалникот имаа задоволителна хомогеност, валидност и осетливост. Т-тестот за независни примероци и едномерната анализа на варијансата не покажаа статистички значајни возрастни и позициски разлики во психолошките вештини. Добиените резултати укажуваат дека со зголемување на играчкото искуство кај одбојкарките не се менува нивото на психолошките вештини и најверојатно некои други димензии на антрополошкиот статус (првенствено антропометриските карактеристики) се причина за позициските разлики кај младите одбојкарки.

**Клучни зборови:** ACSI-28, мерни карактеристики, t-тест АНОВА

## THE INFLUENCE OF THE SOCIOECONOMIC STATUS OF SOME ANTHROPOMETRIC, FUNCTIONAL, AND MOTOR INDICATORS ON YOUNG EXAMINEES

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*(Original scientific paper)***Seryozha Gontarev<sup>1</sup>, Milan Naumovski<sup>1</sup>, Kalac Ruzdija<sup>1</sup> & Sofche Markovikj<sup>2</sup>**<sup>1</sup>*Ss. Cyril Methodius University, Skopje, Faculty of Physical Culture, Skopje, Macedonia*<sup>2</sup>*Nacionalna i univerzitetska biblioteka "Sv. Kliment Ohridski", Skopje, Macedonia*

### Abstract

The research was carried out on 2,083 children from elementary schools in the municipality of Kisela Voda, Republic of Macedonia, their ages ranging from 6 to 10 years old.. The aim of this research is to verify the effects of the socioeconomic status on some anthropometric, functional and motor measurements. Two anthropometric measurements, two functional measurements (diastolic and systolic pressure), three measurements for determining body structure and six motor tests have been used to complete the research. The results have been processed with the appropriate multivariate and univariate statistical procedures. According to the results we can conclude that the socioeconomic status affects the body weight, height, percentage of adipose tissue and some tests that measure the fitness level in the body. These effects are more common within the female respondents.

**Key words:** *anthropometric measurements, body structure, blood pressure, socioeconomic status, students, variance analysis.*

### INTRODUCTION

The well-being and healthiness of humans depends very much on their socioeconomic status, which is a significant determinant. A number of scientific researches point out that the low socioeconomic status (e.g. household income, educational degree) has been the cause of some chronic diseases and health inequity. The connection between the socioeconomic status and health is not only related to adults, but also to children growing up in families with a low socioeconomic status. As a matter of fact, there is a bigger risk for these children to contract or develop a disease in comparison to the children living in families with a high socioeconomic status.

The parents, as well as the environment, have an immense influence on the growth of the children and a great deal of responsibility for their psychophysical development, education and individuality. Stimulating physical activity in children is a result of the parents' interest in the realization of the children's need for sports. The lack of support from the family to the children results in low interest in physical activity after some time and the children often take the wrong direction due to peer

pressure and other factors. The children who have parents with a negative attitude towards sports and physical activity tend to avoid sports or to often skip physical education classes. Having children live in good socioeconomic environments, but without the appropriate conditions to grow and develop, results in failure to the main goal of having physical activity – development of the motor skills and proper nutritional status.

So far, the researches on the influence of the socioeconomic factors on the motor skills (the fitness level) have shown that the physical development and the fitness level depend not only on the heredity, but also on the measurements of social stratification, especially the ones from the social subsystem (educational and residential status) and sanction subsystem. According to Hoshek "the motor skills develop under the influence of the social factors that determine the subject's position in the social subsystem and partially in those that assign its position in the institutional subsystem" (Hoshek, 1997).

The influence of the socioeconomic factors in the children's participation in physical activities can be easily conveyed. This is also confirmed by

the researches that analyzed the influence of the socioeconomic status on the children's involvement in physical activities (Heersink et al., 2004; Humbert et al., 2006; Neves et al. 2005; Matsudo et al. 2006). As a result of a 5-year intervention program, there has been an improvement in the children's levels of physical activity and a decrease in the sedentary habits of all social stratification categories within the target audience. It has been verified that as the socioeconomic status improves, so does the influence of the program to the target audience (Neves et al., 2005; Matsudo et al., 2006). Similar positive correlation between social influence and physical activity in the children has been confirmed by other authors (Brodersen, et. al. 2007; Strauss et al. 2001; Scheerder et al. 2005). According to a research carried out on 3-year old children divided into three groups in accordance with the socioeconomic status of their parents (low, middle, high), it has been ascertained that the children from low socioeconomic status families have a lower motor-based knowledge (Ketelhut et al. 2003).

In the researches of Hoshek and his assistants (1981) and other authors (Matic and Jaksic, 2007) an assumption that a suitable environment has the biggest effect on complex motor skill exercises or in the results of the coordination tests has been emphasized. The authors state that education and coordination play a big role in this analysis. It is stated that the cause is the connection between education and intelligence, while the development of coordination is an indirect cause. This only partially confirms the Hebb's neuropsychological theory. As Hoshek states, this theory includes a repetition of the stimulants leading to the creation of active brain cells (Hoshek, 2004). These stimulants might be a result of influence of the surrounding environment, as well as a result of the motor reactions on whatever caused them.

We must be aware and take into consideration the fact that every country has distinct socioeconomic and cultural characteristics. They all affect the physical activity and the levels of the motor skills in a different way. A research that analyzes the influence of the socioeconomic status on the anthropometric measurements, body composition, blood pressure, and motor skills has never been conducted in our country. Thus, the main objective of this research is to analyze the influence of the socioeconomic status, especially the sanction sub-

system, on the aforementioned points on children from both sexes from 6 to 10 years old.

## RESEARCH PARTICIPANTS

The research was conducted on 2,083 children representing 77.75% of the total student population from 6 to 10 years old. All of the children that took part in this research are students in the elementary schools of the municipality of Kisela Voda, Republic of Macedonia. The selected survey group has been subdivided into two groups according to the gender – 1,047 boys and 1,036 girls, the average age of the boys being 8.32 years old and of the girls being 8.23 years old.

All of the selected children who took part in the research had a parental permission to take part in it, were psychophysically healthy and participated regularly in the physical education classes. All of the children who did not go through all of the tests and who did not take measurements were not allowed to take part in the research.

The measurements were taken in April and May in 2011 in normal school conditions during the physical education and health classes by previously tested medical and kinesiology experts.

## Anthropometric Measurements and Body Composition

The measurements of the anthropometric measurements were taken according to the IBP-International Biological Program (Lohman, Roche, and Martorell 1988). For determining the morphological characteristics of this research, the following anthropometric measurements have been taken: body height, body weight, and body mass index.

The components of the body are determined by the method of bioelectrical impedance (measuring the electrical conductivity- BIA – Bioelectrical Impedance Analysis). The measuring was completed with the Body Composition Monitor, type "OMORON- BF511". This measures the body weight, adipose tissue percentage, muscle mass percentage, and the body mass index (BMI). Before the measurement with the Body Composition Monitor commences, the gender, age, and body height of the examinee are filled in.

For the results to be entirely accurate and precise the precautions issued by ACSM (2005) and Heyward (2006) were followed before every measuring.



### **Blood Pressure**

The blood pressure (systolic and diastolic) and heart rate were measured by medical experts and sports medicine specialists. The examinees were in a room with an appropriate temperature where they were not disturbed. Before the examination the examinees had at least a minute to relax and calm. The previously clinically tested digital monitors from the company "Omron" measured the blood pressure and heart rate. The examinee's left hand was used throughout the process, while the examinee sat upright, did not move or speak.

### **Motor Tests**

All of the examinees are analyzed with the modified battery by the EUROFIT tests, recommended by the European board. Some of them are even modified and adapted for the international projects "Feeding and Assessment of Nutritional Status of Spanish Adolescents (AVENA study)" and "The Healthy Lifestyle in Europe by Nutrition in Adolescence" - (HELENA study) (Ruiz et al., 2006). The following motor tests are included in this analysis: rappid hand tapping, long jump, lifting up the body in 30 s., flexion of the hand, seated forward bend and running (4x10 m.)

### **Socioeconomic Status**

The socioeconomic status of the students is evaluated with the help of the international scale, named Family Affluence Scale (FAS), which includes four questions for the examinees: Does your family own a car/van/truck? Do you have your own bedroom? How many times have you traveled with your family in the last 12 months? How many computers do you have in your family? According to the answers, the examinees are divided into three categories: low (0-2), middle (3-5) and high (6-8) socioeconomic status. The scale had been formulated by WHO- Health Behavior and School Aged Children Study, in 1997 (Currie et al.1997; Wardle et al. 2002).

### **Methods for Analyzing the Data**

From all of the methods for analyzing data, the ones that condensate and transform the information, are the ones that are applied. These methods give scientifically accurate responses, as well as to verify the hypothesis of this research.

The differences in the anthropometric measurements, body composition, blood pressure and

motor skills in terms of the socioeconomic status are detected with a multivariate and univariate analysis of variance (MANOVA and ANOVA). To determine which sub-samples statistically differ from each other we use the LSD test in the variables that have a significant statistical difference.

The data has been analyzed using the software package for statistical analysis SPSS for Windows Version 15.0.

### **RESULTS**

The results from the multivariate and univariate variance analysis of the male and female examinees are shown in the tables 1 to 6.

The differences between the male examinees in their body height and weight, body composition, blood pressure and motor skills are provided in tables 1 to 3. These results are determined according to the socioeconomic status of the examinees. The results show that there are significant statistical differences in the weight, height, body composition and motor tests variables on a multivariate level, whereas the blood pressure does not provide significant multivariate statistical differences.

The value of the F-test for the whole system of analyzed variables for determining body height and weight, body composition and motor tests has reached level  $Q < .00$ . This leads us to the conclusion that these variables are influenced by the socioeconomic status among the male examinees.

The univariate variance analysis was used in order to ascertain the contribution of each variable in the categorizing of each group, formed according to the socioeconomic status. The arithmetic means, the proper amount of the statistical significance and the Post hoc comparison show us that significant statistical differences have been found in the variables: body weight, body height, adipose tissue percentage, hand tapping, flexion of palm and elbow endurance.

The male examinees coming from families with a higher socioeconomic status tend to be taller and heavier and have a higher level of adipose tissue. They achieved better results in the motor skill tests for the rate of alternating motion and in muscle strength in the flexors of the hand. However, the results achieved from the motor skill test for pull up endurance, which determines the muscle endurance of the hands and the trunk, were worse.

The variance analysis for the female examinees (tables 4 and 6) shows multivariate statistical dif-

Table 1. Difference in the body weight, body height and body composition among the male groups (groups formed according to the family's socioeconomic status)

Wilks'Lambda		Rao's R		df 1	df 2	Q		
0,97		2,70		10,00	2080,00	,00		
Varijabli	Grupa	X	SD	F	Q	Post hoc komparacija (LSD-test)		
						1-2	1-3	2-3
ATVIS	Low	132,27	9,47	6,49	,00	ns	>	>
	Middle	133,64	9,65					
	High	136,13	10,72					
ATMAS	Low	33,07	9,50	8,30	,00	>	>	>
	Middle	34,79	10,46					
	High	37,75	12,03					
APRMM	Low	29,83	3,90	0,86	,42	ns	ns	ns
	Middle	29,98	3,57					
	High	30,36	3,66					
APOMT	Low	23,47	7,76	5,16	,01	ns	>	>
	Middle	24,56	7,93					
	High	26,22	7,35					
ABOMI	Low	18,85	5,33	2,70	,07	ns	ns	ns
	Middle	19,14	3,84					
	High	19,94	3,84					

Tabela 1. Difference in the blood pressure among the male groups (groups formed according to the family's socioeconomic status)

Wilks'Lambda		Rao's R		df 1	df 2	Q		
,998		,002		4,000	2086,000	,79		
Varijabli	Grupa	X	SD	F	Q	Post hoc komparacija (LSD-test)		
						1-2	1-3	2-3
FSPRI	Low	102,79	8,19	0,79	,45	ns	ns	ns
	Middle	103,48	8,03					
	High	102,93	7,32					
FDPRI	Low	60,54	9,42	0,38	,69	ns	ns	ns
	Middle	61,09	10,25					
	High	60,53	8,97					

ferences in the body height and weight, body composition and motor tests for girls with different socioeconomic statuses. A multivariate statistical difference could not have been found among the groups with variables of systolic and diastolic pressure.

The arithmetic means, the proper amount of the statistical significance and the post hoc comparison exam shows that the female examinees with a

higher socioeconomic status are taller and heavier. Thus, they have a higher body mass index, better results in rapid hand tapping, long jump, lifting up the body in 30 s., flexion of the hand, seated forward bend and running (4x10 m.). Overall, however, there are no significant statistical differences among the groups of girls of different socioeconomic statuses.

Tabela 3. Difference in the motor tests among the male groups (groups formed according to the family's socioeconomic status)

Wilks'Lambda		Rao's R		df 1	df 2	Q		
0,96		2,61		16,00	2056,00	,00		
Varijabli	Grupa	X	SD	F	Q	Post hoc komparacija (LSD-test)		
						1-2	1-3	2-3
MFLAM	Low	2,08	1,17					
	Middle	2,08	1,18	1,29	,27	ns	ns	ns
	High	2,27	1,24					
MTARA	Low	20,79	4,82					
	Middle	19,88	4,50	7,89	,00	>	>	>
	High	18,87	3,81					
MDPVS	Low	13,88	5,42					
	Middle	13,51	5,08	2,21	,11	ns	ns	ns
	High	12,67	5,42					
MSDOM	Low	121,09	23,90					
	Middle	123,50	23,32	1,31	,27	ns	ns	ns
	High	124,69	22,40					
MFSAK	Low	12,44	10,50					
	Middle	13,80	10,34	5,38	,00	ns	>	>
	High	16,24	11,36					
MPOTR	Low	12,40	5,36					
	Middle	12,29	5,21	1,04	,35	ns	ns	ns
	High	13,03	5,00					
MIZDZG	Low	6,28	7,92					
	Middle	4,76	6,13	4,99	,01	<	ns	ns
	High	4,85	5,81					
MTR4H10	Low	15,05	1,99					
	Middle	15,04	1,94	1,47	,23	ns	ns	ns
	High	14,72	1,90					

## DISCUSSION

Given the results of this research, we can make a general statement that the socioeconomic factors affect the body fitness, especially the one of the females (girls). This can be interpreted as an opportunity of the families with a better socioeconomic status and with a bigger influence on the social environment to ensure the girls will continue to be engaged in physical activities. This plays a big role in the development of their motor skills. Many authors have analyzed how the parents create gender differences between their children from an early age. Hardman states that the children process, learn and get prepared to accept the role of his gender. A reason for this "separation" (to some point) may be the impact of the parents, family,

teachers, as well as the influence of the electronic and written media, old traditions, and sometimes even stereotypes. Starting from the beginning, the author indicates the different approaches of the mother towards the daughter and the son. In most cases the mother is not aware of her different attitude. The author also states that the biological evidence facilitates the comprehension of the sex differences. However, Rowland and Sallis state that the majority of the people think of the physical activity in a socialistic way rather than biological (Rowland, 1999; Sallis, 2000). The authors point out that nowadays the children and teens are not as influenced by their parents as much as they are by their peers. Thus, the motivation for physical activity depends much more on the social factors than

Tabela 4. Difference in the body weight, body height and body composition among the female groups (groups formed according to the family's socioeconomic status)

Wilks'Lambda		Rao's R		df 1	df 2	Q		
0,98		1,87		10,00	2054,00	,05		
Varijabli	Grupa	X	SD	F	Q	Post hoc komparacija (LSD-test)		
						1-2	1-3	2-3
ATVIS	Low	130,54	9,20	4,49	,01	>	>	ns
	Middle	132,18	10,47					
	High	133,75	9,60					
ATMAS	Low	31,11	8,96	3,16	,04	>	>	ns
	Middle	32,53	9,56					
	High	33,48	9,44					
APRMM	Low	29,04	2,77	2,79	,06	ns	ns	ns
	Middle	29,47	2,85					
	High	29,70	3,48					
APOMT	Low	22,24	8,77	0,75	,47	ns	ns	ns
	Middle	22,84	8,22					
	High	23,27	7,81					
ABOMI	Low	18,16	3,54	4,36	,01	ns	>	>
	Middle	18,51	6,50					
	High	20,57	15,32					

Tabela 5. Difference in the blood pressure among the female groups (groups formed according to the family's socioeconomic status)

Wilks'Lambda		Rao's R		df 1	df 2	Q		
,998		,002		4,000	2062,000	,69		
Varijabli	Grupa	X	SD	F	Q	Post hoc komparacija (LSD-test)		
						1-2	1-3	2-3
FSPRI	Low	102,05	8,32	0,32	,72	ns	ns	ns
	Middle	102,47	9,05					
	High	101,91	8,93					
FDPRI	Low	61,21	10,61	0,19	,83	ns	ns	ns
	Middle	61,07	10,51					
	High	61,74	10,46					

the biological or parental factors. Other "indicators" of the sex difference are the toys, books, TV programs.

We can explain the gender differentiation as a result of the immense influence of the socioeconomic factors on the younger girls. In this case we have a stereotype that can affect the parents and make them believe girls should be much more focused on other forms of education such as languages, music etc. Therefore, the authors recom-

mend promotion of physical education among girls, especially among those whose parents are not interested in motivating them.

In order to alternate the stereotype and make girls participate more in physical activity, Shakib and Dumber (2002) point out the communication between the parents and their children as a main factor in this social process. Encouraging physical activity is essential for all ages, especially for the youth. It lays stress upon the positive effects on the

Tabela 6. *Difference in the motor tests the female groups (groups formed according to the family's socioeconomic status)*

		Wilks'Lambda	Rao's R	df 1	df 2	Q			
		0,94	4,09	16,00	2040,00	,00			
Varijabli	Grupa	M	SD	F	Q	Post hoc komparacija (LSD-test)			
						1-2	1-3	2-3	
MFLAM	Low	2,08	1,06						
	Middle	2,06	1,15	1,36	,26	ns	ns	ns	
	High	2,25	1,24						
MTARA	Low	21,90	4,77						
	Middle	20,75	4,54	12,63	,00	>	>	>	
	High	19,41	3,89						
MDPVS	Low	14,84	4,82						
	Middle	15,38	4,76	4,25	,01	ns	>	>	
	High	16,42	4,67						
MSDOM	Low	106,38	17,92						
	Middle	110,43	19,78	12,22	,00	>	>	>	
	High	117,32	21,89						
MFSAK	Low	7,86	7,84						
	Middle	9,13	8,84	5,87	,00	>	>	>	
	High	11,20	9,30						
MPOTR	Low	9,66	4,94						
	Middle	10,51	5,19	19,07	,00	>	>	>	
	High	13,27	5,51						
MIZDZG	Low	3,91	6,01						
	Middle	3,72	5,30	2,42	,09	ns	ns	ns	
	High	5,00	6,83						
MTR4H10	Low	16,28	1,69						
	Middle	15,86	1,92	10,67	,00	>	>	>	
	High	15,34	1,73						

health, and it would be for the best when the content is adjusted for the children as well. Adjusting the sports program according to the girls' needs can result in their active participation in physical activity and can also alter the stereotype that "sport activities are meant only for boys". The higher socioeconomic status provides better conditions for the development of the genetic predispositions of the motor skills. The better conditions have an influence on the motor tests calculating the speed of alternative movements, coordination, agility and strength. On the other hand, the higher the socioeconomic status, the more increased sedentary habits become (watching TV or working on the computer etc.). As a result the boys from a

higher socioeconomic status weigh more and have a bigger percentage of adipose tissue, unlike the boys from a lower socioeconomic status.

## CONCLUSION

We can conclude that the socioeconomic status affects the fitness level of the younger students, living in Kisela Voda, to some degree. The effects are more common among the female examinees. The male examinees coming from families with a higher socioeconomic status tend to be taller and heavier and have a higher level of adipose tissue. They achieved better results in the motor skill tests for the rate of alternating motion and in muscle strength in the flexors of the hand. However, the

results achieved from the motor skill test for pull up endurance, which determines the muscle endurance of the hands and the trunk, were worse. The female examinees with a higher socioeconomic status tend to be taller and heavier. Thus, they have a higher body mass index, better results in

rapid hand tapping, long jump, lifting up the body in 30 s., flexion of the hand, seated forward bend and running (4x10 m.). Overall, however, there are no significant statistical differences among the groups of girls of different socioeconomic status.

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## ВЛИЈАНИЕТО НА СОЦИО-ЕКОНОМСКИОТ СТАТУС ВРЗ НЕКОИ АНТРОПОМЕТРИСКИ, ФУНКЦИОНАЛНИ И МОТОРНИ ПОКАЗАТЕЛИ КАЈ ИСПИТАНИЦИТЕ ОД РАНАТА УЧИЛИШНА ВОЗРАСТ

УДК:316.344.23:796.012.1-057.874(497.711)

(Оригинален научен труд)

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### Апстракт

Истражувањето е реализирано на примерок од 2083 испитаници, од 6 до 10 годишна возраст, од основните училишта во општина Кисела Вода, Република Македонија. Целта на истражувањето беше да се утврди влијанието на социо-економскиот статус врз некои антропометриски, функционални и моторни показатели. За реализирање на целите на истражувањето применети се 2 антропометриски мерки, 2 функционални мерки (дијастолен и систолн притисок), 3 мерки за проценување на телесниот состав и 6 моторни тестови. Добиените податоци се обработени со соодветни мултиваријатни и униваријатни параметриски статистички процедури. Врз основа на добиените резултати генерално може да се констатира дека социо-економскиот статус влијае врз телесната тежина, висина, процентот на масно ткиво и врз некои тестови за проценување на ниво на фитнесот, а ова влијание е изразено кај девојчињата.

**Клучни зборови:** антропометриски мерки, телесен состав, крвен притисок, социо - економски статус, ученици, анализа на варијанса



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## SYNTHETIC THINKING IN (SPORTS) SCIENCE: THE SELF-ORGANIZATION OF THE SCIENTIFIC LANGUAGE

UDC796:001.8(05):  
(Original scientific paper)

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### **Abstract**

*We present a phenomenological model outline of self-organization in the scientific conceptual space with emphasis of the position of sport sciences. The obtained model has a rugged structure of basins of attraction and the learning dynamics is defined as a hopping of the learning system within the confined general basin of attraction. The paper examines how changes in the conceptual space change the structure and the dynamics of exploratory behaviour of learners. When concepts of higher explanatory generality are absent the system becomes fragmented in mutually weakly connected or disconnected basins of attraction which corresponds largely to the current state in science and humanities education. On the contrary, when such concepts are present, the height of the barriers significantly lowers and the system reconfigures itself into a landscape of connected basins of attraction offering a unification of apparently distant areas of knowledge. The general explanatory concepts play the role of 'catalysts' which lower the transition barriers between conceptual spaces of scientific fields. We further discuss how general explanatory concepts from the nonlinear dynamical systems theory and statistical physics can become tenets of a new educational program and teacher profile.*

**Key words:** *science, sports science, education, synthetic thinking, conceptual self-organization, scientific language self-organization*

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### **INTRODUCTION**

Science is a cooperative social endeavor. Large groups of scientists explore and strive to explain the immense diversity of processes dwelling on different levels and time scales of substance organization. The explanations acquired are continuously shared within and among scientific communities through language which enables, among the other, emergence of new ideas and exploratory approaches. Sports science makes no exception to this rule. On the other hand, the diversity of phenomena constrains the scientific language of each discipline to form a specific vocabulary for naming and explaining the natural properties and processes as well as communicating the knowledge among scientists. The communication of the knowledge among sciences is a central topic of this paper. For example, would a cosmologist, cell biologist, sport scientist and a sociologist understand each other when explaining the basic processes within their fields. Not so much, one would say. Cosmologists speak about inflationary and electroweak epoch and space-time metrics, cell biologists about cell membranes, enzymes and ribosomes, sports scien-

tists about triple vault coordination, kicking performance and double-passes and sociologists about group formation, cohesion and social attitudes.

Recently the diversity of phenomena and properties of the organized substance was ascribed to the existence of the so called "mesoscopic protectorates" (see e.g. Laughlin et al. 2000), i.e. emergent organization levels of substance whose key properties cannot be formally, i.e. mathematically, deduced from the laws that govern the behavior of the more microscopic components (for a detailed explanation on this see e.g. Mainwood, 2006). Hence, each level creates idiosyncratic and novel structures and properties which need a specific language for dealing with them. These languages, thus, use context dependent concepts for naming and explaining the process under scrutiny. This context dependence is essentially viewed as the major cause of the fragmented vocabulary among scientific disciplines. That is, while within specific scientific fields and subfields the knowledge communication goes easy being enabled by common vocabulary, it becomes less and less so between

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more distant disciplines.

In the past few decades, however, there is a growing success in explaining and modeling different levels of organized matter by common universal dynamical concepts. The search for minimum principles which explain maximum number of phenomena is a tacit motive in all sciences, at least their theoretical disciplines. On the top of that it has been proven as a very successful one both on theoretical as well as empirical levels. The onset of this trend may be located in Newton's works where he unified different phenomena such as, celestial mechanics, earthly tides and falling bodies into the law of universal gravity. Maxwell followed this trend in unifying the apparently distinct phenomena of electricity and magnetism into a unified electromagnetic theory. Einstein unified the notions of space, time, matter, energy and gravity into an even more general theory and started a program of unifying the fundamental forces of nature in a framework today known under the name of "The Grand Unification".

Aside of this type of unifying tendencies, but closely related to them, yet another type of unifying approach emerged at the start of the second half of the 20-th century with works in condensed matter physics (Landau, 1969). This tendency is characterized by connecting different sciences through finding deep analogies among seemingly unconnected phenomena. Already at the start of 60-es a very fruitful link was established between condensed matter physics and elementary particle physics (e.g. Englert & Brout, 1964; Higgs, 1964) and non-equilibrium physics (Haken, 1964) and the successes of explanation of phase transitions in late 60-es and early 70-es (Kadanof, 1966; Wilson, 1975) was paralleled by similar progress in non-equilibrium chemistry (Glansdorff & Prigogine, 1971) and shortly after in the nonlinear dynamics (e.g. Cvitanović et al, 1984). Already at the end of 70es and in early 80-es first works appeared explaining the animal and human movement organization (Kelso et al., 1979) relevant to sports sciences as well as sociology of groups (Isnard & Zeeman, 1974) using similar concepts as those in the aforementioned areas of science. The advent of neural networks and the protein folding models provided a strong boost to the spreading of these ideas in general biology (Hopfield, 1982; Wolynes et al., 1995, Pollak & Chin, 2008). This wave of applying general explanatory concepts in

diverse fields of research is growing in an ever increasing rate as if it is guided by a positive feedback loop, suggestive of the spontaneous self-organizing transition phenomena.

Hence, the main aim of the research was to examine the changes within the linguistic, i.e. conceptual, landscape profile of scientific fields under the absence and presence of general explanatory principles coming from the nonlinear dynamic systems theory (NDST) and statistical physics (SP) (NDST-SP onwards) in diverse scientific fields. Specifically, we aimed at modeling of the conceptual space of science as a self-organizing system emphasizing sports sciences position within it. Due to the limited space, on the next few pages will be presented the preliminary outline of the results of the investigation undertaken to reveal the change of scientific language within the past several decades. Particularly, we aim to show hallmarks of scientific conceptual self-organization within the language space as represented by a dimension reduction and information compression effects.

## METHOD

### Sampling of concepts and literature

Characteristic concepts from 10, classically widely separated scientific fields, such as: elementary particle physics, cosmology, molecular physics, chemical reactions, cell biology, neurobiology, psychological processes, motor behavior, collective sports research and sociology of groups; were treated as linguistic degrees of freedom. In the first phase, for each scientific discipline 35 basic explanatory and empirical concepts were used. Concepts were extracted from contemporary university and high school textbooks. The concepts which defined the chapters, headings and subheadings were first extracted and then the rest of the most frequent generic concepts within each part of textbooks. Experimental apparatus, data extraction concepts as well as pure mathematico-technical terms were not taken into account. The following general explanatory concepts coming from NDST-SP were used: self-organization (self-assembly or soft-assembly), collective modes (order parameter, collective coordinate or variable, reaction coordinate), control parameter or variable, phase transition, bifurcation, symmetry-symmetry breaking, stability, instability (loss of stability), metastability, criticality (critical point or mani-

fold), gradients, scalar field, vector field, attractor, repeller, entropy-information, network.

The second phase of the data collection consisted of Internet search of published scientific papers from the previously mentioned scientific fields archived in relevant databases, such as Scopus (Science Direct), Web of Science, Google Scholar, ArXiv. The sample papers from each of these fields were taken from pertinent impact factor journals. In total 1276 papers were collected over a period of one year (May 2011 – April 2012). A co-word analysis was performed, that is, combined expressions consisting of previously extracted scientific concepts and concepts from NDST and SP were searched for each scientific discipline. This procedure enabled us to detect the presence or absence of NDST-SP explanatory concepts in each of the scientific disciplines and, among the other, to detect roughly the periods when such combinations first emerged in the scientific literature.

### Methods of analysis

Each conceptual space of scientific fields was represented by a binary vector. The value of 1 was assigned to the concepts that existed in the scientific discipline and the value of 0 otherwise. Salton's cosine similarities were first calculated for each pair of scientific disciplines. The dimension reduction of the initial cosine similarity matrix was conducted using cluster and hierarchical principal component analysis (HPCA). The results of the cluster analysis were presented elsewhere (Hristovski, 2012). Due to the space restrictions we present here only the results from the HPCA analysis. Distances  $d$  between science fields were calculated as  $d = 1 - q$ ; where  $q$  is the Salton's cosine similarity (the overlap order parameter) between the vectors which defined the conceptual spaces of scientific fields. The order parameter  $q$  as a measure of conceptual coherence was projected within the space of two principal components which gave visually tractable image of the position of scientific fields in the conceptual space spanned by those PCs. The plot of the  $d$  values between separate scientific disciplines within that space was conducted by a quadratic fitting procedure where the maxima corresponded to the actual  $d$  values between certain scientific disciplines. The average  $d$  value, for each cell, was then projected within the PC space. This procedure enabled a visualization of the structure of basins of

attraction, i.e. the domains of conceptual coherence, and the saddle points representing the linguistic barriers between scientific fields.

The maximum population entropy (Haken, 2000) was calculated for the system of PCs extracted under Kaiser-Guttman criterion and Varimax rotated, for assessing the information change and the degree of self-organization within the space of scientific language as a consequence of induction of the NDST-SP explanatory principles. Each principal component possesses a population entropy  $I_i = \ln \lambda_i + 0.5 \ln \pi + 0.5$ , where  $\lambda_i$  represents its eigenvalue. The total population entropy  $I_t$  of the PC system equals the sum of the individual population entropies of the extracted PCs. Lower entropies signify the reduction of information within the conceptual space, i.e. an increased coherence in the linguistic communication. The maximum of the population entropy means that it is calculated for the system of independent primary PCs. If they are not independent, but correlated, and reveal more simple secondary structure, the population entropy would attain smaller values.

### RESULTS AND DISCUSSION

For easier apprehension Figures 1 and 2 may be interpreted as a topographic map or landscape in which the deep-bordeaux color regions represent deep valleys (basins of attraction) belonging to certain scientific language and the deep-green regions the high plateaus of the landscape which maximally separate scientific languages. All other colors represent possible passages (saddle points) from discipline to discipline requiring less than maximal conceptual (informational) transformation for mutual communication. To pass from one valley to another one means to transform the language (pass over the hill or barrier) for some quantity proportional to the distance  $d$  as defined further in the text.

The absence of the NDST-SP explanatory principles lead to compression of the original 10 vectors to four PCs with eigenvalues  $\lambda_1 = 3.8$ ;  $\lambda_2 = 2.46$ ;  $\lambda_3 = 1.4$ ; and  $\lambda_4 = 1.02$  explaining 86% of the total variance. The reduction of dimensionality and the information compression is mostly due to the language similarities between neighbouring sciences. The primary PCs were weakly correlated and resulted in one secondary PC which was saturated mostly by the natural science concepts while other scientific disciplines were sharing less infor-

mation with this component possessing low projections. More on the interesting structure of the PCs is given in Hristovski, 2012).

In the absence of the NDST-SP explanatory principles the inter-science conceptual communication form a narrow channel and exist only as a consequence of linguistic nearest-neighbor interactions, whereas between the others there are maximal barriers given in deep-green color (see Fig. 1). The total maximal population entropy calculated for the four extracted primary PCs was  $I_t = 5.575$  nats (natural units). This state corresponds to the conceptual space of the high school and undergraduate university textbooks analyzed or to the explanatory connectedness between scientific disciplines by the early 70-es. The dominance of the nearest-neighbor and absence of long-range connectedness between scientific disciplines arises as a consequence of overlapping concepts mainly between neighboring disciplines. The attractor basin structure resembles a canyon-like configuration in which the path leads through small barrier saddles connecting neighboring scientific disciplines. The explanatory communication between more distant disciplines, say CR and PP or CS, needs a large, sometimes maximal conceptual, i.e. language, restructuring and thus represent pathways of exploration with vanishing probability. This means that a learner would hardly detect a

connection between distant scientific disciplines.

The presence of the NDST-SP explanatory principles lead to compression of the original 10 vectors to three PCs with eigenvalues  $\lambda_1 = 5.76$ ;  $\lambda_2 = 1.62$ ; and  $\lambda_3 = 1.04$ ; explaining 85% of the total variance. This significant reduction of dimensionality and information was a consequence of language similarities not only between neighbouring but also due to sharing common explanatory concepts between widely separated sciences. The primary PCs were strongly correlated and resulted in one secondary PC which was highly saturated by all scientific disciplines almost equally. See more on this in Hristovski, 2012).

The presence of the NDST-SP explanatory concepts, on the other hand, brings about lowering of the barriers and formation of a coherent linguistic domain enabling direct linguistic communication even between fields, classically deemed distant and unconnected, such as PP, MB or CS and CB on the one hand and EP or and CL on the other. The total maximal population entropy calculated for the three extracted primary PCs was  $I_t = 4.346$  nats, and it was lower than in previous case for about 1.23 nats or equivalently 1.77 bits, a clear consequence of information compression. According to Haken (Haken, 2000), the information compression within the system is a hallmark of self-organization and existence of increased

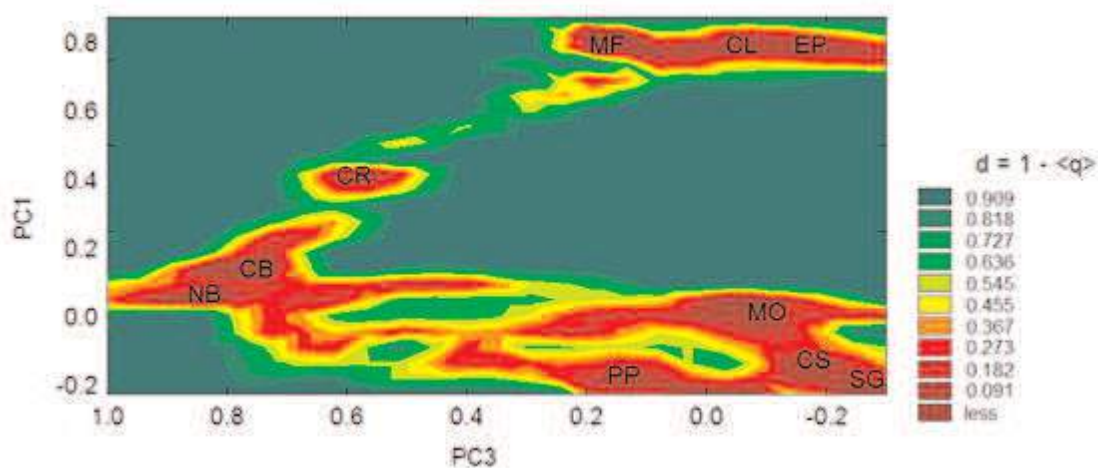


Fig. 1. Basins of attraction and saddle points between scientific fields in absence of general NDST-SP principles in the space spanned by the first and the third principal components (this combination was chosen for visual convenience). The communication between fields is constrained in a narrow channel between conceptually neighbouring disciplines. A state of low linguistic coherence. EP-elementary particles physics; CL-cosmology; MP-molecular physics; CR-chemical reactions; CB-cell biology; NB-neurobiology; MB-motor behavior; PP-psychological processes; CS-collective sports, SG-sociology of groups.

coherence. In other words NDST-SP explanatory concepts play the role analogous to catalysts in chemical systems which lower the barriers between the initial and final states, easing the transformation to occur. It is interesting to note that particularly the tendency of fragmentation between the domain of sport sciences and other scientific disciplines is being suppressed.

Generally speaking, whereas separate scientific fields *maintain* their context dependent language (inter-scientific conceptual distances  $d$  do not go to zero – see Fig 2), the general NDST-SP concepts form an embedding *explanatory* attractor basin within which a stabilizing synthetic knowledge becomes a feasible perspective. The learning process, then, may be defined as a hopping, metastable, dynamics within the general basin of attraction. It becomes obvious that the learning dynamics would be different in the two cases

fields a new emergent *explanatory pattern* is taking place in the last 2-3 decades, enabling a novel synthetic world view. General explanatory concepts or explanatory language play the role of correspondence which forms a stable link among the models of organized matter at different levels. Synthetic thinking thus, viewed epistemologically, becomes an emergent property of science based on the coherence revealed by the increase of the  $\langle q \rangle$  collective variable and the decrease of the populational entropy of the system. The property is emergent since the whole of scientific understanding becomes different than the specialized knowledge within each of scientific disciplines, however still containing the specific, context dependent explanations within each scientific discipline as special cases. Science reveals itself as a *complex learning system* whose macroscopic behaviour in the conceptual space is represented by the conceptual

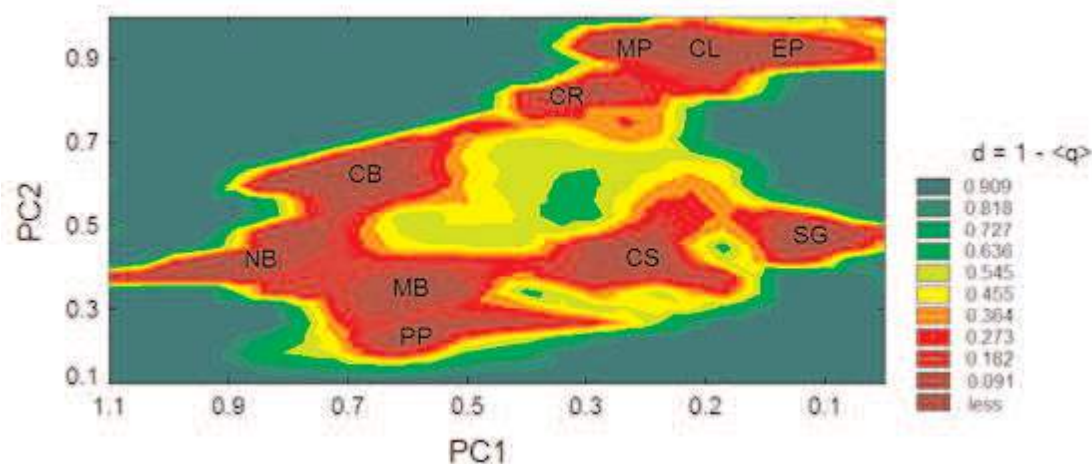


Fig. 2. Basins of attraction and saddle points between scientific fields in presence of general principles NDST-SP in the space spanned by the first two principal components. The communication between fields is confined in a narrow channel between conceptually neighbouring disciplines. A state of lower linguistic coherence. EP-elementary particles physics; CL-cosmology; MP-molecular physics; CR-chemical reactions; CB-cell biology; NB-neurobiology; MB-motor behavior; PP-psychological processes; CS-collective sports, SG-sociology of groups.

depicted in Fig. 1 and 2. Whereas in Fig. 1 the hopping dynamics is severely constrained within the narrow path connecting neighboring scientific fields, the basin of attraction depicted on Fig. 2 enables much more versatile hopping among fields and hence larger exploratory breadth.

Within this model scientific research may be envisioned as a self-organizing process embedded in the linguistic space in which as a result of cooperative, synergic, processes between scientific

overlap order parameter.

Empirical scientific concepts are basically context dependent where the context is formed by the energy and length scales of the system under study. The traditional explanatory concepts are context dependent as well. However, recent developments clearly progresses toward their explanation through more general and thus unifying theoretical framework. This theoretical framework may be called 'context free'. However, this depends on the

way we look at it. If we use the bottom-up strategy, the more general and hence more abstract explanatory terms become truly context free. Conversely, if we apply the top-down strategy, than, since these general explanatory concepts are valid for all levels, they become pluri-contextual, i.e. valid for each of the specific levels of organized substance. In this sense the emergent explanatory pattern is characterized by both: coherent explanatory skeleton, as well as *flexibility* through its context dependence.

The above-mentioned process of generalization is akin to the renormalization procedures used in statistical mechanics. In statistical mechanics the renormalization procedure tells us which parameters of the system remain valid for different description levels of the system under research. One renormalizes, or transforms, the system's model from microscopic toward macroscopic description and finds out that some parameter of interest, say temperature, stays relevant for all those levels. Other parameters of the microscopic description fade out as the scale of description gets larger. Hence, an accurate macroscopic description would be impossible without taking into account the temperature as a relevant parameter, but other microscopic variables may be neglected. Let's use this analogy and instead of physical variables we treat the explanatory concepts. In similar vein, the general concepts from SP and NDST survive the renormalization procedure, i.e. the change of levels of organized matter, and stay relevant, structurally stable, on each of them separately. They survive the coarse-graining transformation procedure of explaining the levels of description from micro to macroscopic, from quantum field and string theory to social systems. This may be envisioned as a special case of evolution, i.e. as a *scientific evolution under selective pressure*, which eliminates the context dependent concepts and stabilizes the context free ones as the fittest. Seen epistemologically, the role of the selective pressure here is played by the process of change of the level of description, or the level of substance organization, seen ontologically. Such general explanatory concepts point to the existence of a kind of *correspondence principle* penetrating across the levels of organized matter. In this sense the interplay of such general explanatory concepts at different levels of substance organization make the backbone of that very organization. A careful reader will also

notice that the very model of scientific language self-organization presented here is, in fact, based on the same explanatory principles belonging to the NDST-SP conceptual complex.

## INSTEAD OF CONCLUSION

### A brief note on possible applications of the synthetic thinking

In the previous text an attempt has been made to model the change within the scientific conceptual space heading toward larger explanatory linguistic coherence (Fig.2). This was not reflected in the structure of high school and undergraduate university textbooks (Fig.1). One of the reasons for this may be that these explanatory concepts are used dominantly within the frameworks of advanced formal models dealing with specific fundamental processes at each level. This, on the other hand, needs a minimum level of mathematical sophistication to be implemented. The enhanced migration of mathematicians and physicists in biological sciences already changed the picture in this realm of investigation. In future we might expect this migratory wave to proceed toward even more distant fields such as sports science and sociology and there are already such examples.

On the other hand, these general explanatory concepts are rather intuitive and may be implemented for the education purposes rather straightforwardly already at the high school education level, if not earlier, in the higher grades of elementary education in a form of a separate educational program. This stems from the very nature of the education program which would be not directed toward acquiring technical skills and specific knowledge, but toward forming a worldview underpinned by the unifying NDST-SP backbone of the scientific language. This would need a new profile of a teacher, a teacher who would play the role of a *catalyst* of the synthetic thinking on the tenets of what was described in the previous text. Similar to the catalysts in natural systems her/his role in the education would be to bring the specific, i.e. context dependent, scientific explanations closer to one another and enable students to couple them by lowering the informational barrier through the use of unifying explanatory concepts. The role of the synthetic thinking teacher would be one of an *enabler* or *facilitator* of explanatory synthesis. The role of physical activities and sports within this educational framework is wide and will

be discussed elsewhere.

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## СИНТЕТСКО МИСЛЕЊЕ ВО НАУКАТА (ЗА СПОРТОТ). САМООРГАНИЗАЦИЈА НА НАУЧНИОТ ЈАЗИК

УДК:796:001.8(05)  
(Оригинален научен труд)

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### **Апстракт**

Презентирана е скица на еден феноменолошки модел на само-организација во проситори на научни концепции со нагласок на позицијата на науките за спортиот. Добиениот модел има нерамна структура на вгнездени базени на привлекување и динамиката на учење е дефинирана како преминување помеѓу концептуалните проситори на посебните научни дисциплини, вгнездени во генералниот базен на привлекување. Трудот анализира како промената на специфичните и генералните објаснувачки концепции ја менуваат структурата и динамиката на учење. Кога концепциите со висока објаснувачка описност се описуваат структурата станува фрагментирана и взаемно слабо поврзана или повољно не поврзана што кореспондира со моменталната состојба во научното образование. Напроти тоа, кога таквите објаснувачки принципи се присутни, висината на јазичните бариери значајно опаѓа и системот од концепции се реорганизира во структура на поврзани базени на привлекување што овозможува обединување на привидно одделните области на знаење. Описните објаснувачки концепции играат улога на 'катализатори' кои ги намалуваат информациските бариери помеѓу концептуалните проситори на науките и обезбедуваат поголема веројатност за пронаоѓање на нивните меѓусебни врски. Понатаму накратко дискутираме како објаснувачките принципи од нелинеарната динамика и синхроничката физика можат да станат основа за еден нов вид на образовна програма и профил на ученик.

**Клучни зборови:** наука, наука за спортиот, образование, синтетско размислување, концептуална самоорганизација, самоорганизација на научниот јазик



## HALF SEASON CHANGES IN PHYSICAL FITNESS FOR THE HIGH LEVEL HANDBALL PLAYERS

UDC:796.322.015.132  
(Original scientific paper)

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### **Abstract:**

*To examine the characteristics and changes in physical fitness (PF) during the half-season period in advanced male handball players (MHP). 32 MHP (National 1<sup>st</sup> division players) served as the subjects. Herein we observed six morphological (M), two cardiovascular–endurance and six motor-status variables at the beginning (I), at the end of the half-season period (II), and at the end of the competition half-season (III). The differences between I, II and III were analyzed by an analysis of the variance (ANOVA). ANOVA showed significant I-to-II increases ( $p < 0.05$ ) in: cardiovascular endurance, agility and explosive-strength, while most of the measured variables remained unchanged from II-to-III. The pre-competition period led to significant improvements in most of the observed motor and endurance variables, regardless of high fitness level of the subjects. Meanwhile, no significant changes were found in M status supporting the considerations that substantial M changes are usually unexpected in mature, well-trained athletes.*

**Key words:** *team-sport, motor-endurance status, specific tests, physical conditioning*

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### **INTRODUCTION**

Limited information is available concerning the physical fitness (PF) status of elite handball players, especially bearing in mind the constant progress in game-dynamics and consequently – the unavoidable requirements in upgrading the PF profile (e.g. motor, endurance and morphological status) of athletes, especially after 2002 and changes in rules of handball game (e.g. after a goal has been scored, the referee restarts the game as soon as an attacking player is at the centre line and holds the ball). Precisely, scientific interest in studying PF in handball is observable, but it is very rare to find such studies where authors sampled the subjects of the non-questionable quality and/or measured the variables of high pragmatic validity and applicability in handball sport. Of course, such problems (e.g. the subjects and variables) are reasonable bearing in mind that: (a) handball players are mostly professionals, and (b) it is very hard to find a sample of equal quality in the same geographic location at the same time. Therefore, (a) athletes, but even more – their coaches, do not of the approve relatively complicated, time consuming and physically demanding fitness testing procedures, and (b) if such a condition is even met –

scientists have a problem to assemble the appropriate number of subjects and to achieve statistical significance in the interpretation of the results. It is evident from the recent studies performed on female handball athletes<sup>1-4</sup>.

A one-year, or a one-season period for league sports can be divided into two half-season periods. Both, the first and second half-season consist of the pre-season (pre-competition; Pre-C) and the competition period. In professional handball (also known as team-handball), the Pre-C period in the first half season can be considered as “the main preparation period”, because of its longer duration (6-9 weeks), compared to the one in the second half-season (3-4 weeks). During the Pre-C, the characteristic training programmes are done, primarily aimed to improving the basic and specific motor and endurance capacities of the athletes (e.g. physical conditioning). As the competitive season approaches, specific training is increased. In the competition period (the competitive season), the high-level handball teams play two, or even three official games a week. It is generally accepted that competition efficacy is highly dependent on PF status, which means that a high competitive level can not be achieved without the appropriate mor-

phological and proper motor and endurance status level, almost exclusively obtainable during the preseason period<sup>5-7</sup>.

Apart from the studies that have observed and investigated some health-related problems, and specific training programmes in handball<sup>8-9</sup>, as far as the authors of this paper know, the determination of PF changes dynamics, during the half-season period, is rarely registered in advanced male handball players. Furthermore, it is still not known whether fitness gains attainable during the Pre-C period can be successfully maintained over the duration of the competition season.

Consequently, the aims of this study were:

to define the PF profile in advanced male handball players (MHP)

to define the changes in the PF profiles in MHP, during the half-season period separately for the Pre-C and competition period

## MATERIALS AND METHODS

*Subjects:* Originally, thirty two MHP from two Croatian advanced handball teams, each consisting of sixteen players were used as the sample. Throughout the investigated periods, all the subjects took part in the National League, National Cup and International Handball Federation (IHF) Cup (second most superior European handball Cup) at almost equal dynamics.

*Variables:* The morphological variables included: body height (BH), body weight (BW), triceps skinfold (TrSF), subscapular skinfold (SSSF), abdominal skinfold (AbSF), thigh skinfold (ThSF), calf skinfold (CaSF), spinailiaca skinfold (SISF), hand span (HS), arm span (AS), calculated body fat percentage (BF%) and lean body mass (LBM). The BW was measured by a digital scale wearing shorts and no shoes (on 0.1 kg), BH was measured using a measuring scale fixed on to the wall at maximum inspiration (to the nearest 0.5 cm), circumferences and spans were measured by measuring tape, ruler and anthropometer, and the skinfolds using the Lange calliper. BF% was calculated using the formula:  $BF\% = (TrSF + SSSF + AbSF + ThSF + CaSF + SISF) \times 0.1051 + 2.585$ ; and  $LBM = BW - Fat\ Body\ Mass$  (Fat body mass =  $BW \times BF\%$ )<sup>10</sup>.

The cardiovascular – endurance status was determined using the maximal multi-level 20-meters shuttle run endurance test (SR20M). In brief, the SR20M test was measured in a group of

six athletes in a handball gym (wooden floor), using the CD player for the reproduction of the running-tempo sound signals (the number of consecutive levels-plus-sub-levels was noted). The motor variables were as follows: Flexibility - sit and reach (S&R) and maximal shoulder circumduction (SC); Power – countermovement jump test (CMJ), and alternate leg triple jump test (TJ); Agility - hexagon test (HEX) and 20 m agility test (A20M). Briefly, the S&R test is measured as maximal over-toes reach distance from the sitting position, with legs fully straighten at the knees; SC as the minimum distance between the palms in both-arm circumduction, while holding the measuring stick with both elbows fully straighten; CMJ is measured as a difference between standing reach-height and one arm jump height from the standing position (using Elan/Slovenia jumping-equipment); TJ as the distance routed in a triple alternate-leg jump from the standing starting position (both legs - right leg – left leg – both legs; or vice-versa); HEX as the time (measured electronically by Brower Timing System, USA) required to perform 18 (3 x 6) double leg hops from the centre of a hexagon over each side and back to the center in a continuous clockwise sequence (drawn on the floor, the hexagon sides are 61 cm long meeting to form 120 degrees angles); and A20M is measured as the time (Brower Timing, Draper/UT/USA) needed to perform simple a 4-time-5-meters shuttle run (4x5 meters run in opposite directions).<sup>11-14</sup>

For the multiple-item tests (all variables with the exception of cardiovascular endurance tests) reliability indicator Cronbach-Alpha ranged from 0.79 (HEX) to 0.97 (S&R) in the motor tests, and 0.81 (abdominal skinfold) to 0.99 (BH) in the morphological tests. For the single-item variables, average correlation coefficients (average correlations between three measurements – see later text) were above 0.80, all defining acceptable to high intraobserver reliability of the tests.

*Experiment:* The first testing (I) was performed during the first week of the pre-competition period. The morphological variables and endurance status were measured on Monday; flexibility, explosive strength and agility tests on Tuesday, while Wednesday was a spare day (for eventual non-completed testing); all after 10-15 minutes warm up and light stretching, with no intensive training on the preceding day. The Pre-C period

Table 1. Descriptive statistics and significance of the analysis of the variance for the repeated measures in the first, second and third measurement

HIGH-LEVEL	First	Second	Third
	measurement	measurement	measurement
	X ± SD	X ± SD	X ± SD
BH (cm)	190.00 ± 6.88	191.05 ± 6.66	190.09 ± 6.31
BW (kg)	90.28 ± 4.21	91.52 ± 4.99	91.25 ± 4.22
BF% (%)	10.97 ± 2.40	10.01 ± 2.13	10.18 ± 2.34
LBM (kg)	80.42 ± 4.14	82.48 ± 4.22	81.98 ± 4.18
HS (cm)	24.71 ± 1.21	24.72 ± 1.23	24.99 ± 1.31
AS (cm)	193.34 ± 8.23	194.23 ± 8.11	192.89 ± 8.13
SR20M (level/sublevel)	8.79 ± 1.31	10.23 ± 1.39 <sup>a</sup>	10.07 ± 1.20 <sup>a</sup>
VO <sub>2</sub> (ml kg <sup>-1</sup> min <sup>-1</sup> )	56.00 ± 3.43	59.81 ± 3.50 <sup>a</sup>	59.31 ± 3.00 <sup>a</sup>
S&R (cm)	13.12 ± 4.82	15.20 ± 5.44	15.39 ± 5.01
SC (cm)*	95.56 ± 18.59	93.31 ± 16.55	93.94 ± 14.93
CMJ (cm)	51.06 ± 6.67	57.51 ± 7.86 <sup>a</sup>	56.32 ± 8.38 <sup>b</sup>
TJ (cm)	700.71 ± 45.04	761.71 ± 41.14 <sup>a</sup>	730.50 ± 45.58 <sup>ab</sup>
HEX (s)*	10.80 ± 1.13	9.92 ± 1.03 <sup>a</sup>	10.03 ± 1.03 <sup>a</sup>
A20M (s)*	5.02 ± 0.27	4.81 ± 0.20 <sup>a</sup>	4.99 ± 0.24

LEGEND: body height - BH, body weight - BW, calculated body fat percentage - BF%, lean body mass - LBM, hand span - HS, arm span - AS, maximal multi-level shuttle-run endurance test - SR20M, maximal relative oxygen consumption - VO<sub>2</sub>, sit and reach - S&R, maximal shoulder circumduction - SC, countermovement jump test - CMJ, alternate leg triple jump test - TJ, hexagon test - HEX, 20 m agility test - A20M; <sup>a</sup> significantly different from the First; <sup>b</sup> significantly different from the Second; \* ability improvement is observed as a numeric decrease

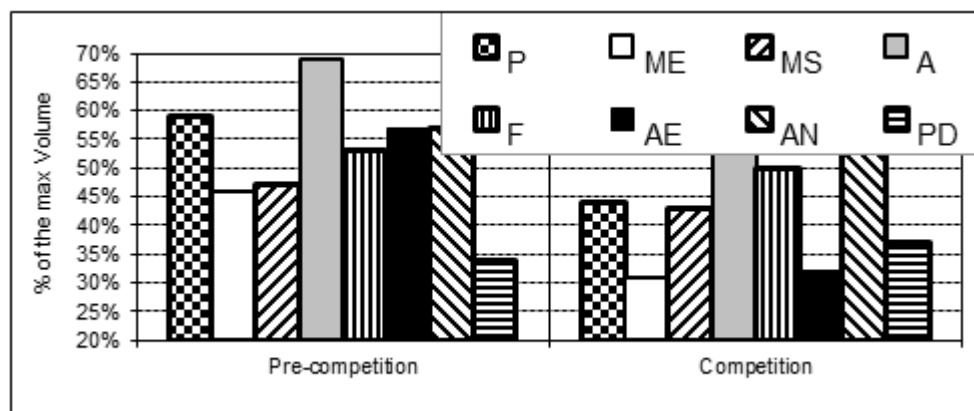


Fig. 1. - Percentage of the maximum volume of the training for each component in the pre-competition and competition period; P - power (explosive strength); ME - muscular endurance; MS - maximal strength; A - Agility; F - flexibility; AE - aerobic endurance; AN - anaerobic endurance; PD - practice drills

lasted 7 weeks, consisting of 2-4 weekly sessions for practice drills and competitive, non-official games and of 8-10 weekly sessions aimed at physical conditioning. The subjects participated in the second (II) testing from the fifth (Monday) to seventh (Wednesday) day after finishing the Pre-C period (5 - 7 days after the last serious training session, with a preceding day-off (Sunday)). The II testing was completed at the same dynamic as the

I one. The competition period (between the II and III testing) lasted 14 weeks and consisted of 1-3 weekly physical conditioning sessions, 4-6 practice drills sessions and 1 - 3 official games (National Championship League, National Cup and IHF Cup at almost equal dynamics for both teams). The third testing (III) was performed a week after the final official game in the competitive half-season the same way as II testing. The

Pre-C and competition seasons' training and workouts for all the subjects were planned, programmed and instructed by one of the authors of this study.

The main scope of the investigation was the motor and endurance status, so all of the measured morphological variables (skinfolds) are not presented in the tables, but only those variables calculated on the basis of the measured ones (BF% and LBM). However, authors will be pleased to provide all details regarding non-presented data to all interested parties.

*Statistical Analysis:* In spite of the descriptive statistics (Mean, Standard Deviation), the differences between the I, II and III test results have been established using the repeated measurements analysis of variance (ANOVA). ANOVA was calculated between: the I and II (I-II), the II and III (II-III), and between the I and III testing results (I-III), for each group separately. The ANOVA coefficients were considered significant at a level of 5%. All the calculations were made using the *Statsoft's Statistica ver 6*.

Finally, we would like to mention that we purposely used the motor-endurance tests where the body size have a significant influence on the subjects' results, because we were of the opinion that in a sport like handball, where athletes body dimension (BH and BW mostly) is directly related to different sport-specific movement patterns (jumping, running, etc.), an assessment of any kind of muscle capability has to be performed taking into account the effect of the body's dimensions<sup>13-14</sup>. Also, since measurements and publication of the data are approved by the National sport authorities, and all subjects gave their informed consent, this study was not exclusively scientifically oriented, but intended to be applicable in the sport of handball also. Therefore, most of the tests used are relatively simple to perform which will allow all interested parties to test their athletes and compare the observed results here presented regardless of the available equipment.

## RESULTS

In Table 1, the descriptive statistics and the significance of the differences between the first (I), second (II) and third (III) measurements are shown.

None of the six morphological measures changed significantly from I to II. Also, between II and III measurement (II-III) no significant morphological changes are observed.

The subjects improved their performance in six of eight of the motor-endurance tests during the Pre-C period, and most of PF measures remained relatively stable during the competition half-season (between the II and III measurement). More precisely, although some of the results decreased during the competitive half-season (A20M for example), the positive changes achieved during the Pre-C period (I-II) allowed for maintenance on a generally significantly higher level in the III, than in the I measurement.

## DISCUSSION

### *Physical fitness profile of advanced male handball players*

The BW and LBM values observed herein are very similar to the values previously reported in high-performance handball teams. For example, in one of the rare study dealing with the MHP of exceptional quality published so far, Gorostiaga et al. (2005)<sup>15</sup> presented data of one of the world's leading handball team and defined  $95.2 \pm 13$  kg;  $81.7 \pm 9$  kg for BW and LBM respectively. Probably, the higher variability (standard deviations) of the results from their study is a consequence of the different approach in the sampling of the subjects (explained in the Method section). Rannou et al. (2001)<sup>7</sup> presented values of French MHP (National and International level). When comparing those data and the here presented ones, we found similarity in BH (190 cm in French Internationals) and  $VO_2$  ( $58.7 \text{ ml min}^{-1} \text{ kg}^{-1}$ ), but also some lower values of BF% in Croatian comparing to French MHP (12 – 13%). Our opinion is that there are two possible reasons for such difference in the BF%. First, as stated in the Introduction, handball rules changed in 2002, which undoubtedly increased dynamics of the play, and probably (although not extensively studied) determined body build of athletes. Second, it is possible that Rannou and his associates included goalkeepers in their study<sup>7</sup> (not specified in their text) which could increase the average values of the BF% in their sample.

### *Physical fitness changes during the half season period*

The significant improvements in the motor and endurance status variables, during the Pre-C were mostly expected, because of the characteristic training-aim of the Pre-C season period. In this period, the training was primarily focused on an improvement of the motor and endurance status

(physical conditioning). Characteristics of this particular period are shown in Figure 1.

Handball is a high-power game. Explosive movements, sprints, repeated jumps and a direction change, requires an extreme power level, which has to be accomplished with mounting agility. Today, it is generally accepted that power and agility, like endurance performance, can be considerably improved with training. But, mainly because of the sampled athletes' level and their relatively high power-status, the changes in the power (explosive strength) and agility variables were not expected at the quantities achieved (Table 1). We share the opinion of some authors<sup>16</sup> that strength training especially plays a key role in agility development. Accordingly, during the Pre-C period all athletes performed 1.8 strength training workouts and 1.7 power training workouts on average every week. But, we can not be sure regarding direct and/or indirect influence of different training programs on agility improvement we are discussing. Namely, although agility (ability to change direction and start and stop quickly) represents an important motor quality for the successful performance in various sports little is known about its physiological and muscular determinants<sup>17</sup>.

However, no significant II-III differences in the agility variables are very encouraging. It indicates that agility, power (explosive strength) and anaerobic-endurance workouts which occupied a significant part during the competition period (1.8 per week) complied with the practice drills (2.2 per week) and official games played, was quite enough stimuli to maintain the agility on a level achieved in the II measurement (after the Pre-C period). It directly relates to one of the questions we emphasized in the introduction, regarding the possible maintainability of the fitness gains attained during off-season training programmes (Pre-C period).<sup>18</sup> It seems that, the agility level achieved during the Pre-C period can be successfully maintained during the handball half-season competition period.

During the Pre-C period all the subjects performed 57% of the theoretic maximum volume in the aerobic endurance training, meaning that of the theoretic maximum for a single week (5 aerobic endurance workouts per week) the athletes performed (on average) 2.85 workouts aimed at improving their aerobic endurance capacities (note that 2.85 is 57% of 5, and the same logic should be followed for other training components in this

text). Contrary to this, during the competition period (between the II and III measurement), they participated in on average (only) 0.66 aerobic endurance training-sessions per week. Therefore, the decrease (although not significant) in endurance capacity ( $\text{VO}_2$ ) is not surprising if we pay attention to the obvious difference in the aerobic endurance training characteristics, that is, between the Pre-C and competition period (see Methods - Experiment).

However, it seems that explosive strength training may lead to specific neural adaptations, such as an increased rate of activation of the motor units, which will potentially affect the muscle power and movement (e.g. running, swimming, etc.) economy. Paavolainen et al. (1999)<sup>19</sup> in their paper, when proved the significant influence of explosive strength training on the 5-km running in endurance trained athletes, presented a model of determinants of distance running performance. Model includes three segments potentially involved in endurance performance: (1) aerobic power, (2) anaerobic power, and (3) neuromuscular capacity (including neural control, muscle forces and running mechanics). (1) Aerobic power can be almost exclusively developed through endurance training; (2) anaerobic power equally through (a) endurance training, and (b) strength and sprint training; while (3) neuromuscular capacity is practically completely related and can be develop throughout sprint and strength training. To conclude regarding our results - it is possible that not only aerobic and anaerobic endurance training, but also explosive strength training initiated significant improvements in the endurance capacities in the MHP we studied here. It mainly relates to the competition period, where aerobic endurance training took a minor part of the complete training volume, but no significant decrease in the aerobic endurance was observed. Of course, the authors are aware that these conclusions are partially speculative, and therefore have to be precisely investigated in some future studies.

We are of the opinion that the changes in flexibility are not adequate and satisfactory (no significant differences in any of the studied flexibility variables in both groups). Knowing the high trainability, a significant improvement in flexibility was expected. For example, Zakas et al. (2003)<sup>20</sup> published a study where presented the effects of stretching during warming-up on the flexibility in junior handball athletes. They studied the improve-

ment in flexibility as a result of the warm up and stretching exercise in junior handball players, and found significant improvements in flexibility and concluded that it improves as a result of muscle elongation during warming-up or even through an incorporated pathetic stretching program. Therefore, from a professional point of view, the results of our study can not satisfy us. The subjects in our experiment participated on average 5% of each training session (5-10 minutes) in flexibility training (proprioceptive stretching, passive and active stretching, and relaxation techniques), with no difference in volume of the flexibility training between the Pre-C and competition period (see Methods). It seems that although regularly performed flexibility training was not adequate in volume (5-10 minute of each training session, while Zakas and his associates in the previously cited article <sup>20</sup> reported significant improvements in flexibility with 20 min workouts). An additional possibility is that the athletes in our experiment did not execute the flexibility workouts properly. In particular, most of the characteristic stretching workouts and exercises are self – controlled by the athlete himself. In other words, there are no quantitative parameters in the evaluation of the intensity of flexibility training (e.g. a lifted weight in strength training, and/or heart-rate during the cardiovascular endurance training, etc). Consequently, coaches are not able to supervise a flexibility workout as they can supervise some other conditioning program (for example - strength and/or endurance training). As a conclusion, the authors are of the opinion that in future training programs, higher standards in flexibility training have to be designed, by means of (a) increasing the total volume of the flexibility training, and (b) assuring a certain control of the training standards and quality.

It is interesting that the morphological changes are not as significant as the motor-endurance changes (see Results). The authors are of the opinion that the main reason for the above stated can be found in the initial morphological status of the subjects (highly trained – athletic physique). Certain support to our conclusion can be found in some recent studies performed on high level athletes from different sports. Most of the studies performed on the well-trained athletes showed similar trends for most of the morphological variables in different season-periods. <sup>21-23</sup> As a brief review,

Casajus (2001)<sup>21</sup> found no significant seasonal 5-month variation (from September to February) in BW, although observed a statistically significant decrease in BF% and the sum of six skinfolds (note that we found significant decrease in the BF% for the TOP-LEVEL group); while Gabett (2005) <sup>22</sup> presented comparable results when studied rugby players during the competitive season. Finally, Schmidt et al. (2005) <sup>23</sup> showed no significant changes in BW, BF%, and LBM from pre- (late October) to mid- (late January) to postseason (late March) in college wrestlers, not surprising knowing that wrestlers are like other martial art athletes very concerned about their weight limit and consequently BF%. Accordingly, we can support the considerations that substantial morphological changes are usually unexpected in mature, adult, previously well-trained athletes.

## CONCLUSION

Based on the results presented and discussed herein, the following conclusions can be drawn.

It seems that the agility level achieved during the Pre-C period can be successfully maintained during the handball half-season competition period. But, since agility slightly decreased during the competition half-season period, it is reasonable to suggest that in the following preparation period (2<sup>nd</sup> half-season Pre-C period) coaches should try to improve agility (again), because of the second competitive half-season.

Handball athletes of a high level must attend 1-2 aerobic exercise sessions weekly, if aerobic endurance status is being aimed at as a training goal.

Since improvements in flexibility during the half season period were relatively low we can suggest certain control of the flexibility training standards and quality (for example: permanent and not only periodical testing, using exercises where a confident definition of the training intensity can be realized, etc.).

Finally, we are of the opinion that an improvement in the PF can be achieved almost exclusively during the Pre-C periods. In this manner, understanding and foreseeing the changes-dynamics during the half-season period is probably one of the most important factors in handball, but also in other league sports (like basketball, football, etc.).

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## ПОЛУСЕЗОНСКИ ПРОМЕНИ НА ФИЗИЧКАТА ПОДГОТВЕНОСТ КАЈ ВРВНИТЕ РАКОМЕТАРИ

УДК:796.322.015.132  
(Оригинален научен труд)

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### **Абстракт**

*Цел на трудот беше да се утврдат индивидуалните промени во мерките за проценување на нивото на фитнесот кај врвните ракометари од маички пол. Во приерокот влегоа 32 ракометари кои играат во прва лига. Следена е состојбата на шест морфолошки, две варијабли за проценување на кардиоваскуларната издржливост и шест моторни варијабли. Испитаниците се анализирани на почетокот на подготвителниот период (I), на крајот на подготвителниот период (II) и на крајот на полусезоната. За да се утврдат промените меѓу мерењата применета е униваријантна анализа на варијансата (АНОВА). Меѓу првото и второто мерење АНОВАТА покажа значајни промени во кардиоваскуларната издржливост, агилноста и експлозивната сила, додека во повеќето мерки не настанале статистички значајни промени меѓу II и III мерење. Подготвителниот период довел до значајни промени во повеќето моторни тестови, без разлика на високото ниво на натпреварувачкиот квалитет на спортистите. Истовремено не настанале значајни промени во мерките за проценување на морфолошкиот статус, со што се потврдува хипотезата дека тешко можат да настнат морфолошки промени кај добро тренирани спортисти.*

**Клучни зборови:** *екипен спорт, моторичко-функционален статус, специфични тестови, физичка подготвеност*



## THE IMPACT OF MOTIVES FOR ENGAGING IN PHYSICAL AND SPORTS ACTIVITY WITH DIFFERENT LEVEL OF PHYSICAL ACTIVITY

UDC:796.03:316.644-057.847

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### **Abstract**

*A survey with the main objective to determine the influence of motives for engaging in physical sports activity, attitude to sport, socially perceived support from friends and family of students with different levels of physical activity was conducted on a sample of 749 subjects aged 11 to 14 years, divided into two sub-samples- 349 male respondents and 391 female respondents. In order to realize the objectives of the research the first and second sub-sample is divided into two specific groups depending on whether students are engaged or not in organized sports. The motives for physical activity are estimated using the scale Behavior Regulation Exercise Questionnaire (BREQ) and Motives For Physical Activity Measure - Revised (MPAM-R), while the attitude towards the sport is valued with Kneer inventory of positions. The Differences are processed by using multivariant and univariant analysis of variance (ANOVA and MANOVA). From the obtained results it can be concluded that girls of middle school age which have different degree of physical activity show higher values in most variables which are used to assess the degree of the autonomous motivation towards physical-sport activity. The greatest differences are defined in an internal regulator - intrinsic motivation, autonomous index of the strength of self-regulation motivation to physical activity, which is a construct of the internal motivation theory. The boys from middle school age which have recommended physical activity show higher values in all seven variables which are used to assess the degree of motivation towards physical-sport activity. The greatest differences are defined in the variables which are constructs of internal motivation theory.*

**Key words :** *students, motivation, sports activities, analysis of variance*

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### **INTRODUCTION**

Internal (intrinsic) motivation means performing the activity because the individual wants it, enjoy it, it is interesting for him / her and is a challenge. The other regulation motivation mechanisms can be found between these two extremes. In the external regulation of motivation the activity is pursued because of some external orders or awards, and it is the least autonomous. In the introduced regulation of motivation the individual participates in the activity but does not accept it as "authorial" own. He/she performs the activity in order to avoid care / anxiety or to boost the ego. The identified motivation regulation is a result of awareness of the value of the activity, and the very action is accepted as significantly important.

Integrated motivation regulation occurs when the regulation of behaviour evolves and when it fits in certain system of values and needs. This is the most autonomous form of motivation extrinsic motivation.

Giving more importance to the intrinsic motivation is positively associated with indicators of general good standing – self-confidence. People sometimes give greater importance to goals that they do not achieve (e.g. material gains). Young people who have been exposed to non-sensitive, controlled motherly care, are more materially oriented. Fulfilment of basic psychological needs is crucial to experience pleasant feeling and daily wellbeing.

The theory of self-determination can be used to

help one understand why children and young people are dealing with physical activity and if they intend to do so in the future. However, personal motives for physical activity are also important. The most common motives identified among people engaging in physical activity are: to improve or keep their health, improve physical appearance, pleasure, desire for competition, social experiences and getting psychological benefit. Motives that are regulated by external motivational regulator (eg. improving physical appearance) can not be lasting as those essential (e.g. enjoyment, social and psychological).

Having regard to the above mentioned, this study has been initiated in order to determine the influence of motives for engaging in physical sports activity, attitude towards the sport, socially perceived support from friends and family of students with different levels of physical activity.

## METHODS OF WORK

The survey conducted on a sample group of 749 subjects from the chronological age of 11 to 14 years (students from fifth to eighth grade). The sample is divided into two sub-samples - 349 males and 391 respondents were female. The first and second sub-sample is divided into two specific groups depending on whether students are engaged or not in organized sports. The data on whether respondents are engaged or not engaged in organized sport were obtained by a questionnaire. The motives for physical activity is estimated by the scale Behaviour Regulation Exercise Questionnaire (BREQ) which is construed by Mullan, Markland, and Ingledenj (Mullan, Markland, and Ingledenj, 1997), consisting of 15 items and is of Likert type and is divided into several sub scale including: external regulator – external regulation, regulator fault - introjected regulation, identification regulator - identified regulation, internal regulator - intrinsic motivation. The four subscales also provide autonomous power index of self-regulation motivation for physical activity that is calculated with the following formula:  $(-2) (EXT) + IJ + ID + 2 (IM)$ .

The second scale estimates what motivates young people to be physically active and it is known as the Motives For Physical Activity Measure - Revised (MPAM-R). It estimates five motives, i.e. what makes young people engage in physical activities such as: interest / enjoyment,

competitive challenge, appearance, fitness, social. Scale is of Likert type, fifth degree, is composed of 30 items, designed by Fredrick & Rdzan (Fredrick & Rdzan, 1993) and modified by Ryan, Frederick, Lepes, Rubio, and Sheldon (Rdzan, Fredrick, Lepes, Rubio, and Sheldon 1997). It showed good measurement characteristics.

Scale that will assess students' attitudes towards the sport consists of 24 particles (items) and is of Likert type - Kneer inventory positions. The 24 items are 12 positive and 12 negative formulated.

Differences between students who are engaged and deal with organized sports are determined by multivariate and univariate analysis of variance (ANOVA and MANOVA). Data are processed with statistical package SPSS for Windows Version 17.0.

## RESULTS AND DISCUSSION

In order to determine whether there are differences in motives for physical-sport activity, attitude towards sports, perceived social support from friends and parents among boys of middle school age who have different level of physical activity it is applied multivariate and univariate analysis of variance (MANOVA, ANOVA). The results of multivariate and univariate analysis of variance and the size of the partial effect (partial  $\eta^2$ ) are presented in Table 1.

For that purpose previously it was performed classification (categorization) of respondents into two categories, according to the recommendations of the World Health Organization, the Commonwealth Health Organization, as well as on the basis of the conclusions of International conference on physical activity in adolescents, in respondents having physical activity recommended and respondents having occasional physical activity.

It is obvious from Table 1 that on multivariate level there are statistically significant differences determined between boys from middle school age having different levels of physical activity. Wilkins-Lambda amounts 90, which Rao's R approximation of 3.10 and degrees of freedom DF (1,2) 12/336, make the differences statistically significant with the highest statistical probability ( $Q = .00$ ). Partial effect of the interaction of multivariate middle level shows the mean impact effect.

Because of it, the analysis of the individual

Table 1. Multivariate and univariate differences in motives for engaging in physical sports-active attitude, socially perceived support from friends and family motivation between the different levels of physical activity

Wilks' Lambda	Rao's R	df 1	df 2	Q	n <sup>2</sup>
,90	3,10	12,00	336,00	<b>,00</b>	,10

	Lower phys.act.		Physical activity		F	Q	n <sup>2</sup>
	Mean	SD	Mean	SD			
External_regulation	2,28	0,97	2,14	0,89	2,06	,15	,01
Introjected_regulation	3,02	1,03	3,23	1,05	3,72	<b>,05</b>	,01
Identified_regulation	3,99	0,69	4,32	0,59	23,12	<b>,00</b>	,06
Intrinsic_regulation	4,23	0,65	4,34	0,56	2,99	<b>,08</b>	,01
Relative_Autonomy_Index	4,87	2,33	5,50	2,32	6,35	<b>,01</b>	,02
Interest Enjoyment	4,14	0,57	4,26	0,54	3,88	<b>,05</b>	,01
Competence	4,18	0,68	4,41	0,57	11,54	<b>,00</b>	,03
Appearance	3,94	0,75	4,10	0,77	4,21	<b>,04</b>	,01
Fitness	4,43	0,55	4,50	0,55	1,44	,23	,00
Social	3,46	0,90	3,61	0,92	2,39	,12	,01
STAV	3,82	0,52	3,91	0,59	1,84	,18	,01
Social support for friend	2,19	0,94	2,30	0,95	1,19	,28	,00
Social support for family	3,22	0,69	3,35	0,71	3,03	,08	,01

contribution of each variable was carried out to define these differences. According to the values of the level of statistical significance of differences between arithmetic one can see that there are statistically significant differences in variables fault regulator - introjected regulation, identification regulator - identified regulation, internal regulator - intrinsic motivation, autonomous index of the strength of self-regulation motivation to physical activity, interest / enjoyment, challenge and competitive outlook. Partial effect of factors that determine partial - n<sup>2</sup> is ranked among 0,02 to 0,06 and shows a small to medium effect on impact. The greatest effect of impact shows identification regulator - identified regulation (partial - n<sup>2</sup> = 0,06).

Boys of middle school age who have physical activity recommended show higher values in all seven variables that assessed the degree of motivation to physical-sport activity. The largest differences are found in variables that are constructs of the internal motivation theory (Intrinsic Motivation Theory) motives that are stronger in terms of external motives (Stucky-Ropp and DiLorenzo 1993; Tinsley et al. 1995).

It is obvious from Table that the multivariate level shows statistically significant differences between girls middle school age who have differ-

ent level of physical activity. Wilkin's Lambda is 0.91 which Rao'sR approximation of 2.98 and degrees of freedom DF (1.2) 12/378, making differences statistically significant with the highest statistical probability Q = .00). Partial effect of the interaction of multivariate middle level shows the impact effect. Consequently, the analysis of the individual contribution of each variable was carried out to define these differences. According to the values of the level of statistical significance of differences between arithmetic one can see that there are statistically significant differences in the variables: identification regulator - identified regulation, internal regulator - intrinsic motivation and autonomous index of the strength of self-regulation motivation, interest / enjoyment, competition challenge, fitness and perceived social support from their friends and parents. Partial effect of factors that determine partial - n<sup>2</sup> is ranked among 0,02 to 0,03 and shows a small to medium impact effect.

Girls from middle school age who have different level of physical activity show higher values in most variables that assess the degree of autonomous motivation to physical-sport activity. The differences are defined in an internal regulator - intrinsic motivation, autonomous index of the

strength of self-regulation motivation to physical activity, which is a construct of internal motivation theory.

Movement is a natural form and people are basically motivated to achieve their physical and mental capacities (White, 1959; Ryan, 1993, 1995), however technological changes in society contributed to dominate the young sedentary habits, and exercising in urban society is not simple. All this makes the physical - sport activity spontaneously become a programmed activity. Very often young people deal with physical activity not for fun, enjoyment or challenge, but are motivated by some external reasons, such as improving fitness (fitness), appearance layout etc.

It is questionable whether the external motives that stimulate physical activity become permanent over time. Based on the results of this research it can be concluded that although there are statistically significant differences in most variables applied to assess the degree of motivation to physical-sport activity among students who are involved in organized sports in relation to those who are not involved, the most evident differences are exactly in internal regulator - intrinsic motivation especially among the female students. The results of this study indicate that students of middle school age should promote internal motives (i.e. fun, personal challenge) or the so called essential motives for engaging in physical activity. There is a great number of scientific studies showing the way the intrinsic motivation (essential motivation), related to physical-sport activity, can be improved (see Ryan, 1985; Frederick & Ryan, 1995).

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Although the external motives such as appearance or condition (fitness) can be important in encouraging the youth to begin to deal with physical and sport activity (Wankel, 1993; Ryan & Frederick, 1993), they are not sufficient maintain the activity for a long time. On the other hand, if the initial motives and procedural variables are associated with intrinsic motivation, especially those like enjoyment / interest, the activity is maintained much longer. Encouraging the Intrinsic motivation among students from middle school age through promotion and messaging can help to increase physical activity among youth and health benefits associated with it.

## CONCLUSIONS

Based on the obtained results it can be concluded:

- The theory of self-determination can be used to help understand why children and young people dealing with physical activity and if they intend to do so in the future.

- Girls from middle school age who have different degrees of physical activity showed higher values in most variables that assessed the degree of autonomous motivation to physical-sport activity. The differences are defined in an internal regulator - intrinsic motivation, autonomous index of the strength of self-regulation motives to physical activity, which is a construct of internal motivation theory. The boys middle school age who have physical activity recommended show higher values in all seven variables that the extent of motivation to physical-sport activity. The largest differences are defined in variables which are constructs

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## ВЛИЈАНИЕТО НА МОТИВИТЕ ЗА ЗАНИМАВАЊЕ СО ФИЗИЧКА-СПОРТСКА АКТИВНОСТ, КАЈ УЧЕНИЦИТЕ СО РАЗЛИЧЕН СТЕПЕН НА ФИЗИЧКА АКТИВНОСТ

УДК:796.03:316.644-057.847  
(Оригинален научен труд)

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### Апстракт

На примерок од 749 испитаника на возраст од 11 до 14 години, поделен во два суп-примерока 349 испитаници од машки и 391 испитаник од женски пол реализирано е испитување со основна цел да се утврди влијанието на мотивите за занимавање со физичка-спортска активност, сè во однос на социјална поддршка од другариите и фамилијата кај учениците со различен степен на физичка активност. За реализирање на целите на испитувањето првото и второ суп-примерок е поделен во две динстички групи во зависност од тоа дали учениците се занимаваат организирана или не се занимаваат со спорт. Мотивите кон физичката активност е проценети со складира Behavior Regulation Exercise Questionnaire (BREQ) и Motives For Physical Activity Measure - Revised (MPAM-R), додека ставот кон спортот со Кнееров инвентар на ставови. Разликите се обработени со мултиваријантна и униваријантна анализа на варијанса (МАНОВА и АНОВА). Врз основа на добиените резултати може да се констатира дека девојчињата од средната училишна возраст кои имаат различен степен на физичка активност покажуваат повисока вредност во повеќето варијабли со кој се проценува степенот на автономота мотивираноста кон физичката-спортската активност. Најголеми разлики се утврдени во внатрешен регулатор - *intrinsic motivation*, автономен индекс на силноста на саморегулација на мотивираноста кон физичката активност, кои се конструирани на внатрешната мотивациона теорија. Момчињата од средната училишна возраст кои имаат преорачана физичка активност покажуваат повисока вредност во сите седум варијабли со кој се проценува степенот на мотивираноста кон физичката-спортската активност. Најголеми разлики се утврдени во варијаблите кои се конструирани на внатрешната мотивациона теорија.

**Клучни зборови:** ученици, мотивација, спортска активност, анализа на варијанса

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## IMPACT OF AGE AS A FACTOR OF DEVIANT BEHAVIOUR OF VISITORS IN THE SPORTS EVENTS IN THE REPUBLIC OF MACEDONIA

UDC:786.093.1:316.647 3(497.7)

*(Original scientific paper)***Ivan Anastasovski, Lence A. Velickovska, Natasha Meshkovska***Ss. Cyril and Methodius University in Skopje, Faculty of Physical Culture, Skopje, Macedonia*

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### **Abstract**

*Every advanced and modern society has a serious attitude towards the sport as a social area which beside the game also manifests specific elements of certain cultures and their mutual influence. In terms of local, regional and national rivalry or complete identification of fans of the club, cultural conflict is going to turn into a conflict between two opposing cultures. Outpouring of human frustration in such situations causes deviant behaviour that gets elements of violent and aggressive behaviour that is sanctioned by law. Deviant behaviour at sports events has long been known as a social phenomenon of modern sport with all the sociological attributes. Rampage at sports events and out of them in the world is a mandatory notice of top sporting event like a decoration with frequent tragic consequences. Stands become a picture of society, with well-defined range of opportunities for fan selection. In the Republic of Macedonia there are rudiments and serious grounds for existence of deviant behaviour by visitors before, during and after sports events. Spirit of deviant behaviour is easily sensed during maintenance of important sports events in Republic of Macedonia.*

**Key words:** *deviant behaviour, sports events, visitors, sport.*

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### **INTRODUCTION**

In any relatively developed country great importance is given to the problem related to the deviant behaviour of visitors in public places, manifested by individuals and the crowds. This social problem has drawn attention of sociologists, psychologists, pedagogue criminologists, lawyers etc. All of them start from their basic scientific interest and treat violence from different aspects (bullying, hooliganism) and aggressiveness that appears during sports events. Deviant behaviour, as separate emerging form of criminality causes feeling of unsafety, fear or disgust in public, personal vulnerability of the citizens.

This paper directly examines age as a factor of deviant behaviour at sports events in the Republic of Macedonia. The Republic of Macedonia has a rudiments and serious grounds for existence of deviant behaviour by visitors before, during and after sports events (Anastasovski, I. 2010).

Spirit of deviant behaviour is easily sensed

during maintenance of important sports events in the Republic of Macedonia, especially when it comes to social status of athletes and professionals who are an example of behaviour in sport that is research by J. Bryant (Bryant J. Cratty, 1978). Our country has still not created a picture of deviant behaviour and its presence at sports events. However, there is a tendency for correction of this condition indicating that lately there are more often organized debate shows for this phenomenon, as radio and television shows.

We must conclude with regret that the research so far has not gone very far in addressing the question of what deviant behaviour means in general. Even now there is no generally accepted definition for it. Thus, for example, Supek defines aggressive behaviour as the use of violent means over living beings in order to achieve certain goal (Supek, R. 1992).

## METHODOLOGY STRUCTURE OF RESEARCH

### *Subject of the research*

The subject of this paper will be exploring the age as a possible factor for deviant behaviour at sports events in the Republic of Macedonia.

### *Aim of research*

The aims of this research are divided into major and specific purpose.

The main objective of the paper is to increase the corpus of scientific knowledge about the impact of a particular group of socio-demographic factors (age) as a potential instigator of deviant behaviour at sports events in the Republic of Macedonia.

Special purpose of this research is to investigate and determine how deviant behaviour at sports events, as a form of public event in the Republic of Macedonia is a result of the impact age as part of a group of socio-demographic factors.

### *Hypothesis of the research*

Deviant behaviour at sports events, as a form of public event in the Republic of Macedonia is a result of the influence of the age as a part of a group of socio-demographic factors.

### *Methods of research*

Based on the subject, objectives and hypothesis of the study, we use a survey (questionnaire) as a method of research.

The method applied in this study corresponds to the subject of research, primarily because it is a scientific research paper that will primarily be based on empirical data obtained by use of a questionnaire.

Survey data are processed in the statistical package SPSS 17.0.

### *Respondents in the research*

This research surveyed 409 respondents by random choice - visitors of sports events in the Republic of Macedonia.

## RESULTS AND DISCUSSION IN THIS RESEARCH

The influence of the group of peers on deviant behaviour of adolescents in sports events is investigated by determining differences in terms of impact on thinking and behaviour of others,

whether the leader imposes a way of winding way that cheer the way of reaction during the winding of sporting events. Many of these features are necessary for successful overcoming of the humanities and natural sciences. (Robet, L. Sajmon 2004). The analysis took into account three categories of impact: no impact, there is impact but it is not crucial and there is strong influence. The significances obtained are shown in the tables that follow. From Table. No.1 it can be noticed that there is no statistically significant difference at 0.01 ( $p < 0.01$ ). The largest percentage of 68.18% of adolescents who had been under strong influence of others, say they regularly follow the winding way that poses the group leader of sports events. On the other side, 52.77% of adolescents who have influence from others, but it is not crucial, sometimes accepted ways of winding which poses the leader of the group.

Graph No. 1 shows the influence of behaviour and thinking of others as compared with whether the leader imposes a way of winding adolescent in the sports events. 52.77% of adolescents said that sometimes the leader imposes impact but it is not crucial. While 68.18% of adolescents said they regularly adopt the way of winding which poses the leader of the group.

*Table No.1  
Percent of age impact*

Influence the thinking and behaviour of others	Leader imposes way of winding		
	Never	Sometimes	Always
Does not effect	26.47%	<b>44.11%</b>	29.41%
Have effect but is not a crucial	11.11%	52.77%	36.11%
Have strong effect	9.09%	22.72%	<b>68.18%</b>

*Graphic No 1  
Percent of age impact*

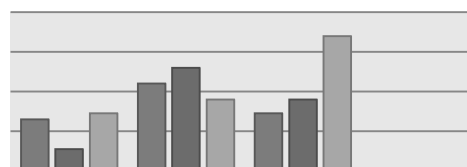
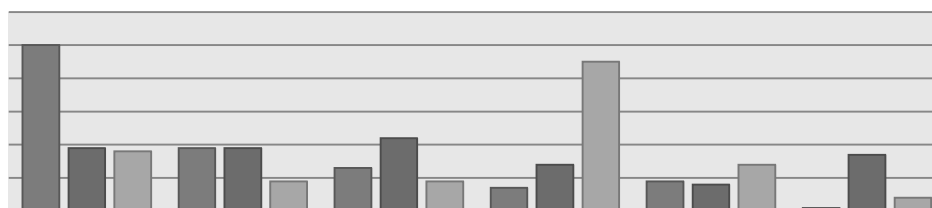




Table No.2  
Percent of age impact

Influence the thinking and behaviour of others	Way of winging in the sports events					All
	Sing song for team	Support our team	Constant winging	Sing offensive song against other	Sing in the match events	
Does not effect	<b>50%</b>	19.11%	13.23%	7.35%	8.82%	1.47%
Have effect but is not a crucial	19.44%	19.44%	22.22%	13.88%	8.33%	16.66%
Have strong effect	18.18%	9.09%	9.09%	<b>45.45%</b>	13.63%	4.45%

Graphic No.2  
Percent of age impact



Statistically significant difference at 0.05 ( $p < 0.05$ ) was found in the manner of winding adolescent sports events and the impact of opinion. Table. 2 shows that the largest percentage (50%) of adolescents are those who sing songs about their team with them which does not affect thinking and behaviour of others.

Unlike them, 45.45% of those adolescents whose opinions and behaviour of others has strong influence, were singing obscene songs directed to the opponents.

Graph no. 2 shows the influence of behaviour and thinking of others compared to how the winding of adolescent sports events. It can be noticed that 50% of the adolescents state that they are not influenced by the leader, and that, by singing songs, they are supporting their team. 45.45% of the adolescents who are under strong influence of the group leader during the winding use insulting words to the opponent. If we add 13.88% of those who are under the influence of the leader, but it is not crucial, one can notice that 1/3 of the adolescents use abusive language towards an opponent during sports events.

When analysing the impact of thinking and behaviour of others by way of responding to ado-

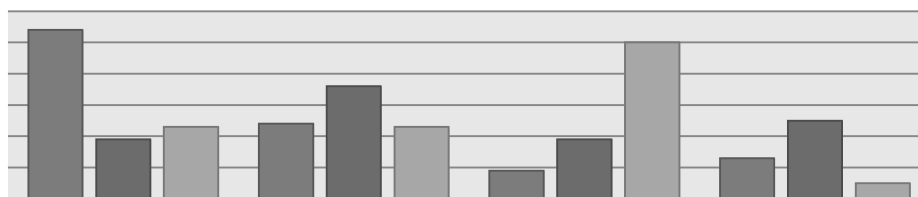
lescents during an incident at sports events four types of reactions were taken into account: I was standing aside, I was a direct participant; I verbally insulted others and had fight with them. The results in Table No.3 show that there is a statistically significant difference at 0.05 ( $p < 0.05$ ) in terms of the impact of the opinion and behaviour of others with the way adolescents react to sporting events. Persons who were not affected were mostly (54.41%) standing aside during the incident at a sporting event. Unlike them, 50% of those who verbally insulted others during an incident were strongly influenced from the behaviour and thinking of others. It is interesting to note that 36.11% of adolescents who were influenced by opinions and behaviour which was not crucial were direct participants in an incident at sports events.

The graph no. 3 shows the influence of behaviour and thinking of others as compared with the way of response of adolescents during the incident at sporting events. 54.41% of adolescents who report that the leader does not influence them were standing aside during the incident at sporting events. On the other side, 50% of adolescents who reported that the leader had strong influence over

Table No.3  
Percent of age impact

Influence of thinking and behaviour of others	Way of reaction in incident in the sports events			
	Staying aside	Direct participant	Verbally insulted others	Use physical force
No influence	<b>54.41%</b>	23.52%	8.82%	13.23%
There is influence but is not crucial	19.44%	36.11%	19.44%	25%
Have strong influence	22.72%	22.72%	<b>50%</b>	4.54%

Graphic No 3  
Percent of age impact



them verbally insulted others during the incident at sporting events. Finally, 25% of those adolescents whose leader has influence that is crucial use physical force during the incident.

## CONCLUSION

I conclude that there is great influence of the peer group as a factor for manifestation of deviant behaviour at sporting events in the Republic of Macedonia, which speaks about the important role of this agent of socialization, especially during adolescence. The assumption that if adolescents socialize and build relaxed and correct relations in the circle of their peers, less manifest deviant behaviour is confirmed by high certainty rate. The obtained results are consistent with the stated theoretical knowledge according to which peer group is one of the prime factors of socialization, which shares common values and attitudes shows cer-

tain equivalent behaviours and preferred lifestyles and makes strong pressure on its members to accept it. In this period of life adolescents are easily influenced to initiate behaviour and accept opinions of others, primarily the impact of imposing leaders of peer groups or the members themselves. Such behaviour of adolescents is dependent on their cognitive, emotional and moral development, and influences from the social environment in which that development takes place. Hence, it is essential to be elected leader, as he/she has strong influenced by what he/she does, through the ideas and goals that propagates and through the effects caused by their actions. If one takes into consideration that between fans often there is rivalry on ethnic or religious basis, which often results in violence and aggression at sporting events, the role of the leader of the group gets much more importance.

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## **ВЛИЈАНИЕТО НА ВОЗРАСТА КАКО ФАКТОР ЗА ДЕВИЈАНТНО ОДЕНСУВАЊЕ НА ПОСЕТИТЕЛИТЕ НА СПОРТСКИТЕ МАНИФЕСТАЦИИ ВО РЕПУБЛИКА МЕКДОНИЈА**

УДК:786.093.1:316.647 3(497.7)

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### **Апстракт**

*Секое напредно модерно општество има сериозен однос кон спортот како општествена област во која покрај играта доаѓа до израз и манифестирање специфични елементи на поделни култури и нивно меѓусебно влијание. Во услови на локално, регионално и национално ривалство или комплетна идентификација на навивачите со клубот, се случува културниот конфликт да се претвори во конфликт меѓу две спротиставени култури. Изливот на човечки фрустрации во вакви ситуации предизвикува девијантно однесување кое добива елементи на насилно и агресивно однесување кое е санкционирано со закон. Девијантното однесување на спортските манифестации уште одамна се познат општествен феномен на модерниот спорт со сите социолошки атрибути. Дивеењето на манифестациите и надвор од нив во светот претставува задолжителна најава на врвните спортски настани како декор со многу чести трагични последици. Трибините стануваат слика на општеството, со јасно изразена палета од можности за навивачки избор. Во Република Македонија постојат зачетоци и сериозна подлога за egzистирање на девијантното однесување од страна на посетителите пред, за време и по спортските манифестации. Духот на девијантното однесување лесно се насетува за време на одржување на значајни спортски манифестации во Република Македонија.*

**Клучни зборови:** *девијантно однесување, спортски манифестации, посетители, спорт*



## DIFFERENCE IN MOTOR CAPABILITIES OF CHILDREN FROM AN EARLY SCHOOL AGE IN RELATION TO GENDER

UDC:796.012.1-057.874-055

*(Original scientific paper)***Seryozha Gontarev, Vujica Zivkovic, Ruzdija Kalac, Nebojsa Markovski, Josko Milenkovski***Ss. Cyril Methodius University, Skopje, Faculty of Physical Culture, Skopje, Macedonia*

### **Abstract**

The research was realized on a sample of 2806 respondents, from 6 to 11 years old (1393 students and 1413 female students), from primary schools in the Municipality of Kisela Vodar, Macedonia. Each superimercite is divided according to the chronological age 9 age groups in the span of one calendar year. The goal of the research is to determine whether there are statistically significant differences in motor tests between boys and girls in each age category. For realization of the purposes of research 8 motor tests were applied, of the international battery of EUROFIT. The obtained data were processed with appropriate multivariate and univariate parametric statistical procedures. Based on the results, it can be generally concluded that boys in almost all motor tests in all age categories showed better results in terms of girls. Girls show better results in all age categories in the motor test, "seated forward bend."

**Keywords:** *early school age, EUROFIT, Manova*

### **INTRODUCTION**

The connection of the motor skills of boys and girls from early school age is directly related to the effects of teaching physical education and development of certain motor skills. Knowing the motor skills of a physical education teacher it facilitates the planning of teaching, selection of methods and forms of work organization and most important the selection of physical exercise, on the basis of which the purposes of the physical education is realised. Setting the problem of this research started from the fact that physical activity of boys and girls in early school age are still determined by the full membership and the amount of physical activity and the structure of the movements.

Among the factors affecting the success of results in motor abilities, endogenous (including a significant heritability) and exogenous factors (in which physical activity important) are also included. Until puberty pupils biologically mainly develop in parallel, which leads to the assumption that between men and women there should not be a significant difference between their motor skills.

However, if we start from the fact that the growth and development of the child is of individual character, there are larger or smaller differences between the developmental level of their

motor skills. To this end point and results of some previous studies, the subject of which is similar to this study (Krsmanović, 1980; Matić, 2007).

These considerations caused skepticism in generalizing the notion that boys from 6 to 11 years are outperforming most motor abilities of women of the same age. Therefore, it is assumed that among pupils in these age categories there are certain differences in motor skills that need to be taken into account in the planning, organization and implementation of sports activities in the teaching process in physical education and training.

Therefore, this study was undertaken to determine the situation and differences in motor tests between boys and girls in each age category.

### **METHODS OF WORK**

The research was realized on a sample of 2806 respondents, from the age of 6 to 11 years (1393 students and 1413 female students), from primary schools in the municipality of Kisela Voda, Macedonia.

Each of the subexamples is divided according to the chronological age 9 age groups in the span of one calendar year. Chronological age is determined based on the decimal years (difference

between the measurement date and the date of birth, which is transformed into an appropriate sized division of the year into ten rather than twelve months). Based on that, we established age groups of 5 male and 5 age groups of females in the span of one calendar year as follows: 6 (6-6,9), 7 (7-7,9), 8 (8-8,9), 9 (9-9,9), 10 (10-10,9), 11 (11-11,9) years.

The sample included all the students whose parents gave consent to participate in the project and were physically and psychologically healthy and regularly attend classes in physical and health education.

For realization of the purposes of the research, 8 motor tests were applied, of battery EUROFIT such as: flamingo, rapid hand tapping, seated forward bend, standing longjump, flexion of the hand, lifting up the body in 30 sec, durability of the chin-ups and running 4 x 10 m.

Data from the manifested motor variables are processed with the basic statistical parameters: arithmetic mean ( $\bar{X}$ ), standard deviation (SD), minimum score (MIN) and maximum score (MAX), and the normality of the distribution of results is tested by the procedure of Kolmogorov and Smirnov (PS). Differences in variables between boys and girls is determined by multivariate and univariate analysis of variance (MANOVA and ANOVA), and testing the differences between groups in individual variables is determined by LSD-test. Data are processed with statistical package SPSS for Windows Version 15.0.

## RESULTS

Quantitative differences in motor tests between boys and girls in each age category is checked with several multifactorial analysis of variance. The results of the analysis are shown in Table 1 and all significant elements in all tables are highlighted with dark characters (**bold**).

At the age of six years, there are multivariate statistical significant difference in performance on motor tests between boys and girls. Boys statistically significantly better performing motor test standing long jump, lifting up the body in 30 seconds, durability of the chin-ups, flexion of the hand and running, and girls seated forward bend. In other motor tests there are statistically significant differences determined. Based on the results it can be concluded that boys of this age group have better explosive strength of the lower extremities,

repetitive forces meven front wall, maximum isometric strength, isometric strength and endurance of arms and shoulder girdle, the ability to quickly perform the movement with change of direction, while girls have better flexibility.

But seven year old boys sstatistically perform the tests significantly better: standing long jump, durability of chin-ups, flexion of the hand and running, while girls significantly better performed the test of seated forward bend. No statistically significant differences in performance on tests and flamingo, rapid hand tapping and lifting up the body in 30 seconds. In this age group the boys have better explosive strength of the lower limbs, maximum izometric strength, izometric power and endurance of the arms and shoulder girdle and the ability to quickly perform the movement with change of direction.

For eight year olds we perceived significant changes in overall motor space, quantitatively and qualitatively. The average performance differentiation is increased in performance of motor tasks between boys and girls.

Quantitative differences in motor tests between boys and girls from eight years are also statistically significant, with a big degree of subject of statistical probability ( $P = .00$ , Table 1). Girls are dominant in flexibility (seated forward bend), and boys in explosive strength, maximal izometric-strength, repetitive strength of the abdominal muscles, izometric strength and endurance of hands and shoulder belt, agility and coordination (jump from place, flexion of the hand, lifting up the body by in 30 seconds, durability of chin-ups and running 4 x 10 m). Significant statistical differences occur in the event of general equilibrium and speed of alternative movements.

Quantitative differences in motor tests between boys and girls of nine years, similar to the eighth, and is also statistically significant, with a high degree of statistical probability ( $P = .00$ , Table 1). Girls in this age group as in previous dominate flexibility (seated forward bend). The boys are dominant in explosive strength, maximal izometric strength, repetitive strength of the abdominal muscles, strength and endurance of the arms and shoulder belt speed of alternative movements, agility and coordination (jump from place, flexion of the hand, lifting up the body in 30 seconds, durability of chin-ups and running 4 x 10 m). Significant statistical differences were observed in the event of

Table.1 Differences by gender within each age category

Age	Variables	Boys	Girls	f	P	F	Q
6 years	MFLAMIN	1,79	1,81	0,05	,82		
	MSKOMES	101,48	93,07	22,67	,00		
	MTAPRAK	25,83	26,04	0,18	,67		
	MP30SEK	8,43	6,81	7,48	,01	7,40	,00
	MIZDRZG	2,96	2,18	3,78	,05		
	MFLEKSA	10,28	9,07	28,25	,00		
	MDLAPRE	14,71	15,98	3,85	,05		
	MCUN4H10	18,00	18,92	20,66	,00		
7 years	MFLAMIN	2,03	2,06	0,16	,69		
	MSKOMES	112,79	103,96	29,65	,00		
	MTAPRAK	22,32	22,56	0,37	,54		
	MP30SEK	10,08	9,32	2,02	,16	14,25	,00
	MIZDRZG	3,42	2,55	5,71	,02		
	MFLEKSA	11,74	10,27	40,71	,00		
	MDLAPRE	13,44	14,75	5,49	,02		
	MCUN4H10	16,90	17,96	48,71	,00		
8 years	MFLAMIN	2,14	2,28	2,52	,11		
	MSKOMES	124,31	109,15	91,97	,00		
	MTAPRAK	19,58	19,87	1,06	,30		
	MP30SEK	12,09	10,67	10,06	,00	28,74	,00
	MIZDRZG	4,36	2,91	12,28	,00		
	MFLEKSA	13,65	11,89	52,24	,00		
	MDLAPRE	12,44	14,41	15,81	,00		
	MCUN4H10	15,97	17,30	116,51	,00		
9 years	MFLAMIN	2,55	2,42	1,54	,22		
	MSKOMES	129,80	117,59	47,59	,00		
	MTAPRAK	17,63	18,08	2,82	,09		
	MP30SEK	13,14	11,67	9,51	,00	20,09	,00
	MIZDRZG	4,77	2,76	20,19	,00		
	MFLEKSA	15,71	13,56	58,58	,00		
	MDLAPRE	11,48	13,66	17,89	,00		
	MCUN4H10	15,55	16,62	71,25	,00		
10 years	MFLAMIN	2,79	2,67	0,78	,38		
	MSKOMES	137,00	121,93	58,00	,00		
	MTAPRAK	16,08	16,12	0,02	,89		
	MP30SEK	15,02	11,77	34,65	,00	15,33	,00
	MIZDRZG	5,76	2,64	22,31	,00		
	MFLEKSA	17,35	16,16	12,65	,00		
	MDLAPRE	12,19	14,06	10,99	,00		
	MCUN4H10	15,21	16,15	56,30	,00		
11 years	MFLAMIN	3,15	3,43	1,54	,22		
	MSKOMES	151,57	131,22	73,58	,00		
	MTAPRAK	14,83	15,22	2,35	,13		
	MP30SEK	16,72	13,77	23,28	,00	19,93	,00
	MIZDRZG	6,87	3,78	13,62	,00		
	MFLEKSA	20,92	18,55	23,13	,00		
	MDLAPRE	12,04	15,58	21,52	,00		
	MCUN4H10	14,06	15,32	84,18	,00		

**Legend:** f- univariate f-test; p statistical significanse of the univariate f-test;  
F -multivariate F-test; Q- statistical significanse of the multivariate F-test

general equilibrium and the speed of alternative movements.

At the age of ten, between boys and girls, there are statistically significant differences in performance on tests of motor multivariate level. Boys statistically significantly better motor tests performed jump from place, flexion of the hand, lifting up the body in 30 seconds, durability of chin-ups and running 4 x 10 meters, while girls performed better at motor test- seated forward bend. In this age group the boys have better explosive strength of the lower limbs, maximum izometric strength, repetitive strength or ability to perform in isotonic repetition of the trunk muscles, better strength and endurance of the arms and shoulder girdle and better agility and coordination in relation to girls. Girls are dominant in flexibility in the hip joint and the lower part of the spinal column. In this age group are also not observed statistically significant differences in the manifestation of the general balance and speed of alternative movements.

Among boys and girls of eleven differences with a high degree of subject of statistical probability ( $P = .00$ , Table 1). Girls in this age group, as in previous ones, are dominant in the flexibility of the joints of the hip and lower spine (seated forward bend), while boys of this age group have more favorable value of the direct indicators of cardiorespiratory capacity obtained Step by triminutiot test (heart rate in load, heart rate in the first and second minute of recovery and average heart rate), explosive strength of the lower limbs, maximum izometric force, repetitive strength of the abdominal muscles, better izometric strength and endurance of the arms and shoulder girdle and better agility and coordination, or the ability to quickly perform the movement with change of direction. In this age category, there is also no statistically significant differences observed in the manifestation of the general balance, speed of alternative movements of the upper limbs in absolute and relative maximal oxygen consumption.

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Based on the results, in general, it can be concluded that boys in almost all age categories, showing better results in motor tests than girls: standing long jump, lifting up the body in 30 seconds, flexion of the hand, running 4 x 10 meters. and girls in all age groups showed better results in the motor test seated forward bend.

The obtained results are similar to results of previous research related to the study of differences in motor skills in relation to sex (Krsmanović, 1980; Matić, 2007; Obradović, Cvetković, Krneta, 2008).

Factual higher level of motor abilities of boys is likely originated from their intensive engagement motor structure and motion that determines the boys, unlike girls. Boys at this age through natural forms of movement and intense games improve speed, strength and coordination as evidenced in this study while girls usually chose games where aesthetics of movement, precision and flexibility dominate. Addition to this research is the researches of (Đorđić, Matić 2006) which indicate that the volume of physical activity of boys this age statistically significantly different in weekly physical activity in relation to girls. According to the results obtained for different levels of motor skills between boys and girls in early school age, there is a need imposed for a differentiated approach to the physical education in terms of adjustment of physical activity in relation to the sex, the level of motor abilities and their needs and interests.

## CONCLUSIONS

On the basis of the research one can draw the following conclusions from the results:

Boys than girls in almost all age categories, show better results in motor tests: standing long jump, lifting up the body in 30 seconds, flexion of the hand, running 4 x 10 meters, and girls in all age groups showed better results in the motpor test-seated forward bend.



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## РАЗЛИКИ ВО МОТОРНИТЕ СПОСНОСТИ КАЈ ДЕЦАТА ОД РАНАТА УЧИЛИШНА ВОЗРАСТ ВО ОДНОС НА ПОЛОТ

УДК:796.012.1-057.874-055  
(Оригинален научен труд)

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### **Апстракт**

Истражувањето е реализирано на примерок од 2806 испитаници, од 6 до 11 годишна возраст (1393 ученици и 1413 ученички), од основните училишта во општина Кисела Вода, Република Македонија. Секој од супримероциите е поделен и според хронолошката возраст во 9 возрастни групи во распон од една календарска година. Целта на истражувањето е да се утврди дали постојат статистички значајни разлики во моторните тестови меѓу момчињата и девојчињата во секоја возрастна категорија. За реализирање на целите на истражувањето применети се 8 моторни тестови, од интернационалната батерија ЕУРОФИТ. Добиените податоци се обработени со соодветни мултиваријантни и униваријантни параметрички статистички процедури. Врз основа на добиените резултати, генерално може да се констатира дека момчињата во скоро сите моторни тестови во сите возрастни категории покажуваат подобри резултати во однос на девојчињата. Девојчињата покажуваат подобри резултати во сите возрастни категории во моторниот тест „длабок претклон во сед“.

**Клучни зборови:** рана училишна возраст, ЕУРОФИТ, МАНОВА

## DIFFERENCES IN THE LEVEL OF DEVELOPMENT OF THE UNDERHAND ROLL SKILL IN CHILDREN AGED 7 - 10

UDC:796.31.012.1057.874  
(Original scientific paper)

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### **Abstract**

*Underhand roll is a skill that is part of the manipulative skills that are present in the curriculum for health and physical education. The aim of the study was to determine the level of development of basic motor skills of manipulative kind of ball rolling in male children aged 7 to 10 years. All groups of respondents statistically are significantly different, except for the respondents 9 and 10 years old. A monotonous increasing trend is present in the average score of the skill and the percentage of master levels of manifestation of the skill in the first and third criteria. Consistency was not achieved among groups of respondents in terms of the most difficult and the easiest criteria for manifestation. This approach, by monitoring the level of development of motor skills in students, is of great benefit to the teacher; thus enabling more effective and efficient planning and programming of the lessons in physical and health education.*

**Key words:** *motor skill, students, performance criteria, level of development, physical and health education.*

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### **INTRODUCTION**

Achieving a high level of proficiency in basic motor skills is essential, given that they are building blocks for other more complex and more specialized movements that appear in sports, recreation, dance and other forms of physical activity (Anderson et al., 2012, Department of Education Community and Cultural Development, 2006, Department of Education and Early Childhood Development, 2009, Haywood & Getchell, 2005, 2009, Okely & Booth, 2004, Vallentyne, 2002), and are an integral part of the curriculum for physical and health education for children at preschool and class instruction. They usually emerge between 1 and 7 years of age (Burton, 1998).

The group of manipulative skills involves manipulating or controlling an object by hand or by foot (SPARC, 2012). Rolling the ball characterizes the coordinated contralateral movement of the arm and leg by keeping the balance to achieve greater accuracy in throwing the ball. The aim of the research was to determine the level of development of the skill underhand roll for children aged 7 to 10 years.

### **METHODS OF RESEARCH**

The research covered 137 children aged 7 to 10 years, male students from "11 October" children's home in Skopje (7 year olds – 32, 8 year olds – 33, 9 year olds – 39 and 10 year olds – 34 students). The students were asked to perform two consecutive rolling of a tennis ball.

This research uses the Test of Gross Motor Development pattern to estimate the level of development (Ulrich, 2000), where the motor skills of underhand roll are defined by four performance criteria.

For greater objectivity in the assessment, each movement was recorded with two High Speed cameras Sony EX-FH 100 adjusted to 240 fps and placed in the frontal and sagittal plane of motion. Movements were then analyzed using software Kinovea 0.8.7 using multiple options which the program allows.

For each student we calculated the total score of skill which represents the total sum of registered criteria in two trials.

Determining the differences in the total score between the groups of respondents was done with applied nonparametric analysis of variance i.e. the

Table 1. Basic descriptive statistics and Kruskal-Wallis test

Age	Average age (days)	Minimum	Maximum	Mean Score	N	Kolmogorov-Smirnov (sig.)	Shapiro-Wilk (sig.)	Kruskal-Wallis test	
								Chi - Square	Asymp. Sig.
7	2517.88	.00	7.00	1.3125	32	.000	.000	33.624	.000*
8	2907.85	.00	6.00	2.8485	33	.047	.001		
9	3003.14	.00	8.00	4.0000	38	.001	.005		
10	3663.32	.00	7.00	4.4412	34	.006	.007		

Table 2. Mann-Whitney test for significance of differences among groups

	Age	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Underhand roll	7	32	26.69	854.00	326.000	854.000	-2.731	.006*
	8	33	39.12	1291.00				
	Total	65						
Underhand roll	7	32	23.52	752.50	224.500	752.500	-4.600	.000*
	9	38	45.59	1732.50				
	Total	70						
Underhand roll	7	32	21.13	676.00	148.000	676.000	-5.154	.000*
	10	34	45.15	1535.00				
	Total	66						
Underhand roll	8 years	33	30.61	1010.00	449.000	1010.000	-2.080	.038*
	9 year	38	40.68	1546.00				
	Total	71						
Underhand roll	8 years	33	27.23	898.50	337.500	898.500	-2.838	.005*
	10 years	34	40.57	1379.50				
	Total	67						
Underhand roll	9 years	38	34.55	1313.00	572.000	1313.000	-.846	.398
	10 years	34	38.68	1315.00				
	Total	72						

Table 3. Percentage of criteria performed on master level

Performance criteria	(Total number)			
	Percent %			
	7 ā.	8 ā.	9 ā.	10 ā.
1. Preferred hand swings down and back, reaching behind the trunk while chest faces cones	(4) 12.500%	(6) 18.182%	(16) 42.105%	(20) 58.824%
2. Strides forward with foot opposite the preferred hand toward the cones	(3) 9.375%	(13) 39.394%	(21) 55.263%	(19) 50%
3. Bend the knees to lower body	(4) 12.500%	(12) 36.364%	(21) 55.263%	(23) 60.526%
4. Releases ball close to the floor so ball does not bounce more than 4 inches high	(1) 3.125%	(8) 24.242%	(6) 15.789%	(4) 10.526%

Kruskall-Wallis test, and for determining of the significant differences among each group separately, the Mann-Whitney U test was applied.

For determining the presence of criteria that respondents performed on master level, percentage was calculated (if the respondent performed the criteria in two trials, then it was registered as a master level).

Data processing was done with the statistical package program SPSS 16.

## RESULTS

Basic descriptive statistics (table 1) shows that respondents aged 7 had the lowest average score (1.3125) and respondents aged 10 had the highest (4.4412). The data of the respondents were not normally distributed. Therefore, the Kruskal-Wallis test was applied.

After the application of the Kruskal-Wallis test, it has been noted that there are statistically significant differences in the average score among the four groups of respondents (sig.000\*).

In order to determine which groups of respondents have statistically significant differences among each other, we applied the Mann-Whitney test and it was determined that all groups differ among each other except for students aged 9 and 10.

The analysis of the percentage of criteria performed on the master level (table 3) showed that they are moving in the range from 12.500 to 58.824 in the respondents aged 7, 9.375 to 55.263 in 8 year olds, 12.500 to 60.526 in 9 year olds and 3.125 to 24.242 year olds.

## DISCUSSION

There was a monotonous trend of average score by students of four groups (table 1). In terms of aver-

age score these statistics groups differ from each other, except for students aged 9 and 10.

This manipulative skills was defined by four criteria, two of which defining movement of the hand and two the leg movement. The lowest percentage, and at the same time the most difficult for manifestation at the respondents aged 7, 9 and 10, is the forth criterion which defined "Releases ball close to the floor whereas the ball does not bounce more than 4 inches high" while for the 8 year olds the first criterion is the most difficult "preferred hand swings down and back, reaching behind the trunk while chest faces cones".

The highest percentage i.e. the easiest for manifestation among 7 year olds is the first criterion and the third criterion, among 8 year olds the second criterion, among 9 year olds the second and the third criterion, while among 10 year olds the third criterion. A monotonous increasing trend in the percentage of master level was present in the first and the second criterion.

Such diversity in terms of representation of the most difficult and the easiest criterion for manifestation among groups may be due to the small number of students included in our research, and that the analysis was conducted by only one analyzer. However, if more respondents are present we could obtain a more comprehensive idea and generalization of greater size, and with the inclusion of more analyzers we could gain greater objectivity in the assessment.

Such research was conducted by Ulrich (2000) where he observed that according to the percentage of master level, the lowest percentage among students aged from 7 to 10 was the forth criterion, and the highest percentage among all students group was the first criterion. In the second, third and forth criteria a monotonous increasing trend in per-

centage of master level was observed.

Knowing the level of development of the skills is important because learning other more complex skills depend on the proficiency of fundamental motor skills (Delaš, et al., 2008). This kind of information can give the teacher a clear picture of the activities that he should conduct for more effective and efficient implementation of instruction. Such information is relevant for professionals who develop curricula as well as for parents who are interested to have insight in the development level.

## CONCLUSION

In conclusion, our results suggest that the students aged 7 to 10 years have statistically significant differences in the level of development of

skill underhand roll. Statistically significant difference has not been determined between respondents aged 9 and 10.

Among the students, constancy by age in terms of the most difficult and the easiest criterion for manifestation was not observed. A monotonous increasing trend was present in the average score of the skill and the first and third criterion.

Such an approach in the assessment of the level of development of skills should be an integral part of the work of every teacher of Physical and Health Education. By doing so, the teacher will have insight into the effects of his work and thus will be able to properly plan and program the lessons for the students.

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## РАЗЛИКИ ВО НИВОТО НА РАЗВОЈ КАЈ ВЕШТИНАТА ТРКАЛАЊЕ НА ТОПЧЕ КАЈ ДЕЦА ОД 7 ДО 10 ГОДИНИ

УДК796.31.012.1057.874:  
(Оригинален научен труд)

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### **Апстракт**

*Тркалањето на топче е вештина која е составен дел од манипулативните вештини кои се присутни во наставните планови по физичко и здравствено образование. Целта на истражувањето беше да се утврди нивото на развој на основната моторна вештини од манипулативен вид тркалање на топче кај деца од машки пол на возраст од 7 до 10 години. Сите групи на испитаници статистички значајно се разликуваат меѓусебно освен испитаниците на 9 и 10 годишна возраст. Присутен беше монотоно растечки тренд во просечниот скор на вештината и во процентуалната застапеност на мастер нивоата на манифестирање на вештината кај првиот и третиот критериум. Не беше добена константност кај групите на испитаници во однос на најтешкиот и најлесниот критериум за манифестирање. Ваквиот приод преку следење на нивото на развој моторните вештини кај учениците е од голема корист за наставникот, со што се овозможува поефективно и поефикасно планирање и програмирање на часот по физичко и здравствено образование.*

**Клучни зборови:** *моторна вештина, ученици, критериуми на изведба, ниво на развој, физичко и здравствено образование.*





## RELATIONS BETWEEN SOME TYPES OF FOREARM STRENGTH IN KINESIOLOGY STUDENTS

UDC:786.012.11-057.875(497.5)

*(Original scientific paper)***Goran Kuvacic, Josip Vrdoljak, Marijana Drazic***Faculty of Kinesiology, University of Split, Split, Croatia*

### **Abstract**

*The aim of this paper was to determine the correlations between maximum, static and repetitive strength, separately of the right and the left forearm in kinesiology students. Partial aim of the research was to determine some metric characteristics of the applied tests assessing particular aspects of strength. Based on the descriptive statistics results, it can be concluded that students' right forearm is stronger than the left in all aspects of manifested strength. The tests assessing static and repetitive strength have good reliability and sensitivity, but did not have good homogeneity. Correlation analysis revealed correlations between maximum and static strength for both right and left forearm. There was no correlation between maximum and repetitive strength in either forearm. Correlation between repetitive and static strength was found on the right forearm, which was not the case on the left forearm. The lack of research studies dealing with similar research problems has greatly hindered the interpretation of the results. The tests should be applied on a larger sample of athletes, such as judo athletes, for whom the investigated aspects of strength are of great importance.*

**Key words:** *correlations, maximum, static and repetitive strength*

### **INTRODUCTION**

Strength is an ability manifested by overpowering different resistances by muscle tension (Milanović et al., 1997), while on the other hand, power is defined as a force manifested by a muscle or a muscle group at a given speed (Knuttggen and Kraemer, 1987). The research studies dealing with the changes of the different aspects of strength are among the most common ones in the area of kinesiology. The changes in different shapes of strength training are achieved relatively simply and fast, so long-term experiments are not necessary. Further on, the performance of strength training is not complicated, meaning that there is no need for expensive laboratory measuring. The research can be executed in relatively simple conditions, by applying simple methods of training and measuring (Sekulić and Metikoš, 2007). Surely, today there are many tests for estimation of different aspects of upper or lower body strength. For example, chin-up endurance (CUE) is surely the best known test for static strength evaluation of the arm and shoulder area. Further on, a test used in estimation of repetitive strength of the same

topologic region is underhand grip chin-up (CHINUP). The problem occurs due to the lack of tests estimating maximum, static and repetitive forearm strength, the left one and the right one separately. The authors' opinion is that forearm strength is of crucial importance in some sports. One of those sports is judo, where static and repetitive strength of the arm and shoulder area are very important for fight success (Franchini, Del Vecchio, Matsushigue, & Artioli, 2011). During a fight, judo athlete should develop maximum dynamometric fist power, so as to prevent the opponent escaping the grip (*guard*). The authors' area of interest is judo research. Therefore, this paper served as a pilot research, with the purpose of aiding future measuring of judo athletes. The aim of this research was to determine the relations between maximum, static and repetitive strength of the left and the right forearm separately, in kinesiology students. The partial aim of the research was to determine some metric characteristics of the applied evaluation tests measuring the listed aspects of strength.

## METHODS

The subject sample consisted of 10 first year kinesiology students in Split, whose average age was  $19.3 \pm 1.2$  years. Although the sample was convenient, all the examinees had been involved, or still have been involved in some sport training process during the conducted research. All examinees were healthy and free of any aberrative signs during the measuring. The group of variables was made up of manifested forearm strength evaluation tests. The measuring was conducted on the right and left forearm. Two tests were conducted, one evaluating maximum static and repetitive strength of the right and one of the left forearm. Variables for assessing maximum strength: maximum right forearm strength evaluation test – maximum dynamometric right hand force (MDFR), maximum left forearm strength evaluation test – maximum dynamometric left hand force (MDFL). Variables for evaluation of static strength: right forearm static strength evaluation test– extended right arm high endurance (EAHER), left forearm static strength evaluation test– extended left arm high endurance (EAHEL). Variables for repetitive strength evaluation: right forearm repetitive strength evaluation test– maximum number of right hand finger flexion on the *grip* machine (MNFR), left forearm repetitive strength evaluation test– maximum number of left hand finger flexion on the *grip* machine (MNFL). Also, a morphological variable of body mass (BM) has been calculated. With the purpose of achieving the main aim of the research - the relations between the three listed aspects of strength - the listed variables were transformed into relative values, with the test values divided by the body mass. According to this, the following variables were gained: MDFR(KG/kg), EAHER(S/kg), MNFR (REP/kg) for the right and MDFL(KG/kg), EAHEL(S/kg), MNFL(REP/kg) for the left forearm, where KG is power of the grip, S stands for seconds, that is, time, and REP denotes the number of repetitions.

Description of the experimental procedure: all the examinees were warned to avoid physical strain one day prior to the measuring, especially the activities involving fist (hand) activities, so as to avoid accumulation of fatigue in that body part. The measuring was conducted in the „Split“ judo club, where „Judo“ kinesiology classes are held. The body mass was measured three times, using a

digital scale, the examinees were barefoot in sport judo equipment and kimono, and the result was read off with the tenth of a kilogram precision. The results of the (BM) morphological variable were condensed by calculation of the three measuring means. A test of maximum dynamometric force (MDF) was used in evaluation of maximum forearm strength, using the *Takei A5401* Japanese manufacturer digital dynamometer. Every examinee had a task of generating as much force as possible by squeezing right and left arm, separately. All three values were read off in kilograms, and the maximum value of the attempts was used in analysis. The metric characteristics of the digital dynamometer used in this research will not be analysed, because it is an instrument of high precision, with wide range of appliance in clinical and sports research. Extended arm endurance test was performed to assess static forearm strength (IV). The examinees had a task of holding on, as long as possible, with their flexed fist on a metal bar. The examiner, using a hand stopwatch, measured the time from the beginning of the test, until the end, when the examinee touched the ground. The test was conducted using the left and the right arm. The values were read off in seconds. A maximum number of flexion on the *grip* machine test (MNFG) was conducted in the evaluation of the repetitive forearm strength. A steel *Heavygrip 200* instrument was used in measuring the maximum number of fist fingers flexion. The test considered correct every repetition where an examinee would press the instrument all the way to the end. The examiner would stand next to the examinee and count the correct repetitions. The test was conducted on the right and left hand. Due to the demanding nature of the tests (EAHE) and (MNFG), only one instance of measuring was conducted. The protocol of the test performance was the following: after determining body mass, every examinee took the maximum dynamometric force test (MDF). When all the examinees took the test, the following test was performed - extended arm high endurance (EAHE), and finally - maximum number of hand finger flexion on the *grip* machine (MNFG). In order to avoid the fatigue of the examinees' forearm muscles, the examinees took one test at a time, with minimum of 30 minutes of recovery between the attempts. The following descriptive statistic parameters were calculated: mean (M), minimum (MIN) and maximum result (MAX), standard

deviation (SD) and Kolmogorov – Smirnov test (K-S) of all the variables for estimation of the manifested aspects of strength and the morphological variables – body mass in kinesiology students. To determine the metric characteristics of the analysed variables of manifested aspects of strength estimation, the following was calculated: the reliability of the measuring instruments was analysed by applying the correlation analysis between two instances of measuring (so called TEST – RETEST METHOD), the sensibility of the measuring instruments was analysed with Kolmogorov – Smirnov distribution normality test, the homogeneity of measuring instruments was analysed using a dependent samples T-test. The Pearson correlation coefficient was calculated to determine the relations between the maximum, static and repetitive strength, separately for the right and the left forearm in kinesiology students.

## RESULTS AND DISCUSSION

Table 1 shows the results of the descriptive statistic parameters: mean (M), minimum (MIN) and maximum result (MAX), standard deviation (SD) and Kolmogorov – Smirnov test (K-S) of the variables assessing maximum, static and repetitive strength of right and left forearm, and of one morphological variable – body mass. Results of the BM variable show that the lightest examinee weighed 75.6 kg, whereas the heaviest examinee weighed 102.7 kg. The MDF test (maximum strength estimation variable) showed the average results of 51.2 kg for the right and 50.2 kg for the left forearm. In comparison, in the research (Gunther, Burger, Rickert, Crispin, & Schulz, 2008) conducted on healthy adults, the average values were 49 kg for right forearm and 47 kg for the left one. Such result is no surprise, since the examinees were athletes. Also, it should be mentioned that in this test the right forearm of the examinees is stronger than the left one. Further on, static strength evaluation variables, i.e., isometric forearm muscle contractions, show that the right arm is dominant over the left one. The average result of the right arm was 18.1 s while the result for the left one was 14.9 s. The last test, the one with repetitive forearm strength evaluation, shows a great range of results. The minimum result for the right forearm was 2 repetitions, and the maximum 25, while, on the other hand, the minimum result for the left forearm was 1 repetition, and the

maximum 24. The values of K-S test show normal distribution of all the variables, indicating the sensitivity of the tests, i.e., a successful differentiation of the examinees according to the subject of measure.

Table 1 Descriptive statistic parameters: mean (M), minimum (MIN) and maximum result (MAX), standard deviation (SD) and Kolmogorov – Smirnov test (K-S)

	M	MIN	MAX	SD	KS
BM	84.9	75.6	102.7	9.10	p > .20
MDFR	51.2	38.4	60.3	6.74	p > .20
MDFL	50.2	42.2	55.6	5.32	p > .20
EAHER	18.1	7.2	39.1	8.65	p > .20
EAHEL	14.9	5.8	31.2	7.98	p > .20
MNFGR	13.4	2.0	25.0	8.79	p > .20
MNFGL	9.2	1.0	24.0	7.51	p > .20

M – mean; MIN – minimum result; MAX – maximum result; SD – standard deviation; KS – coefficient of the Kolmogorov-Smirnov test

As shown in table 2, there was a medium high correlation between the test and retest in all the variables. It can be concluded that the measuring instruments, i.e., the tests, are reliable for left and right forearm. Right and left forearm static strength evaluation variable shows the identical correlation coefficient value ( $r=0.81$ ). On the other side, the value of repetitive strength evaluation variables correlation coefficient is 0.94 for the right and 0.80 for the left forearm. Observing all the tests in total, the MNFGR test is the most reliable. One of the possible explanations of this high correlation is that the examinees' right forearm, or arm, is stronger than the left one, as shown in Table 3.

Table 2 Correlation between two instances of measuring of left and right forearm static and repetitive strength tests (TEST-RETEST)

TEST - RETEST	r
EAHER TEST – EAHER RETEST	0.81
EAHEL TEST – EAHEL RETEST	0.81
MNFGR TEST – MNFGR RETEST	0.94
MNFGL TEST – MNFGL RETEST	0.80

r- coefficient of correlation

The homogeneity of the measuring instruments was checked by the dependent samples T-test (Table 3). The results obtained by test and retest were compared. The T-test EAHER ( $t=1.74$  and  $p=0.12$ ) and EAHEL ( $t=0.56$  and  $p=0.59$ ) variables values show that there were no statistically significant differences between the test and retest, or, there is no result shift towards left or right. It can be concluded that the applied test had good homogeneity for the left and the right forearm. On the other hand, the T-test MNFGR and MNFGL variables show statistically significant differences ( $p=0.01$ ), and the tests lack satisfying homogeneity.

Table 3 Descriptive statistic parameters of the two instances of measuring of the left and right forearm static and repetitive strength test: means (M), standard deviations (SD) and T-test results: the mean difference for the dependent samples (t) and significance level (p) on the analysed tests.

	M	SD	t	p
EAHER TEST	18.1	8.65		
EAHER RETEST	15.2	6.08	1.74	0.12
EAHEL TEST	14.9	7.99		
EAHEL RETEST	14.0	9.17	0.56	0.59
MNFGR TEST	13.4	8.80		
MNFGR RETEST	17.2	9.40	-3.7	<b>0.01</b>
MNFGL TEST	9.2	7.51		
MNFGL RETEST	14.0	7.04	-3.3	<b>0.01</b>

M – mean; SD – standard deviation;  
t-test – coefficient of the dependent samples  
t-test; p – level of statistical significance.

Tables 4 and 5 show correlation coefficients of relative values of the variables assessing maximum, static and repetitive strength of the right and the left forearm. The results lead to the conclusion that there was a statistically significant correlation between the maximum and static strength of the right ( $r=0.69$ ) and the maximum and static strength of the left forearm ( $r=0.82$ ). The muscles engaged in both tests were constantly contracted, so the result was not surprising. Further on, there was no statistically significant correlation between the maximum and repetitive strength of the right or the left forearm (right forearm  $r=0.56$ , left forearm  $r=0.36$ ), which was not expected. One of the possible explanations for the lack of correlation was

Table 4 Correlation of relative values of the variables assessing maximum, static and repetitive strength of the right forearm

	MDFR (KG/kg)	EAHER (S/kg)	MNFGR (REP/kg)
MDFR(KG/kg)	1.00	<b>0.69*</b>	0.56
EAHER(S/kg)		1.00	<b>0.68*</b>
MNFGR(REP/kg)			1.00

\* $p<0.05$

Table 5 Correlation of relative values of the variables assessing maximum, static and repetitive strength of the left forearm

	MDFR (KG/kg)	EAHEL (S/kg)	MNFGL (REP/kg)
MDFL(KG/kg)	1.00	<b>0.82*</b>	0.36
EAHEL(S/kg)		1.00	0.07
MNFGL(REP/kg)			1.00

\* $p<0.05$

the fact that repetitive strength has been manifested in a different manner than maximum and static strength. The muscle performing the movement was constantly contracting and relaxing - partially resting. The basic limit was a part of the excitation signal, which, after some time, was not as strong as it had been at the beginning, so the movement ( in this case fist squeezing) was becoming harder to perform (Sekulić and Metikoš, 2007). Further insight into the results showed that there was a significant correlation between the repetitive and static strength on the right forearm ( $r=0.68$ ), which was not the case on the left one ( $r=0.07$ ). Some authors tried to extrapolate the repetitive strength from the static (Sale and Norman, 1982; Young and Bilby, 1993). A question arises: Can static strength be a successful predictor of the repetitive strength? The researchers who dealt with this problem found conflicting results, some of them showing high correlations, some of them showing relatively low correlations (Ignjatović et al., 2009). One of the possible causes of the instability of the left forearm correlation is a disrupted homogeneity of repetitive strength evaluation test, as explained in the prior analysis. On the other hand, the author did not find any research with similar problems, so interpretation of the results was much more difficult. Surely, the tests should be conducted using a

larger sample, especially the population of athletes whose forearm strength is a key to success, such as judo athletes.

## CONCLUSION

The aim of this research was to determine the relations between maximum, static and repetitive strength, separately for the right and left forearm, as well as to determine some metric characteristics of the applied particularized aspects of strength evaluation tests. The results of descriptive statistics showed that students' right forearm was stronger than the left one in all the aspects of manifested strength. Static and repetitive strength evaluation tests had good reliability and sensitivity, but

they lacked homogeneity. The correlation analysis showed correlation between the right and left forearm maximum and static strength. There was no correlation between maximum and repetitive strength of both forearms. Right forearm showed correlation between repetitive and static strength, which was not the case for the left one. The lack of research dealing with similar problems made the result analysis much more difficult. More tests should be conducted on a larger number of samples such as judo athletes, whose aspects of strength, analyzed in this research, are of great importance.

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## ПОВРЗАНОСТА НА НЕКОИ ВИДОВИ НА СИЛИНА НА ПОДЛАКТИЦАТА КАЈ СТУДЕНТИТЕ ПО КИНЕЗИОЛОГИЈА

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(Оригинален научен труд)

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### **Абстракт**

Цел на ова истражување беше да се утврди поврзаноста на максималната, статичката и репетитивната сила, посебно на десната и посебно на левата подлактица кај студентите по кинезиологија. Парцијална цел на истражувањето беше да се утврдат и некои мерни карактеристики на применетите тестови за проценка на наведените видови на сила. Од добиените резултати на дескриптивната статистика може да се заклучи дека кај студентите десната подлактица е посилна од левата во сите видови на манифестирање на силата. Тестовите за проценување на статичката и репетитивна сила имаат добра валидност и осетливост но не и хомогеност. Со корелационата анализа утврдена е поврзаноста на максималната статичка сила на десната и левата подлактица. Нема поврзаност меѓу максималната и репетитивната сила кај двете подлактици. На десната подлактица добиена е поврзаност на репетитивната и статичката сила, што не е случај и кај левата. Недостатокот од истражувања на слична проблематика во голема мерка го отежнува интерпретирањето на резултатите. Тестовите треба да се проверат на поголем примерок како будисти, кај кои анализираните видови на сила во ова истражување е многу значајна.

**Клучни зборови:** поврзаност, максимална, статичка и репетитивна сила

# PERCENTAGEWISE PRESENCE OF JUDGING SCORES IN THE EUROPEAN, WORLD CHAMPIONSHIPS AND OLYMPIC GAMES IN THE MEN'S ARTISTIC GYMNASTICS FROM 2006 TO 2011 YEAR

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(Original scientific paper)

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## Abstract

The main goal of this paper is a comparison of the percentagewise presence of the scores by the quality levels from the C.I. competition. Establishment of the differences between certain apparatus, competitions and judges' commissions stems from the set goal. There is a big difference in the variability of results at Olympic Games, World and European Championship. Generally, the lowest average score at the competitions was on the pommel horse, and the highest one, on the vault. The article can provide useful information on the role of tactics in gymnastics competition in the team and all around competition.

**Key words:** Men's Artistic Gymnastics, Judging, Code of Points, Percentile, Results

## INTRODUCTION

The first unique instructions *The Fédération Internationale de Gymnastique* (FIG) for evaluation of gymnastic exercises were created in 1949. known as "Code of Points" (CoP) for the assessment of the artistic gymnastics includes seven levels of degree of difficulty. The difficulty value (DV) of the exercise is determined according to the content and difficulty of the routine. Initial degree of severity represents the level A, and the next levels are B,C, D,E,F and G (FIG, 2009). The latest one is the greatest degree of severity. The main purpose and goal of the Code of Points for evaluating is provision of more objective evaluation of exercises. Independent members of the Refereeing Commission (D & E commission) are on all apparatus: D commission evaluates (weight, special requirements, and bonus points) and the assessment starts from 0.0 points to more and E commission the performance of an exercise (performance techniques, body posture and balance) and provides deductions for the performance from 10.0

points to lower. D commission determines the initial assessment of an exercise, and the E commission registers performance errors due to technical performance, body posture and balance of exercise performance so that those two grades would at the end sum up in the final one.

Several authors have tried to evaluate the quality of judging at different gymnastics competitions. In his research on judging in real time, Sands (2010) mentioned the biggest problem of evaluation and that is: reliability and validity. In his paper, the author mentions that the referees could use modern technology and with that, immediately after the performance, give their deductions so that a smaller number of referees would stay at rank. Other authors have dealt with this issue, too, such as Čukand Forbes (2006) who have made the program B Jury Judging Real Time System (RTJS) at the Australian Institute for Sport. The program has improved the objectivity of the evaluation by Jury B Execution Deductions entered during the performance and it cannot be changed, referees must

deduct quickly and precisely each time they see an error. Čuk and Atiković (2009) on the sample of the 44 gymnasts who competed at the OG 2008 in Beijing in all around, tested the equality between disciplines. Vault has the highest A scores, while pommel horse the lowest A scores. T-tests showed that those two disciplines significantly differ from other disciplines in average for 0.4 points. Factor analysis extracted 3 factors, with 67% of explained variance. Leskošek et al. (2010) in results show very high reliability and satisfactory validity of judging at the University games.

It should be emphasized that judging quality differs between apparatus, sessions and judges. In different sessions and apparatus all reliability measures (Cronbach's alpha range from 0.92 up to 0.99, ICC, Armor's theta) are higher than .90. Those indices tend to be a little lower in the all around finals than in qualification and apparatus finals. There appears to be no systematic differences in reliability between apparatus. Vault scores tend to have lower reliability than other apparatus in qualification and all around. Armor's theta ranged from .92 (on the floor) to .98 (rings and high bar), where as in Belgrade Armor's theta ranged from .93 (rings and vault all around finals) to .99 (high bar qualifications and apparatus finals). Finals, but not in apparatus finals. High bar scores have the highest reliability in qualification session and apparatus finals, but only average in all around finals. Atiković et al. (2011) analyzed the score of judges from the World Championship in men's artistic gymnastics, held 2009 in London. Analysis problem was determination of the differences on individual apparatus between judges E1 to E6 and apparatus. Vault has the highest D and E scores, while pommel horse the lowest D and E scores. T-tests showed that those two disciplines significantly differ from other disciplines. Results show very high reliability (e.g. Cronbach's alpha range from 0.94 up to 0.98).

Atiković (2012) in this paper tried to determine the relationship between biomechanical parameters of vault flights with respect to new models of initial vault difficulty values in men's artistic gymnastic. After implementing the regression analysis, it could be established that the best model derived only the second flight phase with 95% of explained variance. Leskošek et al. (2013) found that the new CoP solved the problem of invariant difficulty scores, most efficiently toward the end of

the observed period (2011). Execution scores showed a clear decreasing trend, both in absolute value and also in it's ratio with difficulty score.

## METHODS

The final scores that gymnasts got for the presented compositions in qualifying heats (C.I.) at the European Championships, World Championships and Olympic Games were the subject of the analysis. Determination of the sensitivity of the Code of Points from 2006 to 2009 and from 2009 to 2012 cycles on some apparatus for the proper distinction between gymnasts from different levels was the problem of the analysis. Quality levels were formed on the basis of expert knowledge. The height of the final score represented the basis of shaping the quality levels. The sample was made up of the scores that the contestant received at the following competitions: *Olympic Games*– OG (2008), *World Championships*–WCh (2011-2006), *European Championship* – ECh (2011-2006). From official *Book of results* we made six variables of judges D and E scores, and one for final score F (D+E score) from six apparatus for men: floor exercise (FX), pommel horse (PH), rings (RI), vault (VT), parallel bars (PB) and horizontal bar (HB). To evaluate all judges scores we used SPSS20.0 to calculate: % - Percentile by grades, Kolmogorov-Smirnov test (KS-test) normality of the variables distributions. The main goal of this paper is a comparison of the percentagewise presence of the scores by the quality levels from the C.I. competition. Establishment of the differences between certain apparatus, competitions and judges' commissions stems from the set goal.

## RESULTS AND DISCUSSION

In case of the VT (Table 1), it can be seen that the scores mostly go in the range of 6.0 to 6.9 points. We can conclude from the results that, at the all aforementioned competitions in score ranging from 6.0 to 6.9 points, the highest percentage of competitors is represented at WCh 61.4%, ECh 64.7% and OG 78.0% of all scores. Also, in the range of scores at the OG from 6.0 to 6.9 points, there are scores on FX 53.2% and PB 61.3%. What was stated above shows us that the change of the rules for this apparatus is required. Revision of the results of KS test showed that the distribution of results in just six variables, statistically, was not significantly different from the normal distribution



Table1. *Percentagewise presence of scores in quality levels of D score of the Judges' Commission*

D score	0.0-0.9 p.	1.0-1.9 p.	2.0-2.9 p.	3.0-3.9 p.	4.0-4.9 p.	5.0-5.9 p.	6.0-6.9 p.	7.0-7.9 p.	Type of Competitions
Floor	0.2	0.0	0.0	0.6	18.9	56.7	23.4	0.0	EC
	0.0	0.0	0.0	0.7	17.7	55.3	26.0	0.0	WC
	0.0	0.0	1.2	0.0	1.2	44.1	53.2	0.0	OG†
Pommel horse	0.0	0.0	0.4	7.4	30.2	46.7	15.1	0.0	EC†
	0.1	0.0	0.2	6.2	25.4	52.3	15.5	0.0	WC
	0.0	0.0	0.0	0.0	10.5	60.5	28.9	0.0	OG†
Rings	0.0	0.2	1.3	5.7	24.4	43.9	23.1	1.1	EC
	0.1	0.2	0.7	3.8	21.8	46.5	25.2	1.3	WC
	0.0	0.0	0.0	0.0	2.8	35.7	50.0	11.4	OG†
Vault	0.0	0.0	0.0	0.0	2.4	25.2	64.7	7.4	EC
	0.0	0.0	0.0	0.7	3.1	26.1	61.4	8.5	WC
	0.0	0.0	0.0	0.0	1.3	2.7	78.0	17.8	OG
Parallel bars	0.0	0.2	0.6	5.0	28.0	44.8	21.1	0.0	EC
	0.0	0.2	0.4	3.3	20.3	50.4	24.8	0.2	WC
	0.0	0.0	0.0	0.0	6.6	26.6	61.3	5.3	OG†
High bar	0.0	0.4	0.6	5.1	19.7	49.5	23.2	1.1	EC
	0.0	0.1	1.3	4.8	22.3	47.4	21.9	1.9	WC
	0.0	0.0	0.0	0.0	3.9	48.6	43.4	3.9	OG†
Avg.	0.0	0.1	0.4	2.4	14.5	42.4	36.7	3.3	

**Legend:** E – judges score, D – judges score, F – final score, KS test – Kolmogorov Smirnov test normality of the distribution, Avg.–Average score, †Sig. –Level of significance ( $p<0.05$ ), ECh – European Championships, WCh –World Championships, OG – Olympic Games.

Table2. *Percentagewise presence of scores in quality levels of E score of the Judges' Commission*

E score	0.0-0.9 p.	1.0-1.9 p.	2.0-2.9 p.	3.0-3.9 p.	4.0-4.9 p.	5.0-5.9 p.	6.0-6.9 p.	7.0-7.9 p.	8.0-8.9 p.	9.0-9.9 p.	Type of Competitions
Floor	0.2	0.0	0.0	0.0	0.0	0.0	2.7	18.9	62.8	15.2	EC
	0.0	0.0	0.0	0.0	0.0	0.3	3.3	17.8	63.4	14.8	WC
	0.0	0.0	1.2	0.0	0.0	0.0	0.0	6.4	53.2	38.9	OG
Pommel horse	0.0	0.2	0.0	0.2	0.9	3.6	12.2	34.6	38.6	9.5	EC
	0.0	0.0	0.0	0.1	0.1	1.7	7.6	27.6	54.5	8.2	WC
	0.0	0.0	0.0	0.0	0.0	0.0	1.3	9.3	74.6	14.6	OG†
Rings	0.0	0.0	0.2	0.0	0.2	0.4	5.2	25.1	67.7	0.9	EC
	0.1	0.1	0.0	0.0	0.2	0.6	4.4	20.2	71.0	3.1	WC
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	85.7	11.4	OG†
Vault	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	22.6	73.3	EC
	0.0	0.0	0.0	0.0	0.0	0.0	0.1	5.3	22.9	71.5	WC
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.9	89.0	OG
Parallel bars	0.0	0.0	0.2	0.0	0.0	0.0	2.0	16.9	61.6	19.1	EC
	0.1	0.1	0.0	0.1	0.1	0.2	3.9	18.2	60.0	16.9	WC
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	33.7	62.1	OG
High bar	0.0	0.0	0.0	0.0	0.4	1.3	5.8	26.0	58.3	7.9	EC
	0.1	0.0	0.0	0.0	0.0	1.2	7.3	31.5	58.4	1.3	WC
	0.0	0.0	0.0	0.0	0.0	0.0	2.6	12.0	72.0	13.3	OG
Avg.	0.0	0.0	0.1	0.0	0.1	0.5	3.2	15.6	54.0	26.2	

**Legend:** E – judges score, D – judges score, F – final score, KS test – Kolmogorov Smirnov test normality of the distribution Avg.–Average score, †Sig. –Level of significance ( $p<0.05$ ), ECh – European Championships, WCh –World Championships, OG – Olympic Games.

Table3. *Percentagewise presence of scores in quality levels of final F score of the Judges' Commission*

F score	0.0-8.9 p.	9.0-9.9 p.	10.0-10.9 p.	11.0-11.9 p.	12.0-12.9 p.	13.0-13.9 p.	14.0-14.9 p.	15.0-15.9 p.	16.0-16.9 p.	Type of Competitions
Floor	0.2	0.0	0.7	2.5	17.3	37.6	31.9	9.8	0.0	EC†
	0.1	0.1	0.7	3.1	15.7	32.1	34.7	13.1	0.4	WC
	0.0	0.0	0.0	0.0	1.3	10.4	50.6	37.7	0.0	OG†
Pommel horse	0.9	3.4	5.6	13.5	25.7	23.5	21.2	6.1	0.0	EC†
	0.6	0.7	3.9	8.6	19.0	34.0	25.1	7.7	0.4	WC
	0.0	0.0	0.0	0.0	10.5	27.6	44.7	15.8	1.3	OG†
Rings	0.5	1.1	3.4	7.1	21.5	34.3	22.7	8.7	0.7	EC†
	0.4	0.9	2.1	5.5	16.1	31.6	31.1	10.5	1.8	WC
	0.0	0.0	0.0	0.0	1.4	15.7	37.1	38.6	7.1	OG†
Vault	0.0	0.0	0.0	0.0	0.5	5.7	29.0	45.9	19.0	EC
	0.0	0.1	0.0	0.3	0.8	6.5	31.7	48.2	12.4	WC
	0.0	0.0	0.0	0.0	1.4	0.0	2.7	52.1	43.8	OG†
Parallel bars	0.2	0.0	1.6	4.6	19.4	29.8	31.7	12.3	0.5	EC†
	0.2	0.0	1.6	4.4	18.9	29.1	33.3	12.0	0.4	WC
	0.0	0.0	0.0	0.0	2.7	5.3	29.3	46.7	16.0	OG†
High bar	0.5	0.9	2.3	7.7	15.8	36.7	27.2	8.8	0.0	EC
	0.6	0.4	3.1	6.5	19.9	33.4	29.1	6.8	0.1	WC
	0.0	0.0	0.0	0.0	1.3	23.7	47.4	25.0	2.6	OG†
Avg.	0.2	0.4	1.4	3.5	11.6	23.2	31.1	22.5	5.9	

**Legend:** E – judges score, D – judges score, F – final score, KS test – Kolmogorov Smirnov test normality of the distribution, Avg.–Average score, †Sig. –Level of significance ( $p < 0.05$ ), ECh – European Championships, WCh – World Championships, OG – Olympic Games.

of the results, and those are: DFX OG (.074), DPH ECh (.067), DPH OG (.339), DRI OG (.314), DPB OG (.291) i DHB OG (.508).

The results, shown in (Table 2), indicate that the structure of the final scores E of the Judges' Commission, in the majority of devices, go in the range of scores from 8.0 to 8.9 points. In the case of VT, it can be observed that the lowest deductions of scores mostly go in the range of 9.0 to 9.9 points. We can conclude from the results that, at the all aforementioned competitions at range from 8.0 to 8.9 points, this kind of distribution is represented at all devices but at vault apparatus, in terms of percentage. The largest number of represented E scores, without taking in consideration the VT, is located in RI as follows: ECh 67.7%, 71.0% and WCh OG 85.7%. Revision of the results of KS test showed that the distribution of results in just two variables, statistically, was not significantly different from the normal distribution of the results, and those are: EPH OG (.159) i ERI OG (.135).

The results, shown in (Table 3), indicate that the structure of the final scores (F) at competitions in the majority of devices, go in the range of scores from 13.0 to 15.9 points. In the example of com-

petition at the VT, it can be noted that the scores mostly go in range of 15.0 to 15.9 points at the ECh that is, in terms of percentage it is represented 45.9%, WCh 48.2% and at OG 52.0%. We can conclude from the in the range of 14.0 to 14.9 points, there is PB 31.6% and 27.2% HB. In terms of percentage, by the number of scores at the ECh, there is in the range of scores from 15.0 to 15.9 points on VT 38.5% and PB 46.5%. From the results from the WCh we can conclude that, in the range of scores from 13.0 to 13.9 points, there is RI 31.6%. In the range of scores from 14.0 to 14.9, there is PH 34.7%, PB 33.3% and HB 29.1%. In terms of percentage, the most represented, by the number of scores at the WCh, is in the range of scores from 15.0 to 15.9 points on the VT 48.2%. From the results from the OG we can conclude that in the range of scores from 13.0 to 13.9 points, unlike the other competitions, there is not one discipline. In the range of scores from 14.0 to 14.9 points, there is FX 50.6%, PH 44.7%, PB 33.3% i HB 47.3%. In terms of percentage, the most represented, by the number of scores at the OG, is in the range of scores from 15.0 to 15.9 point on VT 52.0% and PB 46.6%. Revision of the results of

KS test showed that the distribution of results in eight variables, statistically, was not significantly different from the normal distribution of the results, and those are: FFX WCh (.003), FPH WCh (.000), FRI WCh (.000), FVT ECh (.003), FVT WCh (.000), FPB WCh (.000), FHB ECh (.003), FHB WCh (.000). From the results from the WCh we can conclude that, in the range of scores from 13.0 to 13.9 points, there is RI 31.6%. In the range of scores from 14.0 to 14.9, there is PH 34.7%, PB 33.3% and HB 29.1%. In terms of percentage, the most represented, by the number of scores at the WCh, is in the range of scores from 15.0 to 15.9 points on the VT 48.2%. From the results from the OG we can conclude that in the range of scores from 13.0 to 13.9 points, unlike the other competitions, there is not one discipline. In the range of scores from 14.0 to 14.9 points, there is FX 50.6%, PH 44.7%, PB 33.3% and HB 47.3%. In terms of percentage, the most represented, by the number of scores at the OG, is in the range of scores from 15.0 to 15.9 point on VT 52.0% and PB 46.6%.

## CONCLUSION

In order to determine the difference between scores and discipline at the competitions in men's artistic gymnastics, the differences in scores between disciplines and competitions were tried to be found (Olympic Games, World Championships and European Championships from 2006 to 2012). Grades E and D vary between disciplines. There is a big difference in the variability of results. Generally, the lowest average score at the competitions was on the PH, and the highest one, on the VT. Similar results from the Olympic Games in 2008 were acquired by the authors (Kolar et al., 2005, Čuk and Atiković, 2009, Leskošek et al., 2013). Scores on the vault should be equal in scores at all disciplines but is not currently the case. With the Code of Points (FIG, 2009), the results for all six disciplines are not equal by the Judges' Commission D, E and by the final results F.

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**ПРОЦЕНКА НА ПРИСТРАСНОСТА НА СУДЕЊЕТО НА ЕВРОПСКИТЕ  
ПРВЕНСТВА И ОЛИМПИСКИТЕ ИГРИ ВО МАШКА ГИМНАСТИКА  
ОД 2006 ДО 2011 ГОДИНА**

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(Оригинален научен труд)

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**Абстракт**

Основна цел на овој труд е да се компарираат оценките од различни нивоа на Ц.И. натпреварување. Утврдените разлики на оценките кои ги даваат судиите на поединечни справи е цел на ова истражување. Постојат големи разлики во варијабилноста на резултатите на Олимписките игри, Светските и Европските првенства. Генерално најниска просечна оценка на натпреварите било на справата коњ со рачки, а највисока на партер.Трудот може да даде корисни информации за улогата на тактика во гимнастичките натпревари во тимот и се околу натпреварувањето.

**Клучни зборови:** спортска гимнастика, судии, првилник за оценување, проценка на резултатите

## DIFFERENCES IN MOTIVATION FOR PHYSICAL ACTIVITY BETWEEN BOYS AND GIRLS LIVING IN URBAN AND RURAL ENVIRONMENT

UDC:796.03:316.644-057]:911.373/.375

*(Original scientific paper)***Popovski Luka***Ph. D. student of Faculty of Physical Culture, Skopje, Macedonia*

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**Abstract**

The sample of 749 respondents aged 11 to 14 years, divided into two sub-groups of 349 male respondents and 391 female respondents took part in a survey conducted with the main objective to determine the influence of motives for engaging in physical sports activity, attitude to sport, socially perceived support from friends and family of students from urban and rural areas. In order to realize the objectives of the research first and second sub-group is divided into two distinct groups depending on whether they live in an urban or rural environment .. The motives for physical activity is estimated according to the scale of Behavior Regulation Exercise Questionnaire (BREQ) and Motives For Physical Activity Measure - Revised (MPAM-R), while the attitude towards sport according to Kneer inventory positions. Differences are processed multivariate and univariate analysis of variance (ANOVA and MANOVA). Based on the obtained results it can be concluded that male respondents living in rural areas show higher indoor values ??- intrinsic motivation and attitude toward sports, while male respondents living in urban areas perceived greater social support from parents and friends. Girls living in rural areas have more positive attitude to sport, while the other girls from the urban environment perceive greater social support from parents.

**Keywords:** *students, motivation, urban, rural, analysis of variance*

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**INTRODUCTION**

Theoretical models explaining human behavior are in the initial stage, but there is information indicating the way it operates and behaves. There are several theoretical models that explain physical activity and factors affecting it. Some of the theories and models were originally constructed to explain physical activity and factors affecting it, while other theories and models were constructed in order to intervene in order to increase the level of physical activity in the population.

One of these theories is the theory of self-determination (Self – Determination Theory, SDT [Ryan & Deci, 1985, 2000] ). The theory of self-determination can be used to help understand why children and young people dealing with physical and sports activities and if they intend to do so in the future. But personal motives for physical activity are also important. The most common motives identified among people engaging in physical activity are: to improve or maintain health, improve physical appearance, pleasure, desire for

competition, social experiences and getting psychological benefit. Motives that are regulated by external motivational regulator (eg. improving physical appearance) can not be lasting as those which are essential (eg. enjoyment, social and psychological). How the individual perceives autonomy is a decisive factor. In multiple studies the theory of self-determination was used as a framework for exploring the physical-sport activity and the impact of socio - demographic factors on it (Wilson et. al. 2004; Fredrick & Rajan, 1993; Vilson i Roxers 2002; Maltbi & Dan 2001).

The purpose of this research is to determine whether there are differences in motives for physical activity between boys and girls living in rural and urban areas.

**METHODS OF WORK**

The survey was conducted on a group sample of 749 subjects from the chronological age of 11 to 14 years (students from fifth to eighth grade). The sample is divided into two sub-samples of 349

males and 391 female respondents. The first and second sub-sample is divided into two distinctive groups depending on whether they live in urban or rural environment.

The motives for physical activity is estimated according to the scale of Behaviour Regulation Exercise Questionnaire (BREQ) which is constructed by Mullan, Markland, and Ingledew (Mullan, Markland, i Ingledew, 1997), same consists of 15 items and is of Likert type which is divided into several subscales including: external regulator - external regulation, regulator fault - introjected regulation, identification regulator - identified regulation, internal regulator - intrinsic motivation. The four subscales obtained and autonomous power index of self-regulation of motivation to calculate according to the following formula:  $(-2) (EXT) + IJ + ID + 2(IM)$ .

The second scale assesses what motivates young people to be physically active, known as the Motives For Physical Activity Measure - Revised (MPAM-R) It estimates five motives, or what encourages young people to be engaged in physical activities such as: interest / enjoyment, competitive challenge, appearance, fitness, social. The Scale is as of Likert type, fifth degree, and is composed of 30 items, designed by Fredrick & Ryan (Fredrick & Ryan, 1993) and modified by Ryan, Frederick, Lepas, Rubio, and Sheldon (Ryan, Frederick, Lepas, Rubio, and Sheldon 1997). It showed good measurement characteristics.

Scale that will assess students' attitudes towards sport consists of 24 particles (items) and is of Likert type - Kneer inventory positions. The 24 items are 12 positive and 12 are negatively formulated.

Differences between students who live in urban and rural areas are determined by multivariate and univariate analysis of the variance (ANOVA and MANOVA). The data are processed with statistical package SPSS for Windows Version 17.0

## RESULTS AND DISCUSSION

In order to determine whether there are differences in motives for engaging in physical sports-active attitude towards sport, perceived social support from friends and family of boys and girls of middle school aged living in urban and rural areas, where multivariate and univariate analysis is applied (MANOVA, ANOVA).

The results of multivariate and univariate

analysis of variance and the size of the partial effect of determinants (partial  $n^2$ ) are presented in Table 1.

The analysis of the results (Table 1) shows that between boys living in urban and rural areas that show statistically significant differences in the whole system of variables treated at multivariate level ( $Q = .00$ ). The analysis of the individual contribution of each variable was carried out to define these differences.

Thus, from review of arithmetic and corresponding values of the level of statistical significance it can be seen that statistically significant difference is identified in internal regulator - intrinsic motivation, attitude towards sport and perceived social support for physical activity from their friends and parents. Partial effect of the determinants partial  $n^2$  is ranked between .09 and .04 and shows a small to medium impact effect. The greatest effect in determining the differences shows variable "attitude towards sports".

Male respondents living in rural environment show higher values of internal regulator - intrinsic motivation (eg. I do exercises because it is fun) and attitude towards sports, while the male respondents living in urban areas perceive greater social support from parents and friends.

Table 2. shows the results of multivariate and univariate analysis of variance and the magnitude of the partial effect of determinants (partial  $n^2$ ) of female respondents. It is evident from the summary table it can be seen that between girls living in urban and rural areas there are statistically significant differences across the treatment system of variables and multivariable level ( $Q = .00$ ).

At univariate level statistically significant differences were identified in the sport paragraph and perceived social support from parents. Considering the values of arithmetic it can be concluded that girls living in rural areas have a positive attitude towards sports, while the other girls from the urban environment perceive greater social support from parents.

The impact of the environment on the motives, attitudes towards sport capacity and other features are accomplished in an indirect way, and these results should be viewed in a broader context. The life in the urban environment provides better conditions for development of genetic predisposition capabilities and features. On the other side, living in an urban environment leads children to more

Table 1. Multivariate and univariate differences in motives for motivation in physical sports-active attitude, socially perceived support from friends and family who live in urban and rural areas.

Wilks'Lambda	Rao's R	df 1	df 2	Q	n <sup>2</sup>
,88	3,83	12,00	336,00	<b>,00</b>	,12

	city		village		F	Q	n <sup>2</sup>
	Mean	SD	Mean	SD			
External_regulation	2,24	0,94	2,11	0,90	1,50	,22	,00
Introjected_regulation	3,08	1,04	3,25	1,05	1,77	,18	,01
Identified_regulation	4,15	0,65	4,17	0,72	,02	,89	,00
Intrinsic_regulation	4,24	0,62	4,40	0,57	4,73	<b>,03</b>	,01
Relative_Autonomy_Index	5,07	2,40	5,51	2,16	2,40	,12	,01
InterestEnjoyment	4,18	0,56	4,27	0,56	1,84	,18	,01
Competence	4,29	0,63	4,31	0,65	,11	,73	,00
Appearance	4,01	0,75	4,05	0,82	,22	,64	,00
Fitness	4,45	0,56	4,50	0,52	,56	,45	,00
Social	3,51	0,94	3,60	0,85	,76	,39	,00
Stance	3,80	0,53	4,05	0,59	14,41	<b>,00</b>	,04
Social support for friend	2,33	1,03	2,00	0,60	8,36	<b>,00</b>	,02
Social support for family	3,35	0,69	3,11	0,72	8,50	<b>,00</b>	,02

Table 2. Multivariate and univariate differences in motives for engaging in physical sports-active attitude, socially perceived support from friends and family among the girls who live in urban and rural areas.

Wilks'Lambda	Rao's R	df 1	df 2	Q	n <sup>2</sup>
,92	2,85	12,00	376,00	<b>,00</b>	,08

	city		village		F	Q	n <sup>2</sup>
	Mean	SD	Mean	SD			
External_regulation	1,90	0,83	1,85	0,78	,20	,65	,00
Introjected_regulation	2,84	1,13	3,00	1,11	1,24	,27	,00
Identified_regulation	3,98	0,66	4,03	0,90	,38	,54	,00
Intrinsic_regulation	4,27	0,62	4,25	0,83	,09	,76	,00
Relative_Autonomy_Index	5,89	2,58	5,83	2,83	,03	,85	,00
InterestEnjoyment	4,07	0,65	4,18	0,62	1,69	,19	,00
Competence	4,08	0,71	4,03	0,82	,25	,62	,00
Appearance	3,77	0,83	3,64	0,80	1,66	,20	,00
Fitness	4,33	0,65	4,31	0,66	,07	,79	,00
Social	3,25	0,88	3,37	0,83	1,30	,26	,00
Stance	3,97	0,47	4,09	0,46	3,77	<b>,05</b>	,01
Social support for friend	2,12	0,71	2,06	0,86	,42	,51	,00
Social support for family	3,24	0,75	2,93	0,69	11,26	<b>,00</b>	,03

pronounced sedentary habits (sitting in front of televisions and computers, passive transport, etc.), leading them to have other preoccupations.

## CONCLUSIONS

Based on the obtained results it can be concluded:

1. Male respondents living in rural environment have higher values of internal regulator - intrinsic

motivation and attitude towards sports, while the male respondents living in urban areas perceive greater social support from parents and friends.

2. Girls living in rural areas have a positive attitude towards sports, while the other girls from the urban environment perceive greater social support from parents.

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## РАЗЛИКИ ВО МОТИВИРАНОСТА КОН ФИЗИЧКА АКТИВНОСТ МЕЃУ МОМЧИЊТА И ДЕВОЈЧИЊАТА КОИ ЖИВЕАТ ВО УРБАНА И РУРАЛНА СРЕДИНА

УДК:796.03:316.644-057]:911.373/.375  
(Оригинален научен труд)

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### Апстракт

На примерок од 749 испитаника на возраст од 11 до 14 години, поделен во два примерока 349 испитаници од машки и 391 испитаник од женски пол реализирано е истражувањето со основна цел да се утврди влијанието на мотивите за занимавање со физичка-спортска активност, ставот кон спортот, перцепираната социјална поддршка од другарите и фамилијата кај учениците од урбана и рурална средина. За реализирање на целите на истражувањето првиот и вториот примерок е поделен во две динстички групи во зависност од тоа дали живеат во урбана или рурална средина. Мотивите кон физичката активност е проценети со склата Behavior Regulation Exercise Questionnaire (BREQ) и Motives For Physical Activity Measure - Revised (MPAM-R), додека ставот кон спортот со Кнееров инвентар на ставови. Разликите се обработени со мултиваријантна и униваријантна анализа на варијансата (МАНОВА и АНОВА). Врз основа на добиените резултати може да се констатира дека испитаниците од машки пол кои живеат во рурална средина покажуваат повисоки вредности внатрешен регулатор - *intrinsic motivation* и ставот кон спортот, додека испитаниците од машки пол кои живеат во урбана средина перцепираат поголема социјална поддршка од родителите и другарите. Девојчињата кои живеат во рурална средина имаат по позитивен став кон спортот, додека од друга страна девојчињата од урбаната средина перцепираат поголема социјална поддршка од родителите.

**Клучни зборови:** ученици, мотивација, урбана, рурална, анализа на варијанса

## CHANGES IN THE ANTHROPOMETRIC STATUS OF THE UPPER ARM AND FOREARM IN ADOLESCENTS FOLLOWING A SIX-WEEK PROGRAMMED EXERCISES WITH STANDARD AND MODIFIED REPETITIVE LOADS

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(Original scientific paper)

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### **Abstract**

*A programme was carried out on a sample of 51 subjects (adolescents) for transformation of the maximal muscle strength of the flexors in the elbow during a period of 6 weeks, performed on Scott bench. The subjects were divided in 3 groups. The first group performed exercises according to a matrix system, the second group performed the workout according to a reduced amplitudes method (from semi-flexion to full elbow flexion), and the third worked in accordance with the reduced amplitudes method (from maximal extension to half elbow flexion). The subjects were tested in six anthropometric measures, measured on the upper arm and the forearm, on three occasions (at the beginning, after 3 weeks of exercise and after 6 weeks of exercise). From the differences between groups it was concluded that there is no difference between the groups, which means that the subjects behaved similarly during the entire programme. The analysis of the possible changes within each individual group, throughout the entire experimental procedure, also did not show statistically significant changes in the anthropometric indicators. This points out the fact that most probably the benefit from exercises for transformation of the maximal muscle strength of elbow flexors is not based on physiological changes (covered by the anthropometric measures). Answers should, perhaps, be looked for in the mechanisms for management with movements at central level.*

**Key words:** *anthropometry, maximal muscle strength, experimental procedure*

### **INTRODUCTION**

Anthropometry is a field of biology which deals with measuring the physical dimensions of the human body (Peric, 1999). Relations between strength and anthropometric indicators are evident and objective. A typical example of this relation is the strength bodybuilding regime of work. The workout designed in such a manner has emphasised anabolic effect which results into muscle mass increasing. In addition, the anthropometric measures, especially on the trained muscles volumes, become extremely big. In training programmes focused on the transformation of the maximal strength capacity, most authors present the growth of indicators for one maximal repetition independent from the anthropometric indicators on volumes and adipose tissue (Ozmun et al, 1994; Ramsay et al., 1990), which means that no significant changes in the anthropometry field are noted.

Such dilemmas on the connection between the strength capacities and the anthropometric indicators depend on the type of programmes for transformation being delivered, which are directly related to the manner in which trainings are executed (external load intensity, work volume and extent, weekly frequency, load regime, manner of performing movements, etc.).

### **WORK PROGRAMME**

Strength training is frequently connected with changes of anthropometric indicators. It was precisely this paradigm that produced the work realisation idea. Experimental procedure was designed during the six weeks of training in order to create impact on the maximal strength component transformation, not using methods for expressed hypertrophy of local muscles. The problem was posed from here, and the same was to answer the follow-

ing question: Do methods for maximal strength transformation have an impact on possible (local) changes of anthropometric measures, covered in this research? For that reason, a hypothesis was developed claiming that there won't be any statistically significant differences in the arithmetic means of the researched arithmetic indicators.

The six-week experimental procedure was conducted on 51 subjects (students at 18-20 years of age). The subjects were placed in 3 experimental groups (E1, E2 and E3) and their task was to perform "biceps" exercises for the flexor muscles of the elbow of the non-dominant arm, on Scott bench. The load intensity was individually set for each subject and was 90% of the maximal lifted load (in attempt for one elbow flexion) tested through the test for one maximal repetition -1PM (Tan,1999). The work programme for the three groups was identical regarding the load intensity (90% of 1PM), the training volume: 3 series per day – until failure, with 5 minutes break between series (Zaciorski,1975 Kukolj,1996;) 3 workout units in one week (Ramsay et all.,1990; Moss et all.,2004; Marx, et all 1998) and a total duration of 6 weeks (Rasch et all.,1956). After the first 3 weeks of exercising, the 1PM test was again performed so as to, if needed, modify the load for performing the exercises. In addition, the number of series during one training was increased from 3 series to 4 series performed until failure.

The groups differed only in terms of the muscle contractions while exercising on Scott bench: E1 group worked a matrix load system (Redzpegikj, 2004), E2 group – in the zone from half-flexion to maximal flexion of the elbow and vice versa, and E3 group – in the zone from maximal extension to half-flexion and vice versa.

The following anthropometric measures were tested (Toteva M.,Slnehev,1990, Kurelic, N i sar, 1975):

- Volume of forearm minimal (OPMIN)
- Volume of forearm maximal (OPMAX)
- Volume of upper arm minimal (ONMIN)
- Volume of upper arm maximal (ONMAX)

Under skin fatigue and subcutaneous adipose tissue on forearm – dorsally (KDP)

Under skin fatigue and subcutaneous adipose tissue on upper arm-mm.triceps (KDN).

## RESULTS (ANALYSIS AND DISCUSSION)

The results obtained from the tested anthropometric indicators have shown that there is no statistically significant difference of the initial, the control or the final testing between the subjects of the three groups (E1, E2 and E3), in the anthropometric measures covered with the research (Tables No 1, 2 and 3). This points out the fact that the groups, that is, the different samples of subjects, were homogenous in accordance with the researched indicators.

Table 1. Anova result from initial test

INITIAL testing (E1 + E2+ E3)				
Wilks'	Initial			
Lambda	Rao's R	df 1	df 2	p-level
0.88	0.48	12	86	0.92

Table 2. Anova result from control test

CONTROL testing (E1 + E2+ E3)				
Wilks'	cotrol			
Lambda	Rao's R	df 1	df 2	p-level
0.85	0.62	12	86	0.82

Table 3. Anova result from final test

FINAL testing (E1 + E2+ E3)				
Wilks'	final			
Lambda	Rao's R	df 1	df 2	p-level
0.92	0.30	12	86	0.99

The multi-variant analysis of possible differences in the anthropometric measures in E1, E2 and E3 groups, for the six weeks of the experimental programme showed no statistically significant differences of the entire system of variables (Tables No 4, No 5 and No 6).

The training programme in this research enabled similar changes in the anthropometric indicators in the three groups (E1, E2 and E3), although each of the groups had its own manner of performing muscle loads of elbow with the non-dominant arm, and although in terms of motor skills, positive significant changes were noted in the maximal strength of flexors of the subjects from the three groups. Most probably, a similar physiological stimulus is in question, given in the three experimental groups; hence, the anthropo-

metric changes between the groups were not observed.

Table 4. Anova result for E1 group

E1 (Ini to fin)				
Wilks'				
Lambda	Rao's R	df 1	df 2	p-level
0.66	1.68	12	86	0.08

Table 5. Anova result for E2 group

E2 (Ini to fin)				
Wilks'				
Lambda	Rao's R	df 1	df 2	p-level
0.65	1.74	12	86	0.07

Table 6. Anova result for E3 group

E3 (Ini to fin)				
Wilks'				
Lambda	Rao's R	df 1	df 2	p-level
0.65	1.74	12	86	0.07

The stimulus was directed towards improving the maximal strength component, and not towards increasing the circular dimension of the engaged muscle groups (as the case is in the bodybuilding work regime). Changes in the tested arithmetic means of the under skin fatigues are lacking because the energy regime in which the work was carried out consumes ATP and creatine phosphate reserves, and the adipose tissue is not in the mechanisms that donate energy due to which stable condition is present in the consecutive arithmetic mean tests of the researched anthropometric indicators. The initial hypothesis that there won't be any statistically significant differences in the arithmetic means of the researched arithmetic indicators is not abandoned. The application of such directed workout protocols enables realisation of the kinesiological effects determined in advance.

## CONCLUSIONS

The programme directed towards improvement of the strength potential of the elbow flexors, as presented in this research, had no impact on the change of anthropometric measures, in the three experimental groups (E1, E2 and E3).

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**ПРОМЕНИ ВО АНТРОПОМЕТРИСКИОТ СТАТУС НА НАДЛАКТОТ И  
ПОДЛАКТОТ КАЈ АДОЛЕСЦЕНТИ ПО ШЕСТ НЕДЕЛНО ПРОГРАМИРАНО  
ВЕЖБАЊЕ СО СТАНДАРДНИ И МОДИФИЦИРАНИ РЕПЕТИТИВНИ  
НАПРЕГАЊА**

УДК:572.087.1:796.012.424-053.5  
(Оригинален научен труд)

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**Апстракт**

На примерок од 51 испитаник (адолесценти), пласирана е програма за трансформација на максималната мускулната сила на флексорите во зглобот на лакотот во период од 6 недели, изведени на скотова клупа. Испитаниците се поделени во 3 групи. Првата група работи вежби по матрикс систем, втората група по метод на скратени амплитуди (од полуфлесија до целосна флесија на лакотот), третата по метод на скратени амплитуди (од максимална екстензија до половина флесија на лакотот). Испитаниците се тестирана во шест антропометриски мерки, измерени на подлакотот и надлакотот, во 3 наврати (на почетокот, по 3 недели вежбање и по 6 недели вежбање). Од меѓу групните разлики се констатира дека не постои разлика меѓу групите, што значи дека испитаниците слично се однесувале во текот на целата програма. Анализата на евентуалните промени внатре во секоја група засебно, во текот на целата експериментална постапка исто така не покажа статистички значајни промени кај антропометриските показатели. Ова наведува на фактот дека најверојатно бенефитот од вежбите за трансформација на максималната мускулна сила кај флексорите на лакотот, не се темели на физиолошки промени (опфатени со антропометриските мерки). Можеби одговорите треба да се бараат во механизмите за управување со движењата на централно ниво.

**Клучни зборови:** антропометрија, максимална мускулна сила, експериментална постапка