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"Cum grano salis".

(Latin)

Dear reader,
This part of the Earth where we are and where the technical preparation of Sport Science occurs at this time was still under snow. So it is now. Although the temperatures are slightly higher than the previous years, the white cover somehow maintains and makes that life in a special way is nicer and a landscape bathed in the sun, brighter than it otherwise might have been the case. Look at this kind of whiteness and purity makes us slightly in the experience of the world and other people and inspires the full splendor of noon but as the day when left to its role nights. Run over the white carpet, excited souls are presenting themselves singing and dancing, sliding and sometimes involuntarily. Look down in amazement, walking recklessly, wondering: Is there anything unknown below the rate of snow? If it does, is it just froze mug or 'there are any hidden messages to find them, to publish them to the world, and are important anyone to filling our Iris them somewhere and let it go in life? With a grain of salt, the ancient Latins step into the discomfort, if at that time was exactly the same this mysterious universe? Grain of salt, grain of wisdom and knowledge, and the rest of us as a guideline that childhood game requires disclosure of luck, and many doubt a word that rings that anyway mighty Science will never disappear. This is the tenth edition of the journal, a tenth the weight around your neck, ten unsubstantial wings, tenth respect of smile, tenth time we wound deep in our soul, ten we rolled up to the nest and the tenth bird who goes his own way, free and happy lamented the departure answer. Thanks to all who support us, thank you, dear readers, we are a step up from tenth birth, but there we are a small, puzzled, naked, just waiting for us growing up, with time in hand we will meet with you tomorrow, when you carry this timeless river until one day we meet some stormy dawn.

Executive Editor
sen.ass.Danijela Bonacin, MSc

"Sa zrnom soli (skrivena poruka)".

(Latinska)

Dragi čitatelju,
Ovaj dio Zemlje u kojemu se nalazimo i gdje se tehnički priprema Sport Science u ovo vrijeme uvijek je pod snijegom. Tako je i sada. Iako su temperature nešto više nego li prijašnjih godina, bijeli pokrov se nekako održava pa čini da je život na osobiti način ljepši i, krajolik okupan Suncem, sjajniji nego li je to možda inače slučaj. Pogled na tu bjelinu i svojevrsnu čistoću čini nas blagim u doživljaju svijeta i drugih ljudi i inspirira pod punim podnevnim sjajem ali jednako i kad dan prepusti svoju ulogu noći. Hitamo po bijelom tapetu, uzbuđeni iznosimo sebe raspjevane duše i plešemo, kližući se katkad i bez svoje volje. Pogledamo dolje, začuđeno, hodajući nesmotreno, pitajuć se: Ima li što nepoznato ispod stope snijega? Ako ima, je li samo smrznut kal il' postoje kakve poruke skrivene da ih otkrijemo, da ih svijetu objavimo, i jesu li važne ikom da ih negdje obojamo šarenicom i pustimo da u život krenu? Sa zrnom soli, stari su Latini kročili u nemir, je li i u ono vrijeme baš jednako bio tajanstven taj Svemir? Zrno soli, zrno mudrosti i znanja, ostalo i nama kao putokaz djetinjstva koje igrom traži otkrivanje sreće, a za dvojbe mnoge neka zvoni riječ da znanosti silne ionako nikad nestat neće. Ovo je deseti broj časopisa, deseti je uteg oko vrata, deseta nam beztjelesna krila, deseti nam osmijeh poštovanja, deseta nam rana duboko u duši, deseto nam gnijezdo što se savi i deseta ptica koja svojim putem krene, slobodna zapjeva i sretna se u odlasku javi. Hvala svima što nas podupiru, hvala vama čitatelji dragi, deseti smo korak od rođenja, ali još smo mali, začuđeni, nagi, tek nas odrastanje čeka, s vremenom pod ruku srest ćemo s vama sutra, kad i vas ponese ova bezvremenska rijeka sve do nekog uzburkanog jutra.

Izvršni urednik
v.ass.Mr.Danijela Bonacin

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Erratum (Author names correction):

Sport Science, 2011 Dec; 4(2), 55-59.

Differences in agility performance between futsal and soccer players.
Zoran Milanović, Goran Sporiš, Nebojša Trajković and Fredi Fiorentini

Erratum in Authors:
Sport Science, 2011 Dec; 4(2), 55-59. [corrected to Zoran Milanović, Goran Sporiš, Nebojša Trajković, Fredi Fiorentini, Marjan Jerković and Valentin Barišić].

INFLUENCE OF ATTACKING EFFICIENCY ON THE OUTCOME OF HANDBALL MATCHES IN THE PRELIMINARY ROUND OF MEN' S OLIMPIC GAMES 2008

Dinko Vuleta[1], Goran Sporiš[1], Dinko Vuleta[1] jr., Boris Purgar[1], Zvonko Herceg[2] and Zoran Milanović[3]

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Original scientific paper

Abstract
The purpose of this research is to determine parameters influence of attacking efficiency on the score of handball matches at men's tournament Olympic Games in Peking 2008. The exemplar of entity makes 12 national selections 30 matches (60 competitors) of the first contest cycle at the men's tournament Olympic Games in Peking 2008. Data will be resumed with descriptive statistic package and regression analysis. The result outcome gives us tree variables to be exacted: shot from nine meters field, shot from semi-free ball successful on defined criteria. Standard indicators of situational efficiency which describes a set of predictor variables were: a shot from 9 feet successfully, shot from 9 feet unsuccessfully, with the wings of a successful shot, shot from the wing failed, shot from 6 feet successfully, shot from 6 feet failed, shot from a counterattack successfully, shot from the unsuccessful counterattack, shot from 7 feet successfully, shot with a 7 meter failure, the successful passage of the shot, shot from a passage failure. Criterion variable was defined final score of the game. This study was confirmed that handball game became faster with important phases such as: counterattacking, high level of technical skills and concentration. These phases are very important for winning or losing game, so coaches have to include new technologies and modality of training.

Key words: *handball, seniors, Olympic Games, performance, regression analysis*

Introduction

Handball is a game which requires from players continuous movement with and without a change of direction, intertwined with sprints, high jumps, landings and various duels with an opponent (Pavlin, Šimenc, Delija, 1982). Handball game is marked by a variety of typical and atypical situations in the game. Therefore, a detailed knowledge of certain situations in the game, or situational efficiency parameters of each player in a competitive and situational conditions is needed (Vuleta et al., 2003). Hierarchical structure of success factors in sports could be modeled from the viewpoint of analysis of the dimensions of athletes (Milanovic, 2010), which consists of four levels of interrelated factors. At the first level of the pyramid are the basic anthropological characteristics that are condition for the development of specific skills and knowledge of handball players that are on second level. At the third level of the performance hierarchical model is the situation-related efficacy (performance realized by the application of technical-tactical elements) that determines directly the final outcome of a match (the fourth level of the model). Situational efficiency indicators are collected by the existing methods of registration during the events or with subsequent viewing of videos. Each is a specific manifestation of all abilities, characteristics, skills and other characteristics of an athlete, coaches and other related logistics. That is why confronting the two opponents produces a similar, but never identical match courses or a result progress (Vuleta et al., 2005).

Using parameters derived from the aim of handball game can be assessed the situational effectiveness of games, individuals or team. If we recognize the performance that bring good results, it is possible to get better results based on indicators of situational efficiency in attack, defense and transition play in handball. However, a standardized method for the registration of such data which could give us an accurate understanding of the events on the field during and after match, has not been defined yet. Videos have a significan value for by handball experts because they can assess and analyze technical - tactical and other elements in the game.

The aim of research was to determine the effect of the parameters of situational efficiency in the overall success of the men's handball matches of the tournament of the Beijing Olympics. The analysis included the parameters of situational efficiency obtained in a handball Olympic games in Beijing 2008. in the preliminary round of the competition, which was played on league-system by groups. The primary objective of this study was to determine the extent to which the observed variance of situational efficiency indicators differ between the groups in the preliminary round of competition. The secondary objective of this paper was to analyze the level of impact of situational parameters on the performance of the team which is possible to define by the final outcome of the match (goal - difference that includes victory, defeat and tie).

Methods

The sample of cases

The sample of cases was comprised of 30 matches played by 12 national teams in the preliminary round of the 2008 Olympic games in Beiijing. The tournament was played on league and cup system, which means that the preliminary part of the group was played according to league system (each with each) where the top four teams have qualified for the second round. In this part of the competition teams have played with each other on the principle: A1 - A4, A2-B3, B1-A4, B2-A3. Quoterfinal matches were followed by semifinal duels: winning match A1-B4 against B2-A3, and the winners of the match A2-B3 against the winners of the match B1-A3. The defeated teams from quoterfinal duels have played matches for the 5-8 seat. Winners of semi final duels have played in final, and defeated for the third or fourth place.

The sample of variables

The set of predictor variables consisted of the frequencies of either successful shots (goals scored) or shots missed, which were taken by backcourt players, wingers and pivots from their playing positions and from fastbreaks. Variables of situational efficiency were: Field shots scored – from the backcourt positions -ŠUT9MUS, Field shots missed – from the backcourt positions- ŠUT9MNE, Wing shots scored – from the wings' position- ŠUTKRUS, Wing shots missed – from the wings' position- ŠUTKRNE, Goal area line shots scored- from the pivot position- ŠUT6MUS, Goal area line shots missed – from the pivot position- ŠUT6MNE, Fast break shots scored – from a counter-attack - ŠUTKOUS, Fast break shots missed – from a counter-attack- ŠUTKONE, seven meter shot scored- penalty shot - ŠUT7MUS, seven meter shot missed- penalty shot - ŠUT7MNE, breakthrough shot scored - ŠUTPRUS, breakthrough shot missed- ŠUTPRNE.

The success of individual teams can be defined in different ways and outcomes of certain matches (victory, defeat, a draw). Handball is characterized by the pre-agreed values that are added to teams with regard to the result (2 points for win, 0 points for lost, 1 point for draws). As a criterion of success for individual teams a goal-difference at the end of the game can be taken. Goal difference at the end of each game as a criterion of success of each team has additionall weight for previous criterion with the difference in the number of scored goals in relation to the number of goals conceeded by the opposing team (eg . +5 for a victory with 5 goals difference, -2 for defeat with 2 goals, 0 for a tie). The criterion variable for the purposes of this paper was defined as goal difference at the end of a match.

Statistical analysis

Data analysis was performed using The Statistical Package for Social Sciences (v17.0, SPSS Inc. Chicago, IL).

Descriptive statistics with its fundamental measures of central tendency and dispersive parameters gave an overview of performance (situation efficacy) parameters. The differences in performance indicators among different competition groups were established by the univariate and multivariate analyses of variance. Simple regression analysis was used to investigate the contribution of individual performance parameters to the eventual game outcome (goal-difference). Statistical significance was set to $p \leq 0.05$.

Results and discussion

Table 1. Descriptive statistic of the performance parameters in the preliminary round

	Mean	Std.Dev	Min	Max
ŠUT9MUS	7.78	3.494	1	16
ŠUT9MNE	12.17	5.349	2	22
ŠUTKRUS	3.03	2.270	0	9
ŠUTKRNE	2.38	1.851	0	8
ŠUT6MUS	6.17	2.793	2	12
ŠUT6MNE	2.95	2.045	0	10
ŠUTKOUS	5.25	3.062	0	16
ŠUTKONE	2.12	1.530	0	5
ŠUT7MUS	2.28	1.637	0	7
ŠUT7MNE	0.8	0.777	0	3
ŠUTPRUS	2.42	1.871	0	9
ŠUTPRNE	1.05	1.032	0	4

Field shots scored – from the backcourt positions -ŠUT9MUS, Field shots missed – from the backcourt positions- ŠUT9MNE, Wing shots scored – from the wings' position- ŠUTKRUS, Wing shots missed – from the wings' position- ŠUTKRNE, Goal area line shots scored- from the pivot position- ŠUT6MUS, Goal area line shots missed – from the pivot position- ŠUT6MNE, Fast break shots scored – from a counter-attack - ŠUTKOUS, Fast break shots missed – from a counter-attack- ŠUTKONE, seven meter shot scored- penalty shot - ŠUT7MUS, seven meter shot missed- penalty shot - ŠUT7MNE, breakthrough shot scored - ŠUTPRUS, breakthrough shot missed- ŠUTPRNE.

Table 2. Multivariate analysis of variance

	Wil. Lam.	Rao s R	Df 1	Df2	p-level
AB	0.71	2.62	8	51	0.017

Table 3. Basic statistic parameters of predictor and criterion variables in group A

	Mean	SD	Min	Max
ŠUT9MU	6.57	3.66	1	16
ŠUT9MN	11.93	6.06	2	22
ŠUTKRU	3.37	2.70	0	9
ŠUTKRN	2.13	1.72	0	6
ŠUT6MU	6.83	2.76	2	12
ŠUT6MN	3.10	2.32	0	10
ŠUTKOU	5.90	3.69	0	16
ŠUTKON	2.27	1.60	0	5
ŠUTPRU	2.5	2.19	0	9
ŠUTPRN	0.83	0.83	0	3
GOLRAZ	0	9.37	-19	19

Table 4. Correlation matrix for predictor and criterion variables

	ŠUT9MUS	ŠUT9MNE	ŠUTKRUS	ŠUTKRNE	ŠUT6MUS	ŠUT6MNE	ŠUTKOUS	ŠUTKONE	ŠUTPRUS	ŠUTPRNE	GR
ŠUT9MUS	1.00										
ŠUT9MNE	0.51	1.00									
ŠUTKRUS	-0.40	-0.70	1.00								
ŠUTKRNE	-0.36	-0.32	0.32	1.00							
ŠUT6MUS	-0.09	-0.15	-0.08	0.03	1.00						
ŠUT6MNE	-0.09	-0.22	0.23	-0.13	-0.26	1.00					
ŠUTKOUS	-0.20	-0.51	0.24	0.39	-0.01	0.01	1.00				
ŠUTKONE	-0.30	-0.58	0.28	0.25	0.24	-0.03	0.49	1.00			
ŠUTPRUS	-0.53	-0.60	0.43	0.06	0.16	0.08	0.27	0.11	1.00		
ŠUTPRNE	-0.09	-0.15	-0.00	-0.42	0.21	0.01	-0.08	-0.02	0.22	1.00	
GOLRAZL	-0.30	-0.76	0.50	0.38	0.23	-0.07	0.73	0.59	0.46	0.04	1.00

Table 8. Correlation matrix of predictor and criterion variables

	ŠUT9MUS	ŠUT9MNE	ŠUTKRUS	ŠUTKRNE	ŠUT6MUS	ŠUT6MNE	ŠUTKOUS	ŠUTKONE	ŠUTPRUS	ŠUTPRNE	GR
ŠUT9MUS	1.00										
ŠUT9MNE	0.50	1.00									
ŠUTKRUS	0.05	-0.13	1.00								
ŠUTKRNE	0.09	0.16	0.26	1.00							
ŠUT6MUS	-0.23	-0.35	-0.12	-0.35	1.00						
ŠUT6MNE	-0.22	-0.39	0.18	0.08	0.04	1.00					
ŠUTKOUS	-0.35	-0.15	0.28	0.02	0.03	0.03	1.00				
ŠUTKONE	-0.00	-0.03	0.20	0.02	-0.51	-0.01	0.22	1.00			
ŠUTPRUS	-0.20	-0.08	-0.36	-0.37	0.21	0.21	-0.30	-0.09	1.00		
ŠUTPRNE	-0.21	-0.56	0.18	0.04	0.07	0.07	0.03	0.10	-0.09	1.00	
GR	0.19	-0.08	0.27	0.20	0.24	0.24	-0.02	-0.16	-0.05	0.10	1.00

In Table 4 parameters of descriptive statistics show that Olympic games in Beeing were more efficient with 1619 conceded goals compared to Athens with 1619 conceded goals (Kriste, 2006).

The total average number of shots directed toward the opposing goal was about 48, with the percentage of successful shots approximately 55%. The analysis of successful and unsuccessful shots on the goal indicates the following: unsuccessful field shots (730) is greater than the number of successful (467) with somewhat larger deviations. With an average of about 20 shots from the field (background position) with the percentage of realization of about 39%, with the wing positions where 182 shots have been successfull and 143 shots missed. Of the total number of shots - 325, the average of about 5 shots was directed to the opponent's with a 56% of efficiency. Of that number, there were 370 successful shots from 6m and 177 unsuccessful, which indicates to the defensive actions of players or goalkeeper. An avarage of 9 shots with 68 % of realization, out of which 442 shots from counter attack with a total of a successful shots of 315, so it could be concluded that about 5 counter attacks have ended successfully compared to 2 unsuccessful, which indicates to a good physical preparation of defensive players and their good transition from offence to defence. There were 71% successfully realized counterattacks from the total number of shots.

Table 5. Results of regression analysis for the contribution of shot variables on criterion variable goal-difference

STATISTIC	VALUE
MULTIPLE R	0.92
MULTIPLE R2	0.85
ADJUSTED R2	0.77
F(10.19)	10.57
P	0.00
STD.ERR. OF ESTIMATE	4.52

Table 6. Partial results of regresion analysis

	BETA	St.Err.	B	St.Err.	T(19)	p-level
Intercpt			-2.87	9.21	-0.31	0.76
ŠUT9MUS	0.09	0.12	0.24	0.32	0.76	0.45
ŠUT9MNE	-0.46	0.20	-0.70	0.31	-2.26	0.03
ŠUTKRUS	0.14	0.14	0.47	0.48	0.99	0.34
ŠUTKRNE	-0.06	0.13	-0.33	0.72	-0.46	0.65
ŠUT6MUS	0.15	0.10	0.52	0.35	1.47	0.16
ŠUT6MNE	-0.17	0.10	-0.68	0.41	-1.60	0.12
ŠUTKOUS	0.50	0.13	1.27	0.31	4.07	0.00
ŠUTKONE	0.05	0.13	0.24	0.79	0.30	0.77
ŠUTPRUS	0.05	0.14	0.22	0.60	0.36	0.72
ŠUTPRNE	-0.13	0.11	-1.42	1.24	-1.14	0.27

From a 7 meter line, there were 285 shots out of which of which an average of 137 shots was successfully realized, an avarage of 3 shots with the successful implementation of about 67% which is slightly lower values of the criteria of 80%.

Table 7. Basic statistic parameters of predictor and criterion variables in group B

	Mean	SD	Min	Max
ŠUT9MU	9.00	2.89	5	15
ŠUT9MN	12.4	4.62	6	21
ŠUTKRU	2.70	1.72	0	6
ŠUTKRN	2.63	1.97	0	8
ŠUT6MU	5.50	2.71	2	11
ŠUT6MN	2.80	1.75	0	6
ŠUTKOU	4.60	2.14	2	10
ŠUTKON	1.97	1.47	0	5
ŠUTPRU	2.33	1.51	0	6
ŠUTPRN	1.27	1.17	0	4
GR	0	3.02	-7	7

Table 9. Results of regression analysis for the contribution of shot variables on criterion variable final goal-difference

STATSTIC	VALUE
MULTIPLE R	0.60
MULTIPLE R2	0.36
ADJUSTED R2	0.02
F(10.19)	1.06
p	0.43
STD.ERR. OF ESTIMATE	3.00

Table 10. Partial results of regresion analysis

	Beta	Std.Err	B	Std.Err	t(19)	p-level
Intercept			-13.4	6.02	-2.15	0.04
ŠUT9MUS	0.37	0.24	0.38	0.25	1.52	0.14
ŠUT9MNE	0.08	0.30	0.05	0.19	0.27	0.79
ŠUTKRUS	0.16	0.21	0.29	0.38	0.76	0.45
ŠUTKRNE	0.30	0.22	0.47	0.34	1.40	0.17
ŠUT6MUS	0.53	0.28	0.59	0.31	1.88	0.07
ŠUT6MNE	0.34	0.24	0.58	0.41	1.40	0.18
ŠUTKOUS	0.08	0.22	0.11	0.32	0.34	0.73
ŠUTKONE	0.16	0.28	0.34	0.57	0.59	0.56
ŠUTPRUS	0.12	0.23	0.24	0.46	0.53	0.60
ŠUTPRNE	0.06	0.23	0.15	0.60	0.24	0.80

Breakthrough shots on this tournament were a total of 208, from which 145 were successful which was less than 3 breakthroughs per game. Multivariate analysis of variance (Table 2) indicates the overall differences in effectiveness of the situational parameters for the two competing groups. Based on the analysis, results show that the effectiveness of situational parameters differ between the groups so the interpretation of the results for predictor variables were accessed for each group. Based on the results shown in Table 5, the hypothesis H0 can be rejected with the statement that the differences between the variance of the observed indicators of situational efficiency in competitive groups AB preliminary competitions were statistically significant. Based on descriptive analysis of situational efficiency indicators in the group A of the preliminary competition it was was found that the number of goals scored (about 27) is identical compared to the average of the preliminary competition (about 27).

In this group the percentage of successful completion is approximately 56%. It can be concluded that the teams in this group were more efficient - an average of 27.33 goals per game of total 820 that a slightly higher number of shots from both groups (1619). The result can be explained by to the "outsider" (China) in this group, which eventually even had a goal difference of -60, so it turns out that on average per game they were losing with -12 goals. There were about 7 successful shots on avarage from field (9m) and about 12 unsuccessful shots, with realization of 35%, which is below the average for backcourt players. Wings shot efficiency was about 3 succesfull and about 2 unsuccessful from total of 165 shots with the percentage of realization of 61% which indicates on the small number of shots from the wing. This was due to the defensive actions of players. Correlation coefficients which describes the relation between a set of predictor and criterion variables each separetly, and with a defined criterion variables at a significance level $p < .05$ have showed some significant corelation but without deeper analysis. Based on the results from Table 7 it could be seen significant connection between the variables Field shots missed, Wing shots scored, Wing shots missed, Fast break shots scored, Fast break shots missed and Breakthrough shots scored with the final goal-difference with slightly higher values wich indicate a possible impact, but it should be processed by regression analysis. Using regression analysis the total and partial impact of the observed variables on the success of 'achievements was determined. The analysis addressed the impact of variables on the criterion score - the difference. Table 8 shows that the multiple correlation coefficient is 0.92 which indicates a significant correlation with the criterion predictor ($p = 0.00$). Total variability of the system predictor and criterion variables is about 85% (multiple $R2 = 0.85$) or 77% (adjusted $R2 = 0.77$). The remaining 23% of variability in the final outcome can be explained by the technical and tactical actions, efficacy of gatekeepers and other undefined factors. Based on the results we can conclude that the variables Field shots missed (0.46), and Fast break shots scored (0.50) significantly affect the criterion goal-difference (Table 9). It is important to emphasize that the variable Field shots missed has a negative sign, and variable Fast break shots scored has a positive sign. Fast break shots scored is a variable that has the largest impact on goal-difference criterion (0.50) which indicates that the successful fast break shots are the biggest contributor to the goal-difference. Next largest influence on goal-difference has a variable Field shots missed (0.46) which shows that teams that have a smaller number of unsuccessful shots from field, have more quality and diverse selection of shots and greater precision. Partial regression coefficients in the observed predictor variables are statistically significant in two variables, which indicates that they have just been crucial to the criterion goal-difference.

Characteristics of teams that is conditioned on the success of goal-difference criterion was very good in transition stages of handball game: good counterattack, varied shot selection and good organization of the attack as well as return to the defense after unsuccessfull attack. Results of the maximum number of goals (33) and the minimum number of scored goals (21) points to the fact that this group was more homogenuos than group B (maximum 36 and minimum 14). This group is weaker also in the percentage of realization with 54.35% goals in average per match than group A (56.63%). From these results it can be concluded that in this group defensive action had impact on development results. The fact that in this group, several unsuccessful field shots show how defensive action and goalkeepers played well. Percentage of successful implementation is about 42% which is much higher in group A compared to about 35%. In wings shots there were 81 successfull and 79 unsuccessful kicks with the percentage of realization of about 50% which is below than exspected because the expected percentage is about 75% - 80%. In a breakthrough shots, the percentage of successful shots was about 76% so it also represents an important factor in creating the final result. Table 11 shows that there is no significant correlation of variables with the criterion variable - goal-difference. Table 12 show that the multiple correlation coefficient is 0.60 which indicates of a significant correlation with the criterion set of predictor ($p = 0.43$). Total variability of the predictor and criterion variables is about 36% (multiple R2=.36) or cca. 2% (adjusted R2=.02).

The remaining 98% of variability in the final game outcome can be explained by the technical and tactical actions, gatekeepers efficacy, and other undefined factors. Table 13 shows the partial effects of predictor variables on the performance criteria associated with the F-test to assess their significance. Based on the results we can conclude that none of the variables has impact on the criterion of goal-difference. Partial regression coefficients in the observed predictor variables showed that neither variable was statistically significant so we can not conclude what variables have the highest projection on goal-difference criterion. After the analysis and obtained results, the hypothesis which predicts the absence of a statistically significant impact on the criterion defined by goal-difference at the end of the game was rejected, while the hypothesis H1 that predicts differences in the impact of predictor variables in relation to performance criteria was confirmed. The limitation of this study was that defensive actions should be included in research. Unfortunately, the registration system offer very little information in that domain, and only hypothetical conclusions based on available data remains. Research has confirmed that the handball game has speed up the counterattack phase - transition and the high level of technical performance with a maximum concentration of each of the key factors distinguishing winning and defeated teams. Therefore today's coaches in training should identify new technologies and modalities of training for just those technical elements of handball that are important for success.

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UTJECAJ NEKIH VARIJABLI ŠUTIRANJA NA KONAČAN REZULTAT RUKOMETNIH UTAKMICA PRELIMINARNOG DIJELA TURNIRA OLIMPIJSKIH IGARA 2008. GODINE

Sažetak

Cilj ovog rada bio je utvrditi utjecaj parametara situacijske efikasnosti na rezultat rukometnih utakmica na muškom dijelu turnira Olimpijskih igara u Pekingu 2008. Uzorak entiteta čini 12 nacionalnih selekcija, u ukupno 30 utakmica (60 protivnika) preliminarnog dijela muškog turnira Olimpijskih igara u Pekingu 2008. Za obradu podataka koristit će se statistički paket Utjecaj situacijskih parametara na kriterij gol-razlika analiziran je regresijskom analizom. Dobiveni rezultati ukazuju na statistički značajan utjecaj prediktorskih varijabli, šut sa devet metara neuspješno te šut iz polukontre uspješno na definiran kriterij. Kriterijska varijabla definirana je konačnim ishodom utakmice gol – razlika. Istraživanje je potvrdilo da se rukometna igra ubrzala da su faza protunapada - tranzicije te visoka razina tehničke izvedbe uz maksimalnu koncentracije jedni od bitnih faktora razlikovanja pobjednika i poraženih ekipa . Zato bi današnji treneri na treninzima trebali utvrditi novije tehnologije i modalitete treninga za upravo one tehničke elemente radu pokazale važnima za konačni uspjeh.

Ključne riječi: *rukomet, seniori, Olimpijske igre, situacijska efikasnost, regresijska analiza*

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THE EFFECTS OF DIFFERENT RECOVERY CONDITIONS ON BLOOD LACTATE CONCENTRATION AND PHYSIOLOGICAL VARIABLES AFTER HIGH INTENSITY EXERCISE IN HANDBALL PLAYERS

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Original scientific paper

Abstract
The aim of this study was to determine the effects of different active vs. passive recovery on blood lactate concentration after high intensity exercise in handball players. Ten male students (age: 22.4 ± 2.1 years; body mass index: 21.6±1.2 kg/m^2; percent body fat: 14.5±2.1) performed ten 30-meters shuttle run sprints with a 30 second passive recovery between repetitions for production lactate at a similar time of the four days. Four recovery trails were used to determine efficient recovery method in handball players. Statistical analyses revealed a significant difference between active and passive recovery conditions. There was a significant difference between walking with running and jogging recovery conditions (p = 0.012 and p = 0.002 respectively). There were no significant differences between the jogging and running recovery models (p = 0.576). Consequently, the results indicated that, higher intensity recovery might have a greater capacity to remove lactate in handball players.

Keywords: *active recovery, passive recovery, blood lactate, handball players*

Introduction

Modern handball is a fast game and the rules allow interchanging of players at any moment during a match and after a goal has been scored, the referee restarts the game as soon as an attacking player is in possession of the ball at the centre line, independent of the defenders position on the court. In team handball, matches are characterized by repeated accelerations, sprints, jumps, change of directions and technical movements in very short time and with an order determined by the tactical situation. At elite level, regular player actions, such as tackles, feints and shots, have to be carried out with maximal intensity to overcome opposition and be successful.

Therefore, handball is a sport characterized by the involvement of both aerobic and anaerobic metabolic pathways and high levels of blood lactate may sometimes be observed during a match (Ronglan et al., 2006). The ability to repeat high-intensity efforts may be of importance for handball players. Several studies have suggested that lactate accumulation is associated with muscular fatigue (Ahmaidi et al., 1996; Bond et al., 1991). Also, it was revealing that The ability to perform maximally during repeated exercise bouts is influenced by the nature of both exercise and recovery periods (Greenwood et al, 2008). Therefore, in intermittent high-intensity exercise like handball recovery model is so importance. Lactate is removed from the blood through a combination of methods. Lactate is metabolized by the heart, brain and liver through oxidation (Bonen et al., 1979). Previous reports have indicated that active recovery is better than passive recovery for blood lactate disappearance (Ahmaidi et al., 1996; Monedero & Done, 2000; Dodd et al., 1984).

Research has found significant reductions in lactate during short duration low intensity active recoveries when compared with passive recovery involving three or more bouts (Dodd et al., 1984). Also, it has been shown that blood lactate concentrations decrease more rapidly during an active recovery performed at 30-70% maximal O_2 consumption (VO_{2max}) (Bonen et al., 1979; Dodd et al., 1984). This range (30-70% VO_{2max}) is very wide and work rate expressed in percent of VO_{2max} would not be comparable among subject. Therefore, in handball players exercise intensity should be defined in relation to the individual heart Rate. Also, to our knowledge, no commonly agreed strategies or optimal intensity of active recovery for clearing accumulated lactate in handball players. So the knowledge of the most efficient work rate for lactate removal could be useful not only to optimize the strategy during a handball game, but also to design the athlete training session. Additionally, lactate can induce peripheral venous blood pooling, reduce cardiac filling, and impair cardiac pre-load and stroke volume (Crisafulli, 2006).

Therefore, we expect best method for recovery and removal lactate can affect on several physiological variables, like the heart rate (HR), Systolic blood pressure (SBP), diastolic blood pressure (DBP) and rate-pressure product (RPP), that have important role in heart function. With regard to controversy among little studies results about optimal recovery after severe repeated exercise and its efficient effects on athlete performance and physiologic response; the aim of this study was to examine the different recovery methods after high intensity shuttle run sprints for removal lactate and change blood pressure and RPP in handball players.

Methods

Subjects

Physiological characteristics of the subjects are presented in table 1. Ten male students volunteered for this study. All participants were members of the varsity handball team at the University of Guilan. Before the study began, all the experimental procedures, benefits and risks of the study were explained to the participants, and they each provided written informed consent. The study was approved by the Human Investigation Committee of the University of Guilan. All subjects were in good health and were not taking medication, amino acids, or other drugs, including anabolic doping agents that could influence the experimental protocol. Subjects completed a one day food diary on the day before their first test, and repeated this diet before the subsequent trials. In addition, Participants were asked to refrain from exhaustive exercise within 48 hours and avoid food and fluids except water within two hours of all laboratory visits.

Table 1 (Mean ±SD) values of the subjects' characteristics.

Age (years)	22.40 ±2.10
Height (m)	1.77 ±0.13
Body Mass (kg)	69.50 ±3.50
Body mass index (kg/m^2)	21.60 ±1.20
Body fat (%)	14.5 ±2.10
VO_{2max}(ml kg^{-1}min^{-1})	51.4 ±.80

Study design and measurement

the subjects with the procedures and to determine their VO_{2max} and anthropometric measurements. The test for the determination of VO_{2max} was performed on a treadmill (Technogym, Italy) with Bruce protocol. The skin fold-thickness was measured using Lange caliper that make use of the sum of three skinfolds at the chest, abdomen and front thigh (Jackson & Pollock, 1985). Height and weight were measured by digital stadiometer and scales. Body mass index (BMI) was calculated by dividing weight (kg) by height (m^2). The subsequent four sessions involved different recovery models which were performed at 45-55, 55-65, 65-70% (HR_{max}) and passive method. All exercise trials were allocated randomly in a counterbalanced manner and separated by at least 3 days.

Testing Procedures

Participants followed a ten minute warm-up which comprised of light jogging and stretching performed ten 30-meters shuttle run sprints with a 30 second passive recovery between repetitions for production lactate. Before the initial shuttle run and end of test, lactate concentration analyzed with a scout portable lactate analyzer (Roche Diagnostics, Mannheim, Germany). Each subject was required to perform four different shuttle run sprints at a similar time of the day. The 4 recovery trails were investigated as 1) walking with 45-55% HR_{max} 2) jagging with 55-65% HR_{max} 3) running 65-70% HR_{max} and 4) passive.

During exercise and recovery HR was monitored by pulsmeter (PM 80 Germany) Also blood pressure was monitored before the test and at the end of the exercise by sphygmomanometer and stethoscope (ALPK2 Japan).

Statistical analysis

All analyses were performed using the SPSS software (version 16.0, Chicago, USA). Data are reported as means and standard deviation (SD). The distribution of the data was analyzed by the Shapiro–Wilk test, and the results showed a normal Gaussian distribution. ANOVA for repeated measures was used to detect significant difference between groups and Post-hoc analysis of significant differences was investigated using the Bonferroni test. A level of significance of $P<0.05$ was used throughout this study for all the tests.

Results

Blood lactate during recovery

Changes in blood lactate concentration in the 4 recovery conditions are presented in figure 1. Mean blood lactate concentrations on baseline and immediately after exercise were the approximately same in the 4 trials ($p = 0.467$ and $p = 0.952$ respectively). Statistical analyses revealed a significant difference between active and passive recovery conditions. Significant changes in blood lactate concentration appeared on after the all recovery ($p = 0.001$). There was a significant difference between walking with running and jogging recovery conditions ($p = 0.012$ and $p = 0.002$ respectively). There were no significant differences between the jogging and running recovery models ($p = 0.576$). But, the blood lactate concentration following recovery at running was lower than for the other two active recovery conditions.

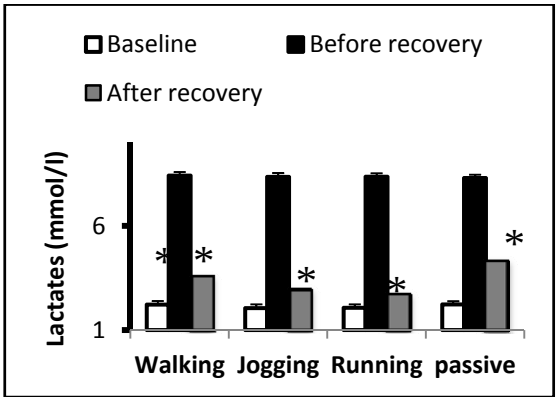

Figure 1. Change in blood lactate concentration in the four recovery conditions. *Significant ($P<0.05$) difference between before- and after-recovery values for each trail group.

SBP, DBP and RPP during recovery

SBP and DBP in the 4 conditions are shown in figure 2. Blood pressure in baseline and immediately after exercise were close together for the 4 conditions (SBP: $p = 0.734$ and $p = 0.657$; DBP: $p = 0.306$ and $p = 0.135$ respectively).

Statistical analyses revealed a significant difference between active and passive recovery conditions (p = 0.005). Significant different and DBP appeared on after the all recovery (p = 0.001). There was a significant difference in SBP between running with walking and jogging recovery conditions (p = 0.007 and p = 0.01 respectively).

But, There were no significant differences between the walking with jogging and running (p = 0.449 and p = 0.155 respectively). Also, the SBP and DBP following recovery at passive recovery were lower than for the other three recovery conditions.

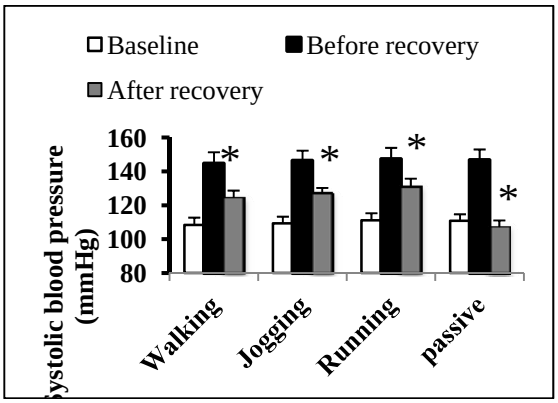

Figure 2. SBP at baseline, before and after four recovery conditions. *Significant (P<0.05) difference between before- and after-recovery values for each trail group

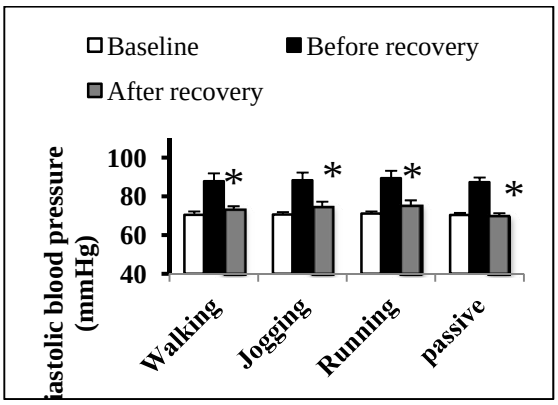

Figure 3. DBP at baseline, before and after four recovery conditions. *Significant (P<0.05) difference between before- and after-recovery values for each trail group.

Changes in RPP for recovery conditions are presented in figure 4. Baseline and immediately after sprint protocol RPP values were relatively same in the 4 conditions (p = 0.339 and p = 0.985 respectively). Statistical analyses revealed a significant difference between active and passive recovery conditions (p = 0.007).

Significant changes in DBP were observed on after the all recovery (p = 0.001). There were no significant differences between the walking with jogging and running (p = 0.656 and p = 0.512 respectively). But the DBP following recovery at passive was significantly lower than for the other three recovery conditions.

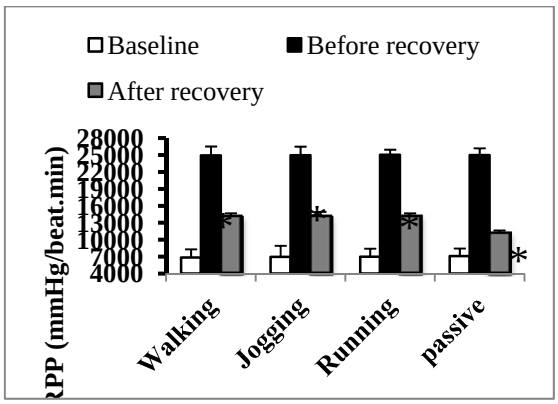

Figure 4. RPP at baseline, before and after four recovery conditions. *Significant (P<0.05) difference between before- and after-recovery values for each trail group.

Discussion and conclusion

This study demonstrated that active recovery after 30-meters shuttle run sprints led to a faster clearance of accumulated blood lactate than passive recovery in handball players. Also, this study showed that the decrease in accumulated blood lactate after 30-meters shuttle run sprints was more effective when followed by active rather than passive recovery. This confirms previous studies showing that active recovery clears blood lactate faster than passive recovery from the blood (Ahmaidi et al., 1996; Monedero & Done, 2000; Dodd et al., 1984). Our study have shown that active recovery for clearing lactate may be most effective in the range 55-70% HR_{max}. We observed in handball players that Lactate decline was more efficient during recovery at 55-65 and 65-70% HR (without significant difference between these work rates), but active recovery at 55-60% and 65-70% of HR were also more effective than 45-55% of HR. This result is in agreement with previous studies showing that active recovery for clearing lactate may be most effective in the range 25-63% of VO_{2max} (Boileau et al., 1983). Also, Its consistent with previous studies that lactate removal occurs more effectively during mild to moderate exercise recovery intensities (Baldari et al., 2004). But, recent finding is inconsistent with few previous studies showing that blood Lactate concentrations decrease more rapidly if light exercise is performed during the recovery phase (Hermansen & Stensvold, 1972; Gladden, 1991). It has been shown that optimum intensity of recovery exercise to promote blood lactic acid removal is around 30% to 40% of $V0_{2max}$ (Dodd et al., 1984). Our result also showed that for trained men higher intensity recovery might have a greater capacity to remove lactate. Therefore, blood lactate concentration during exercise and recovery is a complex event influenced by a combination of lactate production by the exercising muscle, blood flow, and lactate uptake and oxidation by the liver, heart, and skeletal muscle (Bonen et al., 1979). As exercise intensity increases, blood flow to tissues that can oxidize lactate, especially to the slow-twitch fibers of skeletal muscles where lactate oxidation occurs is increased (Greenwood et al., 2008; Gladden, 2000).

Blood lactate can be altered in femoral artery blood flow and vascular tone during recovery (Crisafulli, 2006). Pervious study demonstrated that blood lactate levels remained elevated during the period of persistent vasodilatation after the exercise bout (Crisafulli, 2006). Some physiological variables, such as the HR, BP and RPP have important index for indicator of the heart work during exercise (Duncker & Bache, 2008). RPP (usually called the doubled-product) is an index of myocardial oxygen consumption during exercise and calculated by multiplying the SBP by the HR (Duncker & Bache, 2008; Gobel et al., 1978). This study showed that the SBP, DBP and RPP significantly increased immediately after exercise. Also, it was observed that passive recovery method was more effective for decrease in SBP, DBP and RPP. It has been previously reported that moderate and high intensity exercise bouts produce highest increases in RPP during exercise and fail to reduce RPP below baseline during the recovery period (Duncker & Bache, 2008; Gorman & Feigl, 2012). It also demonstrated that the decrease in blood pressure during recovery is more pronounced following intense exercise (Raglin et al., 1993) for example, Piepoli et al. (1994) observed that maximal exercise provide a post-exercise blood pressure fall in young normotensive humans. So, recovery intensity plays a role in hemodynamic, thermoregulatory and neural responses. Increase in sympathetic activity and attenuated vagal reactivation affect on heart rate, ventricular wall tension and heart contractility maybe cause to increase in SBP and DB in active recovery conditions (Chen & Bonham, 2010). Some studies suggest that the increase in heart rate accounts for 50–70% of the increase in myocardial oxygen consumption during exercise (Duncker & Bache, 2008). Moreover, lactate can induce peripheral venous blood pooling, reduce cardiac filling, and impair cardiac pre-load and stroke volume (Crisafulli, 2006). So, one reason for decrease in BP in passive recovery maybe is result of postpone lactate removal. In conclusion, this study demonstrated active recovery for clearing lactate of handball players was most effective in the range of 55-70% $HR_{max.}$ And passive recovery condition was more effective for decrease in SBP, DBP and RPP. But, in this study performance of handball players wasn't been measured in competition and real training due to uncontrolled condition. Therefore it's unclear that which method is most appropriate for handball match. This issue need to more studies in future.

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UČINAK RAZLIČITIH UVJETA OPORAVKA NA KONCENTRACIJU LAKTATA I FIZIOLOŠKE VARIJABLE NAKON VISOKOG INTENZITETA VJEŽBANJA RUKOMETAŠA

Sažetak

Cilj ovog istraživanja bio je utvrditi utjecaj različitih (aktivnog i pasivnog) oporavka na laktate nakon visokog intenziteta vježbanja rukometaša. Deset učenika (dob: 22,4 ± 2,1 godina, indeks tjelesne mase: 21,6 ± 1,2 kg/m2; postotak masnog tkiva: 14.5 ± 2.1) izvodilo je deset ponavljanja 30-metarskog trčanja shuttle-run testa sa 30 sekundi pasivnog oporavka između ponavljanja za „proizvodnju" laktata u slično vrijeme uzastopna četiri dana. Četiri pravca oporavka su korišteni za određivanje učinkovitosti oporavka rukometaša. Statistička analiza pokazala je značajnu razliku između aktivnih i pasivnih uvjeta oporavka. Značajna je razlika između uvjeta oporavka kod hodanja s trčanjem i joggingom (p = 0,012 i p = 0,002 respektivno). Nije bilo značajne razlike između metoda oporavka joggingom i trčanjem (p = 0,576). Dakle, rezultati pokazuju da, veći intenzitet oporavka možda pokazuje veći kapacitet za uklanjanje laktata kod rukometaša.

Ključne riječi: *aktivni oporavak, pasivni oporavak, laktati u krvi, rukometaši*

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THE DISCOVERY OF THE MIRROR FOR LEARNING NEURONS MOTOR

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Review paper

Abstract

The mechanisms of knowledge have been for centuries a purely philosophic theme. Neuroscience, did not accept a position implicitly empiricist, but in recent years things have changed: the NeuroSciences have Developed a series of techniques to address problems have traditionally Been That of relevance of philosophy. The discoveries of neuroscientists have proved so important That even According to The Economist, 2006 was the year of mirror neurons. The author of the international scientific community That Is Considered a revolutionary discovery reach of the (Equal to That of the double helix of DNA) is Giacomo Rizzolatti Director of the Department of Neuroscience at the University of Parma. This type of cells, Discovered in monkeys, have dual properties: both are activated When the monkey performs an action and when to the monkey sees another individual to do the examination action. An action done by another activation induces, in the interior of Those observing the action of neurons That would work if he did That action, That of mirror neurons. In humans the system "mirror" was Demonstrated in an indirect manner. The system includes multiple brain areas, Including speech and action, as well as in understanding the actions, Including the ability to imitate, with skill That Belongs in the proper sense only to humans and higher primates Through the exploration of the properties of mirror neurons, Neuroscience has uncovered the neural mechanisms underlie That our individual and social behavior and the evolution of them.

Key words: *learning, mirror neurons, development*

Introduction

The mechanisms of knowledge have been for centuries a purely philosophic theme. Neuroscience, did not accept a position implicitly empiricist, but in recent years things have changed: the neurosciences have developed a series of techniques to address problems that have traditionally been of relevance of philosophy. The discoveries of neuroscientists have proved so important that even according to the Economist, 2006 was the year of mirror neurons. The author of the international scientific community that is considered a revolutionary discovery of the reach (equal to that of the double helix of DNA) is Giacomo Rizzolatti Director of the Department of Neuroscience at the University of Parma.

This type of cells, discovered in monkeys, have dual properties: both are activated when the monkey performs an action and when the monkey sees another individual to do the same action. An action done by another activation induces, in the interior of those observing the action of neurons that would work if he did that action, that of mirror neurons. In humans the system "mirror" was demonstrated in an indirect manner. The system includes multiple brain areas, including speech and action, as well as in understanding the actions, including the ability to imitate, a skill that in the proper sense belongs only to humans and higher primates.

Objectives and functions

Through the exploration of the properties of mirror neurons, neuroscience has uncovered the neural mechanisms that underlie our individual and social behavior and the evolution of them.

The immediate understanding of the acts of others, their intentions, the sharing of emotions is determined by the existence of mirror neurons because their property is essential to activate both when we perform a given action in first person is when we see others do it. The discovery is the protagonist of the motor system, whose function has for decades been relegated to a purely executive tasks of the movement, free of perceptual or cognitive value. The brain of a human being you can compare it to a large archive of motor patterns in the life of every day we use to meet our needs. It is important to know that in the brain are both complex and simple gestures and those during the day, we simply compose sequences. For functional brain imaging, called Brain Imaging, has had to use PET and MRI. Positron emission tomography (PET) is a technique of nuclear medicine and medical imaging produces images or three-dimensional maps of functional processes in the body. It allows to measure the metabolic activity of the brain, producing a brain map of this activity. To make the PET must be injected into the bloodstream of the subject a radioactive label that has been previously incorporated in a molecule, for example of fluorodeoxyglucose, water or oxygen. To limit the dose of radiation, the type of radioactive isotope chosen must have short half-life. Also during the decay the radioisotope chosen must emit a positron. After injection of the radio isotope, wait until the radioactive molecule is concentrated in the tissue of interest. Over a region to be studied will be metabolically active, the greater the consumption of this molecule and therefore its concentration in this region.

When the radio isotope decays, it emits a positron annihilates with the first electron encounters. The positron annihilation of electron and produces a pair of photons that move in opposite directions. A special detector that surrounds the body of the subject records the arrival of two photons, their position is possible to reconstruct the geography of the brain region from which the pair has been entered. the scanner then uses the detection of the pairs of photons for mapping the density of the isotope in the brain and to construct images of sections separated by approximately 5 mm. The map, prepared by a special software, is the most active brain area, in which the radioactive isotope is more concentrated. Different colors correspond to different levels of activity PET is a technique used in both medicine and biological research. In the PET research has allowed us to study various functions of the brain. Limitations to wider use of PET are due by the high cost of production of radioisotopes for short acting. To use the PET for scientific studies it is also necessary to obtain a special authorization for the injection of radioactive material of the experimental subjects.

Materials and methods

Functional MRI, however, is a sophisticated analysis and non-invasive localization of brain activity, which uses a combination of a metabolic function of the brain with magnetic properties of matter. Concerning the metabolic function, when the cells are activated, they consume more oxygen, and within a few seconds there is an increase in blood flow in the area of neuronal activity. Hemoglobin is the molecule deputy to the transport of oxygen in the blood, it can be found in an oxygenated or deoxygenated. Together with the increase of blood flow, in the area of neuronal activity also vary the relative concentrations of the two forms of hemoglobin.Hemoglobin "loaded" of oxygen has a different shape compared to that without oxygen, and this deformation is also reflected in the structure of the molecule. Regarding the magnetic property of matter, if we submit the brain area containing the two forms of hemoglobin to a magnetic field, the latter behave differently. The diversity of behavior also depends on differences in the number of nuclei of the hydrogen atoms. The nuclei, in fact, are aligned in a case of parallel and antiparallel in the other in such a way relative to the orientation of the magnetic field. And 'possible to reveal this otherwise disturbing the alignment of the magnetic field produced by the sending to the hydrogen nuclei of an electromagnetic wave. When the nuclei return to the positions of equilibrium, they emit similar wave. In the source are special sensors capable of picking up the waves returned from the nuclei and thus to determine, based on electromagnetic echo delay, the distance between the core of the sensor. The integrated analysis of data collected by the sensors allows to reconstruct a computer image of the localization of cerebral oxygenated and deoxygenated hemoglobin molecules: regions with higher density of oxygenated hemoglobin correspond to the areas most active neurons. Safety is a very important factor in the experiments that make use of it around the MRI scanner generates a very strong magnetic field, more than 1.5 tesla. Then the subjects, before entering the tube, should remove any object that ferromagnetic carry with them, even those who wear a pacemaker or a hearing aid can not undergo this technique.

Functional magnetic resonance imaging is able to record in a non-invasive brain signals without the risk of radiation associated with other methods of scanning, such as PET The spatial resolution is 3-6 mm, while time is of the order of a few seconds. Thanks to these techniques has been found that there are areas of the brain arranged for the movement and other areas implementing it. Recent studies have shown that asking a person to think about moving his hand as if to grasp an object, does activate its premotor cortex, forward of the motor cortex, the frontal lobe. This parallelism between imagination and action also applies to the imagination and the feeling: so, just imagine an object such as an apple, leads to activation of areas of visual cortex that are activated when that object is actually seen.

Results

It has been shown that the planning before action. In fact, the premotor cortex is responsible for preparing the action, even if the decision to perform a movement depends on decisions taken by the anterior areas of the frontal cortex, such as the prefrontal area 46 and the motor, as follows: l ' action depends on a cascade of events in the order from the prefrontal cortex, the premotor and finally from the motor. A relevant fact is that the premotor cortex is also activated the instant you observe other people do the movements, gestures photocopying engines do you see through the action of mirror neurons, called mirror neurons. Mirror neurons are located in the premotor cortex of primates and are activated when an animal observes another animal in a movement is performed: if a monkey grasps an object, the monkey observes that those neurons that are activated in the premotor cortex, neurons prepared of the motor cortex to achieve a similar action. The mirror neurons then establish a bridge between the observer and the actor, are also active in our species and are the focus of imitative behavior, especially important in infancy. Imagine a child who, for the first time, sees another child to do a rolling in his brain, even in automatic mode, you activate groups of neurons that process the schema of a movement that, until then, the child-observer has ever done. The scheme involves muscle sequences, such as pointing their arms, to collect the body, extend your legs, flex your head, take a ride on yourself, go back to his feet. In fact, no words able to convey useful information to the child to explain the movement of rolling, no abstraction would be able to emulate the reality of the movement, if not the child who makes the motor gesture.

The child, therefore, must try, his first venture rolling, even if that movement was in some way already prepared by the mirror neurons that have internalized the motor sequences necessary: the same neurons play a fundamental role in understanding language, when a small child learns to imitate the sounds of adults to make those movements of the lips and face that will lead him to imitate, albeit with some effort, movement that has seen put in place by adults. The mirror neurons will facilitate some aspects, and are very important in child development, because through observation and motor action that a child can perform a number of concrete learning, gradually, will be transformed into abstract concepts. Furthermore, neurons are activated only when no movement is observed by another person, but also when observing the same motion through a screen of a computer, then, it was concluded that visual signals are sent to the premotor cortex which reacts by activating groups of neurons which do not necessarily anticipate that action will occur: the bark of a child who attends a movie or a cartoon, in which the characters perform amazing moves, turns frantically preparing these movements and to some extent helping to energize the baby's nervous system. Motor learning by imitation, action understanding, and their prediction, empathy, here are the three fields in the mirror neurons are involved, and are therefore used to study the best features of these neurons. Motor learning can take place, as mentioned before, by imitation, so it is possible to reproduce the observed action and then learn it. Some important studies on imitation have established that: • delay the implementation of proven could improve learning. • through the motor act, mirror neurons is observed again broken into several fragments, comparing them with their motor repertoire, allowing the learning of new gesture. • the mirror system has the ability to learn in an inconsistent manner, replicating a motor act that is different from that observed. • most likely mirror the system develops in children through Hebbian learning while the child observes and listens to their actions.

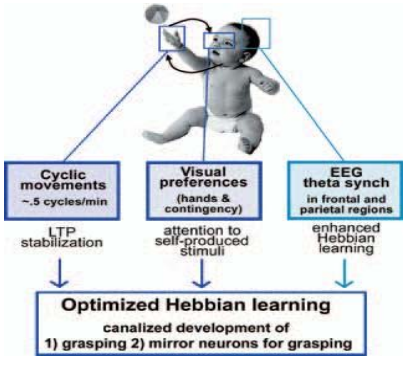

Figure 1: Hebbian learning

Hebbian learning in the brain: The activity in the premotor cortex leads the movement of prehension. The move is seen through individual action, causing activity in neurons of temporal cortex, this activity is in turn discharged to the premotor and parietal cortex, where neurons are active by looking for action, so you create consistent connections to the storm parietal and premotor cortex to the parietal representing the same action. Development of the mirror system about the catch, according to the three key points for the Hebbian learning: visual preference for the hands, cyclic motion with optimal frequency of 5 cycles per minute, synchronized theta EEG during self-observation.

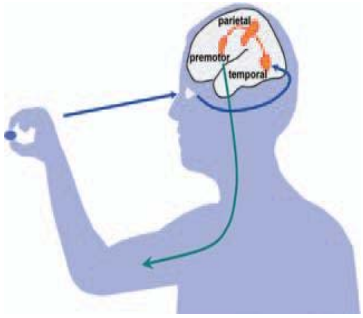

Figure 2: Hebbian learning

It is seen as the motor learning by imitation is of extreme importance, especially in the first of three stages apprenditivi and is characterized by the so-called stage of development of the coordination crude Meinel. And 'this early in the correct proof of the teacher plays a delicate role to give a first input the correct athlete who is preparing to imitate the motor gesture and consequently to learn. The demonstration of the teacher to be effective must: • consult relevant parties to observe, which is known to be biologically speaking. • represent a complete action and not a single movement, emphasizing the increasingly clear goal; • be carried out at normal speed, because the rhythm is a fundamental element of the executive structure of the movement, thus represents one of the first items to introject. A demonstration slowed, however, provides an initial model incorrectly leading the pupil to focus on details, this aspect should intervene only at a later time • be stripped of details that might distract or confuse the viewer. The potential of the mirror system are fully exploited only if you observe the proper rules are followed and all procedures to acquire good learning, remembering that mirror neurons discharge more to motor acts performed for a specific purpose. Initially the teacher will have to pay attention to the effect of the action more than in the details, and make sure it reached the goal.
Of fundamental importance is the perception of the pupil in the form of motor function and not form. Thereafter, the student will be able to finalize the details and refine the movement, through repetition, thus entering the next two stages apprenditivi. The beginner, in fact, is able from the beginning to assess the effects produced by their own action, but can not be represented in a precise manner in motion with which this effect is obtained. The acquisition and awareness of the movement are the fruit of the kinesthetic sensations of the individual, a process that becomes effective only after many repetitions. Speech of extreme importance in the child's motor development, but it

applies equally to achieve the same goal, even the adult who is having to learn a new motor gesture, so that is a child or an adult, the mirror system is called into question, giving support to the process of learning by imitation, when based on the function of a movement. For proper operation of mirror neurons is necessary that the motor act is somehow connected to the repertoire of actions already stored, with which we have mirror neurons play a work of the observed fragmentation. The process of imitative learning, moreover, can never be disconnected to attentional processes, essential for a correct perception observed motor act. The teacher / instructor must always pay attention to the following points: • pinpoint the motor level of the student • propose the learning of motor skills appropriate to that level • simplify the demonstration schematizing gesture and highlighting only the structural elements such as the global movement and rhythm • accompany the demonstration with a few basic suggestions to guide the student to the understanding of what was presented • provide, after the execution, concise and essential feedback, focusing, in the appropriate corrections, only the structural aspects of the movement and avoiding to bring out details. The student, after a certain number of repetitions, take increasingly more conscious of their performance and quality of movement can also be optimized in the aspects purposes. In this phase the system will mirror the instructor to capture aspects and details that the motor system of their athletes, still immature, can not yet perceive, then it will be able to understand the root causes of errors and communicate with the pupil advice you need to delete them. Have the student play action, let him watch a game situation and its development, to interpret the mood and understand their own needs, be seen as motivated and confident to transfer the same feelings and emotions to the student, are things that a good coach, teacher, trainer or instructor, and already do that now, knowing the importance of this mirror neuron system, may be applied more precisely, getting better results, thus having knowledge of the facts for what is proposed and is made to see, and furthermore, no less important, understanding the bases. At this point the demonstration may be performed again in a more refined, and slowing down partial or modified to allow the student to perceive certain aspects of the movement which, in a first stage, had been intentionally concealed not to confuse him. The mirror structure in fact, by improving the performance of perceptual abilities and the ability to kinesthetic differentiation, is able to grasp, but above all, to imitate even the finest and most complex aspects of the movement and develop appropriate programs for their implementation . We have found two important functions attributed to the mirror system: • a function imitative or the ability to replicate gestures already belong to our motor repertoire is the ability to learn new motor patterns by imitation; • a communicative function or capacity that would outline a possible scenario for the origin of human language related to the evolution of the mirror system. The act allows the imitation of nature have a biological basis of behavior that governs the aggregation of social animals. These neurons with specific action imitative, are located in various areas of the brain and act mainly on the reproducibility of the movement observed by others. Obviously, the discovery of mirror neurons has important implications for learning. Imaging systems using fMRI and you noticed that the mirror neuron system is active in reference to actions performed by different subjects. This requires that, at the neurobiological level, the action taken is that the observed movement on the other hand, share the same format and inter-modal. The action of mirror neurons, therefore, can be encoded in the perspective of a virtual resonant cavity, where the neural encoding format is such that interactive and shared dialogue. The resulting neural representations, are thus held in common already at the international level, this discovery goes far beyond the conceptions of learning brain inherited from Descartes, who argued that to enhance learning rationale was to exclude the communicative interaction integrating these mechanisms instinctive and irrational, it must also be isolated from a purely rational learning useful to optimize the choices and solving problems. In essence, understanding the actions is the responsibility of mirror neurons, this is indeed the core competence, as not merely to understand the action view, but even he anticipate his intention, but everything is dependent on our archive of documents with a comparison of the observed motor acts to understand them. The context and action are crucial to understanding the action, you have more motor skills of a particular sport, the greater the activation of the mirror system of observing gestures engines belonging to that particular sport. The development of the mirror system in a professional athlete, in fact, allows a greater ability to understand and predict the outcome of an action so as to bring it forward more quickly. In fact, through the acquisition of understanding the actions, you can help improve the anticipation of an opponent who is attacking or defending, or understand in advance the intentions of a teammate, in the case of a team sport. Situational in sports should emphasize the extreme importance of understanding the action inside a context to which it can be anticipated. In this phase, the mirror neurons, relatively to the context, for discharging the view of targeted action, and the extraordinary is that discharge even if the action is not complete or not is seen totally, so in well-trained athlete may help the phase perceptual improving the total reaction time. A good way to train their mirror system would be to place greater emphasis on observations of action of both opponents, both of his teammates, then you could create two groups, where one is limited to the careful observation of game situations implemented by the other group at the request of the coach. Even the television cameras or videos may be used, but only after a careful viewing of real situations, because we know how mirror neurons are significantly more activated by the sight of live acts

directly observed. Working on film, by the nature of mirror neurons, it is always advisable to use videos of people in the flesh and not virtual images emitted by monitors and LED screens. Obviously, the observation of the opponent will be crucial to anticipate his moves by putting in place a plan of motor response faster than his, is that we should receive his attack, whether it should be avoided, while the act of observing their mates in team sports, would serve to better understand what are the movements of live interaction and as useful for further action. It also appeared that the collection of neural patterns which form the substrate of a feeling originates in two classes of biological variation: a) Changes regarding the state body, obtained through two mechanisms: - Loop body: body, landscape changes and is subsequently represented in somatosensory structures of the central nervous system; - As if body loop: the representation of the changes in body is directly created in the somatic sensory maps, due to the action of other areas of the brain, which has been made without any real body modification, via an internal simulation. b) Changes related to cognitive status, caused by the secretion of chemicals that induce significant alterations in brain function, such as the induction of specific behaviors (such as bond, game), a change in procedures in place in processing somatic states (inhibition or filters), a variation of the mode of cognition (change in rate of reproduction of the images). These three modes would be present in various non-human species, but only in humans, it is assumed that the third might be in a conscious state. Somatic markers are special examples of feelings generated from secondary emotions: the emotions and feelings that have been associated, through learning, to anticipated future outcomes of certain scenarios. In fact, the instant when a negative somatic marker is produced at a particular future outcome the combination functions as an alarm bell, when it intervenes a marker positive, it becomes an indicator of incentives. Finally, one more attention, but not least, was placed on empathy and the emotions of others, processes do not apply anything on the pitch, but reports are intended for the mutual understanding by taking advantage of this understanding. Especially in the growing season, the child sees IN coach a point of reference, and then find its expressions and attitude a lot of information, will find both satisfaction and motivation at the sight of their coach, while the latter will be important to understand the needs and moods of the child so that he can help solve their problems and then, automatically, to give him the push to do better in performance. The recognition of emotions through facial expressions of others is inherent in all of us, what we can definitely improve in sports through the use of mirror neurons is the ability to attach an emotion, but also an attitude, a way of doing, a message that we're giving the other person and to which we refer both to improve the relationship purely emotional, is to bring our students to an optimal state to overcome some difficulties and practical help for the conduct of the practice sports. It is a two-way communication channel, because there is an exchange of information on a bilateral basis and will be important when working with people suffering from conditions, with the elderly or persons who for one reason or another do not feel comfortable with their body or passing a particularly stressful.

Conclusion

The class of mirror neurons has now behind about twenty years' studies, has given us and continue to give us surprises to understand more deeply these three basic processes for the individual or the individual sport, bringing more and more to one embodiment of how to train and understand the person asking and trained. During the phases mentioned above, the mirror neurons via interaction with the limbic system, are associated with the recognition of emotions and bodily attitudes. The circuit that takes part in these mechanisms, understanding emotions is formed by the mirror system, which acts as from islet bridge and limbic system. Specific studies have seen how in disgust and pain in the mirror mechanisms to operate efficiently, making the viewer feel the same emotions as the observed. Empathy is the ability to give its attention to another individual, therefore, the quality of the presentation is mainly based on listening non-judgmental and focuses on understanding the basic needs and feelings of others.

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OTKRIĆE ZRCALNIH MOTORIČKIH NEURONA ZA UČENJE

Sažetak

Mehamizam znanja stoljećima je filozofska tema. Neuroznanost nije prihvatila implicitno empiristički položaj ali se zadniih godina stvari mijenjaju: Neuroznanost je razvila seriju tehnika adresiranja problema koji su tradicionalno bili Od značaja za filozofiju. Otkrića neuroznanstvenika postal su toliko važna da čak prema listu The Economist, 2006 je bila godina zrcalnih neurona. Autor međunardonog znanstvenog društva koji je pretpostavio dosezanje revolucionarnog otkrića (jednakog otkriću dvostruke spirale DNK) je Giacomo Rizzolatti Direktor Odjela Neuroznanosti Sveučilišta u Parmi. Ove vrste stanica otkrivene kod majmuna imaju dvojne osobine: aktivirane su kad majmun izvodi akciju al ii kad promatra drugog pojedinca koji vrši promatranu akciju. Akcija izvršena drugom aktivacijom inducira kod promatrača akciju neurona Koji će raditi da on vrši tu akciju – Zrcalni neuroni. Kod ljudi je "zrcalni" sustav demonstriran na indirektan način. Sustav uključuje višestruka područja mozga uključujući ona za govor i kretanje, kao i za razumijevanje akcije, uključujući sposobnost imitacije, uz vještine koje pripadaju u pravom smislu samo ljudima i višim primatima. Kroz istraživanje ostalih svojstava zrcalnih neurona neuroznanost je otkrila neuralne mehanizme da razumijemo naše socijalno ponašanje i njihov razvoj.

Ključne riječi: *učenje, zrcalni neuroni, razvoj*

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RELATIONSHIP BETWEEN ANTHROPOMETRIC CHARACTERISTICS AND MOTOR ABILITIES OF BOYS IN THE FIRST GRADE OF ELEMENTARY SCHOOL

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Original scientific paper

Abstract

This paper aimed to determine the relationship between anthropometric characteristics and motor abilities of boys in the first grade of elementary school by applying two anthropometric measures (body height and body weight) and six motor tests (medicine ball throw, bent arm hang, shuttle run test, bend forward on a bench, standing jump and sprint length 20 m) on a sample of 135 boys, aged 7.5 years±3 months. The applied regression analysis revealed that, in the manifest space between anthropometric characteristics and motor abilities, there were statistically significant relationships ($p<0.01$), such as the positive influence of both anthropometric characteristics and the motor variable medicine ball throw, and the negative influence of the variable standing jump length. Determination of the latent structure of motor variables by component factor analysis reduced the motor correlation matrix of variables to two latent dimensions, sugesting a topological differentiation of motor abilities to the upper extremity and lower extremity strength. Anthropometric characteristics of boys are very important for the realization of motor structures; they represent the realistic biomechanical basis both as factors that facilitate and hamper the performance of motor tasks.

Key words: *relations, anthropometric characteristics, motor abilities, boys, first grade, elementary school*

Introduction

A child is more or less able to perform a specific physical (motor) activity. Motor skills are very important for the child's motor ability, for the so called locomotor apparatus or the executive subsystem in order to move. Because the motor abilities manifest through effects of peripheral units, or by morphologically structural characteristics of the entity, motor performance also depends on anthropometric (morphological) characteristics. It is impossible to neutralize the influence that morphological structure of the body has on motor activity. Morphological characteristics represent the biomechanical basis, or factors that either stimulate or limit the performance of certain movement tasks. Morphological and functional changes in the child body tissues create special structures and functions of the organic system, which could be seen as a functional process of maturation (Rodić, 2004). The aim of our study was to determine the relationship of morphological characteristics and motor abilities of younger school age children who began their schooling, in order to see their manifestations in the context of school physical education and selected sports activities. In our research we started from the fact that the intense changes as well as the pace of individual growth and development of children make the greatest variability of the results. Determination of these results will be of both theoretical and practical importance in all school systems that include the course of physical education and sport.

Methods

Sample: The sample included 302 children attending the first grade of primary school aged 7.5 years±3 months, of which 147 boys (48.7%). The sample was drawn from the population of elementary schools in West-Backa (Sombor) and Central-Banat county (Zrenjanin) in Serbia.

Variables

Anthropometric measures were obtained using conventional measurement criteria and procedures, applicable widely and used in school conditions, as follows: 1) *Body height* (BH) – to assess longitudinal dimensionality of the skeleton (0.1 kg), 2) *Body weight* (BW) – to assess voluminosity body (mm). *Body mass index* (BMI) – to assess healthy weight based on the heighth (kg/m^2). To define overweight and obesity, the cut-offs proposed by Cole, et al. (2000), were used. Assessment of motor abilities was performed with 6 manifest motor variables, which would meet the criteria of functional models (Gredelj, et. al., according to Rodić, 2011) hierarchical structure of motor abilities and possibilities of mass application in the school system and motor tests: - *to assess the ability to control the intensity of excitation*: 1) medicine ball throw – MBT (cm) – explosive power of upper extremities, - *to assess the ability to control the duration of excitation*: 2) bent arm hang – BAH (s) – static strength of upper extremities, 3) shuttle run test – SRT (min) – aerobic endurance. - *to assess the ability to control tonus and synergistic regulation*: 4) forward bend on a bench – FBB (cm) - flexibility. - *to assess the ability to structure movement*: 5) standing long jump – SLJ (cm) – explosive power of lower extremities, 6) sprint 20 m - S20 (s) – explosive power of lower extremities.

Selection of standardized motor tasks (tests as measuring instruments) was carried out in accordance with the following goals: to meet the minimum standard number of tests needed to identify the motor skills of children in school practice, to apply only composite tests with already established high level of reliability estimated by generalization coefficient, and to optimally exploit the energy potential of the examinee during the mass evaluation of children abilities in many school

systems. *1. Medicine ball throw* (MBT). The child throws the medicine ball weight 2 kg, from the standing position in place as far away and without offenses. The result is the length of the throw with an accuracy of 10 cm. *2. Bent arm hang* (BAH). The child is assisted into position, the body lifted to a height so that the chin is level with the horizontal bar. The bar is grasped using an overhand grip (palms are facing away from body), with the hands shoulder width apart. The timing starts when the child is released. They should attempt to hold this position for as long as possible. Timing stops when the child's chin falls below the level of the bar or the head is tilted backward to enable the chin to stay level with the bar. The result test (which is also called a fixed-arm hang) is the time of the hold measured in tenths of second. *3. Shuttle run test* (SRT). The child runs between the two 20 meters apart markers in time recorded signals. The running speed is determined by a sound signal that is played from a CD set in the track half. For every tone you need to get to one of the lines, cross it by one foot, stop, then turn and continue running to the second line. Initial run speed is 8.5 km/h and accelerates at each minute for 0.5 km/h. Each following speed is the next level, with 20 levels in total. The test ends when the child is not able to reach the line (2 meters from it) at two sequential audio signals.The result is a number of achieved levels and running tracks in the last uncompleted level. *4) Forward bend on a bench* (FBB). The child stands on a bench and bows as deep as possible. A straight-angle ruler which points down with the 40 cm mark at the child's feet, and 40 cm below it, is next to him/her. The score is the depth of the reach measured in cm. 5) *Standing long jump* (SLJ). The child jumps with both feet from the reverse side of Reuter bounce board onto a carpet, which is marked in cm. The result is the length of the jump in cm. 6) *Sprint at 20 m* (R20). On command "GO" the child that stands behind the start line has to run 20 m as fast as he/she can to the end of the track (20 m). The children run in pairs. The score is the time of running, measured in tenths of second. The total number of tests is divided so as to ensure a minimal impact of the applied test onto the result in any other test. Therefore, the choice of measuring instruments, their classification and arrangement have been done in accordance with the criteria which could ensure that successively applied tests should employ different functional "mechanisms" as well as various large muscle groups. The research was done on a voluntary basis, according to the territorial belonging of appropriate elementary school and during the regular evaluation of the school system, or regular monitoring, assessment and evaluation of physical education. The test was carried out in one block period in timetable, and the measurement of height and weight was performed at the beginning of the class. Then, the children were devided into groups and each group was alternately submitted to the measurement of five motor tests. After a ten minutes break, the children were tested by a shuttle run test. During the tests, except for anticipated instructions and demonstrations when needed, the examinees received no additional or special incentives in order to help them improve their performance. *Data analysis:* The basic descriptive statistics parameters were calculated for all variables. Determination of the relationship between a set of independent variables to one dependent variable has been carried out by a series of classical regression analysis. Factor analysis using principal component extraction and oblimin rotation was utilized. The data were processed in the computer software SPSS (Statistical Package for Social Sciences) version 17.0 (Chicago, Illinois, USA).

Results and discussion

Table 1. Descriptive statistics of morphologic and motor variables in boys

Variable		
	M±SD	CV%
Body height (cm)	128.4±4.4	3.43
Body weight (kg)	27.9±4.1	14.69
Body mass index (kg/m^2)	16.83±1.8	10.7
Medicine ball throw (cm)	304.0±39.8 ^{a}	13.09
Bent arm hang (s)	23.0±8.4 ^{a}	36.52
Shuttle run test (min)	4.0±0.9 ^{a}	13.09
Forward bend on a bench (cm)	39.7±3.1	7.81
Standing jump length (cm)	121.7±17.8 ^{a}	14.63
Sprint at 20 m$^\#$ (s)	4.9±0.2 ^{a}	4.08

^{a}p<0.01, ^{b}p<0.05, $^\#$variable with opposite metric orientation

Table 2. Relations between manifest morphologic and motor variables in boys

Variable		
	BH	BW
	Beta	Beta
Medicine ball throw (cm)	0.71**	0.64**
Bent arm hang (s)	-0.17*	-0.09
Shuttle run test (min)	0.04	-0.19*
Forward bend on a bench (cm)	-0.06	0.01
Standing jump length (cm)	-0.17*	-0.22**
Sprint at 20 m (s)	0.11	0.11
R^2	0.39**	0.46**

BH – Body Height, BW – Body Weight, Beta – standardized coefficients, R^2 – coefficients determination, *p<0.05, **p<0.01

Table 3. Latent structure of motor variables of boys

VARIABLE	H1	H2	h^2	A1	A2
Medicine ball	0.56	0.64	0.72	0.02	0.84
Bent arm hang	0.34	0.49	0.36	-0.06	0.61
Shuttle run	0.67	-0.48	0.68	0.84	-0.13
Forward bend	0.49	0.47	0.47	0.07	0.66
Standing jump	0.75	-0.28	0.64	0.78	0.08
Sprint at 20m	-0.75	0.30	0.66	-0.79	-0.07
Eigenvalue	2.25	1.27		r = 0.23	
% of Variance	37.45	21.15			

The basic descriptive statistics parameters of the anthropometric and motor variables of boys in the first grade of elementary school are presented in Table 1. By comparing the results of *anthropometric variables* (Table 1), based on available research, it can be concluded that the througout the world there are but slight differences in parameters for body weight, body height and

body mass index (BMI) on samples of boys of the average age of 7 years (according to Milanese, et al., 2010) and by us (Bala, et al., 2009; Djurašković, et al., 2009) and the former Yugoslavia (Katić, et al., 2005). *Body height* (BH) in this study has a very low coefficient of variation in boys (CV=3.4%), indicating a significant homogeneity of results. This confirms the fact that body height is the best and most stable indicator of growth and development of children, as a measure of bone marrow tissue, which is considered the best indicator of longitudinal dimensionality of the skeleton. *Body weight* (BW) has a moderate coefficient of variation in boys (CV=14.7%), indicating good homogeneity of results and representativeness of arithmetic mean. This confirms the fact that body weight as the indicator represents a mixture of different types of tissue, and thus varies during growth and development, which is a variable dimension of voluminosity and body mass due to age and sex of children. *Body mass index* (BMI) has a medium coefficient of variation in boys (CV=10.7%), indicating a very good homogeneity of results. It is used to estimate a healthy body weight based on child's height and it represents the most widely used diagnostic tool to identify problems with children weight. In this study, according to the BMI Graph (Baylor College of Medicine, 2010), with respect to sex and age of children, indicate that 2% of boys are underweight, 81% are of healthy weight, too overweight is 9% and 8% is obese boys. By comparing the results from researches on *motor variables* (Table 1) that have been carried out in our country and worldwide we could conclude that there are but slight differences between them. The differences are mostly due to unclearly stated age of children in available research, to numerical differences in results between the monthly chronological age of boys of the same age, and particularly due to the biological differences of boys in the first grade of elementary school. Significant differences were found in favor of boys in the motor tests to assess the ability to control the intensity and duration of excitation (Medicine ball throw, Bent arm hang, Shuttle run test) and tests to assess the ability to structure movement (Standing jump length, Sprint at 20 m). Similar results and conclusions were obtained in research on 7 years old children (Katić, et al., 2005) and children of 6.5 years (Bala, et al., 2010). The regression analysis indicates that, in the manifest space between morphological characteristics and motor abilities of boys in the first grade of elementary school, there are some statistically significant relationships ($p<0.01$) which have been affected by gender differences of boys as presented in Table 2. It may be noted that there is the positive *impact of both morphological characteristics* (Body height and Body weight) *on the motor variable* medicine ball throw, and the negative impact of the variable standing jump length in boys (Table 2). This indicates that the longitudinal dimension of the skeleton represents the biomechanical basis for the effective implementation of some motor tasks, as a factor that facilitates the execution of the task, and that the morphological feature of voluminosity is largely determined by the body mass and the active muscle substance, which means that a greater force produced by activating larger quantity of muscle tissue can be developed in boys with a strong body structure in certain motor tasks such as medicine ball throws. The negative impact of weight on the motor ability, such as the ability to control the relative explosive strength (Standing jump length) in boys, points out that the body mass may aggreviate the performance of motor tasks, such as a catapulting one's own body during long jump from place. Determination of the latent structure of motor variables of boys in the first grade of elementary school has been done by the component factor analysis. On the basis of the principal components method, the eigenvalues and their characteristic correlation matrix vectors of manifest motor variables have been determined and presented in Table 3 for boys. The value of Kaiser-Meyer-Olkin measure of sampling adequacy exceeds the recommended value of 0.6, whereas Bartlett's test of sphericity reached statistical significance, indicating that factor analysis is justified. The results gained from calculation of the correlation matrix of main components, their communalities after extraction of factors, matrix patterns and matrix structures as parallel or orthogonal projection of manifest variables, after oblimin rotation, were two oblimin factors, which explain 58% of the total variance of the system in boys. FIRST (Oblimin) FACTOR define motor manifestation variables whose variance depends on the ability to control the duration of excitation (responsible for the variability of the dimensions of static strength of the upper extremities - Bent arm hang) and the ability to control the intensity of excitation (responsible for the variability dimension of explosive power of upper extremities - Medicine ball throw). This dimension which mainly depends on the ability to produce a large muscle force of upper extremities, suggests the topological differentiation of motor abilities in boys age of 7.5 years, and it can be interpreted as Strength of upper extremities. OTHER (Oblimin) FACTOR define motor manifestation variables whose variance depends on the ability to structure movement (responsible for the variability dimension of explosive power of lower extremities - Standing jump length and Sprint at 20 m). This dimension has a very simple structure and is defined solely by motor tasks that require maximum capacity and current agonist activation of the lower limbs of boys, the effects of the simultaneous involvement of as many motor units, the number of impulses that motor cortex can send, as well as the ability of amplification actions of sub-cortical centers onto the transmitted impulses towards the. Motor manifestation variables whose variance depends on the ability to control tonus and synergistic regulation (responsible for the variability of flexibility - Forward bend on the bench) have a significantly high projection (OBL=0.66) on the second motor factor in boys. Additionally, the hard running (aerobic endurance - Shuttle run test) requires, among other things, leg muscle

endurance, which is why the second factor also suggests to topological differentiation of motor abilities of boys, therefore it can be nominated as a of Power of lower extremities.

Conclusions

The results gained from this sample of examinees have confirmed researches carried out by groups of authors in the country and throughout the world, saying there is a significant differentiation of motor abilities, even in pre-school children, and children of junior school age. Anthropometric characteristics of children at the beginning of schooling are very important for the realization of motor structures in which they represent a realistic biomechanical basis as factors that facilitate as well as factors that hamper the performance of motor tasks in physical education as a school subject, mandatory elective sports, clubs and sports sections. Younger school-age period is characterised by a significant differences and undefined motor ability. The results of this study have shown that the development of anthropometric characteristics and motor abilities in seven-year-old performed in a similar manner, and that there are certain peculiarities with respect to sex of children. Minor developmental differences due to sex of children make good grounds to justify co-education in physical education at the beginning of children schooling. This approach facilitates planning, programming and organization of physical exercise. Significant differences in motor abilities require that programs and work be adjusted so as to meet capabilities and needs of children.

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RELACIJE IZMEĐU MORFOLOŠKIH ZNAČAJKI I MOTORIČKIH SPOSOBNOSTI DJEČAKA PRVOG RAZREDA OSNOVNE ŠKOLE

Sažetak

Ovaj članak je ciljao na utvrđivanje relacija između morfoloških karakteristika i motoričkih sposobnosti dječaka prvog razreda osnovne škole primjenom antropometrijskih mjera (visina i težina tijela) i šest motoričkih testova (bacanje medicinke, vis u zgibu, shuttle run, podizanje trupa, skok i sprint na 20 m) na uzorku od 135 učenika uzrasta 7.5 godina ±3 mjeseca. Primjenjena regresijska analiza otkrila je da u manifestnom prostoru između morfoloških karakteristika i motoričkih sposobnosti postoji statistički značajna povezanost (p<0.01), izražena kroz pozitivni utjecaj obiju morfoloških mjera i bacanja medicinke, kao i negativni utjecaj skoka. Determinacija latentne motoričke strukture komponentnom analitzom s rotacijom u oblimin reducirala je prostor na dvije dimenzije sugerirajući topološku diferencijaciju motorike na snagu gornjih i donjih ekstremiteta. Morfološke karakteristike dječaka su važne za realizaciju motoričkih struktura, predstavljaju realni biomehanički temelj jednako kao čimbenik facilitacije ali i ograničavanja izvedbe motoričkih zadataka.

Ključne riječi: *relacije, morfološke značajke, motoričke sposobnosti, dječaci, prvaši, osnovna škola*

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THE IMPACT OF A PROPOSED REHABILITATION PROGRAM ON THE LOWER BACK PAIN

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Abstract

The backbone of a vertebrae stacked on top of each between each paragraph and paragraph cartilage works on human movement in different directions and works to absorb shock during walking, running, jump and composed the backbone of the cervical spine and dorsal vertebrae or thoracic and lumbar spine is located by carrying the weight of the upper limb full of skull cage and chest and its contents and the abdominal contents, which makes the lumbar spine more vulnerable to infection. The study aimed to identify the impact of building rehabilitation program for the victims of pain down the back and use the researcher adopted the experimental design of measuring tribal post test for the two groups, one experimental and the other control included in a sample search with pain lower back pain due to torn ligaments side of the paragraphs of the lumbar spine strength (22) infected between the ages of (35 -45) in (10) patients of the experimental group (10) patients of the control group. The results of the most important influences in the qualifying program improved range of motion of the spine to bend and extending the trunk and also affects the qualifying program on the lack of fat thickness of the back and side abdomen.

Key words: *backbone, pain, exercise*

Introduction and research problem

The backbone of a vertebrae stacked on top of each between each paragraph and paragraph cartilage works on human movement in different directions and works to absorb shock during walking, running, jump and composed the backbone of the cervical spine and dorsal vertebrae or thoracic and lumbar spine is located by carrying the weight of upper extremity full of skull cage and chest and its contents and the abdominal contents, which makes the lumbar spine more vulnerable to infection. Mohamed (2001) has pointed out, to the lumbar region paragraphs of five and two of the discs cartilage, constitute 23 % of the length of the spine and almost characterized paragraphs bone of this region the size of a large lump of spinal wide and horizontal, and combine these paragraphs both with one another strongly, helping to install a set large ligaments and muscles as well as cartilaginous discs that maintain the functional characteristics of this region (Hernandez, 1973). The back area the most important areas responsible for the efficient movement and activity in humans because of the backbone by which is the axis of the human body and the joint working effectively in all motor activities and work almost daily and is therefore susceptible to stress, especially in the regions of the movement, a region the cervical and lumbar and sacral to the composition of anatomy who allows the ability to move flexibly from other parts of the spine where a cartilaginous disks between each paragraph as a means to ease the burden on these areas to facilitate motor performance (Nouaceur, 1984). Ela (1998) has explained that the rate of exposure to infection pain chronic low back 70-80 % of the world's population aged between (20-50 years) did not yet know the real causes of this pain, but the exercise therapeutic benefit in overcoming them has been proven that exercises defibrillation hard abdominal muscles have a better front to resist the impact of this pain (Ela, 1993). According to Susie and Odense Adans & Swezey (2001) to the lower back pain may return to the weakness of the muscles of the back and abdomen, or spinal deformities or habits the wrong reasons membership or to the mental tension and low morale and suffering from the pressures of life events as causes non-organic (Swezey & Adans, 2001) and Stanley & Brown (2001) noble dream and the location of Tulsworld (2004) that low back pain phenomena are widespread among the general public of all age groups and typically include persons with activity limited, and among the reasons for the lack of physical activity and dynamic conditions of the wrong decision to sit and lie down, stand and move incorrectly and lifting heavy objects incorrectly, and the excessive increase in weight and lack of flexibility of the spine, weakness and sagging muscles of the abdomen (Stanley & Brown, 2001; Helmy et al., 2001; Tulsaworld, 2004). All indications of hope Najjar (2005), Musa (2007) Smith et al., (2006) and Akin (2007) to the practice of different exercise programs have a positive impact on improving the physical variables such as the strength of the muscles of the abdomen, and back, and legs, and flexibility of the spine and replace. They also reduce spinal injuries and relieve lower back pain and spinal injuries back. Back Injuries are the reason the loss of working days, it cost the factories of America 10-14 billion a year, and rarely find someone who was not hurt back pain during the period of his life, but this is a back pain of the health problems associated with the manner of living of people more than anything else (Tulsaworld, 2004). One of the problems faced by many individuals that affect the production and limit the activity is lower back pain and the

suffering victim of the difficulty of the ability to move or do daily tasks, and the percentage of people with these cases in some industrialized countries to 80 % vary in severity and location and degree of continuity of one individual to another (Fick, 1977). So trying to researcher recruitment and codify the training load through the qualifying program and use the various tools of exercise addition to the use of certain methods of treatment electricity to work on pain relief and rapid restoration of the back muscles lower to the level of bear pressure and relieve stress and pain on the cartilage between the lumbar spine. Out of the progress of societies does not come only interest the public health, the more attention an individual's health and care the greater the rise of the community and therefore should be given to solving the problems that threaten the health appear to humans as a result of civilian life, technology, and lack of exercise that has become because of the human small group with no exercise for sport on a regular basis, which infected individual muscle weakness and humiliation became susceptible to infections, especially the lower back and so went the researcher to the work of this study the impact of a proposed rehabilitation program for low back pain.

Research objectives

This research aims to identify: 1) Effect of building rehabilitation program for lower back pain Victims? 2) Dimensional measurements of the difference between the experimental group and the control variables in the research? 3) The percentage of improvement between the two variables in the research?

Hypotheses

1- There are significant differences between pre and post measurements for the experimental group in the research variables.

2 - There are significant differences between the dimensional measurements between experimental and control groups for the experimental group in the research variables.

3) There are differences in the rate of improvement between the experimental and control groups for the experimental group in the research variables.

It is clear from the table (1) there is no statistically significant differences in all variables of the study between tribal measurements of the experimental group and control group, which confirms the homogeneity between the experimental group and control group.

Table (2) shows the existence of statistically significant differences in all the study variables between the pre and post measurement of the experimental group for the measurement of post test, while no statistically significant differences in the vicinity of the right leg and the power of hip flexor and right thigh circumference at 3 cm. Discuss the results of the first hypothesis: It is clear from Table (2) that there are statistically significant differences between measurements tribal post test experimental group in the study variables for the post test measurement In the range of motion and seconded to extend the trunk was the difference between Altostat respectively (6.40), (6.80). This is consistent with the study of Fattah (1998) and Alnmory (1985) that the range of motion specific strength muscle groups based movement and elasticity of muscles corresponding, and to develop the range of motion specific strength-based groups to move and rubber muscles corresponding, and to develop the range of motion must be developed force Group-based movement muscle Erector Spine as well as improving muscle group with midwife Rectus Abdomini (Abdel, 1998; Alnmory, 1985). In the thickness of the fat back, side and abdomen was the difference between Altostat respectively (5.80), (5.80) (20.40) is consistent with what was said by Badi (2002) that the exercise air have an important role in weight loss, obesity, which acquired rights are only calories in excess of the body's need to become fat stored in different areas of the body, and here comes the role of aerobic exercise in burning as much fat stored (Badie, 2002). In the vicinity of the right thigh 3 and 8 cm and the area around the left thigh 3 and 8 cm and the area around the left leg, where was the difference between the averages, respectively, (20.40), (1.40) (2.80), (1.80) (3.20) (20.2) as These findings are consistent with Jackson (1988), Hanelson (1991) Shiple & Dinubile (1997) that the contents of the qualifying program proposal and the means of physical therapy appropriate modern and working on the completion of the effectiveness of the qualifying program proposed addition to the gradient in the phases of the program Load different according to the results of measurements that led to improved muscle power and increase the size of muscle fibres and thus increase the vicinity of the working muscles (Jackson, 1988; Harrelson, 1991; Shiple & Dinubile (1997). In the muscle strength flexor and article of the trunk was the difference between Altostat respectively (8.60) (Sadiq, 1994) and the researcher finds that the diversification within the content of the exercises used in the reinforcement of the abdominal and back muscles in terms of intensity and size had the greatest impact in the development of muscle strength, and is consistent with the opinion Fattah (1993) and Sharkey (1997) in doses that varied in training volume and intensity help to further the acquisition and development of power (Fattah, 1993; Sharkey, 1997). In the muscle strength of the hip joint right inner Badie (2002) find the difference between the averages, respectively (8.40), (Mohammed, 1975), (10.80) and in muscle strength of the hip joint the left adductor and abductor and flexor and the article was the difference between the averages, respectively (6.40), (5.60), (Sadoq, 1994), (10.20) and in muscle strength of the right knee flexor and the material was (20.20), (20.20) and in muscle strength of knee flexor and left the material was (18.40), (21.80) This is consistent with what was said by Allawi (2001) and Stanley (2001) that training muscle strength works to increase the

number and size muscle every muscle fibre, increasing the density of capillaries in all the muscle fibre, which leads to increase the size of muscle fibres and increase the circumference muscle (Allawi, 1986; Waiswellner et al., 1995; Stanley, 2001). Also agree with what explained Malkia & Ljunggen (1996) and Mayer (1990) that the exercise of any sporting activity on a regular basis leads to an increase in muscle mass as the sports training regularly leads to an increase in the size of the muscle due to increased section of each muscle fibre and to increase the efficiency of the muscle resulting from the regular sports training helps the muscles to withstand for long periods of work and face the fatigue (Malkia & Ljunggen, 1996; Mayer, 1990; Bromfort & Goldsmith, 1996). They also find that there is a correlation between muscle strength retaining of the spine and the integrity of the trunk and that the safety of curvature spine depends on the strength of muscles and ligaments related and the flexibility of the spine may be one of the reasons that lead to the non-alignment trunk and thus injury pain lower back (Bromfort & Goldsmith, 1996). This achieves the first hypothesis that there are significant differences between pre and post measurements in the experimental group post test for the measurement of research variables.

Table (3) shows the existence of statistically significant differences between measurements of the experimental group and control group in the range of motion for the bending and extending the trunk and in the thickness of the fat back, side, abdomen and in the vicinity of his right thigh at 8 cm and the area around his left thigh at 3.8 cm. In force flexor and article of the trunk and the strength of the hip joint right Bagpipes and the abductor and flexor and article. And the power of hip left close to the article and flexor. In force flexor of the knee of the left and right material and flexor while no statistically significant differences in the vicinity of his right thigh at 3.8 cm. And the area around leg right and left and the strength of the joint left thigh abductor and the strength of the material of the right knee discuss the results of the second hypothesis. It is clear from Table (3) that there are significant differences between the measurements of the dimensions of the experimental group and control group in the study variables for the experimental group. In the range of motion of bending and extending the trunk was the difference averages, respectively (2.40) (3.50), the researcher finds that the superiority of the experimental group is due to the way physical therapy and infrared massage helped to reduce the negative effects of the injury and associated adhesions of the tissues of the muscle as a result the rest period negative decreases range of motion This is consistent with what was said by Hernandez of the use of means of physical therapy (infrared and massage) play an important role in increasing metabolism and building soft tissue when the cell renewal, improving range of motion increase the sensitivity of the protein found in connective tissues and bones, which reduces the severity of pain by reducing the degree of excitation of sensory receptors in the skin (Ayad (1998; Roy & Irvan, 1983; Hernandez, 1973). This is consistent with what was said Basir (1999) that the stretching exercises targeting the muscles and ligaments to prolong and increase the range of motion in the joint is one of the most important means for the development of an element of flexibility (Basir, 1998). In the thickness of the fat side of the back and abdomen and was the difference between the averages, respectively (2.20) (4.40), (6.60). This is consistent with what was said by Badie (2002) that the exercise air have an important role in weight loss, obesity, which acquired rights is nothing but calories in excess of the body's need turned into fats stored in different areas of the body, and here comes the role of aerobic exercises in the burning of the largest as much as possible of the fat stored (Badie, 2002). In the vicinity of the left thigh 3.8 cm, respectively (1.60), (2.20) These findings are consistent with the sentiments both of Allawi (1986) and Davis (1989) & Mathews (1978) that an increase in the percentage of improvement was attributed to the subject group of the proposed program to program rehabilitation procedures proposed, which consisted of exercises to strengthen muscles working on the knee joint and the effectiveness of these exercises, which have increased the size of muscle fibers and thus increase the vicinity of the muscles. In the flexor muscle strength and trunk of the article was the difference between the averages, respectively (2.40) (2.40). In the inner force and abductor and flexor and detailed article to the right thigh, respectively, the difference (1.60), (2), (2.40), (5.20). In the flexor and adductor strength and material to the left hip in the averages, respectively (2.80), (3), 3.80. In the strength of the knee flexor right (10.80). In flexor strength and the material for the left knee (7), (7.80). This is consistent with what was said by both of the just on the good, (Twomey & Taylor, 1994) that strengthen the muscles of the abdomen of the most important muscle groups involved in these activities are unique in their ability to bend and extending the trunk by moving paragraphs bottom of the spine in cooperation with the muscles of the back straight and the muscles of the lower limb will a collar to protect the lower back area (Hassan, 1995; Twomey & Taylor, 1994). This is also consistent with that indicated by the Donley (1986) that the use of natural remedies and allow to start early in the performance of exercises muscle strength fixed and mobile. This achieves the second hypothesis that there are significant differences between the dimensional measurements between experimental and control groups for the experimental group in the research variables.

Table (4) shows that the percentage of improvement between the control and experimental groups for the experimental group in all variables, while the study found the rate of improvement in the thickness of the fat side and the strength of the left hip adductor in favour of the traditional program.

Table (1) Differences and the arithmetic mean and standard deviation between the two groups The control and experimental variables in the study of the measurement of the tribal

t.test	XA Differences	Control		experimental		Measurements
		SD	XA	SD	XA	
0.318	1	5.26	182,80	4.65	181.8	Length
0.140	0.40	4.81	83,00	4.17	83.40	Weight
0.122	0.40	5.63	38,80	4.66	38.40	Age
0.298	0.40	2.17	40,80	2.07	40.40	The kinetic of the trunk bending
0.298	0.30	1.58	10,00	1.60	10.30	Activity in the trunk of the D
0.478	0.40	1.14	13,60	1.48	13.20	Thickness of back fat
0.516	0.40	1.14	36,60	1.30	36.20	Thickness of side fat
0.215	0.40	3.36	39,40	2.45	39.00	Thickness of abdomen fat
0.098	0.20	3.11	41,20	3.32	41.00	The vicinity of the right thigh 3 cm
1.06	2.80	3.78	53,40	4.51	50.60	The vicinity of the right thigh8 cm
0.784	1.20	2.77	38,80	2,00	40.00	The vicinity of the left right thigh 3 cm
0.387	0.60	2.17	50,80	2.70	51.40	The vicinity of the left right thigh8 cm
0.167	0.20	2.17	35,20	1.58	35.00	The vicinity of the right leg
0.538	0.60	1.30	34,80	1.92	34.20	The vicinity of the right leg
0.067	-	0.84	15,20	1.64	15.20	Alqohaljza flexor
0.00	-	0.55	16,60	1.34	16.60	Alqohaljza Art.
0.67	0.40	0.71	13.00	1.14	13.40	Force close to the right hip
0.206	0.20	1.00	12,00	1.92	11.80	Force the right hip flexor abductor
0.540	0.40	1.14	14,40	1.22	14.00	Force the right hip abductor material
0.189	0.20	1.14	15,40	2.07	15.60	Force the right hip material
0.41	0.20	0.84	12,80	0.71	13.00	Strength of the left hip adductor
0.72	0.60	1.48	12,20	1.14	11.60	Strength of the left hip Estranged ,,,
0.22	0.20	1.40	13,80	1.58	14.00	Strength of the left hip Flexor
0.33	0.40	1.48	14,80	2.28	15.20	Strength of the left hip Art.
0.68	1	1.92	32,20	2.68	31.20	Right knee flexor strength
0.121	0.20	1.52	34,60	3.36	34.40	Right knee art strength.
0.416	0.60	1.64	31,80	2.77	31.20	lift knee flexor strength
0.601	2	2.17	32,20	7.12	34.20	lift knee art strength.

Table (2) Differences and the arithmetic mean and standard deviation between the pre and post measurements for the experimental

t.test	XA Differences	Control		Experimental		Measurements
		SD	XA	SD	XA	
1.90	2.40	1.82	44.40	2.16	46.80	The kinetic of the trunk bending
2.75	3.50	1.14	13.60	2.61	17.10	Activity in the trunk of the D
3.05	2.20	1.14	9.60	1.14	7.40	Thickness of back fat
4.40	4.40	1.92	24.80	1.14	20.40	Thickness of side fat
2.29	6.60	6.14	25.20	1.95	18.60	Thickness of abdomen fat
0.00	-	4.16	42.40	4.16	42.40	The vicinity of the right thigh 3 cm
0.571	1.60	4.00	55.00	4.83	53.40	The vicinity of the right thigh8 cm
1.11	1.60	2.59	40.20	1.92	41.80	The vicinity of the left right thigh 3 cm
1.19	2.20	2.70	52.40	3.13	54.60	The vicinity of the left right thigh8 cm
0.877	1	2.00	36.00	1.58	37.00	The vicinity of the right leg
0.67	0.60	1.30	35.80	1.52	36.40	The vicinity of the right leg
1.48	2.40	1.14	21.40	3.42	23.80	Alqohaljza flexor
1.41	2.20	1.14	23.40	3.29	25.60	Alqohaljza Art.
2.31	1.60	0.84	20.20	1.30	21.80	Force close to the right hip
1.64	2	1.92	17.80	1.92	19.80	Force the right hip flexor abductor material
1.86	2.40	1.73	24.00	2.30	26.40	Force the right hip abductor material
1.99	5.20	1.48	25.20	5.64	30.40	Force the right hip material
3.55	2.80	1.34	16.60	1.14	19.40	Strength of the left hip adductor
1.49	1.40	0.84	15.80	1.92	17.20	Strength of the left hip Estranged
2.45	3	1.73	20.00	2.12	23.00	Strength of the left hip Flexor
2.12	3.80	2.70	21.60	2.97	25.40	Strength of the left hip Art.
3.14	10.80	7.30	40.60	2.41	51.40	Right knee flexor strength
0.07	0.20	1.92	54.80	5.86	54.60	Right knee art strength.
2.37	7	6.02	42.60	2.70	49.60	lift knee flexor strength
3.28	7.80	1.64	48.20	5.05	56.00	lift knee art strength.
	1591.90		771.60		820.30	Total

It is clear from Table (4) that the rate of improvement between the experimental group and control group was in favor of the experimental group where I got in range of motion on the rate of improvement and extension of the trunk increased (30.2%), followed by a drape trunk (7.2%). This is consistent with the results of a study of Sayed (1996), which explained that the exercise rehabilitation of invalids lumbar slipped disc is working on an improvement in range of motion of the spine and also strengthen the muscles of the back and abdominal muscles 0 (Sayed, 1996). In the thickness of the fat highest improvement in the back and abdomen and side, respectively (44.83), (16.7), (10.1) and indicates (Bromfort & Goldsmith, 1996) on the impact of exercises trunk on the movement of the spine which explained their positive impact in the treatment of low back pain, also confirms Wilder et al. (1998) excess weight caused by sitting for long periods of time, lack of exercise has a close association pain lower back, and the study of good Alnmory (1984) to increase the weight and increase the amount of fat the body of the most important causes of pain lower back, and in general that the practice of sports activities, especially exercise contribute to improving the physical condition, most important implications of weight loss and decreasing the body fat.

Table (3) Differences and the arithmetic mean and standard deviation between the measurements and dimensions of the two control variables in the experimental study

t.test	XA Differences	Control		experimental		Measurements
		SD	XA	SD	XA	
26.13	6.40	2.16	46.80	2.07	40.40	The kinetic of the trunk bending
12.08	6.80	2.61	17.10	1.60	10.30	Activity in the trunk of the D
15.50	5.80	1.14	3.40	1.48	13.20	Thickness of back fat
23.82	5.80	1.14	20.40	1.30	26.20	Thickness of side fat
83.28	20.40	1.95	18.60	2.45	39.00	Thickness of abdomen fat
2.75	1.40	4.16	42.40	3.32	41.00	The vicinity of the right thigh 3 cm
14.00	2.80	4.83	53.40	4.51	50.60	The vicinity of the right thigh8 cm
9.00	1.80	1.92	41.80	2.00	40.00	The vicinity of the left right thigh 3 cm
8.55	3.20	3.13	54.60	2.70	51.40	The vicinity of the left right thigh8 cm
-	2	1.58	37.00	1.58	35.00	The vicinity of the right leg
11.00	2.20	1.52	36.40	1.92	34.20	The vicinity of the right leg
9.86	8.60	3.42	23.80	1.64	15.20	Alqohaljza flexor
9.48	9	3.29	25.60	1.34	16.60	Alqohaljza Art.
34.29	8.40	1.30	21.80	1.14	13.40	Force close to the right hip
12.32	8	1.92	19.80	1.92	11.80	Force the right hip flexor abductor material
-	-	1.22	14.00	1.22	14.00	Force the right hip abductor material
7.02	10.80	2.07	15.60	2.30	26.40	Force the right hip material
16.00	6.40	1.14	19.40	0.71	13.00	Strength of the left hip adductor
14.00	5.60	1.92	17.20	1.14	11.60	Strength of the left hip Estranged ,,,
28.46	9	2.12	23.00	1.58	14.00	Strength of the left hip Flexor
27.26	10.20	2.97	25.40	2.28	15.20	Strength of the left hip Art.
53.97	20.20	2.41	51.40	2.68	31.20	Right knee flexor strength
9.81	20.20	5.85	54.60	3.36	34.40	Right knee art strength.
75.12	18.40	2.70	49.60	2.77	31.20	lift knee flexor strength
18.17	21.80	5.04	56.00	7.12	34.20	lift knee art strength.

Table (4) Rates of improvement between the two groups in the experimental and the control variables of the study

difference between the percentage of improvement	rate of improvement of the experimental group	rate of improve the proportion of the control group	Measurements
7 ,2	15.84	8.82	The kinetic of the trunk bending
30,2	66.02	36.00	Activity in the trunk of the D
44,83	74.24-	29.41-	Thickness of back fat
10,1	22.14-	32.24-	Thickness of side fat
16,27	52.31-	36.04-	Thickness of abdomen fat
0,5	3.41	2.91	The vicinity of the right thigh 3 cm
2,53	5.53	3.00	The vicinity of the right thigh**8** cm
0,89	4.50	3.61	The vicinity of the left right thigh 3 cm
3,01	6.23	3.15	The vicinity of the left right thigh**8** cm
3,44	5.71	2.27	The vicinity of the right leg
3,46	6.43	2.87	The vicinity of the right leg
15,79	56.58	40.79	Alqohaljza flexor
13,97	54.22	40.96	Alqohaljza Art.
7,31	62.69	55.38	Force close to the right hip
19,47	67.80	48.33	Force the right hip flexor abductor material
10,33	77.00	66.67	Force the right hip abductor material
22,93	40.91-	63.64	Force the right hip material
19,54	49.23	29.69	Strength of the left hip adductor
18,77	48.28	29.51	Strength of the left hip Estranged ,,,
19,34	64.29	44.93	Strength of the left hip Flexor
21,16	67.11	45.95	Strength of the left hip Art**.**
38,65	64.74	26.09	Right knee flexor strength
0,34	58.72	58.38	Right knee art strength**.**
25,01	58.97	33.96	lift knee flexor strength
14,05	63.74	49.69	lift knee art strength**.**

And in the ocean the highest percentage improvement in the vicinity of the left leg, followed by the right and the lowest in the vicinity of his right thigh at 3 cm by (0.5) is due researcher of this superiority in increasing the ratio of the circumference muscle that qualifying program proposed significantly affected the increase in muscle strength of the muscles surrounding the cartilage, increasing section physiological for these muscles and thus increased the size of the muscle twin This is consistent with Mustafa (1989) and Sadiq (1994) in containing the qualifying program on exercise muscle strength and exercise regularly gradient leads to changes in the muscles, including an increase in muscle size and improvement in muscle strength. In the muscle strength of the trunk was found the highest percentage of improvement in muscle flexor, followed by muscle Almadhaly respectively (15.79), (13.97) and because the researcher that the improvement in muscle strength of the muscles of the abdomen and back that a group exercise, which included the program has helped to develop muscle strength of the muscles of the back and abdomen , and this is consistent with the indication by the Rawash (2001) and Maksoud (1992) intended that the objectives of the exercise not only to learn and master the performance of different movements and basic

skills, but also affect the muscles and organs of the body and working on their development, and the transmission of body strength and flexibility ¸(Rawash, 2001; Maksoud, 1992). In the muscle strength it was found the highest percentage improvement in the strength of the right knee flexor by (38.65), followed by the power of the knee flexor left by (25.01), followed by the power of the hip joint article left (21:16) and the lowest percentage of improvement followed by the strength of the material of the knee joint right by (0.34). This is consistent with that indicated by each of the mentioned researches (Garem, Davis, Harrelson, Renstrom) in that the training in accordance with the work of the muscle hard and the motor causes increased muscle strength by using different amounts of intensity and duration of the repetition of the exercise, and the use of training to contract the muscles at a constant speed even if you have changed resistors as well as the appropriate means associated with playing a key role in improving the strength of the muscle groups working on different parts of the body and build full force. Confirmed by many of them that exercise programs inhalers have a positive impact in the development and strengthening of both the back muscles as well as the flexibility of the spine leading to easing the pain of the lower back. This achieves the third hypothesis that there are differences in the percentage of improvement between the experimental and control groups for the experimental group in the research variables.

Conclusions:

In light of the objectives of the research and display we can conclude the following:

1) Affect the qualifying program in improving range of motion of the spine to bend and extending the trunk. 2) Qualifying affect the lack of fat thickness of the back and side and abdomen. 3) Affects the qualifying program to increase the ocean thigh circumference at 3.8 cm, and the area around the left and right leg. 4) Affects the qualifying program to increase flexor muscle strength and material of the trunk. 5) Affects the qualifying program to increase muscle strength of the hip joint of the foot of Yemen and the left foot and adductor muscles of the abductor and flexor and matter. 6) Affects the qualifying program to increase muscle strength of the knee of the left and right in the article and flexor muscles

Recommendations:

1) Further research in the rehabilitation of the pain of the cervical spine. 2) Use of the qualifying program proposed in the treatment and Rehabilitation of Victims of the lower back. 3) The work of educational programs in the media to urge the people of the importance of sports rehabilitation side of treatment. 4) A comprehensive medical examination of the importance of standing on the incidence and treatment before they escalate.

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UTJECAJ PREDLOŽENOG REHABILITACIJSKOG PROGRAMA NA BOL DONJEG DIJELA LEĐA

Sažetak

Okosnica kralježaka složena na svakom vrhu između svakog stavka i stavka hrskavice pomaže u ljudskom kretanju u različitim smjerovima i djeluje na apsorpciji šoka tijekom hodanja, trčanja, skoka i tvori okosnicu vratne kralježnice i leđne kralješnice ili torakalne i lumbalne kralježnice, noseći težinu gornjeg ekstremiteta i prsa i njezin sadržaj kao i trbušne šupljine, što čini lumbalnu kralježnicu osjetljivijom na oštećenja. Studija ima za cilj utvrditi utjecaj provedbe rehabilitacijskog programa za žrtve boli donjeg dijela leđa i koristi adaptirani eksperimentalni dizajn autora mjerenja tribal pozicije za dvije grupe, jedna eksperimentalna i drugih kontrola uključena u uzorak pretrage boli u leđima zbog puknutih ligamenata lumbalne kralježnice (22) zaražene u dobi između (35-45) kod 10 pacijenata u eksperimentalnoj skupini i 10 u kontrolnoj skupini. Rezultati najvažnijih utjecaja u kvalifikacijskom programu je poboljšanje raspona gibanja i savijanja kralježnice kao i trupa te utjecaj kvalifikacijskog programa na gubitak masti leđa i trbuha.

Ključne riječi: *kralježnica, bol, vježbanje*

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SEX DIFFERENCES IN THE ATTITUDES OF STUDENTS OF PHYSICAL EDUCATION RELATED TO LEISURE AND RECREATIONAL SPORTS ACTIVITIES

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Original scientific paper

Abstract
The gender differences in attitudes of students of kinesiology towards leisure and recreational activities were examined on a sample of 109 respondents. On the basis of the responses to the survey, significant differences in the interest in particular sports activities and the influences for engaging in sport recreation activities have been found. There are no differences between male and female students in relation to the current ways of using free time, preferred ways to spend the winter / summer holidays, wishes for learning new sport activities, and the preferred ways of using free time. It is likely that these differences are influenced by gender stereotypes, but also by the evolutionary founded differences between men and women.

Keywords: *leisure, sport recreation, male and female students*

Introduction

How to define leisure? Most of the authors describe leisure as a synthesis of the time spent without demands of work or duties, doing activities that make us feel pleased and enjoy, performed during specified unpaid time (Arbunić, 2004; Previšić, 2000). Thus, Adams (1976, from Arbunić, 2004) perceives four dimensions that strongly articulate activities associated with leisure time: the freedom of choice of activities, internal motivation, enjoyment and relaxation. One way of spending leisure time activities are sports and recreation. In fact, there are numerous evidences that physically active lifestyle is desirable, because it reduces the risk of many chronic diseases. On the other hand, physically active lifestyle relieves the state of stress and depression, improves mood, confidence and life satisfaction. However, today we are witnessing an epidemic of sedentary lifestyle. Mechanization eliminated the mandatory physical activity in our lives, which should be replaced by voluntary physical activity, the so-called recreational physical activity, aimed to satisfy the human need for movement. Promoting regular physical activity has become a public health priority. Programs of physical exercise should be a daily activity in free time of each person. For this purpose, programs should be adapted to the specific needs of potential users. Unfortunately, it is still the practice to offer a general program of exercise or physical activity for 'general', abstract population. Program bidders are rarely familiar with the needs, wishes and preferences of potential users. Individualized recreational programs would probably be more attractive, because they would correspond to the real needs of known subgroups within the population. The research results of Gošnik, Fučkar and Alikalfić (2003) and Gošnik, Sedar and Bunjevac (2007), on the students of the Faculty of Philosophy, Zagreb have shown that there are no significant differences in preferences for sports in four consecutive years : from the academic year 2002/2003 to 2005/2006, with male and female students. The male and female students represent largely homogeneous groups with regard to the choice of most and least attractive and interesting sports. There is a difference only in sports chosen by males and females. Through four generations indicated above, the most interesting sport for both male and female students proved to be swimming. The next most preferred activity is weekend excursion, which indicates the importance of health, for male and female students of the Faculty of Philosophy. Next most preferred sport is a dance, as part of the basic culture and lifestyle. All aggressive, demanding and unaesthetic sports, as well as sports that require close contact with sport opponent are low-ranked and equally unattractive for both male and female students. Cheng (2004) notes significant differences in preferences of recreational sports at students from different countries. Petkovšek (1981) observed the same tendency among students of different faculties in Slovenia, as same as Boyer (1987) in the United States. In this study, the attitudes of students of kinesiology about physical education toward leisure activities are examined, especially in sport-recreation activities. Specifically, it is likely that students of kinesiology have specific attitudes towards these activities. For them, sport is also part of the future in their profession, as well as the most essential way of spending the whole daytime. Namely, except for the purpose of study, a number of physical education students have been active in sports clubs, such as athletes or coaches. On the other hand, it is likely that there are sex differences between male and female students of physical education, in relation to the ways of spending leisure time, and so in terms of preferences for leisure activities. Determination of activities that are favored by male or female students of kinesiology in their free time could help organizing sport-recreational activities, especially for female

student population, especially for male students of kinesiology. Based on these assumptions, research *aims* have been identified, i.e. if male and female students vary in relation to: 1. existing ways of spending leisure time; 2. preferred ways of spending leisure time; 3. preferred ways of spending the winter / summer holidays; 4. interest in individual sports activities; 5. the desire to learn new sports activities; 6. impact on active sport engagement.

Methods

Subjects in the research were male and female students (N = 109) of the Faculty of Kinesiology in Zagreb, with an average age of 22 years (39 female and 70 male). An instrument that was used in this study is essentially a series of questions that reflect the students' attitudes toward recreation. With two demographic variables (sex and age), we used a total of six groups of variables that are related to the following: current ways of spending leisure time (8 variables), preferred ways of spending leisure time (4 variables); preferred ways of spending winter / summer holidays (5 variables); interest in specific sports activities (18 variables), the desire to learn new sport activities (5 variables); influence on active sport engagement (4 variables). In addition, we examined the attitudes about the importance of physical activity for health, the level of systematic planning of leisure time, the desire for an active vacation, a view whether the recreational sport is just for young people; and if the Croats recreate enough (6 variables). So, we used a total of 52 variables. Sex is used in research as an independent variable, while the other variables were dependent. Differences between male and female students were found using discrimination analysis (for variables that could be 'logically' grouped), and using t-test for independent samples (for the 'isolated' variables, that do not belong to any of the variable groups).

Results and discussion

Table 1: Differences between male and female students in relation to the current spending of leisure time (discriminant analysis and ANOVA in relation to the discriminant function)

CHARACTERISTICS *(men= M_1, women= M_2)*	SYMBOLS
Leisure daytime (M_1=3.09; M_2=2.31), λ = 0.96, F = 4.08, p <0.05	0=less than an hour; 1=1 hour; 2= 2 hours; 3= 3 hours; 4=4 hours and more
Daytime for learning (M_1 = 1.50; M_2 = 1.51)	1=1 hour; 2= 2 hours; 3= 3 hours; 4= 4 hours; 5= 5 hours and more
Daytime for recreational reading (M_1 = 1.10, M_2 = 1.26)	
Daytime for a watching TV (M_1 = 1.83, M_2 = 1.69)	
Daytime to stay at a café (M_1 = 1.35, M_2 = 1.49)	
Frequency of weekly cinema (M_1 = 0.33, M_2 = 0.49)	0= not going; 1= once; 2= more than once
Frequency per week theatre (M_1 = 0.07, M_2 = 0.18)	
Weekly frequency of sport activities (M_1 = 3.77, M_2 = 3.85)	1=1 hour; 2= 2 hours; 3= 3 hours; 4= 4 hours; 5= 5 hours and more
Discriminant analysis	λ= 0,90; χ^2= 11,10; p>0,10

Note: just significant differences are pointed at Characteristics

Table 2: Differences between male and female students in relation to their preferred ways of spending leisure time (discriminant analysis and ANOVA in relation to the discriminant function)

CHARACTERISTICS *(men= M_1, women= M_2)*	SYMBOLS
Want to work if you have free time - culture (M_1 = 1.27, M_2 = 1.23)	1= NO; 2=YES
Want to work if you have free time – sport (M_1 = 1.14, M_2 = 1.08)	
Want to work if you have free time – travel (M_1 = 1.57, M_2 = 1.74)	
Want to work if you have free time – social activities (M_1 = 1.26, M_2 = 1.21)	
Discriminant analysis	λ= 0,95; χ^2= 5,19; p>0,10

There are no statistically significant differences between male and female students in relation to the current use of leisure time (Table 1). However, if we analyze individual differences, we can see that female students have significantly less leisure time per day, compared to the male students. There are no differences between male and female students in relation to the preferred ways of spending leisure time (Table 2). There is no statistically significant difference between male and female students in relation to preferred ways of spending the winter / summer holidays (Table 3), except for the fact that female students tend more significantly to choose summertime (without any specific activities), if compared to the male students. There is significant difference between male and female students in relation to the interest in specific sports activities (Table 4). In the analysis of particular differences, female students have shown significantly greater interest in more frequent volleyball, rowing and rollerblading activities, than it is the case so far, if compared to the male students. Male students would prefer to play baseball more than by now, if compared with the females. There was no significant difference between male and female students in relation to their desire for learning new recreational activities (Table 5). There was significant difference between male and female students in relation to the influence of others on their sport engagement (Table 6). For female students, significantly stronger influences on their sport engagement have their parents (father and mother), compared to male students.

It is possible that in case of male students peers and sporting role models (successful athletes) have more influence on their sport engagement, than it is the case with female students.

Table 3: Differences between male and female students in relation to their preferred ways to spend winter / summer holidays (discriminant analysis and ANOVA in relation to the discriminant function)

CHARACTERISTICS *(men= M_1, women= M_2)*	SYMBOLS
Spending winter / summer holidays – earnings (M_1=1.40; M_2=1.23)	1= NO; 2=YES
Spending winter / summer holidays – entertainment (M_1=1.47; M_2=1.46)	
Spending winter / summer holidays – doing nothing (M_1=1.07; M_2=1.08)	
Spending winter / summer holidays – spending summertime (M_1=1.07; $_2$=1.25); λ= 0.93; F= 7.59; p<0.01	
Spending winter / summer holidays – spending wintertime (M_1=1.56; M_2=1.72)	
Discriminant analysis	λ= 0.91; χ^2= 10.42; p>0.05

Note: just significant differences are pointed at Characteristics

Table 4: Differences between male and female students in relation to their interest in specific sports activities (discriminant analysis and ANOVA in relation to the discriminant function)

CHARACTERISTICS *(men= M_1, women= M_2)*	SYMBOLS
Interest in outdoor sports - football (M_1 = 1.00, M_2 = 1.00)	0=NO; 1=periodically; 2=regularly
Interest in outdoor sports - handball (M_1 = 0.95 M_2 = 0.23); λ = 0.83, F = 21.29, p <0.01	
Interest in sports activities - basketball (M_1 = 0.24, M_2 = 0.78)	
Interest in sport activities - tennis (M_1 = 0.63, M_2 = 0.33)	
Interest in sport activities - table tennis (M_1 = 0.46, M_2 = 0.41)	
Interest in sport activities - badminton (M_1 = 0.16, M_2 = 0.15)	
Interest in sport activities - judo (M_1 = 0.16, M_2 = 0.15)	
Interest in sport activities - gymnastics (M_1 = 0.19, M_2 = 0.21)	
Interest in sport activities – combat sports (M_1=0,24; M_2=0,26)	
Interest in sport activities – running (M_1=0.30; M_2=0.28)	
Interest in sport activities - volleyball (M_1 = 0.29, M_2 = 0.64), λ = 0.94, F = 6.35, p <0.02	
Interest in sport activities – dance (M_1 = 0.31, M_2 = 0.38)	
Interest in sport activities – swimming (M1 = 0.57, M_2 = 0.49)	
Interest in sport activities – rowing (M_1=0.08; M_2=0.44); λ= 0.90; F= 11.30; p<0.01	
Interest in sport activities – skiing (M_1=0.34; M_2=0.49)	
Interest in sport activities – bike (M_1=0.10; M_2=0.10)	
Interest in sport activities – skating (M_1=0.05; M_2=0.23); λ= 0.96; F= 4.84; p<0.05	
Interest in other sport activities (M_1=0.03; M_2=0.31); λ= 0.90; F= 11.44; p<0.01	
Discriminant analysis	λ= 0.56; χ^2= 56.45; p<0.01

Note: just significant differences are pointed at Characteristics

Table 5: Differences between male and female students in relation to their desire for learning new sports activities (discriminant analysis and ANOVA in relation to their discriminant function)

CHARACTERISTICS *(men= M_1, women= M_2)*	SYMBOLS
Desire for learning a new sport activity - skiing (M_1=0.23, M_2= 0.26)	2=YES; 0=NO
Desire for learning a new sport activity - diving (M_1 = 0.99, M_2= 1.28)	
Desire for learning a new sport activity – ice skating (M_1=0.76, M_2= 0.79)	
Desire for learning a new sport activity – tennis (M_1=0.64, M_2=0.51)	
Desire for learning a new sport activity - sailing (M_1 = 0.16, M_2 = 0.36)	
Discriminant analysis	λ= 0.91; χ^2= 10.16; p>0.05

Table 6: Differences between male and female students in relation to impact on their sport engagement (discriminant analysis and ANOVA in relation to the discriminant function)

CHARACTERISTICS *(men= M_1, women= M_2)*	SYMBOLS
Impact on engaging in sports – father (M_1 = 0.27, M_2 = 0.72); λ=0.93, F = 8.38, p <0.01	1= NO; 2=YES
Impact on engaging in sports – mother (M_1=0.52; M_2=0.92); λ= 0.96; F= 4.73; p<0.05	
Impact on engaging in sports – sister / brother (M_1=1.49, M_2=1.38)	
Impact on engaging in sports – friends (M_1 = 1.17, M_2 = 1.28)	
Discriminant analysis	λ= 0.87; χ^2= 14.88; p<0.01

Note: just significant differences are pointed at Characteristics

There are no statistically significant differences between male and female students in relation to the view that the recreational sport is just for young people, or the view if the Croats tend to recreate enough. Furthermore, we have found that female students show minimal but significantly more positive attitude, compared with male students, related to the importance of physical activity for health. The desire for an active vacation is significantly higher in female students, compared to male students, according to t-test results. It is likely that these differences in the attitudes between male and female students are caused by sex stereotypes, but also conditioned by evolutionary differences between men and women (congenital, biological).

On the other hand, more positive attitudes toward physical activity may be influenced by the possibility that male students might be to some extent more 'satiated' with frequent sport activities (while attending faculty program, in their leisure time and due to obligations in their sports clubs, i.e. training process), so they might prefer more passive relaxation over a year, than female students. In future research we can expand and improve our research in a few directions.

We should be able to examine a larger and more representative sample size (for example, male and female students of sport faculties in different towns or countries, or compare male and female students from different faculties).

Some research questions could be reformulated, in order to obtain relevant data (for example, we can use MANOVA or ANCOVA in data analysis, trying to find interactive factors that affect differences between male and female students, together with sex).

From practical point of view, few types of promotion sport recreational activities can be provided, specifically adjusted to male and female students.

Conclusion

Male and female students of the Faculty of Kinesiology in Zagreb do not differ significantly in the existing ways of spending leisure time, desired ways how to spend their leisure time, preferred modalities of spending winter / summer holidays and the desire for learning new sport activities. However, sex differences exist in the area of interest for certain sport activities and in the field of impacts on their sport engagement.

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SPOLNE RAZLIKE U STAVOVIMA STUDENATA I STUDENTICA KINEZIOLOGIJE PREMA SLOBODNOM VREMENU I REKREACIJSKIM SPORTSKIM AKTIVNOSTIMA

Sažetak

Ispitane su spolne razlike u stavovima studenata i studentica kineziologije prema slobodnom vremenu i rekreacijskim sportskim aktivnostima, na uzorku od 109 ispitanika. Na temelju odgovora na prigodnu anketu, utvrđeno je da postoje značajne razlike između studenata i studentica u interesu za pojedine sportske aktivnosti, te u utjecajima na bavljenje sportom. Ne postoje razlike između studenata i studentica u odnosu na aktualne načine korištenja slobodnog vremena, željenim načinima provođenja zimskih/ljetnih praznika, željama učenja novih sportskih aktivnosti, te željene načine korištenja slobodnog vremena. Vjerojatno je da su ove razlike stavova studenata i studentica uvjetovane spolnim stereotipima, ali i evolucijski uvjetovanim različitostima muškaraca i žena.

Ključne riječi: *slobodno vrijeme, sportska rekreacija, studenti, studentice*

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DIFFERENCES IN THE HIGH STATIC JUMP WITH AND WITHOUT ONE FOOT (SERGEANT)

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Original scientific paper

Abstract
Basketball is considered among the attractive sports which contain features of movement structure and different situations, related to many dynamic-explosive actions. Young people who deal with the game of basketball should be very careful, in particular with the coordination skills that are directly related to their morphological structure. Namely, basketball is more complex in comparison with other sports. The aim of this paper is to prove the differences between the static vertical jump (sergeant) and the approach jump. This paper treated 48 male entities aged 16-17 years. The data was processed using the statistical program SPSS for Windows version 17.00, and the parameters were analyzed through the statistical method (Mean). Whereas, by using the T-test method, the systematic differences between these two variables were confirmed. This analysis has also proved that the approach jump variable has better values in comparison with the static vertical jump, which is to be expected.

Key words: *entities, sergeant jump, one foot jump, T-test*

Introduction

A basketball player must always be prepared for different game situations. At any point in the game, he should be prepared to catch balls under the basket with a static vertical jump, steps and vigour. For basketball players, the jump is one of the key specific skills, especially during a game under the basket. A good basketball player should show a better performance as possible, which he should consistently preserve (foster) with systematic exercises. While the static vertical jump and the approach jump, in any situation of the basketball game, there is a need for especially tall players playing in the centre, and basketball players singled out for throwing during a jump.

Aims of the study

The aim of this study-experiment is to prove the presented differences, respectively the changes introduced between the static vertical jump and the approach jump.

Research methodology

Sample
The sample of entities treated in this research consists of 48 male basketball players aged 16-17 years. These are active basketball players and systematically train in different basketball schools in the city of Pristina and Gjilan. All these young people train in their respective schools with an average of 2 years, 3 times per week, 1 hour and 15 minutes.

Variables
The sample of movement variables (motor): KSAR1 – Static vertical jump; KSAR2 – Approach jump.

Data processing methods
Data processing was performed by statistical software SPSS for Windows version 17.0, comparison of the values was done through basic statistical analysis using the statistical methods of the minimum value (Min), maximum value (Max), arithmetic mean (Mean), standard deviation (Std. Dev.), coefficient of variation (KV%) and the variation width (GjV). While the T-test method was applied for the changes (differences) presented between the two variables.

Discussion

Table 1 reflects basic statistical parameters and shows the distribution of values for both variables separately. Based on the statistical methods of the arithmetic mean (Mean), the sample of this experiment, respectively, this study has proved to be homogeneous between these variables. If we compare these data with the experiments, namely the studies of other researchers we observe that the data shows approximately the same results.

Table 1. Statistical data

	N	Min	Max	Mean	Std. Dev	KV %	GjV
$MSAR_1$	48	20.00	62.00	46.27	9.53	46.42	-42
$MSAR_2$	48	20.00	66.00	49.69	9.50	14.15	-46

Based on the results presented in table number 2, we observed that between the variables of static vertical jump and the approach differ in the level of reliability in the value of 0.000 (Sig.). While the distinction between these groups will be compared through the arithmetic average (mean), which in this case the value differs only by 2.61cm.

These parameters are explained in such way stating that the approach jump has better values than the static high jump variable.

Table 2. t-test

		Mean	N	Std. De.	Std. Error Mean
Pair 1	$MSAR_1$	47.28	48	8.97	1.29
	$MSAR_2$	49.90	48	9.03	1.30

		N	Correlation	Sig.
Pair 1	$MSAR_1$ & $MSAR_2$	48	.956	.000

		Paired Differences Mean	Std. De.	Std. Error Mean	T	df	Sig. (2-tailed)
Pair 1	$MSAR_1$	-2.61	2.67	.386	-6.78	47	.000

Conclusion

The aim of this paper is reached, where through the difference between the static vertical jump and the approach jump we presented the systematic values of these two parameters. During the measurements of these two parameters, we noticed that some basketball players have achieved better result using the approach jump while others have done the opposite. However, in most cases while playing basketball the approach jump, especially in situational terms is required in the very beginning of the game. Meanwhile, this jump affects the centre position players as well, during their realized shots, which is at the same time related to the accurate and furious shots, requiring that the basketball player should raise his arms over the head as soon as possible, because basketball is one of the most dynamic-explosive sports, characterized by these two jumps. For having a greater success in numerous jumps in the game, it mostly depends on the performance of the basketball players during the meeting. The results obtained from this study indisputably confirm the importance of the high approach jump during the game of basketball, which you can serve for more practical results and values.

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RAZLIKE U SKOKU S MJESTA (SERGEANT) SA I BEZ JEDNOG KORAKA ZALETA

Sažetak

Košarka se smatra jednim od atraktivnijih sportova i koja sadrži svojstva strukture gibanja i različite situacije povezane s mnogim dinamičko-eksplozivnim akcijama. Mladi koji se uključuju u ovu igru trebaju biti jako pažljivi posebno u vezi koordinacijskih vještina koje su direktno povezane s njihovom morfološkom strukturom. Naime, košarka je mnogo kompleksnije u odnosu na druge sportove. Cilj ovog članka je da dokaže razlike između statičkog vertikalnog skoka (sergeant) i skoka sa zaletom. Tretirano je 48 muškaraca uzrasta 16-17 godina. Podaci su obrađeni programom SPSS za Windows-e ver. 17. i podaci su analizirani osnovnom statistikom i t-testom. Korištenjem t-testa potvrđene su sistematske razlike između ovih dviju varijabli. Ova analiza je također pokazala da soko sa zaletom pokazuje bolje vrijednosti u odnosu na statički skok, što je očekivano.

Ključne riječi: *entiteti, sergeant skok, skok sa zaletom, T-test*

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THE MORPHOLOGICAL STATUS OF THE FINALIST IN JUMPING DISCIPLINES AT THE BEIJING OLYMPICS

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Original scientific paper

Abstract

Morphological characteristics of the athlete represents his identification card on the base that can be classified as a constitutional type, and also to get information about his body height, body weight, BMI, and even analyze and age. Different constitutional types present in the sport and are important in terms of routing, selection and pursuit of a particular sport. This is expressed especially in athletic sports in the athletics where we have a number of different constitutional types of athletes that requires Discipline. This paper analyzes the morphological status of the finalists in the jumping events at the Olympic Games in Beijing 2008. The survey includes 32 athletes who competed in the finals and the measured variables to assess the morphological status: body height (AVIS), body mass (AMAS), body mass index (BMI), age of the competitor (GOD). Applying basic statistical parameters was performed descriptive analysis of variables applied to the athletes that were made based on the conclusions.

Key words: *morphological status, athletes, jumping disciplines*

Introduction

Athletics as a branch of sport with a large number of sports disciplines in the men's and women competition occupies a very important place in the hierarchy of sports and is often called the queen of sports, because of the historical emergence and development, of a large number of disciplines (walking, running, jumping, throwing), and the impact of athletic movement in a normal psychosomatic development and motor development of a human in sense of mastery, training, upgrading and testing of motor and functional abilities of man (Pavlović, 2010). What is interesting and a very common topic of many conversations, when it comes to athletics in general, are its disciplines and the results achieved in them, that is which the athletes achieve as their personal records. This imposes a number of questions? Usually we talk about their training technologies (type and composition of the equipment, what is the equipment made of , what are the materials, some new things in their models), diet and its impact on athletes' body (carbohydrates, fats, proteins), the training process (duration of the micro, meso, macrocycle, scope and intensity of work); using (not) allowed stimulants which lately use a number of athletes in order to achieve better results, although aware of the consequences that follow, a disqualification, prohibition of competition in the short and long periods of time, and often negative consequences on the permanent health of athletes. In addition to these questions at which we have complete and sometimes incomplete answers, often are those concerning the morphological and motor status of athletes. Both spaces are very important in the result success and placement and usually are analyzed separately, depending on the discipline and its method of execution. However, best results are achieved if there is a high correspondence between these spaces, which requires a certain discipline. In addition to motor skills, which have a very important role, no less lag have morphological dimensions on the basis of which is made selection and guidance of young athletes in a particular discipline, in which is expected the achievement of the best results. Namely, it is known that jumping disciplines are characterized by increased longitudinallity and transversality of the skeleton, lower body weight and on the basis of which is made one model of jumper. Generally, the jumpers are tall and relatively of less weight, long legs, long and thin muscles. According to the constitution the leading is leptosom type with the participation of athletics. Long jumper and triple jumper are by their appearance and constitution closer to the sprinters, have a very long tibia. One of the main characteristic that is general for all the jumpers in the air, is their body height. Ten best jumpers in the world have a height of 190-201 cm for males and 178-188 for females. Jumpers in the air have long legs and comparatively short torso. About the possibility of increasing the body height of boys and girls jumping beginners can be judged by their long hands and feet. If the child's hands and feet are long, that is the assumption that in the future will come to the leveling of body proportions. If the parents are high it can also be expected high growth. As an indicator of physical condition of jumper, there is the potential of speed power, which is expressed at speed and a maximum strong rebound when the pressure on the soil exceeds the weight of athlete 6-7 times. This requires a specific power, not only of legs but of all muscle groups. Here comes into play synchronized actions of muscular kinetic chains, which extends from the foot to the muscles of arms and shoulders. To perform complex actions, both when entering the bounce, and during the jump, a high level of coordination of movements is needed and a good state of the vestibular apparatus.

The need of larger amplitude in swing movements at variants of jumps requires that jumpers achieve high mobility (Bowerman et al. 1998). It is particularly necessary good movement and mobility of the spine lumbar and thoracic parts. The specific character of the implementation of competition in the high jumping requires from athlete special mental state. The jumper should possess such qualities as the ability to self-analysis, self-criticism of his and opponent's abilities. Beside this is a special form of self-control is needed that will enable the proper distribution of power for long hours of struggle, competition. When it comes to the long jumpers and triple jumpers, one can cite an example that the height of ten world's best jumpers is about 188 cm. Women are also of high growth on average 175 cm. They need the same physical and mental abilities as jumpers in the air.

It should be noted that they need high speed, explosive power, strength of leg muscles, body because jump over 8.50m, is unthinkable without a high-speed run up which on board should be 10 m / sec and higher. Such high speeds require significant training and mastering the rebound with maximum output in minimum part of time (Đurašković, 1997; Pavlović, 2010).

Table 1. Rating of participation of anthropological characteristics in relation to success in some jumping disciplines (Milanović et al. 1986)

Morphological characteristics	Long jump	High jump
Longitudinal dimensionality of the skeleton	+3	+5
Transverse dimensionality of the skeleton	+2	+3
Voluminousity and body mass	+3	+3
Subcutaneous adipose tissue	-2	-5
Motor skills		
Coordination	+3	+3
Accuracy	+3	+2
Balance	+3	+1
Flexibility	+3	+2
Speed of alternative movements	+4	+5
Static power	+4	+4
The explosive power of	+5	+5
Repetitive force	+4	+4
Cognitive abilities	+3	+3
Conative characteristics	+2	+2
Functional skills		
The range of the transport system for oxygen	+2	+2
The stability of the transport system for oxygen	+1	+1
Anaerobic Capacity	+4	+4

Within jumping disciplines can be observed some differences but also and similarities in terms of the morphological status of athlete jumping long jump, triple jump, high jump, pole vault. The existing differences and similarities between these disciplines are conditioned by the physical condition of athletes, technique of performing each of the disciplines, the influence of endogenous factors and so on. For these reasons, it is interesting to define the objective of this research which treats the problem of the morphological status finalists jumpers at the Olympic Games in Beijing in 2008. Where would on the basis of their parameters be possible to get a realistic picture of the morphological status and age structure of the finalists jumpers.

Materials and methods

The study encompassed a sample of 32 top athletes in four jumping disciplines (long jump, triple jump, hurdles, pole) that occurred in the finals of the Olympic Games in Beijing in 2008 year. Variables that were taken in the analysis are those that define the morphological space and the age structure of competitors: body height (AVIS-cm), body mass (AMAS-kg), body mass index (BMI) and age (GOD).

Results and discussion

In Tables 1-4 are shown the previously defined parameters of the final participants in the throwing events: age (years), body height in cm (AVIS), body mass in kg (AMAS) and Body Mass Index (BMI) based on which can be established differences between them.

Table 1. The parameters in the long jump jumpers

	AVIS	AMAS	GOD	**BMI**
Irving Saladino (P-AN)	176	70	25	22,65
Khotso Mokoena RSA	188	73	23	20,67
Ibrahim Camejo (CUB)	175	75	26	24,50
Ngonidzashe Makusha (ZIM)	169	71	21	24,91
Wilfredo Martinez (CUB)	180	83	23	25,61
Ndiss Kuba Badgj (SEN)	192	79	25	21,46
Luis Felipe Meliz (ESP)	182	76	29	22.96
Roman Novotny (CZE)	180	73	22	22,53
Average	180,25	75	24.25	23.16

The average age of the finalists in the long jump jumpers was about 24, 25 decimal years, where the youngest contestant was 21, N.Makusha from Zimbabwe (Table 1). The mean body height was 180.25 cm, with a min. score of 169cm (Makusha) and max. result 192cm (Badge). The mean body weight was 75kg, with min. result 70kg (Saladino) and max. score of 83kg (W.Martinez). Based on height and body mass mean BMI jumpers in the long jump was 23.16, with min. values of 20.67 and max. values of 25.61 (W.Martinez).

Table 2. Parameters of triple jump jumpers

	AVIS	AMAS	GOD	BMI
Nelson Evora (POR)	183	74	25	22,15
Phillips Idowu (GBR)	197	87	30	22,42
Leevan Sands (BAH)	191	82	27	22,52
Arnie Girat (CUB)	178	71	24	22,46
Marian Oprea (ROM)	191	86	26	23,62
Jadel Gregorio (BRA)	202	102	28	25,00
Onochie Ackike (GBR)	188	75	33	21,24
Viktor Kuznyetsov (UKR)	194	77	22	20,47
Averag	190.5	81.75	26.87	19.39

The average age of triple jump jumpers was 26.87 decimal years (Table 2) where the youngest participant was 22 years (V.Kuznyetsov). The mean body height was 190.5 cm, with a min. score of 178cm (A.Girat) and max. result 202cm (J.Gregorio). The mean body mass was 81.75 kg, with min. result of 71kg (A.Girat) and max. score of 102kg (J.Gregorio). This mean value of triple jump jumpers is the result of parameters of a competitor, Brazilian Gregory.

Based on height and body mass was determined the mean value BMI of 19.39 triple jumper with a min. values of 20.47 and max. value of 25.00.

Table 3. Parameters of jumpers in the high jump

	AVIS	AMAS	GOD	BMI
Andrey Silnov (RUS)	198	83	24	21,17
Germaine Mason (GBR)	170	70	25	24,73
Yaroslav Rybakov (RUS)	198	83	28	21,17
Stefan Holm (SWE)	181	71	32	21,71
Raul Spank (GER)	191	77	20	21,15
Jaroslav Baba (CZE)	199	84	24	21,21
Tomas Janku (CZE)	193	85	34	22,84
Tom Parsons (GBR)	192	78	24	21,19
Average	190.25	78.87	26.37	21.89

The age of athletes was on average 26.37 decimal years (Table 3). The youngest competitor from Germany R.Spark had 20 and the oldest Czech Tomas Janku 34 years. Their average height was 190.25 cm, (almost identical to the height of triple jump jumpers) with min. height of 170cm (G.Mason) and max. height 199cm (J.Baba). They had a weight of 78.87 kg, with a min. score of 71kg (S.Holm) and max. score of 85 (T. Iancu). Based on height and body mass was determined the mean BMI of jumpers in the air of 21.89, with min. 21,15 and max values of 24.73, which certainly differs from the arithmetic mean of all participants.

Table 4. Parameters of pole vault jumpers

	AVIS	AMAS	GOD	BMI
Steven Hooker (AUS)	188	85	26	24,07
Yevgeny Lukyanenko (RUS)	190	79	23	21,88
Denis Yurchenko (UKR)	175	75	30	24.50
Derek Miles (SAD)	191	86	36	23,62
Dmitry Staradubtsev (RUS)	183	75	22	22,45
Danny Ecker (GER)	192	82	31	22,28
Jarome Clavier (FRA)	185	70	25	20,46
Raphael Holzdeppe (GER)	181	79	19	24,15
Average	185.62	78.87	26.5	22.92

The average height of pole vault jumper of 2008 Olympic finalists was 185.62 cm with min. score of 175cm (D.Yurchenko) and max. score of 192cm (D. Ecker). (Table 4). Body weight in this athletic event is identical to the mean value of jumping in the air and it was 78.87 kg, with min.values of 70kg (J. Clavier) and max. values of 86kg (D. Miles). In terms of age structure it is almost identical to age of triple jump jumpers and on average amounted 26.5 decimal years, that is the youngest pole vault jumper was German competitor Raphael Holzdeppe age of 19, the oldest was U.S. athlete Derek Miles f 36 years and they are quite heterogeneous. The value of BMI jumper pole on the middle level was 22.92 (higher value of the triple jumpers and jump) and less than from a jumper in the long jump. The highest value recorded BMI pole vault jumper record the index of 24.50 and the lowest of 20.46. In diagram 1 are presented the mean values of body height (AVIS) in the jumping disciplines. Inspecting the numerical parameters can be concluded that triple jumpers and jumpers in the air had the highest bodies that is nearly uniform (Mean = 190.50 cm). In triple jumpers and jumpers in the air, we can say that is more needed and body height followed by increased limb length.

Of course, also the height of center of gravity of the body from ground, the actual way of performing the technique, where in addition to speed, flexibility, explosive strength is significant also the length of racing or jumping steps in the triple jump and also the high jump. Pole jumpers are on average slightly lower (AVIS = 185.62 cm). Height of the body as a parameter to the success of the jump pole segment is not as important as pole vault is a combined movement where the pole jumper uses a pole as a prop, and the result depends on his, primarily motor skills of speed, explosive strength, coordination, flexibility, balance and ability of competitor to transform the kinetic energy (running speed) into potential (movements after sticking pole into the box). The lowest level of the body height had long jumpers (Mean = 180.25 cm).

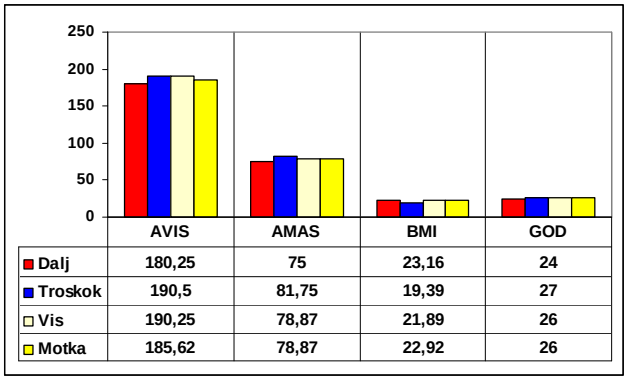

Diagram 1. Mean values of body measures in the jumping disciplines.

We can conclude that body height does not play an important role in the jumping disciplines. The result, in addition to technical performance largely depends on motor components, primarily on the speed and explosive strength (during acceleration and in time of reflection) and then from the coordination and flexibility (after reflection till landing) which in turn depends on which version is about (twisting or stepping). It is known that the long jump is cyclic-acyclic movement where the result depends on the speed, acceleration and initial velocity during rebound and the ratio is 2:1 in favor of speed, where the top jumpers in the running speed achieve over 10m / s, initial velocity in moment of rebound is over 8.5 m / s (Čoh, 2002; Pavlović, 2010). By the analysis of mean values of body mass (AMAS) in the jumping disciplines are observed maximum values of numerical parameters in triple jumpers (Mean = 81.75 kg). At the second position are the jumpers in the air and pole jumpers with identical average mass of 78.87 kg. The lowest body weight, on average, had long jumpers with 75kg. This order of jumpers on body weight was expected since increased body weight, from one aspect presents a disturbing factor in result success, especially in high jump where we have a large influence of gravity on the body, in a moment of rebound, which is trying to land the jumper to the ground. Looking from another perspective, a rebound in all jumps is done with one leg and is very hard to take a big weight on one leg, so the lower body weight is preferred.

In the pole vault increased body mass has a negative impact due to the limited strength and elasticity of the pole and its better effect at the time of stretching, when the body of jumper needs to be raised to a certain height, where a much better effect is manifested in jumpers with less weight, acting as a bow and arrow (body jumpers in relation to the bent pole) (Jovović, 2006; Pavlović, 2010). As for the numerical mean BMI of jumper finalists in the first place are the long jumper with the highest BMI values (Mean = 23.16), so it can be concluded from BMI that they had a lower body height relative to body mass and by the constitution correspond to athletics, and their result is mainly related to motor skills. Pole jumpers have achieved an average BMI (Mean = 22.92) from which comes the fact that they had a greater height in relation to body weight (in relation to long jumper). High jumpers recorded lower mean BMI (Mean = 21.89) which is also characteristic of jumpers in the air. As weakest ''' values of BMI were 19.39 in triple jumpers although by mean values of body weight they are in the first place as the'' heaviest with 81.75 kg, but this is the result of one bigger results of Brazilian Gregory (202cm: 102kg). As for the age structure (GOD) of the participants (Figure 1) long jumper were the youngest with an average of 24 years. In the second place are the jumpers in the air and pole jumpers from 26 years old and the oldest are triple jumpers with 27 years. All athletic jumps are cyclic-acyclic movements. They all start by running, that is by momentum, which belongs to the cyclic movement of rebound and after a rebound follows a flight as an acyclic movements. The distance and height of body depends on the initial velocity (Vo) and the takeoff angle (β). To achieve the ultimate sport performance, it is necessary to develop the maximum initial velocity (Vo) for takeoff of the body (momentum + power of rebound) and direct it under the most favorable angle (α) relative to the horizontal, where the main objective is to achieve the greatest possible length of the flight from the place of rebound (for remote jumps), that is as much as possible height of jump (jumps in height) in accordance with prescribed rules for that discipline (Branković, 1997; Jovović, 2006; Čoh, 2002; Pavlović, 2010; Raković & Stanković, 2011). In terms of technique, jumps share a common structure, and each jump can be divided into four main phases: run-up, reflection (rebound), flight and landing, where each of these phases has its own specific task that seeks realizing in the best possible way, in order to achieve as much as better results. This is particularly pronounced in the triple jump technique, where the jumper has to continuously perform three jumps associated with the change of the legs without compromising speed achieved during run up. These tasks are carried out successively, and the implementation of the previous task is a condition for the realization of the next. If we would like to generally describe the jumpers then we could indicate that the jumpers are with increased longitudinality and with appropriate less body weight. Of motor skills they possess good speed, explosive strength, flexibility, coordination, balance, accuracy. All these skills have a significant share in the jumping disciplines, except that in the long jumping is dominant speed, explosive strength, coordination and in high jumping also flexibility, balance and precision. Speed and explosive power are represented in run up and moment of rebound, while the coordination, flexibility, balance, accuracy, manifest at the time of flight, crossing the bar, range and the mere landing. For example in high jump is very important flexibility of the spine when crossing bar, and in pole vault also balance and precision, during the elements of pendulum swing, stretching, rebounding and crossing of the bar. Height of the jumpers can also vary depending on what discipline it is about. As the tallest are the high jumpers then triple jumpers. Considering that the height of body is not as significant a factor for the long jump and pole vault, it appears that these jumpers are of lower height compared to the previous two disciplines. When it comes to body weight, it can be concluded that it is disturbing factor in all jumping disciplines. It is somewhat greater in long jumpers than in the high jumpers, triple jumpers and pole vault jumpers. Higher values of body weight have a negative impact on flight phase because of a larger action of gravity on the jumper, and also due to greater expression of muscular force at the moment of rebound. Namely the rebound is done with one foot where the jumpers perform active down force 5-6 times larger than their body weight, which ranges from 350kg-500kg (Čoh, 2002) and it is very difficult to withstand that pressure on one leg (takes a very short time 0.12 to 0.16 ms), which is particularly manifested in triple jump and the first step after rebound. In the triple jump pelvis and spine suffer a heavy burden and if the body weight is increased successful technical performance would be lower and the risk of injury would be higher, although it is about top physical preparation of athletes. Long jump as a discipline is specific, because the speed is dominant result success, where the relationship between speed and power of rebound is 2:1 and often we say that good sprinter is a good rebounder and vice versa. Speed of run up achieved by jumpers ranges from 10.30 m / s to 11.50 m / s, and an initial velocity at the moment of rebound is slightly less, about 9.50 m / s (Čoh, 2002; Pavlović, 2010; Raković and Stanković, 2010). Long jumper are generally of strong relief musculature with powerful limbs, broad shoulders and long lower leg muscles, which act as levers of speed. These facts can be argued also by the results of this work on Olympic finalists in 2008. In addition to these observation it is known that athletic jumps belong to a group of ballistic motion in which in the space is catapulted the jumpers body through their own muscle strains or with the help of props (pole vault) in order to achieve as long as possible the length of jump. The jumps are initiated by activation of explosive muscle agonist, followed by their relaxation period, ending with a period of deceleration due to the effects of antagonist muscles or passive stretching of the connective tissue. Most researchers who have studied the research in the space morphologic

characteristics, agree that jumpers in relation to other athletes a greater amount of active body mass, and that by the Šeldons classification they are closest to athletics (long jump and pole) that is to leptosom (high jump, triple jump). (Milanović et al. 1986; Bowerman et al., 1998; Tončev, 2001; Čoh, 2001; Pavlović, 2010). Weight of jumpers ranges from 73-90kg, with isolated cases where the weight of individual participants was more than 95kg, while the average height is between 188-195 cm. The average height of the participants in final of OI ranged from 185.25 cm (long jump) to 190.50 cm (high jump). For all four disciplines the average height was 186.65 cm =AVIS. Their average weight ranged from 75kg (long jumpers) to 81.75 kg (triple jumpers) which is on average AMAS = 78.62 kg. Long jumpers had the lowest body weight but the highest average BMI, precisely because they had a lower height relative to body weight alone and fully they correspond to athletics so that these variables of morphological space do not appear as significant predictors. Finalists in the triple jump had the highest weight abut the smallest value of BMI, because in this discipline is dominant speed, explosive strength, coordination and effectiveness of connecting of continuous rebounds as well as technical performance. Here is the mass disturbing factor precisely because of the way of performing and pressure which body suffers in the phase of jumps. From energy capacity alactate-anaerobic emergent are consumed. BMI values are also very homogeneous and low, they were within the range of 19.39 in triple jumpers to 23.16 in the long jumpers. The mean BMI was 21.84. The low values of BMI in jumpers are expected considering the technique of performing the discipline and the importance of body mass in performance which is characterized as a negative factor. It is very important to note that categorization on the basis of BMI in these athletic disciplines is very reliable because it is a category of athletes to which body weight is not a ballast (but mass of muscles and bones), but assists in performing of motor task. If we categorize the finalists in Beijing by BMI then the triple jumpers would be in the category of sub-optimal weight (BMI = 19.39) and long jumpers, high and pole vault jumpers would be in category of normal weight, BMI = 21-25 (Wilmore et all.1986). Average age was 25.75 decimal years, where the youngest jumpers were long jumpers (average 24 years.) and the oldest triple jumpers (27).. The result in the jumping disciplines beside morphological dimensions (height, weight, BMI) is defined by the run up speed, rebound impulse and by limbs swing (Stefanović, 1992; Tončev, 2001; Jovović, 2006, Pavlović, 2010). To achieve high speed of motion TT in the vertical direction and thereby increase the elevation angle, jumper affects the surface with great powers in the phase of front resistance, while the force of ground reaction is directed dorsally and acts in the opposite direction from the direction of run up. In the long jump, the impulse of front supporting is much larger from the moment of last supporting which is negligible.

That's why is the speed of the jumpers body center of the gravity significantly lower after the rebound than before the rebound so that the speed of TT's top jumpers in the run up start reaches 11 m / s and the initial flight speed is below 10m/s. The effectiveness of the technique depends on the art of jumper to perform a lot of pressure on the track at low stretching of leg, especially in the last step, which provides the required jump height and horizontal motion of the body (Čoh, 2002). This top jumpers develop pressure force on a board about 350kg, women 300 kg depending on their weight. As a result, the rebound leg is slightly bent at knee (β=175º-178º) and in hip joint (γ=165º-170º), and there is also partially present bending in the joints of the spinal column. This all causes the eccentric character of work (Stefanović, 1992; Pavlović, 2010; Idrizović, 2011), where intentional loosening in the knee joint is performed in order to use force of mm. quadriceps femoris to the extent that foot could withstand the pressure, because it is not possible to avoid the torque moment of component of pressure in relation to the knee joint. To neutralise the effect of this moment, that is to achieve rebound it is necessary that product of muscle force (Q) and its branch (r- is a constant) is equal to or to be more than the product of pressure force (R) and its branche (k). The current top jumpers in the moment of rebound have less flexion of the knee joint, but a stronger quadriceps force (Jarić, 1997; Jovović, 2006; Pavlović, 2010). Because rebound is vertically directed and run up in the horizontal direction then in long jump we have two different angles. One is closed by the run up direction and rebound (β) and is called, rebound (the local) angle. The other is closed by the resultant of both components and by the horizontal of surface (TT-a path about 1 m above ground) and is called the elevation angle (α). The effect of horizontal and vertical components directs the body so that the elevation angle may be between 18 º - 26 º (Jovović, 2006; Jarić, 1997). This means that by the reduction of the angle (β) increases the movement resultant (R) which reduces the elevation angle (α). Bearing this in mind, a rebound in the long jump is to be executed at top speed to the ultimate limits only after the moment of the vertical. It all depends on the constitution of jumper and his technical level.

Conclusion

Based on the results of morphological space study of the finalists in the jumping disciplines at the Olympic Games in Beijing in 2008 the following can be concluded: Among all the finalists - triple jumpers had the highest body height (Mean=190.50cm). Almost identical values can be attributed to the jumpers in the air (Mean=190.25cm) and pole jumpers, Mean=185.62cm and the lowest height had the long jumpers Mean=180.25cm. The analysis of body mass of finalists can be concluded that the greatest mass had triple jumpers (Mean=81.75kg), but this high value is a consequence of one result, of Brazilian Gregory.

The second position takes the high jumpers and pole vault jumpers with the same body mass of 78.87 kg, and as the lightest are the long jumper with an average weight of 75kg. Inspecting the values of BMI finalists, one can conclude that the maximum value are in the long jumpers (BMI=23.16). At the second position are the pole jumpers (BMI=22.92), followed by jumpers in the air (BMI = 21.89). The minimum values BMI recorded triple jumpers (BMI = 19.39). by the analysis of age structure of the finalists it can be concluded that triple were the oldest with an average of 27 years.

Pole jumpers and high jumpers are of the same age (jumpers in the air with an average of 26.4 years, pole jumpers, with an average of 26.5 years). As the youngest participants finalists in the jumping disciplines are long jumpers with an average 24 years. This order is expected, perhaps a little surprising, because triple jumpers are those who have a little more weight than expected. All the jumping disciplines in its technique have the participation of speed and explosive strength, which decreases with age (Nićin, 2000), and here we have just such an example of the age structure of participants and their age at the time of OI's.

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MORFOLOŠKI STATUS FINALISTA U SKAKAČKIM DISCIPLINAMA NA OLIMPIJSKIM IGRAMA U BEIJINGU

Sažetak

Morphological characteristics of the athlete represents his identification card on the base that can be classified as a constitutional type, and also to get information about his body height, body weight, BMI, and even analyze and age. Different constitutional types present in the sport and are important in terms of routing, selection and pursuit of a particular sport. This is expressed especially in athletic sports in the athletics where we have a number of different constitutional types of athletes that requires Discipline. This paper analyzes the morphological status of the finalists in the jumping events at the Olympic Games in Beijing 2008. The survey includes 32 athletes who competed in the finals and the measured variables to assess the morphological status: body height (AVIS), body mass (AMAS), body mass index (BMI), age of the competitor (GOD). Applying basic statistical parameters was performed descriptive analysis of variables applied to the athletes that were made based on the conclusions.

Key words: *morphological status, athletes, jumping disciplines*

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EFFECTS OF AQUATIC PROGRAMS IN CHILDREN AND ADOLESCENTS WITH CEREBRAL PALSY: SYSTEMATIC REVIEW

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Review paper

Abstract
Cerebral palsy is the most common cause of serious physical disability in childhood. Inadequate physical fitness is one of the major problems in children with cerebral palsy. Various aquatic activities and exercises can improve fitness levels in children with cerebral palsy. The aim of this paper is the analysis of the studies published from 1990 to 2011, which investigate the effects of aquatic programs in children and adolescents with cerebral palsy. The following research databases have been googled: PubMed, Web of Science, PEDro and Google Scholar. The criteria for acceptance the papers have been as follows: the examinees were children and adolescents with cerebral palsy, the experimental programme was a longitudinal study which involved aquatic exercise programme and the papers were published in English. On the basis of the search databases and the criteria, 13 papers were included in the analysis. The analysis of applied aquatic programs in the analyzed studies indicate that they can have positive effects and impact on improving physical fitness and social behavior in people with CP. Aquatic programs have consisted of different aquatic exercise and aqutaic activities, whereas swimming was the most common. Optimal duration of aquatic programs should have been at least 10 weeks, with a frequency as high as three times per week, and a 45-minute single session. A small number of collected papers should be a subject of the further research in terms of aquatic activities, aquatic exercise and cerebral palsy.

Keywords*: aquatic activities, influence, effect, physical fitness, cerebral palsy*

Introduction

There are many different definitions of cerebral palsy (CP). One of the latest and the most comprehensive was given by the Executive committee in 2006. According to it, the definition of cerebral palsy is as follows: "Cerebral palsy (CP) describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to nonprogressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication, and behavior, by epilepsy, and by secondary musculoskeletal problems "(Rosenbaum, Paneth, Leviton, Goldstein, & Bax, 2007). According to the Surveillance of Cerebral Palsy in Europe, if CP affects between 2 and 3 per 1000 live births, it is thought to be the most common cause of serious physical disability in childhood (Cans, 2000).

According to Porretta (2005), there are three main types of CP: spasticity, athetosis and ataxia. CP has also been classified according to topographical distribution of the affected extremities: monoplegia, diplegia, triplegia, hemiplegia and quadriplegia (Lockette & Keyes, 1994). According to Lockette et al. (1994), crebral palsy falls into the category of dynamic disabilities. In the treatment of children with cerebral palsy different methods are used, including hidrokinesitherapy (Dimitrijević, Bjelaković, Lazović, Stanković, Čolović et al., 2012).

Early diagnosis and therapy are very important for the rehabilitation process of children with cerebral palsy (Dimitrijevic & Jacob, 2005). Major problem affecting the function and health of children with cerebral palsy is inadequate physical fitness. Development of secondary conditions associated with CP such as chronic pain, fatigue, and osteoporosis may be contributed by lack of optimal physical activity (Fowler et al., 2007). According to Kelly & Darah (2005), aquatic exercise can be used for the improvement of the level of fitness among children with cerebral palsy. The potential benefits of adaptive aquatic programs include the increase in cardiorespiratory endurance, strength, coordination and the improvement in swimming skills (Fragala-Pinkham et al., 2010). Buoyancy is one of the physical properties of water which provides postural support and reduces loading on unstable joints to allow children with CP to move independlently (Kelly et al., 2005). Bouyancy is a force which can assist, resist and support movement in water (Irion, 2009). Unrestrained movement and the ability to use muscles which have trouble overcoming gravitational constraints are the primary reasons why swimming and any related aquatic activities are suitable for individuals with a wide range of physically disabling conditions which include amputation, cerebral palsy and even paraplegia (Prins, 2009). Aquatic activities also enhance breath control and improve the functions of cardiorespiratory sistema.

Also, when a person with physical disability learns to move and swim without help of others, he seems to improve his self-esteem and self-awareness (Lepore, 2005). Water actually represents a medium in which everyone can take part in recreational and therapeutic activities, irrespective of their age (Daly & Lambeck, 2007). *The aim* of this paper is the analysis of the studies published from 1990 to 2011, which investigate the effects of aquatic programs in children and adolescents with cerebral palsy.

Methods

Literature search

In order to collect the papers for the research of the effets and impacts of various aquatic programs on people with cerebral palsy, the following databases have been used: PubMed, Web of Science, PEDro and Google Scholar. The studies in the period between 1990 and 2011 were included. Key words in the search were "cerebral paralysis" combined with aquatic, swimming and water exercise. The titles of the research, the abstracts and the full texts were read and analyzed by two independent reviewers. In order to accept the study for final analysis, three criteria had to be met: the subjects should have been the children and the adolescents with cerebral palsy, the experimental programme should have been a longitudinal study with an aquatic exercise programme, and the papers should have been published in English.

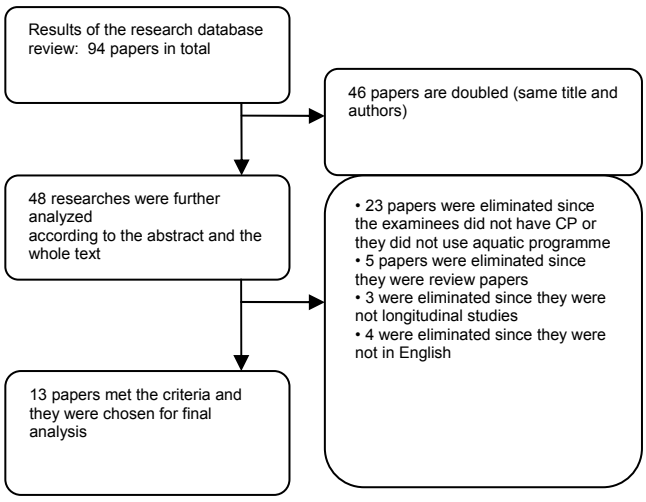

Figure 1. Flow of data retrieval procedure

Teorethical approach to the problem

Descriptive method and theoretical analysis were used to analyze the collected research. According to the selected keywords, the initial study involved 94 paper. Out of 94 papers, 46 were eliminated because those were the papers repeated in the search engine results, according to the chosen keywords. The remaining 48 studies were analyzed on the basis of abstracts and full text. Out of 48 studies, 23 were eliminated because the subjects were not people people with cerebral palsy or they did not use the aquatic exercise programme. 5 papers were eliminated because they were review papers. 3 papers were eliminated because the research was not a longitudinal study. During the further study, 4 papers were eliminated since they were not written in English. The final number of the paper which satisfied the criteria was 13 papers. The selected paper were further analyzed. The analysis procedure and elimination are presented in the Figure 1.

Results with discussion

Based on the review of research databases, 13 papers (studies) were chosen for further analysis since they involved longitudinal studies, aquatic exercise programme and children and adolescents with cerebral palsy. Out of 13 selected researches, 10 have been published since 2005. This indicates an increasing interest to scientifically prove the results of application of aquatic programs in children with cerebral palsy, in the last decade (or more precisely since 2005). The results of the systematic review are corresponding to the results obtained from Getz, Hutzler, & Vermeer (2006). They selected 5 papers from the research database to study the aquatic intervention in children with CP, in the period from 1966 to 2005. The results of the analysis of 13 studies that met the established criteria are presented in Tables 1 and Table 2. Table 1 shows the following parameters: the reference (the first author and year of publication), the sample of respondents (sample size, age range, type of cerebral palsy, involvement of body parts, GMFCS level), experimental treatment (number of groups, length of programme, duration of each session, weekly frequency). In Table 2, the following parameters have been shown: the reference (the first author and year of publication), a brief description of aquatic activities, outcomes and results. A total of 216 examinees with celebral palsy were included in this study. The largest number of examinees in the survey was 46 (Hutzler, Chacha, Bergman, & Szeinberg, 1998a; Hutzler, Chacha, Bergman, & Rechez, 1998b). In other studies, the number of examinees did not exceed 23, while the lowest number of subjects in the survey was one (Retarekar, Fragala-Pinkham, & Townsend, 2009). It can be concluded that the small number of examinees in the research is in prevailence with CP, which is 2 children with CP per 1000 live births (Cock, 2009). According to the ACSM, the subjects in the analyzed studies belonged to childhood and adolescence stages (ACSM, 2006). The youngest examinees were children aged 3 years and 8 months, and children aged 6 (Getz, Hutzler, & Vermeer, 2007). The oldest examinees were between 14 and 21 (Ballaz, Plamondon, & Lemay, 2010). When it comes to the age of the examinees, the studies by Hutzler et al. (1998a, 1998b), Getz et al. (2007) and Retarekar, et al. (2009) proved that the aquatic programs can be applied in young children with CP aged 3 years and 8 months, to 7 years of age. In nine studies, the subjects had only a spastic type of CP. In addition to the spastic type of CP, the examinees had ataxia and athetosis in two studies (Hutzler et al., 1998a, 1998b).

In the study by Aidar et al. (2008), the subjects suffered from athetosis and spastic type of CP. In the research by (Ozer et al., 2007), the examinees had spastic and mixed type of CP. Spastic CP was the most common among the subjects involved in the research. This was expected, since the most of children had spastic type of cp (Dimitrijević, Stanković, Živković, Mikov, Čolović et al., 2007). According to Lockette, about 70% of people with CP have spatic type of cerebral palsy (Lockette et al., 1994). According to the topographic classification, the most frequent were diplegia, hemiplegia and quadriplegia. Aidar et al. (2008) did not provide the data about which body parts were affected in cerebral palsy. GMFCS level of the subjects was shown in seven researches. In six studies, GMFCS level was I, II and III, whereas in one study (Ballaz et al., 2010) the subjects had a GMFCS level from I to IV. The lack of the remaining six studies is the fact that there were no information about GMFCS level, which could help us determine the impact of the aquatic exercise programme on functional abilities of children with CP, as well as their need for assistive technology (Palisano et al., 1997). Experimental research programme lasted from 6 weeks to 8 months (Fragala-Pinkham, Dunaz, Barlow, & Pasternak, 2009) knowing that there were two different examinees. In four studies, the experimental programme lasted for 10 weeks (Dorval, Tetreault, & Caron, 1996; Thorpe, Reilly, & Case, 2005; Chrysagis, Douka, Nikopoulos, Apostolopoulou, & Koutsouki, 2010; Ballaz et al., 2010;). A 14-week experimental programme was used in three studies (Ozer et al., 2007, Fragala-Pinkham, Haley, & O'Neil, 2008; Fragala-Pinkham, Haley, & O'Neil, 2010;). Retarekar et al. (2009) included 12-week experimental programme, while Aidar et al. (2006) described 16-week programme. In the studies by Hutzler et al. (1998a, 1998b), the experimental research programme lasted for 6 months. A 4-month experimental programme was used in the study by Getz et al. (2007). Duration of aquatic programme in the analyzed studies was usually between 10 and 14 weeks, which can be an optimal time needed for adaptation in order to achieve certain changes in the body after training loads or aquatic activities and exercise. Minimum duration of each aquatic session was 30 minutes in four experimental programs (Hutzler et al., 1998a, 1998b; Ozer et al., 2007; Getz et al., 2007), while maximum duration was 60 minutes (Fragala-Pinkham et al., 2009). In 6 researches, duration of each aquatic session was 45 minutes (Thorpe et al., 2005; Aidar et al., 2007; Fragala-Pinkham et al., 2008; Chrysagis et al., 2009; Fragala-Pinkham et al., 2010; Ballaz et al., 2010;). In the research done by Retarekar et al. (2009), duration of an individual training was 40-50 minutes, and in the research by Dorval et al. (1996) it was 55 minutes. Weekly frequency of exercise was between once a week to three times a week. Three times a week frequency of exercise was in five studies (Hutzler et al., 1998a; Thorpe et al., 2005; Hutzler 1998b; Ozer et al., 2007; Retarekar et al., 2009;). In 6 studies, the frequency of exercise was twice a week (Getz et al., 2007; Aidar et al., 2007; Fragala-Pinkham et al., 2008; Chrysagis et al., 2009; Fragala-Pinkham et al., 2010; Ballaz et al., 2010;). Dorval et al. (1996) explained once a week experimental research programme. Fragala-Pinkham et al. (2009) described two exercise programs, with a twice-per-week frequency. It shows that the most frequent and the most optimal duration of a session of aquatic programme is about 45 minutes, whereas most optimal frequency is twice-a-week and three-times-a-week. Such frequency of exercise is recommended in cases of development and increasing muscle strenght in person with celebral palsy (Laskin, 2003). Also, twice-a-week and three-times-a-week frequency of exercise is recomended for strenght and power development in healthy schildren and adolescents (Faigenbaum et al., 2009). When it comes to the development of aerobic capacity and endurance in children with CP, frequency of exercise should be at leat five times a week (Laskin, 2003). The largest number of groups in the research was two (one experimental and one control group). Two groups of the subjects were included in six studies (Dorval et al., 1996; Hutzler et al., 1998a, 1998b; Getz et al., 2007, Ozer et al., 2007; Chrysagis et al., 2009;). In five studies, the experimental treatment was performed on a single experimental group without a control group (Thorpe et al., 2005; Aidar et al., 2007; Fragala-Pinkham et al., 2008; Fragala-Pinkham et al., 2010; Ballaz et al., 2010;). In one study, there was a single subject design (Retarekar et al., 2009). In the study by Fragala-Pinkham et al. (2009), there was a case study of four subjects, out of whom two children had CP. The analysis of the groups in an experimental programme shows that the control group was present in six studies (out of total thirteen studies). In the remaining seven studies, there was no control group which can be disadvantageous in terms of the results in applied aquatic programs. In four studies (Dorval et al., 1996, Thorpe et al., 2005, Ozer et al., 2007; Retarekar et al., 2009), ABA design was used, which means that the results were monitored in the follow up period after completing the exercise programme. In the analyzed researches, different aquatic programs of exercise have been applied; they involved aquatic activities, aquatic exercise and swimming. Ozer et al. (2007), Chrysagis et al. (2009) used swimming as an exercise programme.

Ballaz et al. (2010) used mainly swimming and aquatic activities like water polo and water volleyball. Dorval et al. (1996) used the aquatic programme which implied swimming and aquatic games in a control group, while an experimental group had a programme designed to raise self-esteem and functional independence. Hutzler et al. (1998a, 1998b) used the aquatic exercise which included water orientation skills. Getz et al. (2007) used Halliwick method which can be a successful swimming programme and therapy in people with disabilities, according to Grosse & Lambeck (2004). Thorpe et al. (2005) used the aquatic exercise for stretching and strengthening mucles of lower extremity, and aquatic activities like water walking, deep-water running and water treading.

Table 1. Review of researches and conditions

Reference	The sample of examinees					Experimental programme			
	No	Age range	Type CP	Topographical type of CP	GMFCS level	No groups	Duration	Duration of each lesson	Weekly frequency
Fragala-Pinkham et al. (2010)	16 (2 sa cp)	7 and 10	spastic	diplegia, hemiplegia	n	1.E	14 weeks	45 min	2*weeks
Ballaz et al. (2010)	12	14-21	spastic	diplegia, hemiplegia, quadriplegia	I, II, III, IV	1.E	10 weeks	45 min	2*weeks
Fragala-Pinkham et al. (2009)	4 (2 sa cp)	7 and 10	spastic	FC:diplegia, SC:hemiplegia	I	CS	FC:6 weeks SC: 8 months	60 min	FC:2 *weeks SC:1 *week
Chrysagis et al. (2009)	12	13-20	spastic	diplegia, tetraplegia	n	1. E 1. C	10 weeks	around 45 min	2*weeks
Retarekar et al. (2009)	1	5	spastic	diplegia	III	SSD	12 weeks	40 -50 min	3*weeks
Fragala-Pinkham et al. (2008)	16 (2 sa cp)	7 and 10	spastic	diplegia, hemiplegia	I, II	1. E	14 weeks	oko 45 min	2*weeks
Aidar et al. (2008)	21	6.3-12.7	spastic, athetosis	n	n		16 weeks	45 min	2*weeks
Getz et al. (2007)	22	3.8-6	spastic	diplegia	I, II, III	1.E, 1.C	4 months	30 min	2*weeks
Ozer et al. (2007)	23	5-10	spastic, mixed	tetraplegia, diplegia, hemiplegia, triplegia.		1.E, 1.C	14 weeks	30 min	3*weeks
Thorpe et al. (2005)	7	7-13	spastic	diplegia, hemiplegia	I, II, III	1.E	10 weeks	45 min	3*weeks
Hutzler et al. (1998a)	46	5-7	spastic, ataxia/ athetosis	diplegia, hemiplegia, quadriplegia	n	1.E, 1.C	6 months	30 min	2*weeks in pool and 1*week in a gym
Hutzler et al. (1998b)	46	5-7	spastic, ataxia/ athetosis	diplegia, hemiplegia, quadriplegia	n	1.E, 1.C	6 months	30 min	2*weeks in pool and 1*week in a gym
Dorval et al. (1996)	20	10.2-17.3	n	diplegia, hemiplegia, quadriplegia, triplegia	n	1.E, 1.C	10 weeks	55 min	1*week
FC-frst child; SC- second child; SSD- single subject design; CS- case study; 1E- one experimental group; 1C- one control group; n-not given in the research									

Table 2. Review of outcomes and results

Reference	Description of the applied aquatic programa	Outcomes	Results
Fragala-Pinkham et al. (2010)	Swimming, running, jumping, different games, strength exercise in water with barbells, aquatic noodles, and water resistance.	SCS, PEQ, PAQ	Sig. ↑ SCS (p< .0001). Improvement in PEQ and PAQ.
Ballaz et al. (2010)	Swimming, water polo or water volleyball.	Gait analysis, EEI, Isometric strength, GMFM (D, E)	Sig.↑ in reduction EEI (p=0.007). In gait analysis Sig.↑ in opposite foot off and foot off variables (p=0.005) and (p=0.029). Sig.↑ in GMFM (E) subgroup of children with III and IV GMFCS (p=0.041).
Fragala-Pinkham et al. (2009)	Swimming, running, kickboard kicking, hip knee and ankle strength exercise, balance, gait exercise.	COPM, GMFM-66, PEDI (FS, CA), 3-min walk, EEI, OGS, FRT, FTS, MMT, isometric muscle strength, PROM	FC and SC made improvements in all of them measures
Chrysagis et al. (2009)	Swimming (back stroke and crawl stroke)	GMFM (D,E), ROM, MAS	Sig. ↑ in ROM: active range of motion of the shoulder (p=0.05), and pasive range of motion of the hip abduction and knee exstension (p=0.01 and p=0.04). Sig.↑ in MAS in reduction spasticity of the hip adductors (p= 0.002) and knee flexors (p= 0.049).
Retarekar et al. (2009)	Aerobic aquatic programme consist of: swimming, treadmill walking, shutlle running, running, jumping, deep water running, creeping and kicking.	COPM, GMFM-66, 6-Minute Walk Test, MEEI, PAQ	Sig.↑ in GMFM-66 test for 2.71 point. Improvement in 6-Minute Walk Test, by increased walking speed by 9 m/min and walking distance by 56 m. Sig.↑ in MEEI. Improvements in the COPM.

Fragala-Pinkham et al. (2008)	Swimming, running, jumping, different games, strength exercise in water with barbells, aquatic noodles, and water resistance.	Half-mile walk/run, peak isometric muscle strength, modified curl-up, PEDI (FS), FTS	Sig. ↑ only in half-mile walk/run (p=0.03).
Aidar et al. (2008)	Programme comprised of aquatic exercise	APP, PEDI (SF)	Sig.↑ in PEDI (SF) p=0.05 Sig.↑ in APP p=0.05).
Getz et al. (2007)	Halliwick method.	PS, PEDI (CA, SF), AIM	Sig.↑ AIM (p<0.003). Sig. differences were found between the groups in social acceptance of PS (p<0.035). Sig.↑ in PEDI (CA) (p<0.003).
Ozer et al. (2007)	Bobath treatment in both groups. E group also performed swimming exercise in line with Sport Skills Assessment.	Body Awareness, CBCL	Sig.↑ in Body Awarness in E group in comparison to C group.
Thorpe et al. (2005)	Aquatic exercise for stretching and strengthening mucles of lower extremity. Aquatic activities: water walking, deep water running, treading water.	lower extremity muscle strength, gait velocity, TUG, GMFM (D,E), EEI, FRT, SPSCA	Sig.↑ in GMFM (E) (p=0.01), increasing results for 7% after the applied programme and added 11% after the follow up period. Improvement in GMFM (D) was 8%. Sig.↑ in TUG (p=0.00). Improvement in gait velocity was near sig.↑ (p=0.07).
Hutzler et al. (1998a)	Aquatic exercise consisting of water orientation skills. Exercise on land (locomotion and ball-handling skill)	VC, WOC	Sig.↑ in VC for 65.1% (p=0.009). Sig.↑ in WOC (p=0.001) and it was 33.4%.
Hutzler et al. (1998b)	Aquatic exercise consisting of water orientation skills. Exercise on land (locomotion and ball-handling skill)	WOC, Matrinek-Zaickowsly SCS	Sig.↑ in WOC (p=0.001).
Dorval et al. (1996)	Swimming and aquatic games in C group. Aquatic program with 10 different structured and stimulating aquatic sessions namenjen poboljšanju self-esteem and functional independence in E group.	LAI, Rosenbergs SEC, WeeFim	Sig.↑ in Rosenbergs SEC and WeeFim.

E group- experimental group; C group- control group; VC-vitalni kapacitet; WOC-water orientation checklist; Matrinek-Zaickowsly SCS-self concept scale; LAI-Leisure's activity Inventory; Rosenbergs SEC -Self-Esteem Scale; WeeFim-Functional independence Measure for Children; PEQ-Program Evaluation Questionnaire; PAQ- Physical Activity Questionnaire; SCS- Swimming Classification Scale; FTS -Floor to Stand; COPM- Canadian Occupational Performance Measure; GMFM-66- Gross Motor Function Measure; PEDI (FS, CA, SF) Pediatric Evaluation of Disability Inventory (functional skills, caregiver assistance, social function); EEI-Energy Expenditure Index; OGS-Observational Gait Scale; FRT- Functional Reach Test; MMT- manual muscle testing; PROM- passive range of motion; TUG- Timed Up and Go test; GMFM (D,E)- Gross Motor Function Measure (dimension D and E); SPSCA-Self Perception Scale for Children and the Self Perception Scale for Adolescent; ROM- Range of motion pasive and active; MAS-modified Ashworth Scale; MEEI-Modified Energy Expenditure Index; PS-Pictorial Scale of Perceived Competence and Social Acceptance for Children with Cerebral Palsy; AIM-Aquatic Independence Measure; APP-Ability- paper and pencil; CBCL- Child Behaviour Check List (parent and teacher form)

Retarekar et al. (2009) used aquatic programme of aerobic intervention which involved swimming, treadmill walking, shutlle running, running, jumping, deep-water running, creeping and kicking. Fragala-Pinkham et al. (2008) and Fragala-Pinkham et al. (2010) used aquatic programme designed for increasing aerobic endurance, strength and flexibility. Their programme involved swimming, running, jumping, different games, strength increase exercises and flexibility of leg and arm muscles. Fragala-Pinkham et al. (2009) used swimming, running, kickboard kicking, hip knee and ankle strength exercise, balance, gait exercise and cardiorespiratory endurance. The greatest number of various aquatic activities was used in experimental programs (Thorpe et al., 2005; Fragala-Pinkham et al., 2009; Fragala-Pinkham et al., 2008; Retarekar et al., 2009; Fragala-Pinkham et al., 2010). Taking into account all analyzed studies, we can see that swimming was the most common form of activity and exercise in the water. The aquatic exercise programs used in the analyzed studies were aimed at increasing the gross motor function and functional mobility, various motor and functional abilities. Different outcomes were used accordingly. The outcomes used in the analyzed studies measure the changes in the dimensions according to International Classification of Functioning, Disability and Health for Children and Youth (ICF-CY), World Health Organization (2007). It is in line with ICF which suggested that an individual should be observed in a multidimensional context not only from a medical perspective (Getz, Hutzler, & Vermeer, 2006). GMFM test for gross motor function for children with celebral palsy is used five studies (Thorpe et al., 2005; Fragala-Pinkham et al., 2009; Chrysagis et al., 2009; Retarekar et al., 2009; Ballaz et al., 2010). Apart from GMFM test for asessment of gross motor function and functional ability, PEDI test - Functional Skills (FS) domain (Fragala-Pinkham et al., 2008; Fragala-Pinkham et al., 2009). WeeFim test was used to measure functional independence in children (Dorval et al., 1996).

The tests with dynamometer for measuring isometric strenght were used in four studies (Thorpe et al., 2005; Fragala-Pinkham et al., 2008; Fragala-Pinkham et al., 2009; Ballaz et al., 2010). To measure energy efficiency, or efficiency of movement, the tests EEI and MEEI were used; the tests of 3, 5 and 6 minute walk were used in four researches: (Thorpe et al., 2005; Retarekar et al., 2009; Fragala-Pinkham 2009; Ballaz et al., 2010). Hutzler et al. (1998a) measured vital capacity. The tests of passive and active range of motion with goniometer were used to measure flexibility and movements (Fragala-Pinkham et al., 2009; Chrysagis et al., 2009). Apart from these tests for measuring motor and functional abilities of children with CP, the following tests were used: FRT, FTS, MMT, TUG, half-mile walk/run, modificate curl-up and gait velocity. Changes in the walking parameters were measured by Gait analisys (Ballaz et al., 2010). Ashworth Scale for spasticity was used to determine spasticity (Chrysagis et al., 2009).In three studies, swimming skills or movement and function skills in water were tested by AIM, WOC, SCS (Hutzler et al., 1998a,1998b; Getz et al., 2007; Fragala-Pinkham et al., 2010). Apart from the impact on functional mobility and motor status, the effects of the applied aquatic programs aimed at improving social function of people with cerebral palsy and raising their self-esteem and frequency of physical activity have also been examined. Social function was determined using the social function (SF) domain of PEDI (Aidar et al., 2007, Getz et al., 2007). To assess the changes in self-esteem, Rosenbergs SEC was used in the research by Dorval et al. (1996). Matrinek Zaickowsly self-concept scale was used in the study by Hutzler et al. (1998b). PAQ was used to determine the frequency of physical activity in children with cerebral palsy (Retarekar et al., 2009; Fragala-Pinkham et al., 2010). To determine the perception and parental perceptions of physical and social competences of children with cerebral palsy, the following tests were used: COPM tests (Retarekar et al., 2009; Fragala-Pinkham et al., 2009), SPPA and SPPC tets (Thorpe et al., 2005) and Pictorial Scale of Perceived Competence and Social Acceptance for Children with Cerebral Palsy (Getz et al., 2007). Knowing all outcome measures analyzed in the analyzed researches, the tests which were used most often were: GMFM and EEI tests, isometric muscle strength tests, the tests with goniometer for measuring range of motion, TUG, PAQ, PEDI and COPM. There was a statistically significant improvement in rough motor function measured by GMFM-66 test (Retarekar et al., 2009). Thorpe et al. (2005) found a statistically significant improvement in dimension E of GMFM test, but not in dimension D. Ballaz et al. (2010) found statistically significant improvement in GMFM dimension E of the test only in subgroups of children with GMFCS III and IV level. Fragala-Pinkham et al. (2009) found that the improvements in GMFM-66 and PEDI exceeded both the minimal detectable change (MDC) and minimal important difference (MID). Fragala-Pinkham et al. (2008) found no statistically significant change in the results of the PEDI (FS) domain, while Chrysagis et al. (2009) found no statistically significant change in the GMFM test results. Statistically significant reduction in EEI, and therefore improvement in walking efficiency was obtained in the study by Ballaz et al. (2010). Retarekar et al. (2009) also found improvement in walking efficiency using MEEI. In the study by Fragala-Pinkham et al. (2009), there were positive changes in EEI, which exceeded MDC and MID. In the study by Thorpe et al. (2005), there were no significant statistic changes in EEI. Statistically significant improvement in cardio-respiratory endurance measured by half-mile walk / run test was achieved in the research by Hutzler et al. (1998a, 1998b). Fragala-Pinkham et al. (2008) found a statistically significant increase in vital capacity. Ballaz et al. (2010) used gait analysis to find a statistically significant improvement in the variables opposite foot off and foot off. When it comes to flexibility, or range of motion, Chrysagis et al. (2009) found statistically significant improvement in active shoulder flexion and abduction and the passive hip abduction and knee extension. Fragala-Pinkham et al. (2009) also found positive changes in the passive ROM. In the study by Fragala-Pinkham et al. (2009), there was an increase in peak isometric strength, while Thorpe et al. (2005), Fragala-Pinkham et al. (2008) did not find statistically significant change in isometric strength and modifica curl-up. Thorpe et al. (2005) found a statistically significant change in the results of the TUG test which contains the elements of strength, balance and gait. In four researches, the applied programs have led to a statistically significant improvement in swimming skills measured by tests of WOC (Hutzler et al., 1998a, 1998b), AIM (Getz et al., 2007) and SCS (Fragala-Pinkham et al., 2010). Positive impact of the aquatic programs on increased swimming skills in children with cerebral palsy was confirmed in the study by Jorgić, Alexandrovich, Okičić & Madić (2010). When it comes to social function of children with cerebral palsy, Aidar et al. (2007) found statistically significant improvement in PEDI social function - (SF) domain. Dorval et al. (1996) comfirmed a statistically significant improvement in self-esteem of children in both groups, on the basis of the scores of SEC Rosenbergs, as well as the increase of functional independence by the test WeeFim. The frequency of physical activities increased in the researches (Retarekar et al., 2009; Fragala-Pinkham et al., 2010). This was confirmed by the tests in Physical Activity Questionnaire (PAQ). Retarekar et al. (2009), Fragala-Pinkham et al. (2009) found statistically significant scores of Canadian Occupational Performance Measure (COPM) test. The tests used in the research (Hutzler et al., 1998b; Thorpe et al., 2005, Getz et al., 2007) did not show statistically significant changes in the perception of physical and social competences. The analysis of the obtained results in the surveys indicated that the applied aquatic programs had various effects in terms of statistically significant improvement in measured outcomes among children and adolescents with CP.

Conclusion

The analysis of the aquatic programs shows that they can have positive effects on improving physical fitness and social behavior in children and adolescents with CP. In people with cerebral palsy, a variety of aquatic activities and exercises can be used. Safety is extremely important while practicing, since those activities are carried out in an aqueous environment. Swimming is the most common aquatic activity that should be a part of any aquatic programme, because it allows people with CP to move independently without the help of others. Swimming can also be used to increase aerobic stamina.

Apart from swimming, there are other activites which can be practiced for the same purpose: running, shallow water walking and deep-water running. Aquatic programme for children with CP should include proper exercise to increase muscle strength, with the aim to improve their postural stability while moving on land. Optimal duration of an aquatic programme should be at least 10 weeks, with a frequency of at least three times per week and a 45-minute individual session. A small number of collected papers (studies) require further research on aquatic activities, exercise and cerebral palsy.

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UČINAK AQUATIC PROGRAMA KOD DJECE I ADOLESCENATA S DJEČJOM PARALIZOM: SISTEMATSKI PREGLED

Sažetak

Cerebralna paraliza je najčešći uzrok teške tjelesne invalidnosti u djetinjstvu. Neadekvatna fizička kondicija je jedan od glavnih problema u djece s cerebralnom paralizom. Razne vodene aktivnosti i vježbe mogu poboljšati razine fitnessa u djece s cerebralnom paralizom. Cilj ovog rada je analiza studija objavljenih 1990 - 2011, koje istražuju učinke vodenih programa u djece i adolescenata s cerebralnom paralizom. Istraživane su slijedeće baze podataka: PubMed, Web of Science, Pedro i Google Scholar. Kriteriji za prihvaćanje radova bili su kako slijedi: ispitanici su bili djeca i adolescenti s cerebralnom paralizom, eksperimentalni program bio je longitudinalna studija koja je obuhvaćala vodeni program vježbanja i radovi su objavljeni na engleskom jeziku. Na temelju pretraživanja baza podataka i kriterija, 13 radova je uključeno u analizu. Analiza primjenjenih vodenih programa u analiziranim studijama pokazuje da oni mogu imati pozitivne efekte i utjecaj na poboljšanje fizičke kondicije i socijalno ponašanje kod ljudi s CP. Vodeni programi su se sastojali od različitih vodenih vježbi i aqutaic aktivnosti, dok je plivanje bio najčešći program. Optimalno trajanje vodenih programa treba biti najmanje 10 tjedana, s visokom frekvencijom tri puta tjedno, a cca. 45 minuta u jednoj sesiji. Mali broj prikupljenih radova treba biti predmetom daljnjeg istraživanja u smislu vodenih aktivnosti, vodene vježbe i cerebralne paralize.

Ključne riječi: *vodene aktivnosti, utjecaj, učinci, fizički fitness, cerebralna paraliza*

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EXAMPLE BEHAVIOR OF ALGORITHM AND PROGRAM FOR QUANTITATIVE AND STRUCTURAL MULTIVARIATE DIFFERENTIATION OF GROUP OF ENTITIES WITH DIFFERENT MOTOR STATUS

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Original scientific paper

Abstract

The purpose of this work was the preparation and testing of algorithm prepared for the analysis of structural multivariate distinguishing groups of entities derived from the total distributed deployments. The fundamental methodological pattern is evident in the fact that within the sample defined in any way that there are sub-samples on the basis of some objective criteria can be classified at least as inferior, average and superior, or at transformational process as initial, transitive and final state. The algorithm has been tested on several examples of which two are prepared as example. One is presented in this paper as an example of unstable subsamples in motor domain that show differences in the structure of the transformation process with inferior and average entities. Another example was published in the "Acta Kinesiologica" journal in the morphological domain and shows no structural changes how they are, just the algorithm detect (Bonacin & Bonacin, 2012).

***Key words**: algorithm, groups of entities, motor abilities, structure, distinguishing*

Introduction

Multivariate analysis, of course, are the only procedures that can give an objective picture of the world in which we are a part and to ensure convergence of the natural laws of science (Harman, 1970; Cooley & Lohnes, 1971; Mulaik, 1972, Johnson & Wichern, 1992; Momirović et al., 1987). That's why the solution to the problem of determining the structural differences in the patterns that are predefined as potentially significant structurally different is a serious problem in all disciplines in which there is unity of the dynamic features of objects, transformations, and long-term effects (Bonacin & Smajlović, 2005; Bonacin et al., 2008; Bonacin et al., 2012). Such processes are of course all the processes of physical education, all educational, all medical, and also all in which there is a time delay of reaching effects, such as economic or management.

Since the objects (egg, people in our examples) differ in the anthropological features, including the ability for adaptation or reservoirs that absorb incoming information and tasks, then it is quite likely that the consequences of applying the operator to be different, and we should not forget the fact that differences exists often already in the start of groups or profiles, because of sufficiently different objects. For these reasons it is of multiple interests to explore, and systematically explore the diversity of sub-groups of the population, mainly in relation to that very group they belong to all subgroups. Although this can be done by taxonomic analysis, the fact remains that such an analysis, it is clear, even in close coordination with the discrimination analysis, however, remain in a quantitative field of preferred phenomena explication, but it is very difficult to apply in the analysis of changes in the structure that is in qualitative area.

For these reasons, it is prepared, tested and implemented algorithm "SubStru" in order to provide information on the structural differences between the subsamples.

Algorithm

If $\mathbf{E} = (e_i ; i=1,...,n)$ is set of entities randomly selected from some population **P** and $\mathbf{V} = (v_j ;j:=1,...,)$ is set of linearly independents, normally distributed quantitative variables. Then with operation of joining values from **V** with entities from **E** the result is matrix $\mathbf{X} = \mathbf{E} \otimes \mathbf{V}$ which explains state of set **E** on the set **V** at some point of time. If $\mathbf{M}= s(m_j ; j=1,..m)$ is vector of middle values on m variable of matrix **X** ($m_j= \Sigma x_i / n$) and vector $\mathbf{S} = (s_i ; j=1,..m)$ contains standard variable variations from **V** presented in **X** ($s_j = sqrt(\Sigma (xi - X)^2)/n$) then in matrix **Z** ($z_{ij} ; i=1,..n, j=1,...,m$), we will find standardized entity result values per each variable expressed in values of standard deviations of each variable ($z_{ij} = (x_{i,j} – m_j)/s_j$).

Let $\mathbf{E} = (e_i , i = 1, ... , n)$ is some set of entities in general, with some procedure defined as sample from some population **P**. Let we have defined set of variables $\mathbf{V} = (v_j , j = 1, ... , m)$. Let suppose that effective n of sample E is big enough, so m<<n.

Let

$$\mathbf{Z} = \mathbf{E} \otimes \mathbf{P} \mid \mathbf{Z}^t e = 0 , dg (\mathbf{R}) = \mathbf{I}$$

where e is summation vector (n,1), then

$$\mathbf{R}= \mathbf{Z}^t \mathbf{Z}$$

is correlation matrix of results, and **Z** is matrix of standardized results in variables from **V**.

Let there exists a set of conditions that ensures independent trader objective assessment of the success set of entities in an some activity or activity which properties can be described with a several (m) linearly independent variables of **V**, which allocates an arbitrary number of entities in the group k (k = 3 standard, w_i, i= 1, .. k) but the number k can be get by taxonomisation of total effectives from **P** or with regression coefficient *Beta* with screening technique of saliency. *Beta* coefficients are then when the criterion is undoubtedly some objective indication that score or placement. The effective overall then decomposed into k subsets, one of which is extremely superior, one extremely inferior and the rest are located within these extremes, while not necessary for the subsets with the same number of elements although it is desirable to have an estimate. Under the criteria of the highest credibility then for each of the subsets, we can calculate the local association in the set of variables

$$\mathbf{R_w} = \mathbf{Z_w^t}\,\mathbf{Z_w}$$

ie, for example, k = 3, then $\mathbf{R_1}$, $\mathbf{R_2}$ and $\mathbf{R_3}$ are the correlations between variables in each of the subsets of entities from **E**.

Given that in these subsets is a virtually the same set **E**, it is realistic to assume that the overall multivariate measure of consistency of each of the samples to **E** is defined with some function of common association. Such associations are, for example, correlation, and **E** in **R** so then **Y** = **R**, but it could be also a simple additive function like average correlation of the $\mathbf{R_1}$, $\mathbf{R_2}$, ..., $\mathbf{R_w}$ or **Y** = avg($\mathbf{R_1}$ + $\mathbf{R_2}$ + ... + $\mathbf{R_w}$).
Now, operation

$$\mathbf{Aw = Rw - Y}$$

results in differences in the local association (correlation) for each subset of the entities, and in the matrix

$$\mathbf{G_w = A_w * A_W^T}$$

it will be virtual covariance that describe the differences of each association in relation to a subset of the total set of entities defined from b. This matrix can be considered a realistic description of the structural differences of particular sets of entities in relation to the total of the effective entity from **E**. Of course, assuming that in the total sample exist same set of latent mechanisms that will surely be worth it as a subset of **w** closer to average or otherwise defined common status of the total sample, and it will be the difference in $\mathbf{A_w}$ smaller, respectively. This hypothesis is of course possible to test by some of the other methods (Bonacin, 2010), and this principle works before applying this algorithm, but it is not the subject of this method, just as it is possible that the whole system could be transferred to some other area, such as Guttman's image or Bonacin's Iterim and then it could be possible to apply all other procedures (Bonacin, 2006).

Testing of the difference significance we can provide in two directions. One is to test the difference between the subsets, where such tests are k(k-1)/2, but usually for a small number of subsets (k <= 5), such a test may not have much meaning for the global assessment of the difference since the subsets and defined based on the different achievements, and can be used for detecting global statistical significance or impact of individual variables from **V** to form a difference. Such a test, however, certainly makes sense in another case for which this algorithm is made, and it is for overall statistical significance of the difference of multivariate associations between subsets ($\mathbf{R_w}$) and general measures in the sample (**Y**), regardless of how these general measure (**Y**) was obtained.

Significance of possible obtained differences for different subsets of $\mathbf{G_w}$ can be easily tested, since at least one function of trace of matrix $\mathbf{G_w}$

$$g = (n/(m-1)) * \mathrm{Trace}(\mathbf{G_w})$$

and finaly $f = g * g$

has a chi-square distribution with degrees of freedom which are a function of the number of variables in **V** so df = m.

Furthermore, the algorithm can be applied in a situation where one and the same group of entities undergoing a transformation process in which the expected changes in the structure of the dimensions are affected (education, training, ...). Then, simply states in which estimates are made for certain successive state are just data in $\mathbf{R_w}$. Of course, the algorithm makes factor structure of the total sample and subsamples using principal components model with keeping the number of significant components in accordance with the PB criterion and finally rotation in orthoblique position. On special request can be thus obtained latent dimensions analyzed in terms of the subsamples.

The algorithm is designed, tested, coded and implemented in August 2012. Program adaptation for computational device is made by Dobromir Bonacin with the software tool "Delphi 2009" (Delphi 12, code named Tiburón).

Results – Numerical example

Therefore it is interesting to study the behavior of this model in reality and what differences will be between subgroups. To verify quality of algorithm we analyzed data of 249 male entities, all just turned 7 +/- 2 months, Elementary school First grade students who were subject to systematical transformational procedures to help functions of growth and developments. This lasted for a year and a half. In the beginning, middle and at the end of treatment subjects were measured so we gained absolute continuum of 747 objects (subjects) for this analysis.

We applied 12 motor variables and it is certain they follow international kinesiological standards, but also they are capable of covering different models of latent dimensions gained in different researches. Variables are: side steps – MKUS, polygon backwards – MPOL, standing on the bench – MP2O, straddle forward band – MPRR, hand tapping – MTAP, foot tapping – MTAN, long jump from a stand still – MSDM, throwing ball from a distance – MBLD, 20 m run from a standing start – M20V, sit-ups – MDTS, held part in the hang – MVIS) and one functional variable 3 minute run – MT3M).

As a hyphotesis, we expect significant differences between transitive points in process.

Table 1. Correlations of inferior/initial subsample

INF	MKUS	MPOL	MP2O	MPRR	MTAP	MTAN	MSDM	MBLD	M20V	MDTS	MVIS	MT3M
MKUS	1.00	0.29	0.17	0.02	0.27	0.28	0.35	0.22	0.23	0.20	0.18	0.13
MPOL	0.29	1.00	0.20	0.00	0.23	0.20	0.40	0.26	0.27	0.27	0.21	0.18
MP2O	0.17	0.20	1.00	0.04	0.16	0.25	0.20	0.19	0.21	0.24	0.21	0.12
MPRR	0.02	0.00	0.04	1.00	0.04	-0.04	0.04	0.00	0.08	0.11	0.03	0.04
MTAP	0.27	0.23	0.16	0.04	1.00	0.42	0.22	0.15	0.25	0.16	0.15	0.19
MTAN	0.28	0.20	0.25	-0.04	0.42	1.00	0.28	0.17	0.20	0.16	0.12	0.18
MSDM	0.35	0.40	0.20	0.04	0.22	0.28	1.00	0.35	0.49	0.30	0.30	0.14
MBLD	0.22	0.26	0.19	0.00	0.15	0.17	0.35	1.00	0.27	0.33	0.23	0.27
M20V	0.23	0.27	0.21	0.08	0.25	0.20	0.49	0.27	1.00	0.24	0.21	0.02
MDTS	0.20	0.27	0.24	0.11	0.16	0.16	0.30	0.33	0.24	1.00	0.27	0.16
MVIS	0.18	0.21	0.21	0.03	0.15	0.12	0.30	0.23	0.21	0.27	1.00	0.20
MT3M	0.13	0.18	0.12	0.04	0.19	0.18	0.14	0.27	0.02	0.16	0.20	1.00

Table 2. Correlations of middle/average subsample

MID	MKUS	MPOL	MP2O	MPRR	MTAP	MTAN	MSDM	MBLD	M20V	MDTS	MVIS	MT3M
MKUS	1.00	0.39	0.22	0.06	0.31	0.35	0.51	0.28	0.38	0.37	0.27	0.17
MPOL	0.39	1.00	0.22	0.09	0.29	0.36	0.56	0.36	0.39	0.37	0.35	0.21
MP2O	0.22	0.22	1.00	0.09	0.14	0.28	0.29	0.19	0.20	0.20	0.12	-0.06
MPRR	0.06	0.09	0.09	1.00	0.06	-0.01	0.04	0.03	0.19	0.16	0.11	0.17
MTAP	0.31	0.29	0.14	0.06	1.00	0.51	0.32	0.20	0.24	0.25	0.12	0.18
MTAN	0.35	0.36	0.28	-0.01	0.51	1.00	0.37	0.18	0.25	0.26	0.18	0.17
MSDM	0.51	0.56	0.29	0.04	0.32	0.37	1.00	0.44	0.46	0.35	0.34	0.23
MBLD	0.28	0.36	0.19	0.03	0.20	0.18	0.44	1.00	0.33	0.37	0.29	0.30
M20V	0.38	0.39	0.20	0.19	0.24	0.25	0.46	0.33	1.00	0.41	0.37	0.28
MDTS	0.37	0.37	0.20	0.16	0.25	0.26	0.35	0.37	0.41	1.00	0.33	0.20
MVIS	0.27	0.35	0.12	0.11	0.12	0.18	0.34	0.29	0.37	0.33	1.00	0.28
MT3M	0.17	0.21	-0.06	0.17	0.18	0.17	0.23	0.30	0.28	0.20	0.28	1.00

Table 3. Correlations of superior/final subsample

SUP	MKUS	MPOL	MP2O	MPRR	MTAP	MTAN	MSDM	MBLD	M20V	MDTS	MVIS	MT3M
MKUS	1.00	0.30	0.12	0.03	0.27	0.31	0.44	0.20	0.35	0.33	0.21	0.16
MPOL	0.30	1.00	0.14	0.08	0.24	0.31	0.49	0.27	0.35	0.28	0.32	0.19
MP2O	0.12	0.14	1.00	0.06	0.09	0.23	0.21	0.15	0.10	0.13	0.05	-0.07
MPRR	0.03	0.08	0.06	1.00	0.09	-0.03	-0.01	0.03	0.18	0.12	0.11	0.22
MTAP	0.27	0.24	0.09	0.09	1.00	0.45	0.29	0.18	0.22	0.23	0.12	0.18
MTAN	0.31	0.31	0.23	-0.03	0.45	1.00	0.34	0.16	0.26	0.23	0.17	0.15
MSDM	0.44	0.49	0.21	-0.01	0.29	0.34	1.00	0.37	0.39	0.32	0.31	0.22
MBLD	0.20	0.27	0.15	0.03	0.18	0.16	0.37	1.00	0.30	0.31	0.26	0.26
M20V	0.35	0.35	0.10	0.18	0.22	0.26	0.39	0.30	1.00	0.41	0.36	0.35
MDTS	0.33	0.28	0.13	0.12	0.23	0.23	0.32	0.31	0.41	1.00	0.29	0.17
MVIS	0.21	0.32	0.05	0.11	0.12	0.17	0.31	0.26	0.36	0.29	1.00	0.32
MT3M	0.16	0.19	-0.07	0.22	0.18	0.15	0.22	0.26	0.35	0.17	0.32	1.00

Table 4. Average correlations generated by subsample correlations

AVG	MKUS	MPOL	MP2O	MPRR	MTAP	MTAN	MSDM	MBLD	M20V	MDTS	MVIS	MT3M
MKUS	1.00	0.33	0.17	0.04	0.28	0.31	0.44	0.23	0.32	0.30	0.22	0.16
MPOL	0.33	1.00	0.19	0.06	0.25	0.29	0.48	0.30	0.34	0.31	0.29	0.19
MP2O	0.17	0.19	1.00	0.06	0.13	0.25	0.23	0.18	0.17	0.19	0.13	0.00
MPRR	0.04	0.06	0.06	1.00	0.06	-0.03	0.02	0.02	0.15	0.13	0.09	0.14
MTAP	0.28	0.25	0.13	0.06	1.00	0.46	0.28	0.17	0.24	0.22	0.13	0.18
MTAN	0.31	0.29	0.25	-0.03	0.46	1.00	0.33	0.17	0.24	0.22	0.16	0.17
MSDM	0.44	0.48	0.23	0.02	0.28	0.33	1.00	0.39	0.45	0.32	0.32	0.20
MBLD	0.23	0.30	0.18	0.02	0.17	0.17	0.39	1.00	0.30	0.33	0.26	0.28
M20V	0.32	0.34	0.17	0.15	0.24	0.24	0.45	0.30	1.00	0.35	0.31	0.22
MDTS	0.30	0.31	0.19	0.13	0.22	0.22	0.32	0.33	0.35	1.00	0.30	0.18
MVIS	0.22	0.29	0.13	0.09	0.13	0.16	0.32	0.26	0.31	0.30	1.00	0.27
MT3M	0.16	0.19	0.00	0.14	0.18	0.17	0.20	0.28	0.22	0.18	0.27	1.00

Table 5. Statistical significance of structural differences

Group	n	df	HI^2	P
Inferior/initial	249	12	90.82	<0.05
Middle/average	249	12	21.74	<0.05
Superior/final	249	12	12.95	>0.05

Discussion and conclusion

As seen in Table 1, 2 and 3, the correlations between variables are relatively unstable, which is not surprising considering that it is a motor dimensions that in the selected sample should significantly structurally altered. This was confirmed by testing significance (Table 5), showing that two of tree situations defined statistical significance at p = 0.05 or less.

These results show that the algorithm is very qualitative and prepared sensitive to clear structural changes, and it is surely recommended for use in all of these situations when we expect that changes in the structure of the parameters that define the stability of a system or multivariate described by the transformation are expecting any dramatic changes.

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PRIMJER PONAŠANJA ALGORITMA I PROGRAMA ZA KVANTITATIVNO I STRUKTURALNO MULTIVARIJANTNO RAZLIKOVANJE GRUPA ENTITETA RAZLIČITOG MOTORIČKOG STATUSA

Sažetak

Svrha ovog rada bila je priprema i provjera algoritma prirađenog za analizu strukturalnih multivarijantnih razlikovanja skupina entiteta dobivenih i raspoređenih iz ukupnog efektiva. Temeljni metodološki obrazac očituje se u činjenici da unutar bilo kako definiranog uzorka postoje subuzorci koje je temeljem nekog objektivnog kriterija moguće razvrstati najmanje kao inferiorne, prosječne i superiorne, ili kod transformacijskog procesa kao početno, tranzitivno i finalno stanje. Algoritam je testiran na više primjera od kojih su zadržana dva. Jedan je prikazan u ovom radu kao primjer nestabilnih subuzoraka u motoričkoj domeni koji pokazuju razlike u strukturi početnih i prijelaznih faza kroz transformacijski proces. Drugi primjer je objavljen u časopisu „Acta Kinesiologica" u morfološkoj domeni i ne pokazuje značajne strukturalne promjene koje se inače, ako postoje, upravo ovim algoritmom mogu otkriti (Bonacin & Bonacin, 2012).

Ključne riječi*: algoritam, grupe entiteta, motorika, struktura, razlikovanje*

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THE EFFECT OF 8 WEEKS SPECIFIC CORRECTIVE EXERCISE IN WATER AND LAND ON ANGLE OF KYPHOSIS AND SOME PULMONARY INDICES IN KYPHOTIC BOY STUDENTS

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Original scientific paper

Abstract
The purpose of this study was to compare the effect of 8 weeks specific corrective exercise in water and land on the angle of kyphosis and some pulmonary indices in kyphotic students. Thirty males with increased normal thoracic kyphosis (kyphosis ≥40 degrees, 20.70 ±0.705 years old, height 175.5 ±6.19 cm, weight 64.19 ±8.23 kg) were selected and randomly divided in two groups(n=15): group(1) (corrective exercise in water) and group(2) (corrective exercise in land). The angle of kyphosis measured by using a flexible ruler as a non-invasive and reliable method. Pulmonary indices such as: force vital capacity (FVC), forced expiratory volume in one second (FEV1) and maximal voluntary ventilation (MVV) measured by digital spirometer. The repeated measure test was used to compare the differences between the pre and post-test in both groups. All statistical analyses were performed using SPSS statistical software version 18 and the significance level was set on 0.05.In land group and in water group the degree of kyphosis, FVC, FEV1 and MVV improved significantly (p≤0.05). Finally, between two groups were not observed any significant difference in degree of kyphosis and pulmonary indices (FVC, FEV1, MVV) (p≥0/05).According to the results; we can suggest the performance of both corrective exercises in land and water for kyphotic persons.

Key words*: kyphosis, aquatic exercise therapy, spirometry, corrective exercise*

Introduction

Natural alignment of spinal column depends on the function of its muscle, bone and joint structural. This weakness of spinal column extensor muscles can cause to static, dynamic and stature unbalance in persons that called faulty posture. It is caused unfavourable status on mental, social and physiological Function of person (Nitzschke & Hildenbrand, 1990; Peters, 1987). Physiological disorders caused by unfavourable physical status are serious. Increasing back curve of thoracic area that recognized as kyphosis has the unfavourable result of the respiratory system by the shortness and the inflexibility of chest muscles and also the weakness of expiratory muscles (Taheritizabi et al., 2012). Because shortening weakness in chest muscles of aspiration cause to decreasing ribcage volume, then decreasing lung volume (Rajabi et al., 2008). Therefore it seems effective to improve kyphosis and pulmonary volumes by reformation of muscle-skeletal structure of ribcage and spinal column, by corrective protocols of strengthening back muscles of ribcage and stretching of muscle chest. In the field of rehabilitation, physical attributes of water have many advantages like muscular relaxation, decreasing sensitivity to pain, decreasing cramp, flowing and comfort of joint, increasing muscular power and endurance when a person is very weak. Practice in water in comparison to practice in land is a certain method to achieve mental calmness and has many advantages to quality of life. Many people who have unsuitable organs and look and also have congenital means of physical weakness of illness or even over weight and weak person don't like to do social activities or even if they want, they can't do any exercise whereas aquatic exercise solved this problem (Sato et al., 2007; Tsukahara et al., 1994; Wenger et al., 1984). The purpose of this research is comparing the effect of corrective particular exercise in water and land on changes of kyphosis and some respiratory indices in male students. To find answers to this question, which exercises methods (water or land exercise), has more affection on kyphosis reformation and pulmonary indices? Pulmonary volumes gathered by GAGER spirometry system in following conditions, each object is sitting on lab chair and getting sensor of the system in his hand then cross expiration and inhalation through a replaceable tube. The object should get the tube by lips and uses a particular set for black nose to not go out the air. Each subject done each test three times and the best records were gathered and registered at MVV, FEV1 and FVC. Exercising protocol on land: 1) Warm up: inclusive walking and running slowly about 5 or 10 min. 2) Particular stretching exercises: all static stretching actions were done by him or his assistant, the purpose of static stretching was changing the length of shortened muscles to its natural length in the front chest area and its duration was 20 or 25 min. The period of each stretching action was 10 or 15 second and in 15th sets. In the exercise pain threshold was important. 3) Particular strengthening exercises: It was done single and two times. Exercises were static or isometric and dynamic (isotonic).

The main purpose of the exercises was the retrieval power of weakened back muscles, its duration was 20 or 25 minutes, the duration for each static strengthening action was 10 or 15 seconds in 5th or 10th sets. 4) Cool down period: running slowly and stretching action was done at the end about 5 or 10 min. Exercising protocol in water: all of exercises in land were done in water. But the exercises were proportionate to aqueous area. For example making warm up and cool down exercises include different walking was done in the pool. ANOVA repeated measure test was used to compare the differences between groups in pre & post-test. All statistical analyses were performed using SPSS statistical software version 18 and the significance level was set at 0.05.

Results

As for kyphosis angle interactive effect F (1, 28) =0.102, P≥0.05, isn't significant and group interior effect of the test F (1, 28) =192.92, P≥0.05. So kyphosis angle increase significantly (Fig.1).

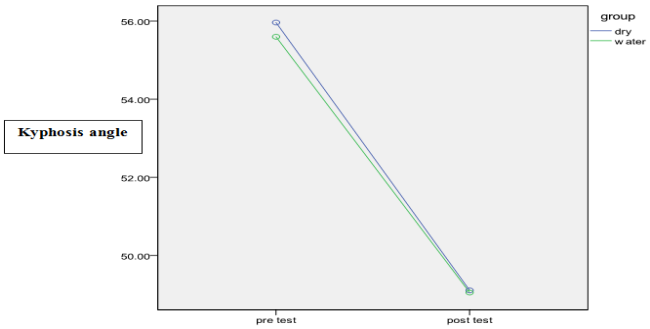

Figure 1. Mean thoracic kyphosis angle (degree)

As for FEV1 interactive effect isn't significant, F(1,28)=0.28/P≥0.05, and inter group test effect are significant, F(1,28)=13.40/P≤0.01, result FEV1 in two groups of aquatic and land increased so much over a period of particular corrective exercises (Fig.2). Also there aren't any significant differences between variations of kyphosis degree in two groups of aquatic and land F (1, 28) =0.001/P≥0.05.

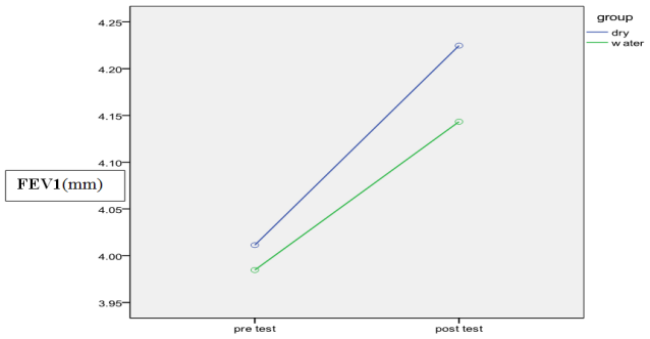

Figure 2. FEV1 values (mm) in groups before and after 8 weeks specific corrective exercise in water and land

Finlay, there is no significant difference in interactive effect F(1.28)= 1.736, P≥0.05 and there is a significant difference in intergroup effect F(1.28)=23.381, P ≤ 0.001, consequently FVC value increases significantly in both groups after 8 weeks specific corrective exercise in water and land (Fig. 3). There aren't any significant differences in FVC between subjects in both groups F (1.28) = 0.001, P≥0.05.

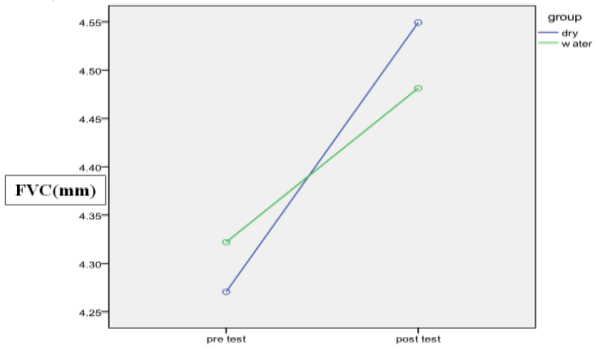

Figure 3. FVC values (mm) in groups before and after 8 weeks specific corrective exercise in water and land

As for MVV the connected effect isn't significant in F (1.28)=0.129/P≥0.05 and the inter group effect of the test F (1.28)=19.55/P≤0.001, results MVV in both aquatic and land group is so much increased over a period of particular corrective exercises (Fig. 4).

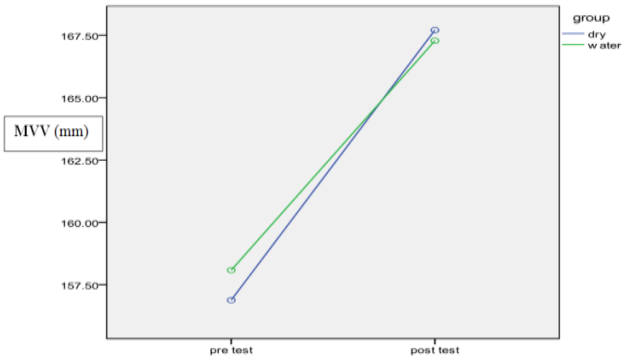

Figure 4. MVV values (mm) in groups before and after 8 weeks specific corrective exercise in water and land

Discussion and Conclusion

The research shows there is an important decrease in both kyphosis angle and important reformation in MVV, FEV1 and FVC after a particular corrective aquatic and land exercise in both groups (aquatic exercise group and land exercise group). Eun-Hee, Haley, Goodman and Fairweather show through corrective exercises to increase power of back extensor muscles, the kyphosis would decrease (Choi et al., 2005; Lynn, 2001; Hrysomallis & Goodman, 2001; Fairweather & Sidaway, 1993), moreover Mika, Sinaki, Briggs also show in their researches there is inverse correlation between power of back extensor muscles and level of kyphosis thus level of back disorders can be result of decrease power of back extensor muscles their results are same to our results (Mika et al., 2005; Sinaki et al., 1996; Sinaki et al., 2005; Briggs et al., 2004), unlike results of Sedlock and Egan are different, they declared that level of back extensor muscles power has slight effect on level of kyphosis (Eagan & Sedlock, 2001; Kim et al., 2006).

Hildenbrand and colleagues performed an aquatic athletic exercise program in water on asthmatic patients for 12 weeks, they didn't observe any significant difference between pre-test and post-test in FEV1 and FVC that was different by the result of this research, but the sample of this research was asthmatic patients (Hildenbrand et al., 2010). Anonymous research's results showed that aquatic athletic treatment lead to important increases in FEV & MVV in 10 weeks in respiratory operation of MR patients in educable group, their results are similar to the current study (Can et al., 2005). The reason of decrease kyphosis angle in samples after a period of land & aquatic corrective exercises is strengthened stretched muscles in the backside of the spinal column (back extensor muscles, through strengthening and endurance corrective exercises in water and land and also flexibility exercises in chest area using help and without help. Samples in water (Flotage principle) and inland causes volubility of the spinal column and reform of shortened muscles too. Regarding to effect of particular corrective land & aquatic exercises on (MVV, FEV1, FVC) and important improvement of them, it's noticeable that probably decrease in kyphosis angle using corrective exercise caused not only increasing in pulmonary ribcage compliance and ventilation but also decreasing in aerial path resistance and lung tissue resistance, and lungs get more capacity so this can reform all pulmonary indices. On the other hand more over these factors, reinforce intercostal muscles and respiratory muscles impress pulmonary indicators (MVV, FEV1, FVC), probably important in all pulmonary MVV, FEV1, FVC is related to this factor by doing aerobic exercises in warm up and cool down exercises. Also hydrostatic pressure made by floating organs or body in water, makes physiological response of the circulatory system. As hydrostatic pressure results leading blood from lower extremity to the trunk and body and cusses of stroke volume level, cardiac output and vo_2max and then the pulmonary volume will increase. It should point that this research is one of few researches that studied the effect of aquatic exercise on kyphosis and pulmonary volumes.

Nevertheless many recommendations of physiotherapist about using aquatic exercise there are few researches in this field. Thereforeit's necessary to more researches about aquatic exercise on posture and disorders. Also in the research method of variance analysis with repeated measure shows there isn't important difference in two groups in each related variables. There isn't any difference between two groups, results showthat the changes in each studied variable isn't related to particular exercise area, but both exercise area (water & land) shows equal effect on this variable statically.

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UČINAK 8-TJEDNOG SPECIFIČNOG KOREKTIVNOG VJEŽBANJA U VODI I NA SUHOM NA KUT KIFOZE I NEKE PULMONALNE POKAZATELJE KOD KIFOTIČNIH STUDENATA

Sažetak

Svrha ovog istraživanja bila je usporediti učinak od 8 tjedana specifične korektivne vježbe u vodi i kopnu na kut kifoze i neke plućne indekse u kifhotičnih studenata. Trideset muškaraca s povećanom normalom prsišta kyphosis (kyphosis ≥ 40 stupnjeva, 20,70 ± 0,705 godina starih, visine tijela 175,5 ± 6,19 cm, težine 64,19 ± 8,23 kg) odabrani su i slučajno podijeljeni u dvije skupine (n = 15): Grupa (1) (korektivne vježbe u vodi) i grupa (2) (korektivne vježbe na zemlji). Kut kifoze mjeren je pomoću fleksibilnog ravnala kao neinvazivna tehnika i na pouzdan način. Pulmonalni indeksi kao što su: forsirani vitalni kapacitet (FVC), forsirani izdisajni volumen u prvoj sekundi (FEV1) i maksimalna dobrovoljna ventilacija (MVV) mjereni su digitalnim spirometrom. Ponovno mjerenje korišteno je radi usporedbe i utvrđivanja razlike između pre i post-testa u obje skupine. Sve statističke analize su izvedene pomoću SPSS statističkog softvera verzije 18 i razina značajnosti je postavljena na 0.05. I kod skupine na zemljištu i skupine na vodi stupanj kyphosis, FVC, FEV1 i MVV znatno su poboljšani (p ≤ 0,05). Konačno, između dvije grupe nisu uočene značajne razlike u stupnju kifoze i plućnih indeksa (FVC, FEV1, MVV) (p ≥ 0/05) Prema rezultatima;. Možemo predložiti izvedbu obje vrste korektivnih vježbi na zemlji i u vodi kod kifotičnih osoba.

Ključne riječi: *kifoza, terapija vježbama u vodi, spirometrija, korektivne vježbe*

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EMOTIONAL INTELLIGENCE AND DETERMINATION OF SOCIOMETRIC STATUS IN SPORT

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Review paper

Abstract
Emotional intelligence (EI) is a new research subject in the field of psychological science. As a term and concept appears nineties. Salovey and Mayer defined EI as a set of skills that contribute to a better and more accurate estimate and express their emotions, assess others' emotions and use emotions in motivating the actions to reach our goals in life. Roberts, Zeidner and Matthews defines EI as a type of intelligence that involves the ability to process emotional information where emotions are organized mental response to current events involving psychological, experiential, and cognitive function. The changing relationship of a person or object to another, change and emotions toward the person or property, regardless whether these relationships are real, stored in memory or imagined. According to Mayer EI is the ability to recognize the meanings of emotions and their relationships, then using emotions as a basis for understanding and solving problems involving cognitive processes, which means that the use of emotions can be very useful for the improvement of cognitive activity. There are different conceptualizations of EI. One involving a range of adaptive characteristics associated with emotions, others emphasize cognitive elements, and the third conceptualize EI as ability and personality traits. Subtle analysis is required to determine what is and is not part of EI. EI concepts rely on one of two ways of looking at the relation between emotions and logical thinking in psychology. Something of great importance is that appreciation direct correlation between psychological factors and sporting success, has led to the psychological findings are treated as an inseparable part of the equation specification sports. In working with athletes and previously investigated psychological dimensions relevant to the success of the sport as well as those that are of importance for the development and operation of an integrated personality. EI athletes as well as the dynamics of micro-social environment, especially in team sports, been systematically studied to date in spite of the utmost importance to the success of any sports activity. The text of these reasons, it is primarily intended for psychologists and kinesiologists who work in the sport. Psychologists with the effort made to encourage the construction of good measuring instruments for measuring EI athletes and focus on the efficient use of sociogram method and kinesiologists to cooperate with psychologists in the most efficient way to take advantage of the results obtained.

Key words: *Emotional inteligence, model, sociometry, sport, training*

Emotional intelligence in context of theories of intelligence

Emotional intelligence (EI) is a relatively new subject of research in the field of psychological science. In the scientific literature, EI, as a term and concept first appeared in the works of the nineties by Peter Salovey (Yale) and John D. Mayer's (New Hempshire), which (according Takšić 1998) define EI as a set of skills that contribute to more accurate assessing and expressing their emotions, as well as assessing other people's emotions and use emotions in motivating the actions to reach our goals in life. Authors (Roberts, Zeidner, and Matthews, 2001) define EI as a type of intelligence that involves the ability to process emotional information. At the same way, emotions are organized mental response to current events involving psychological experiential and cognitive function. Emotions occur regularly in the context of relationships. As it changes the relationship of a person to another person or property, are changing and her feelings towards that person or object, independently, whether these relationships are real, stored in memory or imagined they were always accompanied by sensors and emotions.

According to Mayer et al., (1999), and according to Mayer, Caruso, Salovey, and Sitarenios, 2001), EI is the ability to recognize the meanings of emotions and their relationships, then using emotions as a basis for understanding and solving problems, which certainly includes the cognitive processes which in turn tells that the use of emotions can, and to efficiently serve to enhance cognitive activity. An individual who possesses these skills is considered to be well-adjusted and emotionally skilled. Conversely, those who do not possess the will be damaged in the emotional and social functioning (Salovey and DiPaola 1990). EI concept builds on one of the two ways of looking at the relation between emotions and logical thinking in psychology. The first concept is based on the belief that emotions and logical thinking, opposite each other, the result of which would interfere with the emotions and wrong direction and generally adversely affect the functioning of the rational man. The second concept is based on the view that emotions are part of logical thinking and in that way contribute to intelligence and thus the quality of functioning in all aspects of life. The authors emphasize the concept of EI because that emotional intelligence does not preclude

intelligence and that EI is not a "victory of the head over the heart," but that it is a unique blend of both. Recent studies showed that a test of EI could soon take the place of the other important psychological variables as predictors of different factors of success in all human activity (Brackett, 2001; Formica, 1988, Mayer, Perkins, Caruso and Salovey, 2001; Rubin, 1999; Salovey Mayer, Caruso and Lopez, in print, according to Mayer, Salovey, Caruso and Sitarenios, 2001). General intelligence can be defined as the total capacity of people to adapt effectively through the opinions and information processing (Roberts, Zeidner, and Matthews, 2001). There are many different approaches and models of many authors who have attempted to describe the nature of intelligence and its function. Some of these models include certain constructs that are conceptually related to the construct of EI. One of these constructs is social intelligence, from which, according to (Roberts, Zeidner, and Matthews, 2001) derives EI. Back in 1920 Thorndike intelligence sharing in the abstract (verbal), mechanical (visual-spatial) and social.

Welfare is defined as "the ability to understand men and women, boys and girls and wise action in interpersonal relations" (by Papić, 2003). The numerous attempts to define and measure social intelligence, to date, these attempts have been successful. One reason for that is certain is that it is social intelligence studied less than other types of intelligence because (Mayer and Geher, 1996, according to Roberts, Zeidner and Matthew, 2001) seems to be the most difficult theoretically and empirically separated from each other. Based on Thorndike's abstract definition of social intelligence (Babić, 2004). The construct is a standardized instrument to measure individual differences in this construct. Sternberg, based on our own research found that coping with everyday situations requires different skills from those classic intelligence tests measure, therefore, the analytical and creative intelligence in his theory and practice included. He is of the opinion that the contents of most of the tests that assess academic intelligence analytical problems that are clearly defined and that they contain all the information needed to make them can be solved, but they only have one solution, which can be reached only by one road. In contrast, practical problems require the recognition and formulation of the problems that are poorly defined and does not contain all the necessary information and have more acceptable solutions, and require previous experience, motivation and personal interest.

Cantor and Kihlstrom (1985) propose social intelligence as a single construct for understanding the personality. In their deliberations solving social problems is a central process that supports social behavior (Papić, 2003). Due to problems in the definition and operationalization of social intelligence Geher Mayer (1996) proposed to do away with the construct of social intelligence and that it is split in emotional and motivational. Motivational, that incorporate an understanding of different forms of motivation and an understanding of what Sternberg et al. (According to Takšić, 1998) called "implicit knowledge" ("Tacit Knowledge") define it as an "action-oriented knowledge learned without direct help from others, which enables the person to achieve the goals of personal importance." Emotional Intelligence would include recognition of each other's emotions, reasoning about emotions and the information associated with them, and the processing of emotional information as part of a general problem-solving abilities. The concept of EI overlap with Gardner's notion of social intelligence that is defined as a type of personal intelligence. In their model of multiple intelligences among the seven included two forms of personal intelligence.

With musical, kinesthetic, logical-mathematical, spatial, linguistic, and, in the category of intelligence included the interpersonal and intrapersonal intelligence. Intra-defined as the ability to access their own emotional life through identifying, describing and distinguishing their own feelings and their symbolic representation. Interpersonal defines as the ability to recognize the moods, intentions, and desires of other people. (Roberts, Zeidner, & Matthew, 2001). Intelligence in understanding the behavior and its meaning is contained in Guilford's (1959) model of intelligence, whom the author based on all possible combinations of three main factors: Operations (cognition, memory, divergent production, convergent production and evaluation); Facilities (figural, semantic, symbolic and conduct) and Products (units, classes, relations, systems, transformations, and implications). Any intellectual activity consists of facilities, operations and products. Each of the four types of intelligence (information content categories) comprises of 30 abilities (6 times 5 products operations). Figural, semantic and symbolic content refers to the abstract material contained in standard IQ tests. Behavioral domains is neglected in conventional tests, although associated with socio-emotional intelligence. EI is in some way overlap with behavioral content of cognition (the ability to identify the internal state of the individual, the interpretation of the social consequences of behavior, etc.). Particles formed test to measure these abilities are reminiscent of behavioral measures of EI. Out of 30 possible factors of social intelligence research Guilford and associates confirmed the existence of 12 of them related to cognition and divergent production (Petroski-Beška, 1987, according to Takšić, 1998). The concept of EI can be accommodated in the theory of fluid and crystallized intelligence, Cattell's (1971), Horn (1988) and their associates. Researchers who are doing the EI opinion that forms part of crystallized intelligence, and that opinion is based on the assumption that the evaluation, expression, regulation and use of emotions developed through experience and social interaction in the same way as other psychological processes that make crystallized intelligence (Roberts, Zeidner, & Matthew, 2001).

Models of emotional intelligence

There are different, and among them, rather wide, conceptualization of emotional intelligence. One involving a range of adaptive characteristics associated with emotions, others emphasize cognitive elements, such as facilitating reasoning and memory, and the third conceptualize EI as ability and personality traits (Schutte et al., 1998). Mayer, Caruso and Salovey, 1999, 2000, according to Roberts, Zeidner and Matthew, 2001) concluded that the warning subtle analysis is needed to determine what is and is not part of EI. Mayer et al. analyzed the differences between the different models of EI and divided them into two groups: Models of mental abilities, which focus on the ability to process information and affective Mixed models, concepts, where EI appears as a diverse construct that includes aspects of personality, and the ability whenever you see, processing, understanding and managing emotions and motivational factors and affective dispositions. (Mayer et al., 2003). The works that treat emotional intelligence as a set of mental abilities commonly used and quoted exactly the model of Mayer and Salovey. In its first version (1990) model included three levels of competence: Assessment and expressing emotions in themselves and in others, Regulating emotions in themselves and others, and Using emotions for adaptive purposes. Model had a heuristic value and represents the first attempt conceptualization of this construct, with an attempt to integrate knowledge from different fields of psychology and conceptually related processes of emotional information that is necessary for a minimum level of competence and intelligent functioning (Takšić, 1998).

Model of Mayer and Salovey

Model that is most frequently cited in the works that deal with emotional intelligence, and treat it as a set of mental ability model of Mayer and Salovey. In its first version in 1990. was comprised of three levels of ability as said before. He is a good feature which includes capabilities that include conceptually related treatment processes emotional information necessary for a minimum level of competence and intelligent functioning (Takšić, 1998). In accordance with the logic of the model, the authors have defined EI as "the ability to monitor their own and others' feelings and emotions, and use this information in thinking and behavior" (Salovey and Mayer, 1990). Improvement model, the authors have released another version of the construct, and have proposed a revised definition that "emotional intelligence involves the ability to quickly observations, evaluations and emotions, ability to recognize and generate emotions to facilitate thinking, the ability to understand emotion and emotional knowledge, and the ability to regulate emotions in to promote emotional and intellectual growth" (Mayer and Salovey, 1996). This version of the construct was extended for one level of competence and is shown as a diagram in which the four branches of the simpler diagrams ordered psychological processes to higher, more psychologically integrated processes. Each branch has four representative capacities. Abilities that occur at early stages of development are on the left side of the branch, and those of later developments, on the right. Of persons of high emotional intelligence are expected to progress faster through these requirements and to cope with the greater number (Salovey and Sluyter, 1997).

Level 1 (Perception, appraisal and expression of emotion) describes the capabilities and skills of people to accurately eve emotional form. At this level learn to identify their own and others' emotional states, and to distinguish them. As the child grows, it imaginatively attributed feelings of the living and non-living phenomena. This imaginative thinking can help your child perform general conclusions from self to others. A mature person knows carefully monitor the inner feelings. Adequately developed and independent entity are beginning to assess emotions wherever they may express it in other people, the architecture, artwork, etc. This level of capability includes the ability to accurately express their feelings and needs that surround these feelings. And because emotionally intelligent individuals familiar expression and manifestation of emotions, they are also vulnerable to manipulative phrases (Salovey and Sluyter, 1999). This aspect of EI affects the awareness of their own emotions and thoughts concerning emotions, to differentiate among them, and the ability to adequately express emotions, capacity for understanding and distinguishing emotional states (Roberts, Zeidner and Matthew, 2001). As the child grows, it imaginatively attributed feelings of the living and non-living phenomena. Imaginative thinking can help your child perform general conclusions from self to others. A mature person knows carefully monitor the inner feelings. Adequately developed and independent entity are beginning to assess emotions wherever they may express it in other people, the architecture, artwork, etc. This level of capability includes the ability to accurately express their feelings and needs that surround these feelings. And because emotionally intelligent individuals familiar expression and manifestation of emotions, they are also vulnerable to manipulative phrases (Salovey and Sluyter, 1997). This aspect of EI affects the awareness of their own emotions and thoughts concerning emotions, to differentiate among them, and the ability to adequately express emotion (Roberts, Zeidner and Matthew, 2001).

Level 2 Emotional facilitation opinion includes the ability to use emotions in ways that facilitate intellectual processes. Emotions determine priorities in mind by directing attention to important information. They are sufficiently vivid and accessible so they can be recalled as needed to assist in assessment and memory of events. When we manage to get into an event or a person whose sense of "story" to follow, easier to manage, and we will decide (for a more favorable outcome) in similar situations in which we find later.

Mood swings change the individual's perspective from optimistic to pessimistic, urging him to different choices to take action. Different kinds of moods facilitate selection of ways in performing different tasks, as well as different forms of reasoning (Salovey and Sluyter, 1997). This component of EI involves assimilating basic emotional experiences into mental life (Mayer, Caruso and Salovey, 1999; 2000). Putting emotion into the objective function is necessary for selective attention, self-monitoring, self-motivation, etc. (Roberts, Zeidner and Matthew, 2001). Level 3 Understanding and analyzing emotions and use emotional knowledge includes the ability to understand emotions and use emotional knowledge. Already during childhood are starting to notice the similarities and differences between sympathy and love, hostility and anger, etc. Later, there is the ability to interpret the meanings that emotions convey regarding interactions as well as the ability to understand complex emotions. (Eg sadness that accompanies the loss, the joy of victory, etc.) In some situations can occur simultaneously and opposite emotions (eg love and hate). A combination of different emotions get new qualities (eg, hope is a blend of faith and optimism). In mature individuals occurs ability to identify plausible transitions between emotions, such as the transition from anger to satisfaction or from anger to embarrassment. Knowledge of the course of sensitivity in interpersonal relationships is an important element of emotional intelligence.

Emotional acquire knowledge of childhood and improved lifetime. People usually agree in their opinions about what triggers certain emotions (Salovey and Sluyter, 1999). This component refers to the observation of legality occurrence of specific emotions, understanding the emotional issues as well as knowledge about which emotions are similar and the relations (Roberts, Zeidner and Matthew, 2001). Level 4. Reflexive regulation of emotion for the emotional and intellectual development of the most complex levels of emotional intelligence and the conscious regulation of emotion leads emotional and intellectual progress. Essential skill at this level is openness to feelings, whether pleasant or unpleasant. Only when a person is aware of their feelings and open to them, can about them and learn something. The child learns through childhood socializing emotion. It takes place in a selective process of expressing emotions, depending on the amount of information available, its judgments about the appropriateness of such reactions and social norms. It increases ability reflexive inclusion or exclusion of emotion from them, depending on the assessment of their informativeness or usefulness. A person who has this ability is emotionally mature person in different situations and respond adequately "cool." This level of emotional intelligence involves the ability to monitor the reflexive emotion in relation to them and others by recognizing each other's responses shape the vision clarity, typicality, impact and usefulness and prudence, which is essentially a meta-evaluation. The most complex capability highest levels of emotional intelligence, according to this model, the ability to manage emotions in ourselves and others mitigate negative emotions and increasing pleasurable, and that without affecting strained or information that they convey. This aspect of improving social adaptation and problem solving, as it includes knowledge of how to calm down after a stressful feelings or to alleviate the stressful emotions of other people (Roberts, Zeidner and Matthew, 2001). Mayer and Salovey model of EI is treated primarily as a set of mental abilities. There are also mixed models, except capabilities include some other non-cognitive traits, some of which will allocate the 1995 Goleman's and Bar-on's in 1997.

Goleman's model

Goleman's leaning on Mayer and Salovey underlined some parts of their theory and emotional intelligence is defined as: knowing one's emotions, managing emotions, self-motivation, recognizing emotions in others and managing relationships. In this way Goleman's model of emotional intelligence is incorporated constructs such as optimism, motivation, awareness, social competence and specific social and communication skills.

Bar-On's model

Bar-ons model in emotional intelligence involves "a series of personal, emotional and social competencies and skills that influence one's ability to succeed in coping with environmental demands and pressures" (Bar-On, 2000). His concept of emotional intelligence includes five components: a) intrapersonal, defined by emotional self-awareness, perseverance, self-esteem, self-actualization and independence, b) interpersonal, defined by empathy, interpersonal relationship and social responsibility, c) adaptability, defined by problem solving, and objectivity in assessing and flexibility, d) stress management, which defines stress tolerance and impulse control, and e) general mood, which defines happiness and optimism.

Mayer and Salovey model of EI is treated as a set of mental abilities while Goleman's model and Bar-On except capabilities include various aspects of personality, motivational factors, orientation skills in interpersonal relationships, and a variety of social skills. Mixed models of emotional intelligence appear to be too broad and unjustified critics unintelectual characteristics attributed to intelligence. That is why they use models of Mayer and Salovey in studies of emotional intelligence seems scientifically justified. Although there are differences in the approach to the concept of EI, the general idea of these authors have in common: "The processing of emotional information: a) different and relatively independent of the capabilities that are associated with the traditional notion of intellectual resources, b) a special class abilities, not a system of preferred behavior, and c) specific important determinant of success in many areas of life, which "may be more important than IQ (Goleman, 1997, Kulenović et al, 2000).

Table 1. The revised model of emotional intelligence, (Mayer and Salovey, 1997)

Level 4: Reflexive emotion regulation in promotion of emotional and intellectual development			
capacity for openness for	ability of reflexive	ability of	management capacity with
feelings - for those pleasant	empathy or	reflexive monitoring	their own and others
and those unpleasant	separation of emotion depending on the assessment of informativeness or utility	emocija u odnosu na sebe i druge kao prepoznavanje toga koliko su tipične, jasne, utjecajne ili odmjerene	emocijama ublažavajući neugodne i pojačavajući ugodne emocije, bez umanjivanja ili prenaglašavanja informacija koje prenose
Level 3: Emotion understanding and analysis: using knowledge emotional			
ability of naming	ability of	ability of	ability of
emotion and recognition	interpreting meanings	understanding	detection
relationship between words and	which emotions are transferred	complex feelings	probable transitions
emotions themselves (eg	(eg, that the sorrow	(eg simultaneous	between emotions - like
between liking and loving)	associated with loss)	feelings of love and hate)	transition from anger to satisfaction or anger to embarrassment
Level 2: Emotional facilitation of opinions			
emotions determine	emotions are sufficiently	changes	emotional states
opinion so that	clear and accessible to	moods	facilitate access
focus attention on	Help to judgment	changing perspective	specific
important information	memories of events that are related to the different emotions	individual from optimistic to pessimistic, encouraging consideration of different views of the same situation	problems: the joy facilitates inductive thinking and creativity
Level 1: Perception, assessment and expression of emotions			
ability to observe	ability to observe	ability to correct	ability
emotion in someone	emotions in others	expression of emotion	accurate differentiation of
physical condition	people in the arts	and expression	incorrect or
feelings and opinions	actions, language and behavior	requirements associated with that emotion	true from false expression of emotion

Ways of emotional intelligence measuring

Models of emotional intelligence as a construct are assumed multiple skills that need to find ways and methods to assess. Authors Mayer and Salovey have set the criteria based on which EI can be properly measured and assessed. Emotional intelligence research conducted in three ways: respondents' self-assessments, assessments of other people and direct assessment of capability. The scales are designed for self-assessment so that they are used to assess an individual's beliefs and perceptions of competence in specific areas. Not proved to be particularly useful in the assessment of emotional intelligence and they also had poor reliability. Davies and colleagues in their research they found that emotional intelligence as measured by self-assessment scales for patients can not be distinguished from personality traits, since the results obtained on these scales highly correlated with personality factors. Descriptors rely on a person's self-understanding. In cases where self-assessment is incorrect, the results will include information relating to the person's self-perception, and not on the actual level of EI. Studies indicated the presence of a weak association between self-perceived and actual measures of ability. A meta-analysis that included 55 studies (Mabe and West 1982). Received from 0.34 correlation between self-reports and objective intelligence test scores of intelligence. Estimates of others are rarely used to measure emotional intelligence. This approach has a number of drawbacks. The first is the lack of assessment of other people's behavior significantly depends on the perception of the observer. If the appraiser has a low level of emotional intelligence, then his answer will not be valid and he would not know a good estimate another person's emotional intelligence. Valuer, in principle, operate with a very small amount of information that excludes real thoughts and feelings of others. The estimates of appraisers can affect some properties evaluated persons who are not related to emotional intelligence. For example attractiveness assessed person, her beauty, age and communication, etc. Even the authors believe that the concept of assessing other people do not have their place in the scientific methodology of measuring the emotional intelligence. Such attempts only provide interesting information about how others see us and experience our skills. Immediately assessing emotional intelligence is done using psychological instruments that directly measure abilities. The answers given are evaluated in relation to the criteria. Such an instrument constructed by the authors of the concept of emotional intelligence and operational is Multi-Factor Emotional Intelligence Scale (Meis, Mayer, Caruso and Salovey, 1999). After that they developed the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT, Mayer, Caruso and Salovey, 2000). MSCEIT-In the subjects are asked to: identify emotion in facial expressions and images generated by the mood and resolve specific problems in the mood, define the causes of different emotions and understand the progression of emotions and to determine how

best to engage the emotions in mind in situations that relate to themselves or to others. There are difficulties in determining accurate and inaccurate responses in these tests. The scoring of answers can be determined by different criteria by consensus, according to which criteria the correct answer is the one that is chosen by the majority of respondents. Appropriateness of using this criterion is based on the evolutionary and cultural findings that confirm the consistency of information that signal emotions (Bar-On, 1997; Mayer, Caruso and Salovey, 1999). This criterion may affect distorted cultural beliefs, such scoring can indicate the degree of agreement with cultural or gender stereotypes. Expert opinion (expert thinking) is a judgment on the accuracy of the responses made by experts who deal with emotions (psychiatrists and psychologists) making the use of professional experience. Correct answer is chosen by the expert.

However, researchers agree that assessments of experts are not necessarily more reliable indicator of the correct answer from a consensus group (Legree, 1995, according to Roberts, Zeidner and Matthew, 2001). Criterion may be thinking the target person (target scoring). In this case, the correct answer is determined by a person who is involved in an emotional activity (writing songs, playing or painting), and the appraiser evaluates the other person feels. It is believed that the person has more information than what's available outside observer (Bar-On, 1997; Mayer, Caruso and Salovey, 1999, 2000, Mayer and Geher, 1996, according to Roberts, Zeidner and Matthew, 2001). This method of determining the correct answer is poorly represented in research, probably because it is only suitable for the tasks of identifying emotions, and not to assess higher levels of emotional intelligence. Credible standard for evaluating response largely depends on the nature of the test particle emotional intelligence. As with the cognitive ability of particles, it can be related to different levels of abstraction. Emotional intelligence can be estimated through the processes of a lower order, which include sensation and perception. Examples of this are the detection of the presence of emotion on his face presented tahistoscopically or deciding whether two words have the same or similar valence. Meanwhile particle test of emotional intelligence can be related to higher order thinking processes, such as the choice of solutions when confronted with stressful statement. Core competencies can be most objectively assessed. In this process, expert opinion seems to be appropriate and there is no room for consensus. However, the scoring of particles which test the ability to manage emotions is much more complex, because certain emotional reactions can be assessed only by personal and social standards. Mayer and colleagues agreed that determining the correct answer by using the expert opinions and consensus overlap to some degree. Consensus has proven to be more reliable because such a criterion in the final solutions produced better factor structure, so it should be more frequently used (Mayer et al., 2003).

Emotional intelligence and different indicators of child and adolescent adaptation

It is assumed that a high level of emotional intelligence is associated with success in the important aspects of life such as education, work and relationships with people. Evidence shows that people who have a highly developed emotional skills and know well and manage their own feelings well and reread and effectively respond to the feelings of others, have the advantage in all areas of life and work. The results of research into the connection between the perception of emotions from nonverbal content with different criteria in more than seven thousand people in the United States and eighteen other countries have shown an advantage in the ability to sense from reading non-verbal cues given to people with better emotional harmony, greater popularity, greater openness and greater sensitivity. Respondents who have achieved better results were better students while they, on average, IQ was higher than the quotient in children who were less successful in reading the nonverbal messages. Those who have misconstrued emotional signs in schools, reaching results that are worse compared to the potential shown in tests of IQ (Goleman, 1997). Young people who've had trouble with the law are usually not acquired the skills of perception of emotions (McCown, Johnson, & Austin, 1986, according to Mayer, Salovey and Di Paolo, 1990). It has been shown that children who stated emphatically aggressive behavior have more difficulty in recognizing and managing their emotions. Among children of school age, a higher level of extreme symptoms was associated with reduced ability to find examples of past emotional experiences with suitable examples of feeling (Cook, Greenberg and Kusch, 1994, according to Bohnert, Crnić and Lim, 2003). Emotionally stable children showed that they know how to handle their actions, thoughts and feelings in a customized and flexible manner and in different contexts have demonstrated efficacy, self-confidence and a sense of connection with others and were better accepted by peers (Salovey and Slyter, 1999).

Sociometrical status

Social status indicates that a group accepts a person and how the person is socially adapted in group. Social adaptedness, among other things, sets and different sociometric procedures. Such techniques include sociometric test as a tool for the study of family, work and school groups. Sociometric test allows to determine the acceptability of an individual in the group. The advantage of this test in front of psychometric tests is that the artificial situation replaces natural situations that occur in everyday life. Sociometric method was developed by JL Moreno 1934th year. According to him, sociometry has several functions: 1) Sociometry is a research technique that is used to study the organization of the group or groups; 2) second Sociometry is a diagnostic procedure to determine the position of the individual to the group and the position of the group in the

community, and 3) Sociometry includes psychotherapeutic technique that helps an individual or group in a better adaptation. In the simplest form of sociometric questionnaire contains questions to each group member to indicate, among other members of the group with whom they would like to participate in an activity or those with whom they would not. Activities to participate in examining the relationship of acceptance or rejection call sociometric criteria. The sociometric test can be used one or more criteria. The criteria must be logical and must relate to the activities relevant to the individual. Testing is conducted in small group and the condition for the application of the tests that the participants know each other and that they spent some time together. It is desirable that testing be anonymous. Sociometric status of individuals in a group can be determined using three types of information. These are positive dialing, dialing, negative and neutral voices. There are different sociometric procedures such as, for example: 1) Technique appointments - where the individual seeks to appoint a number of members of the group who he really likes or dislikes. Dial number can be limited (eg, 3 or 5 possible dialing) or unlimited, 2) Second Ranking technique - the individual is asked to by a criteria in addition to all the group members. 3rd Technique comparisons in pairs - the individual is present names of two members of the group and he must choose the person with whom he is like. After evaluation of all possible pairs we get a result that shows how much an individual like every member of the group. Data obtained by sociometric testing are summarized quantitatively (sociometric matrices, and group and individual indices) and graphic (sociogram). In the case of larger groups sociogram is immense, and it is not used. Sociometric questionnaire is highly adaptable to different groups and is used in various fields of human activity in industry, schools, dormitories, military units and of course sport. Applies everywhere where some collective or group incurred or would be formed within a broader, but created, collective. In a study in which the sociometric questionnaire was used as a criterion to adapt children's early adolescence, or as a measure of acceptance in the peer group results suggest the following conclusions. If it is assumed that the emotional intelligence necessary to develop different emotional and social skills that ensure higher sociometric status in their peer group or to individuals who have developed emotional intelligence have a greater capacity to develop social skills, it can be expected that the level of skills emotional intelligence to explain the variance in sociometric status of the subjects.

School success and emotional intelligence

Exploring the determinants of academic achievement is the most intelligent students questioned, but it was determined that it explains only part of the variance in the search for other factors that could affect the success of children in school, exploring the social factors such as family background and socio-economic status, personality factors and motivational factors. Cattel, Sealy and Sweny (1966) have investigated the correlation between scholastic success to factors of personality and motivation, and found that of the total variance in school achievement tests of intelligence explain between 21 - 23%, 23-27% motivational qualities and personality traits 27 -36%. In recent years, the idea occurred to at least some success in the field of educational and professional success could explain emotional intelligence. Even more Kahneman (1973) argued that how a person is able to keep under control the other, for the background and irrelevant thoughts and events affecting success in performing basic activities (Takšić, 1998). Goleman also describes the importance of managing emotions for success in school and said: "The extent to which emotional upset can affect the mental life of teachers are nothing new. Students who are anxious, angry or depressed do not learn; persons who are engaged in these states do not receive information in an efficient way or treat them worse. Strong negative emotions shift attention to their own preoccupations, hampering attempts to focus on something else" (Goleman, 1995). Logic model of Mayer and Salovey is based on the assumption that emotional intelligence could have positive effects on school performance was based mainly on the part of the model that discussion of how emotions facilitators opinion (level B). Takšić in his study came to the conclusion that the variables of emotional intelligence significantly contribute to further explain school success. The variables of emotional intelligence have increased by 13.5% percentage of variance explained by school performance general intelligence (Takšić, 1998). Generally speaking, the personality factor explains only a small part of the life story, so that the contribution of emotional intelligence of 10% in clarifying this could be considered a very large (Salovey and Sluyter, 1999).

Sport success and emotional intelligence

Words "training", "physical education classes and procedures", are synonyms from the standpoint of kinesiological transformations. Changes occurring under the action of the operator kinesiology (exercise) and is always a complete personality change so that in real cases it is not possible to study the isolated structure. And if the training and education process is the transformation goal (to achieve functional efficiency), the only issue is the question of differences in which the field is achieved functional efficiency. Man as an integral being always works the same way, by developing a whole. In practice there is no difference between the process of training and learning process, or if there are, they are only and always of a technical nature. Success in each sport activities depends on a number of different and interrelated factors such as the morphology and structure, practical qualities, intellectual and emotional characteristics, motivational structure, physiological functional characteristics, technical and tactical knowledge, theoretical knowledge, and more. Equation

specification few sporting disciplines is a mathematical expression that combines all the factors that are relevant to the success of her with that is included by mistake. The logic of the mathematical model should always reflect the reality and logic of a mathematical model of action should fully embrace complexity of given sporting discipline. Appreciation direct correlation between psychological factors and sporting success, has led to the psychological findings are treated as an inseparable part of the equation specification sports activities, and total specific athletic preparation. In psychological work with athletes were investigated psychological dimensions relevant to the success of the sport and those that are of importance for the integral development and functioning of personality, and that in the teaching field can significantly affect. Until recently, psychologists have explored the area standard of intellect (cognition), the area of emotions (connate factors) and motifs, and relatively few have dealt with the evaluation of the structure and dynamics of sports groups which otherwise belongs to the field of sociology (Lozovina, M. et al. (2011) and Lozovina et al., (2012). Emotional intelligence athletes and micro dynamics of the social environment, and sociometric status of athletes, especially in team sports have not been systematically studied to date, and clearly that is of great importance to the success of any sports discipline. For these reasons, this text is intended primarily for psychologists and kinesiologists who work in the sport. Psychologists with the effort made to encourage the construction of good measuring instruments for measuring emotional intelligence athletes and efficient use of sociogram method and kinesiologists to cooperate with psychologists in the most efficient way to take advantage of the results obtained.

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EMOCIONALNA INTELIGENCIJA I ODREĐIVANJE SOCIOMETRIJSKOG STATUSA U SPORTU

Sažetak

Emocionalna inteligencija (EI) novi je predmet istraživanja u području psihologijskih znanosti. Kao pojam i koncept pojavljuje se devedesetih godina. Salovey i Mayer EI definiraju kao skup sposobnosti koje pridonose boljoj i točnijoj procjeni i izražavanju svojih emocija, procjeni tuđih emocija i upotrebi osjećaja u motiviranju i planiranju akcija u dosezanju ciljeva u životu. Roberts, Zeidner i Matthews EI definiraju kao tip inteligencije koji uključuje sposobnost procesiranja emocionalnih informacija gdje emocije predstavljaju organizirani mentalni odgovor na aktualne događaje koji uključuju psihološke, iskustvene i kognitivne funkcije. Kako se mijenja odnos neke osobe prema drugoj ili objektu, mijenjaju se i emocije prema toj osobi ili objektu, nezavisno dali su ti odnosi stvarni, pohranjeni u sjećanjima ili zamišljeni. Prema Mayeru EI predstavlja sposobnost prepoznavanja značenja emocija i njihovih veza, dakle korištenja emocija kao temelja za razumijevanje i rješavanje problema što uključuje kognitivne procese što znači da korištenje emocija može efikasno poslužiti i za poboljšanje kognitivnih aktivnost. Postoje različite konceptualizacije EI. Jedne uključuju čitav raspon adaptivnih karakteristika povezanih sa emocijama, druge naglasak stavljaju na kognitivne elemente, a treće EI konceptualiziraju kao sposobnosti i crte ličnosti. Potrebna je suptilna analiza kako bi se utvrdilo što jest, a što nije dio EI. Koncepti EI naslanjaju se na jedan od dvaju načina gledanja na relacije između emocija i logičkog mišljenja u psihologiji. Ono što je posebno važno jest da uvažavanje neposredne povezanosti između psiholoških faktora i sportske uspješnosti, omogućilo je da se psihološka saznanja tretiraju kao nerazdvojni dio jednadžbe specifikacije sportske aktivnosti. U radu sa sportašima i ranije su ispitivane psihološke dimenzije relevantne za uspjeh u sportu kao i one koje su od značaja za integralni razvoj i funkcioniranje ličnosti. EI sportaša kao i dinamika mikro socijalne sredine, posebno u kolektivnim sportovima, nisu sustavno istraživani do danas iako su od izuzetnog značaja za uspjeh u svakoj sportskoj aktivnosti. Ovaj tekst iz tih razloga, prvenstveno je namijenjen psiholozima i kineziolozima koji rade u sportu. Psiholozima sa nakanom da ih potakne na konstrukciju dobrih mjernih instrumenata za mjerenje EI sportaša i usmjeri na efikasno korištenje sociogram metode, a kineziolozima da u suradnji s psiholozima na što efikasniji način iskoriste dobivene rezultate.

***Ključne riječi**: Emocionalna inteligencija, model, sociometrija, sport, trening*

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LOWER-EXTREMITY DEFORMITIES IN STUDENTS OF PRIMARY SCHOOL-AGE

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Abstract
The study was conducted on a sample of 204 respondents – students of both sexes of Primary school "Vuk Stefanovic Karadzic" in Banja Luka. Out of total number of respondents, the male population encompassed 110, and the female group consisted of 94 respondents. All respondents regularly attend physical education classes. In order to assess the presence of the lower-extremity deformities, angular problems which include bowlegs and knock-knees were considered for the purpose of the current study. The aim of the study was to determine the actual situation regarding the presence of the lower extremity deformities in the primary school students, of both sexes, as well as to undertake certain activities in the sense of timely diagnosis, monitoring and taking efficient corrective programs of physical exercise. The results of the study indicate a relatively low presence of measured lower-extremity deformities in the knee joint of studied population, with somewhat higher percentage of presence in girls compared to boys. Thus, these results oblige us to be cautious and carry out a constant monitoring of the students, so as to be able to conduct a timely diagnosis and undertake adequate activities on preventive and corrective work.

Key words: *Knock-knees, bowlegs, students, sex, corrective program*

Introduction

Posture is the basic prerequisite for good health, proper growth and development of man in general, which is why it is very important that proper development of posture starts at an early age. Past experiences show that the characteristics of the environment affect the way of life, including the posture, which are later reflected in the life cycle of each individual. The fact is that in the physical education of children there are a number of defects that need to be obviated. If one should look for the causes of poor posture in school population, then they certainly should be sought first in the family, and then in preschool institutions, because the right approach and understanding of the importance of physical activity in general by parents and educators, is a prevention for school children and youth. Based on numerous studies conducted by different authors in the area of postural disorders and physical deformities in the school population in primary schools (Bogdanovic, Z., Konicanin, A., 2009), it can be argued with certainty, that the number of children with disturbed bodily status each year is constantly increasing. Professor of physical education plays a significant role in the timely detection of deformity, implementation of corrective treatment, and the process of education in proper posture (Koturovic, Lj, Jaricevic, D., 1984, Bogdanovic, 2007). According to Kosincu (2008), the proper body posture creates favorable conditions for the activity of the locomotor apparatus. The muscles that maintain balance of the body are in the normal tonus (tension). Their tonus is balanced, and it provides the readiness of muscle to move. Thus, the imbalance of tonus and weakness in certain muscle regions, primarily the muscles of the back, chest and abdomen are the primary causes of the deformity in the proper posture in children. Also, muscle weakness in pelvic girdle and lower extremities can lead to secondary deformities in the upper parts of the body. The subject matter of this research is to determine the real situation of the presence of the lower-extremity deformities (knocked-knees and bowlegs) in primary school students and their connection to gender.

Methods

Sample of respondents
The sample encompassed 204 respondents – students of higher grades from Primary school "Vuk Stefanovic Karadzic" in Banja Luka who represented the population of primary school students of both sexes. The selection of sample respondents was conditioned by organizational, economic and personnel capabilities for implementation of measurements. All respondents regularly attend physical education classes.

Sample of variables
To assess the presence of deformities in lower extremities, the disorders in the knee joint, namely bowlegs and knock-knees were taken into account, which are quite present in the population of this age, 1. Bowlegs (Genu varum) (GVR), 2. Knock-knees (Genu valgum) (GVL).

Data processing
Statistical procedures have confirmed relevant frequencies of certain deformities and the percentage of deviation from the proper posture based on the applied variables and the size of deformity by gender.

The technique for determination of deformity in lower extremities

Conditions of the lower extremities were observed from the front side. Respondents who had straight legs and whose knees and feet were touching were recorded as respondents with normal lower extremities. If the intercondylar distance was greater than 20 mm, the respondents were recorded as subjects with bowlegs, and if the intermalleolar distance was more than 20 mm, these respondents were registered as subjects with knock-knees.

Results and discussion

Table 1 shows the sample respondents by grade and gender. As shown in Table 1, study included 204 respondents. Out of total number, there were 110 or 53.9 % of male and 94 or 46.1% of female respondents. Thus, the sample respondents can be considered representative in terms of size and selection.

Table 1. Data on sample respondents by grade and gender

Grade	Male	Female	Total
VI	35	37	72
VII	29	22	51
IX	46	35	81

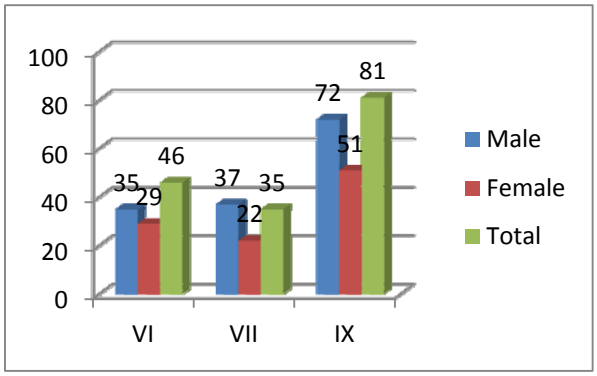

Figure 1 Graphical representation of respondents by grade and gender

Presence of deformities in lower extremities knock-knees and bowlegs in the entire sample respondents

Table 2 shows the results of present deformities in lower extremities in the knee region in the studied population of primary school students of both sexes. Table 2 shows, in number and percent, the condition of body posture and the presence of deformities in lower extremities.

The prevalence of knock-knees was 11% (22 cases) out of which 4% (8 cases) had a smaller deviation and 7% (14 cases) had a larger deviation from the normal position. The bowleg abnormality was established in only 1% (2 cases) of respondents and that with a smaller deviation, while a larger deviation was not recorded.

Table 2 Presence of deformities in lower extremities in relation to the total number of respondents of both sexes

Variables		Normal	Smaller deviation	Larger deviation	Total
Bowlegs	Number	202	2	0	204
	Percent	99%	1%	0%	100%
Knock-knees	Number	182	8	14	204
	Percent	89%	4%	7%	100%

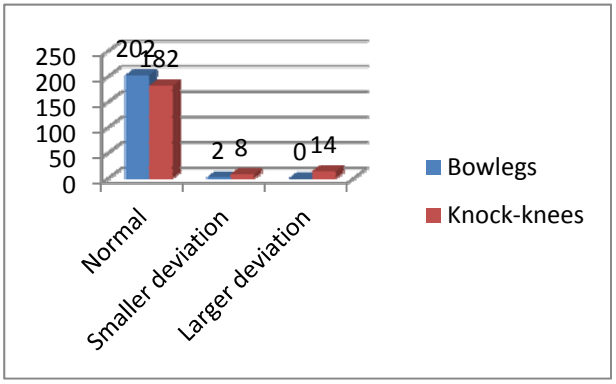

Figure 2 Graphical representation of presence of deformities in lower extremities in relation to the total number of respondents of both sexes

Presence of deformities in lower extremities in male respondents

Table 3 shows the results of present (frequent) deformities in lower extremities in the knee region in the studied population of primary school-age boys. Data analysis in Table 3 shows the presence of deformities in lower extremities in male respondents and it can be concluded that lower-extremity deformity "knock-knees" was present in only 9% of all cases while deformity "bowlegs" was not recorded in boys.

Table 3 Presence of lower extremity deformities in boys (M = 110)

Variables		Normal	Smaller	Larger	Total
Bowlegs	Number	110	0	0	110
	Percent	100%	0%	0%	100%
Knock-knees	Number	101	4	5	110
	Percent	91%	4%	5%	100%

Presence of lower-extremity deformities in female respondents

Table 4 shows the results of present lower-extremity deformities in the knee region in the studied population of primary school-age girls.Data analysis in Table 4 shows the presence of lower-extremity deformities in female respondents and it can be concluded that the lower-extremity deformity "knock-knees" was recorded in 14% of cases while deformity "bowlegs" was recorded in 2% of studied cases. The review of research results regarding the presence of lower-extremity deformities in boys and girls shows the prevalence of lower extremity deformities in the knee region more in female respondents compared to male respondents.

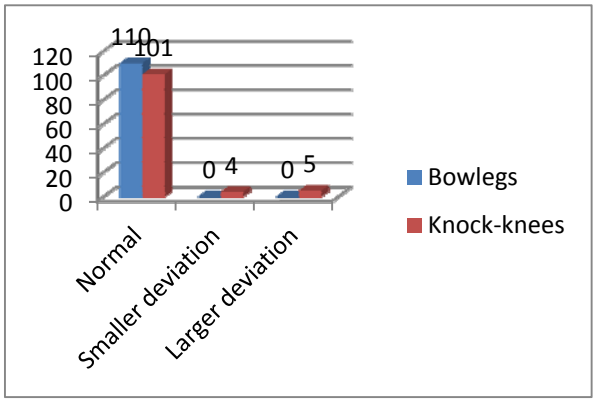

Figure 3 Graphical representation of the presence of lower-extremity deformities in boys (M = 110)

Table 4 Presence of lower-extremity deformities in girls (F = 94)

Variables		Normal	Smaller deviation	Larger deviation	Total
Bowlegs	Number	92	2	0	94
	Percent	98%	2%	0%	100%
Knock-knees	Number	81	4	9	94
	Percent	86%	4%	10%	100%

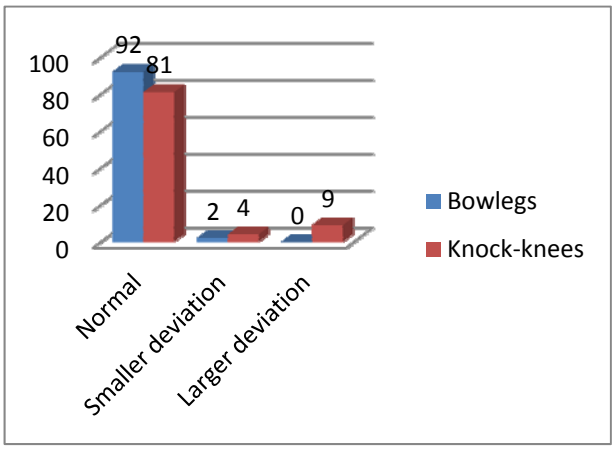

Figure 4 Graphical representation of the presence of lower-extremity deformities in girls (F = 110)

Conclusion

The study was conducted on a sample of 204 respondents of both sexes of Primary school "Vuk Stefanovic Karadzic" in Banja Luka. Out of total number of respondents, the male population encompassed 110 respondents, and the female population consisted of 94 respondents. All respondents regularly attend physical education classes. The aim of the study was to determine the actual situation regarding the presence of the lower extremity deformities in primary school students, of both sexes, as well as to undertake certain activities in the sense of timely diagnosis, monitoring and taking efficient corrective programs of physical exercise. Analysis of the presence of lower-extremity deformities in the studied sample came to the following conclusions: The prevalence of knock-knees was 11% (22 cases) out of which 4% (8 cases) had a smaller deviation and 7% (14 cases) had a larger deviation. The bowleg deformity was observed in only 1% (2 cases) of respondents and that with a smaller deviation. In relation to the gender, the obtained results show that the deformity in lower extremities "knock-knees" in male respondents was present to a lesser extent, only 9%, while "bowlegs" deformity was not found. In female respondents a somewhat higher presence of lower-extremity deformities was observed and that "knock-knees" in 14% of cases and "bowlegs" in 2% of studied cases. The review of research results regarding the presence of lower-extremity deformities in boys and girls shows the prevalence of lower extremity deformities in the knee region more in female respondents compared to male respondents. The results of the study indicate a relatively low presence of measured lower-extremity deformities in the knee joint of studied population, but these results compel us to be cautious and carry out a constant monitoring of the students, in order to be able to conduct a timely diagnosis and undertake effective corrective programs of physical exercise. This certainly implies the introduction of at least one medical examination during the school year, in cooperation with professionals, and during which a special attention would be given to the timely identification of deformities in students.

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DEFORMITETI DONJIH EKSTREMITETA KOD ISPITANIKA UZRASTA OSNOVNE ŠKOLE

Sažetak

Istraživanje je provedeno na uzorku od 204 ispitanika - učenika oba spola osnovne škole „Vuk Stefanović Karadžić" iz Banja Luke. Od ukupnog broja ispitanika mušku populaciju činilo je 110 ispitanika, a žensku populaciju činilo je 94 ispitanika. Svi ispitanici redovno pohađaju nastavu fizičkog vaspitanja. Za procjenu prisustva deformiteta donjih ekstremiteta uzeti su poremećaji u zglobu koljena, „X" i „O" noge. Osnovni cilj istraživanja bio je da se utvrdi stvarno stanje prisustva deformiteta donjih ekstremiteta kod učenika osnovnoškolskog uzrasta oba spola i pokrenu određene aktivnosti u smislu pravovremenog dijagnosticiranja, kontrole i preduzimanja efikasnih korektivnih programa tjelesnog vježbanja. Rezultati istraživanja ukazuju na relativno malo prisustvo mjerenih deformiteta donjih ekstremiteta u zglobu koljena kod ispitivanog uzorka ispitanika i da je ono u nešto većem procentu prisutno kod učenica nego kod učenika. Međutim, i ovi rezultati nas obavezuju da moramo biti obazrivi i vršiti stalne kontrole učenika radi pravovremenog dijagnosticiranja i preduzimanju adekvatnih aktivnosti na preventivnom i korektivnom radu.

Ključne riječi: *„X" noge, „O" noge, učenici, spol, korektivni program*

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DIFFERENTIAL ANALYSIS OF THE WING ROLE IN THE TEAM TACTICS OF MALE WATER POLO

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Abstract
Collective tactics is based on the division of roles in all phases of the game. There are several roles or positions in water polo: center forward, guard, wing, external attacker and goal keeper, all of which are instruments in the realization of collective tactics. The aim of this study was to describe the play on the position of wing (W) and compare it with other roles. The subject of this investigation was the description of all the activities in the game without contact with the ball (all swimming, duels, man up/down situations). Data collection was performed by registering players' activity on official games of the International Adriatic Water Polo League in the season 2009/10. The main units of measurement, i.e. entities were: position-player-quarter. The results were registered using 21 indicators and basic statistics was performed. Differential analysis for the position of W. regarding other players (positions) was carried out on the basis of testing the model of binary logistic regression equation. The biggest differences of the wing against other roles are noted in the frequencies of duels (1:3) and duels duration(3:16)as well in the all types of swimming (crawl, back stroke and breast stroke) in all intensities on the smaller distances (express in frequencies and meters), fkaul (18:14), fled (3.07:2.08), prlag (1.64:0,99), mkraul (188.54:160.71), mled (12.60:10.05), mprsno (7.87:4.82). In the frequencies according to intensities for maximal (3.63:2.30), sub maximal (9.13:7.05) and light (10.06:8.46) and in the frequencies totally (22.82:17.81).In various techniques measured in meters: in crawl technique (188.54:160.71), back stroke (12.60:10.05) and breast stroke (7.87:4.82), according to different intensities, maximal (33.39:31.80, sub maximal (102.58:86.29) and light (73.04:67.49). On the indicator MUKUPNO, irrespective the intensities and techniques, these relationship are (209.25:178.11). Placed binary logistic regression model is adequate and have prediction power of 39.2%. Statistically significant contributions in regression equitation have indicators: FLESMAX (OR=3.23) i FDUEL (OR=1.134), with positive and MLESMAX (OR=0.81), MLELAG (OR=0.87) i MDUEL (OR=0.80) with negative contribution. Specify is detailed statistical description of the play without ball on the position wing in the water polo game. Signification and structure of the differences of the wing against other roles is affirmed. Characteristics in the play of wing are exceeds total activity and frequencies of the swimming. By applying binary logistic regression, we defined the differential characteristics of the W in contrast to other roles in the game, which resulted in the equation of play structure on the position of W. Solitary contributions in the prediction of the role of W are represented in the linear equation for the position W. The results of this investigation will contribute to the elaboration of water polo game model in the domain of situational play without the ball (realization of the collective tactics regardless of the choice of the type of tactics in either attack or defense).

Key Words: *water polo, game, tactic, wing, statistics, model, logistic regression*

Introduction

The tactic of collective Olympic sport game Water Polo is a plan which relies on the partition of players' roles in the game (Lozovina, 2009, Pavičić 1991). A water polo team consists of 7 players with allocated roles: center forward, wing, guard, external attacker and goal keeper. Depending on the development of the play any player can take up the given roles, but it is usual for players to play only one given role. Collective tactics in the defense is divided into two main types: zone defense, man to man defense on the team's own half, on the whole playfield and pressing as a drastic type of such defense. In attack, the tactics focus on efficiency of goal scoring. In the simplest tactics, attack is performed as an attempted counter attack and subsequently as positional attack. For any position the tactics provide area of the play field where activity will take a place as well as the type of duties in attack and in defense where the players implemented theirs roles (Lozovina, 1985, 2002, 2003, 2004, 2006, 2007, 2009, Pavičić 1991). From the tactical point of view, man up/down situations, are particularly interesting and important. As such situations arise from penalty expulsion (20 seconds), they are a great advantage or handicap for teams and represent extremely important fragments of tactics. Actions carried out in movement are defined by horizontal positions (horizontal phase of the game). All man up/down situations as well as duels are defined by the vertical position (vertical phase of the game), regarding the surface of water line in the swimming pool. In the total game duration, it is possible to describe two main phases of players' activity: active and idle phase (Lozovina 2009, Pavičić 1991, Bratuša, Z., Matković, I., & Dopsaj, M. 2003, Platonou T, Geladas N 2006). The idle phase is a situation in which a player participates in the game

only by overlooking the development of the game, but in situ and without contact with the ball. The idle phase directly raises the time spent in the quarter, and, of course, belongs to the vertical phase of the game and was not included in this investigation. In this paper the model of the wings play is appointed and verifies on the base of comparison of the models elements with all other positions in the play. In respect that the wings are reliance of the team in transition, positional attack as well in defense it is await by them the major quantities of swimming (crawl maximal and sub maximal) increasing frequencies and larger distances (in meters) pass over. For the wings the play area, by the longitudinally axis, is space between two imagined penalty lines and near out line by transversally sides of the play field (Lozovina at al 2002). This specialization determines repertoires of individual techniques, types of movements and types of duels. Theirs effects zone (the part of the play field where realized own tasks) are besides lateral sides of playground). Therefore the wings have considerably smaller requirements on the pressing play in defense phase as well les swimming in positional attack phase of the game. Meantime, considerably expressed is requirement to obstruct the counter attack of the opponents, in the first defense phase (transition) as well as prevention of the shots from lateral and external positions, in the second phase of defense (positional defense). In the transition and attack phase wing gives remarkable contribution in organization of outflow of the play towards goal (implementation and accompanying of counterattack, reception and allocation of the ball to other players in transition phase, transmission of the ball and passing in the creating phase for potential realization). In positional attack wing is in charge for fast flow and distribution of the ball and just sometimes actively participate in attackers actions (cross-swimming, quotations either crossing blockages). It assumes that different roles and task aimed to wings in frame of their tactics in attack and defense will result by differences in swimming techniques, frequencies and intensities in horizontal phase of the game equally as differences in frequencies, quantities of the time spent in the play with unequal number of players and duels in vertical phase of the game (Lozovina at al. 2002, 2003, 2004, Lames 2006).

Methods

In the experimental phase, the following were objectively registered during official water polo games: quantities, means, frequencies and intensities of players' activities in the roles of wing, guard, center forward, and external attacker. This was achieved by monitoring and registration of players' activity on the official games of the International Adriatic Water Polo League in the season 2009/10 (Lozovina 1985, Lozovina at al. 2002, 2003, 2004, 2006, 2009, Platonou 2006). The basic statistics were calculated for: frequency of actions, quantities according to techniques of swimming in three intensities for the phases where the players were in horizontal position. For the vertical phase, duels and man up/down situations in the game were registered. Activities were monitored by the system of 21 indicators on the 28 official matches. However, play with the ball was not registered in this experiment, regardless of the types of tactic applied. The entities in this investigation were players–in given roles–in one quarter. Totally, 665 such entities were registered. Although the indicator values in the model were registered by frequencies, meters and seconds, these registered values found themselves on the real and ordinal scale with expected normal and Poisson distribution. Placed is the model for W's (wings) role expressed by binary logistic regression equation:

$$\mathbf{ln\ [odds(Y=1)=Y=b0 + b1X1 + b2X2 + .. bmXm + e}$$

Where Y is the play on the position of C.F., b coefficient of the ponder for variable X.

Measurements

Data collection was carried out on the official games of the International Adriatic Water Polo League in the season 2009/10. Registration and data sampling was performed by five qualified surveyors, professors of kinesiology, and experienced water polo trainers. In the game, during the time the player spent playing, all his movements, intensities and positions of the body (horizontal and vertical) were recorded. The criteria for estimation of work intensity, namely of burden, were: maximal, sub maximal and slight. They were determined on the basis of swimming speed in the course of actions. The vertical phase in the play was registered using frequencies and time spent in duels as over maximal load as well as frequencies and time spent in man up/down situations as maximal load . The measurers were trained in measuring the same player on 10 games. The survey was carried out only after a complete concordance among surveyors was achieved. They were positioned on high-visibility positions, which enabled optical coverage of the whole playing field. Standard water polo markers (2 m, 5 m, goal out line, center, etc.) enabled precise recording of swimming distances at various intensities of players. Each official recorded all activities of their designated player. At every moment, they had full view of the official time clock, which showed a down count of the official, clean game time and of smaller time clocks that showed ball possession and attack time. Each official consecutively recorded every action taken by his designated player. In case a player was thrown out of the game or had not been in the game (excluding time or change of players), time was measured when the player exited the game and reentered the game (Lozovina at al 2002, 2003, 2004, 2006, 2007).

Data analysis

All variables are presented by statistics: Min. Max, Med. A.M. and S.D. For testing the normality of distributions K.S.-test was performed. For the purpose of identification of structure and the comparative relevance of individual measures for

differentiation of the role W. (wing) from others, regression algorithm was applied, i.e. in respect with metric characteristics of results on indicators the Binary Logistic Regression Model was applied. Adequacy of placed model was tested by Hosmer and Lemeshow tests whereas quantity of explained variance was obtained by Cox & Snell R Square and Nagelkerke R Square determination coefficients (multiple correlations). Calculated and presented are tables with frequencies and guess percents of the Model. For any variable B (Logistic beta), Wald (Sig.), (Odd Ratio – Exp (B), and 95% CI Exp (B) were calculated. All results were plotted in graphics (Wing against other roles), given as relations of expected probabilities on the Y axis, and as expected standardized residuals on the X axis. For the purpose of interpretation the W. activity, indicators per swimming techniques (crawl and back stroke) in intensities (maximal, sub maximal and light) were added up. In addition, the total number of actions expressed by frequencies as well as the total number of meters swum was calculated. These results are presented in histograms. For statistical conclusions we used lower rigorous criteria $p<0.05$ and higher rigorous $p<0.001$. For analysis statistical SPSS 19 package was used (Cox Dr, Snell Ej, 1989, Hosmer Dw., Lemeshow S, 2000, Nagelkerke Njd 1991).

Results

Statistics of frequencies showed that the wings did not differ since other players according to swimming frequencies, total frequencies of backstroke swimming and frequencies of breast stroke light swimming. Significant differences are registered in the frequencies of total swimming (FUkupno 21.5:16). Significant differences are also noted in total frequencies in crawl swim technique (FKraul 18:14), brute expressed through intensities of maximal and sub maximal swimming (FMax 3:1 and FsMax 8:6) and weaker expressed next to light intensity (Flag 9:8). In the quantity of swam meters, totally, in all techniques with all intensities, wings statistically significantly differ from other players (MUkupno 205:172). The biggest, statistically significant differences are registries in the meters swam in crawl technique (MKraul 186:158), somewhat lower, but statistically significant differences in the meters swam in back stroke technique (MLed 9.5:6) and smallest, but statistically significant, in meters swam in breast stroke technique (MPRLAG 5:2). Besides in the meters swam in crawl technique, statistically significant and greatest differences are registries in the swimming in maximal intensities (MMax 23.5:13), somewhat lower, but statistically significant in the swimming in sub maximal intensity (MsMax 93:78), and significant, but minimal, in the meters swam in light intensity (Mlag 61:59). In the meters swam in back stroke technique statistically significant differences are registries in the swimming in maximal and sub maximal intensities (MLEMAX 0.88:0.33 and MLESMAX 3.62:2.37). Set forth parameters and relations defined horizontal phase in the play of wing in juxtaposition with players in other roles in the game. In vertical phase of the play (over maximal and maximal load) wings from other players differs in the frequencies and duration of duels (FDUEL 1:3 and MDUEL 3:16). In the play with unequal number of players, in the play with player more in the frequencies wing did not differs from other players but differs according the spent time in the play with player more (FIGVIS 1:1 and SIGVIS 20:15). The same happened in the play with player les (FIGMAN 1:1 and SIGMAN 16.50:12). By applying binary logistic regression model, the differential characteristics of the wing regarding other roles in the game are defined and typified in the equation of play structure on the position W. The adequacy of placed model was tested by Hosmer and Lemeshow tests. We conclude: The Model is very well calibrated ($\chi^2 =$ 8.858 with 8 degrees of freedom and $p=0.35$). Coefficients of determination, (R^2) Cox &Snell (0.25) and Nagelkerke (0.39), are quite small, providing for 39% of variance. Prediction for total is 84.2%, for the position of wing is high 95.3% and for other roles 41.2% (Table 4.). Solitary contributions in prediction for the role of W. are represented in (Table 5.).

Linear equation for the position of W. is:

$$\mathbf{ln[odds(Y=1)=Y= -1.978 + 0.72\ _{FLESMAX} - 0.13\ _{MLSMAX} - 0.08\ _{MLELAG} + 0.40\ _{FDUEL} - 0.18\ _{MDUEL}}$$

Thru the indicators with positive contribution /formula (100-(odds ratio-1)/ it is possible to conclude that any entity with increase in result in FLESMAX of one standard deviation will raise the chance (odds) that is wing, per 31% (increasing in result of 1 SD (0.902), respectively 13% in FDUEL (SD=2.234). Conversely, in indicators MLESMAX, MLELAG and MDUEL, with negative sign, by increasing of 1 SD (5.958; 9.252 and 15.903) will decrease chance (odds) that they are wings, for adequate percent (19.4% ; 13.2% and 21%).

Discussion

According given results typical for the wings are longer swimming in maximal intensities, which satisfies the formation tasks of this position, especially in transition phase of the play. Greater values on the other indicators (swimming according length and type) correspond with necessary activities of the wing in defense where the wings are especially most movable when performing tactical tasks in obstruction of opponents movements in attack and prevents opponents ball passing (Lozovina at al 2002, 2007, Lozovina M and Lozovina V. 2009). In other swimming in attack (according length and type) wings additionally realize an active role in positional attack in the actions of cross-swimming and blockage. In the implementation of the tactics, in the tasks related with transition phase, wings practice intensive translation themselves and the ball in the attack zone thus materialize space advantage in counter attack which is confirmed in the results of this investigation.

Table 1. Minimum, maximum, mean and standard deviation statistics of frequencies

		Other					**Wing**					**Total**			
	Min	Median	Max	Mean	S.D.	Min	Median	Max	Mean	S.D.	Min	Median	Max	Mean	S.D.
FKRMAX++	0	1	13	2.20	2.40	0	2.5	17	3.37	2.96	0	2	17	2.44	2.57
FKRSMAX++	0	6	20	6.59	3.97	0	7.5	26	8.18	4.49	0	6	26	6.92	4.13
FKRLAG*	0	5	20	5.94	3.90	0	6	20	6.55	4.35	0	5	20	6.06	4.00
FKraul	0	**14**	41	14.72	6.99	1	**18**	45	18.10	7.64	0	**15**	45	15.42	7.25
FLEDMAX*++	0	0	4	0.10	0.36	0	0	4	0.26	0.71	0	0	4	0.13	0.46
FLESMAX++	0	0	5	0.46	0.90	0	0	6	0.95	1.33	0	0	6	0.56	1.02
FLELAG*	0	1	9	1.53	1.69	0	1	10	1.87	1.97	0	1	10	1.60	1.75
Fled++	0	**2**	12	**2.09**	2.09	0	**2**	14	**3.07**	2.78	0	**2**	14	**2.29**	2.28
FPRLAG++	0	1	11	0.99	1.43	0	1	12	1.64	2.04	0	1	12	1.13	1.60
FMax++	0	**1**	17	2.30	2.55	0	**3**	21	3.63	3.36	0	**2**	21	2.57	2.78
FsMax++	0	**6**	25	7.05	4.42	0	**8**	27	9.13	5.12	0	**7**	27	7.48	4.65
Flag++	0	**8**	39	8.46	5.41	0	**9**	29	10.06	6.23	0	**8**	39	8.79	5.62
FUkupn++	0	**16**	49	17.81	8.82	2	**21.5**	71	22.82	10.20	0	**17**	71	18.83	9.33

*/**KS – normal distribution at p>0.05/0.01, +/++ significant - Mann-Whitney U at p>0.05/0.01

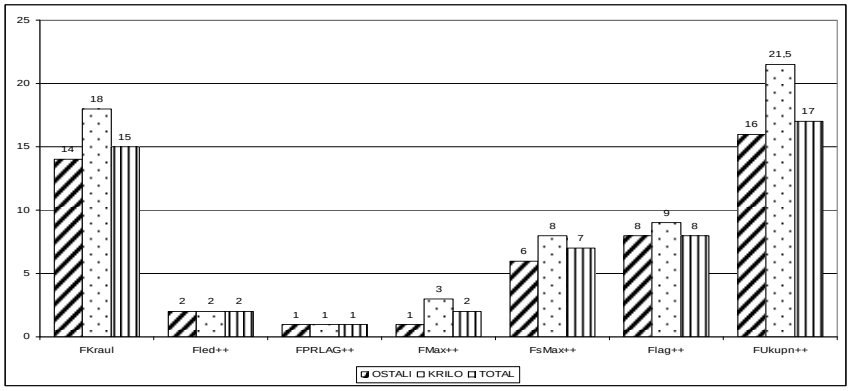

Figure 1. Histogram of medians-frequencies of actions in various intensities-horizontal phases

Table 2. Minimum, median, maximum, mean and standard deviation statistics meters swum in various intensities - horizontal phase

		Other					Wing					Total			
	Min	Median	Max	Mean	S.D.	Min	Median	Max	Mean	S.D.	Min	Median	Max	Mean	S.D.
MKRMAX**	0	13	191	21,47	27,37	0	22,5	166	32,52	31,07	0	15	191	23,73	28,49
MKRSMAX+**	0	75	285	83,92	51,75	0	90	398	98,96	60,70	0	79	398	87,00	53,99
MKRLAG+	0	50	213	55,31	38,77	0	46	165	57,067	41,58	0	49	213	55,67	39,34
MKraul+**	**0**	**158**	**454**	**160,71**	**72,41**	**10**	**186**	**463**	**188,54**	**78,33**	**0**	**162**	**463**	**166,40**	**74,45**
MLEMAX+**	0	0	13	0,33	1,26	0	0	20	0,88	2,58	0	0	20	0,44	1,63
MLESMAX**	0	0	67	2,37	5,96	0	0	25	3,63	5,467	0	0	67	2,63	5,88
MLELAG+	0	5	75	7,35	9,25	0	6	51	8,10	9,31	0	5	75	7,51	9,26
MLed**	**0**	**6**	**75**	**10,05**	**11,32**	**0**	**9,5**	**71**	**12,60**	**12,72**	**0**	**7**	**75**	**10,57**	**11,66**
MPRLAG**	0	2	39	4,82	6,85	0	5	47	7,87	9,46	0	2	47	5,44	7,55
MMax**	**0**	**13**	**191**	**21,80**	**27,81**	**0**	**23,5**	**166**	**33,39**	**32,25**	**0**	**15**	**191**	**24,17**	**29,12**
MsMax+**	**0**	**78**	**291**	**86,29**	**52,79**	**0**	**93**	**400**	**102,59**	**61,86**	**0**	**81**	**400**	**89,63**	**55,11**
Mlag+	**0**	**59**	**216**	**67,49**	**44,61**	**0**	**61**	**201**	**73,04**	**49,14**	**0**	**60**	**216**	**68,62**	**45,59**
MUkupno**	**0**	**172**	**454**	**178,11**	**80,22**	**10**	**205**	**499**	**209,25**	**85,27**	**0**	**179**	**499**	**184,48**	**82,18**

*/**KS – normal distribution at p>0.05/0.01; +/++ significant - Mann-Whitney U at p>0.05/0.01

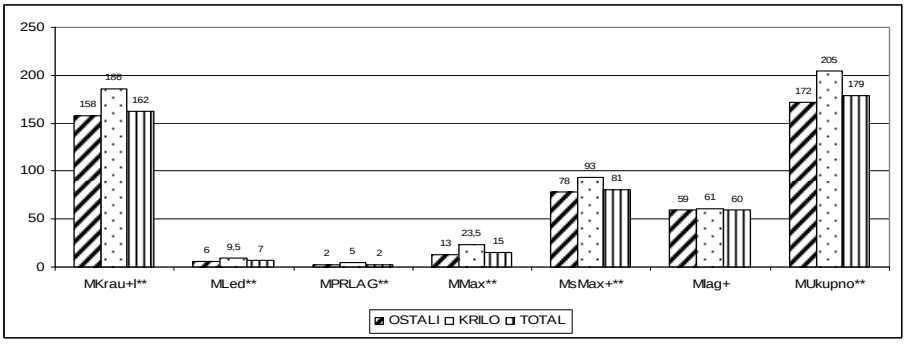

Figure 2. Histogram of medians – meters swam in various intensities – horizontal phase

Table 3. Minimum, median, maximum, mean and standard deviations statistics of duels, unequal number of players, total time in the play – vertical phase

		Other					**Wing**					**Total**			
	Min	Median	Max	Mean	S.D.	Min	Median	Max	Mean	S.D.	Min	Median	Max	Mean	S.D.
FDUEL**	0	3.00	10	3.01	2.23	0	1.00	10	1.68	2.16	0	2.00	10	2.74	2.28
MDUEL**	0	16.00	78	18.40	15.90	0	3.00	46	6.49	9.11	0	12.00	78	15.96	15.53
FIGVIS**	0	1.00	5	1.15	1.09	0	1.00	7	1.63	1.23	0	1.00	7	1.25	1.14
SIGVIS**	0	15.00	106	16.69	17.43	0	20.00	69	23.77	18.05	0	16.00	106	18.14	17.78
FIGMAN+**	0	1.00	5	.87	.91	0	1.00	4	1.16	.95	0	1.00	5	.93	.92
SIGMAN+**	0	12.00	77	13.50	15.10	0	16.50	74	17.68	16.59	0	13.00	77	14.36	15.50
SUKUPNO**	24	284.00	480	289.76	121.25	24	341.00	480	338.13	121.42	24	298.00	480	299.65	122.76

*/**KS – normal distribution at p>0.05/0.01; +/++ significant - Mann-Whitney U at p>0.05/0.01

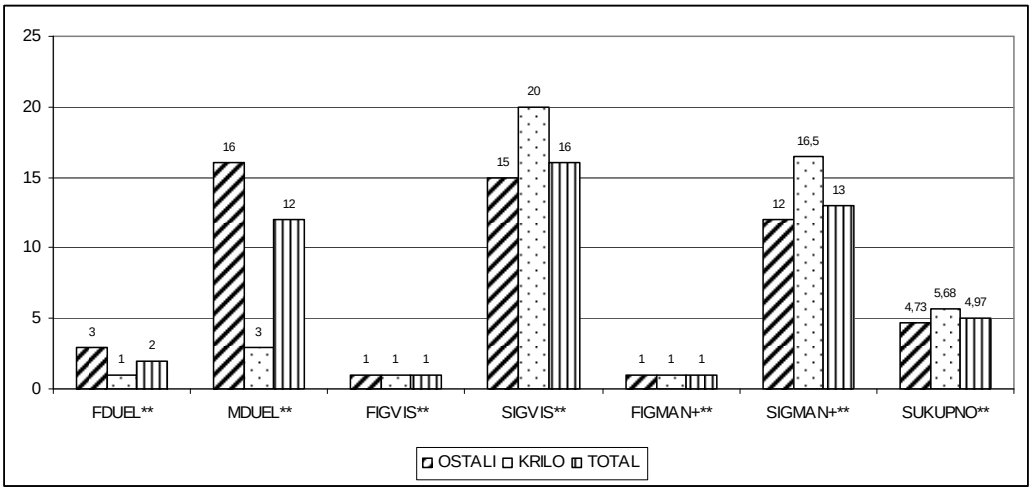

Figure 3. Histogram of medians – vertical phase

Table 4. Results of binary logistic regression (b – beta, se – standard error, wald – chi – square test, p – level of significance, exp (b) – exp beta, ci – confidence interval 95% of variables in the equation

	B	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**	**95% CI**	
							Lower	**Upper**
FKRMAX	-.001	.097		1	.988	.825	1.208	.999
FKRSMAX	-.101	.078	1.655	1	.198	.776	1.054	.904
FKRLAG	-.002	.081	.001	1	.979	.852	1.169	.998
FLEDMAX	.273	.474	.330	1	.566	.518	3.328	1.313
FLESMAX	**.722**	**.230**	**9.818**	**1**	**.002**	**1.310**	**3.234**	**2.058**
FLELAG	.192	.152	1.603	1	.205	.900	1.631	1.212
FPRLAG	.082	.179	.210	1	.647	.764	1.542	1.085
MKRMAX	.009	.009	1.076	1	.299	.992	1.026	1.009
MKRSMAX	.008	.005	2.314	1	.128	.998	1.017	1.008
MKRLAG	-.001	.009	.029	1	.865	.982	1.015	.999
MLEMAX	.049	.138	.128	1	.721	.802	1.376	1.050
MLESMAX	**-.129**	**.044**	**8.556**	**1**	**.003**	**.806**	**.958**	**.879**
MLELAG	**-.080**	**.031**	**6.386**	**1**	**012**	**.868**	**.982**	**.924**
MPRLAG	.030	.036	.697	1	.404	.960	1.107	1.031
FDUEL	**.398**	**.139**	**8.229**	**1**	**.004**	**1.134**	**1.953**	**1.488**
MDUEL	**-.178**	**.029**	**36.628**	**1**	**.000**	**.790**	**.887**	**.837**
FIGVIS	.132	.205	.417	1	.519	.764	1.704	1.141
SIGVIS	.010	.013	.588	1	.443	.984	1.037	1.010
FIGMAN	.512	.302	2.869	1	.090	.923	3.018	1.669
SIGMAN	-.028	.018	2.424	1	.119	.938	1.007	.972
SUKUPNO	.003	.002	2.004	1	.157	.999	1.007	1.003
Constant	**-1,978**	,324	37,281	1	,000	,138		

Table 5. Logistic regression

Model Summary			
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	482.488[a]	.250	.392
a. Estimation terminated at iteration number 6 because parameter estimates changed by less			

Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	8.858	8	.354

Classification Table[a]					
			Predicted		
			Wing		Percentage
	Observed		.00	1.00	Correct
Step 1	Wing	.00	504	25	95.3
		1.00	80	56	41.2
	Overall Percentage				84.2
a. The cut value is .500					

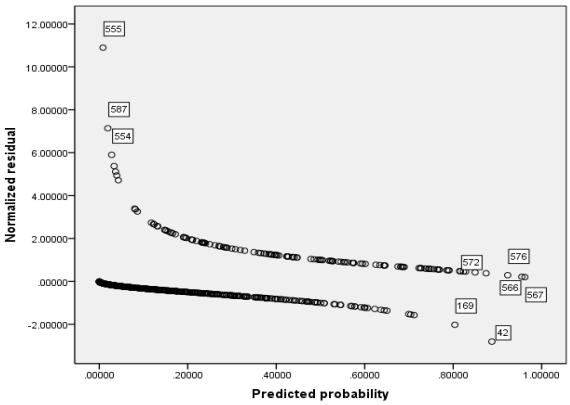

Figure 4. With this model less treated entities

Wing over the all indicators, regarding other roles in the game, have the biggest values and is obvious that the frequencies and total swimming are the barycenter of their play (Lozovina 2009, Lozovina at al 2007). From the structure of frequencies, types of movements and intensities is possible conclude what determines their tactical formation in the game. In the phases of positional defense or attack the wings dominate in the supporting function of play development. According to frequencies of actions and intensities, the requirements, in energetically sense, for this role are very high, bigger than for other roles, in all phases of the play in attack as well in defense, in enforcement of self selected or opponents imposed tactic. Typical for the wings is that they rarely enter in duels independently of any tactics (pressing, zone-defense or combine-defense) (Lozovina 2009). This determines their position in the playfield where wings utilize space along with sidelines of the playfield. On the sidelines of playfield is less traffic and density in the players formation which makes possible longer swimming for the wings which is confirmed in the results of this investigation.

Play in duels is not an expressed segment of the wing tactics, as it is thought in tactics (our hypothesis) and as showed in the results of investigation (confirmation of our hypothesis). From the slant positions, the possibility of realizations significantly decreased. Wings in defense will attack the opponent, on the wing position, only when he achieves position for realization. Besides using the technique blockage-start-blockage, light foul (in short-lived duel) he will move back in his main position. In attack tactically aim in the play of the wing is uncovering from the opponent and develop the availability for ball transfer to the players on other positions. In defense, the wing covers the opponent taking control over the space and opponent player, which confirms frequencies and swam meters with crawl technique in all intensities (Lozovina 2009, Lozovina at al 2006, 2007). In the context of the play with unequal number of players, higher average values in both indicators. The wing position has statistically significant less expulsion from the play, because of less heavy fouls. In the powers zone of the wing, because of position relatively far from the goal, and slantwise regarding the goal, considerably decreases necessity for hard play and logically that results with significantly less number of heavy fouls and expulsions of the wings. In logistic regression entities (players in quarter) will be the best described as wings, if in the average or over, have values on indicators of frequencies in swimming in back stroke technique in sub maximal intensities and frequencies of duels. If they satisfy this condition of the model, necessary for classification, players will be recognized as a good/high-quality wings. Contrary, by increasing of the quantities of the swam meters by back stroke technique sub maximal and light, respectively by longer time spent in the duels, will decrease own efficiency on the wing position and will be less recognized as wings. Within the meaning of interpretation of the position wing, we perceive that their profile significantly characterized sub maximal back stroke swimming, what is most often, in the tactic of the team (especially wings), as an instrument for control of transition (in attack and in defense). Oftentimes duels (frequency of duels) a characteristic of wings in positional attack (opponents attack toward obstruction of passing), or in defense (when he obstructs the opponent by light foul). The wings space is allocated on the sidelines of the playfield where the traffic of the players is relatively light and players playing on this position perform jobs important for organization in all of tree phases of the game. That confirmed short distances expressed in meters of the back stroke swimming in sub maximal and light intensities, in transition, and frequencies of duels realized in positional attack and defense, in the play of the wing. In the Figure 4 are entities who with this model can be less treat and because of that is possible acquire results with unexpected height effect on the model. Detailed analysis of that entities show that two of five entities are not wings. Cluster of three players 567,566 and 576 are not pronounced wings.

By inspection of their results is shown that they are in zone of higher results on the indicators FLEDsmax i Mduel and that did not play full quarters. Second cluster (585 and 554) in results on indicators FLedSubMax i FDUEL are with average values of the wings. It is possible, but we did not investigate, that elimination of that clusters can give a better and more precise model.

Conclusion

The analyzed position of the W. is statistically described by indicators of frequencies, types and quantities of movements, intensities in various modalities in the horizontal and vertical phases of the game, regardless of the type of tactics and phase of the play (attack, transition and defense). A markedly light frequency of total actions is noted on the position wing regarding other player roles (21.5:16). We find differences in the range from (18:14) in crawl swimming in light intensity (9:8), sub maximal intensity (8:6), to even (3:1) in maximal intensity, as well in back stroke swimming (3.07:2.09) in sub maximal and maximal intensity. This is in accordance with the play of the wing on the general tactics plan. The W. significantly differ from other players in total swam meters in all techniques (205:172). Dominantly in crawl technique (186:158) expressed in intensities (max 23.5:13; sub max 93:78 and light 61:59). In the total back stroke swimming wing is significantly different from others and relation is (9.5:6). Such swimming defines the play of the W. in the transitional phase, where the tactical tasks for all players including wings are defined by quantities, techniques and intensities of the swimming in order to attempt a faster and more effective counter attack or to obstruct opponents' counter attack. The W. spends totally higher period in the game than other players. Proportionally, he spends more time in man up/down situations. A remarkable characteristic in the play of the W. are less of duels regarding other players, expressed in frequencies and spent time (1:3 and 3:16).

In the play with unequal number of players, in the play with player more in the frequencies wing did not differ from other players but differs according to the spent time in the play with player more (FIGVIS 1:1 and SIGVIS 20:15). The same happened in the play with player less (FIGMAN 1:1 and SIGMAN 16.50:12). This fact determines the wings basic tactic role in the collective team tactics. By applying the binary logistic regression we defined differential characteristics of the W. regarding other roles in the game, which is typified in the equation of play structure on the position of W. Solitary contributions in the prediction of the role of W. are represented in the linear equation for the position of W.

Linear equation for the position of W. is:

$$\mathbf{ln[odds(Y=1)=Y= -1.978 + 0.72\ _{FLESMAX} - 0.13\ _{MLSMAX} - 0.08\ _{MLELAG} + 0.40\ _{FDUEL} - 0.18\ _{MDUEL}}$$

The hypothesis, formulated in the context of the differences between the W. and the remaining positions within the borders of the chosen tactics expressed in: frequencies, time duration, meters swum in different techniques as well as in different intensities in horizontal and vertical phases of the game and in man up/down situations, has been confirmed in this investigation.

Logistic regression manifests itself as a good choice of methodology for efficiently analyzing such kind of problems in this segment of water polo game (tactics) which is defined by indicators on unequal measurement scales with specific distributions. The results of this investigation will be a contribution to elaboration of water polo game model in the domain of situational play without ball (realization of the collective tactics regardless of the choice of the type of tactics in either attack or defense). These results not only comprise statistical descriptions of the role of W. but also offer an unusual analysis which brings to light the comparative properties of the tactic role of W. in contrast to others.

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DIFERENCIJALNA ANALIZA ULOGE KRILA U TIMSKOJ TAKTICI U MUŠKOM VATERPOLU

Sažetak

Kolektivna taktika bazira se na podjeli uloga u svim fazama igre. Uloge ili pozicije koje igrači odigravaju u vaterpolu su: uloga centra, beka, krila, vanjskog napadača i vratara, a svi su oni instrument u realizaciji kolektivne taktike. Cilj ove studije jest opisati igru na poziciji krila usporediti je s drugim pozicijama odnosno ulogama u igri. Predmet istraživanja jest opis svih aktivnosti u igri bez kontakta s loptom (sva plivanja, svi dueli, sve situacije s nejednakim brojem igrača – igrač više/manje). Prikupljanje podataka izvršeno je registracijom igračkih aktivnosti na službenim utakmicama Internacionalne jadranske vaterpolo lige u sezoni 2009/10. Glavni predmet mjerenja ili entiteti u ovom istraživanju su: pozicija-igrač-četvrtina. Rezultati su prikupljeni registriranjem (notifikacijom) preko 21 indikatora. Izvršena je statistička obrada dobivenih podataka. Diferencijalna analiza za poziciju krila u odnosu na druge uloge u igri provedena je na osnovi testiranja jednadžbe modela binarne logističke regresije. Najveće razlike između krila i drugih uloga u igri zabilježena je u frekvenciji duela (1:3) i trajanju duela (3:16) kao i u svim tipovima plivanja (kraul, leđno plivanje i prsno plivanje) u svim intenzitetima na kraćim distancama (izraženo frekvencijama i metrima) fkaul (18:14), fled (3.07:2.08), prlag (1.64:0,99), mkraul (188.54:160.71), mled (12.60:10.05), mprsno (7.87:4.82). U frekvencijama a u odnosu na intenzitete, za maksimalan (3.63:2.30), submaksimalan (9.13:7.05) i lagani (10.06:8.46), kao i za ukupne frekvencije (22.82:17.81). U različitim tehnikama plivanja, mjereno u metrima: u kraul tehnici (188.54:160.71), u leđnoj tehnici (12.60:10.05) i u prsnoj tehnici (7.87:4.82), a u odnosu na različite intenzitete u maksimalnom (33.39:31.80, submaksimalnom (102.58:86.29) i laganom (73.04:67.49). Na indikatoru MUKUPNO (ukupno isplivani metri) nezavisno o tehnikama i intenzitetima odnosna relacija prema drugim igračima je (209.25:178.11). Primijenjeni binarni logistički regresijski model pokazao se adekvatnim sa snagom predikcije od 39.2%. Statistički značajne doprinose u regresijskoj jednadžbi imaju indikatori: FLESMAX (OR=3.23) i FDUEL (OR=1.134), s pozitivnim doprinosom i MLESMAX (OR=0.81), MLELAG (OR=0.87) i MDUEL (OR=0.80) s negativnim doprinosom. Specificirana je i statistički opisana igra bez lopte na poziciji krila u muškom natjecateljskom vaterpolu. Signifikantnost i struktura razlika krila u odnosu na druge uloge u igri ustanovljena je i potvrđena u ovom radu. Karakteristika u igri krila jest veća ukupna aktivnost i učestalost plivanja. Primjenom binarne logističke regresije definirali smo diferencijalne karakteristike krila u odnosu na druge uloge u igri a što je rezultiralo jednadžbom strukture igre za poziciju (ulogu) krila. Pojedinačni doprinosi u predikciji uloge krila reprezentirani su u linearnoj jednadžbi za poziciju krila. Rezultati ovog istraživanja doprinijet će stvaranju modela vaterpolo igre u domeni situacijske igre bez lopte time i realizaciji kolektivne taktike nezavisno od izabranog tipa taktike bilo u napadu ili u obrani.

Ključne riječi: *vaterpolo, igra, taktika, krilo, statistika, model, logistička regresija*

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SELF-DEFENCE TECHNIQUES AS AN INSTRUMENT OF COMPETITOR'S DEVELOPMENT IN KARATE SPORT

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Review paper

Abstract
Modern trends in Karate sport that are in accordance with organizational concept of WKF have tendencies toward Olympic Sports and they are significantly strengthen by the new competition rules that are, despite of great progress in providing dynamics into Karate, still seeking for constant improvement. When it comes to Jujitsu, it is often said that it is "the mother of traditional Martial Arts" which puts it directly into basic martial education system that can later develop specialization in direction of Judo, Karate, Aikido etc. As with the most Martial Arts (meaning sports), Jujitsu as well develops certain directions and tendencies which are reflected in three main goals that later on can bring compatibility, especially with Karate. These goals are the following: 1) self-defense skills; 2) sports and technical development direction; 3) professional expertise and interdisciplinary. This paper brings comparative explication of basic elements of compatibility among Karate and Ju-jutsu techniques that are equivalent for application in competitors training process in Karate and especially in Kumite discipline.

Key words: *self-defense, Ju-jutsu, Karate sport*

Introduction

Sport Karate represents modern phenomenon at the largest scale. It can be said that it is not only sports but also sociological phenomenon that has marked the XX century, especially in the last decade when it gained great popularity. As a result, millions of people today practice Karate and reasons for such expansion are in its original characteristics and values (skill that is applicable in specific situations and in cases of threats to personal safety including the characteristic of the discipline that develops the one's personality, etc.) and as well in Karate's dominate orientation towards dynamic and exciting martial art. As it is already known, Karate has been developing for long time as a martial art, carrying along the original principles of its home – the Far East. However, in contact with different cultures and mentalities, Karate has been transforming. The orientation towards high mass, in particular, caused its distinct and visible transformation. From the art of self-development, Karate became a hobby, recreational activity and finally modern sport. By following the modern tendencies towards dynamic sport, Karate faced the inevitable changes and transformations. They were reflected primarily in changes of the rules of combat and the trial, which basically require a change in training process, especially in terms of competitor's preparation for sport karate fight. Defining Jujitsu is usually associated with the meaning of self-defense in it's broadest sense. However, contemporary tendencies and point of view claims that Jujitsu is a lot more than that. This skill has become a new, attractive sport, that meets three different and most popular disciplines: Judo, Karate and Aikido. Therefore, Ju-jitsu became exceptional form of professional application integrating interdisciplinary knowledge and skills, trying to outdo it's competition and derivatives.

As with the most martial arts (sports) in the system of Jujitsu, there are certain trends and tendencies which are reflected in three major objectives whose achievement brings compatibility, especially with Karate. These goals are the following: 1) self-defense skills; 2) sports and technical development direction; 3) professional expertise and interdisciplinary. It is often said that Jujitsu is "the mother of traditional Martial Arts" which puts it directly into basic martial education system that can later develop specialization in direction of Judo, Karate, and Aikido etc. Such concept is supported by general classification of Ju-jutsu techniques that might bring effective progress among Karate competitors.

Concept of modern sport karate

The original systems and methods of competition, which are still evocated by the traditional Karate followers, have been focused on the concept of "the final impact". It was basically consisted on idea of taking over the techniques that are efficient enough, strong and properly developed in order to incapacitate an opponent-the attacker. This concept at the same time considers opposition to any opponent without taking into account his physical constitution (weight, strength, height etc.) According to this concept, the whole Karate fight was based on one point (IPPON) so the practicing technology was based as well on the practice of individual kicks and blocks or simple combinations. Such system of training, especially in sports combat fights, has led to a certain saturation among competitors and especially the audience that was expecting more dynamics, attractiveness and excitement. The concept of the one point combat could not secure such thing.

In transformation towards modern sport, Karate was seeking a new contents and forms, so rules of combat and trial have changed. Participation in sports fight and reaching good results are most important motives for competitors and Karate concept has finally got it's attractive and dynamic characteristic. Therefore, the emphasis was no longer on the expression of real power of impact or the demonstration of the "final dead impact", but on the ability of competitor to outwit it's opponent by taking technical points. However, Karate stays the "skill" (because there is no sport without the skill developed) but it is consisted of earned points and ability to prevent the opponent to do the same for his own score. Precisely, that is the reason for actual Karate transformation in terms of rules and concept in general. Because of that, Karate had to be adapted to the sport combat and it's final effects. One of the basic postulates of the modern sport Karate has became the speed and the skill that contributes the efficient point achievement which is different than earlier opinion that included "final dead impact". Karate competitor can be very physically strong but it does not mean that he is skillful and fast enough in order to achieve the objectives of the sport-points that bring advantage. Starting from the basic concept of modern trends in sport in general, fundamental and qualitative transformation of Karate is representing a step forward to more dynamic flow of sports fight. Requests for more efficient elements have caused a lot better execution of Karate techniques in impressive form and speed. In the light of this tendency of sports fight in Karate and the scoring along that, the most prominent are sports explications that are assimilated in modern Karate. The efficiency criteria shows more complex dimension and number of used techniques for achieving points is significantly larger. Features of modern Karate competitors are rich technique which allows him to achieve dominant positions in sport combat. Steadily built technical form, as well as the physical preparedness can give confidence to modern Karate competitor to keep the dominant position while attacking and, at the same time, to control and provide good defense. Unlike the former Karate competitors, modern Karate competitor has to act relying on idea that maintains an efficient flow of the sport fight: *"I attack-I am ready to defend myself; I defend-I am ready to attack".* Modern trends in sport Karate fight (*Kumite*) place the emphasis on attack technique and have significantly conditioned the training process of the athlete. Attacking style of fighting has put new demands on competitors, in terms of technical perfection and in terms of physical preparation. Techniques with more complex motor structure (especially foot and hand, in combination with the throws and the like), that are efficiently and properly performed, can bring to contestant significant point advantage (IPPON-3 points). The dynamics of the combat and its duration (3-4 minutes and without 3 points limit) puts the competitors in condition that they have to focus their training process on two parallel directions, equally important: technically-tactical and specifically-physical. Neglecting or giving importance to only one of mentioned can bring to incomplete and poor sport shape and finally to poor score.

Application of ju-jutsu techniques in sport karate training process

It can be thought that modern trend of development of sport Karate has imposed one new dimension of application techniques which are according to their efficiency ranked among the top criteria for reaching points. These are the throwing techniques and their motor structure is highly complex. Therefore, throwing techniques put certain demands in front of competitors and their trainers, which are reflected in improving the training process, its development and implementation. Several years ago, among Karate competitors, even among ones highly positioned, this element could not be seen in repertoire of used techniques. Karate players often didn't applied even popular "cleaning methods" while competing. Yet, new trial rules have put an strong emphasis to elements such as throwing techniques and put them in the category of the highest technical level (proper implementation gives IPPON-3 points). Throwing techniques are, by their roots, related to Judo and Ju-jutsu self-defense systems, and so far they did not get special attention into technical training process of Karate competitors. Still, today they have brand new dimension. The need for their usage and compatibility of characteristics are illustrated on Table 1. First of all it should be noted that their adoption enriches Karate motor structures that are relevant for combats in general, especially those related to movement and orientation in non standard Karate positions (falls, positions of the ground and continuing the fight in them, etc.) Second, by choosing effective and applicable Karate techniques increases the repertoire of scoring that brings significant points advantage (3 points).

Table 1 – Compatibility of Ju-jutsu and Karate techniques

Ju-jutsu techniques that are compatible with Karate	Techniques that are specific in Ju-jutsu
Positions and Guards	Strikes and blocks techniques
Moving and Distance	Leverage
Falls	Strangulation and chokes
Throws and Takedowns (side, hand, foot,)	Techniques that are banned in sport performance (pressure on the sore spots, hair pulling, etc.)
Hits (hand, foot)	Ceremonial rules and behavior
Blocks and parry (hand, foot)	
General warm-up exercises, breathing exercises, mental relaxation etc.	

Third, at the tactical level (among top rated fighters) the possibility of predicting the fight is reduced, meaning the preparation of contra attack by the opponent is poor which can bring certain psychological advantage at the very beginning of the combat. Previous experience in the preparation and training process of Serbian best Karate competitors (especially senior and junior and can be related to cadets as well) have shown that this problem still has not been paid on attention. There is not much thought about throwing techniques (including final scoring) so the competition fight are without them as well. This "problem" is included in certain number of expert analysis which showed that the level of competitor's representative technical elements are not significantly known. This supports the statement that researching, training and practicing certain techniques of self-defense, and later by its application, can significantly improve the efficiency of sport Karate fighting. This must include as well putting the quality of Karate athletes on a higher level. Actual sports practice demonstrates that Karate competitors develop "cleaning" techniques, mostly the *"De Ashi Barai"* and meaning both, by foot from back position and by foot from front position. Other applicable throws can be barely recognized and the mentioned technique has been used mostly as the attacker technique or preparation to attack.

On its application in terms of defense technique or technique for achieving points from "clinch" it is almost unable to discuss. It has already been mentioned that modern sport Karate is strongly related to traditional Karate skills. By practicing a self-defense skills, Karate maintains all the impurities related to similar Martial arts such as Judo, Aikido etc. All of these arts were made on principles of unarmed fight. In Karate techniques, self-defense is searching for answers or possibilities of overcoming the opponent by leg or hand hits while Judo or Ju-jutsu are putting the following role in top perspective*: "Release pressure in order to win"* and *"With minimum power, maximum efficiency".* Such principles indicate that essence of these skills is directed and very often limited by the sports rules. However, by understanding and practicing the essence and techniques, and according them to competitor physical and technical characteristics each sportsman can find various possibilities on his aspirations towards development. New trends in sport Karate have raised the importance of certain groups of self-defense techniques, especially cleaning and throwing. They have become the basis for effective technical upgrade which is reflected in composition of complex technical scoring combinations. Even though they are part of different group of Martial Arts (or skills), some techniques of self-defense have high compatibility with Karate techniques, which is particularly reflected in their application in training process. Whether they are practiced as a supplementary exercise (in general preparation period or interim period of the annual cycle), independent techniques or in combination with other Karate technique, they are very useful.

Advantages are numerous and the links between Karate and other techniques are the following: a) Self-defense techniques are performed from the fighting attitude, the position that does not require severe form and has the character of various possibilities and adaptability; b) The reality of the techniques performed, especially in terms of being attacked by the opponent, is that they are performed in almost real contact with the goal; c) The necessity of the achieving contact with the opponent for more efficient execution of prescribed techniques (such as blocking that requires high efficiency instead of a strict form); d) Connection with the real finish (throw, lever or hit) which in sport Karate means-scoring. This is governed by the rules of combat and trials where each "cleaning" or throw has to be continued with certain scoring technique. Since they were not enough trained and prepared by self-defense techniques, (especially the throw, cleaning and control techniques) Karate competitors were aimed in their training process on movement, avoiding and hitting techniques (hand or foot) that could bring them in final score 3 points. However, that also brought them certain difficulties while fighting, especially when the opponents were in the positions such as the "clinch". Mainly these situations were solved by pushing or holding the opponent until the judge signs to stop fighting. Knowledge and upgrading of certain self-defense methods would solve mentioned situations in fighting by giving the alternative to continue fighting or making score. Although numerous self-defense techniques and possible combinations and situations, that can be applied effectively in Karate fight are impossible to predict, some of those can be separated as orientation to Karate trainers and competitors for using them in training process. These techniques include the following: a) Falls (by practicing basic falls: forward, sideways, backwards); b) Cleaning (during the catching the opponent or clinch); c) Throw (performed out of guard or clinch position); d) Throw (with entry) after stopping the opponent's hand or foot attack. By setting the proper system of "fighting actions", certain self-defense techniques or group of self-defense techniques, can be practiced well. As in any other fighting sport, their goal is to set the options for application of learned techniques in nearly real conditions.

Teaching and training methods as well should be adapted to real situations and only in circumstances in which the athlete (competitor) could find the way to apply all learned skills and abilities. Whether it's about sport Karate fight, Ju-jutsu or any other real situation, in order to properly apply all learned techniques and methods of fight, training process should put emphasis on methods of fighting actions (technique combination) and like that, put competitors on test. Also, during the training and preparation for Karate fight, selected and adopted techniques can be tested on competitors in the situational treatments. Techniques that will be listed represent an illustration of possibilities of self-defense systems as a supplementary means for better preparation of Karate competitors.

The following proposition does not have the tendency to became a standard in training and preparing process or to be considered as the only appropriate to use.

Falls:
- Fall forward *(mae-ukemi)*
- Fall backward *(ushiro-ukemi)*
- Side fall *(yoko-ukemi)*

Throws:
- Throwing the opponent *(tai-otoshi)*
- Scoop throw *(sukui-nage)*
- Double leg takedown *(morote-gari)*
- Major outer reaping *(o-soto-gari)*
- Advanced foot sweep *(deashi-barai)*
- Major inner reaping *(o-uchi-gari)*
- Counter throw – twisting hands *(ko-uchi-gari)*

Combinations of defense and counter scoring:
- Avoiding, out braking the foot,
- Missing the leg, hit
- Lower block, out braking the foot, hit
- Lower block , throw, hit
- Upper inside block, fall the opponent down, hit
- Front leg withdrawal, hit.

Conclusion

The organizational concept of the WKF includes tendencies to put guidance of sport Karate towards the family of Olympic sports. This is supported by adoption of new competing rules, which despite major contribution to sport Karate dynamics, still seeks constant improvement. Such is conditioned by permanent monitoring and analyzed trends in modern international sport where fundamental guiding lines are – attractiveness, popularity and mass distribution. Modern sport Karate is focused on the improving the character of the process bounding all that is common to all Olympic sports by saving its specialties. This is reflected in respecting some of the basics of sports and scientific principles:

- an interdisciplinary approach to processes,
- physical condition of competitors,
- technical preparation of competitors,
- psychological preparation of competitors,
- tactical preparation of competitors,
- organizational conditions in the sports branch and its social environment,
- material and technical equipment of organization,
- sports diplomacy.

Taking into account the given flows of large number of Karate competitors and their efforts to put sports and technical results into higher level, Karate experts must involve elements of interdisciplinary into their work. This is particularly reflected in the use of resources, methods and training technology of similar or compatible Martial Arts. One of them is Ju-jutsu system of skills, meaning self-defense, which is very popular and dynamic sport. This tendencies and opinion is supported by the conceptual orientation of Karate experts, who especially pay attention to technical preparation of Karate competitors by putting the special emphasis on throw, clinch and cleaning techniques. Also in the tactical preparation of Karate competitors, clinch element has a great significance especially in situations of temporary interruption of the attack and its effective continuation in the combat. Thus, the work of Karate experts and competitors must be enriched by technical elements of self-defense, especially in terms of sports and competition program of Ju-jutsu in order to achieve improvement of technical knowledge and efficiency of Karate competitors, and finally the quality of combats in Karate disciplines.

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TEHNIKE SAMOODBRANE KAO NAČIN USAVRŠAVANJA TAKMIČARA U KARATE SPORTU

Sažetak

Suvremena kretanja u karate sportu, koja se odvijaju prema organizacijskom konceptu WKF-a, a čija je osnovna tendencija njegovog usmeravanja ka porodici olimpijskih sportova, znatno su ojačana novim takmičarskim pravilima, koja i pored velikog napretka u davanju dinamičnosti karate sportu i dalje teži stalnom usavršavanju. Za Ju-jutsu se veoma često kaže da je „majka borilačkih vještina" kojim se on stavlja u položaj bazičnog borilačkog obrazovanja, iz kojega su se kasnije izdiferencirale specijalizacije u pravcu džudoa, karatea, aikidoa, itd. Kao i kod većine borilačkih vještina (odnosno sportova) i u sistemu Ju-jutsu postoje određeni pravci i tendencije, koji se ogledaju kroz tri osnovna cilja čijim se ostvarenjem realizuje kompatibilnost sistema, posebno sa karateom: 1) samoobrambena vještina, 2) sportsko-tehnička usmjerenost i 3) stručnost i naučna interdisciplinarnost. Rad se bavi komparativnom eksplikacijom osnovnih elementa kompatibilnosti karate i ju-jutsu tehnika koje su ekvivalentne za primjenu u sportskom treningu karatista, posebno u sportskoj disciplini kumite.

Ključne reči: *samoodbrana, ju-jutsu, karate sport*

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IMPACT OF PSYCHOMOTOR ABILITY ON SUCCESS IN LEARNING

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Original scientific paper

Abstract
In order to determine the influence of anthropological space of psychomotor and cognitive skills and their association with success in learning, research was conducted in part on a simple random sample of 200 female high school population of entities, described by seven sets of primary psychomotor indicators and a set of general indicators of success in learning. By the criterion of formal representation of kinesiology education classes in the curriculum, the sample was stratified on the subsamples with two or four hours a week. To determine the influence of predictor variables in the system of psychomotor criterion variable success in teaching applied regression analysis. According to the actual parameters in multiple linear regressions, it confirmed the initial assumption that the system of psychomotor variables and variables of the general student success in high school there is a statistically significant association. Then it was concluded that the results do not contradict current scientific knowledge and the actual connection psychomotor and cognitive dimensions of anthropological space. The data indicate the need for transition model curriculum of the treated population in favour of their biosocial integrity of its entities.

Key words: *psychomotor skills, cognitive abilities, regression, female pattern, Middle School*

Introduction

It is of the utmost importance for the anthropology to determine the level of connectedness and interaction among the phenomena and processes. Psychomotor abilities research on the relationship with other anthropological dimensions of space has resulted in numerous findings of their bivariate and /or multivariate structural, functional and performance connection. This paper examines the partial correlation in the space of anthropological psychomotor and cognitive dimensions at the level of success in learning the subjects in the population of high school students, in order to - in the final biologically and psychologically relatively stable stage of development students - determine the actual state of development and legality of underlying dimensions by formally unequal external factors limit. *The main objective of this study* was to determine and analyze the impact of psychomotor skills for success in teaching secondary school students, and all the formal criteria of unequal representation of kinesiology education classes in their assigned curriculum.

Methods

Sample of entities
Appointed as the GR-AB, includes 200 students, divided into two subgroups, namely: (1) subsample of 100 students (GR-A), which was scheduled for two hours a week of regular classes of kinesiology education in the 2nd year of high school, and (2) subsample of 100 students (GR-B), which was scheduled for four hours per week of regular classes of kinesiology education in the 2nd year of high school was appointed as the GR-B. The initial classification was made solely on the basis of the planned number of weekly hours of regular physical education students who just completed the second year of high school.

Sample of variables
To assess the psychomotor status it is significant to estimates all the sizes that exist in a hypothetical psycho-motor area, but due to objective features, the sample sizes for a hypothetical primary were selected, which was presumed to be of particular interest for planning of kinesiology education with regard to the characteristics of psychomotor female student status. For the assessment of these dimensions following instrument was applied: (1) Explosive power: standing long jump / MFESDM /, From the numerical values of the general success of students at the end of the second grade high school a variable was formed, which is assumed to be predominantly caused by partly cognitive anthropological dimensions of space responsible for the success in learning (SUCCESS).

Results

Table 1. Distribution testing

T-01: MFESDM	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
GR-A	.055	100	.200	.993	100	.895
GR-B	.051	100	.200	.990	100	.685
GR-AB	.045	200	.200	.993	200	.506

By accepting the assumption that the variable long jump comes from a normal distribution, the risk set of 5% may be, based on interval arithmetic mean, calculated by expanding the characteristic ± 3.2794 times the standard deviation, 99.73% claim that the distribution GR-A subsample of this variable is between 83 713 cm and 179 437 cm, and subsamples GR-B between 197 893 cm and 89 542 cm, and sample the GR-AB between 84 803 cm and 190 489 cm.

Comparison of distribution of subsamples A-GR and GR-B variables long jump shall be applied the Kolmogorov-Smirnov test, which calculates the maximum distance between the cumulative distributions of the subsamples. In this case, the maximum distance is DM = 0.37, two-sided large sample KS = 2.6163 and p = 0.000 approximately. Since the p-value is less than 0050, meaning that, at the risk of 5.00%, there is a statistically significant difference between the distribution of subsamples A-GR and GR-B variables long jump. In accordance with the already mentioned in connection with the conditions of release, the variable SUCCESS is graphically represented, through the control chart "three sigma" box diagrams and histograms of frequency distribution of subsamples A-GR and GR-B. With graphical form control chart "3S": SUCCESS GR-AB is seen that the values in the sample GR-AB variable SUCCESS distributed within the range of three standard deviations, i.e. the arithmetic mean of the sample (mean: 3425) to lower (DL = 1,817) and upper (= GL 5033) limit. Box-diagram: SUCCESS GR-AB is a visualization of the relationship between the central values and dispersion of subsamples A-GR and GR-AB sample GR-AB variable success.

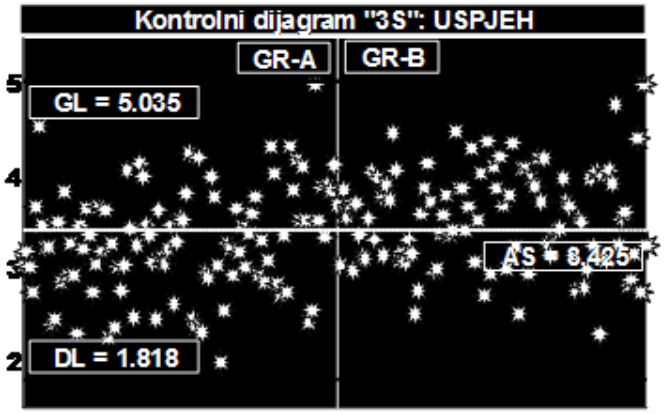

Figure 1. Control diagram

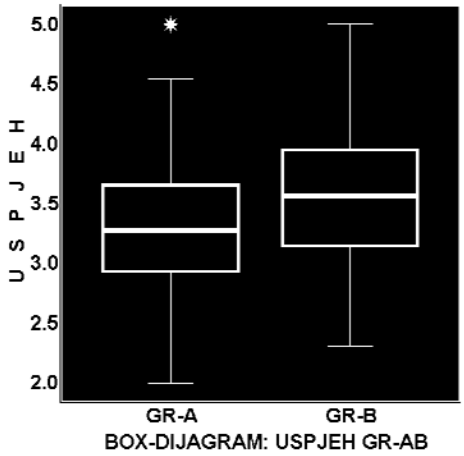

Figure 2. Dispersion

Histogram of frequencies: SUCCESS GR-AB presents the frequency distribution of numerical values of the general success of subsamples GR-GR-A and B in sample GR-AB variable success.

Shown is the normal distribution curve. Tests for normal distribution, the Kolmogorov-Smirnov and Shapiro-Wilk, showed no statistically significant difference between, the distribution results of subsamples GR and GR-A and-B sample GR-AB variable SUCCESS, and the given parameters of a Gaussian normal distribution curve.

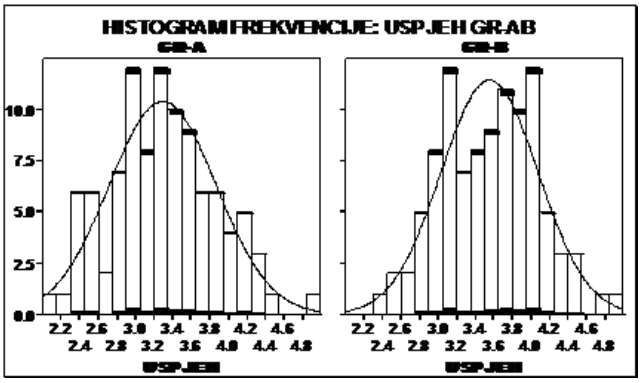

Figure 3. Distributions

With all three figures, there are also differences between the subsamples GR-GR-A and B in sample GR-AB in the mean, range and dispersion success variables, defined in the numerical part of descriptive statistics, which is preceded by a graphical representation of the basic statistical characteristics of the studied parameters. This displays the comparative frequency histogram of variables and the general SUCCESS of psychomotor factor / GMF /, with the intention to present a general picture of their relationships. This is possible if the variables are reduced to the same, namely z-measure.

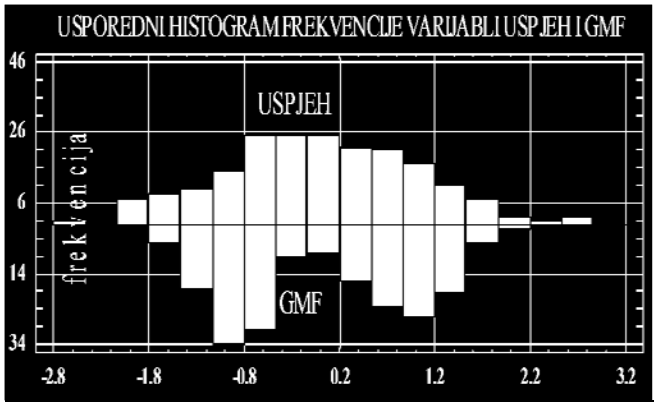

Figure 4. Paralel histogram

The visual impression is that the sample SUCCESS variable has a unimodal distribution, while the pattern variable of general psychomotor factor / GMF / has a bimodal distribution. This means that in the psychomotor variable there are more widespread results and pronounced results heterogeneity, with a tendency to divide the sample into two approximately equal parts. Since the criterion for the formation of subsamples of respondents required a varied representation of kinesiology education in their intended curriculum, it is likely that this fact influenced the outcome.

The results of testing the significance of multiple correlation (R_0)

Regression procedure based on correlations in Table 2 refers to the results of testing hypotheses about the statistical significance of multiple correlation (R_0) between the dependent variable SUCCESS-AB and independent manifest / MGR AB /, primary / Science AB /, secondary / SMF-AB /, tertiary / TMF-AB / motor variables, as well as general psychomotor factor / GPMF-AB /, respectively: (1) MGR AB, (2) Science AB, (3) SMF-AB, (4) AB-TMF, (5) GPMF-AB. The table shows the R_0, R_0^2accustomed to R_0^2 and standard error estimates. $R_0$is the coefficient of multiple correlations and it expresses the optimum relationship between the variables because it takes into account the relative contribution of each independent variable in the overall relationship with the dependent variable. The range is 0 to 1; higher value means a stronger bond. Kvadtat coefficient of multiple correlation (R_0^2), in this case, is a common measure of variability of motor and cognitive dimensions of anthropological space. It can be argued that it determines the proportion of common variance of the dependent and independent variables, subject to the regression model. The value of R_0^2 is ranked from 0 to 1. Statistics changes include changes in R_0^2, and the likelihood of changes in F, p, and F. Changes in R_0^2 are produced by adding or subtracting one independent variable, and in this specific case of all motor variables simultaneously. If R_0^2 is associated with a block GR-AB, a large, this means that the GR-AB is a good predictor of the dependent variable. Degrees of freedom are associated with changes in the F calculation, where the df1 is a numerator and df2 is a denominator. Durbin-Watson test is testing a serial correlation (autocorrelation) of the residuals. One of the assumptions of regression analysis is that in the variety of observations residuals are not correlated. If this is true, the expected value of the Durbin-Watson statistic is 2, while lower values suggest a positive and significant negative autocorrelation. The fact that D-W value is greater than 1.4 means that there are certainly not any serious autocorrelations in the residuals. Inspection of the table 2: From the results of testing the significance of R_0 can be concluded that the R_0 for each of the five suppositions at $p \leq 0050$ is statistically significant with $p = 0.000$. So there is no reason for the statistically significant association of SUCCESS–AB with : (1) MGR AB, (2) Science AB, (3) SMF-AB, (4) TMF-AB, (5) GPMF-AB MGR-SUCCESS-AB and AB to not be accepted. Similarly, with probability greater than 95% it can be concluded that such a correlation will be also achieved in the respective populations. Achieved for R_0^2 = 0434 (1) MGR-AB and AB-SUCCESS means that 43.4% of variance exhibited in the SUCCESS-AB with MGR-AB. The SUCCESS-AB and: (2) Science AB R_0^2 = 0302, (3) SMF-R02 AB = 0289, (4) TMF- R_0^2 AB = 0.273, (5) GPMF- R_0^2 AB = 0228. Custom R02 sample tends to statistically optimally estimate how well the model fits the population. Customized to $R_0^2$is R_0^2 correction in the sense that it more closely reflects the adaptation of the model population, so that in 95% and more cases in a population 36.7% change SUCCESS-AB could explain MGR-AB. Custom R_0^2 SUCCESS-AB individually with: (2) Science AB R_0^2 = 0.277, (3) SMF- R_0^2 AB = 0.275 (4) the TMF- R_0^2 AB = 0266, (5) GPMF- R_0^2 AB = 0224. The last implies that general psychomotor ability accounted for 22.4% of the results of proficiency in the population of high school students. Of course, this is a statistical measure, but not contradictory to actual connection between psychomotor (which is often treated as intellectual) and cognitive dimensions of anthropological space. In addition, a share of affective factors is likely present in the results, which are to a large extent relevant part of the anthropological premises. Furthermore, the result of general success in physical education also contains a part of the motor results.

The regression coefficients

Table T-03: Regression Coefficients MGR-AB with the SUCCESS-AB shows: constant (a), not standardized b - coefficients (NstKf) and their standard error (SG), standardized β - coefficients (StKf), t-test results and their significance, 95% level of confidence in the β (95% CI (β), zero (R_0), partial (Rp) and partial correlation (pR), and test results of collinearity (VIF). β - coefficients are standardized values, which are interpretable as they are in the same units of measurement. If the analyzed data is previously transformed into z-values, then β - coefficients are not standardized. They are tested with T-statistics, in other words, the relative importance of each variable in the model is being tested. Statistical significance is expressed by the probability (p) for each of the variables treated. Inspecting Table 3: It can be concluded that the connection of motor and cognitive anthropological space was realized through the mechanism for the regulation of movement, and almost with equal participation of the mechanism for the synergistic regulation and control of tone and structure of the mechanism of movement. Among other things, the solution is real likely because with the concerned age of the patients exercise can achieve significant progress in not only maintaining but also increasing levels of interaction capabilities that depend on the relation of these mechanisms and psychological processes. Whether through the optimization of control of movement (stimulating cognitive and affective processes) and / or energy regulation (homeostatic stimulating the adaptation process), in each case there is motor contribution to the physiological and psychological aspects of success in learning. The following analysis will surely present more information about the strong influence. Anthropological relations latent motor skills with proficiency in studies among the subjects in the population of high school students have made positive regression effects on the secondary, tertiary and general level. Fitness index (CI) is the square root relationship of eigenvalue, larger with each successive eigenvalue.

Value greater than 15 indicates possible problems and if greater than 30 it indicates serious correlation problems, which in this model is not the case. According to the results achieved, success-AB was significantly associated with the mechanism for the synergistic regulation and the regulation of tone duration (β = 0411, T = 4912, P = 0.000), as well as the mechanism for the structure of movement (β = 0187, T = 2163, p = 0036), and the mechanism for the regulation of movement (β = 0520, T = 5636, P = 0.000). The results of success in learning are significantly related to general psycho-motor ability, which is expressed in the statistics parameters: β = 0478, T = 7655, P = 0.000). It should be noted that this outcome does not mean lack of influence SMF1-AB and SMF2-AB, or TMF1-AB on the SUCCESS-AB, because their effects are statistically significant in the hypothesized model, in simple linear regression. In addition, subsamples of these meetings were statistically significantly associated with their respective subsamples of the SUCCESS variable. According to the actual parameters in multiple linear regression, it might be concluded that in defining the psychomotor effects on cognitive performance in middle school students, a multipotent role have: the mechanisms responsible for the bilateral integration movement, the formation of ideomotor structure, the control process of afferentation and reafferentation, as well as mechanisms for the regulation of tone individual muscle groups and when performing relaxation of antagonists of cyclic motion. On the other hand, if one takes into account the low average level of all results, while there were significant differences in the framework of such mediocrity, it is possible to estimate the influence of problem to be burdened with the level of these differences, or - problems in the realization of individual subjects psychomotor content, more than is supported by indications of the actual level of reciprocal changes. Of course, it is important to consider the fact that the subjects in a population partially explored are in biologically stable phase of their development, while their stability in the psychological sense is significantly relativized by psychosocial factors of environment in which they live and are educated. These factors in the continuity, together with the economic factor, have produced, and also systematized low average results, of which no human ability is immune. The conclusion is that the motor system of independent variables and the dependent variables of the general student success in high school there is a statistically significant association, namely that the coefficient of multiple correlation was R0 = 0659, which explained 36.7% (R02 = 0367) jointly realized variability of these features in their overall variability student population in secondary schools. Finally, we performed and tabulated Parallel of ANOVA and presented graphically Comparison line of regression GPMF-AB and SUCCESS-AB, and the regression line GPMF with SUCCESS-A and the regression line GPMF-B with SUCCESS-B. The tested hypothesis was set in the sense that there are no statistically significantly different values between the impact factors of general psychomotor / GPMF / and general success in learning among secondary school students. Which can be explained by that part of variance that is due to the effects of unequal representation in kinesiology education high school curriculum. Neter and others (1996) introduces an example of qualitative (indicator) variables - to explain a certain status. In this case they are: A (2 hours per week of regular classes and B (regular teaching hours per week). Intention behind the use of these variables is to make a comparison between the regression models the GRP and GRP-B. Procedure for comparative analysis of regression lines (Statgraphics Plus for Windows) automatically constructs the necessary indicator variables and permits comparison of two or more regression models. Result is appropriate separate line for each level of categorical variables, which is then tested whether the sequences on the Y-axis (a - determines the level of regression equation), the ratio of slopes regression line (B - the beta coefficient, equal to the angle tangesu regression lines forming the X-axis shows the intensity of the expected change in Y resulting from changes in X) are between these different levels. If A is a regression line SUCCESS-A and GPMF-A, and B is a regression line SUCCESS-B and GPMF-B, it was assumed that the effects of GPMF-A on SUCCESS-A based on the strength and direction are identical to the effects of GPMF-B on SUCCESS-B.

Table 4. Parallel of ANOVA

Source	SS	Df	MS	F-relation	p
GPMF-AB	28.769	1	28.769	175.12	0.000
GPMF-A	11.203	1	11.203	68.20	0.000
GPMF-B	0.755	1	0.755	4.59	0.033
Model	40.727	3			

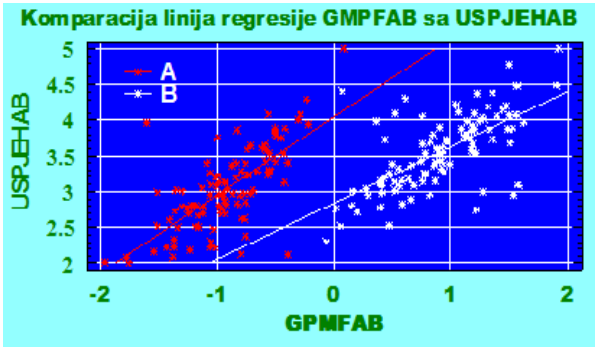

Figure 5. Regression lines comparison

Since p (a) = 0.000 is less than 0010, means that in more than 99% of cases there is a statistically significant difference between the value of a sequence on the Y-axis for levels A and B. Also, P (B) = 0.033, means that in more than 95% of cases there are significant differences between the values of the slope levels A and B. This further means that the impacts of GPMF-A on SUCCESS-A and GPMF-B on the SUCCESS-AB are significantly different in their level and direction.

Overall differences in the effects of GPMF-AB on the SUCCESS-AB are statistically significant at p = 0.000. The conclusion is that the initial assumption is rejected, which means that the representation of kinesiology education in the curriculum of high school significantly affects the level and direction of correlation between the psychomotor and cognitive dimensions of subjects from a population of high school students. Of course, in favor of those with more planned time for physical education and, on that basis, better results of GPMF and SUCCESS, to optimize these effects. By controlling the movements in a specific order, cognitive processes significantly affect the time of execution of complex motor activity, while, on the other hand, complex motor tasks stimulate the flow of information and the cognitive level, which is reflected in a greater connection between motor and cognitive variables. Kinesiology education classes, under the proclamation of versatility and harmonious development, is predominantly forcing a informatics component of the content of work, without enough exercise, which is the basic requirement for any changes in quantitative and qualitative dimensions of kinesiology, and anthropological status. As Kinesiology education is insufficiently represented in the curriculum, this approach generally results in low energy, including affective component, which is uncontested issue in physical education state among female subjects. With some differences, cognitive and psychomotor skills are mostly of dispositional character. It is evident that the psychomotor activity generally carries considerable cognitive load. The part of the variability that can be attributed to not inherited factors, the influence of psychomotor on cognitive functioning, could be attributed to positive biochemical changes that occur in the central nervous system under the influence of psychomotor activity, and work content (information) complexity of psychomotor tasks on the activation process of intellectual. Psychomotor performance and cognitive interaction is a rather complex way associated with emotional and motivational functions and structure of personality as a whole, to enable the adaptation to environmental conditions and better psychomotor performance.

Conclusion

On a representative sample of 200 middle school students the parameters are estimated on mutual influences in the anthropological area of psychomotor and cognitive dimensions at the level of success in learning, and in terms of representation of kinesiology education in the curriculum of secondary school. The regression analysis was applied to determine the influence of the predictor system of psychomotor variable on criterion variable of success in teaching. According to the actual parameters in multiple linear regression, the initial assumption was confirmed, that the system of psychomotor variables and variables of the general student success in high school there is a statistically significant correlation.

It is concluded that, in the anthropological space, there is a positive correlation between psychomotor ability and success in learning. Also, such a correlation exists between the number of hours allocated to kinesiology education curriculum: a higher number of hours of kinesiology training will have a greater transfer on psychomotor skills, and thus to a better success in learning. Hence, the results of this study indicate the need for transition of the model of teaching curriculum of treated population, in favor of the biosocial integrity of its entities.

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UTICAJ PSIHOMOTORIČKIH SPOSOBNOSTI NA USPJEH U UČENJU

Sažetak

Radi utvrđivanja uticaja u antropološkom prostoru psihomotoričkih i kognitivnih sposobnosti te njihove povezanosti sa uspjehom u učenju, provedeno je djelomično istraživanje na jednostavnom slučajnom uzorku od 200 entiteta ženske srednjoškolske populacije, opisanih sa 7 setova primarnih psihomotoričkih indikatora te setom indikatora općeg uspjeha u učenju. Po kriteriju formalne zastupljenosti nastave kineziološke edukacije u nastavnom planu, uzorak je stratificiran na subuzorke sa po dva i sa po četiri sata sedmično. Za utvrđivanje uticaja prediktorskog sistema psihomotoričkih varijabli na kriterijsku varijablu uspjeha u učenju primijenjena je regresiona analiza. Prema ostvarenim parametrima u multiploj linearnoj regresiji, potvrđena je početna pretpostavka da između sistema psihomotoričkih varijabli i varijable općeg uspjeha učenica u srednjoj školi postoje statistički značajna povezanost, potom je zaključeno da rezultati ne proturječe dosadašnjim naučnim saznanjima i stvarnoj povezanosti psihomotoričkih i kognitivnih dimenzija antropološkog prostora. Podaci indiciraju potrebu tranzicije modela nastavnog plana i programa tretirane populacije u korist biopsihosocijalnog integriteta entiteta.

Ključne riječi: *psihomotoričke sposobnosti, kognitivne sposobnosti, regresija, žene, srednje škole*

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THE NINE STEP CONNECTION MODEL AS ONE OF THE METHOD OF DANCE SPORT PSYCHOLOGICAL PREPARATIONS

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Review paper

Abstract
Psychological preparation is one of the most easily neglected parts of sports training in Standard and Latin American dances. Due to the large number of stress factors that affect sports dancers, psychological preparation is an essential part of success on dance competitions. As for the techniques that help dancers to achieve higher levels of psychological preparation, many can be borrowed from other sports. This paper presents Winkelhuis' Nine Step Connection Model, which enables dancers to achieve the optimal levels of relaxation, concentration and connection with the partner. By using The Model, dancers can lower their stress levels and have better time management in between dances, which contributes to the quality of their performance on competitions.

Key words*: psychological preparation, dance-sport, The Nine Step Connection Model*

Introduction

Psychological preparation is one of four segments of sports training, and psychological skills are considered to be a crucial segment, without which any other aspect of an athlete preparedness cannot come to the fore (Barić, 2006; Hardy, Jones, Gould, 2003). The higher the skill level of athletes, the more important role the mental factor plays. Sports dancers are usually mostly devoted to technical preparation, then physical, and least of all tactical and psychological preparation. Psychological preparation is an unduly neglected part of sports training, although dancers are affected by many stress factors – those one cannot affect, such as judges, other competitors, music, competition schedule etc, as well as those that may be prevented in time and which are associated with the dancer's body, costumes, choreography, etc. The psychological preparation of sports dancers includes different psychological techniques used in other sports (e.g. breathing exercises, relaxation techniques, visualization of goal achievements, autogenic training). This article will present a specific mental technique called „The Nine Step Connection Model", developed by Maximiliaan Winkelhuis (2001).

The Nine step connection model

People react differently under pressure; some dance couples exhibit bad habits like drinking water or soaking the soles of their shoes in water in between dances. These habits are not necessary, as it is possible to get the body used to dancing five dances in succession, and shoes can be prepared before entering the dance floor, but they are an inadvertent way of coping with stress. Although the levels of experienced stress may be reduced through better preparation, stress will still be there. Therefore, a stronger focus on potential factors that can be controlled must be put in practice.

The way in which this can be accomplished was introduced by Maximiliaan Winkelhuis (2001). It is The Nine Step Connection Model, which helps dancers to repeat what they can do in between dances, helps them to minimize stress and facilitate the dance performance in the finals. It helps the dancer to achieve the necessary relaxation and concentration, and improve relationship with the partner. The dancers have only a few seconds in between dances in the semi-finals or finals. In those few seconds they must go through nine steps of The Nine Step Connection Model. Consciously following each of the steps should lead to a significant decrease in stress levels. Following this routine, a dancer does not have time to think about the previous dance, the partner's or his mistakes, he does not have time for peremptory thoughts about the quality of the performance. The dancer's body and mind must be focused on one thing and one thing only – preparation for the next dance. The dancer must go through three important stages of the mind and body to maximize his performance. These stages are: the ending of the last dance (including the actual end of the dance and applause), physical and mental preparation for the next dance (including relaxation, concentration and charging with new energy), and entering the next dance (involves connecting with your partner, positioning and call).

1. Step: FINISH
The beginnings and endings are moments people remember the most. The beginnings and endings are, in general, one of the most memorable moments in life. Endings are also the most memorable moments of the dance. These are moments when the dancer can make the biggest impression. Many dancers tend to practice the beginning of the choreography, which is much easier because one can never know when the music might end.

For that reason it is important to find a natural end when the music stops so the dance is not abruptly interrupted, but also not prolonged too much.

Table 1. The nine step connection model

STEP NUMBER	NAME	STAGE
1 2	FINISH APPLAUSE	ENDING OF THE LAST DANCE
3 4 5	RELAXATION CONCENTRATION ENERGY	PHYSICAL AND MENTAL PREPARATION
6 7 8	RELATIONSHIP POSITIONING INVITATION	ENTRY TO THE NEXT DANCE
9	ACTION	NEXT DANCE

2. Step: APPLAUSE
The applause of the audience is the most special gift and dancers should be grateful and enjoy the moment. This can also be the first chance to recuperate for the next dance. By concentrating on the applause, for a brief moment the dancer will forget about the last dance, other competitors, judges, next dance etc. To each dancer this will be a brief moment for recuperation. While receiving the applause, it is desirable not to place hands above the shoulder line, and the female partner should be located diagonally in front of the male partner. It is undesirable to move towards a position for the next dance while the applause is still going on. It is advisable to look at the audience while the applause lasts, swiftly glance over the audience, or raise hands in a gesture of gratitude.

3. Step: RELAXATION
Although the idea of relaxation during competition might sound a bit strange, it helps the dancer to do the next six steps. After completing each dance, it is advisable to forget about that dance as soon as possible and concentrate on the next one. Without such relaxation, dancers will go through the finals without the opportunity to recuperate or a chance to make a few adjustments. Adjustments are necessary because the character of each new dance is different from the one before. If the dancer focuses too much on the result and not enough on the dance itself, it may have a negative effect on his dance performance. Dancers need to think about the next dance in positive terms. It is important to focus on what is essential for a successful performance and to concentrate fully on breathing – inhaling through the nose and exhaling through the mouth, slowly and deeply.

4. Step: CONCENTRATION
It has been scientifically proven that mental activity precedes physical activity (Winkelhuis, 2001). For good performance, it is desirable to maintain a good emotional state, which depends on the dancer's mental image, i.e., his cognitive assessment. By consciously thinking about the next dance before the music starts, the dancer prepares his body for the dance. Concentration for the next dance must also be practiced. Only through repeated practice of concentration during training one can create a habit which can help the dancer to maintain stress on minimum levels. Concentration means making the choice of what to think or not to think, as well as choosing what is important among the multitude of available information. Optimal concentration is achieved through the use of "key words". The dancer should choose a word or a phrase which reminds him of what he must take into account during the dance to make a good performance. By doing this, he can achieve the right state of mind and body for the next dance. For each dance, a different key word is needed. Finding five or ten key words takes time. To most dancers it takes six to twelve months to create a positive habit of using key words in all of the five dances. The dancer needs to decide in the beginning what is his long term starting point. By trial and error, the dancer must next find a keyword that inspires him the most. Once the keyword is found, it needs to be used for several times during the trainings to see if it inspires the dancer. If the key word is not inspirational enough, the process must be repeated until a successful key word is found. Seeking key words can be based on the following principle: visualization of the beginning of the choreography, compensation of a weakness, emphasizing the advantages of the dancer, and the characteristics of a dance.

5. Step: ENERGY
The toning of the body follows after the concentration step. By creating the needed energy, the dancer will be ready to dance even before music starts or before physical contact with the partner. If the previous step is practiced well, the dancer's body will start creating the tone for the next dance.

6. Step: CONNECTION
During the dance the dancers should constantly be aware of their partner. In the third, fourth and fifth steps of the connection model, dancers are more occupied with themselves, therefore the sixth step is necessary to re-establish a relationship with the partner. This connection can be visual or physical, e.g. partners hold their hands. This step is of vital importance for the performance. The partners are sending messages just by looking at each other or holding hands. If those messages are not positive or sincere, but rather mechanical and automatic, no connection will be achieved. By recognizing the connection, a more permanent partnership can be build and it will ease movements while dancing in a couple.

7. Step: POSITIONING
Positioning on the floor can be stressful and the dancer can reduce that by controlling where the dance begins, rather than simply depending where others are positioned on the dance floor.

There are many options: the couple can find the most accessible spot on the dance floor or strategically position themselves so they have optimum visibility towards judges or audience. Opinions differ on whether it is desirable to move close to the strongest competitors in order to try to overshadow them or to move away from them. By choosing the starting positions before the competition, the dancer helps his mind and body. After a few rounds the dancer's body is used to what his mind chooses. Walking up to a starting position has a big impact on how judges perceive the couple. Both members of the couple should know the starting position in order to have a clear focus of where to go. A straight line is much more convincing than zigzags. It is a good thing not to start each dance from the same starting position or with the same part of the choreography. Also, it is not advisable to leave from the chosen place on the dance floor if it is too crowded with other dance couples. It is good to start earlier or later than other couples. In stationary dances such as rumba, a couple can start with the basic moves. One should bear in mind that the partners should move together to the next starting position and that the couple can increase its space by keeping a strong visual connection.

8. Step: INVITATION
During Invitation both members of the couple make their contribution and bear a certain responsibility. In this step, the partners develop awareness of each other, which raises the quality of the dance.

Standard dances: five touching points – actions and responsibilities of the dancers:
1) The dancers need to establish visual contact that carries a certain quality of energy connection. This action is performed by both members of the couple; 2) The male dancer's left hand is associated with the female partner's right. The male partner initiates the action, but both members of the couple should maintain hand contact; 3) The female dancer approaches her partner and closes the gap between the two bodies. This is the action that is performed solely by the female dancer. The male dancer must accept it in fourth step; 4) The male dancer's right hand closes the figure only when the female dancer is in the right position towards him. As long as the dancer does not close his right hand, the female partner will know that a necessary correction is required. This action begins with the male dancer and finishes with the female dancer's acceptance in step five; 5) The female dancer keeps her left hand on the male dancer's shoulder. The male dancer should not start the dance before the female dancer gives him the signal. The connection is not optimal until the female partner gives her signal by placing hers left hand. The male dancer might a have too strong or a too weak grip and necessary correction must be made before the next dance. A bad start leads to bad performance and any correction is harder as the dance continues.

Latin American dances: two to three contact points: In Latin-American dances, all dances do not start with the same positions. Sometimes partners are unable to have visual contact on the start of the choreography. Hence, next steps are important. 1) Visual contact: partners should not only maintain visual contact, but really see each other and be aware of the partner; 2) Energy connection: when there is no physical contact at the beginning of the dance, the connection can still be established by synchronized movements. It is advisable to establish a sense of invisible elastic connection between two dancers; 3) Physical contact: in some dances (such as paso doble) physical connection can be part of the starting position. All points of contact should be visible whether it is hand, leg or any part of the body. It takes time to develop a good partnership. This process requires concentration, awareness, patience and practice. It must become a habit. As the dance nears end, its quality is decreasing. The higher the qualities of the dance on its beginning, the higher the chances of it remaining on high levels until its end. Any correction is easier made on the beginning than towards the end.

9. Step: ACTION
After all eight steps are completed, dancers must do everything in their power to decrease stress levels. They are the ready for the next dance. It is good to start the dance in the moment music starts, although it is preferred to start dancing a few moments after the music starts.

How much time is required for all nine steps?
Nine steps may seem a lot to do in a few seconds. All steps are equally important and must be rehearsed in order to be controlled. In the beginning it takes around 30 seconds, later the gap in between dances should suffice. Not all steps are equally important. Two steps are of key influence. If the other seven steps are taken and these two aren't, the dance will not be performed with optimal quality. These steps areare the fourth step and eight step. *Concentration* gives strength to focus on the important parts of the dance and *Connection* is crucial for obtaining a connection between two partners. This connection must be obtained before the dance starts. If this connection is omitted, the dance might seem as mechanical.

Recommendations before using The Nine step connection model
This model is useful only if it is exercised frequently. By doing so, dancers can see how much they have improved over time and what needs to be done to push the performance to the next level. This technique will effectively reduce stress levels to a minimum. By forming this routine, dancers have considerably less time in breaks between dances to deal with negative thoughts and different distractions. This routine enables the dancers to successfully apply the model to gradually focus only on the important parts of their performance.

To successfully apply this model, it is important to practice its use, which requires months of training. A good start would be to begin with only the third and eighth steps, adding the fourth and fifth steps later. In time, other steps can be included.

Conclusion

In a situation where athletes compete, dancers in this case, with equal physical preparation, the one with better psychological preparation will most surely win. The Nine Steps Connection Model is a special mental technique that helps a dancer's psychological preparation and makes the most use of the seconds in between dances.

Practicing this model may take several months, but in that time the time necessary for preparation is progressively decreasing, allowing the dancer to reach his optimal performance levels.

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MODEL POVEZANOSTI U DEVET KORAKA KAO JEDNA OD METODA PSIHOLOŠKE PRIPREME U SPORTSKOM PLESU

Sažetak

Psihološka priprema je nepravedno zanemareni segment sportske pripreme u standardnim i latinsko-američkim plesovima, a zbog velikog broja stresora koji utječu na sportske plesače, postoji potreba za tim aspektom pripreme o kojem puno može ovisiti sam plasman plesača na natjecanjima. U psihološkoj pripremi sportskih plesača mogu se primijeniti različite psihološke tehnike koje se koriste i u ostalim sportovima, a u ovom radu prezentira se Winkelhuisov Model povezanosti u devet koraka koji plesačima omogućuje postići optimalnu razinu opuštenosti, koncentracije i povezanost s partnerom. Koristeći Model plesači mogu smanjiti stres na natjecanju i bolje iskoristiti sekunde između plesova, što pridonosi kvaliteti natjecateljske izvedbe.

***Ključne riječi**: psihološka priprema, sportski ples, Model povezanosti u devet koraka*

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ANALYSIS OF MOST OFTEN RESULTS IN THE BOXING BY AGE (CADET, JUNIOR, SENIOR) AND CATEGORIES (LIGHT, MEDIUM, HEAVY)

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Original scientific paper

Abstract
This study was applied according to interesting problem of tactics in boxing and possible most often types of match ending by cadets, juniors and senior fighters. In the most common results of combat there are no differences between categories in general. By looking at the chart we can see that there are similarities of all ages because of the large ellipse relative overlap. A sample of 147 boxers drawn from the population, defined as a population of light, which is divided into 3 subgroups according to ages, then sample of 176 boxers drawn from the population defined as population mean, which is divided into 3 subgroups according to age groups and sample of 106 athletes drawn from the population, defined as heavy populations that were divided into 3 subgroups, according to the ages.

Key words: *boxing, match end, differences*

Introduction

Often considered as boxing toughest, most complex and most specifically the Olympic disciplines. Favorite name among his supporters is ''Noble skill''. Advantage over the opponent and points are realized and obtained a good, visible and well-placed blow. In any other Olympic sport, a deliberate blow to the opponent is severely punishable by a warning, and usually a disqualification. Only boxing entails a deliberate blow to the opponent, the stronger (on the rules defined impact area) in the head and body, the front side, above the waist. Sufficient talent, psychological balance, optimum power, speed, stamina, agility with the necessary perseverance in boxers, taking part together in the realization of the set and the desired task. In order to most efficiently reach the target it is necessary to adopt and implement, together with athletes agreed tactics. It should be noted the level of its achievements and potential, both physical and technical, and motivational - willingly - psychological. When it comes to tactical preparation, in addition to knowledge about their own form (the general state of the organism at a given time and moment), preferred are also aware of the opponent, its characteristics, constitution, style, method of engagement, the results achieved so training and improvement in technical elements box, and progression in primary, general physical properties and characteristics, to obtain better conditions for the implementation and realization of prepared and adopted tactics. Good tactic involves achieving the greatest impact on competition, with less risk and effort. For successful training, development and application of tactics, the decisive role is played by a good tactical thinking boxer.

To properly and meaningful impact on development, it is necessary to know all the elements, to sport, and the specifics of the fight in the ring. It is very important to the proper pedagogical and gradually affect the development of athletes, given the current level of his sporting achievements (forms) competition which is being prepared and we have set a goal that so (designed sports results). Expected result implies the realization of responsible well thought out plan. Gradual in the preparatory period, the wealth of techniques and practical application should be based on specific characteristics and individual characteristics of the individual. Common techniques, individual benefits and specialty were not always equally applicable to any opponent (in style). Very often we have called delayed implementation of technical training, and adoption and implementation of individual achievements and benefits of the respective opponents. This is often caused by individual characteristics, competitors, or the unity of physical, technical, psychological and motivational preparedness. To choose the best tactics in the fight, it is the more relevant information about the opponent: recent results, the style of engagement, experience, constitution, psychological status, good and bad characteristics, techniques commonly used in attack, defense, etc. Information about the opponent is collected and analyzed in order to reach the best and most rational strategy of managing tactical battle in the ring. During performance testing conducted in the preparation of training, athletes are required to perform different techniques, both attack and defense, and counter-attacks. Thus we can clearly assess the level at which the diversity of technical elements, and the rate of change of plan and actions themselves fighting in the ring.

Successful application depends on the talent (the assembly of all the features), the volume of its technical sophistication, and level of efficiency and practical application. Development of tactical opinion is controlled by examining the speed of the new assessment of the situation, the efficiency of pronounced bumps and implementation requires in relation to different sparring partners. And combination of tactical tasks are far smaller in scope than the overall technical achievements of athletes. There is often an opportunity to see training of tactical elements of a perfect application, versatility, imagination and timeliness of actions, while the meeting is often absent and action are mostly monotonous, slow and inefficient. It talks about the poor tactical preparedness, as well as low motivational levels and poor form. Since boxing is one of the acyclic sports, does not mean, if we failed in the first or second attempt to realize a particular idea, it will be next and that should not be more trying. The application of technical-tactical elements during the fight, it is essential for success in combat. Higher levels of performance and capacity of technical elements to a better realization of the given variant of tactical combat in the meeting. A small variety of technical elements to facilitate the implementation of the strategy the opponent defense. This speaks to the diverse and well-trained technique based implementation and execution of tactical elements, both in defense and in attack. Uncertain and unpredictable dynamics of the battle in the ring often changes the agreed tactics. It may not be the stencil, but it is very often caused during the performance of the combat. The application of technical-tactical elements during combat is closely linked and mutually dependent than the general and specific physical fitness, psychological stability and motivation fighter. Constitution, the level of sports mastery (technical skills) and the character of the basic prerequisites of forming individual peculiarities boxer, or his style of training and the leadership struggle, and the finality and its overall success.

Aim and methods

The aim is to emphasize the importance of boxing tactics, and its application through the movement of results during the struggle. This paper covers the results of athletes with two European Championships, held in Sombor 2007 (Junior). and in Novi Sad, 2008 (Cadet). and with an international tournament for seniors'' winner'' Belgrade in Belgrade 2007. It will also determine which are the most common stop fighting in relation to age, as well as movement between Boxers results classified into groups in which is concentrated in several weight categories: lightweight (Paper 48, flies 51, bantam 54 and featherweight 57), medium (light 60, half-velter 64, velter 69 and middle 75) and heavy: (half-heavy 81, heavy 91 and super-heavy +91 kg category). The Cadet European Championships in Novi Sad 2008 was attended by 149 fighters from 20 countries. There were 133 fights.

At the European Junior Championships, Sombor 2007th attended by 209 fighters from 37 countries. There were 198 battles. The international tournament for seniors Belgrade Winner'' 2007'' was attended by 73 fighters from 13 countries. There were 63 fights. 4 results were processed with the most fighting ended. International labels that are applied to the box are: WP (Win on Points) - victory on points, or points, RSC (Win by Referee Stop Contest) - Termination by the judge in the ring, RET (Retired) - (withdrawal), the termination of the coach - RSCO (Referee Stop Contest Overscore), interruption of more than 20 points difference. Will analyze a sample of 147 soldiers belonging to the category of light, divided into 3 subgroups according to ages: Cadets (52), juniors (66), seniors (29). Then a sample of 176 soldiers belonging to the category srednjiih divided into 3 subgroups according to ages: Cadets (50), juniors (90), seniors (36). Finally, the sample of 106 soldiers belonging to the category of heavy divided into 3 subgroups according to ages: Cadets (31), juniors (40), seniors (35). A sample of 133 cadets is divided into 3 subgroups according to the categories: light (52), medium (50), heavy (31). A sample of 196 junior is divided into 3 subgroups according to the categories: light (66), medium (90), heavy (40). A sample of 100 seniors is divided into 3 subgroups according to the categories: light (29), medium (36), heavy (35). Results were obtained using analysis of multivariate variance analysis and discriminant analysis.

Results

Cadets

In accordance with previously established draft research analyzes the results of the most topical units fighting at lightweight boxer. The analysis is performed on the 4 most common results of the battle: victory on points (WP), interrupt the judge in the ring (RSC), interrupt the judge-scoring difference (RSCO) and handing coach (RET), all on a sample of 393 fights, held on Cadet and Junior European Championship and the senior International tournament'' Belgrade winner''. The analysis included three human ages of competitors: Cadets (133), junior (198) and seniors (63). Feature victory on points (WP) has 2 modes: other decisions and the victory on points (WP). The characteristic fine judges in the ring (RSC) has two modes: other decisions, fine judges in the ring (RSC). Feature fine judge-scoring difference (RSCO) has 2 modes: other decisions, rating difference (RSCO). Feature legends trainer (RET) has 2 modes: other decisions, handing-coach (RET). It is possible to note that the pupils (pupils) represented the most wins on points (WP) consisting of 34 fights (65.4%) of 52, which is significantly higher than the frequency of other decisions (18 fights 34.6%, $p = .002$). In junior representation victory on points (WP) (53 fights 80.3%), which is significantly higher than the frequency of other decisions (13 fights 19.7% $p = .000$).

Table 1 Victory on points (WP)

	Other decisions		(WP)	
	n	%	n	%
Light	18.	34.6	34.	65.4
Medium	11.	22.0	39.	78.0
Heavy	9.	29.0	22.	71.1

With senior representation of the victory on points (WP) (27 fights 93.1%), which is significantly higher than the frequency of other decisions (2 fights 6.9% p = .000). The difference between the ages: the modality most other decisions are represented by pupils (34.62%), which is significantly higher than juniors (19.70% p = .070) and seniors (6.90%, p = .007). The victory on points (WP) was most common for senior citizens (93.10%), which is significantly higher than pupils (65.38% p = .007). Since p = .013 c2 - test, ac = .237 with a confidence interval (105, .369), which does not contain zero, one can say that there is low correlation between the ages of competitors and win on points (WP).

Table 2 Interruption by the judge in the ring (RSC)

	Other decisions		(RSC)	
	n	%	n	%
Light	46.	88.5	6.	11.5
Medium	45.	90.0	5.	10.0
Heavy	27.	87.1	4.	12.9

It is possible to note that the most frequent interruption of school children in relation to other decisions, which makes the fight, or 46 (88.5%) of 52, which is significantly higher than the frequency of interruption of the judges in the ring (RSC) 6, or fighting (11.5%, p =. 000). In junior representation interruption in relation to other decisions of 63 fight (95.5%), which is significantly higher than the frequency of interruption of the judges in the ring (RSC) 3 or fighting (4.5%, p = .000). With senior representation interruption for other decisions than 27 fights is (93.1%), which is significantly higher than the frequency of interruption of the judges in the ring (RSC) 2 or fighting (6.9%, p = .000). The difference between the ages of competitors by landmarks: the most characteristic of other decisions is represented by junior (95.45%), characteristic of fine judges in the ring (RSC) is the most frequent in school children (11.54%). Since p = .355 can be said that by C2 - the test is not significant link between ages and breaks judges in the ring (RSC).

Table 3 Judge-break points the difference (RSCO)

	Other decisions		(RSCO)	
	n	%	n	%
Light	41.	78.8	11.	21.2
Medium	44.	88.0	6.	12.0
Heavy	25.	80.6	6.	19.4

It is possible to note that the most frequent interruption of pupils to other decisions, which makes the fight or 41 (78.8%) of 52, which is significantly higher than the frequency points the difference (RSCO) 11 or fight (11.2%, p = .000).

In junior representation interruption for other decisions of 58 was fighting (87.9%), which is significantly higher than the frequency points the difference (RSCO) 8 or fight (12.1%, p = .000). The difference between the ages: stop fighting over other decisions is most prevalent in seniors (100.00%), which is significantly larger than the juniors, where (87.88% p = .053), and with the pupils (78.85% with p = .009). Break points the difference (RSCO) is most prevalent in schoolboy (21:15%), which is significantly larger than the representation of seniors where (.00% p = .009). Since p = .024 c2 - test, ac = .220 with a confidence interval (.120, .320), which does not contain zero, one can say that there is low correlation between the ages of competitors and judges feature to break-points the difference (RSCO).

Table 4 Withdrawal-coach (RET)

	Other decisions		(RET)	
	n	%	n	%
Light	51.	98.1	1.	1.9
Medium	50.	100.0	0.	.0
Heavy	31.	100.0	0.	.0

It is possible to note that the most frequent interruption of pupils for making other decisions or fight 51 (98.1%) of 52, which is significantly higher than the frequency of handing-coach (RET) 1 fight or (1.9%, p = .000). In junior representation interruption modality for other decisions were 64 fights or (97.0%), which is significantly higher than the frequency of handing-coach (RET) 2 or fighting (3.0%, p = .000), which is significantly higher than the frequency of handing-coach (RET) 0 or battle (0%, p = .000). The difference between the ages: to end the fighting in relation to other decisions, most seniors are represented (100.00%), interruption of handing-coach (RET) is most prevalent in junior (3.03%). Since p = .628 can be said that by C2 - the test is not significant link between ages and traditions-coach (RET).

Table 5 Multivariate differences

	n	F	p
MANOVA	4	.851	.559

	γ	R	F	p
WP	.121	.122	.996	.372
RSC	.035	.035	.082	.921
RSCO	.109	.110	.804	.450
(RET	.108	.109	.782	.460

	discr	Light	Medium	Heavy
RSCO	0.16	RSCO	RSCO	Other
RSC	0.28	RSC	Other	Other

Since p = .000 rejects the hypothesis H1 and acceptance of alternative A1, which means that there are significant differences found between the 3 different fighting age. As the pn> .05 There is no reason not to accept the hypothesis H3, which means that no significant difference between the results of the struggle of different ages, with features: fine judges in the ring (RSC) .357, handing-coach (RET) .631.

Since the p <.05 accepts the alternative hypothesis A3, which means that there are significant differences between some of the results of the struggle of different ages with features: the victory on points (WP) (decision of judge .012), fine judge-scoring difference (RSCO) .023. Based on the results of common struggle with competitors grouped in a category, it can be easy to say that pupils have the following characteristics: Breaking Point fight the big difference was significantly higher compared to other Boxers ages, a fine judge in the ring is slightly higher in this category. This means that the riders of this age are different levels of tactical and technical preparations boxers and their general level of preparation. Also noted is that judges disposed towards this age group in order to protect their health and future development. For juniors, there are also similar precautionary characteristics in relation to the judge still totally untrained and unprepared physically individual competitors. For seniors, this decision are negligible since it is already well formed, and a trained competitors.

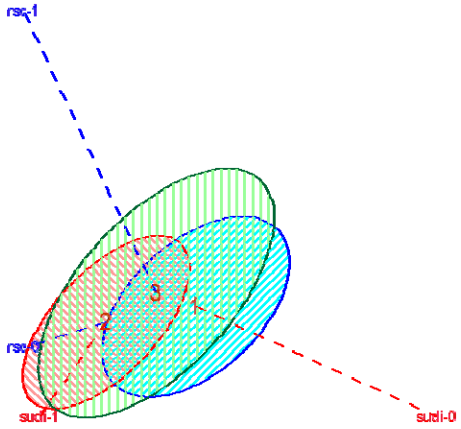

Figure 1 Relative position of groups

Juniors

It is possible to observe that for most pupils represented the victory on points (WP) consisting of 39 fights (78.0%) out of 50, which is significantly higher than the frequency of other decisions (11 fights 22.0%, p = .000). In junior representation victory on points (WP) is 71 fight (78.9%) and significantly higher than the frequency of other decisions (19 fights 21.1% p = .000). With senior representation of the victory on points (WP) is 31 fight as 86.1%, a significantly higher incidence of other decisions (5 fight, or 13.9% p = .000). The difference between age groups: modality fight other decisions, the most prevalent in school children (22.00%); a victory on points (WP) is the highest in seniors (86.11%). Since p = .595 can be said that by C2 - the test is not significant link between ages and the victory on points (WP). It is possible to note that the most frequent interruption of pupils other decisions, which makes the fight, or 45 (90.0%) out of 50.

Table 6 Victory on points (WP)

	Other decisions		WP	
	n	%	n	%
Light	13.	19.7	53.	80.3
Medium	19.	21.1	71.	78.9
Heavy	12.	30.0	28.	70.0

Table 7 Interrupted the judge in the ring (RSC)

	Other decisions		RSC	
	n	%	n	%
Light	63.	95.5	3.	4.5
Medium	85.	94.4	5.	5.6
Heavy	35.	87.5	5.	12.5

It is significantly higher than the frequency of interruption of the judges in the ring (RSC) (5 fight, or 10.0%, p = .000). In junior representation interruption in relation to other decisions were 85 combat or 94.4%, which is significantly higher than the frequency of interruption of the judges in the ring (RSC) (5 fight, or 5.6% p = .000). For seniors, the distribution of interruptions in relation to other decisions of 34 fights or 94.4%, which is significantly higher than the frequency of interruption of the judges in the ring (RSC), where we have 2 fights, or (5.6%, p = .000). The difference between age groups: modality other decision is the most prevalent in junior (94.44%); fine judges in the ring (RSC) is the most prevalent in schoolboy (10.00%). Since p = .573 can be said that by C2 - the test is not significant link between ages and characteristics of fine judges in the ring (RSC).

Table 8 Representation of judge-break points the difference (RSCO)

	Other decisions		RSCO	
	n	%	n	%
Light	58.	87.9	8.	12.1
Medium	82.	91.1	8.	8.9
Heavy	36.	90.0	4.	10.0

It is possible to note that the pupils, the most frequent interruption in relation to other decisions, which is 44 fights, or (88.0%) out of 50, which is significantly higher than the frequency points the difference (RSCO) 6 or fight (12.0%, p =. 000). In junior representation interruption in relation to other decisions the 82nd combat or (91.1%), which is significantly higher than the frequency points the difference (RSCO) where we have 8 or fighting (8.9%, p = .000).

With senior representation interruption in relation to other decisions of the 34 fights that (94.4%), which is significantly higher than the frequency points the difference (RSCO) where iman fight or two (5.6%, p = .000). The difference between the ages of competitors: other mode decision is the most prevalent in elderly persons (94.44%) points the difference (RSCO) was highest in schoolboy (12.00%). Since p = .588 can be said that by C2 - the test is not significant link between ages and features fine judge-scoring difference (RSCO).

Table 9 Representation of withdrawal-coach (RET)

	Other decisions		RET	
	n	%	n	%
Light	64.	97.0	2.	3.0
Medium	84.	93.3	6.	6.7
Heavy	37.	92.5	3.	7.5

It is possible to note that the most frequent interruption of juniors in relation to other decisions, which makes the fight 84 or (93.3%) out of 90 fights, which is significantly higher than the frequency of handing-coach (RET), where we have 6 fights or (6.7 % p = .000). With senior representation interruption in relation to other decisions that the fight is 35 (97.2%), which is significantly higher than the frequency of handing-coach (RET), where we have a fight or (2.8%, p = .000).

The difference between the ages of competitors: other mode decision is the most prevalent in school children (100.00%), which is significantly higher than juniors (93.33% p = .064). Stop fighting, withdraw competitors, surrender-coach (RET) is most prevalent in junior (6.67%), which is significantly higher than pupils (.00%, p = .064). Since p = .141 can be said that by C2 - the test is not significant link between the different ages and breaks, handing-coach (RET). In this chapter will be to prove or reject the claim that there are significant differences between the struggle of different ages (school children, juniors, seniors) in relation to the four most frequently found fighting group, secondary categories.

Table 10 Multivariate differences

	n	F	p
MANOVA	4	.002	1.00

	γ	R	F	p
WP	.092	.093	.843	.432
RSC	.120	.121	1.435	.241
RSCO	.047	.047	.216	.806
RET	.081	.081	.642	.527

	n	F	p
Discriminative	2	1.07	.371

Since p = .979 is no reason not to accept the hypothesis H1, which means that no significant difference between fighting with competitors, various ages. As the pn> .05 There is no reason not to accept the hypothesis H3, which means that no significant difference between the struggle of competitors, the different ages of characteristics: the victory on points (WP) (decision of judge .598), fine judges in the ring (RSC) .576, fine judge-scoring difference (RSCO) .591, handing-coach (RET) .142. Since p = 680 for 2 synthesized competitors, there is no reason not to accept the hypothesis H2, which means that no significant difference and clearly defined boundaries between the results of any fight different ages in relation to disruption of athletes classified in a category middle, to end the judges in the ring (RSC) and the termination of the judge-scoring difference (RSCO).

Based on previous considerations, a sample of 176 fights, in accordance with the methodology applied, can be logically derived characteristics of each of the three ages. Since p = 680 indicates that there is no clearly defined boundaries between ages, so it is not possible to determine the features of the group in relation to stop fighting with competitors grouped in a category middle.

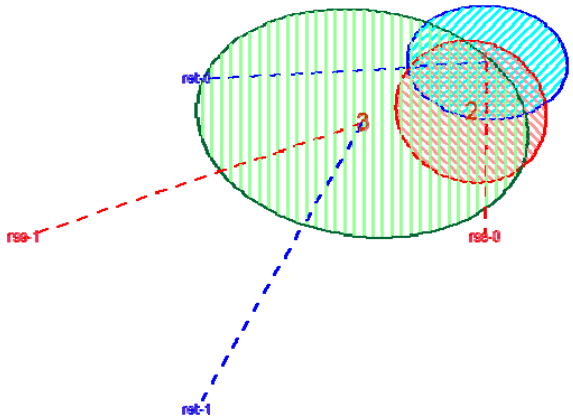

Figure 2 Ellipses represent different ages in relation to termination of the struggle of competitors, the features of the results: interruption of the judges in the ring (RSC) and the termination of the judge-scoring difference (RSCO)

By looking at the chart we can see that there are similarities of all ages in relation to termination of the fight referee decisions (RSCO) and suspension of judges of the fight in the ring (RSC), because the ellipse in large part overlap.

Seniors

The table shows the numeric (n) and percentage (%) represented the most common result of the struggle with the athletes belonging to the category, teškiih for ages 3 levels in 4 break: the victory on points (WP), interrupt the judge in the ring (RSC), interrupt the judge -points the difference (RSCO), handing-coach (RET). We will address the important also differences between and within levels. Descriptive procedure is only possible nagovestiti some characteristics of individual level interrupts the fight, while a significant difference between ages later analyzed.

Table 11 Representation of the victory on points (WP)

	Other decisions		WP	
	n	%	n	%
Light	2	6.9	27	93.1
Medium	5	13.9	31	86.1
Heavy	8	22.9	27	77.1

It is possible to observe that for most pupils represented the victory on points (WP) consisting of 22 fights (71.0%) out of 31, which is significantly higher than the frequency of other decisions where we have a fight or 9 (29.0%, p = .002).

In junior representation victory on points (WP) is 28 or fight (70.0%), which is significantly higher than the frequency of other decisions where imamo12 fight, or (30.0%, p = .001). With senior representation of the victory on points (WP) is 27 or fight (77.1%), which is significantly higher than the frequency of other decisions or 8 fights (22.9%, p = .000). The difference between age groups: modality other decision is the most prevalent in junior (30.00%); victory on points (WP) is the highest in seniors (77.14%). Since p = .763 can be said that by c2 - test revealed no correlation between ages and the victory on points (WP).

Table 12 Representation interrupted the judge in the ring (RSC)

	Other decisions		RSC	
	n	%	n	%
Light	27	93.1	2	6.9
Medium	34	94.4	2	5.6
Heavy	32	91.4	3	8.6

It is possible to note that the most frequent interruption of school children in relation to other decisions, which consists of 27 or fight (87.1%) out of 31, which is significantly higher than the frequency, fine judges in the ring (RSC) (4 fights p = 12.9%. 000). In junior representation interruption in relation to other decisions of 35 fights or 87.5%, which is significantly higher than the frequency, fine judges in the ring (RSC) (5 fight 12.5% p = .000). With senior representation interruption in relation to other decisions in 32 fights and 91.4%, which is significantly higher than the frequency, fine judges in the ring (RSC) (3 fights 8.6% p = .000). The difference between age groups in relation to the other mode of decision is most prevalent in elderly persons (91.43%), interruption of the judges in the ring (RSC) is the most prevalent in school children (12.90%). Since p = .820 can be said that by C2 - the test is not significant link between ages and fine judges in the ring (RSC).

Table 13 The presence of fine judge-scoring difference (RSCO)

	Other		RSCO	
	n	%	n	%
Light	29	100.0	0	.0
Medium	34	94.4	2	5.6
Heavy	34	97.1	1	2.9

It is possible to note that the most frequent interruption of school children, other decisions, which makes up 25 fights (80.6%) out of 31, which is significantly higher than the frequency points the difference (RSCO) (6 fight 19.4% p = .000). In junior representation interruption in relation to other decisions in 36 fights and 90.0%, which is significantly higher than the frequency, rating difference (RSCO) (4 struggles 10.0%, p = .000).
With senior representation interruption in relation to other decisions of 34 fights or 97.1%, which is significantly higher than the frequency, rating difference (RSCO) (1 match 2.9% p = .000). The difference between age groups in relation to the mode of fighting, the other decision is the most prevalent in elderly persons (97.14%), which is significantly larger than the schoolboy (80.65% p = .033). Break points the difference (RSCO) is most prevalent in school children (19:35%), which is significantly higher than seniors (2.86%, p = .033). Since p = .090 one can say that there is an association with increased risk between the ages of conclusion and termination of judge-scoring difference (RSCO).

Table 14 Representation of withdrawal-coach (RET)

	Other decisions		RET	
	n	%	n	%
Light	29	100.0	0	0
Medium	35	97.2	1	2.8
Heavy	31	88.6	4	11.4

It is possible to note that for most juniors represented a break in relation to other decisions, which makes 37 fights (92.5%) of 40, which is significantly higher than the frequency of handing-coach (RET) (3 fights 7.5% p = .000). With senior representation interruption in relation to other decisions of the (31 Fight 88.6%), which is significantly higher than the frequency of handing-coach (RET) (4 struggles 11.4% p = .000). The difference between age groups in relation to the mode of fighting, the other decision is the most prevalent in school children (100.00%), which is significantly higher than seniors (88.57% p = .056). Stop, surrender-coach (RET) is most prevalent in seniors (11.43%), which is significantly larger than the schoolboy (.00%, p = .056). Since p = .168 can be said that by C2 - the test is not significant link between ages and traditions-coach (RET).

Table 15 Multivariate differences

	n	F	p
MANOVA	4	.890	0.526

	γ	R	F	p
WP	.177	.180	1.632	.201
RSC	.050	.050	.122	.885
RSCO	.130	.131	.851	.430
RET	.217	.222	2.549	.083

	n	F	p
Discriminative	2	1.664	0.160

Since p = .234 for 2 synthesized competitor Since p = .307, there is no reason not to accept the hypothesis H1, which means that no significant difference between the struggles of different ages. As the pn> .1 no reason not to accept the hypothesis H3, which means that no significant difference between the struggle of different ages with features: the victory on points (WP) (decision of judge .766), fine judges in the ring (RSC) .823, handing-coach (RET) .169. Since the p <.1 accept the alternative hypothesis A3. That means that there are significant differences between some of the different ages of features fine judge-scoring difference (RSCO) .089. Well, there's no reason not to accept the hypothesis H2, which means that no significant difference and clearly defined boundaries

between the struggle of different ages in relation to the characteristics. Based on previous considerations and the sample of 106 fights, in accordance with the methodology applied, can be logically derived characteristics of each of three ages. Since p = .234 indicates that there is no clearly defined boundaries between ages, so it is not possible to determine the features of ages in relation to stop fighting with competitors grouped in a heavy category.

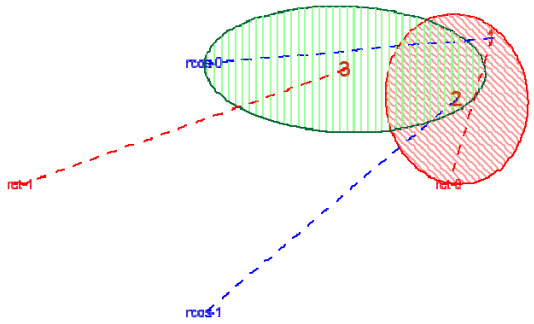

Figure 3 - Ellipses fight different ages in relation to termination of the characteristics of the competitors, judges break-points the difference (RSCO) and termination of the judges in the ring (RSC)

By looking at the chart we can see that there are similarities of all ages because of the large ellipse relative overlap. A sample of 147 boxers drawn from the population, defined as a population of light, which is divided into 3 subgroups according to ages, then sample of 176 boxers drawn from the population defined as population mean, which is divided into 3 subgroups according to age groups and sample of 106 athletes drawn from the population, defined as heavy populations that were divided into 3 subgroups, according to the ages. In the most common results of combat veterans classified in a category, lightweight (MANOVA .000) no significant difference between age 3 times, winning on points (WP) (.012), interrupt the judge-scoring difference (RSCO) (.023).

The difference was not observed at the termination of the judges in the ring (RSC) (.357), teacher-trainer (RET) (.631), interrupt the judge-scoring difference (RSCO) (.061), interrupt the judge in the ring (RSC) (.020) and handing-coach (RET) (.008). In the most common results of combat athletes classified as middle (MANOVA.979) there is no difference between the three human ages. In the most common results of combat athletes classified as severe (MANOVA.307) there is no difference between the three ages.

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ANALIZA NAJČEŠĆIH REZULTATA U BOKSU PO UZRASTU (KADETI, JUNIORI, SENIORI) I KATEGORIJAMA (LAKE, SREDNJE, TEŠKE)

Sažetak

Ova studija je provedena u skladu sa zanimljivim problemom taktike u boksu i mogućim tipovima završetka meča kod kadeta, juniora i seniora. Kod najčešćih rezultata borbe nema razlike između kategorija u cjelini. Gledajući grafikone možemo vidjeti da postoje sličnosti svih uzrasta zbog velikih preklapanja.elipsi. Uzorak od 147 boksača izvučeni iz populacije, definirane kao populacije koja je podijeljena u tri podskupine prema dobi, zatim uzorak od 176 boksača izvučenih iz populacije definirana kao srednja vrijednost populacije, koja je podijeljena u tri podskupine prema dobi skupine i uzorku od 106 sportaša izvučeni iz populacije, koja je definirana kao teške populacijama koje su podijeljene u tri podskupine, prema dobi.

Ključne riječi: *boks, završetak meča, razlike*

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