THE PARTIAL QUANTITATIVE CHANGES OF HANDBALL SPECIFIC MOTOR ABILITIES PRODUCED BY 12-WEEK FITNESS PROGRAM

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Summary
The aim of the study was to find out partial quantitative changes of students' specific handball motor abilities, produced by applied 12-week combined fitness program. All participants were health sport faculty male students with ages 19 ± 1. The experimental program included a three times work out per week, two times resistance, weight training and once a week plyometric training. In order to detect potential changes we conducted paired sample t-test. The obtained results showed that the program has made statistically significant changes on 8 of 9 tests. The highest level of transformation has made on variables for ball handling estimation (28, 20 and 10, 66 %), while the smallest changes are produced on variables for evaluation of movement speed with the ball (2, 87 and 10, 66 %). We think, that fine adjusted training load to all participants, respectively, an individualised approach, contributed to the obtained results. Our opinion is that this kind of fitness program should be a part of regular faculty program during all educational period, in order to enhance students' basic and specific motor capacities and make their way to improve tehnical elements of different sports, easier.

Key words: *wheight and plyometric training, paired sample t-test*

INTRODUCTION

Every sport is demonstration of different basic and specific motor abilities through an application of technique of certain sport. Successful performance in all sports is determined by a large number of different abilities, its level and quality. Only well developed basic motor abilities can be a solid foundation for development of specific motor abilities. What we see, as a technique, during a football, basketball, volleyball or handball match (shooting, passing, dribbling, blocking, slam dunking, faking…) is just a manifest of what is behind it; basic motor abilities, or better said, specific motor abilities or skills. The basic motor abilities have been the interest of many researches in past years Gredelj at al 1975, Metikoš, et al. 1982, while the specific motor abilities are not so investigated.

The researches as Pavlin at al. (1982)[(5)] succeed in revealing the latent structure of handball specific abilities. They factorised twenty five instruments of assessing handball specific motor abilities. The obtained results showed existence of five factors that can be interpreted as factors responsible for shooting precision, ball handling skills, a movement speed with the ball, a movement speed without the ball and the power of throwing the ball. Also, Vuleta at al. (2003)[(11)] analysed a latent structure of similar battery of specific motor tests on sample of 215 Faculty of Kinesiology students and they confirmed research conducted by Pavlin and colleagues.

The other studies have been conducted in order to find out relationships between basic and specific handball abilities. Vuleta and Šimenc (1996)[(7)] using canonical correlation analysis confirmed statistical significant relationship between four basic motor abilities, represented by forty four tests, and handball specific motor abilities, represented by fifteen tests. Also, Vuleta (1999) [(8)] conducted a study on sixty four young handball players Using regression analysis he confirmed relationship between nine variables for basic motor abilities assessment and criterion variable defined as ball handling skills.

There are few researchers who dealt with effects of different fitness programs on the handball specific motor abilities. They mostly were conducting studies in order to test effects of fitness programs on basic motor abilities, or to test a combine handball-fitness program on basic and specific motor abilities. Vuleta et al. (2000)[(9)] analysed effects of 9-week programmed handball training on eight basic and four specific motor abilities. Using pair sample t-test they obtained results that showed positive changes on all tested variables. In addition, Vuleta et al. (2002)[(10)] investigated

changes of anthropological attributes in senior male handball players induced by training. They used 15-test battery (2 physiological tests, 9 basic motor tests and 4 specific handball motor tests). Obtained results showed the changes on fourteen of fifteen tests.

There wasn't any available research that checked only effects of fitness program on handball specific motor abilities. That is the main reason for conducting this study, respectively, to make sure if 12-week combined (resistance/plyometric) fitness program will create any changes of students' specific handball abilities.

METHODS

Participants

Thirty six actually healthy college male students with ages 19 ± 1 year participated in this study. All participants chose subject Fitness as an optional course. All of them had a shorter or longer history of physical activity participation, but during the study they were not included in any organised sport activity except those related with the research. Only participants who had hundred percent of training session attendance have been considered in the examination.

Instruments

The sample of variables consisted of a 9-test battery of measuring instruments assessing handball specific motor abilities. The analyzed tests covered the following hypothetical motor abilities: the ball handling skills: SPR2LO - the two balls dribbling, SBHZ1R - throwing and catching the ball with one hand, SBHL2R - jump shot throwing and catching the ball with two hands; a speed movement with the ball: SBVLS20 - 20 m slalom dribbling, SSBL20 – 20 m acceleration ability with the ball; a speed movement without the ball: SKOTBBL – a triangle movement – defence movement, SBIDP - lateral and back/forward movement speed; the power of throwing the ball: SSBLDS - the power of throwing the ball with the jump, SSBLM - the power of throwing the ball without the jump. In following tables variables are written with letter "I" or "F" at the end of all variables' acronyms. The letters represent initial and final testing session variables. The assessment was carried out in University sport hall in morning hours.

Experimental program

The realised fitness program consisted of two programs combination; the weight training (two times a week) and plyometrics (once a week). The program was carried out in the first semester of school year and it lasted for twelve weeks. Before participants started with weight training, they had been tested by sixteen weight lifting exercises (bench press, squat, hang clean, leg press, step ups, leg extension, leg curl, leg adduction and abduction, back extension, sit ups, sitting military press, triceps press downs, lat pull-downs, barbell upright row, standing curl bar curls) in order to get their 1 RM - repetitium maximum (the maximal load a person can lift in one attempt). Based on 1-RM the exercises' intensity has been determined for each participant. Prior the weight training subjects performed 15-minut warm up. The exercises' intensity has increased linearly from week to week as participants get stronger. Because the subjects were beginners in weight training, first two weeks of the program were designed in order to prepare their musculoskeletal system for the following training and to learn proper techniques and principles of this kind of resistance training. The rest of program was created to enhance muscular endurance and hypertrophy, and, as the program was approaching to the end, participants had to deal with sub maximal and maximal exercise's intensity which implicated maximal power enhancement. A number of series, repetitions and rest intervals were determined according to recommendations for beginners: "Training loads characterized by one to three series, with eight to twelve repetitions, intensities of 70 to 85% of 1MR and pauses between one and two minutes, correspond to the recommendations for muscular hypertrophy training with amateur/intermediate individuals" [(3)].

The second part of the program was related to plyometrics training. "Plyometrics refers to human movement that involves an eccentric muscle contraction immediately and rapidly followed by a concentric contraction. Plyometrics is a type of exercise training designed to produce fast, powerful movements (jumps, sprints, throws...), and improve the functions of the nervous system" [(3)]. Fifteen minutes warm up was standard procedure prior to plyometric exercises. In first two weeks subjects have met plyometrics training, its principles and safety consideration, and using low intensity exercises (skips, sprints, hops, double-leg jumps in place, running in place, skipping rope and side to side jumps over a small barrier) gradually reached more intense exercises, that included different depth jumps and medical balls toss. By means of different bench heights for drop jumps and different medical ball weights we successfully controlled the work out intensity.

The types of exercises and its intensity was determined according to the book "Jumping into plyometrics" (1998)[1], written by Chu, D.A.

RESULTS

Using a paired sample t-test we tried to ensure if the 12-week combined fitness program had produced any partial quantitative effects on tested variables. Two testing sessions were carried out; an initial, before the start of the program, and the other, a final assessment, after the program realisation. Table 1 shows descriptive statistic for all variables. As it noticeable all final variables' values have been increased comparing them with their initial pairs, except time determined variables where lower value means better result. Pre-post standard deviation values reveal that participants had the highest variability in variables for ball handling estimation, but the lowest variability in variables for a speed movement with the ball evaluation. Table 2 shows statistically significant correlation between every pre-post variable.

Table 1.

Paired Samples Statistics					
Pairs	**Variables**	**Mean**	**N**	**Std. Deviation**	**Std. Error Mean**
Pair 1	SPR2LOI	100,6203	36	83,53901	13,92317
	SPR2LOF	98,765	36	74,7458	12,4576
Pair 2	SBHZ1RI	13,33	36	3,389	,565
	SBHZ1RF	18,56	36	3,139	,523
Pair 3	SBHLZ2RI	17,03	36	2,063	,344
	SBHLZ2RF	19,06	36	1,620	,270
Pair 4	SBVLS20I	6,3911	36	,51405	,08568
	SBVLS20F	6,2083	36	,55482	,09247
Pair 5	SSBL20I	3,7689	36	,23889	,03981
	SSBL20F	3,6639	36	,19912	,03319
Pair 6	SKOTBLI	76,31	36	8,239	1,373
	SKOTBLF	83,19	36	6,342	1,057
Pair 7	SBIDPI	88,17	36	7,879	1,313
	SBIDPF	94,00	36	5,782	,964
Pair 8	SSBLDSI	27,71	36	4,192	,699
	SSBLDSF	29,736	36	3,6596	,6099
Pair 9	SSBLMI	28,319	36	4,2023	,7004
	SSBLMF	30,49	36	4,157	,693

Table 2.

Paired Samples Correlations				
Pairs	**Variables**	**N**	**Correlation**	**Sig.**
Pair 1	SPR2LOI & SPR2LOF	36	0,356	0,03
Pair 2	SBHZ1RI & SBHZ1RF	36	0,624	0,00
Pair 3	SBHLZ2RI & SBHLZ2RF	36	0,547	0,00
Pair 4	SBVLS20I & SBVLS20F	36	0,623	0,00
Pair 5	SSBL20I & SSBL20F	36	0,637	0,00
Pair 6	SKOTBLI & SKOTBLF	36	0,626	0,00
Pair 7	SBIDPI & SBIDPF	36	0,688	0,00
Pair 8	SSBLDSI & SSBLDSF	36	0,814	0,00
Pair 9	SSBLMI & SSBLMF	36	0,793	0,00

Table 3, the column "Mean" illustrates average differences of pre-post variables, that is, the effects produced by the 12-week fitness program realisation. The biggest differences are evident with variables for throwing and catching the ball estimation (SBHZ1R), and with variable jump shot throwing and catching the ball with two hands (SBHLZ2R). The t-test values are statistically significant for eight of nine variables, that means, the produced effects can be attributed to the

accomplished fitness program. That was not a case with one variable (SPR2LO), which t-test value are not statistically significant, although, there are some average differences between pre-post results, but they are not consistent across all subjects, i.e. several subjects improved their results, but several others did not. The produced outcome of the variable cannot be attributed to the program.

Table 3.

Paired Samples Test									
Paires	variables	Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	SPR2LOI - SPR2LOF	1,8555	90,08146	15,013	-28,623	32,334	,124	35	,902
Pair 2	SBHZ1RI - SBHZ1RF	-5,222	2,840	,473	-6,183	-4,261	-11,034	35	,000
Pair 3	SBHLZ2RI - SBHLZ2RF	-2,028	1,797	,299	-2,636	-1,420	-6,772	35	,000
Pair 4	SBVLS20I - SBVLS20F	,18278	,46539	,07757	,02531	,34024	2,356	35	,024
Pair 5	SSBL20I - SSBL20F	,10500	,18994	,03166	,04073	,16927	3,317	35	,002
Pair 6	SKOTBLI - SKOTBLF	-6,889	6,532	1,089	-9,099	-4,679	-6,327	35	,000
Pair 7	SBIDPI - SBIDPF	-5,833	5,730	,955	-7,772	-3,895	-6,109	35	,000
Pair 8	SSBLDSI - SSBLDSF	-2,0278	2,4464	,4077	-2,8555	-1,2000	-4,973	35	,000
Pair 9	SSBLMI - SSBLMF	-2,1667	2,6886	,4481	-3,0764	-1,2570	-4,835	35	,000

Table 4 shows a percentage of the effects produced by the applied fitness program. The variables in the table are arranged according to the abilities they represent. As it evident, the highest changes are made on variables for ball handling estimation (28, 20 and 10, 66 %), while the smallest changes are produced on variables for evaluation of movement speed with the ball (2, 87 and 10, 66 %).

Table 4.

Num	VARIABLES	Percentage of produced effect
1.	SBHZ1R - throwing and catching the ball with one hand	**28,20 %**
2.	SBHLZ2R - jump shot throwing and catching the ball with two hands	**10, 66 %**
3.	SBVLS20 - 20 m slalom dribbling	**2, 87 %**
4.	SSBL20 - 20 m acceleration ability with the ball	**2, 79 %**
5.	SKOTBL - a triangle movement	**9, 28 %**
6.	SBIDP - lateral and back/forward movement speed	**6, 21 %**
7.	SSBLDS - the power of throwing the ball with the jump	**5, 50 %**
8.	SSBLM - the power of throwing the ball without the jump	**7, 13 %**

DISCUSSION

Observing the obtained results, it is obvious that the established hypothesis was confirmed i.e. the realised program have produced the partial quantitative changes on eight of nine tested variables for handball specific motor abilities estimation. The highest effects have been produced on variables for ball handling evaluation (28, 20 and 10, 66 %). According to research conducted by Vuleta (1999)[8], for achieving good results in ball handling tests it necessary for one to have a high level of movement speed, agility, and explosive power of lower and upper limbs. Our training program was designed to enhance mentioned abilities. Weight training was a good base for application of plyometric training, that is, for sure, contributed improvement of limbs speed and explosive power. Knowing the structure of the tests (a result depends on number of bouncing

balls in determined time), it is clear that these abilities are dominant in the tests' realisation. On a base of the obtained results, Vuleta and Šimenc (1996) [7] concluded that mechanisms for muscles excitation intensity dominantly determine success in the three handball specific motor factors: a speed movement with the ball, a speed movement without the ball and the power of throwing the ball. Improvement of the mentioned mechanisms is a goal of combined resistance-plyometric training. That is to say, „When we mix weight training and plyometrics the purpose is the enhancement of speed - strength. We are concerned not just with the application of force, but the rate of force development. Speed strength deals with the "amount of internal strength which the neuro-muscular (the body's electrical system) is able to mobilize per unit of time"[6]. Therefore, it can be said that the applied fitness program produced positive changes on the variables.

It is noticeable that the lowest changes (2, 87 and 2, 79 %) are produced on variables for estimation of a speed movement with the ball. This fact, in a certain measure, was expected, because the participants had to apply their speed through a dribbling technique in the tests. As it said before, the applied program didn't include handball training, but only weight and plyometric training, so it wasn't expectable to improve their technique through the training. The low level of the technique probably influenced results obtained on the final testing session, and consequently lower changes comparing to the other variables.

CONCLUSION

As it was hypothesised, the twelve weeks combined fitness program has produced statistically significant partial quantitative changes on students' handball specific motor abilities. The effects are produced on all tested latent dimensions of handball techniques. So it is obvious that fitness program (weight and plyometric training) can be applied, independently of handball training, in order to improve specific handball abilities. Of course, this is not a case in a practice when handball players are trained, but an integrative approach of training is used, a combination of fitness training and handball training.

The research has been conducted to show that an improvement of basic motor abilities can increase a level of specific motor abilities, respectively, that basic motor abilities are, as their name says, a base, foundation, for specific motor abilities development. The fitness program can be used among sport faculty students in order to improve their basic motor abilities, and consequently, to simplifies their sport techniques affiliation.

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PARCIJALNE KVANTITATIVNE PROMJENE SPECIFIČNE RUKOMETNE MOTORIKE NASTALE POD UTICAJEM DVANAESTOSEDMIČNOG FITNESS PROGRAMA

Izvorni naučni rad

Sažetak
Na uzorku od 36 studenata Fakulteta za tjelesni odgoj i sport, dobi 19 ± 1 godina, primjenjen je kombinovani dvanaestosedmični fitnes program, koji se sastojao od dva treninga sedmično s tegovima u teretani i pliometrijskog treninga, jedanput sedmično. Obzirom na cilj rada, da se utvrde eventualne parcijalne kvantitativne promjene rukometnih situaciono motoričkih sposobnosti , nastale pod uticajem provedenog programa, korišten je t-test za zavisne uzorke. Na osnovu dobijenih rezultata vidimo da je provedeni program proizveo statistički značajne promjene na 8 od testiranih 9 varijabli. Najveći nivo promjena desio se na varijablama za procjenu sposobnosti manipulacije loptom, i to od 28, 20 % do 10, 66 %, dok su najmanje promjene nastale na varijablama za procjenu brzine kretanja s loptom. Također, manje, ali ne beznačajnije promjene evidentne su i na ostalim varijablama. Individualno prilagođeno opterećenje svakom ispitaniku, za sigurno je proizvelo ove značajne promjene. Smatramo da bi program trebao biti ugrađen u redovni plan nastave na svim godinama, kako bi doprinjeo povećanju motoričkih kapaciteta studenata, te samim tim poboljšanju svih situaciono motoričihm sposobnosti, a koje su neodvojiv dio tehnike svakog sporta posebno.

Ključne riječi: pliometrijski trening, trening s tegovima, t-test za zavisne uzorke

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