

DIFFERENCES IN SPRINT SPEED AND LOAD SIZE BETWEEN SOCCER AND HANDBALL FEDERATION RANK PLAYERS DETERMINED BY THE 7x35m TEST

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(Original scientific paper)

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Abstract:

The study was conducted on a sample of 16 athletes, which comprised of 8 soccer players and 8 handball premier league players by using the 7x35m test as a measuring instrument for the assessment of sprint speed (J. Bangsbo, 2003). The aim of this study was to determine the differences in sprint capacity between athletes in two different branches of sport. The resulting differences in the tested area of sprint speed of the tested groups indicate the cumulative effects of years of sports experience in a variety of spatial and weather conditions.

Key words: testing, speed-endurance, fatigue, recovery, t-test.

INTRODUCTION

Comparing the cumulative effects of training in two different sport branches, such as soccer and handball and their influence on the organism has appeared as the subject matter of scientific research in a few scientific papers. Previous research has shown the differences between the maximum oxygen consumption VO_{2max} between soccer and handball players (Jasem, 1999.), we however, have conducted our research with the goal to determine the differences in speed characteristics between soccer and handball players.

Sprint and sprint capacity are very important factors for modern soccer, as well as handball. Handball players in an average game have to run more than 4km (Jovanoviæ, 2009, from Njaradi, 2008) which is mostly run at high intensity, which shows the explicit need for anaerobic energy capacity. Also, the top soccer player (Jukiæ, 2009) crosses between 10 and 13 km for the duration of a match, all the while he must make sudden direction changes, sprints, jumps and tolerate a sharp duel game. Both sports are characterized by the low-and

high-intensive activities, which for the handball players ranges from 3:1 to 5:1 (Jovanoviæ, 2009, from Bon, 2004), and for the soccer players ranges from 7:1 to 12:1 (Jovanoviæ, 2009, from Bangsbo, 2004).

The study was conducted on a sample of 8 soccer players and 8 handball players by using the 7x35m test as a measuring instrument for the assessment of sprint speed (J. Bangsbo, 2003). During the performance test, all subjects wore Polar Team System belts to measure the frequency of heart beats. In the aforementioned test indicators were obtained for maximum speed, speed recovery and the degree of fatigue, also the data obtained through the polar belts showed the level and structure of the load for the subjects during the performance test. The research was conducted in order to determine the differences in long-term, cumulative effects of the training process for soccer and handball players, or rather the long-term impact of practicing these disciplines on the sprint characteristics of athletes.

Picture no. 1. Display of the course for the 7x35m test.
 (The picture of the course was taken from the book "Fitness training in soccer", Bangsbo, 2003, page 84.)

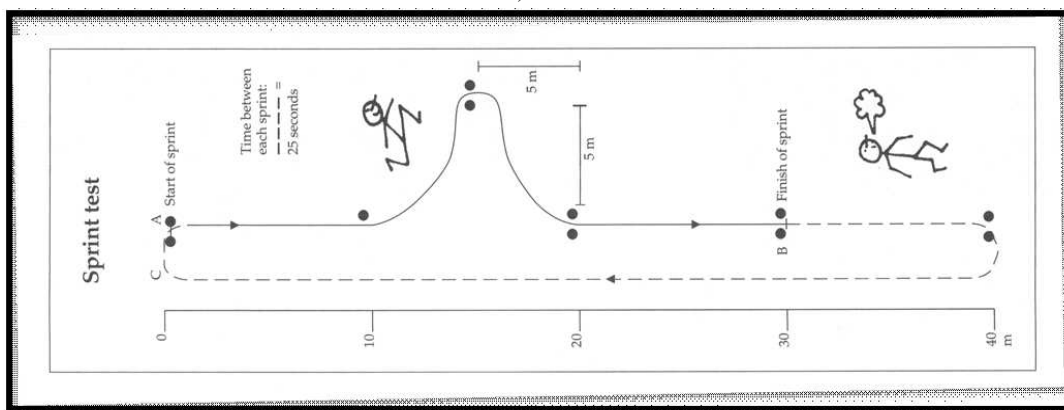


Table 1. The results of the handball player

			Handball pl.		7x35m										
	YOB	Age	1	2	3	4	5	6	7	Min	Max	AS	R		
	1985	25	6,47	6,69	6,65	7,44	7,12	7,22	7,18	6,47	7,44	6,97	0,97		
	1989	21	6,25	6,25	6,40	6,60	6,81	6,94	6,91	6,25	6,94	6,59	0,69		
DN	1990	20	6,19	6,16	6,15	6,34	6,62	6,37	6,59	6,15	6,62	6,35	0,47		
	1987	23	6,44	6,42	6,63	6,50	6,57	6,52	6,66	6,42	6,66	6,53	0,24		
	1989	21	7,01	6,62	6,78	6,81	6,75	6,78	6,75	6,62	7,01	6,79	0,39		
DM	1988	22	7,12	7,49	7,72	7,38	7,57	7,78	7,91	7,12	7,91	7,57	0,79		
	1985	25	6,50	6,35	6,66	7,13	7,06	7,22	6,92	6,35	7,22	6,83	0,87		
	1988	22	6,85	6,72	7,00	7,68	7,84	7,82	8,23	6,72	8,23	7,45	1,51		
		22	6,60	6,59	6,75	6,99	7,04	7,08	7,14	6,42	7,01	6,79	0,79		

Table 2. The results of the soccer players

			SOCCER PL.		7x35m										
	INIC.	YOB	AGE	1	2	3	4	5	6	7	Min	Max	AS	R	
	S V	1988	22	6,34	6,09	6,53	6,46	6,65	6,4	6,37	6,09	6,65	6,41	0,56	
	Z D	1988	22	6,43	6,21	6,18	6,28	6,46	6,53	6,41	6,18	6,53	6,36	0,35	
	R M	1986	24	6,46	6,49	6,65	6,75	6,79	6,62	6,87	6,46	6,87	6,66	0,41	
	M I	1990	20	6,28	6,31	6,49	6,56	6,56	6,39	6,69	6,28	6,69	6,47	0,41	
	K D	1988	22	6,37	6,25	6,59	6,35	6,31	6,4	6,48	6,25	6,59	6,39	0,34	
	P N	1989	21	6,28	6,21	6,45	6,54	6,67	6,69	6,61	6,21	6,69	6,49	0,48	
	S A	1990	20	6,28	6,37	6,59	6,25	6,49	6,59	6,49	6,25	6,59	6,44	0,34	
	S M	1991	19	5,85	6,15	5,96	6	6,15	6,3	5,89	5,85	6,3	6,04	0,45	
	med		21	6,29	6,26	6,43	6,40	6,51	6,49	6,48	6,20	6,61	6,41	0,42	

Chart 1. Comparative review of the results of average values of handball and soccer players: the best time (min), the worst time (max), average time (AS) and range (R).

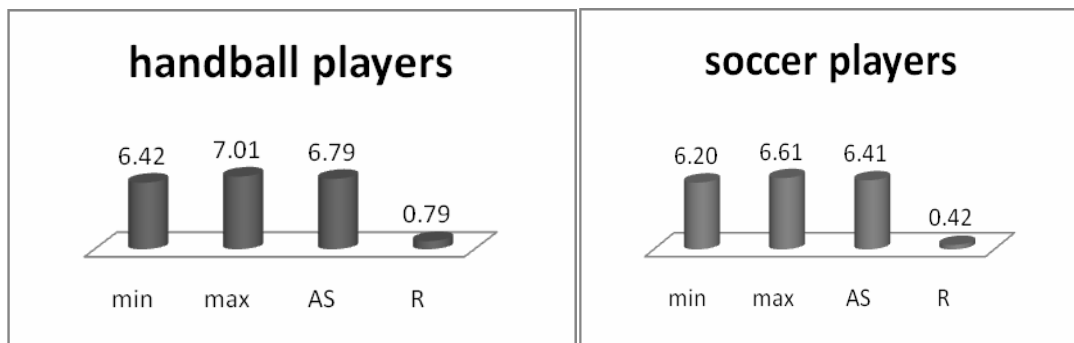


Table 3. The zones of encumbrance for the handball players

				HRZ 5	HRZ 4	HRZ 3	HRZ 2	HRZ1	HR	HR max
	INIC.	YOB	age	93-100%	87-93%	80-87%	73-80%	68-73%	average	
1	RM	1985	25	0	27,7	46,8	10,6	14,9	159	177
2	TI	1989	21	0	31,5	35,2	11,1	7,4	160	178
3	ĐN	1990	20	0	15	67,5	12,5	5	167	174
4	MI	1987	23	0	31,1	55,6	11,1	2,2	167	177
5	BB	1989	21	0	0	33,3	43,8	8,3	151	167
6	ĐM	1988	22	0	44,4	42,2	4,4	8,9	169	179
7	VK	1985	25	0	73,9	13	4,3	2	167	175
8	IM	1988	22	15,2	58,7	13	4,3	4,3	177	186
	AS		22	1,90	35,29	38,33	12,76	6,63	164,63	176,63

Table 4. The zones of encumbrance for the soccer players

				HRZ 5	HRZ 4	HRZ 3	HRZ 2	HRZ1	HR	HR max
	INIC.	YOB	age	93-100%	87-93%	80-87%	73-80%	68-73%	average	
1	S V	1988	22	0	74,4	18,6	4,7	2,3	173	182
2	Z D	1988	22	0	0	63	28,3	8,7	156	167
3	R M	1986	24	0	0	41,7	27,1	12,5	147	165
4	M I	1990	20	0	50	32,5	12,5	2,5	169	178
5	K D	1988	22	0	52,4	26,2	11,9	9,5	165	169
6	P N	1989	21	0	51,2	20,9	18,6	9,3	167	181
7	S A	1990	20	0	0	4,5	50	22,7	143	162
8	S M	1991	19	0	26,8	63,4	2,4	4,9	169	177
	AS		21	0,00	31,85	33,85	19,44	9,05	161,13	172,63

Chart 2. Comparative view displaying the percentage value of time spent in certain workzones for handball players and soccer players.

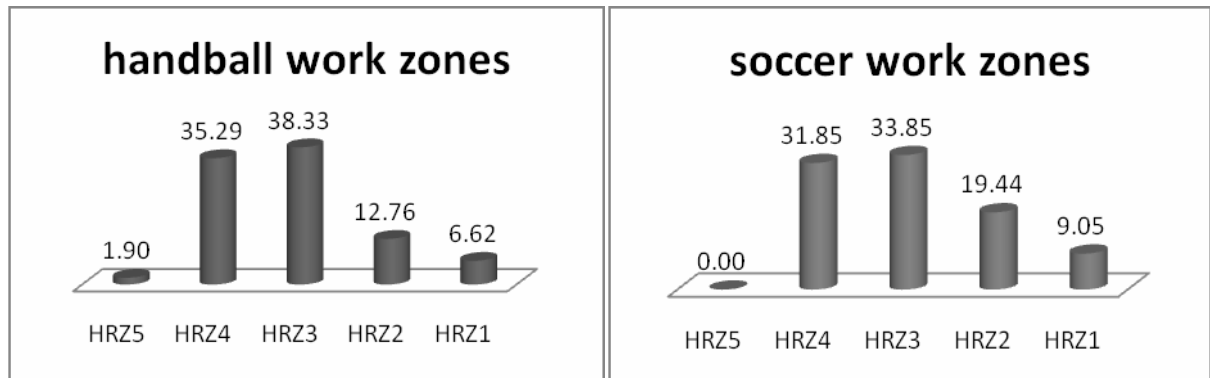


Table 5. The values for the frequency of heart beats in the recovery phase of the handball players

				OPO	OPO	OPO	OPO	OPO%	OPO%	OPO%
	INIC.	Y.O.B.	Age	0 min	1 min	2 min	3 min	1 min	2 min	3 min
	RM	1985	25	177,00	135,00	108,00	105,00	23,73	38,98	40,68
	TI	1989	21	178,00	141,00	120,00	112,00	20,79	32,58	37,08
	ĐN	1990	20	174,00	141,00	117,00	114,00	18,97	32,76	34,48
	MI	1987	23	177,00	130,00	115,00	105,00	26,55	35,03	40,68
	BB	1989	21	166,00	126,00	117,00	100,00	24,10	29,52	39,76
	ĐM	1988	22	179,00	143,00	125,00	114,00	20,11	30,17	36,31
	VK	1985	25	175,00	147,00	109,00	98,00	16,00	37,71	44,00
	IM	1988	22	186,00	152,00	132,00	125,00	18,28	29,03	32,80
	AS		22	177	139	118	109	21,07	33,22	38,22

Table 6. The values for the frequency of heart beats in the recovery phase of the soccer players

				OPO	OPO	OPO	OPO	OPO%	OPO%	OPO%
	INIC.	Y.O.B.	Age	0 min	1 min	2 min	3 min	1 min	2 min	3 min
	S V	1988	22	180	151	126	115	16.11	30.00	36.11
	Z D	1988	22	167	127	108	100	23.95	35.33	40.12
	R M	1986	24	165	118	96	84	28.48	41.82	49.09
	M I	1990	20	178	144	119	102	19.10	33.15	42.70
	K D	1988	22	169	124	99	86	26.63	41.42	49.11
	P N	1989	21	181	140	121	117	22.65	33.15	35.36
	S A	1990	20	162	117	94	87	27.78	41.98	46.30
	S M	1991	19	177	147	131	127	16.95	25.99	28.25
	AS		21	172	134	112	102	22.71	35.35	40.88

Table 7. Results of the T-test

Vari-ables	Mean (handball pl.)	Mean (soccer pl.)	t-value	p
1	6,5125	6,1963	2,530380	0,024013
2	7,2538	6,6137	3,018921	0,009200
3	6,8850	6,4075	2,898172	0,011684
4	0,7412	0,4175	2,254269	0,040725
5	164,625	161,1250	0,727334	0,479009
6	176,6250	172,6250	1,202391	0,249155

METHODS

Test Description

The “7x35m” test is actually 7x34,2m. The schematic of the test can be seen on picture no.1. The test was performed by having the test subjects run the distance from point A to point B at the maximum sprinting speed via the marked path, which after the first 10m had a change of direction in one way and after 5m a change in the other way. After finishing the sprint, the subject shall be stopped on the section of the following 10 m, turn and lightly run to starting line. Stopping and starting to run slowly back to the starting should be done in a period of 25 seconds (which considering the average sprint time of 6.41 sec is an active rest in a 1:4 relation, which theoretically should be sufficient for the restoration of the ATP and CP mechanisms).

The test consists of 7 repeatable sprints on a marked path (A and B), and every time achieved is measured and noted. For the test to be executed it takes at least three executers: no. 1. measures the time it takes to get to the finish line, no. 2. measures the rest time of 25 sec, no. 3. enters the results in a previously prepared report. The run-time for one of the subjects was $7 \times 7 \text{sec} + 6 \times 25 \text{sec} = 199 \text{sec}$; which is 3min, 19sec. To test an entire team the predictable amount of time per player is about 4 minutes.

From the values obtained by measuring seven repeated runs, the following indicators can be distinguished:

The fastest time - best time of seven repetitions - this shows the maximum speed of the subjects,

The average, mean time - the arithmetic mean of the seven measured times – this shows how fast (or slow) the ability to compensation for the consumed

energy sources is, i.e., how fast (good result) or slow (bad result) the recovery rate is, which is a practical indicator for the coach of how long the player can take in repeated sprint mode in short intervals, which is the main characteristic of movement in a soccer game;

The difference between the best and worst time achieved of the measured times - indicating the degree of fatigue or inability to compensate for the consumed energy sources and decrease in the ability to repeat top sprint speed. A big difference between the best and worst time will indicate a poorer recovery rate and increased levels of fatigue and vice versa. This difference indicates how highly intensive labor, such as repeated sprint (those applied in the test), will affect the players performance. During the test subjects wore “Polar Team Transmitter belts” for measuring the frequency of heart beats. The transmitter belts were removed after five minutes of recovery.

The subject sample

The sample of subjects in this study consisted of eight handball and soccer players members of the premier league of Serbia. Testing was conducted in February of 2010. The average age of the handball players was 22 years, and the average of their playing experience is 8 years. The average age of soccer players is 21 years and a somewhat longer playing experience of 10 years.

Variable samples

For the purposes of this study the following set of variables has been determined: best time (Min – Var1), worst time (Max – Var2), the average time (AS – Var3) and the difference between the best

and worst time – range (R – Var4). For the purpose of evaluating the level of encumbrance the following variables were used: the average pulse values (HR average – Var5) and the maximum pulse value (Hyrax – Var6) which were achieved during the test.

Data processing methods

For the needs of the analysis of the results the basic statistical, descriptive parameters were calculated: arithmetic mean (Mean), range (Range), the minimum value (MIN), the maximum value (MAX), standard deviation (STD), and variance. To determine differences between the groups the t-test was used.

RESULTS

For the sake of determining the difference between the observed groups of handball and soccer players the 7x35m maximum running test was used, according to which four variables were obtained to assess the difference of the investigated groups: the fastest time (Min), the slowest time (Max), the average time (AS) and the difference between the best and worst time, the range (R).

The results which were achieved by the handball players are shown on table no.1.

The measured results show the following:

The average maximum speed achieved (the best time) was 6.42 sec with a range of results from 6.15 sec to 7.12 sec.

The worst time achieved on average was 7.01 sec, with the results ranging from 6.62 to 8.23 sec.

The average value of the arithmetic mean of all of the results achieved amounted to 6.79 sec. Considering that the best time amounted to an average of 6.42 sec, the difference between the best and average time being **0.37** sec indicates a weaker recovery ability of the ATP and CP mechanisms and poor preparation of the team as a whole.

The average difference between the best and the worst time was **0.79** sec with the results ranging from 0.24 sec to 1.51 sec. Such a large average difference indicates a high degree of fatigue or poor physical preparation of the tested handball players. The results of the soccer players on the 7x35m test are shown in table no. 2, from we can see the following:

The average maximum speed achieved (the best time) was 6.20 sec with a range of results from 5.85 sec to 6.46 sec.

The worst time achieved on average was 6.61 sec, with the results ranging from 6.30 to 6.87 sec.

The average value of the arithmetic mean of all of the results achieved amounted to 6.41 sec. Considering that the best time amounted to an average of 6.20 sec, a small difference between the best and average time being **0.21** sec indicates a good and fast recovery ability of the ATP and CP mechanisms and good preparation of the team as a whole.

The average difference between the best and the worst time was **0.42** sec with the results ranging from 0.34 to 0.56 sec. Such a small average difference indicates a low degree of fatigue or good physical preparation of the tested soccer players.

DISCUSSION AND CONCLUSIONS

Analysis of the load structure for the subjects during the 7x35m test on the basis of the frequency of cardiac impulse

All subjects during the test carried Polar Team System belts to measure the frequency of cardiac impulse. The belts were removed after 5 minutes of recovery. Based on the measured heart rate of the soccer and handball players in tables 3 and 4 the structure of physiological strain to which the subjects were exposed during the test can be clearly determined.

The results in Tables 3 and 4 shows the percentage of time the subjects spent in each zone. The measured results show:

that most of the time is spent in the intensive aerobic zone, zone No. 3 (HRZ 3)-a total of 38.33% for the handball players and for the soccer players a total of 33.85% for the duration of the test,

right after that the most time was spent in the zone of the anaerobic threshold (HRZ 4) – a total of 35,29% for the handball players and 31,85% for the soccer players,

Not even a single soccer player entered the anaerobic zone - (HRZ 5) but one handball player did enter this zone, which can be explained by short-time exposure to exercise for an average of 6.79 sec (handball players) and 6.41 sec (soccer players) and sufficient time for recovery or the readiness of the tested team. From this it can be concluded that the for implementation of this test in addition to engaging the ATP and CP mechanisms the mechanism of aerobic energy compensation is

also engaged; or rather that when there is no going into the anaerobic zone through the anaerobic threshold it can be assumed that the glycogen mechanism will be engaged and that lactate will appear in the muscles and bloodstream, which confirms that this test is a good measuring tool for sprinters, alactate speed.

Analysis of the results shows that the 7x35m test was conducted in the intensive aerobic and the aerobic zone, since the average value of heart rate frequency for the handball players was 164.63 beats / min, and 161.13 beats / min for the soccer players, while the average value of the maximum frequency was 176.63 beats / min for the handball players and 172.63 beats / min for the soccer players.

Recovery analysis

In tables 5 and 6 the values for heart rate frequency is given for the first three minutes of recovery.

Handball player results:

The average maximum heart rate at the end of the test of 177 beats / min during the recovery phase was decreasing with the average value of:

139 beats / min after the first minute, which represented a reduction of the frequency of heart beats for 21.07%,

118 beats / min, after the second minute, which is a decrease of 33.22%,

109 beats / min, after three minutes, or an average of 38.22% less than at the end of the test.

Soccer player result:

The average maximum heart rate at the end of the test of 177 beats / min during the recovery phase was decreasing with the average value of:

134 beats / min after the first minute, which represented a reduction of the frequency of heart beats for 22.71%,

112 beats / min, after the second minute, which is a decrease of 35.35%,

102 beats / min, after three minutes, or an average of 40.88% less than at the end of the test.

The frequency of heart beats in both groups of subjects had the fastest decline in the first minute of recovery, a little slower in the second and at least in the third minute with an observation that the soccer players start with a lower average of maximum frequencies and had a faster recovery, which generally indicates better fitness preparation in the soccer players. From the point of sports training, speaking from the perspective of an interval

workout, subjects were prepared for the next labor already after the second minute of recovery.

Based on the results of the T test with the significance level of $p < 0.05$ statistically significant differences were found in the first four variables: Var1-best time (Min), Var2-worst time (Max), Var3-average time (AS) and Var4-difference between the best and the worst time - range (R). In the fifth Var5-average value of pulse (HR average) and sixth variable Var6-maximum heart rate (HRmax) there were no statically significant differences. Based on these results we can conclude that between tested groups of handball and soccer players there were significant differences in sprinting speed, but not in the size of the load.

To assess the sprint speed properties of the group of soccer and handball players from the premier league of Serbia the maximum run test 7x35m was used as a measuring instrument. The test results indicate that the soccer players had better results in all tested variables:

the average speed of the subjects was 6.42 sec with the handball players and 6.20 sec with the soccer players,

the lowest average time amounted to 7, 01 sec with handball players and 6.61 sec with soccer players,

The value of the average medium time, the arithmetic mean, of the measured time results in 6.79 sec with handball players and 6.41 sec with soccer players, which is an indication of faster restitution of the ATP and CP mechanisms of energy compensation, and better physical preparation of the soccer players. The difference between the best and the worst times the average value was 0.79 sec for handball players and 0.42 sec for soccer players. Which is a large indication of fatigue in handball players and a small degree of fatigue in soccer players and confirms a bad (in the cas of handball players) or rather a good level of physical preparation of the tested soccer players.

The physiological assessment of the labour during the execution of the test by both of the examined groups was conducted on the basis of the measured heart beat frequency, which was obtained through Polar Team System belts which were carried by all of the subjects. From the results we calculated the average maximum heart rate of 176 beats / min for the handball players and 173 beats/min for the soccer players indicates that the 7x35m test was carried out in the intense aerobic zone and in the zone of the anaerobic threshold. On

the basis of this it can be concluded that this is a test of alactic speed capability in which the dominant sources of energy compensation, given the way the test was conducted and the duration, are ATP, CP and aerobic sources, with the observation that the soccer players have better physical preparation which is confirmed here with a lower maximum and average heart rate frequency, as well as with proportionally less time spent in the higher encumbrance zones.

In the period of recovery based on the decline in the frequency of heart beats it can be concluded that the fastest decline in heart rate was achieved in the first minute in which the decline is an average of about 21.07% for handball players and 22.71% for soccer players. The decline is slower in the second minute, at the end of which the average value was 33.22% and 35.35% less than at the end of the test, and at the end of the third minute the heart rate reduction on average amounted to 38.22% and 40.88%. Analysis of the results shows a faster recovery rate of the soccer players rather than with the handball players, which confirms previous estimates of the level of physical preparation of the observed groups.

From comparative analysis of the results from the 7x 35m test between two different groups of athletes, handball and soccer players, it can be concluded that the soccer players showed better results both in the test, compared to the achieved time, and in the structure of the load which showed their fatigue was less and had a faster recovery. This can be explained by the fact that soccer is still a discipline that is being implemented in much more space than 105x75m, as opposed to the handball courts, whose dimensions are 40x20m, and different game time; the duration of the competitions (games) is greater for soccer with 90 minutes of play and 60 minutes for handball. Considering that the tested soccer players and handball players have many years of playing experience the results obtained by this test can be viewed as a result of the cumulative effects of many years of training in sports, as a general conclusion of this study it can be said that soccer is a sports event that has a greater influence on the development of alactate sprint speed than handball.

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**РАЗЛИКИ ВО СПРИНТЕРСКАТА БРЗИНА И ГОЛЕМИНАТА НА
ОПТОВАРУВАЊЕТО, УТВРДЕНА СО ТЕСТОТ „7x35“ МЕТРИ
МЕГУ ФУДБАЛЕРИТЕ И РАКОМЕТАРИТЕ ОД
СОЈУЗЕН РАНГ НА НАТПРЕВАРИ**

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(Оригинален научен труд)

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Апстракт:

На примерок од 16 спортисти кој беше составен од 8 фудбалери и 8 ракометари од сојузен ранг на натпревари, применет е тестот „7x35“ (Банџобо (Банџобо), 2003) за проценување на спринтерска брзина и брзинска издржливост. Целта на истражувањето беше да се утврдат разликите меѓу спортистите на две различни спортиски иври, со кои може да се изврши диференцирање на нивото на спринтерскиот капацитет кај ивираниите групи. Добиените резултати укажуваат на кумулативните ефекти на повеќегодишниот спортиски стаж во различни спортирни и временски услови низ добиените разлики во тестираното подрачје на спринтерската и брзинската издржли-вост кај испитуваните групи.

Клучни зборови: тестирање, брзинска издржливост, замор, обновување, фреквенција на срцеито, т-тести