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Research articles in Social and Biomedical Sciences are given in this issue.

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Gražių šv. Kalėdų ir laimingų Naujųjų!

Vyriausiasis redaktorius

Words are not literature, bare facts are not science. Aspirations and completeness need many things – halting, retrospection and reflections. Enjoy the work carried out, go on searching and developing future plans, believe in people around you.

Merry Christmas and a Happy New Year!

Editor-in-Chief

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THE INFLUENCE OF SHORT-TERM HIPOCALORIC NUTRITION ON BODYWEIGHT REDUCTION IN LITHUANIAN OLYMPIC TEAM WRESTLERS

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ABSTRACT

Research background and hypothesis. These days many athletes of combat sports prior contest practice unsafe hipocaloric diets. Hypothetically the content of macronutrient and micronutrient composition of wrestlers' food rations must be corrected individually during the time of bodyweight loss and after weigh control.

Research aim of the present study was to examine the effects of bodyweight reduction on athletes' body weight (BW), lean body mass (LBM), body fat (BF), body fluid (BFL), body protein (BP) and minerals.

Research methods. Wrestlers (n = 10) were measured before, at the end (before weight control) rapid bodyweight reduction and 2 days after contest. Food records were analyzed and macronutrient and micronutrient contributions from meals were assessed. The measures of body mass components were taken using BIA tetra-polar electrodes.

Research results. Analysis of wrestlers 4-day food records revealed average values at 18.2 ± 10.6 kcal·kg^{-1}·day^{-1}, 0.8 ± 0.4 g·kg^{-1}·day^{-1} of proteins, 2.0 ± 1.5 g·kg^{-1}·day^{-1} of carbohydrates and 0.8 ± 0.4 g·kg^{-1}·day^{-1} of fat throughout the period of rapid bodyweight reduction. Low total energy intake contributed to the insufficient on take of vitamins A, B_1, B_2, PP, D, E, B_6, folic acid and minerals as potassium, calcium, phosphorus, magnesium, iron, zinc intakes during the rapid bodyweight loss season. Additionally wrestlers followed low-carbohydrate and high-fat diet and did not consume adequate energy or carbohydrate diet after the contest.

Discussion and conclusions. During rapid bodyweight loss period athletes showed a significant decrease in BM (–3.7 ± 1.9 kg, $p < 0.05$), LBM (–1.5 ± 1.3 kg, $p < 0.05$), BF (–2.1 ± 0.6 kg, $p < 0.001$), BFL (–1.1 ± 0.9 kg, $p < 0.05$), minerals (–0.2 ± 0.1 kg, $p < 0.05$), but not BP (–0.2 ± 0.1 kg, $p \leq 0.05$). After contest wrestlers had significant increases in BM (+3.1 ± 1.9 kg, $p < 0.05$), BF (+2.6 ± 0.5 kg, $p < 0.001$) and minerals (+0.2 ± 0.1 kg, $p < 0.05$), but non-significant increase in LBM (+1.0 ± 1.8 kg, $p > 0.05$) and BFL (+0.7 ± 1.3 kg, $p < 0.05$). Wrestlers' food rations must be corrected individually during the time of bodyweight loss, after weigh control and follow-up recovery, during the period of contest.

Keywords: nutrition, wrestlers' food rations, weight reduction.

INTRODUCTION

Aiming at high sports achievements athletes often try to adjust their body mass. Many athletes competing in their weight categories try to reduce their body weight before the competitions at any cost, ignoring the impact of such methods applied on their health and physical working capacity. Thus, analysis of body mass components and continuous supervision of nutrition are prerequisites for high performance in sport. Depending on the duration, body weight loss is divided into short-term (lasting for 24–72 h), moderate (lasting from 72 h to several weeks),

and gradual, which lasts from several weeks to several months (Wilmore, 2000). Body weight loss can have a negative impact on athletes' working capacity. However, only a few studies confirm the negative effect of short-term body weight loss on athletes' working capacity (Timpmann et al., 2008; Ööpik, Timpman, 2009). Other studies, on the contrary, did not establish any effect of short-term body weight loss on athletes' working capacity and (or) its decrease during a competition if athletes' dietary habits were appropriate before the competition and their bodies were provided with optimum nutrients and liquids (Felgholm et al., 1993; Rankin, 2006). For this reason much attention should be paid to athletes' diets right after their short-term body weight loss, before, during and after the competition.

Research aim was to study and assess the peculiarities of short-term body weight loss as well as their impact on the indices of body mass components of Lithuanian Olympic team Greek-Roman wrestlers.

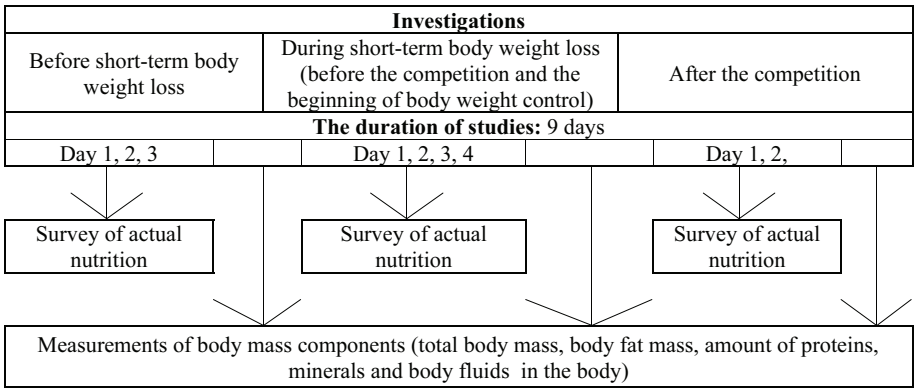
RESEARCH METHODS

Aiming at evaluating the impact of short-term body weight loss on the indices of athletes' body mass components we investigated 10 Lithuanian Olympic team Greek-Roman wrestlers aged 15.6 ± 1.5 years who were reducing their body weight for four days before the competition. The method applied was a survey of actual nutrition which investigated athletes' actual nutrition of three consecutive days, 24 hours a day before athletes' body weight reduction programme; actual nutrition of four consecutive days, 24 hours a day during athletes' body weight reduction programme; and two consecutive days, 24 hours a day during a period of recovery (Figure 1). In accordance with the tables of food chemical composition we calculated the chemical composition and the energy value of athletes' food rations (Sučilienė, 2002). We assessed the nutrient balance in the diets and their conformity with the physiological needs of the body according to the recommended norms of the day (*Rekomenduojamos paros maistinių medžiagų ir energijos normos, 2000*). Meeting the energy needs of the body was assessed applying the method of alimentary calorimetry (*Position of the American Dietetic Association, 2000; Rekomenduojamos paros maistinių medžiagų ir energijos normos, 2000;* Ainsworth, 2011).

Aiming at establishing and evaluating changes in athletes' total body mass and its separate components during short-term body mass reduction we used BIA tetra-polar electrode method to measure the resistance of the body with 8–12 tangential electrodes at different measuring signal frequencies (5, 50 and 250 kHz), and thus we measured athletes' total body mass, lean body mass, muscle mass, body fat mass, general, intracellular and extracellular body fluids, proteins and minerals in the body. The investigations were carried out before short-term body weight loss, after it and in addition – two days after the competition.

Statistical data processing was carried out using programme package *SPSS v.15.* The data were analyzed using the following methods of mathematical statistics: we calculated arithmetic means ($\bar{x}$), the data distribution was evaluated according to standard deviation (S). The differences in the indices of athletes' body mass components before and after body mass reduction were evaluated using Student's *t* test for paired samples. Relations between variables were established using Pearson's correlation coefficient (r).

Figure 1. **Research algorithm**



RESEARCH RESULTS

We evaluated the impact of most often applied short-term (four-day) body weight loss on the indices of body mass and its components (Table 1) and established that athletes' body mass decreased by 3.7 ± 1.2 kg (p = 0.002) on average, and their lean body mass – by 1.5 ± 1.3 kg (p = 0.05). Lean body mass decreased due to the decrease of general body fluids – by 1.1 ± 0.9 kg (p = 0.05), and intracellular fluids among them – by 0.8 ± 0.5 kg (p = 0.025). During body mass reduction the amount of body fat and minerals decreased respectively by 0.2 ± 0.1 kg and 2.1 ± 0.6 kg (p = 0.003 and p = 0.001), however, muscle mass and the amount of proteins did not change statistically significantly (p = 0.067 and p = 0.136).

Greek-Roman wrestlers' body mass decreased by 5.2 ± 1.7% on average because their food rations were extremely hipocaloric. Before the body weight reduction programme the energy values of food rations of Greco-Roman wrestlers, which were 3566 ± 946 kcal (53.8 ± 22.1 kcal·kg^{-1}·day^{-1}), covered the energy consumption of the day by 95 ± 36%; during the short-term body weight loss the energy values of food rations were 1106 ± 497 kcal (18.2 ± 10.6 kcal·kg^{-1}·day^{-1}) on average and they covered only 32 ± 18% of the energy consumption of the day (Table 2). The amounts of nutrients in hiopocaloric diets equaled to 2.0 ± 1.5 g·kg^{-1}·day^{-1}, 0.8 ± 0.4 g·kg^{-1}·day^{-1} and 0.8 ± 0.4 g·kg^{-1}·day^{-1} respectively and were unbalance (Table 3). Misbalance was due to the energy values of carbohydrates, proteins and fats which did not conform to the requirements of balanced diets in the food rations of Greco-Roman wrestlers: 43.2 ± 6.9%, 18.3 ± 2.2 % and 38.5 ± 5.4% (Table 4). Body fat reduction can be explained by both the decreased energy value (r = 0.4; p=0.04), and the decreased amounts of carbohydrates (r = 0.4; p = 0.04), proteins (r = 0.5; p = 0.03) and fats (r = 0.3; p = 0.05) of Greco-Roman wrestlers food rations during short-term hipocaloric nutrition.

Table 1. **Athletes' body mass components ($\bar{x}$ ± S)**

Body mass components	Groups			Statistical indices	
	1	2	3		
	Before body mass reduction	After body mass reduction before the competition	2 days after body mass reduction (after competition)	Difference between Group 1 and 2	Difference between Group 2 and 3
Body mass	70.6 ± 16.9	67 ± 15.7	70.1 ± 16.3	t = 6.805, df = 9, p = 0.002	t = –3.565, df = 9, p = 0.023
Lean body mass, kg	58.4 ± 11	56.9 ± 10.1	57.9 ± 11.4	t = 2.746, df = 9, p = 0.050	t = –1.290, df = 9, p = 0.267
Lean body mass, %	83.4 ± 4.7	85.9 ± 5.9	82.6 ± 4	t = – 4.250, df = 9, p = 0.013	t = 3.632, df = 9, p = 0.022
Muscle mass, kg	54.3 ± 10	52.9 ± 9.2	53.7 ± 10.4	t = 2.494, df = 9, p = 0.067	t = –1.053, df = 9, p = 0.352
Muscle mass, %	77.7 ± 4.8	80 ± 5.8	76.8 ± 4	t = – 4.247, df = 9, p = 0.013	t = 3.682, df = 9, p = 0.021
Muscle and fat mass index	5.2 ± 1.9	6 ± 3.9	4.7 ± 1.4	t = – 0.632, df = 9, p = 0.562	t = 0.865, df = 9, p = 0.436
BMI, kg·m^2	23.3 ± 2.6	22.1 ± 2.4	23.1 ± 2.5	t = 10.95, df = 9, p < 0.001	t = –3.715, df = 9, p = 0.021
General body fluid, kg	42 ± 7.9	40.9 ± 7.3	41.7 ± 8.2	t = 2.692, df = 9, p = 0.050	t = –1.258, df = 9, p = 0.277
General body fluid, %	60.1 ± 3.5	61.8 ± 4.2	59.5 ± 2.9	t = – 4.229, df = 9, p = 0.013	t = 3.665, df = 9, p = 0.021
Intracellular fluid, kg	27.5 ± 5.2	26.7 ± 4.8	27.3 ± 5.5	t = 3.516, df = 9, p = 0.025	t = – 1.724, df = 9, p = 0.160
Extracellular fluid, kg	14.5 ± 2.7	14.3 ± 2.5	14.4 ± 2.7	t = 1.580, df = 9, p = 0.189	t = – 0.434, df = 9, p = 0.686
Proteins, kg	12.2 ± 2.1	12 ± 1.9	12.1 ± 2.3	t = 1.863, df = 9, p = 0.136	t = –0.425, df = 9, p = 0.693
Proteins, %	17.6 ± 1.3	18.2 ± 1.6	17.3 ± 1.1	t = – 4.238, df = 9, p = 0.013	t = 3.698, df = 9, p = 0.021
Mineral substances, kg	4.1 ± 0.9	3.9 ± 0.9	4.1 ± 0.9	t = 6.325. df = 9, p = 0.003	t = – 5.880. df = 9, p = 0.004
Mineral substances, %	5.8 ± 0.1	5.9 ± 0.1	5.9 ± 0.1	t = -0.535. df = 9, p = 0.621	t = –0.535. df = 9, p = 0.621
Body fat, kg	12.2 ± 6.2	10.1 ± 6	12.7 ± 5.5	t = 7.835. df = 9, p = 0.001	t = –11.131. df =9, p < 0.001
Body fat, %	16.5 ± 4.9	14.1 ± 5.9	17.4 ± 3.9	t = 4.393. df = 9, p = 0.012	t = –3.608. df = 9, p = 0.023

The food rations of athletes who were reducing their body weight contained lower amounts of minerals – potassium, calcium, magnesium, phosphorus, iron and zinc – compared to the recommended daily norms. The amount of potassium made up 64 ± 19%, calcium – 52 ± 25%, magnesium – 35 ± 13%, phosphorus – 55 ± 20%, iron – 57 ± 21% and zinc – 45 ± 12% of the recommended daily intake (Table 5). Only the amounts of sodium and vitamins C and B_1 were sufficient. They amounted to 135 ± 13 and 124 ± 52% respectively of the recommended norm (Table 6). Low energy intake contributed to insufficient amounts of vitamin D, almost all B group vitamins – B_1, B_2, PP, B_6, folic acid and antioxidants vitamins A and E. The amount of vitamin D was 17 ± 6, B_1 – 26 ± 15, B_2 – 45 ± 18, B_6 – 65 ± 21, E – 70 ± 35, folic acid – 44 ± 18% of the recommended daily intake.

After short-term body weight reduction, the recovery of the body and its rate are of great importance. Our research findings showed that in the period of two days after the contest the recovery processes of total body mass, minerals and body fat for Greco-Roman wrestlers were optimal (Table 1). After the competition the total body weight of the research participants statistically significantly increased from 67 ± 15.7 kg to 70.1 ± 16.3 kg ($p = 0.023$), body fat – from 10.1 ± 6.0 kg to 12.7 ± 5.5 kg ($p < 0.001$). However, due to insufficient recovery of fluid in the body the recovery processes of lean body mass were too slow. Athletes' lean body mass increased from 56.9 ± 10.1 kg to 57.9 ± 11.4 kg, the amount of general body fluid – from 40.9 ± 7.3 kg to 41.7 ± 8.2 kg, including intracellular fluid – from 26.7 ± 4.8 kg to 27.3 ± 5.5 kg, after the competition, but the increases were not statistically significant ($p = 0.267$; $p = 0.277$; $p = 0.160$).

Table 2. **Athletes' energy expenditure and the energy value of their food rations ($\bar{x}$ ± S)**

Energy value	Before body mass reduction	During body mass reduction	After body mass reduction
Daily energy expenditure			
Energy expenditure (kcal·day^{-1})	3911 ± 792	3751 ± 741	2676 ± 416
Energy expenditure (kcal·kg^{-1}·day^{-1})	55.8 ± 2.3	56.4 ± 2.4	38.8 ± 3.4
Energy value of food rations			
Energy value (kcal·day^{-1})	3566 ± 946	1106 ± 497	2188 ± 403
Energy value (kcal·kg^{-1}·day^{-1})	53.8 ± 22.1	18.2 ± 10.6	33.3 ± 13.4
Ratio of energy consumption and expenditure (percent)			
RDN, %	95 ± 36	32 ± 18	84 ± 26

Note. RDN – recommended daily norm.

Table 3. **Composition of athletes' food rations – carbohydrates, proteins, fats ($\bar{x}$ ± S)**

Nutrients	Before body mass reduction	During body mass reduction	Recommended	After body mass reduction	Recommended
Proteins (g·kg^{-1}·day^{-1})	1.95 ± 0.8	0.8 ± 0.4	1.4–2	1.2 ± 0.4	1–1.5
Carbohydrates (g·kg^{-1}·day^{-1})	6.9 ± 2.9	2.0 ± 1.5	7–9	3.9 ± 1.7	5–6
Fats (g·kg^{-1}·day^{-1})	2 ± 0.8	0.8 ± 0.4	1.2–1.8	1.5 ± 0.5	0.8–1.3

Table 4. **Percentage of energy value of the main nutrients received from athletes' food rations ($\bar{x}$ ± S)**

Supply of energy value (percent)	Before body mass reduction	During body mass reduction	After body mass reduction	Recommended
Carbohydrates	50.9 ± 4.8	43.2 ± 6.9	46.6 ± 3.4	55 – 65
Proteins	14.7 ± 1.6	18.3 ± 2.2	14.8 ± 2.4	10 – 15
Fats	34.7 ± 4	38.5 ± 5.4	39.9 ± 2.3	20 – 30

Table 5. **Mineral substances in athletes' mean food rations ($\bar{x}$ ± S)**

Mineral substances	Before body mass reduction		During body mass reduction		After body mass reduction	
	mg·day^{-1}	RDI %	mg·day^{-1}	RDI %	mg·day^{-1}	RDI %
Sodium	5556 ± 1275	370 ± 85	1570 ± 854	105 ± 57	3316 ± 390	221 ± 26
Potassium	4335 ± 761.4	173 ± 30	1600 ± 473	64 ± 19	2892 ± 721	116 ± 29
Calcium	1626 ± 438	203 ± 55	418 ± 203	52 ± 25	968 ± 224	121 ± 28
Magnesium	546 ± 143.6	136 ± 36	141.4 ± 52.5	35 ± 13	275 ± 78	69 ± 20
Phosphorus	2185 ± 593	182 ± 49	659 ± 239	55 ± 20	1204 ± 214	100 ± 18
Iron	25.2 ± 5.5	210 ± 46	6.9 ± 2.5	57 ± 21	15.9 ± 2.1	132 ± 17
Zinc	18.2 ± 4.5	121 ± 30	6.8 ± 1.8	45 ± 12	10.3 ± 0.9	69 ± 6

Note. RDI – recommended daily intake.

Table 6. **Vitamins in athletes' mean food rations ($\bar{x}$ ± S)**

Vitamins	Before body mass reduction		During body mass reduction		2 days after body mass reduction (after competition)	
	(mg*·µg**·day^{-1})	RDI %	(mg*·µg**·day^{-1})	RDI %		RDI %
B_1	1.7 ± 0.2*	121 ± 14	0.4 ± 0.2*	26 ± 15	1.4 ± 0.4	103 ± 28
B_2	3 ± 0.8*	178 ± 48	0.8 ± 0.3*	45 ± 18	2.1 ± 0.4	123 ± 22
PP	26.9 ± 7*	150 ± 39	10.8 ± 2.7*	60 ± 15	15 ± 2.8	83 ± 16
B_6	3.1 ± 0.5*	154 ± 27	1.3 ± 0.4*	65 ± 21	2 ± 0.4	100 ± 20
B_{12}	7.1 ± 1.6**	236 ± 54	3.7 ± 1.6**	124 ± 52	5.2 ± 0.7	175 ± 25
Folic acid	262 ± 48**	131 ± 24	87.8 ± 35.3**	44 ± 18	172 ± 28	86 ± 14
D	4.3 ± 1.7**	85 ± 34	0.8 ± 0.4**	17 ± 6	1.1 ± 0.3	23 ± 6
Antioxidants						
A	1393 ± 400**	140 ± 40	382 ± 200**	38 ± 20	587 ± 183	60 ± 18
E	22.1 ± 5*	221 ± 50	6.9 ± 3.5*	70 ± 35	10.6 ± 2.4	106 ± 25
C	72.5 ± 16.5*	121 ± 27	81 ± 26*	135 ± 13	179 ± 159	297 ± 264

Note. RDI – recommended daily intake.

In the period of two days after the competition the energy value of the food rations for Greco-Roman wrestlers was 33 ± 13.4 kcal·kg^{-1}·day^{-1} on average, and it was lower than the recommended norm of the day – 38 ± 14.2 kcal·kg^{-1}·day^{-1}, thus it amounted to 84 ± 26% of the recommended norm of the day (Table 2). The amount of proteins was 1.2 ± 0.4 g·kg^{-1}·day^{-1} and thus it matched the recommended norm of proteins – 1–1.5 g·kg^{-1}·day^{-1}. The amount of fat was sufficient – 1.5 ± 0.5 g·kg^{-1}·day^{-1}, and the amount of carbohydrates, which was 3.9 ± 1.7 g·kg^{-1}·day^{-1} on average, did not reach the recommended daily intake of 5 – 6 g·kg^{-1}·day^{-1} (Table 3). The amounts of vitamins A, D, PP, folic acid, calcium and zinc did not reach the recommended norms of the day either (Tables 5 and 6).

DISCUSSION

So far there has not been any research in Lithuania about dietary peculiarities of elite wrestlers who were trying to reduce their body weight before the competition. Our research findings revealed that in a very short period of time Greco-Roman wrestlers reduced their body mass at the expense of body fat and fluid by 5.2%. Similar body mass loss of 4–6% was found for Estonian wrestlers, who reduced the energy value of their food rations before the competition to 861 kcal – 1525 kcal (Timpmann et al., 2008). In contrast, the evaluation of 12 Japanese wrestlers and the impact of 7-day body weight reduction on their body mass indices showed that in the short-term period of

body weight reduction their body mass decreased more, i. e. by 7.3%, body fat – by 9.3%, lean body mass and general body fluid – by 5.9% (Kukidome et al., 2008).

According to the findings of researchers involved in the studies o athletes' nutrition, when wrestlers reduce their body weight rapidly, the decrease in their body fat is affected not so much by the low energy values of their food, but low amounts of carbohydrates in their food (Shwartz et al., 1995; Johnson et al., 2009), when the processes of ketogenesis become more intensive in athletes' bodies and glucose oxidation in muscles becomes slower (Peters et al., 2001), metabolism of triacilglycerols in the body fat, free fatty acids in blood plasma and the whole body fat become more intense, thus due to greater energy expenditure both body fat mass and muscle mass are reduced in athletes' bodies. Our research results showed different results – the decrease in body fat mass for Greek-Roman wrestlers during a period of 4 days was affected by low energy values of food, as well as low amounts of proteins, fats and carbohydrates in their food rations.

However, scientists emphasize that low-calorie diet of athletes in combat sports, where the energy value% of carbohydrates is from 12 to 50, and when dehydration of the body is increased (inadequate amount of fluids in food, saunas and baths, etc.), the supplies of muscle and liver glycogen is reduced by 54%, and this negatively affects the indices of aerobic working capacity (Ööpik, Timpmann, 2009; Timpmann et al., 2008). Our research findings confirmed that short-term low-calorie nutrition of Greek-Roman wrestlers, where the energy value% of carbohydrates is only 43, was irrational, unbalanced and could negatively affect the indices of aerobic working capacity of wrestlers during the competition.

Besides, researchers have established that short-term low-calorie nutrition, when the energy values of food rations make 18 $kcal \cdot kg^{-1} \cdot day^{-1}$, and the amount of proteins – 0.8 $g \cdot kg^{-1} \cdot day^{-1}$, affects more intensive processes of protein degradation in athletes' bodies as well as negative balance of nitrogen. For this reason athletes who are trying to reduce their body weight are recommended to consume more proteins in their food rations – 1.2–1.6 $g \cdot kg^{-1} \cdot day^{-1}$ (Wilmore, 2000). Other authors suggest that negative balance of nitrogen and impaired immune system are caused by low energy values of food rations despite the amounts of proteins consumed (Umeda et al., 2004; Tsai et al., 2009). We should note that ours research results do not coincide with the results obtained by other authors. In our case, when the energy values of athletes' 4-day food rations were 18.3 $kcal \cdot kg^{-1} \cdot day^{-1}$ and the amount of proteins – 0.8 $g \cdot kg^{-1} \cdot day^{-1}$, neither the muscle mass nor the amount of proteins in the body decreased statistically significantly. We suppose that a 4-day period of low-calorie and low-protein diet is too short to have a negative effect on the muscle mass and the amount of proteins in wrestlers' bodies.

On the other hand, when reducing body weight, it is very important to ensure the necessary balance of fluids in athletes' bodies. When dehydration is applied during short-term body weight reduction, rehydration processes require from 24 to 48 hours (Rankin et al., 2006) and athletes are recommended to consume the amount of water or other drinks for 1.5 times bigger than the recommended one (Rankin, 1996; Rankin et al., 2006). Bigger than 2% dehydration of the body is not recommended for athletes because the blood gets thicker, the body temperature rises and working capacity decreases. In our study the dehydration of athletes' bodies before the competition was only 1.6%. On the other hand, our research findings confirmed that after the competition the amount of fluid in Greek-Roman wrestlers' bodies amounted to 80% of the fluid before the body weight reduction program, and this can be explained by little amounts of drinks during the competition and after it as well as rather slow processes of rehydration in athletes' bodies.

To sum up, during the short-term body weight reduction program for athletes in combat sports, the energy values of their food rations, the amounts of proteins, carbohydrates, vitamins A, B_1, B_2, PP, D, E, B_6, folic acid and such minerals as potassium, calcium, phosphorus, magnesium, iron and zinc are too low, so the food rations and the amounts of biologically active substances for athletes during the short-term body weight reduction program should be modified individually. In the period of two days after the short-term body weight reduction, the recovery processes of the lean body mass and general body fluid are too slow, and the amounts of water, energy value, carbohydrates, vitamins A, D, PP, folic acid and minerals like calcium and zinc are inadequate.

CONCLUSIONS AND PERSPECTIVES

1. Short-term low-calorie nutrition, the energy value of which is 20 kcal·kg^{-1}·day^{-1} and the energy values of carbohydrates, proteins, and fats in food rations make up respectively 43/18/39%, when the dehydration of the body is 1.6%, is effective for overall body weight reduction ($p = 0.05$), lean body mass reduction ($p = 0.05$), and body fat mass reduction ($p < 0.001$) for athletes in combat sports.

2. The energy values of athletes' 4-day food rations lower than 20 kcal·kg^{-1}·day^{-1} and the amount of proteins – 0.8 g·kg^{-1}·day^{-1} were not enough to have a significant impact on the muscle mass ($p > 0.05$) or the amount of proteins ($p > 0.05$) in the body.

3. During the recovery period the energy values and amounts of carbohydrates and fluid in wrestlers' food rations are inadequate as they influence slow processes of lean body mass recovery ($p > 0.05$) and general body fluid recovery ($p > 0.05$).

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LIETUVOS OLIMPINĖS PAMAINOS IMTYNININKŲ MITYBOS YPATUMAI TRUMPALAIKIO KŪNO MASĖS MAŽINIMO METU

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Sportininkai, kultivuojantys sporto šakas pagal savo svorio kategorijas, dažnai prieš varžybas labai sumažina maisto raciono energinę vertę ir drastiškai mažina kūno masę. Hipotetiškai Lietuvos olimpinės pamainos graikų-romėnų imtynininkų maisto raciono maistinių ir biologiškai aktyvių medžiagų sudėtis turi būti koreguojama individualiai.

Tikslas – ištirti ir įvertinti trumpalaikio kūno masės mažinimo ypatumus ir jų daromą poveikį Lietuvos olimpinės pamainos graikų-romėnų imtynininkų (n = 10) kūno masės komponentų (lieknosios kūno masės, riebalų masės, kūno skysčių, baltymų ir mineralinių medžiagų) rodikliams.

Metodai. Panaudojus faktinės mitybos apklausos metodą, iširta graikų-romėnų imtynininkų faktinė mityba prieš kūno masės mažinimą, jo metu ir po varžybų. Sportininkų kūno masės ir atskirų jos komponentų pokyčiams trumpalaikio kūno masės mažinimo metu nustatyti naudotas *BIA tetra* – poliarinis elektrodų metodas.

Rezultatai. Trumpalaikės graikų-romėnų imtynininkų sumažintos energinės vertės mitybos metu angliavandenių, baltymų ir riebalų kiekis vidutiniškai sudaro 18.2 ± 10.6 kcal·kg, 2.0 ± 1.5 g·kg, 0.8 ± 0.4 g·kg ir 0.8 ± 0.4 g·kg kūno masės, o vitaminų A, B_1, B_2, PP, D, E, B_6, folio rūgšties ir mineralinių medžiagų kalio, kalcio, fosforo, magnio, geležies ir cinko kiekiai nesiekia rekomenduojamų. Atsigavimo laikotarpiu, po varžybų, nustatyta dvikovininkų maisto raciono energinė vertė – angliavandenių ir skysčių kiekiai per maži.

Aptarimas ir išvados. Kūno masės mažinimo metu graikų-romėnų imtynininkų bendroji kūno masė, lieknoji kūno masė, viduląstelinių skysčių kiekis, riebalų masė, mineralinių medžiagų ir organizmo baltymų kiekis sumažėjo atitinkamai 3.7 ± 1.2 kg ($p < 0.05$), 1.5 ± 1.3 kg ($p \leq 0.05$), 0.8 ± 0.5 kg ($p < 0.05$), 2.1 ± 0.6 kg ($p < 0.005$), 0.2 ± 0.1 g ($p < 0.05$) ir 0.2 ± 0.1 g ($p \leq 0.05$). Atsigavimo laikotarpiu, po varžybų, sportininkų organizmo lieknosios kūno masės ($p > 0.05$) ir bendrųjų kūno skysčių ($p > 0.05$) atsigavimo procesai per lėti.

Raktažodžiai: mityba, imtynininkų maisto racionas, kūno masės mažinimas.

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PECULIARITIES OF CARDIOVASCULAR REACTIONS OF ELITE GRECO-ROMAN WRESTLERS TO REPETITIVE DOSED EXERCISE TEST

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ABSTRACT

Research background and hypothesis. The *s*ynergy of central and peripheral changes while performing easy exercises in repetitive manner should show central or peripheral changes which start increasing and become a trigger for functional mobilization.

Research aim. The aim of this study was to determine the mobilization peculiarities of central and peripheral cardiovascular function in Greco-Roman wrestlers cohort while performing a dosed exercise test in repetitive manner.

Research methods. Greco-Roman wrestlers, sprinters, endurance runners and non-athletes underwent three Roufier tests (30 squats per 45s) with 2 minutes of recovery between them. The changes in the heart rate (HR) and JT interval taken from 12-lead ECG and O_2 desaturation (StO_2) registered by near-infrared spectroscopy were analyzed.

Research results. HR increased and JT interval decreased more and more in both non-athlete cohorts while there were no significant changes in all three athlete cohorts, i. e. we did not find any summing effects of the repetition of workloads. The tendency of increase in StO_2 at the second minute after the dosed workload was greater and greater with each consequent repetition of the testing workload in all cohorts.

Discussion and conclusions. We have proved our hypothesis that peripheral changes during repetitive exercising start increasing earlier than the central ones. The dynamics of central and peripheral cardiovascular indices in non-athlete cohorts while repeating a dosed aerobic exercise test every two minutes demonstrates the cumulative effect of physical exertion whereas in elite Greco-Roman wrestlers as well as in other individuals adapted to physical loads functional indices reiterated.

Keywords: electrocardiogram, dosed exercise test, oxygen saturation.

INTRODUCTION

One of the substantial peculiarities of competitive performance and predominant training loads in combat sports is the fluctuating load intensity which can not be planned precisely in advance. Therefore, the peculiarities of mobilization of body functions and fast recovery is an important factor influencing sports performance, so training these peculiarities is a basic principle in athlete's physical and functional training.

At the onset of exercise, cardiovascular system adapts itself with a series of integrated responses to meet the metabolic demands of exercising muscles (Hughson, Tschakovsky, 1999). The mechanism for exercise hyperemia is a century old enigma (Clifford, 2007) and interrelation between central and peripheral changes still remain of interest in physiology. Since the cardiovascular system is one of the constituent part and a holistic system of the body, the reactions of cardiovascular system to constant-load tests allow assessing the functional capabilities and functional peculiarities of the body (Vainoras, 2002; Perkiomaki, 2003; Van Schuylenbergh et al., 2004). Muscular activity is the trigger of various functional changes and with

the development of fatigue the enrolment rate of various physiological mechanisms is a dynamical process. We hypothesized that the synergy of central and peripheral changes while performing easy exercises in repetitive manner should show central or peripheral changes which start increasing and become a trigger in response to exercising. The aim of this study was to determine the mobilization peculiarities of central and peripheral cardiovascular function in Greco-Roman wrestler cohort while performing a dosed exercise test in repetitive manner.

RESEARCH METHODS

The study participants were four cohorts: elite Greco-Roman wrestlers (n = 12); endurance runners (n = 12); sprint runners (n = 15); healthy adult males (n = 15) and females (n = 15) who were not engaged in any sport training.

The subjects underwent three Roufier exercise tests (*30 squats per 45 seconds*) with 2 minutes of recovery between them. A computerized ECG analysis system "Kaunas-workload", developed at the Kaunas University of Medicine, Institute of Cardiology, was employed for continuous 12-lead ECG recording. The changes in RR interval or heart rate (HR), JT interval were analyzed.

Near-infrared spectroscopy was employed for the registration of changes in O_2 desaturation (StO_2) in active muscles during exercising. Standard System Model 325 (*Hutchinson Technology*) device was used for this purpose. The detector for the registration of infrared signal was placed on right leg (*m. vastus lateralis*) and StO_2 measurements were collected continuously every 3.5 s throughout the entire protocol.

Statistical analysis. All the data were expressed as mean ± standard error of the mean (SEM). Hypothesis concerning the difference between means was verified using Student *t* test for independent and dependent variables. For comparison of rank means within the group, Wilcoxon *Z* criterion for independent variables was used. Difference in means was regarded as statistically significant when error probability with respect to criteria was $p < 0.05$.

RESEARCH RESULTS

A lot of cardiovascular indices showed the summing effects of workloads while performing the Roufier exercise test. The results obtained during the study showed that values of HR and their dynamics in non-athletes women cohort differed from the ones in other cohorts during the rest and during the performance of all three testing workloads. At the beginning of registration in non-athlete women's cohort the HR was 94.6 ± 3.35 b/min, in non-athlete men's cohort – 89.4 ± 4.06 b/min, in sprint cohort – 77.2 ± 2.93 b/min, in endurance cohort – 71.2 ± 3.01 b/min and in Greco-Roman wrestlers cohort – 61.0 ± 3.5 b/min. The HR increased at the end of the first workload up to 134.3 ± 5.04 b/min in non-athlete women's cohort, up to 125.4 ± 3.31 in non-athlete men's cohort, up to 118.6 ± 3.91 b/min in sprint cohort, up to 108.4 ± 3.4 b/min in endurance cohort and up to 109.6 ± 2.8 b/min in Greco-Roman wrestlers sport cohort. These figures and the increase in HR while performing all three testing workloads are presented in Figure 1. The similar increases in HR were observed while the participants of the study performed the second and the third testing workloads comparing the absolute values of HR. The same difference between cohorts was found in the summing effects of the workloads. Figure 1 shows that the HR increased more and more in both non-athlete cohorts while there was no significant increase of maximal values of HR in all three athlete cohorts, i. e. we found no summing effects of the repetition of workloads.

The duration of JT interval decreased at onset of exercising and Figure 2 presents the shortest values of JT interval registered at the end of workloads. The same tendencies were found in comparison to these data. We found no summing effect of repetitive performance of the testing procedure in endurance and Greco-Roman wrestlers cohorts, between significant ($p < 0.05$) differences were found in both non-athlete cohorts. The sprint cohort data presented in Figure 2 show that there was a further decrease in duration of JT interval found during the second testing workload ($p < 0.05$) but there was no further decrease during the third workload.

The index of peripheral cardiovascular reaction to testing workloads was the dynamics of StO_2 in thigh muscles (*m. vastus lateralis*). At onset of exercising the StO_2 decreased but there were no significant differences found between cohorts while comparing the dynamics of StO_2 during the workloads. During the recovery after exercising the StO_2 recovered and increased more than the baseline registered before the testing procedures. The greatest increase was observed at the end of the second minute after exercising, i. e. close to the repetition of the next

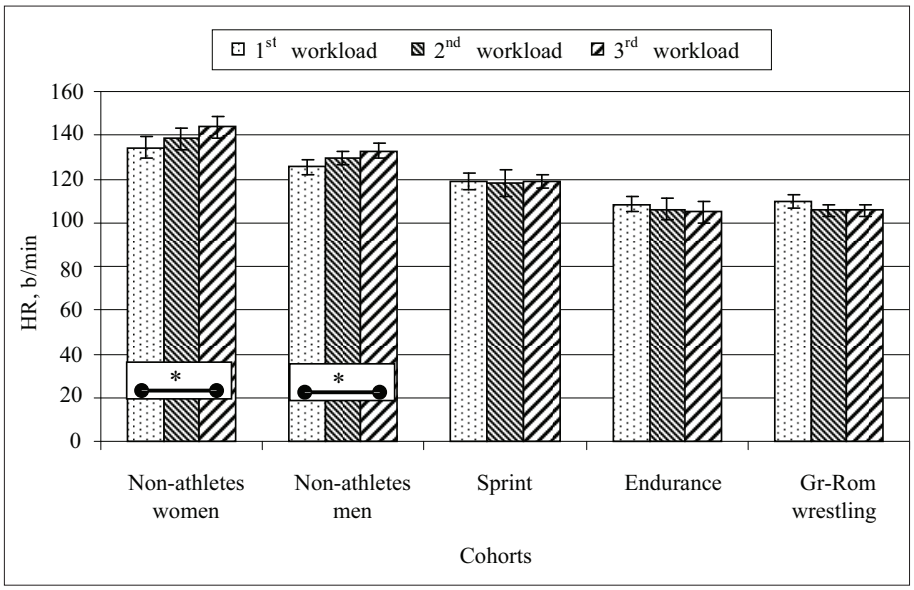

Figure 1. **Value of HR registered at the end of workload while performing three Roufier exercise tests**

Note. * – significant difference.

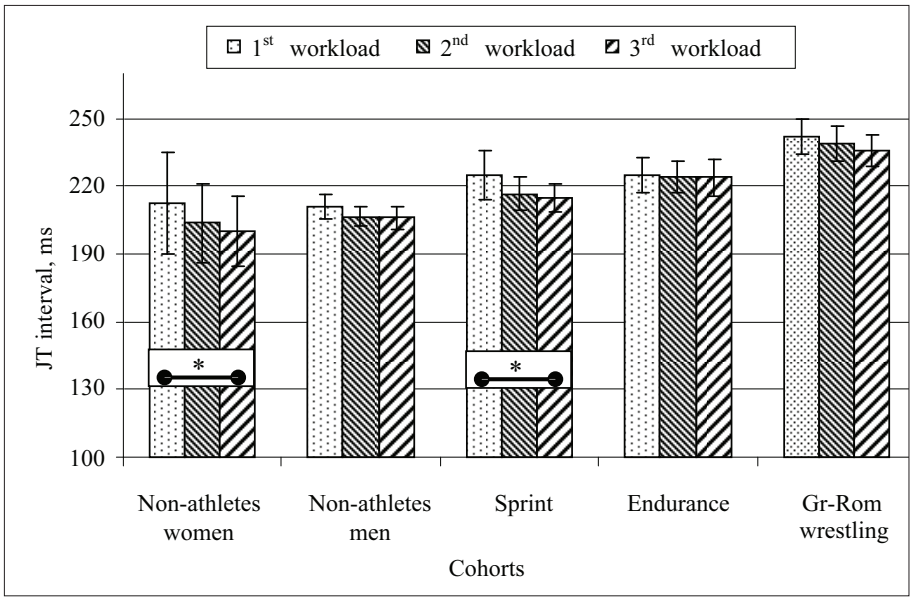

Figure 2. **The registered shortest duration of JT interval while performing three Roufier exercise tests**

Note. * – significant difference.

testing procedure. Figure 3 presents the increase in StO_2 in thigh muscles registered before the next testing procedure or 2 minutes after exercising. The results obtained during the study showed that the summing effects of repetitive character exercising could be found in all cohorts. The greatest summing increase was found in the women in non-athlete cohort, i. e. the increase after the first workload was 17.2 ± 2.7%; after the second – 21.6 ± 3.1% and after the third – 27.4 ± 3.2%. All these changes were significant ($p < 0.05$). The smallest increase along with the performance of repetitive workload was found in endurance cohort (in 3.0 ± 0.7 % after the first, 3.9 ± 1.4% – after the second and 4.7 ± 1.6% – after the third workload.) The increase of StO_2 in Greco-Roman wrestlers cohort was similar as it was found in the sprint cohort (in 3.9 ± 0.8% after the first; 3.7 ± 0.8% – after the second and 4.4 ± 0.8% – after the third workload).

DISCUSSION

It is well known that adaptation to regular exercising has many advantages including improvement of cardiovascular abilities. Endurance trained athletes, for example medium and long-distance runners, have exceptionally good cardiovascular and functional preparedness, (Карпман и др., 1978; Fagard, 1997; Urhausen et al., 1997; Тхоревский, 2001). For this reason we involved representatives of various kinds of sport in our stydy to compare the central and peripheral cardiovascular reactions at onset of exercising. Results obtained by this study, namely

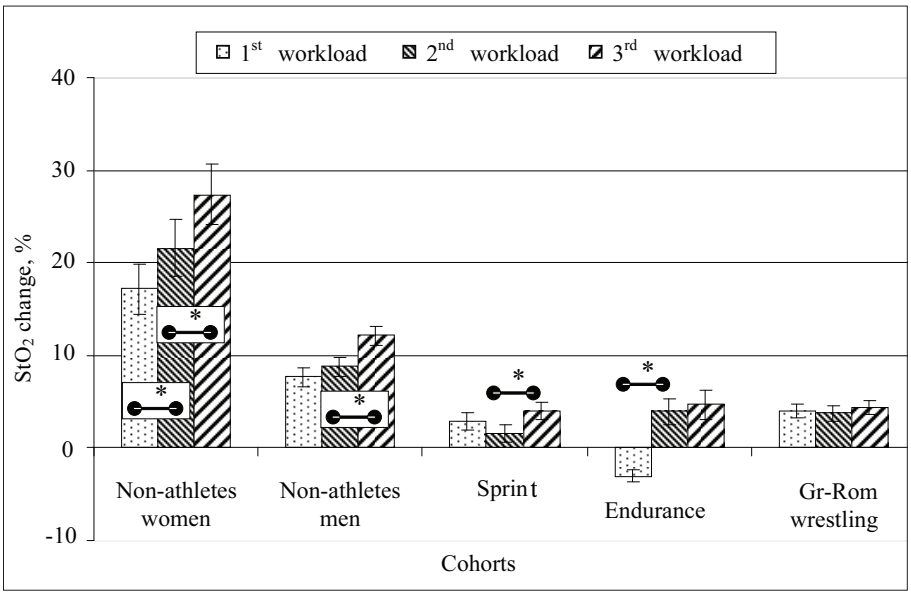

Figure 3. **Level of oxygen saturation (StO_2) in thigh muscles (m. vastus lateralis) before the next testing procedure or 2 minutes after exercising.**

Note. * – significant difference.

the features of the dynamics of cardiovascular functional indices, are not exclusively new. Vast amount of research has been done evaluating the changes in cardiovascular functional parameters during various repetitive exercises and exercise tests (Карпман и др., 1978; Тхоревский, 2001; Vainoras et al., 2002). The results obtained during this study showed that the changes of central and peripheral cardiovascular indices during dosed exercise test were significantly associated with adaptation and the type of adaptation to physical loads. In both non-athlete's cohorts (women's and men's) all central and peripheral cardiovascular indices while repeating a dosed aerobic exercise test every two minutes demonstrated a cumulative effect of physical exertion and in cohorts adapted to physical loads only peripheral indices had a tendency to increase. This can be explained by different functional preparedness of cardiovascular function (Shephard, 2001; Vainoras, 2002). Active heart muscle during metabolic processes is accelerated from 4 to 5 times, and in order to meet the increased O_2 demands, myocardium needs an increase in the coronary circulation system (Žemaitytė, 1996; Тхоревский, 2001). Thus, these differences in cardiovascular response to exercise during dosed workload should be assigned as a result of adaptation to physical loads.

It is known that the size and nature of adaptation, i. e. functional changes in the body systems depend on the type of training and improvements depend on the size and intensity of exposure (Jones, Koppo, 2002). It has been shown that the bigger the size of the heart (*left ventricular end-diastolic diameter*), the lower the maximum heart rate is the characteristic feature of elite athletes adapted to endurance type of training loads (Карпман и др., 1978; Fagard, 1997; Urhausen et al., 1997; Martinelli et al., 2005). Speed and strength training in general is not a very strong stimulus to myocardium excesses, even in cases when it takes several hours per day (Haykowsky et al., 1998). In general, speed and strength training is not considered as a very strong stimulus for cardiac hypertrophy, even in cases where it lasts for several hours a day (Haykowsky et al., 1998).

At onset of exercising cardiovascular system adapts to a series of integrated responses. The peripheral changes in blood flow and StO_2 starts with the beginning of muscular activity but these changes last up to full recovery after exercising (Тхоревский, 2001; Clifford. 2007) and post-exercise hyperemia could be an index of intensity of recovery processes (Тхоревский, 2001; Clifford, 2007). Other researchers (Grassi, 2001; Hughson, 2007; Jones, Pole, 2007) have found that the changes in StO_2 in muscular tissue is a good index of the intensity of local arterial blood flow. The results obtained in this study showed that the increase in StO_2 at the second minute after dosed workload was greater and greater with each next repetition of the workload. So the second significant result of this study is that it has proved our hypothesis that the peripheral changes (StO_2) during repetitive exercising start to increase earlier than the central ones and the synergic properties of these changes significantly relate to the adaptation to physical loads.

Summing up, the results obtained during the study showed that during dosed exercise tests synergic peculiarities of the dynamics of the central and peripheral functional indices of the

cardiovascular system were significantly associated with the adaptation and its character to physical loads. During the repetitive dosed tests performed every 2 minutes the dynamics of the majority of central functional indices of the cardiovascular system in non-athletes showed the effect of physical load summation, whereas in the elite Greco-Roman wrestlers and other individuals adapted to physical loads, the functional indices reiterated. This can be explained by the different functional readiness of the studied groups. The second significant result of the study confirmed the idea that the dynamics of peripheral changes (StO_2) was more important; it influenced the dynamics of central functional indices of the cardiovascular system (indices of ECG). Synergic peculiarities of the dynamics of the cardiovascular system were significantly associated with the adaptation to physical loads.

CONCLUSIONS AND PERSPECTIVES

During dosed exercise tests the synergic peculiarities of the dynamics of central and peripheral functional indices of the cardiovascular system were significantly linked to the character of the adaptation to physical loads. Dynamics of central and peripheral cardiovascular indices in non-athlete cohorts while repeating a dosed aerobic exercise test every two minutes demonstrates the cumulative effect of physical exertion whereas in elite Greco-Roman wrestlers as well as in other individuals adapted to physical loads functional indices were reiterating.

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GRAIKŲ-ROMĖNŲ IMTYNININKŲ ŠIRDIES IR KRAUJAGYSLIŲ SISTEMOS REAKCIJOS YPATYBĖS ATLIEKANT KARTOTINIUS DOZUOTO KRŪVIO MĖGINIUS

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Tyrimo hipotezė formuluojama remiantis šiais teiginiais: kartojant subjektyviai lengvus fizinius krūvius, centrinių bei periferinių širdies ir kraujagyslių sistemos funkcinių rodiklių pokyčių greitis turėtų parodyti, kurie centriniai ar periferiniai mechanizmai yra svarbiausi.

Tikslas – nustatyti graikų-romėnų imtynininkų širdies ir kraujagyslių sistemos funkcinių rodiklių kaitos ypatybes atliekant kartotinius dozuoto fizinio krūvio mėginius.

Metodai. Graikų-romėnų imtynininkai, sprinto ir ištvermės bėgikai, nesportuojantys asmenys atliko tris dozuoto fizinio krūvio mėginius (Rufjė testą, t. y. 30 pritūpimų per 45 s pailsint dvi minutes tarp krūvių). Norint įvertinti ŠSD ir EKG JT intervalo pokyčius, dvylikos standartinių derivacijų elektrokardiograma (EKG) buvo registruojama nenutrūkstamai. Deguonies įsisotinimo (StO_2) šlaunies raumenyje kaita buvo registruojama neinvazinės artimosios spektroskopijos metodu.

Rezultatai. Kas dvi minutes atliekant kartotinius Rufjė mėginius, nesportuojantiems asmenims būdingi nuovargio sumavimosi efektai; sportininkams – mažai išreikšta centrinių ŠKS funkcinių rodiklių reakcija į dozuoto krūvio kartojimus (reakcijų stabilumas) ir tik nedidelė periferinio ŠKS rodiklio StO_2 didėjimo tendencija podarbinės hiperemijos fazėje.

Aptarimas ir išvados. Buvo patvirtintas teiginys: atliekant kartotinius Rufjė fizinio krūvio mėginius, periferiniai pokyčiai yra pirmesni ir veikia kitus centrinius ŠKS funkcinius rodiklius. Centrinių ir periferinių ŠKS funkcinių rodiklių kaitos sinerginės ypatybės atliekant dozuotus fizinius krūvius yra reikšmingai susijusios su adaptacijos prie fizinių krūvių pobūdžiu. Kas dvi minutes atliekant kartotinius dozuoto fizinio krūvio mėginius, nesportuojančių asmenų daugumos centrinių ŠKS funkcinių rodiklių kaita sukelia suminį fizinio krūvio efektą, o didelio meistriškumo graikų-romėnų imtynininkų, kaip ir kitų asmenų, kurie adaptavęsi prie fizinių krūvių, funkciniai rodikliai pasikartoja.

Raktažodžiai: elektrokardiograma, dozuoto krūvio mėginiai, deguonies įsisotinimas.

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PECULIARITIES OF PHYSICAL ACTIVITY AND SELF-ESTEEM OF YOUNG PEOPLE WITH DIABETES MELLITUS TYPE 1 AND HEALTHY PERSONS AGED 18–25 YEARS

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ABSTRACT

Research background and hypothesis. Careful diabetes control slows the onset and progression of life-threatening complications, the development of disability and early disability-related unemployment, and prolongs life expectancy (Danytė et al., 2000). The benefits of physical activity on regular basis comprise improved cardiovascular health, increased lean body mass, improved blood lipid profile, enhanced psycho-social wellbeing and decreased obesity (Riddell, Iscoe, 2006). Physical activity is one of the main factors influencing glucose level in diabetic patients' blood (Wiśniewski, 2010). Analysis of self-esteem of the studied revealed a wide range of findings, from trying to outline the modest achievements, pride, and even unwillingness to discuss it to low self-esteem, feeling of guilt and self-reproach for mistakes and failures (Žemaitis, 1995).

The aim of the study was to determine physical activity and self-esteem of healthy subjects and patients with diabetes mellitus type 1 aged 18–25 years.

Methods. The study included 140 individuals (aged from 18 to 25 years). Among 41 patients with type 1 diabetes mellitus there were 33 young women and 8 young men, and among 99 healthy persons – 79 young women and 29 young men. All the subjects were asked to fill in the questionnaire orientated to physical activity and self-esteem. The short IPAQ questionnaire was used to research physical activity and Rosenberg's Self-Esteem Scale was used to assess self esteem.

Research results. Approximately 60% of subjects with diabetes mellitus type 1 and about 50% of healthy persons rated their physical activity as moderate. Intensive 60-minute-physical activity was reported by 48.5% of healthy subjects and 34.1% of diabetic patients, moderate 60-minute-physical activity was pointed out by 38.2% of diabetic patients and 35.8% of healthy research participants. The largest walking interval was 1–1.5 hours: in the diabetic group– 28.8%, in the healthy group – 31.65%. Healthy young men and women were physically more active than diabetic patients. Self-esteem in both genders of healthy subjects and diabetic patients was determined as moderate.

Discussion and conclusions. Physical activity of women and men with diabetes mellitus type 1 aged 18–25 years was valued as moderate, meanwhile physical activity in healthy persons – moderate or high. Self-esteem is moderate in both groups of patients with diabetes and healthy persons. Healthy men are more active than diabetic patients, similarly, women having diabetes mellitus type 1 are more physically passive than healthy ones. Both patients with diabetes mellitus type 1 and healthy individuals aged 18–25 reported moderate self-esteem.

Keywords: diabetes mellitus type 1, physical activity, self-esteem.

INTRODUCTION

Recently diabetes as a chronic disease has been the focus of attention. So far few studies have been in Lithuania. However, we think that this is a relevant problem, which requires a deeper investigation and may provide patients with information and advice on how to live with this disease. Although the disease is incurable, people with diabetes can still lead a normal life. Diabetes mellitus is the most prevalent disease of the endocrine system and is characterized by person's

inability to perform normal glucose regulation and carbohydrate metabolism (Hoffman, 2002). Thus, in this case, administration of insulin injections is necessary. People with type 1 diabetes do not experience any health disorders or inconveniences if they have the right dose of insulin at a suitable time.

The morbidity from diabetes mellitus is growing all over the world. Lithuania is not an exception. According to the data of the Lithuanian Health Information Center, morbidity from diabetes mellitus in the people aged 18 and above was 62% or 26.63 cases per 1000 population *(Lithuanian Health Information Center*, 2009). This illustrates that the scale of the disease is growing but there is still a lack of preventive measures. Sufficient physical activity is one of the primary prevention factors, reducing morbidity from ischemic heart disease, diabetes mellitus and stroke, mortality from ischemic heart disease and general mortality (Leon, Connett, 1991). Although the authors determined this fact twenty years ago, people with diabetes still lack help to integrate into the society without feeling of being humble. As H. Pek et al. (2002) assert, whether people assess themselves positively they usually have high self-esteem. According to them, self-respect may be assessed in terms of family, parents, education, age, activities and economic status. We agree with the authors since the environment and people who surround these patients are of great importance. A family should help diabetic patients adjust to the disease and perform their daily activities, such as working, studying and entertaining. Education and special training should help them acquire knowledge about the disease. Socio-economic conditions may provide better possibilities to obtain newer and more effective drugs.

RESEARCH METHODS

The research participants. The study included 140 individuals (aged from 18 to 25 years). Among 41 patients with type 1 diabetes mellitus there were 33 young women and 8 young men, and among 99 healthy persons – 79 young women and 29 young men (Table).

The study design. The questionnaire-based study was performed in February–April, 2011. The healthy subjects were randomly selected. The subjects with diabetes mellitus type 1 were identified through Diabetes Association. The questionnaires to the healthy subjects and subjects with diabetes were sent by e-mail. The selected subjects with diabetes were given two weeks to send a reply. Out of 160 sent questionnaires, 140 answers were received. Each questionnaire consisted of 23 questions. A few questions were about the personal data of the studied: gender, age, height, weight, presence of diabetes, etc.

Table**. Anthropometric data of healthy subjects and subjects with type 1 diabetes**

Subjects / Anthropometric data	With type 1 diabetes (n = 41)		Healthy (n = 99)	
	Women (n = 33)	Men (n = 8)	Women (n = 79)	Men (n = 29)
Height, m	1.70 ± 0.07	1.86 ± 0.1	1.70 ± 0.1	1.83 ± 0.1
Body mass, kg	66.8 ± 11.9	85 ± 12.5	62.1 ± 9.7	78.3 ± 11

The study instruments. Young people with type 1 diabetes and healthy subjects of the experimental group were asked to fill in the questionnaire orientated to physical activity and self-esteem. The questions regarding the duration of low, moderate and high physical activity were included. Additionally, the participants had to reply to the questions concerning their self-esteem, social equality, self-satisfaction, etc.

The short IPAQ questionnaire was used to analyze physical activity. Seven open questions on high, moderate and low physical activity were presented concerning the amount of daily physical activity and the number of days per week. Physical activity was estimated in MET values.

Rosenberg's Self-Esteem Scale was used to assess self esteem. The 10-point Likert scale offered four answers: „Strongly agree" (SA), „Agree" (A), „Disagree" (D), and „Strongly disagree" (SD). Each answer was given a score. The scores were calculated as follows: Items 1, 2, 4, 6 and 7 – by 3 for the answer „Strongly agree", etc. Items 3, 5, 8, 9 and 10 (which are reversed in valence) – 0 for the answer „Strongly agree". The subjects were introduced to the aim of the study, they were also allowed to refuse the participation. Prior to starting filling in, the respondents were given explanations how to complete the questionnaire.

Statistical analysis. Statistical analysis of the data was performed using *Statistical Package for Social Science* („SPSS 15") and *Microsoft Office „Excel* 2003". Pearson's correlation coefficient r was used to analyze the relationships between groups, $p < 0.05$ was taken as the level of significance.

RESEARCH RESULTS

Physical activity of subjects with diabetes mellitus type 1 and healthy subjects aged 18–25 years and a comparison between these two groups.

Students accounted for the largest group of the respondents: 51.2% of subjects with type 1 diabetes and 68% of healthy subjects. The number of employed (22%) and school pupils (26.8%) ranked the second and was similar in both groups (Figure 1).

Subjects with diabetes mellitus type 1 and healthy persons rated their physical activity as moderate, 60% and 50%, respectively. While one-fifth of healthy subjects rated physical activity as high, nobody in the group of subjects with type 1 diabetes persons gave a positive answer (Figure 2).

Intensive daily 60-minute-physical activity was pointed out by 48.5% of healthy subjects and 34.1% of subjects with diabetes and it was as follows: lifting heavy things, playing basketball, doing aerobics, or riding a bicycle vigorously. Mean 60-minute-lasting physical activity was reported by 38.2% of subjects with type 1 diabetes and 35.8% of healthy respondents. The largest walking interval was from 1 to 1.5 hour in the diabetes group – 28.8% and 31.6% in the healthy group.

Healthy men and women showed higher physical activity compared to the subjects with diabetes of both genders (Figure 3).

Physical activity levels were as follows: low physical activity: 600 MET min/week, moderate: 600–3000 MET min/week, high: more than 3000 MET min/week. Mostly healthy men reported

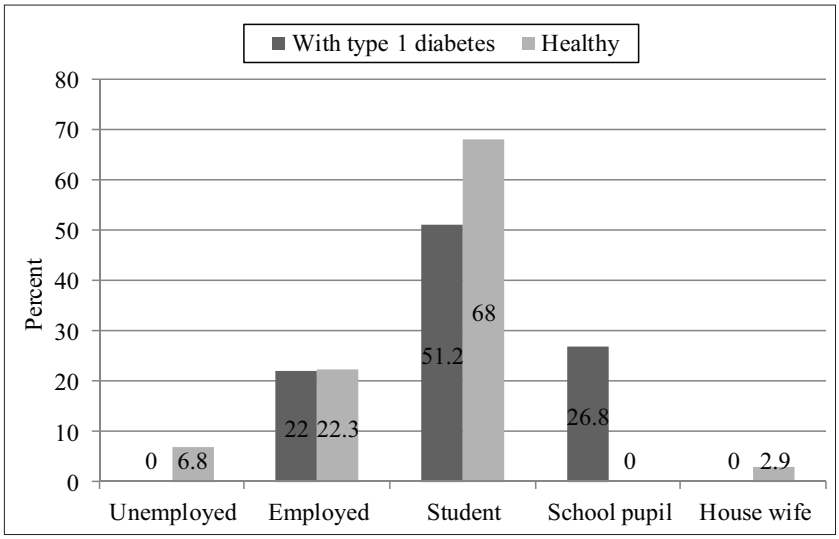


Figure 1. **Distribution of respondents by their status**

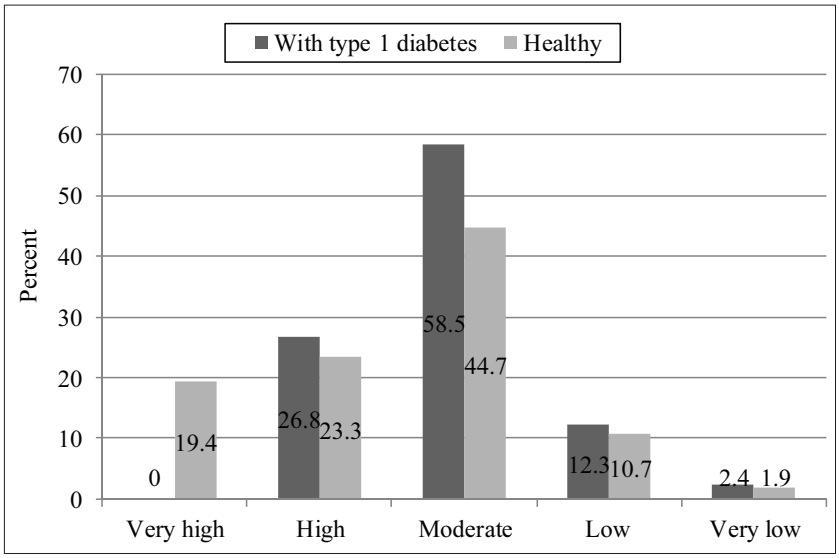


Figure 2. **Percentage of self-rating of physical activity in healthy subjects and subjects with type 1 diabetes**

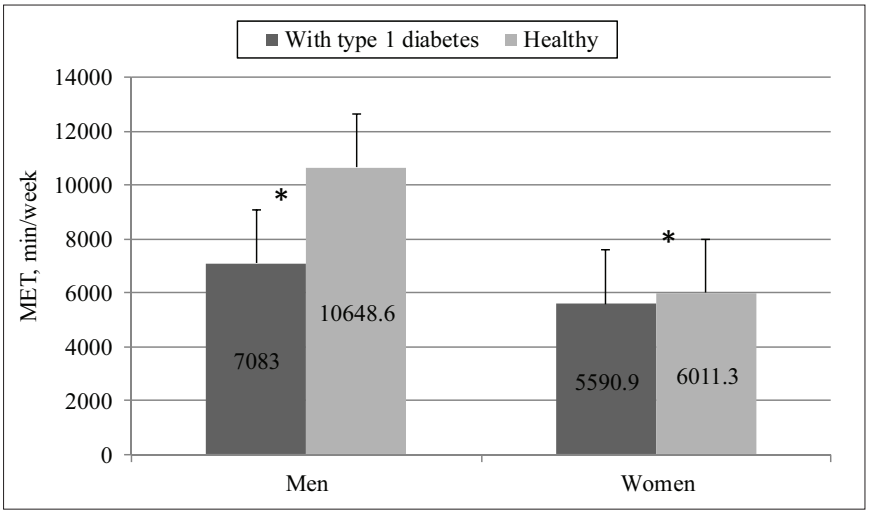
their physical activity as intensive, their physical activity was high, 6256.6 MET min/week. The men with diabetes reported lower results compared to healthy men, 3120 MET min/week, but they still fell into the high level category. Both healthy women and women with type 1 diabetes women demonstrated a moderate physical activity level (Figure 4).

Distribution of moderate physical activity in the research participants was similar: healthy men ranked first, 1785 MET min/week, however, there was only a slight difference in the group of subjects with type 1 diabetes for men – 1613.8 MET min/week. The lowest moderate physical activity was 1225.5 MET min/week (Figure 5).

Healthy men walked most – 2778.3 MET min/week; a slight difference was reported by men with diabetes – 2178 MET min/week. Women with diabetes walked 2484 MET min/week. Interestingly, healthy women reported the least duration of walking, 1972.9 MET min/week (figure 6).

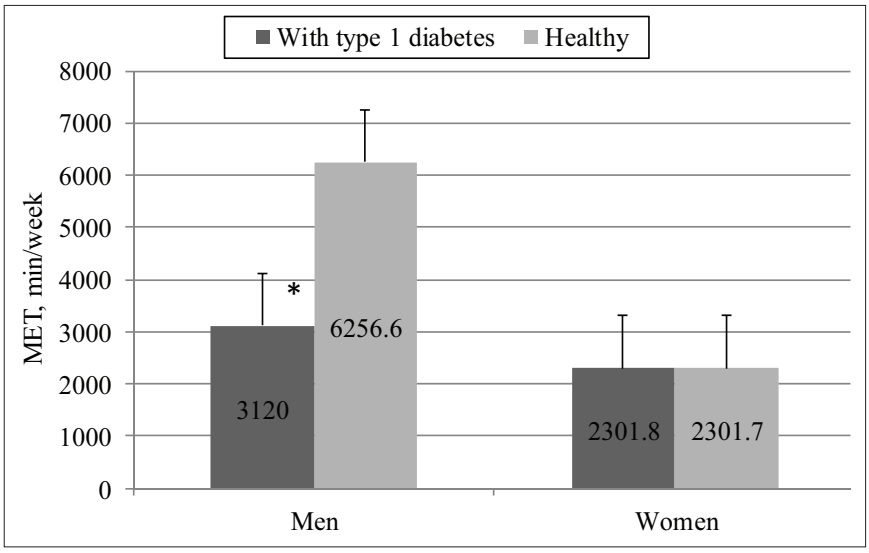
Self-esteem of young persons with diabetes type 1 and healthy subjects aged 18-25 years and a comparison between the groups. The data of Rosenberg's Self-Esteem Scale were calculated by scores (the highest score was 30). The lower score a person received, the lower self-esteem he/she had, and the opposite. Scores from 15 to 25 were valued as normal self-esteem; scores below 15 suggested low self-esteem. Healthy men valued their self-esteem by 18 within normal range. The women reported 17; thus, self-esteem was normal in both genders. Women and men with diabetes valued their self-esteem as normal. High self-esteem was when the scores were between 25 and 30 (Figure 7).

Figure 3. **Physical activity of healthy and subjects with diabetes type 1 in MET values**



Note. * – $p < 0.05$.

Figure 4. **High physical activity assessed in MET values in the healthy and diabetes groups**



Note. * – $p < 0.05$.

DISCUSSION

Three main aspects such as diabetes mellitus type 1, physical activity and self-esteem of young women and men aged 18–25 years were assessed in our study. These three aspects by themselves have significance for person's health and wellbeing. Although health is of great biological and social value, scientists have noticed that young people are less likely to consider it as important (Urbonaitė et al., 2002). We had anticipated that the analysis of physical activity and self-esteem of subjects with diabetes type 1 would have shown worse results than that of healthy persons. Patients with diabetes

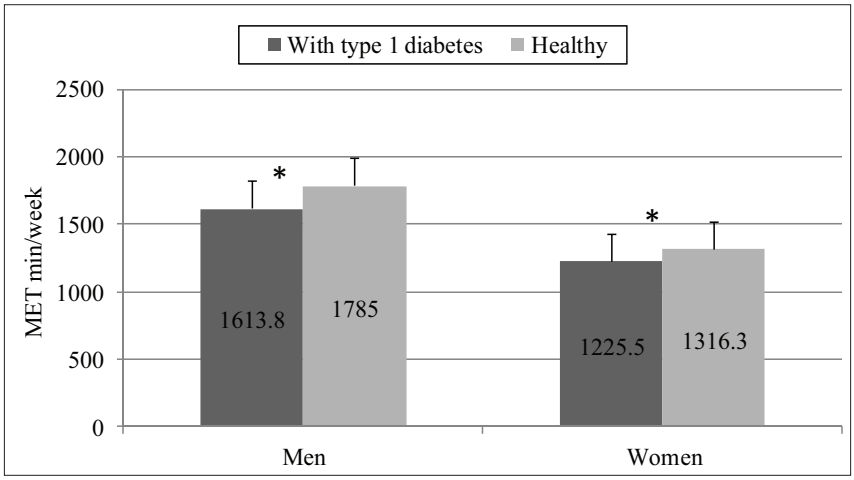


Figure 5. **Moderate physical activity expressed by MET values in the healthy and diabetes groups**

Note. * – $p < 0.05$.

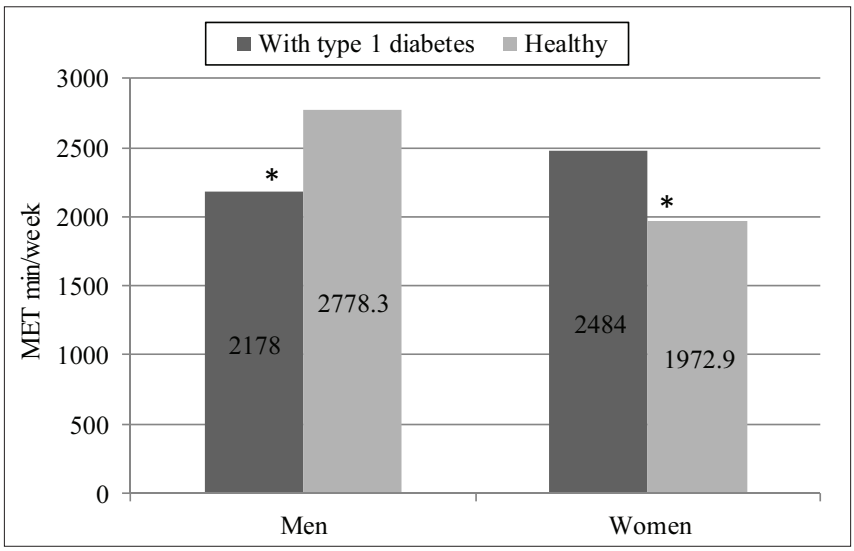


Figure 6. **Assessment walking in MET values in healthy subjects and subjects with type 1 diabetes in both groups**

Note. * – $p < 0.05$.

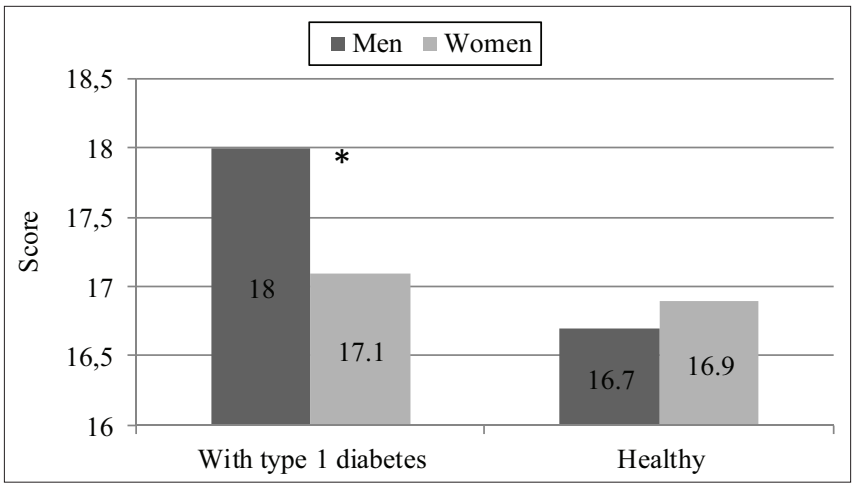


Figure 7. **Self-esteem in healthy and subjects with type 1 diabetes groups**

Note. * – $p < 0.05$.

mellitus type 1 were the least physically active, their self-esteem was lower, they reported experiencing a shortage of happiness and sense of unequality. Our study revealed that distribution by gender was similar; about a quarter of healthy subjects and subjects with type 1 diabetes were women, and the rest were men. Not long ago, diabetes mellitus accounted for 5% of the world population, furthermore, its prevalence is doubling with every generation. The highest prevalence of the disease is in India suggesting also the highest number of patients (approximately 35 million) (Marso, 2003). The study revealed that young people with diabetes mellitus type 1 were physically more passive. We did not find any significant difference. Subjects with diabetes mellitus type 1 rated their physical activity as moderate, so did the healthy individuals. At this point, it should be taken into consideration that the *American Diabetes Association* (2004) recommends enhancing daily exercising that is beneficial for patients with diabetes. The implementation of these recommendations in the meetings with patients is linked to better results of physical and mental health. Only one-fifth of healthy research participants rated their physical activity level as high, meanwhile the subjects with type 1 diabetes gave a negative answer. Every day or few days per week healthy persons and patients with diabetes mellitus type 1 reported having the intensive physical activity such as lifting heavy things, playing basketball, doing aerobics or riding a bicycle vigorously. The subjects with diabetes pointed out that they mostly had daily 60-minute physical activity. Mostly moderate 60-minutes of physical activity were reported by individuals with diabetes mellitus type 1. Most commonly, healthy persons were physically active about 60 minutes. Physical activity level of the studied was as follows: moderate in diabetic patients, high – in healthy subjects for men, low in healthy subjects, and moderate – in subjects with type 1 diabetes for women. S. Kanner and V. Hamrin (2003), who investigated depression in young people, found that the peculiarities of depression in young patients with diabetes mellitus type I were more significantly expressed compared to the general population. Moreover, depression poses a threat to most young people with other diseases, such as behavioral problems, personality disorders, substance abuse, obesity, intrapersonal conflicts (Zalsman et al., 2006). Similar to women, self-esteem of men with diabetes mellitus type 1 was moderate, the difference between them was not significant. Our results obtained were similar to those of A. L. Unsden and et al., (2008), who concluded that the quality of life, self-esteem and mental wellbeing of diabetic women were worse, compared to those of men. Therefore, it is important to work out the strategies enhancing the quality of life, self-esteem in diabetic patients. Healthy women and men reported moderate self-esteem. High self-esteem is when scores are between 25–30. J. M. Norris and G. J. Klingensmith (2001) determined that both adolescences and adults with diabetes were more frequently prone to depression compared to healthy individuals, and depression was more prevalent in women than in men. Lower physical activity and lower self-esteem results mean the poor quality of life. In our opinion, this fact is due to a lack of awareness of other people surrounding these patients, insufficient help, and a judicious approach to the problem of our community and the state. In order to improve the condition of patients with diabetes mellitus it is necessary to aggregate all institutions, and only then tangible benefits can be achieved.

CONCLUSIONS AND PERSPECTIVES

Physical activity of women and men with diabetes mellitus type 1 aged 18–25 years is valued as moderate, meanwhile physical activity in healthy persons – moderate or high. Self-esteem is moderate in both groups of patients with type 1 diabetes and healthy persons. Healthy men are more active than diabetic patients, similarly, women having diabetes mellitus type 1 are physically more passive than the healthy ones. Both patients with diabetes mellitus type 1 and healthy individuals aged 18–25 report moderate self-esteem.

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18–25 METŲ AMŽIAUS SVEIKŲJŲ IR SERGANČIŲ 1 TIPO CUKRINIU DIABETU FIZINIO AKTYVUMO IR SAVIVERTĖS YPATUMAI

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Tik gerai kontroliuojant diabetą galima atitolinti grėsmingas komplikacijas, sustabdyti jų progresavimą ir taip sumažinti invalidumą, ankstyvą nedarbingumą, pailginti sergančiųjų gyvenimą (Danytė et al., 2000). Reguliarus fizinis aktyvumas gerina širdies ir kraujagyslių fizinę būklę, didina liesąją kūno masę, gerina kraujo lipidų profilį, stiprina psichosocialinę gerovę ir mažina nutukimą (Riddell, Iscoe, 2006). Fizinis aktyvumas laikomas viena iš keturių pagrindinių veiksnių, lemiančių cukriniu diabetu sergančiųjų gliukozės kiekį kraujyje (Wiśniewski, 2010). Savęs vertinimo amplitudė labai plati. Vieni ypač pabrėžia nors ir menkus savo laimėjimus, puikuojasi savimi. Kiti, priešingai, net nemėgsta, kad apie tai būtų kalbama. Treti, nors būdami talentingi, pasirodo esą labai nepatenkinti savimi, nuolat save kaltina ir smerkia net už menkiausias klaidas ar nesėkmes (Žemaitis, 1995).

Tikslas – nustatyti 18–25 m. amžiaus sveikųjų ir sergančiųjų 1 tipo cukriniu diabetu fizinį aktyvumą ir savivertę.

Metodai: Tiriamųjų kontingentą sudarė 140 tiriamųjų (amžius – nuo 18 iki 25 m.) – iš jų 41 sergantis 1 tipo cukriniu diabetu (33 merginos ir 8 vaikinai) ir 99 sveiki (79 merginos ir 29 vaikinai). Visi tiriamieji buvo apklausti klausimynais, kurie orientuoti į fizinį aktyvumą bei savivartę. Fiziniam aktyvumui tirti naudotas trumpasis IPAQ klausimyno variantas. Asmens savęs įvertinimui naudota viena iš plačiausiai naudojamų *Rosenberg* savęs vertinimo skalė.

Rezultatai. Apie 60% sergančių 1 tipo cukriniu diabetu savo fizinį aktyvumą vertino kaip vidutinį, apie 50% vidutiniškai vertino ir sveikieji. Intensyvia 1 valandos trukmės fizine veikla dienos metu užsiima 48,5% sveikųjų ir 34,1% cukriniu diabetu sergančių jaunų žmonių, vidutine 1 valandos trukmės fizine veikla dienos metu užsiima 38,2% sergančių cukriniu diabetu ir 35,8% sveikųjų. Didžiausias vaikščiojimo intervalas yra 1–1,5 h: sergančių cukriniu diabetu grupėje – 28,8%, sveikųjų grupėje – 31,6%. Sveiki vaikinai ir merginos yra fiziškai aktyvesni už sergančius 1 tipo cukriniu diabetu. Abiejų lyčių savivertė tiek sveikųjų, tiek sergančių 1 tipo cukriniu diabetu respondentų grupėse buvo nustatyta kaip vidutiniška.

Aptarimas ir išvados. Sergančių 1 tipo cukriniu diabetu jaunų 18–25 m. žmonių fizinis aktyvumas yra vidutiniškas, o sveikųjų fizinis aktyvumas įvertintas kaip vidutiniškas arba geras. Tiek sergančių 1 tipo cukriniu diabetu, tiek sveikų jaunų asmenų savęs vertinimas yra vidutinis. Sveiki vaikinai yra fiziškai aktyvesni už sergančius 1 tipo cukriniu diabetu jaunus vyrus. Sergančios 1 tipo cukriniu diabetu merginos yra fiziškai pasyvesnės už sveikąsias. Ir sergantys 1 tipo cukriniu diabetu, ir sveiki jauni 18–25 m. žmonės save vertina vidutiniškai.

Raktažodžiai: 1 tipo cukrinis diabetas, fizinis aktyvumas, savivertė.

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IMPACT OF EXTRA CURRICULAR TRAINING (BASKETBALL AND ATHLETICS) ON MUSCLE STRENGTH IN BOYS 11–14 YEARS OF AGE

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ABSTRACT

Research background and hypothesis. Human growth and maturation is determined by interaction of endogenous and exogenous factors. The most sensitive to the external influences is the age period between 11 and 14 years. The investigations of this age period in boys engaged in sports may reveal the complex interaction of the endogenous and exogenous factors. Hypothesis: Improvement of the muscle capacity indices in early adolescence depends on the nature of physical load.

Research aim was to examine long-term extra curricular training in basketball games and athletics (sprint) effects on muscle strength of boys in early adolescence.

Research methods. 105 boys – non-athletes (n = 35), athletes – sprint runners (n = 35) and basketball players (n = 35) – participated in the study. The boys were engaged in the chosen sports for no less than 2 years. The same cohorts were followed for four years at the age of 11, 12, 13 and 14 years. The strength of the arm levators, femoral flexors, calf extensors, calf flexors, forearm extensors and forearm flexors was measured using the dynamometer "Nicholas". The maximum force required for the isometric muscle contraction mode was obtained when the resistance, caused by the investigator, occurred.

Research results. Dynamometry assessments between the groups showed that the muscle strength of the athletes – sprint runners was greater than that of non-athletes and basketball players. Statistically significant differences between boys were identified in all age groups in assessment of both right and left sides.

Discussion and conclusions. Improvement of the muscle capacity indices in early adolescence depends on the nature of physical load: the muscle strength indices increased more in the athletes – sprint runners than in the basketball players.

Keywords: adolescence, dynamometry, sport.

INTRODUCTION

Human growth and maturation is determined by interaction of endogenous and exogenous factors (Armstrong, Welsman, 2005). A significant role in this interaction is given to the exogenous factors, i. e. physical activity, the nature of physical load and other physical load characteristics (Szopa, Żychowska, 2001).

A number of epidemiological studies have already highlighted the positive effects of physical exercise on the working capacity and functional state of skeletal muscles and cardiovascular system (Strong et al., 2005; Hilberg, 2008). Regular participation in training sessions of a particular sport for a long time during childhood and adolescence is a significant factor of the prevalence of the nature of physical exercises (Pearson et al., 2006). The most sensitive age to the external influences is the age period between 11 and 14 years. Therefore the investigations of this age period in boys engaged in sports may reveal the complex interaction of the inherent and acquired (endogenous and exogenous) factors. Reports and case studies on this issue are

still insufficient grounds for drawing conclusions about the safety of intense training or high-level competition in young athletes (*American Academy of Pediatrics* – further AAP, 2010). Hypothesis: Improvement of the muscle capacity indices in early adolescence depends on the nature of physical load.

The aim of the study was to examine long-term extra curricular training effects on muscle strength of basketball players and athletes – sprint runners and non-athletes boys in early adolescence.

RESEARCH METHODS

Subjects. The sample consisted of 105 boys, 11 years of age at the beginning of the research, Lithuanian high school and sports school students. All subjects were divided into three groups: non-athletes (n = 35), athletes – sprint runners (n = 35) and basketball players (n = 35). The study involved the boys engaged in the chosen sports not less than 2 years. The same boys were followed for four years and took part in the study at the age of 11, 12, 13 and 14 years (Table).

Research methods and organization. The measurements were carried out at the Kinesiology Laboratory, Lithuanian Academy of Physical Education and started in spring 2006 (April/May). The protocol of the study was approved by Local Ethics Committee. All tests and measurements were performed at the same time of the day during all four years of the study. Two days before testing the boys did not perform any all-out exercise.

Muscle strength was measured using the dynamometer "Nicholas" (*Lafayette Instruments Company*, Lafayette, Indiana). The maximum force required for the isometric muscle contraction mode was obtained when the resistance caused by the investigator occurred. The dynamometer measured strength range between 0 and 199.9 kg, therefore, it was possible to assess the major muscles strength. The strength of the arm levators, femoral flexors, calf extensors, calf flexors, forearm extensors and forearm flexors was measured. The measurements were repeated three times and the best score was registered.

Data processing methods. The obtained data were processed by descriptive statistics methods. In order to evaluate the significance of the obtained differences between the groups one-way analysis of variance – ANOVA (Student's test summary of several independent samples) was used. The differences between the measured values were statistically significant at the level of $p < 0.05$.

RESEARCH RESULTS

Intergroup significant differences were found in forearm elevators strength in the time point of 12 years of age between the non-athletes and both groups of athletes (both the left and right arms); in the time point of 13 years of age – between the non-athletes and athletes – sprint runners (both the left and right arms); in the time point of 14 years of age – between all the three groups (the right arm) and between both groups of sportsmen and the non-athletes (the left arm) (Figure 1).

Significant differences in femoral flexors strength were found: in the time point of 13 years of age – between the athletes – sprint runners,

Table. **Basic anthropometric characteristics of subjects**

Age	Sport event	Body height, cm	Body mass, kg
11 years	Non-athletes (n = 35)	150.3 ± 2.2	42.6 ± 3.4
	Athletes sprint runners (n = 35)	149.1 ± 2.5	40.2 ± 2.6
	Basketball players (n = 35)	154.1 ± 2.1	43.2 ± 2.4
12 years	Non-athletes (n = 32)	158.6 ± 1.8	46.6 ± 1.8
	Athletes sprint runners (n = 21)	159.4 ± 2.2	45.4 ± 2.4
	Basketball players (n = 19)	162.2 ± 2.4	47.8 ± 2.4
13 years	Non-athletes (n = 30)	165.7 ± 2.4	54.5 ± 2.1
	Athletes sprint runners (n = 18)	166.1 ± 1.9	51.2 ± 2.2
	Basketball players (n = 17)	169.6 ± 1.9	53.5 ± 2.2
14 years	Non-athletes (n = 26)	171.9 ± 1.6	61.5 ± 2.3
	Athletes sprint runners (n = 15)	170.9 ± 1.9	56.2 ± 2.0
	Basketball players (n = 16)	175.2 ± 2.4	58.9 ± 2.5

basketball players and non-athletes (both the left and right leg); in the time point of 14 years of age – between all the three groups (the right leg), between non-athletes boys and athletes – sprint runners (the left leg) (Figure 2).

Calf extensors strength scores showed significant differences: in the time point of 12 years of age between the athletes – sprint runners, basketball players and non-athletes (both the left and right leg); in the time point of 13 years of age –

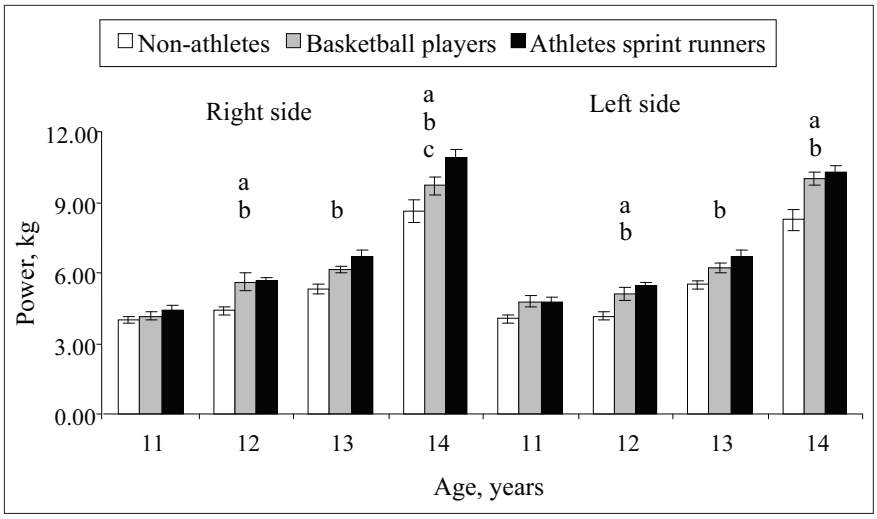

Figure 1. **The results of arm levators strength in the non-athletes, sport basketball players and athletes sprint runners**

Note. The difference between: the non-athletes and basketball players – a, the athletes sprint runners and non-athletes – b, the basketball players and athletes sprint runners – c; statistically significant at $p < 0.05$.

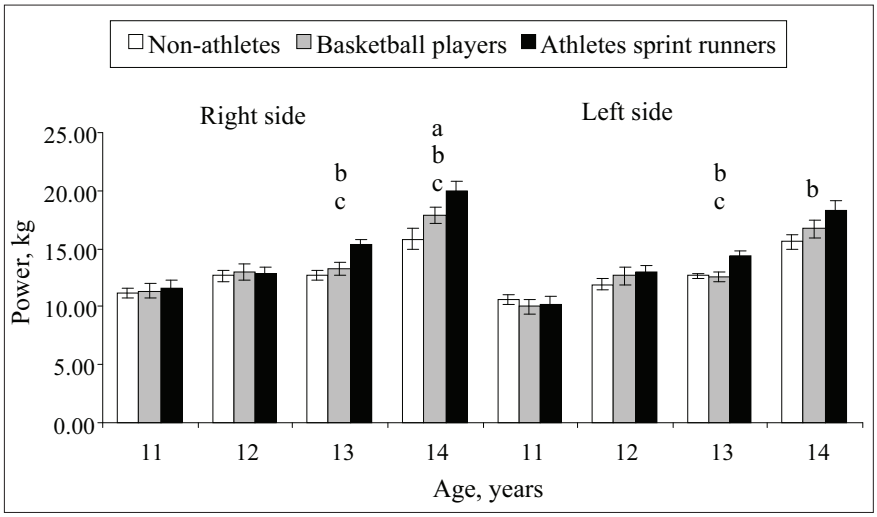

Figure 2. **The results of femoral flexors strength in the non-athletes, basketball players and athletes sprint runners**

Note. The difference between: the non-athletes and basketball players – a, the athletes sprint runners and non-athletes – b, the basketball players and athletes sprint runners – c; statistically significant at $p < 0.05$.

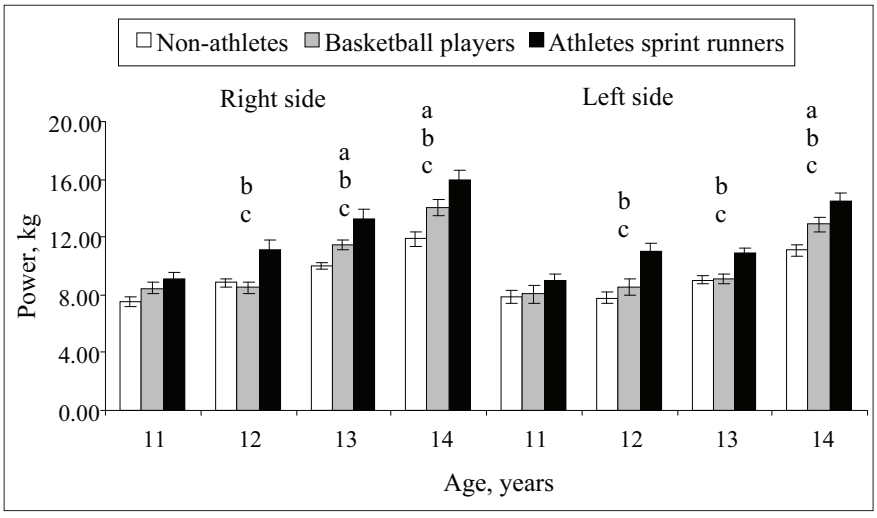

Figure 3. **The results of calf extensors strength in the non-athletes, basketball players and athletes sprint runners**

Note. The difference between: the non-athletes and basketball players – a, the athletes sprint runners and non-athletes – b, the basketball players and athletes sprint runners – c; statistically significant at $p < 0.05$.

between all the three groups (the right leg), and between the athletes – sprint runners, basketball players and the non-athletes (the left leg); in the time point of 14 years of age – in all the three groups (both the left and right leg) (Figure 3). Intergroup comparison of calf flexors' strength showed the significant differences: in the time points of 12 and 13 years between the athletes – sprint runners, basketball players and the non-athletes (both the left and right leg); in the time point of 14 years – between the groups of athletes – sprint runners and non-athletes (the right leg) and between all the three groups (left leg) (Figure 4).

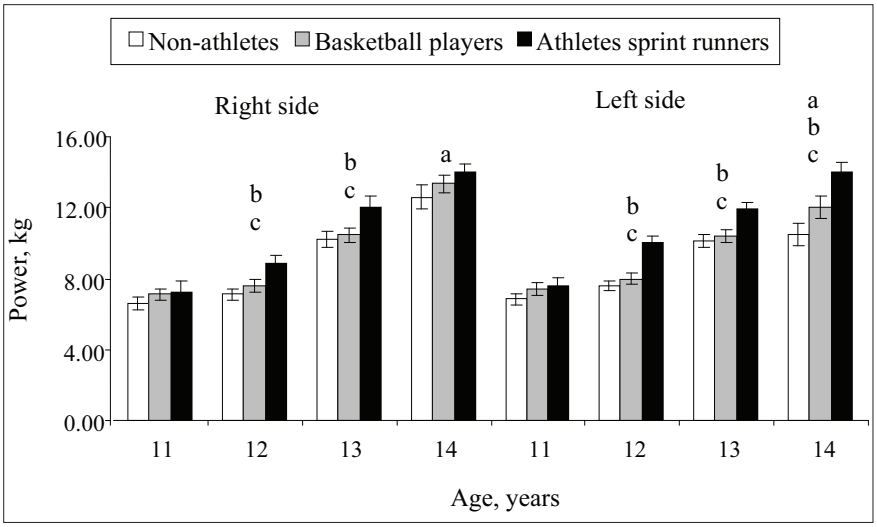

Figure 4. **The results of calf flexors strength in the non-athletes, basketball players and athletes sprint runners**

Note. The difference between: the non-athletes and basketball players – a, the athletes sprint runners and non-athletes – b, the basketball players and athletes sprint runners – c; statistically significant at $p < 0.05$.

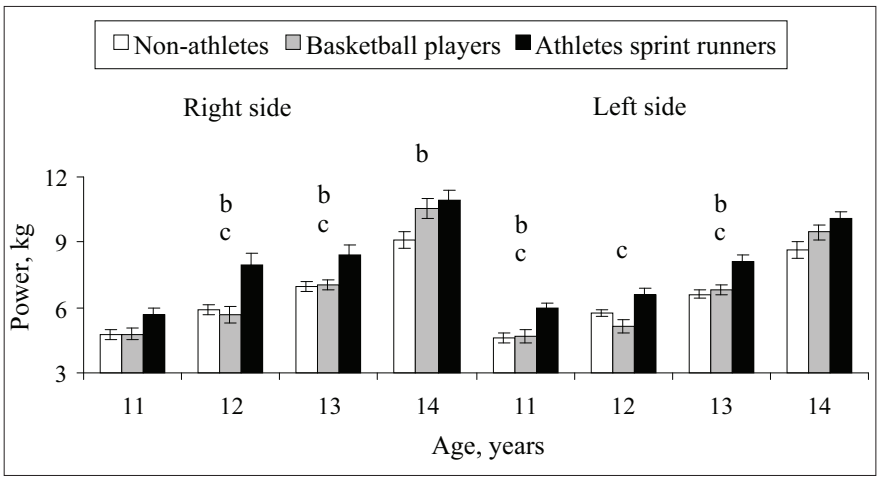

Figure 5. **The results of forearm extensors strength in non-athletes, basketball players and athletes sprint runners**

Note. The difference between: the non-athletes and basketball players – a, the athletes sprint runners and non-athletes – b, the basketball players and athletes sprint runners – c; statistically significant at $p < 0.05$.

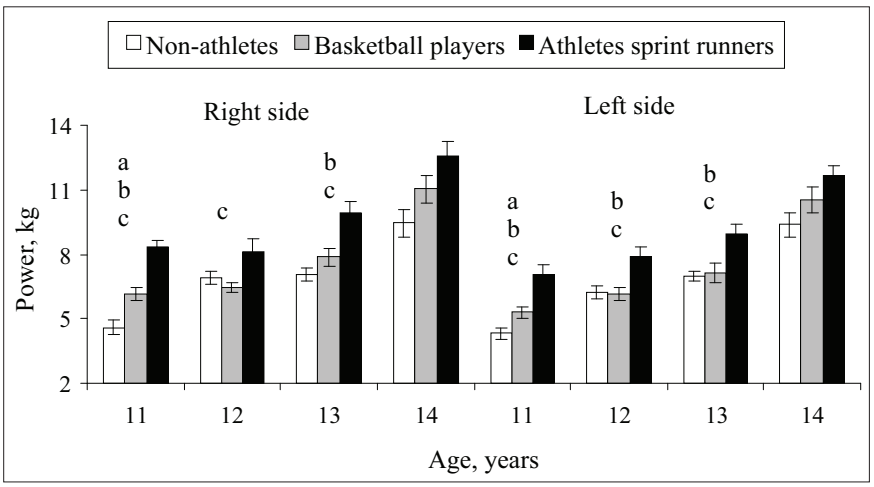

Figure 6. **The results of forearm flexors strength in non-athletes, basketball players and athletes sprint runners**

Note. The difference between: the non-athletes and basketball players – a, the athletes sprint runners and non-athletes – b, the basketball players and athletes sprint runners – c; statistically significant at $p < 0.05$.

Measurements of forearm flexors strength in 11–14 years of age, as well as the best results achieved in athletes – sprint runners group, and statistically significant difference compared with the results of non-athletes and basketball players group (Figure 5). The same situation was observed in the evaluation of forearm extensors strength right side and left side of 11 and 13 years of age groups (Figure 6).

Dynamometry assessments between the groups showed that the muscle strength of the athletes – sprint runners was greater than non-athletes and basketball players. Statistically significant differences between boys were identified in all age groups in assessment of both: right and left sides.

DISCUSSION

Response of human body to regular physical exercise, affecting the body growth and development features, manifests itself as impact on the functional and morphological changes in the bodily systems (Gilbert, 2000; Lodish et al., 2000). The most sensitive age to the external influences is age period between 11 and 14 years. Therefore the investigations of this age period in boys engaged in sports may reveal the complex interaction of the inherent and acquired (endogenous and exogenous) factors. Reports and case studies on this issue are still insufficient grounds for drawing conclusions about the safety of intense training or high-level competition in young athletes (AAP, 2010).

The present study has evaluated longitudinal impact of basketball game and athletics (sprint) on the features of development dynamics of muscular strength in boys from 11 to 14 years of age. It has shown that the nature of physical load (partially regulated in basketball game-specific activities and strictly regulated physical load in sprint training sessions) differently affects the features of CVS and muscles strength development in growing and rapidly evolving body (Pearson et al., 2006).

Although better results of the results of dynamometric strength assessments and intergroup comparison showed that muscle strength was more specific to the athletes sprint runners than to the non-athletes and basketball games players. Such significant differences between boys were identified at all the age points and in the assessments of both the right and the left side. Muscle capacity assessment data confirmed findings of a number of other authors claiming that exercise affects the growth and development processes (Macera et al., 2003; Myers et al., 2004).

A large number of studies has been done in order to assess growth and development patterns (McCarthy et al., 2002; Munchmeier, 2001) and to find the most appropriate physical load (Docherty, 2002; Wolpert et al., 2003). Generalization of results of previous studies and of this study suggest that interaction of the external and internal factors determine properties of muscular development and its expression during exercise in the 11–14-year-old boys.

Precisely regulated physical load, specific to the cyclic sports, is an external factor influencing boys' muscle strength parameters in the period of 11–14 years of age.

These results are in concordance with the previous findings of other authors (Pearson et al., 2006; Krustrup et al., 2010), where diversely directed physical loads, creating different external and internal stimuli relations, lead to different adaptation properties. Thus, due to regular physical loads exposure, but of different nature, the functional state of muscular system of athletes in sprint training sessions improves faster.

To sum up, it is necessary to take into account the fact that the athletes' physical maturity and functional ability indicators are also the outcome of the selection process and adaptation dynamics (Philippaerts et al., 2006; Vaeyens et al., 2008). It is well known that the initial functional readiness of a child is an important factor in choosing the kind of sports activities and in sports selection as well. Nevertheless, our study confirms previous research findings (Strong et al., 2005; Baquet et al., 2006; Horst et al., 2007; Emeljanovas, Poderys, 2010) that sports activities unquestionably have a considerable influence on the capabilities of skeletal muscles.

CONCLUSION AND PERSPECTIVES

Improvement of the muscle capacity indices in early adolescence depends on the nature of physical load: the muscle strength indices increased more in the athletes – sprint runners than in the basketball players.

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KREPŠINIO IR LENGVOSIOS ATLETIKOS PRATYBŲ POVEIKIS 11–14 METŲ BERNIUKŲ RAUMENŲ JĖGAI NEFORMALAUS FIZINIO UGDYMO METU

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Žmogaus augimą ir brendimą lemia vidinių ir išorinių veiksnių sąveika. Labiausiai išoriniams veiksniams jautrus yra 11–14 metų amžiaus tarpsnis. Šio amžiaus sportuojančių berniukų kompleksinės būklės tyrimai gali atskleisti sudėtingą endogeninių ir egzogeninių veiksnių sąveiką. Hipotezė: paauglystėje raumenų pajėgumo rodiklių gerėjimas priklauso nuo fizinio krūvio pobūdžio.

Tikslas – nustatyti ilgalaikio neformalaus fizinio ugdymo (krepšinio žaidimo ir lengvosios atletikos (trumpųjų nuotolių bėgimo)) pratybų poveikį paauglių raumenų jėgai.

Metodai. Buvo tirti 105 berniukai: nesportuojantieji (n = 35), lengvaatlečiai (sprinteriai, n = 35) ir krepšininkai (n = 35), lankantys pratybas ne mažiau kaip dvejus metus. Tie patys respondentai buvo tiriami ketverius metus iš eilės, t. y. kai jiems buvo 11, 12, 13 ir 14 metų. „Nicholas“ dinamometru buvo matuojama pasirinktų raumenų (rankos keliamųjų ir šlaunies lenkiamųjų, blauzdos tiesiamųjų ir lenkiamųjų, dilbio tiesiamųjų ir lenkiamųjų) grupių jėga. Tyrėjui sukėlus pasipriešinimą, buvo matuojama didžiausia izometrinio raumenų susitraukimo jėga.

Rezultatai. Dinamometrija tiriamųjų grupėse parodė, kad lengvaatlečių (sprinterių) raumenų jėga buvo didesnė nei krepšininkų ir nesportuojančių berniukų. Statistiškai patikimi skirtumai tarp berniukų grupių rodiklių buvo aptikti visais tirtais amžiaus tarpsniais matuojant tiek kairės, tiek dešinės pusės raumenis.

Aptarimas ir išvada. Paauglystėje raumenų pajėgumo rodiklių gerėjimas priklauso nuo fizinio krūvio pobūdžio: lengvaatlečių (sprinto bėgikų) raumenų jėga tiriant buvo didesnė nei krepšininkų.

Raktažodžiai: paauglystė, dinamometrija, sportas.

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EFFECT OF POSTURAL CHANGES ON LEG MUSCLE TONE AND ARTERIAL BLOOD PRESSURE IN ABLE-BODIED PEOPLE AND PEOPLE AFTER CHRONIC SPINAL CORD INJURY

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ABSTRACT

Research background and hypothesis. Following spinal cord injury part of sympathetic nervous system is disrupted from the brain stem control, which results in cardiovascular system regulation disorders. Impaired cardiovascular regulation may cause orthostatic hypotension or other negative impacts on persons' health. However, there are adaptive mechanisms which may change cardiovascular regulation and compensate these cardiovascular disorders. One of the mechanisms that may affect the occurrence of orthostatic hypotension may be changes in muscle tone after spinal cord injury.

The aim of research was to ascertain the effect of muscle tone changes on blood pressure in persons with spinal cord injury through ortho-clinostatic test.

Research methods. During passive ortho-clinostatic test, non-invasive blood pressure was continuously measured using the vital signs tracking monitor and leg muscle tone measurement was performed using myotonometer.

Research results. In control group muscle tone is characterized as constant wave – it decreases in orthostasis and increases in clinostasis. In paraplegic group muscle tone changes are as similar to those in controls, except that dynamics is not so constant and numeric values are lower. In tetraplegics we can see that muscle tone changes rapidly and tone in thigh muscles has a tendency to decrease through all the test.

Discusion and conclusions:

1. Leg muscle tone changes are important for blood pressure compensating mechanisms when the body position changes: it increases during orthostasis and decreases during clinostasis.

2. Blood pressure varies differently among able-bodied persons and persons with spinal cord injury. The degree of the breach has a significant impact on the occurrence of compensatory peripheral regulation mechanisms. Characteristics of blood pressure fluctuations during body position changes in paraplegics are similar to those of reactions as in the able-bodied controls, while in tetraplegia case, possibilities of homeostatic blood pressure compensation during body posture changes are significantly reduced.

Keywords: blood pressure, muscle tone, paraplegia, tetraplegia.

INTRODUCTION

Following spinal cord injury innervation of muscle and organ below lesion level is disrupted. Regulatory mechanisms of the cardiovascular system (CVS) are disturbed, too. If these mechanisms do not recover fully during acute rehabilitation, problems of the cardiovascular system may persist for life. As a result, persons with chronic spinal cord injury (CSCI) may have orthostatic hypotension or other sudden, life-threatening health problems as increased heart rate, blood pressure variability, and episodic hypertension and so on. It was also found that among people with spinal cord injuries, due to the relatively passive lifestyle, obesity, diabetes and

other health conditions, morbidity and mortality due to diseases of cardiovascular system are very high.

However, there are various adaptive mechanisms which may change cardiovascular regulation and compensate these cardiovascular disorders (Claydon et al., 2006).

Orthostatic hypotension is a condition when systolic blood pressure decreases by at least 20 mmHg, diastolic – at least 10 mmHg in standing position (Pauza et al., 2002). This condition is characterized by headache, dizziness, fainting and so on.

Research literature includes a number of studies dealing with orthostatic hypotension of individuals with SCI, but the results are rather contradictory. S. Houtman et al. (2000) showed reduced abilities or complete inabilities of persons with SCI to tolerate orthostatic hypotension because of decreased leg and visceral vascular vasoconstriction. Other authors suggest that despite the manifestation of hypotension, orthostatic intolerance in high SCI occurs even less frequently than in able-bodied controls, supposedly due to increased cerebral vasoconstriction opportunities that lead to a sufficient supply of oxygen to the brain during orthostasis (Cariga et al., 2002; Mathias, Frankel, 2002; Wecht et al., 2004). S. Houtman et al. (2000) as the key factor in determining the conscious state in the orthostatic test is not specific cerebral blood flow, but cerebral oxygenation. SCI persons are exposed to greater blood pressure drop in orthostatis than the able-bodied persons, but they showed the same decrease in cerebral oxygenation as the persons in the control group.

Studies dealing with the problem of orthostatic hypotension in SCI can be divided into several groups – analyzing cerebral oxygenation problems, muscle pump dysfunction, baroreceptor activity and so on. However, studies dealing with muscle tone and blood pressure relationship in SCI during orthostatic maneuvers were not found.

Muscle tone changes – muscle spasticity or less responsiveness – are shown in all SCI cases, depending on the type of paralysis – central or peripheral. Central paralysis is characterized by widespread paralysis, muscle stiffness, worsening deep physiological reflexes, absent or decreased skin reflexes, joint contractures and pathological synkineses.

Peripheral paralysis is characterized by localized (involving single muscle groups or monotype), decreased or extinct muscle tone, decreased or extinct all physiological reflexes, early muscle atrophy, joint contractures likely to occur only after a considerable time after the beginning of paralysis (Adomaitienė et al., 2003).

In case of altered muscle tone, work one of the key mechanisms for ensuring the circulation of blood through the veins – the muscular pump – is disrupted. After standing up, in 10–15 minutes at 10–20% of blood volume (400–600 ml) is accumulated in the legs, deep vein walls stretch and cause a large hydrostatic pressure (about 90 mmHg blood pressure in the veins of the foot). When striated muscles of the legs shrink, they compress the veins and accelerate the flow of blood toward the heart, which is very important in maintaining venous circulation in an upright position (Faghri et al., 2001). A key function here is carried out by three-headed calf muscle. In case of venous valve insufficiency or with impaired peripheral vascular vasoconstriction, the effect of muscle pump weakens.

Persons with spinal cord injury, due to muscle paralysis, have a lack of muscle pump activity. Blood stagnation in the veins of the legs is highly increased in people with chronic SCI, which increase deep vein thrombosis, pulmonary embolism and the risk of orthostatic hypotension. Due to decreased venous flow in a vertical position and therefore decrease of blood pressure, systolic and cardiac output, people with spinal cord injury are prone to circulatory hypokinesis (Faghri et al., 2001).

The aim of research was to ascertain the effect of muscle tone changes to blood pressure in persons with spinal cord injury through ortho-clinostatic test.

RESEARCH METHODS

The study included a control group and two groups of people with disabilities (paraplegia and tetraplegia, Table 1). To carry out the investigation agreement from Lithuanian Bioethics Committee was obtained.

Experimental procedure. Blood pressure data is registered in a lying position (duration – 5 minutes) and myotonometric samples are carried out; an orthostatic test is performed – a table is raised up to a 70 degree angle (Harms et al., 1999) and the myotonometric samples are carried out, and the blood pressure data is recorded (duration – 5 minutes); shift to 10 degrees of clinostasis is made

Table 1. **Anthropometric data of subjects (means and standard deviations)**

Subjets	Gender	Number of subjects	Age, years	Height, cm	Weight, kg	Duration of disability, years
Control group (n = 14)	m	9	44 ± 12.01	182.5	94 ± 2	–
	f	5	36 ± 12.02	162 ± 6	70 ± 20	–
Tetraplegia group (C5 – C6) (n = 7)	m	6	43 ± 5.5	183.5 ± 8.6	82 ± 6.7	21 ± 4.5
	f	1	34	170	50	16
Paraplegia group (Th1 – L5) (n = 14)	m	9	38 ± 12.4	182 ± 2.5	84 ± 6.6	11 ± 1.5
	f	5	42 ± 11.2	164	67	18

Note. Abbreviations: m – male, f – female.

(Harms et al., 1999) and myotonometric samples are carried out, the blood pressure data is recorded (duration – 5 minutes).

Non-invasive blood pressure measurement (NIBPM). Blood pressure is non-invasive, oscillometric, continuously automatically measured during the ortho-clinostatic test, using the monitor of vital signs tracking "Hospitex Diagnostic VS-800".

Leg muscle tone measurement. Leg muscle tone is measured by myotonometer (*Myotonometer, neurogenic Technologies, Inc*.). The test is carried out by measuring muscle strength of the quadriceps of one thigh and lower leg biceps in basical position and immediately after the postural change.

Ortho-clinostatic test. Ortho-clinostatic cardiovascular function is tested by using the orthostatic test (head-up tilt table test [Rating Form for Physical and Biological Constructus (Pathology and Impairment) and Their Implications for Diagnosis, Health, Function, and QOL. "Tilt-Table Testing" for the Evaluation of Cardiovascular Autonomic Function after Spinal Cord Injury (SCI)]. This test includes a passive postural change from horizontal to vertical and from vertical to clinostatic position. Orthostatic test is performed using a tilt-table, "Veronese" (Italy).

The study was carried out in the Lithuanian Academy of Physical Education, in the laboratory of Physical Activity in Adapted Physical Activity Science and Study and in the Lithuanian Association of Paraplegics' Landscape Therapy and Recreation Center.

The subjects were asked not to use stimulant drinks, alcohol and drugs to reduce spasticity 12 hours prior to the test. Individuals with a medically approved cardiovascular dysfunction were not enrolled in the research.

Upon arrival at the laboratory, subjects were introduced with the purpose and protocol of the study. The subjects completed a questionnaire, giving information on their health status, personal and other data.

After is lying on the orthostatic table, the person was fixed with the straps to the table in order to ensure the safety after the changes in the body position occur. All subjects were asked not to talk, sleep or make any movements.

The data were processed using *Microsoft Excel* program. The arithmetic mean and standard deviation were calculated; comparisons between groups were tested by Student's t-test (significance level $p < 0.05$); correlations between changes of muscle tone and blood pressure in the three groups were determined by Pearson's correlation coefficient.

RESEARCH RESULTS

During the study, after moving from a lying to a standing position, two subjects (tetraplegics) experienced orthostatic hypotension (OH) symptoms – dizziness, nausea, and so on. They stayed In the standing position for 2–3 minutes. Because of increased OH symptoms they were returned to the position of rest. These results confirmed the results obtained by other authors for tetraplegics intolerance of orthostatic hypotension (Claydon et al., 2006).

Analysing systolic blood pressure (SBP) data (Figure 1) we can see that in the control group the rates were stable and within the normal range – 110 to 120 mmHg, the dynamics of blood pressure was even.

Results differed markedly in the disabled groups: in paraplegics group systolic BP was slightly elevated – 115–130 mmHg, but within the normal range. Analyzing its dynamics we can see that it can be characterized as uneven. In response to postural change, the shift from a lying position to standing, systolic BP increased to 130 mmHg and remained the same for some time, then it declined

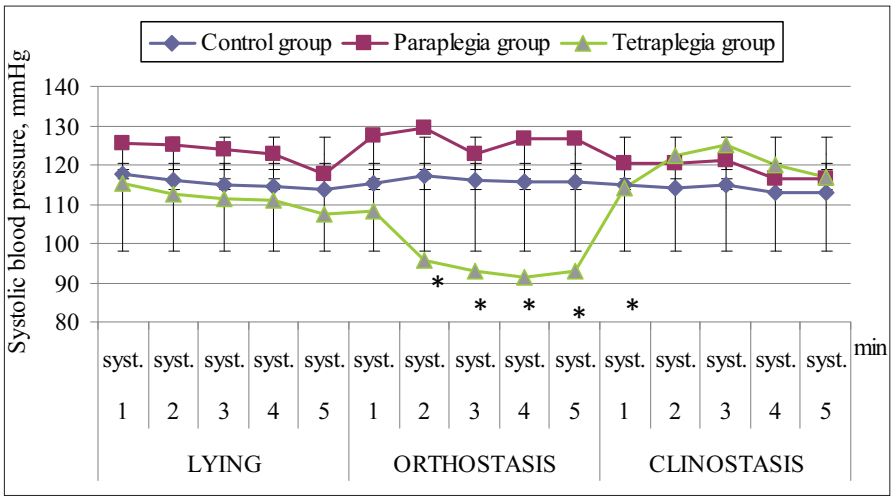


Figure 1. **Mean systolic blood pressure (mmHg) in ortho-clinostatic test**

Note. * – statistically significant difference between all three groups ($p < 0.05$).

and rose again in a minute. These changes were statistically significantly different from the ones in the control group.

We did not find any significant changes in clinostasis. As these changes were statistically insignificant, we cannot say that they were different from the physiological norms of the human body.

In tetraplegia group, systolic blood pressure changes were most significant, especially during orthostatics. We can see clearly that after the shift in the standing position, systolic blood pressure rapidly and significantly reduced to 90 mmHg and remained like this all the time during orthostasis. This suggests that compensatory mechanisms responsible for blood pressure regulation are very weak. Given that two subjects experienced orthostatic hypotension phenomena we can suppose that the tetraplegics are at risk for experience OH.

From the analysis of diastolic blood pressure results (Figure 2) shows that obtained data are substantially similar to the ones of systolic blood pressure. The most remarkable case of changes observed in tetraplegia was the decrease in BP up to 60 mmHg in orthostasis and remained like this all the time in the standing position. In clinostasis indicators increased very sharply and suddenly, indicating that even a short time in upside-down position affected blood pressure significantly, much more than in the control group or in paraplegia group.

After the performance of the myotonometric test of the leg muscle during ortho-clinostatic test, we see that in the control group the calf muscles were more relaxed than in the other experimental groups – sensor penetration reached 11.5 mm, while in the disabled groups the maximum penetration of the sensor was up to 8.2 mm (Figure 3). It is

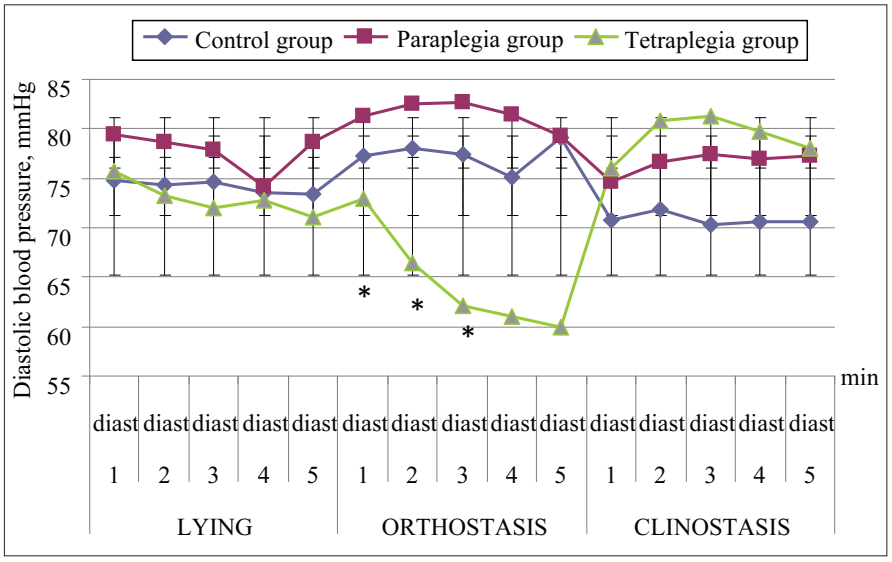


Figure 2. **Mean diastolic blood pressure (mmHg) in ortho-clinostatic test**

Note. * – Statistically significant difference between all three groups ($p < 0.05$).

Figure 3. **Calf myotonometric test results in ortho-clinostatic test (averages)**

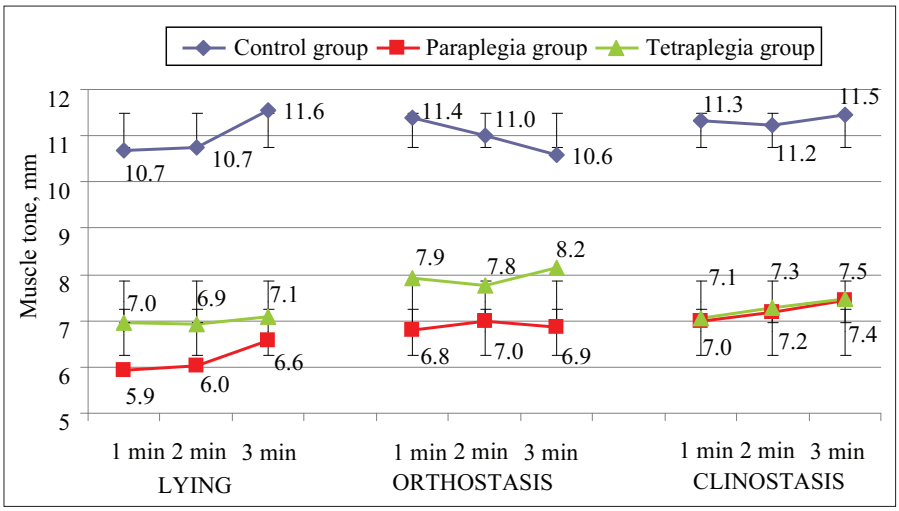
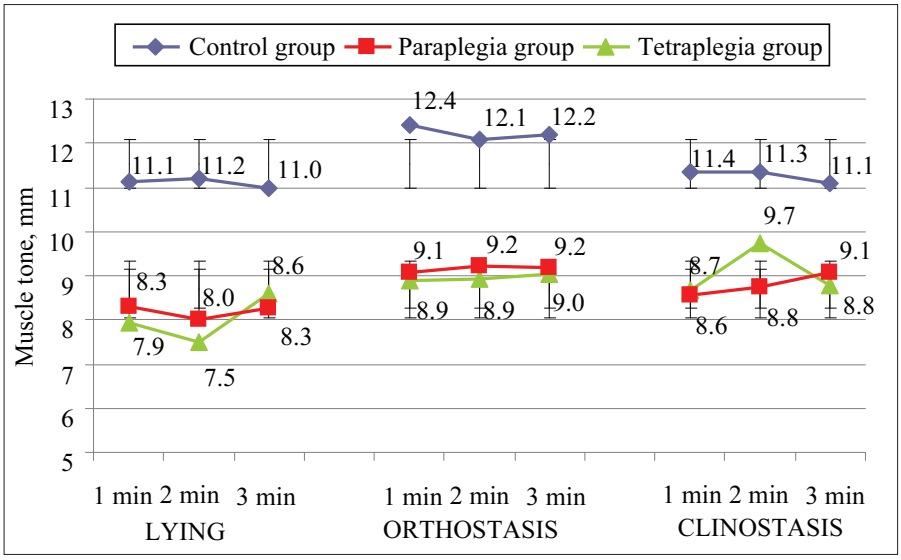


Figure 4. **Thigh myotonometric test results in ortho-clinostatic test (averages)**



worth noting that muscles in tetraplegia subjects are more relaxed than in paraplegia, although most of tetraplegics have increased muscle tone (spasticity).

The differences between the control group and two disabled groups were statistically significant ($p < 0.05$) in all three body positions. The differences between paraplegia and tetraplegia groups were statistically insignificant.

When monitoring the dynamics of muscle tone, we observe that the initial reaction to the orthostatic test in all groups led to the loss of muscle tone. During orthostasis changes in group dynamics were different: if the control group could be characterized by the tendency of muscular tension, tetraplegia in this case was the opposite – after standing muscles were relaxed.

The transition from orthostatic to clinostatic position in the control group was characterized by a stable state of muscle tone – the tone was reduced and remained such all the time. Paraplegia group dynamics was almost the same. Tetraplegia group could be characterized by the opposite reaction – muscle tone increased and then slightly decreased.

The analysis of the femoral myotonometry (Figure 4) results shows that the control group was characterized by a relatively strong muscle relaxation, in response to the standing position. These rates were maintained all the time in orthostasis, and after the transition to clinostatic position muscle tone slightly increased.

In both disabled groups muscle tone and dynamics were quite similar – in lying position muscles were more tense compared to the ones in able-bodied group and in response to orthostatic position we observe relaxation persisting all the time in standing position.

In clinostasis, paraplegia group subjects experienced loss of thigh muscle tone, while the control group was in the reverse process – the tone increased. Tetraplegia group changes were very sharp and abrupt.

The differences between the control group and two disabled groups were statistically significant ($p < 0.05$) in all three body positions. The differences between paraplegia and tetraplegia groups were statistically insignificant.

Presented correlations between muscle tone and blood pressure changes shows that the correlation in strength was from weak to strong. This relationship always had a negative value (it was reverse).

DISCUSSION

Typically normal response to postural changes consists of gradually decreasing blood pressure, the heart rate gradually increases during the first 2–3 minutes. After a brief period hemodynamic response reaches a stable level. Recovery is rapid and reaches a similar rate as it was before the change of body position (Claydon et al., 2006).

In our study group the systolic blood pressure response to orthostatic stress in tetraplegia group decreased significantly compared to the control group. These results confirm the findings of other authors: J. M. Legramante et al. (2001) found that tetraplegics' systolic blood pressure decreased significantly ($p < 0.05$) during orthostasis. Other foreign authors (Houtman et al., 2000; Ditor et al. 2005) reported on the reduction of SBP, too. As two of our study participants (tetraplegics) experienced orthostatic hypotension, this confirmed other authors' data (Legramante et al., 2001; Ditor et al., 2005). In paraplegia group, the mean systolic blood pressure was higher than in the control group, but the dynamics of BP was almost the same. Diastolic blood pressure changes and the dynamics of systolic differed slightly.

Analyzing the relationship between blood pressure and changes in muscle tone we found differences between the disabled groups and the control group reactions. The control group received a strong inverse correlation (–0.7) between muscle tone and blood pressure changes in the transition from orthostasis to clinostasis while in tetraplegia group there was no correlation. This suggests that changes in body position from vertical to horizontal for people without a spinal trauma blood pressure decreases with increasing muscle tone. In our study ortho-clinostatic test was passive, but even passive changes in postural and muscle tone responsed influencing other body functions including blood pressure. The fact that after the transition to clinostasis, tetraplegics' blood pressure returned to normal and even rose above the starting line, shows that there are mechanisms responsible for these changes.

Changes in muscle tone in tetraplegia group affected blood pressure during the transition from lying to standing position (correlation coefficient –0.52 and –0.041). Although these relationships were not strong, they implied that the muscle pump activity was very important in case of tetraplegia to maintain a constant BP in the standing position (Houtman et al., 2000). However, the fact that tetraplegics' blood pressure decreased rapidly and significantly in orthostasis suggests that passive standing positive did not have effect on blood pressure control.

Subjects	Blood pressure	Dynamics	Muscle tone	
			Δ m1 – m2	Δ m2 – m3
Control group	Systolic BP	Δ m1 – m2	–0,09	
		Δ m2 – m3		–0,68*
	Diastolic BP	Δ m1 – m2	–0,25	
		Δ m2 – m3		–0,70*
Tetraplegia group	Systolic BP	Δ m1 – m2	–0,52*	
		Δ m2 – m3		–0,04
	Diastolic BP	Δ m1 – m2	–0,41*	
		Δ m2 – m3		–0,04
Paraplegia group	Systolic BP	Δ m1 – m2	–0,37*	
		Δ m2 – m3		–0,13
	Diastolic BP	Δ m1 – m2	–0,61*	
		Δ m2 – m3		–0,58*

Table 2. **Correlations between changes of muscle tone and blood pressure during the ortho-clinostatic test**

Note. Abbreviations: m1 – lying position, m2 – orthostasis, m3 – clinostasis. * – statistically significant differences.

Changes in muscle tone in case of tetraplegia affected blood pressure during the transition from lying to standing position (correlation coefficient –0.52 and –0.041). Although these relationships were not strong, they implied that the muscle pump activity was very important for the case of tetraplegia to maintain a constant AC standstill. However, the fact that tetraplegcs' blood pressure orthostasis decreased rapidly and significantly suggests that passive standing positive by a effected blood pressure control.

The analysis of paraplegia group data suggests that the test results of this group were intermediate between the control and tetraplegia groups. In paraplegia group we observe medium and strong (–0.37, –0.61 and –0.58) inverse relationship between muscle tone and blood pressure. These relationships were observed in all body positions – move from lying to orthostasis and then to the clinostasis. These results were specific to this group of subjects. The data suggest that in case of paraplegia blood pressure reacts to changes in body muscle tone in all body positions.

CONCLUSIONS AND PERSPECTIVES

1. Leg muscle tone changes are important for blood pressure compensating mechanisms when the body position changes: it increases during orthostasis and decreases during clinostasis.

2. Blood pressure varies differently among able-bodied persons and persons with spinal cord injury. The degree of the breach has a significant impact on the occurrence of compensatory peripheral regulation mechanisms. Characteristics of blood pressure fluctuations during body position changes in paraplegics are similar to those of reactions as in the able-bodied controls, while in tetraplegia case, i. e. when the degree of infringement is greater, possibilities of homeostatic blood pressure compensation during body posture changes are significantly reduced.

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KŪNO PADĖTIES KEITIMO POVEIKIS ĮGALIŲJŲ IR NUGAROS SMEGENŲ PAŽEIDIMĄ TURINČIŲ ASMENŲ KOJŲ RAUMENŲ TONUSUI IR ARTERINIAM KRAUJO SPAUDIMUI

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Pažeidus nugaros smegenis, dalis simpatinės nervų sistemos atsiskiria nuo smegenų kamieno kontrolės. Dėl to asmenims po nugaros smegenų pažeidimo sutrinka širdies ir kraujagyslių sistemos (ŠKS) reguliacijos mechanizmai. Šie sutrikimai gali sukelti ortostatinę hipotenziją ir neigiamai veikti sveikatą. Tačiau pradėjus veikti įvairiems organizmo adaptaciniams mechanizmams, ŠKS reguliacija gali pakisti ir sudaryti sąlygas kompensacinėms galimybėms atsirasti. Vienas iš mechanizmų, galinčių sukelti ortostatinę hipotenziją, raumenų tonuso pokyčiai po nugaros smegenų pažeidimo.

Tikslas – įvertinti, kaip asmenų, turinčių nugaros smegenų pažeidimą, raumenų tonuso pokyčiai veikia kraujo spaudimą ortoklinostatinio poveikio metu.

Metodai. Pasyvaus ortoklinostatinio poveikio metu kraujo spaudimas matuojamas automatiškai, neinvaziškai, naudojant gyvybinių funkcijų sekimo ekraną; kojų raumenų tonuso pokyčiai matuojami naudojant miotonometrą.

Rezultatai. Kontrolinės grupės raumenų tonusas matomas kaip pastovi banga, kuri mažėja ortostazės metu, o klinostazės metu didėja. Paraplegikų grupėje raumenų tonuso pokyčiai yra panašūs, tačiau jie nėra pastovūs ir skaitinės reikšmės mažesnės. Tetraplegikų grupėje pastebimas staigus raumenų tonuso kitimas, o blauzdos raumenų tonusas turi tendenciją mažėti viso testo metu.

Aptarimas ir išvados:

1. Kintant kūno padėčiai, AKS kitimą kompensuojančių mechanizmų grandinėje svarbūs yra kojų raumenų tonuso pokyčiai: padidėjimas – ortostatinio poveikio metu ir sumažėjimas – klinostatinio poveikio metu.

2. Kraujo spaudimas kinta nevienodai sveikųjų ir nugaros smegenų pažeidimą turinčių asmenų grupėse. Pažeidos laipsnis lemia kompensacinių periferinių reguliacinių mechanizmų pasireiškimą. Paraplegijos atveju AKS kaitos ypatybės, kintant kūno padėčiai, yra panašios į sveikų asmenų reakcijas, o tetraplegijos atveju, t. y. esant didesnio laipsnio pažeidai, AKS homeostatinio kompensavimo galimybės, kintant kūno pozai, yra reikšmingai sumažėjusios.

Raktažodžiai: kraujospūdis, raumenų tonusas, paraplegija, tetraplegija.

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CORRELATION OF THE INDICATORS OF HIGH PERFORMANCE WOMEN BASKETBALL PLAYERS' GAME CHARACTERISTICS WITH PHYSICAL DEVELOPMENT AND PHYSICAL FITNESS

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ABSTRACT

Research background and hypothesis. Indicators of physical fitness and physical development influence individual performance results.

Research aim was to identify correlation between basketball performance indicators and physical development and fitness.

Research methods. The basketball players (n = 12) of the Lithuanian National Women's Basketball Team were investigated. The performance indicators of this team were analyzed on the basis of data collected during the European Basketball Championship. During competition period the indicators of physical development and physical fitness of female basketball players were measured. Mathematical statistics methods were applied for the analysis of the research data. Pearson's correlation coefficients were applied to identify correlations among the indicators.

Research results. The correlations of the number of blocks with height, body mass, standing reach and psychomotor response were established. This indicator of game performance was technically simple and its efficiency was determined by good physical development and fast psychomotor reaction. The correlations of shooting percentage of different throws with physical fitness were different.

Discussion and conclusions. The shooting percentage of 2-point field goals correlated with muscle mass, body mass and take-off duration. This allows suggesting that a certain number of shots are performed after the physical contact with an opponent and jumping faster during the moment of throw. No correlation was established between 3-point field goals, free throws and physical fitness indicators. This means that shooting percentage was influenced by other factors. Steals, turnovers and passes, as complex technical and tactical actions, did not correlate with the researched physical fitness indicators.

Keywords: shot, jump, height, block, power.

INTRODUCTION

The activity of basketball players during play is determined by a big number of factors. Both researchers and practitioners make attempts to identify components of players' preparation that predetermine good result of match. Statistical indicators of the competitions alone are not enough for a deeper insight into the process of elite basketball players' training. T. O. Bompa and G. G. Haff (2009) argue that the quality of technical and tactical actions in game sports is mainly conditioned by physical fitness of players. However, coaches frequently raise the question: which component of training content is the most relevant technical, physical, tactical or psychological preparation?

The research on physical fitness and physical development of the best Lithuanian basketball players has been conducted (Balčiūnas et al.,

2009). Similar research on young basketball players' adaptation to physical load and its evaluation has also been carried out (Paulauskas et al., 2009 a). Other researchers (Mendes, Janeira, 2001; Sampaio et al., 2004; Reano et al., 2006) investigated the effect of technical actions (throws, passes, rebounds and others) on the achievements during competitive performance. J. Sampaio and M. Janeira (2003) analyzed other factors, i. e. the venue of the match and the stage of competitions. Analyzing statistical indicators of winning and losing teams, the researchers also made attempts to identify defence and tactical actions, which have crucial effect on the result of the match (Tavares, Gomes, 2003; Tsamourtzis et al., 2005).

Thus, training of a basketball team and results it achieves is an outcome of a multisided pedagogical, psychological, social, technical and tactical process which asks for a deep cognition and analysis. This work aims at getting an insight into the interaction of the aforesaid components: how indicators of physical fitness and physical development influence individual performance results. **The aim of the study** was to identify correlation between basketball performance indicators and physical development and physical fitness

RESEARCH METHODS

The basketball players (n = 12) of the Lithuanian National Women's Basketball Team were investigated: the mean age ($\bar{x}$ ± s) of the players was 25.8 ± 4.1 years and their average training experience totaled 12.8 ± 3.9 years. The performance indicators of this team were analyzed on the basis of data collected during the qualifying round to European Basketball Championship and playing in the 2009 European Women Basketball Championship. The research focused on 14 official games: seven victories and seven losses. The research data was based on official score sheets, which are available from official website of European Women Basketball Championship at www.fibaeurope.com.

The following indicators of competition performance were analysed:

- 2 point field goals (2P FG%);
- 3 point field goals (3P FG%);
- Free throws (FT%);
- Rebounds in offence (Re);
- Assists (As);
- Personal fouls (PF);
- Turnovers (TO);
- Steals (St);
- Blocks (Bl).

During competition period the indicators of physical development of female basketball players were measured: height, body mass, arm grip. The research on players' physical fitness focused on: jump height while taking off with both legs and swinging with both hands, take-off duration, single muscular contraction power (SMCP) (Bosco et al., 1983), anaerobic alactic muscular power (AAMP) (Margaria et al., 1966). Combined anaerobic alactic power in a 30-s veloergometer test was investigated (*Wingate test*) (Bar-Or, 1987). Psychomotor response time (PRT) to light stimulus and 10-s movement frequency (MF) were also measured (Skernevičius et al., 2004).

Mathematical statistics methods were applied for the analysis of the research data: the mathematical means were calculated ($\bar{x}$) and their biases ($S\bar{x}$), standard deviation (*S*), dispersion were evaluated according to variation coefficient (*V*), dispersion area according to *Min* and Max values. Pearson's correlation coefficients (r) was applied to identify correlations among the indicators considering that $p < 0.05$, when $r = 0.532$. The data were processed using *Statistica for Windows* software package.

RESEARCH RESULTS

The Lithuanian National Women's Basketball Team won 50% of the matches played in the European Women's Basketball Championship and the qualifying round to European Basketball Championship. Indicators of player's performance are presented in Table 1. Shooting percentage of 2 point and 3 point field goals was low among separate players and on the average in the team. The evaluation of the dispersion of these two indicators showed the following: V = 21.8% for 2 point shots, whereas dispersion of 3 point field goals totaled V = 82.83%. The research revealed the difference in technical preparedness of the players and in contribution of players in separate positions to the final result of the match. The team demonstrated the average percentage of free throws but its spread around the mean was large, i. e. V = 75.41%. The dispersion area regarding free throws ranged from 100% to 45%.

Large dispersion was observed in the parameters of rebounds. The average indicators were not high and the variation coefficient totaled 60.2%.

The following parameters of competitive performance directly influenced the results of

Table 1. **Statistical indicators of competition performance of high level female basketball players**

Indices	2P FG%	3P FG%	FT %	Re	As	PF	To	St	Bl
$\overline{X}$	38.05	27.40	75.32	3.83	1.53	2.14	1.58	0.79	0.48
$S\overline{x}$	2.62	7.18	4.79	0.73	0.28	0.30	0.29	0.17	0.23
S	8.29	22.70	15.13	2.31	0.87	0.93	0.91	0.55	0.72
V%	21.80	82.83	20.09	60.20	56.98	43.62	57.61	69.70	150.81
Min	25	0	45	1	0.5	0.8	0.2	0.3	0
Max	50	75	100	7	3.5	3.8	3.5	1.8	2.4

Table 2. **Indicators of physical development and physical fitness of female basketball players during competition period**

Indices	Height, cm	Body mass, kg	Arm grip, kg	Jump height, cm	Take off, ms	SMCP, W	AAMP, W	PRT, ms	MF, t/10 s	Wingate Test, W
$\overline{X}$	181.9	72.1	37.9	46.70	206.80	1592.20	1050.3	171.5	77.4	508.9
$S\overline{x}$	2.66	2.42	2.06	1.27	9.01	87.04	29.51	2.96	2.33	13.99
S	8.40	7.64	6.51	4.03	28.49	275.24	93.33	9.37	7.37	44.25
V%	4.62	10.60	17.17	8.63	13.78	17.29	8.89	5.46	9.52	8.70
Min	170	62.5	24	40	154	1176	893	154	69	440
Max	194	85	47	54	246	2059	1172	188	91	563

matches. Very large dispersion around the mean was characteristic of passes, mistakes, fouls and blocks.

Evaluating indicators of physical development and physical fitness it can be observed that their spread is considerably lower around the mean compared to that of parameters of competitive performance (Table 2). The average height of the players was 181.9 cm and their dispersion was only V = 4%, body mass totaled 72.1 kg and demonstrated low dispersion as well (V = 10.6%). The average dispersion around the mean was observed in indicators of arm grip, take-off duration and single muscular contraction power. The dispersion of other parameters around the mean was low and did not exceed 10.15%.

We found competitive performance indicators which correlated with physical development and physical fitness parameters (Table 3). 2 point shooting percentage correlated with arm grip r = 0.610 and anaerobic alactic muscular power r = 0.569. The number of rebounds related to body mass r = 0.556, and to psychomotor response time r = –0.555. The inter-correlation of these indicators was statistically reliable.

It was established that the number of personal fouls negatively correlated with SMCP r = –0.543. More powerful single muscle contraction may result in a smaller number of fouls.

The number of blocks had a strong correlation with height r = 0.698, standing reach, body mass r = 0.755 and psychomotor response time r = –0,776.

DISCUSSION

The correlation of basketball players' physical development and physical fitness indicators have already been established in our earlier research (Paulauskas et al., 2009 b). Therefore, this study is targeted not only at identification of correlation among physical development, physical fitness and competitive performance indicators but also at search for reasons. Our investigated average indicators of the team (Tables 1 and 2) are objective criteria for preparedness of female basketball players during competitive period. The dispersion of players' preparedness in the sample (the Lithuanian National Team) was also evaluated. It is important to mention that the dispersion of a big number of the investigated indicators is large, whereas indicators of physical fitness are dispersed less. This shows that physical fitness was developed applying physical loads of the same volume and that selection to the team was conducted according to the objective criteria. The large dispersion of competitive performance indicators is conditioned by a big number of factors: opponent's activity, psychological condition, tactical preparedness, physical fitness, etc. This research is mainly targeted at identification of correlations among physical development, functional capacity and competitive performance.

Table 3. **Correlation of high performance basketball players' game indicators with physical development and physical fitness**

No.	2P FG	3P FG	FT	Re	As	PF	TO	St	Bl	Height	Body Mass	Arm grip	Jump Height	Take Off	SMCP	AAMP	PRT	MF	Wingate test
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	1																		
2	0.180	1																	
3	–0.506	–0.429	1																
4	0.734	0.638	–0.616	1															
5	0.403	0.290	0.053	0.570	1														
6	0.155	0.227	0.365	0.320	0.764	1													
7	0.244	0.423	0.106	0.409	0.696	0.795	1												
8	0.604	0.095	–0.209	0.540	0.664	0.396	0.500	1											
9	0.220	0.626	–0.821	0.558	–0.249	–0.296	–0.135	–0.023	1										
10	0.399	0.101	–0.685	0.430	–0.307	–0.333	–0.354	–0.065	0.698	1									
11	0.526	0.260	–0.771	0.572	–0.220	–0.211	–0.134	0.061	0.755	0.892	1								
12	0.610	0.083	–0.463	0.421	0.274	–0.188	–0.096	0.341	0.061	0.261	0.392	1							
13	0.442	0.370	–0.410	0.376	0.310	0.181	0.272	0.229	0.155	0.203	0.392	0.623	1						
14	0.315	0.323	–0.318	0.413	0.356	0.570	0.637	0.374	0.268	0.108	0.370	–0.057	0.532	1					
15	0.275	–0.009	–0.262	0.114	–0.281	–0.532	–0.405	–0.208	0.149	0.546	0.458	0.637	0.305	–0.446	1				
16	0.569	0.131	–0.645	0.561	–0.211	–0.348	–0.045	0.012	0.409	0.681	0.767	0.587	0.567	0.191	0.710	1			
17	–0.142	–0.428	0.691	–0.555	0.148	0.376	0.333	0.066	–0.776	–0.705	–0.691	–0.393	–0.103	0.117	–0.501	–0.400	1		
18	–0.111	0.402	0.144	–0.090	–0.358	–0.249	–0.189	–0.413	0.175	–0.001	–0.107	–0.200	–0.062	–0.405	0.305	0.029	–0.011	1	
19	0.286	–0.523	0.161	–0.161	–0.267	–0.210	–0.481	–0.296	–0.237	0.276	0.071	0.034	–0.279	–0.405	0.310	0.138	0.154	0.164	1

Note. $r = 0.532$, $p < 0.05$.

The percentage of shooting is a complex coordination action, which has a considerable effect on the final result of the match. It was established that the percentage of 2 point field goals shooting correlated with body mass. As it is widely known, the majority of 2 point field goals are scored from the three seconds zone, where physical contact with opponent occurs; therefore, players of bigger body mass and muscle mass in particular achieve better results. One more indicator, which links (r = 0.543) with the shooting percentage of 2 point field goals is take-off duration. The majority of basketball players make a jump shot. Therefore we assume that this important functional indicator may condition an advantage over an opponent, and, thus, result in a better shooting percentage.

It was established that the shooting percentage of 3-point field goals is not related to indicators of physical fitness and physical development. Differently from 2-point field goals, female basketball players take 3 points not at a jump but standing, therefore take-off is not relevant in this situation. This complicated technical action is affected by other factors. Free throws do not correlate with the researched indicators of physical fitness. It is assumed that psychological condition and ball throwing technique have bigger effect on these elements of competitive activity (Vaughn et al., 1994).

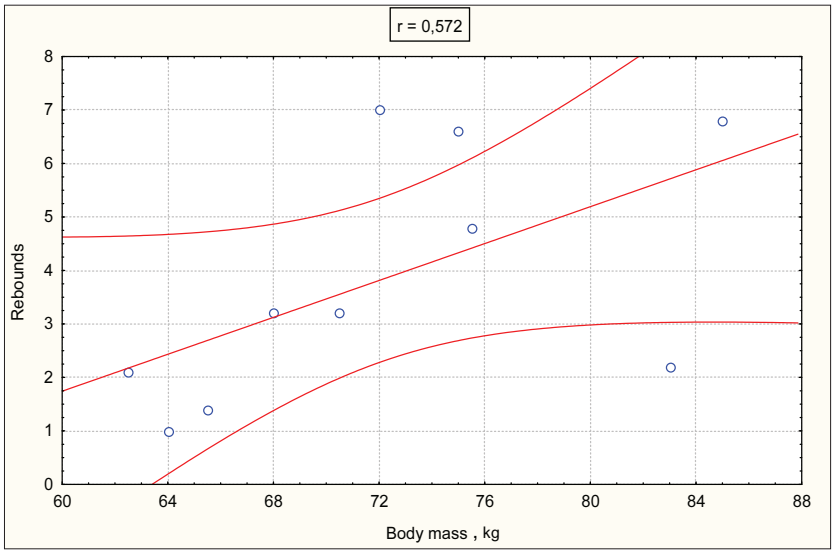
The correlation of body mass with rebounds (r = 0.572) (Figure 1) may be explained by the fact that a player in a better position may rebound the ball. Therefore, bigger body mass may positively effect the fight for a better position close to the basket. Particular attention should be paid to the correlation between psychomotor response time and the number of rebounds (r = –0.555). This proves that to make a fast movement towards a bound ball, psychomotor response time is of utmost importance. In fact, the reliability of this correlation is not very strong; therefore we assume that other factors (location of a player, techniques) are very important to this competitive element (Sampaio, Janeira, 2003). The correlations were identified between the number of rebounds and anaerobic alactic muscular power. It can be concluded that power of short-tem muscle work, which enables to lift the body mass into a certain height as well as to change the direction of movement, to perform repeated high-amplitude movements, play an important role.

It should be pointed out that no reliable correlation was observed among the number of rebounds, jump height and take-off duration. We think that this is a specific feature of women's basketball, where the taken position – blocking technique and standing reach play – are of considerable importance. The number of rebounds did not correlate with the height of players, which showed that the height is not a decisive factor fighting for rebounds.

It has been established that the number of successful passes does not correlate with physical development and fitness indicators and that it is a result of fast tactical thinking.

The analysis of correlation links revealed that the correlation of the number of personal fouls,

Figure 1. **The correlation of body mass with rebounds**



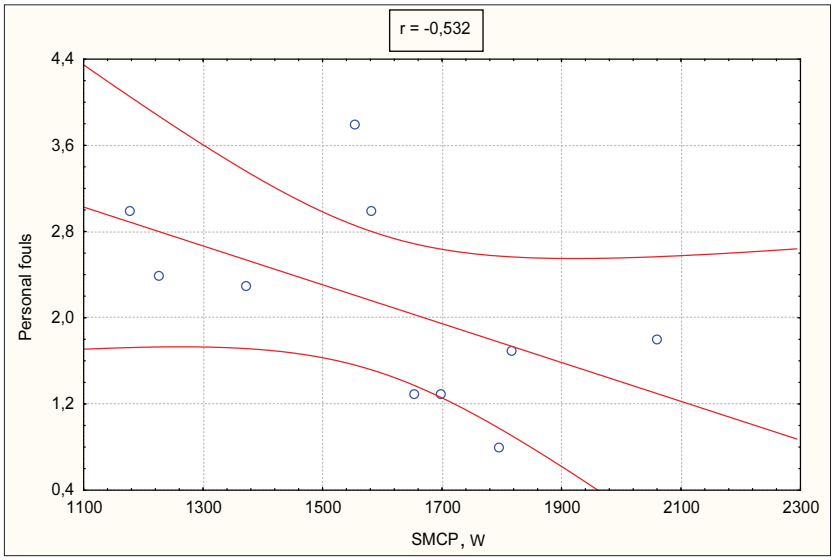


Figure 2. **The correlation of the number of personal fouls and single muscular contraction power**

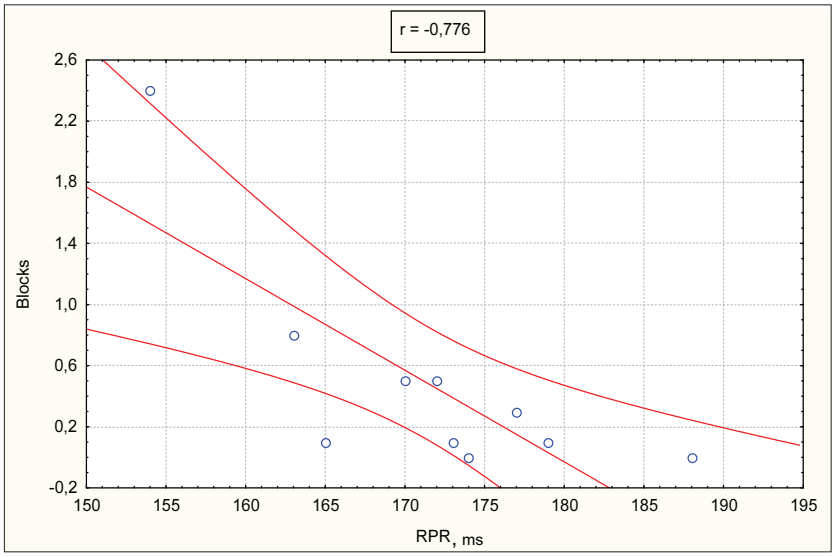


Figure 3. **The correlation of number of blocks and psychomotor response time**

muscle contraction speed and single muscular contraction power exists (Figure 2). A conclusion can be drawn that a player with higher SMCP (single muscle contraction power) will manage to more successfully defend avoiding personal fouls. This action requiring lower technical and tactical preparedness, i. e. fast moving without a ball, reflects its direct link to fast muscle functional parameters (Pim, 1986).

No correlation was established between the number of turnovers, steals and physical fitness parameters investigated previously. This depends on technical and tactical preparedness (Lidor, Arnon, 2000).

The number of blocks shows a large dispersion around the mean. The correlative analysis revealed that this technically simple action had a strong link with height, hand reach, body mass, muscle mass and psychomotor response time (Figure 3). This proves that the hand movement is more exact when psychomotor response time is shorter.

It is thought that height is one of the major factors playing basketball (Wissel, 2004). However, our research showed that the height of female basketball players did not correlate with other competitive performance indicators (except blocks). This means that higher players need good physical fitness to perform individual game actions.

Frequently a lot of attention is paid to power development during training sessions. It has been established that static power does not relate to competitive performance indicators.

The research revealed that jump height, function of central nerve system liability expressed through movement frequency for 10 s, agility, 30-s veloergometer tests at maximum power did not correlate.

CONCLUSIONS AND PERSPECTIVES

1. The correlation of the number of blocks with height, body mass, standing reach and psychomotor response was established. This indicator of competitive performance is technically simple and its efficiency is determined by good physical development and fast psychomotor reaction.

2. The correlation of shooting percentage of different throws with physical fitness is different. The shooting percentage of 2-point field goals correlates with muscle mass, body mass and take-off duration. This allows for conclusions that a certain number of shots are performed after the physical contact with an opponent and jumping faster during the moment of throw. No correlation has been established between 3-point field goals, free throws and physical fitness indicators. This means that shooting percentage is influenced by other factors.

3. It has been established that the number of rebounds depends not on the height of a player but correlates with body mass and functional muscular features: speed and power of muscle contraction. Psychomotor response time is of utmost importance to the number of rebounds in offence.

4. Steals, turnovers and passes, as complex technical and tactical actions, do not correlate with the researched physical fitness indicators.

5. It can be concluded that a player with bigger SMCP will be able to more successfully defend, to take better position in defence and to avoid personal fouls because the correlation is established among the aforesaid indications.

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DIDELIO MEISTRIŠKUMO KREPŠININKIŲ ŽAIDIMO VEIKLOS IR FIZINIO IŠSIVYSTYMO BEI PAJĖGUMO RODIKLIŲ SĄSAJOS

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Krepšininkių veikla aikštelėje priklauso nuo daugelio veiksnių. Manoma, kad fizinio pajėgumo ir išsivystymo rodikliai veikia individualų žaidimo rezultatą.

Tikslas – ištirti didelio meistriškumo moterų krepšinio komandos žaidėjų fizinį išsivystymą bei pajėgumą ir nustatyti koreliacinius ryšius su žaidimo veiklos rodikliais.

Metodai. Lietuvos moterų krepšinio rinktinės žaidėjų žaidimo rodiklių analizė atlikta tiriamosioms dalyvaujant atrankoje į Europos krepšinio čempionatą. Varžybų laikotarpiu buvo išmatuoti krepšininkių fizinio išsivystymo rodikliai. Ryšiams tarp rodiklių nustatyti skaičiuoti Pirsono koreliacijos koeficientai.

Rezultatai. Nustatyta, kad blokuotų metimų skaičius turi sąsajų su ūgio, kūno masės ir psichomotorinės reakcijos laiko rodikliais. Šis žaidimo veiklos rodiklis yra techniškai nesudėtingas, todėl jo veiksmingumą lemia geras fizinis išsivystymas ir greita psichomotorinė reakcija. Skirtingų metimų tikslumo ir fizinio pajėgumo ryšys nevienodas.

Aptarimas ir išvados. Dvitaškių tikslumui turi įtakos raumenų ir kūno masė bei pasispyrimo laikas šuolio metu. Tritaškių ir baudų metimai sąsajų su mūsų tirtais fizinio išsivystymo ir fizinio pajėgumo rodikliais neturi. Vadinasi, jų tikslumą lemia kiti veiksniai. Krepšininkių atkovotų kamuolių skaičius priklauso ne nuo ūgio, o nuo kūno masės bei raumenų funkcinių ypatybių (susitraukimo greičio ir galingumo). Atkovotų kamuolių skaičių puolant lemia psichomotorinės reakcijos laikas. Perimti kamuoliai, klaidos ir rezultatyvūs perdavimai, kaip sudėtingi technikos ir taktikos veiksmai, sąsajų su mūsų tirtais fizinio pajėgumo rodikliais neturi. Galima daryti prielaidą, kad žaidėjas, turintis didesnį vienkartinį raumenų susitraukimo galingumą, galės sėkmingiau gintis prieš varžovą, užimti geresnę padėtį gindamasis ir išvengti asmeninių pražangų, nes tarp šių rodiklių yra nustatytas koreliacinis ryšys.

Raktažodžiai: metimas, šuolis, ūgis, blokas, galingumas.

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PHYSICAL EDUCATION TEACHERS' RELATIONSHIP WITH UNIVERSITY AS SCIENTIFIC, EDUCATIONAL AND SOCIAL INSTITUTION

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ABSTRACT

Research background and hypothesis. Academic environment necessitates university teachers to carry out three essential professional functions: scientific, educational and social, and to gain such professional self-perception which is desirable for the individuals themselves and are also rooted in the cultural perception of the academic community and matches the expectations of modern society.

Research aim was to reveal the relationship between university physical education teachers and the university as scientific, educational and social institution.

Research methods. The study employed a non-standardized questionnaire drawing upon the survey of L. Paterson et al. (2003) about the expression of democratic intellect in Scotland and England. The attitudes of the research participants were interpreted using nonparametric statistical methods.

Research results. Educational activities remained the major priority of professional activities at the beginning of professional careers. The lower priority was ascribed to scientific and social functions.

Discussion and conclusions. Physical education teachers carried out three essential professional functions: scientific, educational and social giving the major priority to the educational function: preparation of textbooks, course books, worksheets, courses, vocational events, updating their professional knowledge. Physical education teachers are also oriented towards applied research which is related to scientific function at the university – preparation of doctors of science.

Keywords: higher education, academic profile, professional functions of teachers.

INTRODUCTION

Academic community in the specific professional field determines the origin and functioning of each professional community including physical education. Aiming at achieving its existential goals, it fosters cultural values and accumulates professional experience while educating new physical education specialists, providing professional services and creating institutional systems of physical activity. In this way, academic community is the background of a certain professional community and its transformations and survival.

University teachers as a professional community are defined as an informal group of teachers in related professions. They gain new knowledge dealing with common academic work problems and finding their solutions (Stake, 1998). Even during the first year of their studies they gain a feeling and habits of belonging to an academic community. This is especially noticeable during doctoral studies, and particularly after the acquisition of scientific degree or when they are employed in a higher education institution (Becher, 1989). In social sciences there is abundance of publications concerning the functions of university teachers (Braskamp, Ory, 1994; Austin, 1996; Nixon, 1996; Välimaa, 1998; De Simone, 2001;

Paterson, 2003; Krabi, 2005). Publications show that academic culture necessitates university teachers to carry out three essential professional functions: the scientific, educational, and social, as well as to develop professional self – awareness. It also corresponds to the expectations of contemporary society. Professional identity of university teachers is expressed not only in perception of professional role (who are they), but also in professional activity – what they do and how they combine teacher's essential functions (Austin, 1996; De Simone, 2001; Harris, 2005; Krabi, 2005).

The studies of academic community, its origin, scientific profile and the analysis of its social environment cover a wide range of contexts of the communities involved in academic practice. The scientific profile of the academic community helps understand the causes of science evolution (Kuhn, 1962, 1970), culture and identity of disciplinary communities, (Becher, 1989; Scheff 1995; Austin, 1996; Braxton, Hargens, 1996; Ylijoki, 2000; Harris, 2005; Churchman, 2006). During the last decade in Lithuania scientists focused on the following aspects of physical activity profile: sports science paradigm (Skurvydas, 2008), functions of sports science and expansion of sports science (Skurvydas 1996; Poderys, 2002; Poderys, Visagurskienė, 2004). In Lithuanian higher education institutions research is carried out about the tendencies of physical education (Tamošauskas, 2007) including university teachers' approach to the institutional activity and academic values (Kardelis et al., 2007), value orientations of teachers at the Lithuanian Academy of Physical Education (Šukys et al., 2006).

The formation of communities interested in scientific practice has been examined theoretically. However, interdisciplinary sciences such as sports science or health sciences have received too little attention tough they are interconnected with the functions of university teachers. There are not many surveys on the interrelations of physical education teachers and the university. Academic community dealing with sport science practice is comparatively a very young community. It started functioning markedly in the middle of the twentieth century due to the growth in basic sports science disciplines. It was also due to an increased interest in modern public health and sports needs. This situation requires empirical evidence. Thus, our **research questions** were as follows: 1) What are the dominant attitudes of physical education teachers performing their professional activities in the universities? 2) What professional functions are recognized and carried out by teachers in the area of physical education? 3) What factors determine major recognition of physical education teachers' professional functions? The **aim** of the research was to reveal Lithuanian university physical education teachers' professional relationship with the university as a scientific, educational and social institution.

RESEARCH METHODS

The research sample included 78 respondents (60 men and 60 women). All research participants were employed in physical education departments in Lithuanian institutions of higher education (Lithuanian University of Health Sciences, Lithuanian University of Agriculture, Klaipeda University, Mykolas Romeris University, Vilnius University, Vytautas Magnus University, and Vilnius Pedagogical University). There were also 42 respondents from the Lithuanian Academy of Physical Education engaged in individual sports, fitness and gymnastics. Even 45 respondents had a scientific degree; 71 persons did not have any academic title. This sample represented the population of about 200 Lithuanian university physical activity specialists. The data were collected in 2009.

In preparing a nonstandard research questionnaire we applied L. Paterson's (2003) test of the expression of democratic intellectualism in Scotland and England. We added our own statements as well. We divided them into the following sections of professional roles: the scientific function, educational function and social function. We elaborated on an expression of the professional functional priorities of physical education teachers. We tried to find out if one function was not given a higher priority compared to the others. By expressing their opinions respondents evaluated each given statement in points by selecting one of four possible options. From 1 – it does not matter at all, up to 4 – it is very important. They were standardized in rage of the values from – 1 to 1. In this way the following formula was used to calculate standardized rate I:

$$I = \frac{-1 \times n_1 - 0.5 \times n_2 + 0.5 \times n_3 + 1 \times n_4}{n_1 + n_2 + n_3 + n_4},$$

where n_1 – the number of subjects who evaluated the statement as unimportant (1); n_2 – the number of subjects who evaluated the statement as not very important (2); n_3 – number of subjects who evaluated the statements fairly important (3); and

n_4 – who evaluated the statement as very important (4), –1; –0.5; 0.5; 1 – factors of the evaluation score. Interpretation of the standardized index is shown in Table.

Table. **Interpretation of the standardized index I**

Range of index I	Assessment
From 0.50 to 1.00	Very important
From 0.00 to 0.49	Quite important
From –0.01 to –0.49	Not so much important
From –0.50 to –1.00	It makes no difference

For the analysis of the statistical data we applied *Chi-square* test. Comparable samples have been chosen according to the statistical survey rules of W. C. VanVoorhis and L. B. Morgan (2001). The differences were statistically significant when the probability for the error was not higher than 5% ($p < 0.05$). In this study the independent variables were scientific degree of the respondents and training professionals of physical education and sports at LAPE.

RESEARCH RESULTS

Figure 1 shows a dispersion of standardized indicators of the scientific function expressed in the attitudes of the research participants.

Figure 1 shows that, despite of the scientific degree held by Lithuanian universities physical education teachers, one third of them agreed on the importance of university contribution to the regional or the whole country's economical development. Almost half of the respondents thought that it was very important to carry out fundamental research. However, depending on qualification ($\div^2 = 10.9$ (3); $p = 0.02$), points of view about the fundamental investigations differ. The importance of basic research ($I = 0.68$) is more emphasized by people without scientific degree than by their certified colleagues ($I = 0.56$). Respondents favorably evaluated planning research methodologies and innovations for commercial purposes. However, only one fifth of the respondents evaluated this type of activity as a very important. Development of applied research is most supported by Lithuanian teachers of physical education.

Figure 2 shows a dispersion of the standardized indicators for the educational functional attitudes of Lithuanian high school physical education teachers.

Figure 2 illustrates that all components of educational function are considered as very important. In opinion of two – thirds of physical education teachers, training doctors of science is a very important function of education at the university. More than half of the respondents thought that continuous education was also very important. Vocational events for students were considered as important by one third of the respondents. Only one tenth of the respondents considered students' academic ambitions and general competences as unimportant part of the university education.

Respondents' attitudes differed about the statement that a university should prepare practitioners who are able to compete in the labor

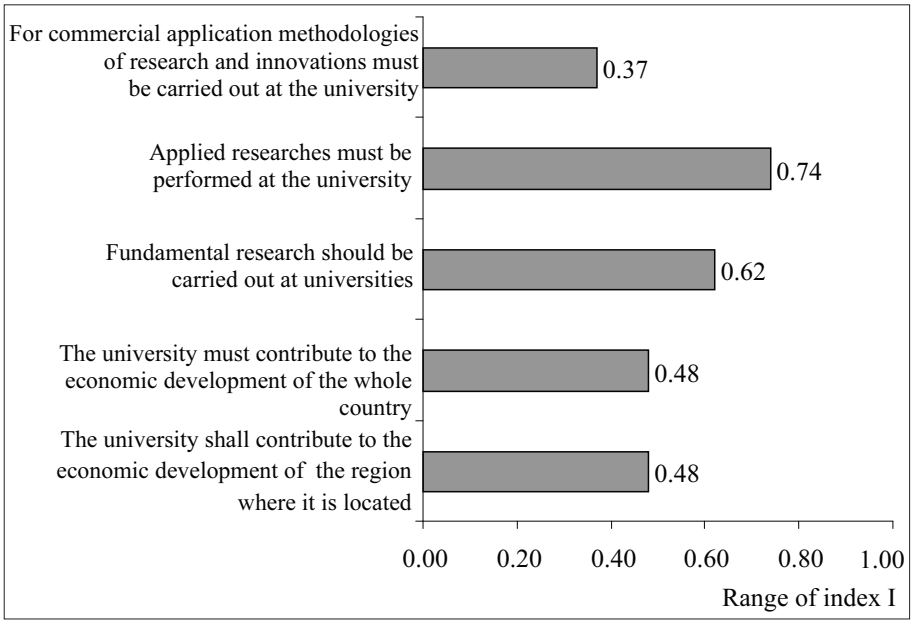


Figure 1. **Dispersion of standardized indicators of scientific functions expressed by the attitudes of university teachers**

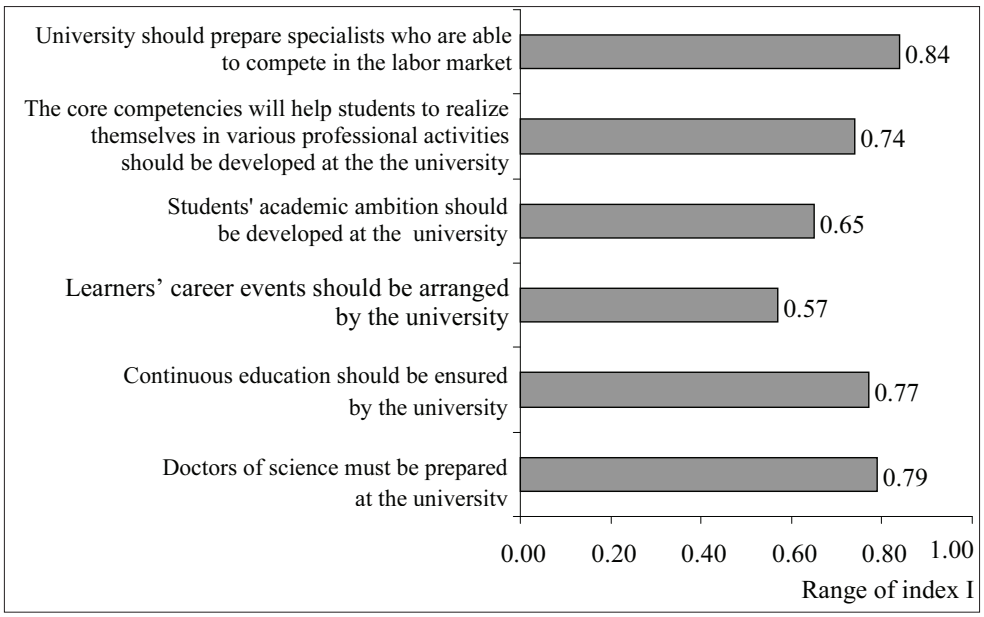


Figure 2. **Dispersion of standardized indicators for attitudes of the educational function of university teachers**

market. Here we observed a link with the university profile ($\div^2$ = 11.9 (2); p = 0.03). Physical education teachers of the Lithuanian Academy of Physical Education more disagreed with the statement (I = 0.85) than teachers in other universities (I = 0.87).

Except for the negative attitude towards the management of the university as a profit organization, respondents evaluated all social functions as very important (Figure 3).

As it is indicated in Figure 3, a quarter of surveyed physical education teachers did not completely agree that the university should be managed as a profit-making organization; nearly half of participants fully agreed that university must be autonomous. As the research shows, depending on the profile of a university ($\div^2$ = 8.9 (3); p = 0.03), autonomic attitudes were different. Physical education teachers at the Lithuanian Academy of Physical Education (I = 0.62) more emphasized this statement in comparison with the teachers at other universities (I = 0.60).

We did not find significant differences in the attitudes depending on the competence

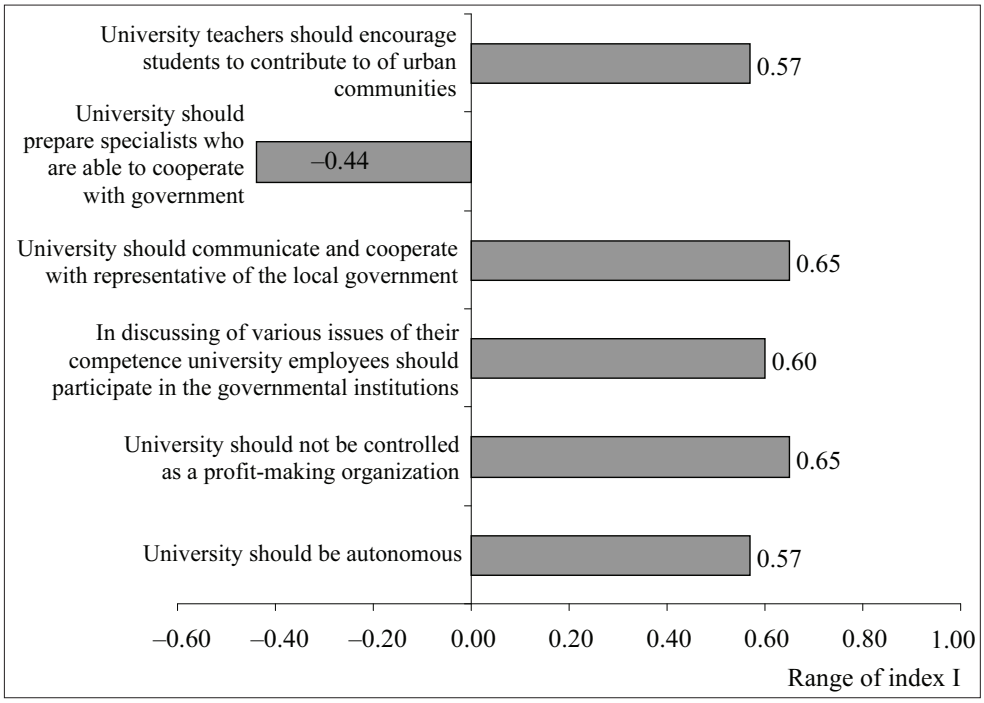
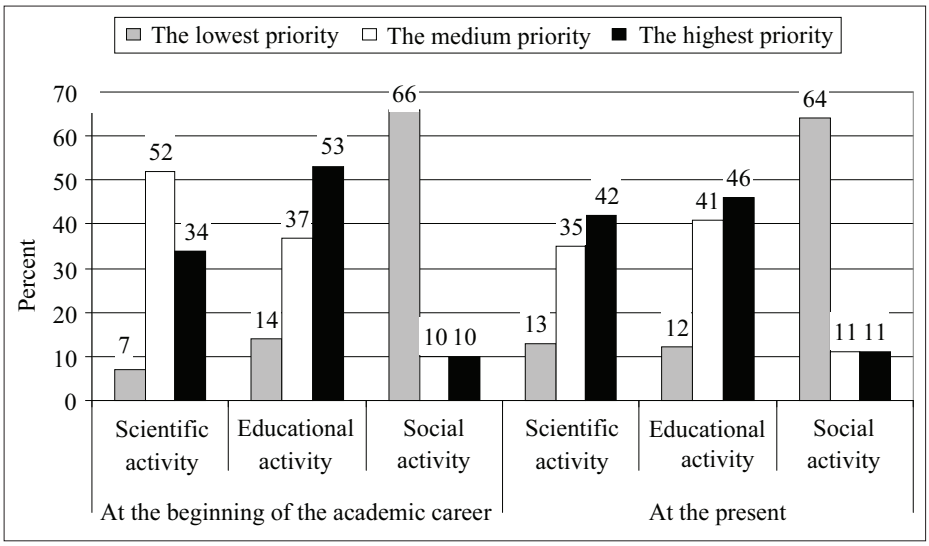


Figure 3. **Dispersion of standardized indicators of attitudes to university social functions**

Figure 4. **Dispersion of priorities in professional activities**



of university employees that they should be involved in discussions on various issues in other governmental institutions. Half of the respondents fully agreed with the statement that university employees depending on their competence should collaborate with representatives of local government. The statement was less emphasized by the teachers at the Lithuanian Academy of Physical Education (I = 0.60) in comparison with physical education teachers of other universities (I = 0.61) ($\div^2$ = 8.9 (3); p = 0.02). Almost half of participants claimed that it was very important to train specialists who are able to critically evaluate and discuss issues with people in power. Only one third of the teachers at the Lithuanian Academy of Physical Education tended to encourage students to contribute to the life of the local community.

Figure 4 represented to what kind activities priorities were given at the beginning of the respondents' pedagogical – research work and how these priorities changed teachers' functions.

More than half of the respondents (61%) said that priorities of their professional functions changed with years of their professional experience. More than half of the current Lithuanian university physical education teachers said that their strength was the educational activity (63%). A quarter of them said that it was their scientific activity (20%). Almost the same number of subjects indicated that their strength was in their social activities (23%). Scientific activities is a growing a priority to people with master's degree, but not with the doctoral degree ($\div^2$ = 6.6 (2); p = 0.04).

DISCUSSION

Two – thirds of the present Lithuanian physical education teachers give priority to the educational activity. The priority is given for textbooks, study books, preparation for teaching materials, teaching, planning of curriculum and so on. A smaller part (one quarter) - the scientific activities: scientific research administration and article preparation, participation in conferences and social and administrative activities, participation in the governing process of the university, strategy planning, search of funds, consultation activity and so on. The research shows that the main priority of the professional career from the beginning is given to educational activity, which still exists as the main. Less priority is given to scientific and social functions. Our research confirms scientific approach that stronger focus on one or another professional function is not the result of personal individual attitudes only. It results in consensus level paradigm admitted by scientific communities: theoretical orientations, research aims and methods. A high level of consensus paradigm is specific for the communities of physical sciences, the middle level for the social sciences, while the lowest – the members of the humanities. High paradigmatic consensus societies are more orientated to research, the lower ones – to education (Austin, 1996; Neumann et al., 2002). In physical education, scientific paradigm focuses on the high consensus of natural science and on the lower consensus of sociology. Accomplished research shows that physical education teachers of practical disciplines give priority for educational activity.

Most of physical education teachers in Lithuanian institutions of higher education agree that this is rather important that a higher school contributes to the region or the whole country's economical development. However, one-fifth of the respondents don't link their scientific activities with country's economical development. Does not pay focus on the importance of the public interests meeting. V. Zuzevičiūtė and M. Teresevičienė (2007) found that not only Lithuanian teachers but also teachers from Polish universities do not recognize links between the development of a university and the whole country. They give lower priority to above mentioned aspect, as well as to critical thinking or the formation of skills. British scientist L. Paterson's (2003) research results emphasize regional development – in England and Scotland university teachers agree that accumulated and generated knowledge in universities must benefit the society. Fundamental and applied research is considered a prior university function by physical education teachers. Traditionally it is associated with an exclusive function of universities – preparation of scientists.

Our survey data are compatible with A. E. Nir and R. Zilberstein-Levy's (2006) study. It shows that aiming for a doctoral degree and going through the entrenchment period in a career (25–44 years) younger teachers give acceptable preference to an economic development, fundamental, applied and commercial research. Older teachers (45–64 years of age) going through career adapt in order to preserve their achieved positions.

University goal is not only to train researchers but professional specialists of physical education, too. Lithuanian universities organize vocational events for enlisting more motivated students. Physical education teachers positively evaluate the importance of vocational orientation events. In the point view of physical education teachers, universities should organize studies for the persons who already have completed education. The studies should be arranged to those who seek to improve or change their qualifications. This attitude shows that in a field of physical education the occurring changes are progressive. For this reason it is necessary to update professional knowledge of physical education specialists constantly. Physical education teachers underestimate the importance of academic ambitions. It depends on the type of university as well.

Each university seeks for its autonomy which ensures academic freedom. Academic freedom affects academic community as well, so members of it can openly tell their opinions about the organization and administration of the studies and scientific research, to express critical ideas. This is not only their right, but their obligation, too (Будылин, Полатайко, 2005; Westerheidjden, 2005). R. E. Stake and E. J. Cisneros-Cohernour (2004) state that although teaching is quite individual work, an institution creates its own significance. It does not matter whether loudly or quietly teacher supports the university policy or contradicts with it. Instructor supports that system which defends the university. Our study shows that one-fifth of research participants do not have an opinion about the university autonomy. One tenth of them think that autonomy is not necessary. This can be explained by the fact that during the Soviet times the link between university and the state was perverse, the dialogue between universities and society was missing (Putinaitė, 2004). These deformations of academic culture can be expressed by the teachers' attitudes concerning university autonomy.

An ideologue of a higher education R. Barnett (Барнетт, 1997) understands autonomy as freedom which requires dealing with the general aims of the whole society. In the point of view of D. Churchman (2006), it is not possible to avoid some kind of a compromise in a job as a university professor. However there is not any coordination between an individual motivation and requirements of the social context. Lithuanian physical education teachers positively evaluate the statements describing their social role: teachers' activities outside the university, their roles in the education of socially active citizens capable of expressing and defending their opinions.

CONCLUSIONS AND PERSPECTIVES

The analysis of the relationship between Lithuanian university physical education teachers and the university revealed that physical education teachers carry out three core professional roles: scientific, educational, and social. The priority is given to the educational function: preparation of the text, study books, teaching materials, study programs, arranging the vocational training events, updating professional knowledge.

As we know physical education teachers underestimate the connection between their professional activity and the development of the country's economy. For this reason they

underestimate the necessity of the preparation of research methodologies and innovations for commerce. They are more orientated to the applied investigations and less to the fundamental research. Fundamental investigations are the priority for the teachers holding master's degree. The teachers' role is the education of socially active citizens capable of expressing and defending their opinions.

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KŪNO KULTŪROS DĖSTYTOJŲ SANTYKIS SU UNIVERSITETU KAIP MOKSLINE, EDUKACINE IR VISUOMENINE INSTITUCIJA

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Akademinė aplinka įpareigoja universiteto dėstytoją derinti tris esmines profesines funkcijas (mokslinę, edukacinę, visuomeninę) ir įgyti tokią profesinę savivoką, kuri yra patraukli pačiam asmeniui, įsišaknijusi akademinės bendruomenės kultūriniame suvokime ir atitinka šiandieninės visuomenės lūkesčius. Žinant, kad mokslo praktika suinteresuotų bendruomenių santykį su socialine aplinka suformuoja tikrovės pažinimo būdai, šiuo tyrimu bandyta gilintis į kūno kultūros mokslo srities akademinės bendruomenės nuostatas.

Tikslas – atskleisti Lietuvos aukštųjų mokyklų kūno kultūros dėstytojų profesinį santykį su universitetu kaip moksline, edukacine ir visuomenine institucija.

Metodai. Rengdami nestandartizuotą tyrimo klausimyną rėmėmės L. Paterson (2003) demokratinio intelektualizmo raiškos Škotijos ir Anglijos universitetuose tyrimu. Šios autorės požiūrį papildėme savo teiginiais. Tiriamųjų nuostatos buvo interpretuotos neparametrinės statistikos metodais, gilintasi į mokslo laipsnio ir aukštojo mokslo įstaigos profilio įtaką.

Rezultatai. Atliktas tyrimas rodo, kad pagrindiniu profesinės veiklos prioritetu profesinės karjeros pradžioje buvo ir išlieka edukacinė veikla. Menkesnis prioritetas teikiamas mokslinei ir visuomeninei funkcijoms.

Aptarimas ir išvados. Lietuvos aukštųjų mokyklų praktinių kūno kultūros disciplinų dėstytojai, derindami esmines profesines funkcijas (mokslinę, edukacinę, visuomeninę), prioritetą teikia edukacinei funkcijai (vadovėlių, studijų knygų, mokomosios medžiagos rengimui, dėstymui, studijų programų rengimui, profesinio kryptingumo akcijų rengimui, studentų bendrųjų kompetencijų ir ambicingumo ugdymui, profesinių žinių atnaujinimui baigusiems aukštojo mokslo studijas asmenims) ir orientuojasi į taikomojo pobūdžio tyrimus, susijusius su moksline universiteto funkcija – mokslo daktarų rengimu.

Raktažodžiai: aukštasis mokslas, mokslo profilis, universiteto dėstytojo profesinės funkcijos.

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INFLUENCE OF CONCENTRATED POWER ENDURACE WORKLOADS ON SPRINTERS' FUNCTIONAL STATE

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ABSTRACT

Research background and hypothesis. There are few studies about the variables of the duration of power-endurance workloads and their total and residual effects.

Research aim was to evaluate the changes in the functional state indices of muscular and cardiovascular systems while two training micro-cycles were designed to develop power-endurance abilities, and the third one was appointed for active rest.

Research methods: Seven sprint athletes performed two micro-cycles of concentrated power-endurance type loads and one micro-cycle was appointed for recovery. Three groups of indices were chosen: muscular power; cardiovascular indices and indices of recovery. 12-leads ECG was registered during the Ruffier test and 30 s vertical jumping tests.

Research results. Under the influence of two training micro-cycles using concentrated power endurance workloads muscular power deteriorated and the recovery rate was individual. After two training micro-cycles the effect of total fatigue caused an increased biological efforts to perform the locomotion task and cardiovascular changes were more expressed than before training. Seven days was a too short period of time so that the changes in the indices caused by total effect of training would return to the baseline values again.

Discussion and conclusions. Reduced abilities in the regulation of peripheral vascular tone after heavy training could be compensated by the changes in the cardiac function, i. e. by an increase in systolic blood pressure. Cardiovascular indices could be useful for describing changes in the functional state of athletes under the influence of training.

Keywords: cardiovascular system, recovery, anaerobic load.

INTRODUCTION

The problem of increasing the efficiency of training has a few important aspects, and the choice of physiologically appropriate means is one of them (Stoboy, 1973; Giada et al., 1998; Price et al., 2000; Trinkūnas et al., 2001). The analysis of the publications of few lasts decades shows new qualitative changes in planning training loads (Giada et al., 1998; Isurinas, Škliaras, 2001; Karoblis, 2001). Various training macro-cycles for solving a particular task are planned. Concentrated power endurance micro-cycles and mezzo-cycles are often planned during the preparatory period and their effect on athlete's performance still remains the interest of sports science. It has been shown that concentrated workloads of endurance and power have a positive effects on the development of capillary density in skeletal muscles, which improves muscular blood flow (Bell eal., 2000; Poderys, 2000). These changes in the cardiovascular system (CVS) are very important as they strongly impact the ability to recover and train using high training workloads (Martienz Caro et al., 1999). There are few studies about variables of the duration of power-endurance workloads, total and residual effects of training on the cardiovascular system. **The aim of this study** was to evaluate the changes of functional state indices of muscular and cardiovascular systems while two training micro-cycles were designed to develop power-endurance abilities, and the third was appointed for active rest.

RESEARCH METHODS

Seven athletes (age – 22.4 ± 0.72 years; body mass – 74 ± 1.18 kg) training in sprint events participated in the research. Their training mezzo-cycle consisted of three micro-cycles: during two micro-cycles athletes performed concentrated heavy training loads of power-endurance type, and the third micro-cycle was appointed for active rest. The duration of a micro-cycle was 7 days, mezzo-cycle – 21 days. Totally 3 assessments were performed: before, at the 15th and at the 22nd days of the mezzo-cycle.

Three groups of indices was chosen for the evaluation of s in the state of athletes: 1 – muscular power indices (triple standing jump); 2 – CVS indices (arterial blood pressure(ABP): systolic (S) and diastolic (D), heart rate (HR), JT-interval and ST-segment depression taken from the electrocardiogram (ECG)); 3 – indices of recovery after testing the workload ($_{1/2}$T – systolic blood pressure; $_{1/2}$T – indicator of blood pressure quality, i. e. (S–D)/S; $_{1/2}$T HR; $_{1/2}$T JT interval and $_{1/2}$T – JT/RR). During the research all participants of the study performed a Ruffier functional test (30 squats per 45 s) and the 30 s vertical jumps test. Twelve standard leads of ECG were registered continuously by computerized ECG analysis system "Kaunas–krūvis".

Statistical analysis was carried out using *SPSS 14.0 package for Windows*. Standard statistical methods were used to calculate means and standard deviations (± SD). A one-way analysis of variance (ANOVA) was used to establish the differences between the measurements. A significance level of 0.05 was used.

RESEARCH RESULTS

Performed training workloads of power endurance type during first two micro-cycles strongly affected muscular performance indices of athletes. During the first assessment athletes were able to show the result of 7.38 ± 0.14 m in triple standing jump. After two micro-cycles all athletes without exception exacerbated their results. On average the result in triple jump decreased by 0.21 ± 0.04 m ($p < 0.05$). The results of the third assessment showed that three athletes (43% of cases) improved their result in triple jump, i. e. they jumped more than during initial assessment, two athletes (28.5% of cases) jumped as much as during the initial study, and the result of two athletes (28.5% of cases) remained lower than during the first assessment. On average, the results of investigated group in the triple jump during the third assessment did not differ significantly ($p > 0.05$) from the initial results. The obtained results showed that muscular power indices unambiguously deteriorated because the recovery after training by when using concentrated heavy workloads of power endurance type was individual.

The results of assessment of dynamics of CVS functional indices showed that after two training micro-cycles most of the registered parameters significantly changed. Figure 1 presents the mobilization of CVS while performing exercise tests, i. e. the values of the registered indices

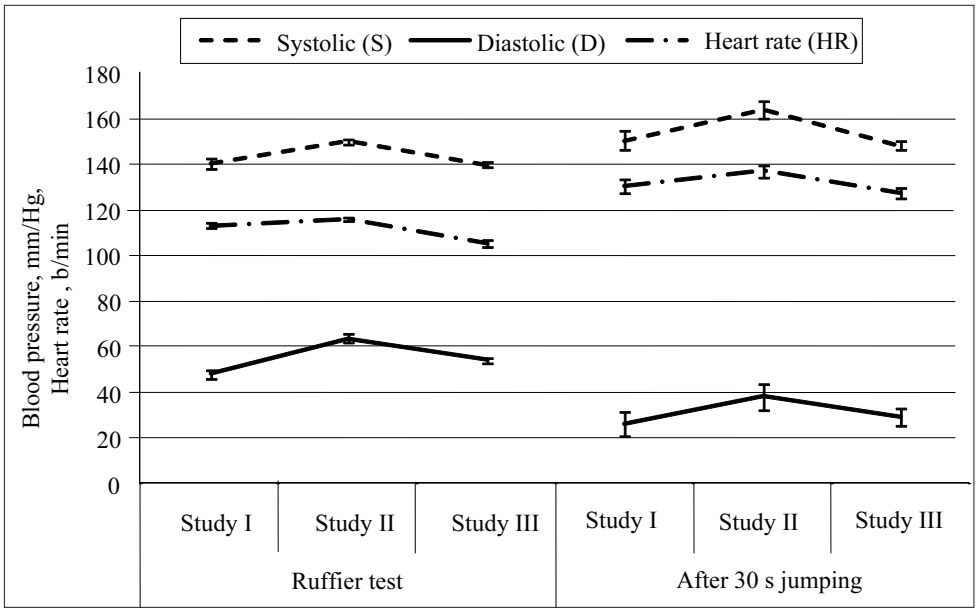


Figure 1. **ABP and HR values at the end of modified Ruffier functional test and after 30 s vertical jumps**

Figure 2. **JT-interval, ST-segment depression values at the end of modified Ruffier functional test and after 30 s vertical jumps**

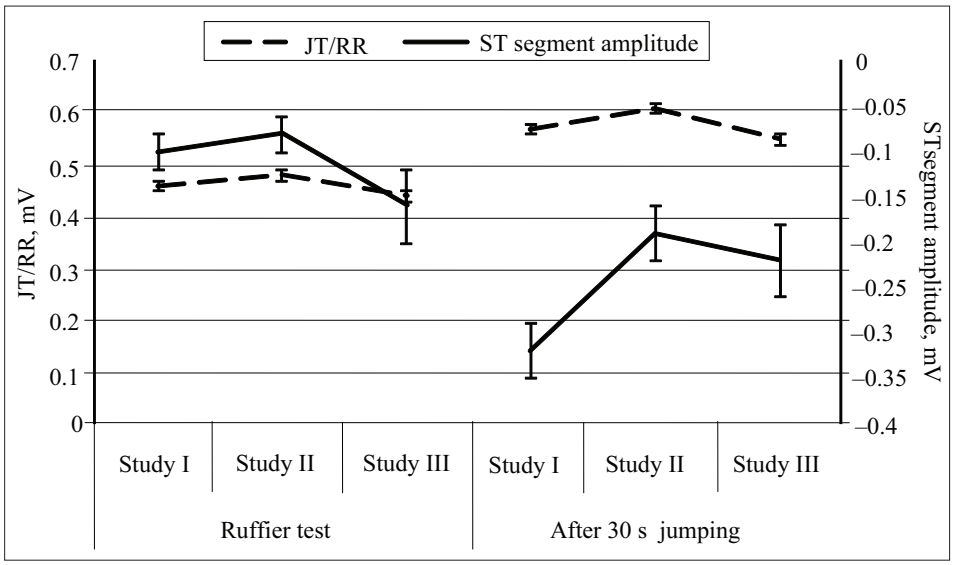
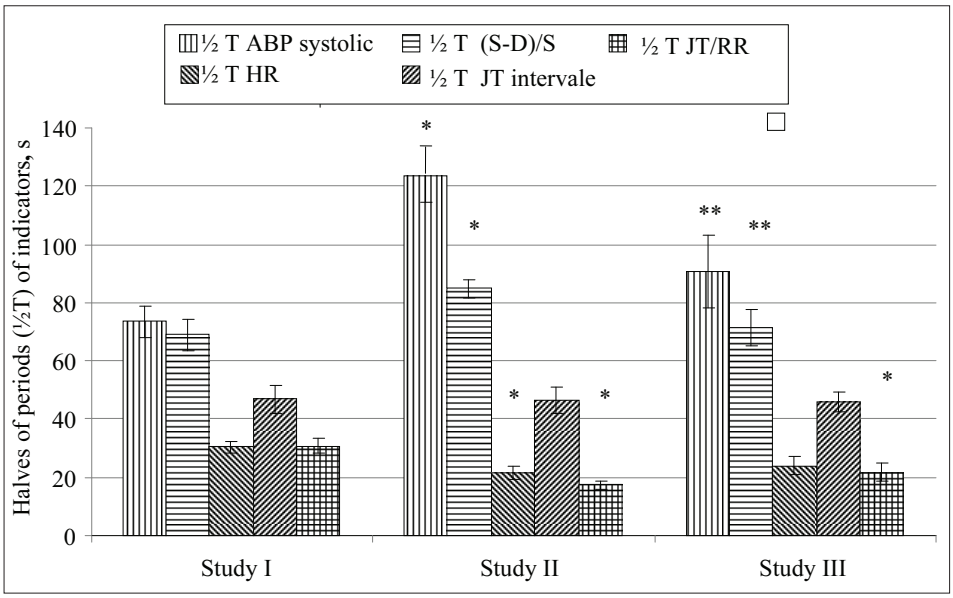


Figure 3. **Halves of periods (½T) of indicators at the end of modified Roufier functional test and after 30 s vertical jumps**



Note. * – $p < 0.05$ compared to study I, **– $p < 0.05$ compared to study II.

at the end of Ruffier test and after 30-s vertical jumps. Significant changes ($p < 0.05$) were found in systolic and diastolic ABP responses to both samples of testing workloads, however the pulse pressure of ABP remained unchanged. Analysis of registered ECG indices showed that the change in JT/RR during testing workloads was more expressed after two training micro-cycles than during the first assessment (Figure 2). During the third assessment, i. e. after recovery the changes in JT/RR were close to the same as it was recorded during the first assessment.

Figure 3 presents the data about the speed of recovery of CVS indices ($_{1/2}T$). The results obtained during the study showed that after two training micro-cycles the recovery of the registered ECG indices had statistically significant ($p < 0.05$) changes. The results of the third assessment showed that one micro-cycle designed for active recovery was not enough for full recovery. The period of time of only 7 days was too short for the dynamics of ECG indices after dosed or maximal exercising to remain slower.

DISCUSSION

Athlete's body could be described as a complex dynamic system (Korobeynikov et al. 2006), thus changes in the functional state and the interplay of various physiological mechanisms are so important for sports science. All cardiovascular mechanisms are interrelated in supplying oxygen and energy to active tissue. The results in the changes of ABP at the onset of exercising should be analyzed by taking into account the principle of unity of body functioning. Such changes of ABP can be explained by changes in peripheral vascular tone. It is known that regular physical activity positively

affects (decreases) both systolic and diastolic ABP not only at rest, but, according to some scientists, alsoduring physical load as well (Keul et al., 1989; Allison et al., 1999; Cornelissen, Fagard, 2005; Chakhunashvili et al., 2011). At first sight similar athletes can responded to the same external physical load with different reactions of CVS. The reactions of systolic blood pressure in response to the same charge can be significantly different. This, of course, determines their different long-term adaptation to the same external physical loads. We have observed recovery of various degree of ABP indicators during the active rest micro-cycle, and according to average systolic and diastolic blood pressure values of participants of the study, recovery after testing workloads was not the same as it was before training.

Power endurance workloads far less affected the values of HR and JT-interval of ECG. The smaller values in ST-segment depression after two training micro-cycles could be explained as a consequence of the increase in systolic blood pressure.

The change of ratio JT/RR of ECG during the testing provides information about the mobilization of CVS during exercising (Vainoras, Jaruševičius, 1996; Poderys et al., 2005). The results obtained during the study showed that the change of JT/RR after two training micro-cycles was more expressed than during the first assessment. This shows that there was more mobilization of CVS in both cases, i. e. while performing a dosed Ruffier test and maximal anaerobic 30-s vertical jumps test. This could be explained as an effect of total fatigue and increased biological efforts to perform the locomotion task.

The speed of recovery of ECG indices after testing workloads was assessed by halves of periods (½T). These halves of periods of recovery could be treated as the index of velocity in metabolic flow of processes (Vainoras, Jaruševičius, 1996). We found that active rest micro-cycle after training was too short so that the changes of indices, caused by total effect of workout, would return to the baseline values again. This means that concentrated power-endurance workloads strongly affect the athlete's body functions and therefore must be scheduled earlier than 3 weeks before competitive activities or applied during preparatory training period. Although high power-endurance loads inhibit strength development (what was confirmed by others and in this our study as well), they stimulate an increase of capillary density in muscles (Bell et al., 2000). It is very important because these long-term adaptational changes are the basis for fast adaptation to heavy training loads and athlete's ability to recover and perform in the next training session.

CONCLUSIONS AND PERSPECTIVES

1. Under the influence of two training micro-cycles of concentrated power endurance workloads muscular power deteriorates and recovery rate is individual.

2. Reduced abilities in the regulation of peripheral vascular tone after heavy training could be compensated by changes in the cardiac function, i. e. by an increase of systolic blood pressure.

3. Cardiovascular indices such as halves of periods of recovery (½T) in heart rate, arterial blood pressure, JT interval and in ratio JT/RR could be appropriate indices for describing changes in the functional state of athletes under influence of training.

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FUNKCINĖS BŪKLĖS RODIKLIŲ KAITA TAIKANT JĖGOS IŠTVERMĖS KRŪVIUS

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Skirtingos trukmės jėgos ištvermės fizinių krūvių suminis ir liekamasis poveikiai širdies ir kraujagyslių sistemai yra mažai nagrinėti.

Tikslas – nustatyti lengvaatlečių raumenų, širdies ir kraujagyslių sistemų funkcinės būklės rodiklių kaitą mezociklo metu, kai sportininkai du mikrociklus atlieka didelius jėgos ištvermės krūvius, o trečią skiria aktyviam poilsiui.

Metodika. Funkcinė būklė vertinama pagal tris rodiklių grupes: 1 – raumenų funkcinio pajėgumo (trišuolis iš vietos); 2 – ŠKS funkcinės būklės (arterinio kraujo spaudimo rodikliai); 3 – organizmo atsigavimo po fizinio krūvio. Tyrimo metu visi respondentai atlikdavo modifikuotą Rufjė fizinio krūvio ir anaerobinio krūvio mėginį (30 s vertikalūs šuoliai didžiausiomis pastangomis). Dvylika standartinių EKG derivacijų buvo registruojama ir analizuojama kompiuterine EKG analizės sistema „Kaunas–krūvis“.

Rezultatai. Raumenų funkcinio pajėgumo rodikliai vienareikšmiškai blogėja tada, kai du mikrociklus sportininkai atlieka didelės apimties jėgos ištvermės krūvius, o atsigavimo greitis po šių fizinių krūvių yra individualus. Dėl didelės apimties jėgos ištvermės krūvių sumažėjusios periferinių kraujagyslių tonuso reguliavimo galimybės yra kompensuojamos centrinio kraujotakos organo širdies funkcija – sistolinio kraujospūdžio padidėjimu. Širdies ir kraujagyslių sistemos funkciniai rodikliai (ŠSD, AKS, elektrokardiogramos JT intervalo ir intervalų JT/RR santykio, atsigavimo pusperiodžiai (½T) po fizinio krūvio mėginio) rodo organizmo funkcinės būklės pokyčius ir teikia informacijos apie suminio bei liekamojo nuovargio požymius.

Aptarimas ir išvados. Raumenų funkcinio pajėgumo rodikliai vienareikšmiškai blogėja tada, kai du mikrociklus sportininkai atlieka jėgos ištvermės krūvius, o atsigavimo greitis po šių fizinių krūvių yra individualus. Sumažėjusios periferinių kraujagyslių tonuso reguliavimo galimybės yra kompensuojamos centrinio kraujotakos organo širdies funkcija – sistolinio kraujospūdžio padidėjimu.

Raktažodžiai: širdies ir kraujagyslių sistema, atsigavimas, anaerobinis krūvis.

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CHANGES IN PHYSICAL FITNESS AMONG HIGH GRADE SCHOOLGIRLS

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ABSTRACT

Research background and hypothesis. During the last five years Lithuanian long-term research related to the peculiarities of changes in physical fitness among 10-12th-grade schoolgirls has not been found. Other research in Lithuania showed negative tendencies of physical fitness changes of Lithuanian schoolchildren and prevailing sedentary lifestyle.

Research aim was to determine peculiarities of change results in physical fitness among Kaunas schoolgirls (10–12th grades).

Research methods. The present research included 10th-grade schoolgirls (n = 244) of Kaunas city who were at school during the research and were able to perform the necessary Eurofit tests: 10 × 5 m Shuttle run, Standing Broad Jump, Sit ups in 30 seconds, 20 m endurance Shuttle run.

Research results. Changes in results of Eurofit tests performed from 10th grade autumn to 12th grade spring were different. Results of girls (10–12th-grade) in 10 × 5 m shuttle run test did not change ($p > 0.05$). Results of standing broad jump improved significantly in Grade 11 ($p < 0.05$). Results in 20 m endurance shuttle run test improved in Grade 12 ($p < 0.05$). Results in Sit ups in 30 seconds test improved in spring. Significant differences were found between 10 and 12th-grade schoolgirls spring Sit ups in 30 seconds test results, and 10 and 11th-grade autumn results.

Discussion and conclusions. Comparison of physical fitness of 10 and 12th-grade girls showed that it improved only in 20 m endurance shuttle run, in the 11th grade explosive strength of schoolgirls significantly improved.

Keywords: changes in physical fitness, Eurofit tests, physical characteristics.

INTRODUCTION

Physical fitness is an integral part of health and healthy lifestyle. Understanding physical fitness and knowledge of physical characteristics help children educators to successfully prepare the younger generation for happy life. That should help understand and improve schoolchildren themselves (Jaras, 1999; Puišienė, 2004; Skurvydas et al., 2006).

Decreased physical activity, high static loads and the resulting poor posture can affect the structural and functional changes in the growing human organism. Children grow and develop until their maturity, and during this complex process special and important changes take place in their organisms. Extremely important for child development are teenage years when the child begins to mature sexually because during this period tumultuous changes in all body systems take place. Exactly during this period the bodies of boys and girls sensitively react to loads. So, high physical loads at this age can disturb harmonious development of children (Tutkuvienė, 1995).

Measurements of physical fitness, access to information about the observed results and suggestions for improving physical fitness would motivate schoolchildren to come to the gyms more often, use sports equipment, do exercises in the fresh air, increase their physical activity, and thereby enrich their lives and improve their health (Volbekienė, Kavaliauskas, 2002; Corbin, Lindsey, 2007).

During the last five years Lithuanian long-term research related to the peculiarities of changes in physical fitness among 10–12th-grade schoolgirls has not been found. Other research in Lithuania concerning physical fitness of schoolchildren in Lithuania were on physical activity and physical self-study (Volbekienė, Kavaliauskas, 2002; Batutis, 2003; Baublienė, 2003; Mozūrienė, Volbekienė, 2006). Negative tendencies in the changes physical fitness among Lithuanian schoolchildren and prevailing sedentary lifestyle were determined.

The aim of the study was to determine the peculiarities of changes results in physical fitness result among Kaunas schoolgirls (10–12th grades).

RESEARCH METHODS

Research object. The present research included 10th grade schoolgirls of Kaunas city who were at school during the research and were able to perform the necessary Eurofit tests. The same girls took part in all their studies, from the 10th to the 12th grades. The total amount of subjects was 244, we used the data of 230 girls as 14 girls did not complete the study due to illness, injury, or moving to another school. This group included the girls who had participated in sports activities for more than 1 year before (n = 47) or during (n = 38) the research period.

Organization of the research. The research was conducted in four secondary schools in Kaunas. The research was conducted from 2006 to 2009. The data were collected 2 times during the school year – in September and May. Long-term research from the 10th grade autumn to the 12th grade spring was conducted.

There were two weekly physical education lessons at school. During these lessons the testing was carried out. Researchers encouraged to perform the test accurately, quickly and consistently. The girls were not allowed to carry out preliminary test trials if test instructions did not include that. Eurofit tests for agility, explosive strength of leg muscles, strength endurance of waist muscles, endurance were carried out. The following tests were used:

- for running speed and agility – 10 × 5 m Shuttle run;
- for explosive leg power – Standing Broad Jump;
- for trunk strength – Sit ups in 30 seconds;
- for cardiorespiratory endurance – 20 m endurance Shuttle run.

For testing Eurofit proposed test sequence was taken into account (during one physical education lesson the tests included Standing Broad Jump, Sit ups in 30 seconds, 10 × 5 m Shuttle run. During the next lesson the girls performed 20 m endurance Shuttle run). Between the tests we made the necessary breaks in order to allow the organisms of children to recover (Volbekienė, Kavaliauskas, 2002).

Statistical analysis. All calculations were performed using „Microsoft Excel 2007“ program. The averages of tests, their standard deviations and percentage values were calculated for each investigated group. Reliability of result differences was assessed by Student's *t* test. Statistical significance in this investigation was set at $p < 0.05$.

RESEARCH RESULTS

Research data showed that results of explosive leg power in 10th–12th grade girls were lower compared to the results of same test for Lithuanian girls in 1992 and 2002. Therefore, running speed and agility, trunk strength, cardiorespiratory endurance were better developed in our tested cohorts.

The change in the result of Eurofit tests performed from 10th grade autumn to 12th grade spring were different. Results of girls (10–12th grade) in 10 × 5 m shuttle run test did not change ($p > 0.05$). Results of standing broad jump improved significantly in Grade 11 ($p < 0.05$) (Figure 1). Results in 20 m endurance shuttle run test improved in Grade 12 ($p < 0.05$) (Figure 2). Sit ups in 30 seconds test results showed the tendency of improvement in spring. Significant differences were between 10 and 12th-grade spring Sit ups in 30 seconds test results compared to 10 and 11th grade autumn results (Figure 3). However, comparing the 10th grade better results (which were reached in spring) with the 12th grade results, we did not define any changes.

We made a comparison of results of girls (from 10 to 12th grade) in physical fitness tests as well (Figure 4). As a starting point we used autumn results of Grade 10. We can see that the biggest changes were in cardiorespiratory endurance results, in 12th grade spring they were better by 6.06%. Figure 4 shows that among girls' results of three physical fitness tests performed in 11th grade autumn, comparing them wit the 10th grade autumn level, only Standing Broad Jump results improved by 4.36%. Results of 10 × 5 m Shuttle run remained the same (not more then 1.5%).

DISCUSSION

Physical characteristics develop during the whole school age, but not at the same rate. Each physical characteristic has critical periods of development when its development is the most effective. The final formation of individual human organs and systems has different ending points (Ivaškienė, 2002). During maturation mobility increases speed, strength, accuracy, coordination and stamina of children. Interestingly, mobility matures in such sequence: "from the head towards the feet", i. e. first maturation is observed in muscles which are closer to the axis centre and then muscles of limbs, "from whole to parts", i. e. first movements mature and then the separate parts of body (Neumann, 2002). Total efficiency and development of individual physical characteristics of the girls stabilize at the age of 13–14 years, i. e. when they matured sexually (Malina et al., 2004). This phenomenon can be explained by increased weight (especially adipose tissue) and decreased movement (Volbekienė, Griciūtė, 2007). There is also research (Malina et al., 2004), claiming that such consistent pattern of development of girls' mobility does not depend on race or on the environment. Presumably, this female peculiarity of maturation with its related deleterious effects (obesity, decline of physical fitness, etc.) can only be compensated by increased movement (special training, intensive physical exercises).

Our research showed that in the 10–12th grades significant changes were found only in the results of endurance test. In the 11th grade we found improvement in explosive leg power and fluctuation

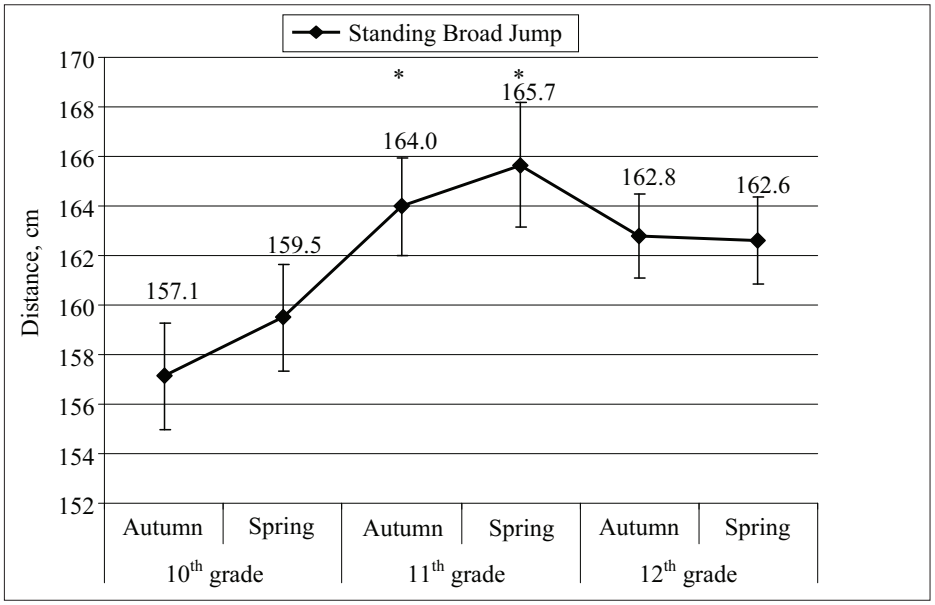


Figure 1. **Changes in Standing Broad Jump test results**

Note. * – $p < 0.05$ compared to the 10th grade autumn and spring results.

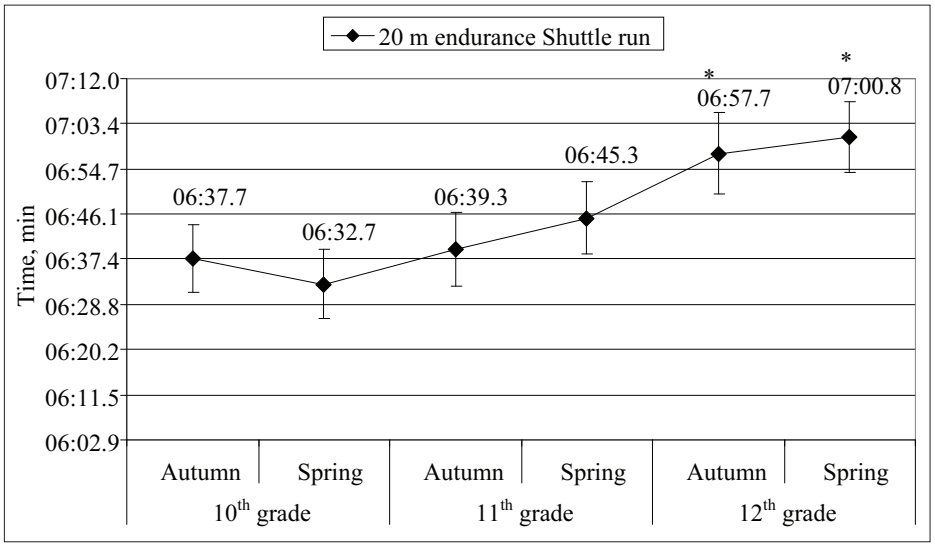
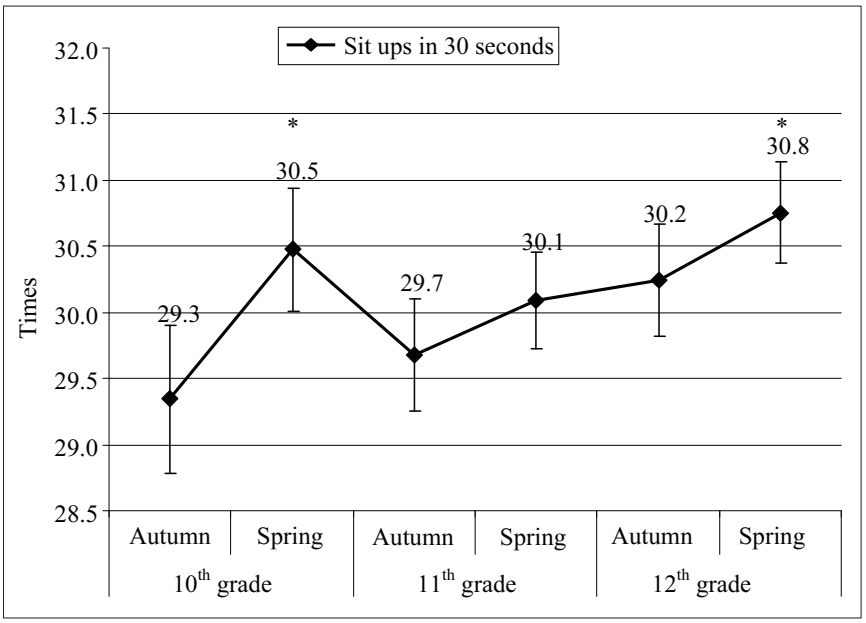


Figure 2. **Changes in 20 m endurance Shuttle run test results**

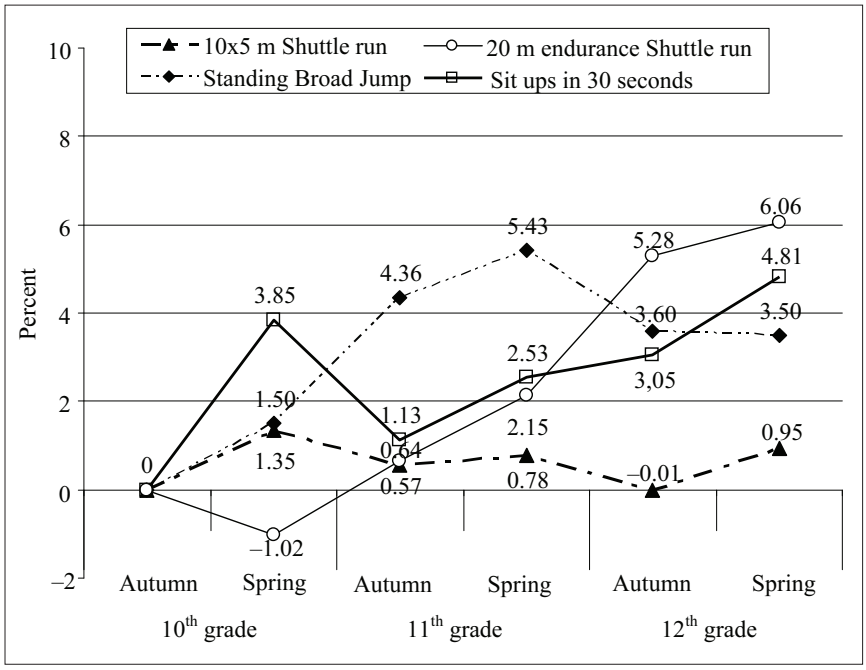
Note. * – $p < 0.05$ compared to the 10th grade autumn, spring and 11th grade autumn results.

Figure 3. **Changes in Sit ups in 30 seconds test results**



Note. * – $p < 0.05$ compared to the 10th and 11th grades autumn results.

Figure 4. **Comparison of changes in results in percent**



in the results of trunk strength. Comparing our findings with the ones by other authors we can see similar results. The research carried out with the girls of the eleventh grade showed that without additional special physical education program indicators of 11th grade schoolchildren physical characteristics during the school year remained the same (Ivaškienė, Meidus, 2007). Girls' physical abilities more or less linearly improve from 6 to 14 years. Strength endurance of trunk muscles improves up to 14 years, and later it remains at the similar level (Malina et al., 2004). Girls' results of standing broad jump, which reflect explosive leg power, increase linearly up to 14 years. After 14 years of age, indicators of explosive leg power improve but at a slower rate (Malina et al., 2004). Agility of girls starts to improve from 5–8 years to 13–14 years, in older age the results of agility improve very slightly (Malina et al., 2004). In this case, our research revealed significant changes in the girls' agility results. Agility of girls from 10–12th grades spring never changed more than by 2%.

Capability of girls' cardiovascular system increases from 7 to 17 years of age, and during this period it increases more than twice (Armstrong, Welsman, 1994; Malina, Katzmarzyk, 2006). Our research also shows that girls' cardiorespiratory endurance improves. The last change was the highest than the one in other tests ever carried out, and it was 9.72%.

Slowdown or stabilization of physical fitness indicators is related to biological changes during girls' maturation (i. e. sexual maturation, fat accumulation and body composition changes) or it is related to cultural factors (i. e. changes in social needs and expectations, pressure of contemporaries, lack of motivation or lack of opportunities to engage in physical activity-related activities). The interaction of biological and cultural factors influences the indicator curves (Malina et al., 2004; Volbekienė, Griciūtė, 2007).

CONCLUSION AND PERSPECTIVES

Comparison of physical fitness of the 10th and 12th grade girls, shows that it improves only in 20 m endurance shuttle run, in the 11th grade explosive strength significantly improves. Further research is needed to determine the results of physical fitness influencing factors and find ways to encourage girls in high grades to improve physically.

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VYRESNIŲJŲ KLASIŲ MERGAIČIŲ FIZINIO PAJĖGUMO KAITA

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Lietuvoje per pastaruosius penkerius metus 10–12 klasių mergaičių fizino pajėgumo kitimo ilgalaikių tyrimų nepavyko rasti. Netiesioginiai šių ypatumų tyrimai parodė, kad Lietuvos moksleivių fizinio pajėgumo kitimas turi neigiamų tendencijų ir tarp moksleivių vyrauja sėdima gyvensena.

Tikslas – nustatyti Kauno miesto mergaičių fizinio pajėgumo rezultatų kitimo ypatumus 10–12 klasėje.

Metodai. Tirtos Kauno miesto 10 klasės mergaitės (n = 244), tyrimo metu buvusios mokykloje ir galinčios atlikti reikiamus Eurofito testus. Duomenys buvo registruojami 2 kartus per mokslo metus – rugsėjo ir gegužės mėnesiais. Ilgalaikis tyrimas pradėtas 10 klasės rudenį ir tęsėsi iki 12 klasės pavasario. Moksleivės atliko Eurofito testus (10 × 5 m bėgimo šaudykle, šuolio į tolį iš vietos, „Sėstis ir gultis“, 20 m ištvermės bėgimo šaudykle).

Rezultatai. Nuo 10 klasės rudens iki 12 klasės pavasario mergaičių skirtingų Eurofito testų rezultatų kaita buvo nevienoda. Tyrimas parodė, kad 10–12 klasėse reikšmingai pakito tik ištvermės testo rezultatai, o 11 klasėje pastebėtas staigiosios jėgos pagerėjimas ir liemens jėgos rezultatų svyravimas.

Aptarimas ir išvados. Lyginant 10 ir 12 klasių mergaičių fizinį pajėgumą nustatyta, kad jis pagerėja tik atliekant 20 m šaudyklinio bėgimo testą, o 11 klasėje reikšmingai pagerėja staigioji jėga.

Raktažodžiai: fizinio pajėgumo kaita, Eurofito testai, fizinės charakteristikos.

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MANIFESTATION OF PROSOCIAL AND ANTISOCIAL BEHAVIOR IN A BASKETBALL MATCH

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ABSTRACT

*Research background and hypothesis***.** The number of studies examining moral issues in sport has increased but we still lack research about actual behavior of athletes during the match. It was hypothesized that players and coaches' behavior would differ in relation with players' age, course and the final outcome of the match.

Research aim was to explore the manifestation of observed prosocial and antisocial behaviors in a basketball match.

Research methods. Data were collected using observation technique. 40 games were observed in the two age groups: 13–14 and 17–18-year-old players.

Research results. Younger players more often than the older ones demonstrated respect to the referee ($p = 0.05$), but older players showed respect to opponents more often ($p = 0.01$). In the second half of the game players quarreled with referees more often than at the beginning of the game ($p = 0.001$). When the difference in the final outcome of the game was less, athletes were more often angry with each other ($p = 0.001$) and cursed more often ($p = 0.034$). Coaches working with younger players showed disrespect to them more often ($p = 0.02$).

Discussion and conclusions. Research partly confirmed the hypothesis that younger basketball players more often demonstrated prosocial behavior during the game. Antisocial behaviors of players were more common in the second half of the match and when the difference in the final result was less. Research did not confirm the fact that coaches who worked with older players demonstrated more antisocial behavior and that such behavior was more common when there was less difference in the results of the match.

Keywords: basketball players and coaches' behavior assessment, moral behavior in sport, players' age, course of the game, final outcome of the game.

INTRODUCTION

Sport may be described as a unique moral context encouraging adaptations in participants' moral reasoning (Bredemeier, Shields, 2001). Thus, in the last years the number of studies examining moral issues in sport has increased. The studies deal with judgments about the legitimacy of injurious acts, moral intention (Vallerand et al., 1992), moral judgment, intention, and behavior as indicators of moral functioning (Kavussanu, Ntoumanis, 2003), sports participants and nonparticipants' moral maturity, considering both sport and life moral reasoning (Bredemeier, Shields, 2001), athletes own sportspersonship attitudes, the perceived collective norms of the team, perceptions of the behavior of coaches and spectators (Shields et al., 2007), effects of goal orientations and perceived motivational climate on prosocial and antisocial behavior (Kavussanu, 2006).

Since moral behavior has been typically defined as low frequency of engagement in negative social behaviors, in some studies athletes have been presented with moral dilemmas describing cheating or aggressive behaviors likely to occur during a game, and they were asked to report the frequency of engagement in these behaviors

during a specified period of time (Kavussanu, Ntoumanis, 2003). This suggests that the studies dealing with athletes' behaviors highlight problems of aggression in sport. Although all these studies expand our understanding of moral behavior in sport, they still have some limitations. One of them refers to overwhelming emphasis on negative social behaviors. But as some scholars suggest, *"*full representation of social conduct in sport can only be achieved if both positive and negative social acts are examined*"* (Kavussanu et al., 2006, p. 327). Referring to this consideration we claim that it is important to investigate positive and negative social behavior in the sport context. We will use the terms prosocial and antisocial behaviors to refer to positive and negative acts respectively. Prosocial behavior has been defined as voluntary behavior intended to help or benefit another individual (Eisenberg, Fabes, 1998). Antisocial behavior has been defined as voluntary behavior intended to harm or disadvantage another individual (Eisenberg, Fabes, 1998). Recent research has revealed two factors representing prosocial behavior (prosocial with teammates and opponent) and two factors representing antisocial behavior (antisocial with teammates and opponent) (Kavussanu, Boardley, 2009).

Another limitation of studies examining moral behavior in sport is that moral behavior has been judged exclusively by athletes or coaches' reports rather than actual behavior. Thereby it is important to assess actual athletes' behavior during the game. Research of this kind is topical as all sports competitions are different – they are a complicated dynamic system (Lebed, 2007) the process of which mostly depends on the decisions made by competitors, especially their coaches, in a specific context. Only some studies investigated actual behavior within the sport context. Researchers have observed prosocial and antisocial behaviors of football players of different age and they established that prosocial behavior was less common among players of older age (Kavussanu et al., 2006). It has also been established that losing teams use more aggression during a match (VaezMousavi, Shojaei, 2005 b). A tendency has been observed that away-from-home team is more aggressive when they are losing (Jones et al., 2005).

Summing up we can claim that there is still a lack of research about actual behavior during the match as the existing studies are more oriented to the evaluation of aggression. Besides, the findings of the present studies raise more unanswered questions: how athletes' behaviors change in the course of the match and how they differ according to the outcome of the match. Thus, the **aim** of our research was to explore the manifestation of prosocial and antisocial behaviors of athletes during a basketball match. While analyzing athletes and coaches' behaviors during the match we checked several hypotheses which specified our research aim: (H1) younger basketball players more often demonstrate respect to referees and opponents compared to the older players, (H2) antisocial behaviors of basketball players are more common in the second half of the match, (H3) the smaller the difference in the results at the end of the match, the less respect to the opponents and the referee's decisions is observed, and (H4) coaches who work with older basketball players demonstrate more disrespect to players and referees during a match, and such behavior is more common when there is less difference in the results of the match.

RESEARCH METHODS

While planning our observations we aimed at defining variables linked to our research object. Thus we carried out pilot observations of two matches where we determined preliminary behavioral patterns which could be attributed to the behavior we were interested in. The list of behavioral patterns was given for the evaluation to two basketball coaches training children. According to their suggestions the preliminary list was corrected, i. e. several actions of athletes which had not been recorded during our pilot observation were added to the list. In this way we distinguished two groups of behavior, i. e. we compiled lists of actions that could be attributed to prosocial and antisocial behavior.

Referring to those changes we made up an observation protocol and then observed two matches. During the observation the coach's actions were given attention. We noticed that it was during the match when the coach demonstrated disrespect to athletes, i. e. the coach shouted at them (e. g. "move on, or you will be running the whole training session"), athletes were incorrectly dubbed (e. g. "asshole", "don't you hear, idiot"). Coaches also showed disrespect to referee's decisions when they started arguing with them, contradicted to them and used obscene words. For this reason we included such actions into our observation protocol. It should be noted that actions of players (bench)

who were not on the court during the game were not recorded. All in all there were 24 observable variables on the protocol.

The third phase of the research included the analysis of the observation findings aiming at assigning actions to prosocial or antisocial behavioral patterns. The evaluation of prosocial behaviors of basketball players allowed distinguishing the following factors: players' respect to referees (compliance with a foul, compatibility with other referee's decisions), respect to competitors (athletes' apologies after unauthorized actions against an opponent, help when they fall on the ground), and the etiquette of the game (such actions as greeting before and after the game, congratulating a teammate on making a successful shot or passing the ball). It should be noted that while distinguishing the last factor, the etiquette of the game, we referred to the studies by other researchers (Wells et al., 2008), who evaluated such actions as the ones mentioned above as elements of game etiquette. Evaluating the antisocial behavior of athletes we distinguished the following groups: disrespect to referees (noncompliance with a foul, objection to other referee's decisions), anger (being angry with teammates and competitors), conflicts using physical force (pushing teammates or opponents), physical aggression against an opponent, i.e. actions aiming at achieving certain goals but the outcome of which is usually a foul (e. g. the player bars the way, trips the opponent up, etc.). A separate group of antisocial behavior included obscene vocabulary used by athletes. Antisocial behavior of coaches was evaluated as three groups of actions: disrespect to athletes (shouting at them, calling incorrect names), disrespect to referee's decisions (arguments with referees, commenting their decisions) and obscene vocabulary of referees.

In order to measure reliability of the data we estimated inter-observer reliability which was based on the scores of two or more observers who recorded the same information while simultaneously and independently observing the same individual or group behavior (Sattler, Hoge, 2006). Although several procedures are available for measuring inter-observer reliability, we applied percentage agreement calculation. We carried out five control observations when the match was observed by two observers. Then we evaluated the percentage agreement of data recorded by both observers. As the observation took place directly during the match recording behaviors on the protocol, and not watching video-recorded materials, so we did not seek that the agreement was necessarily 100%. Five cases of behavior were agreed upon 100%, two cases – no less than 95%, eight cases – in between 90–95%, and all other cases – up to 90%, but no less than 86%.

Research participants. The chosen research participants were teams of schoolchildren participating in one Lithuanian pupils' basketball tournament. The organizers of the tournament were informed about the research, and their consent to observe the matches was received. It should be noted that the tournament included 81 teams of pupils of different age. We chose the age groups of 13–14 and 17–18 years, the schoolchildren of which played in 43 teams in this tournament. We observed 17 teams in 40 games. Twenty games were observed in the age group of 13–14-year-old children (8 teams), and 20 games – in the group of 17–18-year-old players (9 teams). Observation took place in 2008.

Statistical analysis. Analysis was conducted using statistical package *SPSS for Windows 13.0.* We registered the number of cases of behaviors during the whole research as well as the mean values per one game. Student's *t* test was applied to verify the hypothesis about the differences in athletes and coaches' behaviors in the aspect of basketball players' age. One-way ANOVA was applied to check the hypotheses about the differences in athletes and coaches' behaviors depending on the final result of the match, the differences in behaviors in the first and the second halves were assessed using Paired – Samples *t* test. Correlations between the variables of the research were estimated calculating Pearson's correlation coefficient. Statistical significance of differences was set at $p < 0.05$.

RESEARCH RESULTS

Our research revealed that during a match the mean frequency value of prosocial behaviours demonstrated by basketball players was 60.30 (SD = 14.79) times, and the mean frequency value of antisocial behaviours – 40.20 (SD = 15.90) times. The assessment of separate behaviours showed that on average basketball players showed respect to a referee 48.58 (SD = 12.28) times a match, thanked their teammates 11.43 (SD = 6.32) times and they demonstrated respect to their opponents only 0.3 (SD = 0.56) times. The evaluation of antisocial

behaviours revealed that during a game the basketball players contradicted to the referee 4.90 (SD = 4.69) times on average, they got angry with other players 0.65 (SD = 1.02) times, demonstrated physical aggression 23.48 (SD = 9.59) times and used obscene words 6.53 (SD = 5.48) times. The coaches shouted at athletes and abused them3.05 (SD = 3.24) times, used obscene words 1.38 (SD = 2.65 times and quarrelled with referees 0.63 (SD = 0.83) times.

We did not establish any differences in athletes and coaches' behaviors in the aspect of basketball players' age (Table 1). But it should be noted that a tendency was observed showing that athletes tended to demonstrate unfair behaviors in the second half of the game ($p = 0.06$). Analogous antisocial behavior was more common in those games which ended at a difference less than 10 points ($F = 5.98$; $p = 0.02$).

The analysis of athletes of different age and their coaches' behaviors during the match revealed more differences (Table 2). Younger players more often than older players demonstrated respect to the referee ($t = 2.03$; $p = 0.05$), but older players (though such cases are seldom in general) showed respect to opponents more often ($t = –2.58$; $p = 0.01$). Speaking about antisocial behaviors we should note that older players cursed more often during the game ($t = –3.74$; $p = 0.001$). We observed a tendency that more often they disagreed with the referee's decisions. However, coaches working with younger players showed disrespect to them more often ($t = 2.37$; $p = 0.02$).

Our findings showed that in the second half of the game basketball players quarreled with referees more often than at the beginning of the game ($t = 3.72$; $p = 0.001$). Our observation showed that when the difference in the final outcome of the game was less, athletes were more often angry with each other ($F = 43.72$; $p = 0.001$) and cursed more often ($F = 4.82$; $p = 0.034$). We found a tendency that coaches were more often angry with players and used obscene words when the game ended with a bigger difference in points.

Significant correlations were found between athletes' contradictions to referees and their anger ($r = 0.68$; $p < 00.1$), conflict behavior ($r = 0.54$; $p < 0.01$) and physical aggression ($r = 0.59$, $p < 0.01$). By analogy, athletes' anger was linked to physical aggression ($r = 0.32$; $p < 0.01$) and the use of obscene vocabulary ($r = 0.40$; $p < 0.01$). Negative correlation was established between the use of obscene words by basketball players and their respect to referees ($r = –0.40$; $p < 0.01$). We also found a negative correlation between the players' actions that could be attributed to the etiquette of the game and obscene words used by the coach ($r = –0.37$; $p < 0.05$) as well as players getting into conflicts and coaches' disrespect to the referees ($r = 0.42$; $p < 0.01$).

DISCUSSION

Analyzing the data of basketball players' behaviors in different age groups during the match we established that the first hypothesis of our research was only partly conformed. We hypothesized that younger players would demonstrate respect to referees and opponents more often than their older counterparts. Observation data indicated that younger players more often agreed with the referees' decisions, but they more seldom demonstrated

Table 1. **Absolute and mean frequency values of basketball players and coaches' behavior during the game in the aspect of the players' age, the course of the game and final result**

Research participants	Basketball players and coaches' behavior					
	Prosocial behavior of basketball players		Antisocial behavior of basketball players		Antisocial behavior of basketball coaches	
	N	M (SD)	N	M (SD)	N	M (SD)
13–14-year-old players	1315	62.62 (12.59)	790	37.62 (11.75)	113	5.38 (3.83)
17–18-year-old players	1097	57.74 (16.88)	818	43.05 (19.38)	89	4.68 (6.04)
First half of the game	1190	29.75 (7.33)	771	19.28 (7.85)	107	2.68 (3.03)
Second half of the game	1222	30.55 (8.66)	837	20.93 (8.88)	95	2.38 (2.42)
The final result differs in less than 10 points[1]	853	60.92 (14.57)	673	48.07 (12.86)	52	3.71 (3.95)
The final result differs in 10 points and more	1559	59.96 (15.18)	935	35.96 (15.92)*	150	5.77 (5.38)

Notes. 1 – Fifteen matches ended with a less difference than 10 points, and 25 matches – 10 points and more. The absolute values show the total number of registered actions in all matches observed. * – statistically significant difference ($p < 0.05$) comparing expressions of basketball players' antisocial behavior despite their final results.

Table 2. **Absolute values and mean frequency values of observed behavior during the game in the aspect of athletes' age, the course of the game and final outcome**

Basketball players and coaches' behavior	Basketball players' age		Halves of the game		Final result[1]	
	13–14 years N (M, SD)	17–18 years N (M, SD)	First half N (M, SD)	Second half N (M, SD)	Difference >10 points N (M, SD)	Difference ≤ 10 points N (M, SD)
Basketball players' behavior						
Respect to referee's decisions	1096 (52.19; 10.95)	847 (44.57; 12.71) *[a]	969 (24.23; 6.42)	974 (24.35; 7.24)	673 (48.07; 14.06)	1270 (48.84; 11.51)
Respect to opponents	2 (0.10; 0.30)	10 (0,53; 0.70)**[a]	5 (0.13; 0.33)	7 (0.18; 0.44)	3 (0.21; 0.58)	9 (0.35; 0.56)
Game etiquette	217 (10.33; 6.40)	240 (12.63; 6.18)	216 (5.40; 3.43)	241 (6.03; 3.41)	177 (12.64; 5.58)	280 (10.78; 6.70)
Contradictions to the referee	79 (3.76; 3.30)	117 (6.16; 5.69)	74 (1.85; 2.45)	122 (3.05; 2.66)***[b]	79 (5.64; 3.95)	117 (4.50; 5.07)
Demonstration of anger	104 (4.95, 3.17)	71 (3.74, 2.98)	83 (2.07, 1.86)	92 (2.30, 1.80)	104 (7.43, 2.44)	71 (2.73, 1.97)**[c]
Reactive aggression	19 (0.90; 1.22)	18 (0.95; 1.27)	13 (0.33; 0.65)	24 (0.60; 0.87)	16 (1.14; 1.40)	21 (0.81; 1.13)
Physical aggression	507 (24.14; 8.58)	432 (22.74; 10.78).	477 (11.93; 4.36)	462 (11.55; 6.00)	348 (24.85; 9.33)	591 (22.73; 9.82)
Obscene words	81 (3.86; 3.95)	180 (9.47; 5.50)***[a]	124 (3.10; 3.01)	137 (3.43; 3.28)	126 (9.00; 6.56)	135 (5.19; 4.38)*[c]
Coaches' behavior						
Coach's disrespect to players	87 (4.14; 3.52)	35 (1.84; 2.46)*[a]	71 (1.78; 1.99)	51 (1.28; 1.78)	38 (2.71; 3.95)	84 (3.23; 2.86)
Coach's disrespect to referees	12 (0.57; 0.68)	13 (0.68; 1.01)	9 (0.23; 0.58)	16 (0.40; 0.59)	7 (0.50; 0.75)	18 (0.69; 0.88)
Obscene words	14 (0.67; 1.28)	41 (2.16; 3.50)	27 (0.68; 1.52)	28 (0.70; 1.29)	7 (0.50; 1.09)	48 (1.84; 3.11)

Notes. 1 – Fifteen matches ended with a less difference than 10 points, and 25 matches – 10 points and more. The absolute values show the total number of registered actions in all matches observed. a – statistically significant difference comparing behaviors of athletes of different age and their coaches who trained them; b – statistically significant difference comparing behaviors of athletes and their coaches in the first and the second halves of the game; c – statistically significant difference comparing behaviors of athletes and their coaches during the game despite their final result. * – $p < 0.05$; ** – $p < 0.01$; *** – $p < 0.001$.

respect to opponents. By analogy, older basketball players more often quarreled with referees and used obscene words in this way showing their dissatisfaction with the course of the game. It should be noted that other researchers who investigated athletes (football players) of similar age established that older than 15-year-old players demonstrated less prosocial behavior than their younger counterparts (Kavussanu et al., 2006). So why older basketball players demonstrated more respect to opponents (though such behavior is rather seldom in general)? This can be explained by the findings of other researchers who observed a different tendency to the ones mentioned above, i.e. prosocial behavior was more common to older basketball players (it should be noted that the subjects were younger compared to the ones in the previously mentioned study) (Arthur-Banning et al., 2009). Researchers explained such facts by the greater number of points earned when the players had more possibilities to express gratitude to their teammates for successful actions. Similarly, we suggest that older basketball players more often demonstrate respect to opponents apologizing for their fouls because at an older age their fouls are ruder compared to the ones of younger players. We also believe that such situations are often discussed in the teams, and older players are more aware of their appropriate behavior under certain conditions. This would also explain the fact that older players more often greet their opponents before and after the game. Besides, older players greet the referees, which is absolutely uncharacteristic of younger players.

Research showed that in the second half of the game basketball players demonstrated more antisocial behavior and this confirmed our second hypothesis. Those results are of no surprise because in the course of the game the tension increases, and this is related to anger and more discussions with referees. Other researchers (Coulomb, Pfister, 1998) have also found that in the second half of the game cases of hostile aggression are more common, and it usually manifests in anger outbursts.

The analysis of basketball players' behavior in the aspect of the final result confirmed our third hypothesis. More antisocial behavior was observed in those matches that ended in less than ten-point difference. This difference was influenced by more common cases of anger, obscene language and contradictions to referees' decisions. These results could be expected as little difference in points testifies persistent sports duel, and each unfavorable decision of the referee or unsuccessful attack as well as certain opponents' actions can stimulate the players to react more sensitively.

The analysis of the coach's behavior revealed only some tendencies which in essence did not confirm our hypothesis that incorrect behavior and quarrels with referees were more common to those coaches who trained older basketball players and such behavior could be more often observed during a tighter game. We established that coaches working with younger players more often called them incorrect names and shouted at them. On the other hand, coaches working with older players more often used obscene vocabulary. We found an opposite tendency to our hypothesis – coaches were angrier with players and referees and more often use obscene words when the game ended in more than 10-point difference. Besides, our research showed that coach's disrespect to referee's decision correlated to athletes' threats to other players. We can draw a conclusion that inappropriate behavior of coaches can encourage inappropriate behavior of their trainees. This supposition has been partly confirmed by other studies which suggest that aggressive verbal communication of coaches determine unfair behaviors of athletes (Hassandra et al., 2007) and that there is a link between the coach's behavior during the game and the level of athletes' aggressiveness (VaezMousavi, Shojaei, 2005 a). While evaluating the influence of the coach on athletes' behavior, it should be noted that athletes' well-being and performance are not so much affected by the coach's manner of speaking, but by nature of the information forwarded (Vargas-Tonsing, 2009). This information can differ greatly. It has been established that during the game the coaches most often give instructions what to do, they praise athletes more seldom, and sometimes they keep silent (Cushion, Jones, 2001). It should be noted that being silent can have a certain meaning.

Though the research data mentioned above suggest that the coach makes influence conveying certain models of behavior to the trainees during the match, some aspects still need consideration. The coach not necessarily has to be polite and friendly to athletes, and the angry tone of voice not necessarily should be evaluated negatively. In the development of athletes' fair behaviors the coach should be more an educator and not a friend (Ciairano et al., 2007), and not only talk about fair behavior, but demonstrate it leading by example. Such behavior would mostly affect athletes' behaviors more than simple talking (Arthur-Banning et al., 2009). Thus

it is natural that during the game the coaches might lose their temper, be angry with athletes and referees, but they should not exceed a certain threshold and use words that should not be used working with children. The coaches should not use obscene vocabulary either. On the basis of this research we could recommend that while training would-be coaches and counseling already working coaches much attention should be paid to the culture of language and the educational impact of verbal communication on the work with children. Some research data show that up to 70% of children younger than 13 years old leave sorts activities (Arthur-Banning et al., 2009). There are many reasons for that, but among them is the atmosphere of justifying unfair behavior in the team.

CONCLUSIONS AND PERSPECTIVES

The present research not only revealed some tendencies of children athletes and coaches' behavior, but also indicated the perspectives for further research. Older basketball players more seldom agree with referees' decisions, but they more often show respect to opponents than younger players. Generally quarrels with referees and anger, obscene words are more common in the second half of the game and in those games which end with a smaller difference in points. More often the coaches demonstrate disrespect to younger players, and they argue with referees more in the second half of the game. Continuing similar research it would be appropriate to evaluate the behavior of the coach of a winning and a losing team. Besides, evaluating the behaviors of coaches in the course of the game, especially their verbal communication, it would be useful to compare male and female coaches. This study was limited to observation of negative behaviors of coaches, but in the future positive behaviors should also be studied. As we investigated only the boys, it is still unclear if the same tendencies are common for the girls playing basketball.

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PROSOCIALAUS IR ANTISOCIALAUS ELGESIO RAIŠKA KREPŠINIO RUNGTYNIŲ METU

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Pastaraisiais metais nemažai tirta aiškinantis vaikų moralinio elgesio sportinėje veikloje ypatumus, tačiau trūksta tyrimų apie realų elgesį per rungtynes. Tyrimo metu stebint žaidėjus ir trenerį keltos hipotezės, kad jų elgesys skirsis priklausomai nuo krepšininkų amžiaus, rungtynių eigos bei galutinio rezultato.

Tikslas – išsiaiškinti prosocialaus ir antisocialaus elgesio raišką krepšinio rungtynių metu.

Metodai. Buvo naudotas stebėjimo metodas. Stebėta 20 rungtynių 13–14 amžiaus grupėje (8 komandos) ir 20 rungtynių 17–18 metų grupėje (9 komandos).

Rezultatai. Vyresni krepšininkai rečiau sutinka su teisėjų sprendimais ($p = 0,05$), tačiau dažniau rodo pagarbą varžovams nei jaunesni ($p = 0,01$). Antroje rungtynių dalyje krepšininkai dažniau ginčijasi su teisėjais nei rungtynių pradžioje ($p = 0,001$). Pyktis ($p = 0,001$), ypač necenzūriniai žodžiai ($p = 0,03$), būdingesni tose rungtynėse, kurios baigiasi mažesniu skirtumu. Nepagarbą treneris dažniau rodo jaunesniems krepšininkams ($p = 0,02$).

Aptarimas ir išvados. Tyrimas iš dalies patvirtino keltą hipotezę, kad jauni krepšininkai dažniau rodo pagarbą teisėjams ir varžovams nei vyresni krepšininkai Pasitvirtino kelta hipotezė, kad antroje rungtynių dalyje krepšininkai dažniau elgiasi antisocialiai. Pasitvirtino ir trečioji hipotezė – krepšininkų elgesys skiriasi priklausomai nuo galutinio rungtynių rezultato. Nepasitvirtino hipotezė, kad vyresnius krepšininkus treniruojantys treneriai rodo daugiau nepagarbos žaidėjams bei teisėjams rungtynių metu, ir toks elgesys būdingesnis rungtynėse, kurios baigiasi mažesniu skirtumu. Tęsiant tyrimus tikslinga atskirai įvertinti laimėjusios ir pralaimėjusios komandos trenerių elgesį. Be to, vertinant trenerių elgesį rungtynių metu, tikslinga palyginti trenerius vyrus ir moteris. Buvo tirti berniukai, todėl lieka neaišku, ar nustatytos tendencijos būdingos ir krepšinį žaidžiančioms mergaitėms.

Raktažodžiai: krepšininkų ir trenerio elgesio vertinimas, moralinis elgesys sportinėje veikloje, žaidėjų amžius, rungtynių eiga, rungtynių galutinis rezultatas.

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DYNAMICS OF MUSCULAR PERFORMANCE INDICES DURING THE 30-s VERTICAL JUMP TEST IN ENDURANCE AND SPRINT COHORTS

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ABSTRACT

Research background and hypothesis. According the methodological requirement testing procedures do not modify the main training objectives. It is well known that specificity of performance assessment tests is important if we want to compare performance of different groups tested.

Research aim was to find out the peculiarities of muscular performance indices in sprint and endurance cohorts while performing a 30-s vertical jump test.

Research methods. The participants of the study were two groups of athletes, i. e. sprint and endurance runners. The participants of the study performed a 30-s vertical jumps test with maximal efforts. The sum of height of all jumps was calculated by a special computerized program and the values in height of jumps, contact time and relative power at onset of workload and at each 5 seconds of the test were analyzed.

Research results. The difference between the cohorts in jumps height was statistically significant ($p < 0.05$) during the whole series of jumps. Athletes' adaptation to speed-power type of exercising produced higher anaerobic muscle performance indices while performing 30-s duration jumps test. Endurance runners usually demonstrate lower results in jumping than sprint- athletes and they compensate reduced muscular power with prolonged duration of take-off.

Discussion and conclusions. Despite some methodological limitations the results of this study show that the assessment of muscular performance indices allows assessing the peculiarities of dynamics of relative muscle power and fatigue.

Keywords: endurance and sprint running, muscular performance, vertical jump test.

INTRODUCTION

It is accepted that the best index of sports performance abilities is a competitive result and pedagogical, physiological, biochemical, psychological or other tests indicate only the factors on which sports results depend (Maud, Foster, 1995; Raslanas, 2000 et al.).

The exercise tests are widely used for the assessment of preparedness for performance of athletes and the changes in various stages of training. We tested the hypothesis that some muscular performance indices or their interplay should be more sensitive while comparing the groups with different type of exercising.

Testing procedures have clearly formulated methodological requirements so that a testing procedure could not modify the adaptation planned by the coach (Viru, A. M., Viru, M., 2004).

The 60-s vertical jump test suggested by Bosco was designed to determine the maximal anaerobic power, and based on the measurements of individual performance in a task of vertical jumps (Luthanen, Comi, 1978; Bosco et al., 1983; Narita, Anderson, 1992; Bosco, 2000). This test is very popular and usually used to assess muscle functional performance of athletes. Special research on the functional changes of the

cardiovascular system was carried out using Bosco test and the modified version of it of this test, i. e. the 30-s vertical jump test (Poderys et al., 2005, 2010). 60 s vertical jump test is a very difficult test, so this testing procedure is recommended only for well prepared athletes to determine the changes in their anaerobic capacity. The shorter variant of testing is recommended to determine the abilities of non-trained persons. Authors suggest to apply a 30-s duration vertical jump test (Buliuolis, 2006). In this study we analyzed the peculiarities of muscular performance indices during 30- s vertical jump test. The aim of this study was to find out the peculiarities of muscular performance indices in sprint and endurance cohorts while performing a 30-s vertical jump test.

RESEARCH METHODS

The participants of the study were students from various Lithuanian universities, athletes of different running events, i. e. runners in sprint or endurance events and candidates of Track and Field Athletics team of Kaunas, some of them were top or near-top athletes. The athletes were divided in to endurance and sprint cohorts (Table). After a warm-up and short recovery time the athletes performed a 30-s vertical jump test with maximal efforts. The height, push-off and relative power of jumps were registered and analyzed.

During this test, the subjects stood up on a contact platform and performed a 30-s vertical jump test with maximal efforts. The jumps were performed without active swings by hands. To measure the height of jumps, the contact platform was connected with a PC. The sum of the height of all jumps (Σ) was calculated by a special computerized program. Then muscular performance indices were analyzed: the values of the height of jumps, contact time and relative power at onset of workload and at each 5 seconds of the test.

Table 1. **Characteristics of research participants**

Indices	Sprint	Endurance
Number of participants (n)	30	23
Age, years	20.9 ± 0.3	20.7 ± 0.4
Height, cm	182.6 ± 1.1	180.1 ± 1.2
Weight, kg	76.2 ± 1.1	70.6 ± 1.1
BMI, kg/m^2	22.9 ± 0.3	21.7 ± 0.3

Note. (Means ± SE).

Statistical analysis. The research data were processed using *Microsoft Excel 2007* program for mathematical statistical analysis. Descriptive data are presented as means ±SE. The mean peak torque was compared between cohorts using Student's *t* test. The level for statistical significance was set to an alpha level of $p < 0.05$.

RESEARCH RESULTS

The computerized program registered and presented the absolute values and dynamics of averaged results in height of jumps, relative muscle power, the sum of jump height, the number of jumps, and the decrease in jump performance indices. The results obtained in the study showed that the mean values of jump height in the sprinters cohort at the beginning of the workload were (45.4 ± 0.9 cm), and it was significantly greater than in the endurance runners cohort (34.9 ± 1.1 cm) (Figure 1). The difference was statically significant ($p < 0.05$).

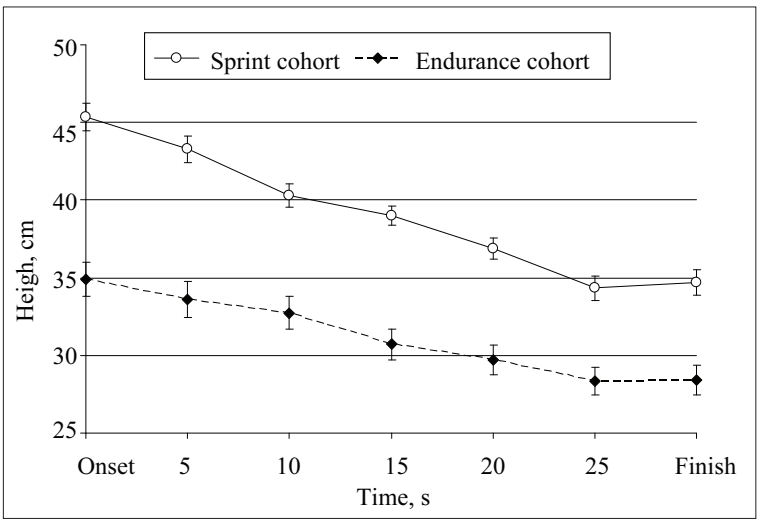

Figure 1. **Dynamics of jumps height while performing 30-s jump test**

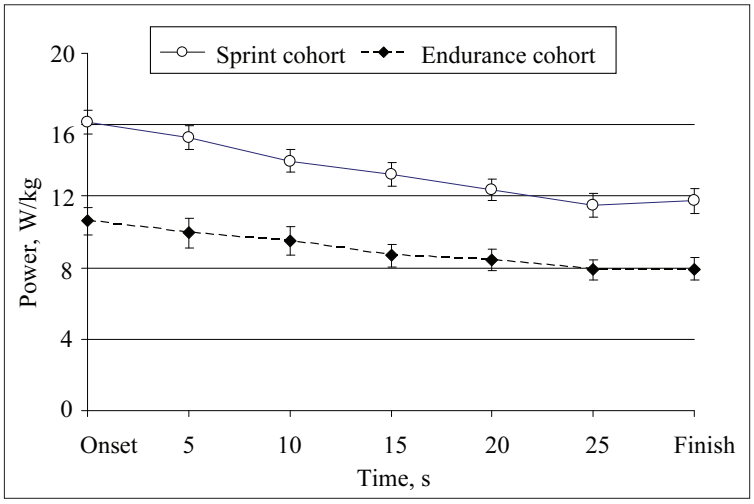

Figure 2. **Dynamics of relative muscle power while performing 30-s jumps test**

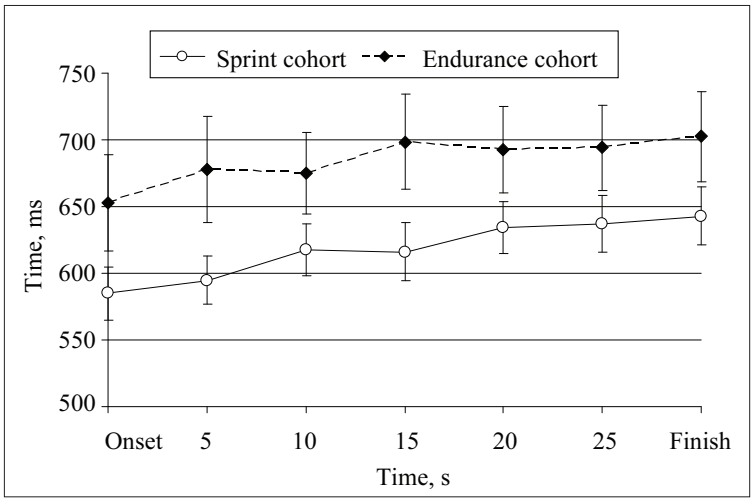

Figure 3. **Duration of take-off while performing 30-s duration jump test**

The averaged values of jump height registered every five seconds during the workload decreased in both experimental groups. The difference between the cohorts in jump height remained statistically significant ($p < 0.05$) during the whole series of jumps. At the end of the series sprinters were able to jump 34.7 ± 0.8 cm, and endurance athletes – 28.4 ± 1.0 cm.

The changes in relative muscle power during whole jumping test had a similar trend as the jump height in both experimental cohorts. Accordingly, in the series of jumps at the beginning of the workload, the sprinters were able to develop 16.1 ± 0.7 W/kg, and 10.6 ± 0.8 W/kg – endurance runners (Figure 2). At the end of the series of jumps, the relative power values were reduced, respectively –11.7 ± 0.7 W/kg (sprint cohort) and 7.9 ± 0.6 W/kg (endurance cohort). The difference was statistically significant ($p < 0.05$).

While comparing the decline between the groups in the speed of jump height and relative muscle power during the whole testing procedure, we found that sprinters' jump height decreased by 24.1 ± 1.3% and the relative power of – 28.7 ± 2.0%. In endurance runners cohort the jump height decreased by 18.5 ± 1.7%, while the relative power decreased by 24.0 ± 3.3%. Both groups performed the same number of jump during the workload: sprinters – 26.8 ± 0.4, and endurance athletes – 26.7 ± 0.5 jumps. However, the sum of height in sprinters' group was higher, i. e. 1029.8 ± 24.8 cm, endurance runners – 815.7 ± 33.9 cm. This difference was statically significant ($p < 0.05$). The amount of relative muscle power while performing 30-s maximal jumping series, was also statistically different between the groups ($p < 0.05$). A total sum of all jumps in relative muscular power were as follows: sprinters cohort 347.1 ± 19.9 W/kg and

endurance runners cohort – 225.4 ± 19.6 W/kg. Figure 3 shows that the contact time in sprinters cohort increased with the development of fatigue from 584.8 ± 19.9 ms up to 643.0 ± 22.1 ms and in endurance cohort from 652.9 ± 36.1 ms up to 702.5 ± 33.7 ms, respectively.

DISCUSSION

Vertical jump test required involvement of main muscle groups. In literature we can find some data concerning the importance of participation of various muscle groups during the jumps. C. L. Hubley and R. P. Wells (1983) present the data that for performance of a vertical jump with a take-off with both legs without swinging arms muscles performing the thigh movement (*buttocks, etc.*) gave approximately 28%; thigh muscles (*calve movement*)– 49% and calf muscles (*foot movement*) – 23% of energy. Australian researcher (Blight, 1994) presented the data about the contribution of various muscles to performance of a single vertical jump with active swing by arms. The active muscules include the primary (*main*) muscles, i. e. quadriceps – 33%; secondary muscles, i. e. thigh spinal muscles – 27% and buttock muscle – 5 %; muscles bending the foot – 7%, back spinal muscles (*m. deltaic, m. trapezium*) – 18%; and tertiary_muscles, i. e. other muscles of the body – 10%. So, the vertical jump could be an integral power index of the whole-body muscles.

Muscles can adapt to workloads performed during the training session – short-term or fast adaptation and to regular exercising – long-term adaptation (Häkkinen, 1994; Pette, 1986; Skurvydas, 1991). Muscle adapts differently to strength, power, and speed or endurance type of exercising (Häkkinen, 1994; Maio Alves et al., 2010; Nimphius et al., 2010). Results obtained during this study showed that persons having adapted to speed and power type of loads could be characterized with ability to demonstrate a higher muscle performance index and to perform short-term exercising with maximal efforts than the persons adapted to endurance type of exercising.

The results of our research demonstrated that athletes with different type of long-term adaptation showed that subjects were able to demonstrate different results in high of jumps. Endurance runners usually demonstrate a lower result in jumping than sprinters and the reduction in muscular power is compensated by the prolonged duration of contact time.

These results have demonstrated well-known fact that the specificity of workload during the testing procedure is an important factor when the task is to compare the performance abilities between different cohorts.

We found that the absolute values of all measured muscular performance indices were higher in sprint cohort. Such an unambiguous gain between participants of sprint cohort was like an advantage for anaerobic performance. There was no doubt that athletes, adapted to endurance physical loads, would have an advantage in the assessment of the other aspects of muscular performance, such as endurance or economy during long-term tasks.

Research literature suggests that the assessment of anaerobic working-capacity needs to choose the duration of testing workload depending on athlete's specialization. For example, in the assessment of sprinters, muscular performance should take shorter workloads compared to endurance athletes (Maud, Foster, 1995; Taylor, Romer, 2008).

In conclusion, the results of this study show that despite some methodological limitations mentioned above the assessment of muscular performance indices allows assessing the peculiarities of dynamics of relative muscle power and fatigue.

CONCLUSION AND PERSPECTIVES

Athletes, who have adapted to speed-power type of exercising, demonstrate higher anaerobic muscle performance indices while performing 30-s duration jump test than endurance athletes. Endurance runners usually demonstrate a lower result during the jumping test than sprinters and the reduction in muscular power in compensated by prolonged duration of contact time.

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GREITUMĄ IR IŠTVERMĘ LAVINANČIŲ SPORTININKŲ RAUMENŲ DARBINGUMO RODIKLIŲ KAITA ATLIEKANT 30 S TRUKMĖS VERTIKALAUS ŠUOLIAVIMO TESTĄ

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Vertinant sportuojančiųjų parengtumą ir jo pokyčius po treniruotės etapo taikomi fizinio krūvio mėginiai, kurių metu greitai pavargstama. Suformuluotas aiškus metodinis reikalavimas, kad testavimo procedūra neturi modifikuoti treniruotės tikslų. Gerai žinoma, kad darbingumo vertinimo testų specifiškumas yra reikšmingas tada, kai norime palyginti skirtingų tiriamųjų grupių darbingumą.

Tikslas – nustatyti sprinto ir ištvermės bėgikų raumenų darbingumo rodiklių kaitos ypatybes atliekant 30 s trukmės vertikalaus šuoliavimo testą.

Metodai. Buvo tiriami lengvaatlečiai bėgikai (sprinto ir ištvermės grupės). Tiriamieji atliko 30 s trukmės vertikalaus šuoliavimo testą didžiausiomis pastangomis. Sportininkui šuoliuojant ant kontaktinės platformos, vertinome šuolio aukščio, santykinio galingumo, jų mažėjimo spartos, atremties fazės trukmės rodiklius, skaičiavome visų atliktų šuolių aukščio sumą.

Rezultatai. Visos šuolių serijos metu abiejų tiriamųjų grupių, šuolių aukščio vidutinės reikšmės, užregistruotos kas penkias sekundes, mažėjo. Lyginant abi tiriamųjų grupes, šuolių aukščio vidutinių reikšmių skirtumas išliko statistiškai reikšmingas ($p < 0,05$) visos šuolių serijos metu. Abiejų tiriamųjų grupių raumenų santykinio galingumo kaita serijos metu turėjo panašią tendenciją. Šuolių serijos metu nustatėme, kad sprinterių grupėje šuolio aukštis ir santykinis galingumas mažėjo didesne sparta nei ištvermės bėgikų. Viso šuolių testo metu atsispyrimo trukmė buvo kur kas ilgesnė ištvermės bėgikų grupėje.

Aptarimas ir išvados. Nepaisant kai kurių metodinių apribojimų, vertikalaus šuoliavimo testas, sukuriantis greitai besivystančio nuovargio sąlygas, leidžia vertinti sportuojančiojo raumenų santykinio galingumo, nuovargio ir jų kaitos ypatybes. Prie greitumo krūvių adaptavęsi asmenys pasiekia reikšmingai didesnių raumenų darbingumo rodiklių nei ištvermės šakų sportininkai. Atlikdami fizinio krūvio užduotis greitai besivystančio nuovargio sąlygomis ištvermės bėgikai mažėjantį raumenų susitraukimo galingumą kompensuoja atremties fazės trukmės pailginimu daugiau nei sprinteriai.

Raktažodžiai: ištvermės ir sprinto bėgimas, raumenų darbingumas, vertikalių šuolių testas.

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Literatūros aprašo pavyzdžiai:

Gikys, V. (1982). *Vadovas ir kolektyvas*. Vilnius: Žinija.

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INFORMATION TO AUTHORS

1. General information

1.1. All papers submitted to the journal should contain original research not previously published (except preliminary reports or conference thesis). The material published in the journal should be new, true to fact and precise. The methods and procedures of the experiment should be identified in sufficient detail to allow other investigators to reproduce the results. It is desirable that the material to be published should have been discussed previously at conferences or seminars.

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1.7. Data about all the authors of the article (address, e-mail, fax and phone number, research interests of the authors) should be presented, as well as a guarantee letter proving that the article submitted is original and not previously published.

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2.1. **The title page** contains the title of the article; the authors' names and surnames; the names of the institutions where the authors work or study (indicating the city and the country); the address for correspondence.

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2.9. **Acknowledgements.** On the Acknowledgement Page the authors are required to state all funding sources, and the names of companies, manufacturers, or outside organizations providing technical or equipment support (in case such support had been provided).

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3.1. Manuscripts must be typed on white standard A4 paper (210 × 297 mm) with the interval between lines 6 mm (1.5 line spaced), with a character size at 12 points, with 3 cm margin on the left and 1.5 cm on the right, with a 2.5 cm margins at the top and the bottom of the page. Pages are numbered in the bottom right-hand corner beginning with the title page numbered as Page 1.

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Bjork, R. A. (1989). Retrieval inhibition as an adaptive mechanism in human memory. In H. L. Roediger III, F. I. M. Craik (Eds.), *Varieties of Memory & Consciousness* (pp. 309–330). Hillsdale, N J: Erlbaum.

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Gibbs, J. T., Huang, L. N. (Eds.). (1991). *Children of Color: Psychological Interventions With Minority Youth.* San Francisco: Jossey–Bass.

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Mokslinis vadovas prof. dr. Vytautas Streckis.

We congratulate **Giedrius Gorianovas**, the student of doctoral studies at the Lithuanian Academy of Physical Education, to have defended his thesis “Repeated bout effect on people of different age and gender” (Biomedical Sciences, Biology) at the Lithuanian Academy of Physical Education on September 23, 2011.
Scientific advisor Prof. Dr. Vytautas Streckis.

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