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THE RESIDUAL EFFECT OF PRIOR DROP JUMPS ON EMG PARAMETERS OF THIGH MUSCLES DURING MODERATE AND HEAVY CYCLING

Neringa Baranauskienė, Loreta Stasiulė, Sandra Raubaitė, Arvydas Stasiulis
Lithuanian Academy of Physical Education, Kaunas, Lithuania

ABSTRACT

Research background and hypothesis. Prior eccentric or eccentric-concentric exercise induces long lasting muscle fatigue and delayed onset muscle soreness (DOMS). Moreover, the surface electromyogram sEMG amplitude increases under fatigue conditions. We suppose that prior eccentric – concentric exercise, inducing DOMS, increases EMG amplitude of thigh muscles during constant cycling exercises.

Research aim of the study was to assess the residual effect of 100 prior drop jumps (PDJ) on the sEMG of *m. vastus lateralis* and *m. vastus medialis* during moderate and heavy intensity cycling exercises.

Research methods. On four different days 10 female students performed one increasing and three (control, 45 min and 24 h after 100 drop jumps) moderate and heavy cycling (Ergoline-800, Germany) exercises. The cadence of cycling was 70 rpm. The sEMG of right thigh *m. vastus lateralis* and *m. vastus medialis* were continuously recorded during moderate and heavy cycling exercise. Creatine kinase activity was measured and DOMS was rated 24 h after PDJ.

Research results. After 24 h the subjects felt moderate DOMS (5.0 (2.79)) according to 10 point scale. The sEMG root mean square amplitude of *m. vastus lateralis* significantly increased 24 h after PDJ during moderate, but unaltered during heavy cycling exercise under fatigue conditions (45 min and 24 h after PDJ).

Discussion and conclusion. Prior drop jumps seem to have significant residual (within 24 h of recovery) effect on EMG of thigh muscles during moderate cycling exercise in female students.

Keywords: delayed onset muscle soreness, constant load, EMG root mean square.

INTRODUCTION

Repeated eccentric muscle actions, during which the muscle lengthens during action, are known to induce delayed onset muscle soreness (DOMS), which is first felt 6–10 hours post exercise and peaks between 24 and 48 h post exercise (Gleeson et al., 1995). Associates with eccentric exercise induced DOMS are evidence of muscle fibres disarrangement (Hortobagay et al., 1996; Stupka et al., 2001; Laanksonen et al., 2006; Malm, Yu, 2012), increased serum creatine kinase (CK) activity (Gleeson et al., 1995; Stupka et al., 2000; Chen et al., 2010; Skurvydas et al., 2010), decreased muscle force production (Chen et al., 2010; Laanksonen et al., 2006; Semmler et

al., 2007; Skurvydas et al., 2010) and decreased cycling performance efficiency (Horita et al., 2003; Moysi et al., 2005). Repetitive prior drop jumps (PDJ) from 0.4 m height induce long lasting (within 24–48 h of recovery) muscle fatigue, DOMS and increased CK activity (Skurvydas et al., 2000, 2007; Gorianovas et al., 2010).

The surface electromyography (sEMG) signal is commonly used to evaluate neuromuscular fatigue during isometric leg muscle actions (Hendrix et al., 2009) and cycling exercise (Camic et al., 2010). Fatigue is characterized by an increase in sEMG amplitude that reflects the recruitment of additional motor units, increased firing rates, and/

or synchronization (Basmajian, DeLuca, 1985; Hortobagay et al., 1996). It has been reported that prior heavy cycling increases integrated EMG (iEMG) of thigh muscle during heavy cycling (Burnley et al., 2002) and in contrast no alteration of the root mean square (RMS) of sEMG during moderate cycling has been observed (Gonzales, Scheuermann, 2008). Recent study results have demonstrated increases in sEMG amplitude during biceps brachii isometric contractions for at least 24 hours after eccentric exercises (Semmler et al., 2007; Starbuck, Eston, 2011). We have not found data about the residual effect of DOMS induced eccentric exercise on EMG during dynamic exercise.

The aim of the study was to assess the residual effect of 100 PDJ on the EMG of *m. vastus lateralis* (mVL) and *m. vastus medialis* (mVM) during moderate (MCE) and heavy (HCE) intensity cycling exercise.

RESEARCH METHODS

Participants. Ten healthy female students (anthropometry and physical characteristics are presented in Table) volunteered to participate in this study after giving written informed consent. The subjects were physically active but did not take part in any formal physical exercise or sport program. The experimental protocol was approved by the Lithuanian Ethics Committee of Kaunas Medical University and conducted in accordance with the Declaration of Helsinki.

Incremental cycling exercise. The first and the second ventilation thresholds (VT_1 and VT_2 , respectively) and peak oxygen uptake ($\dot{V}O_{2peak}$) were evaluated using an incremental cycling exercise (ICE) test (two W every five s) on an electronically braked cycle ergometer “Ergometrics-800S” (Ergo Line, Medical Measurement Systems; Binz, Germany) at a pedal cadence of 70 rpm. The test was started by three min of baseline pedalling at 20 W and continued until the intensity of cycling could not be maintained at the required level for longer than 10 s. Subjects breathed through low resistance mouthpiece and gas exchange was

measured breath-by-breath using wireless portable ergospirometric system “Oxycon mobile” (Viasys Healthcare; California, USA). The average value of $\dot{V}O_2$ over the last 30 s of cycling was referred to as $\dot{V}O_{2peak}$ and the VT_1 and VT_2 were determined from the result of the ICE. The seat and handlebar positions on the cycle ergometer were adjusted for each subject prior to initial exercise test and maintained in that position for the subsequent exercise tests.

Moderate and heavy cycling exercises. The intensity of MCE test was 80% of VT_1 and the intensity of HCE test was $\Delta 50\%$ of VT_2 and VT_1 values ($(VT_1 + VT_2) \cdot 2^{-1}$). The MCE and HCE were preceded by three min of baseline pedalling at 20 W when six min moderate /heavy cycling and three min baseline (20 W) pedalling at a pedal cadence of 70 r.p.m. were performed.

Prior drop jumps. Subjects performed 100 drop jumps from a 0.47 m stage with 20 s of recovery between every drop jump. After drop the subject got to amortization phase while the knee joints were flexed at the angle of 90 degrees when the subject performed a vertical jump (hands on hips).

Plasma creatine kinase activity and blood lactate concentration. Blood sample (25 μ l) for the measurement of blood lactate concentration ([La]) (Accutrend Portable Lactate Analyzer, Roche, Germany) was taken from fingertips.

Approximately 2500 μ l of capillary blood sample was collected into a tube containing lithium heparin to determine the CK (IU \cdot L $^{-1}$) activity by using an automatic biochemical analyzer “Spotchem EZ SP-4430” (Arkray Inc, Kyoto, Japan).

Muscle soreness and perceived exertion rating. DOMS was reported subjectively performing one squat using a visual scale of 0–10 points in which 0 represented no pain and 10 represented intolerably intense pain.

The subject was asked to rate their perceived exertion (RPE) using the Borg scale, ranging from 6 to 20 (7 – very, very light; 19 – very, very heavy).

EMG recording. Bipolar Ag-AgCl surface electrodes were used for sEMG recordings (silver

Table. Subjects' descriptive characteristics. Values are means (SD)

Note. VO_{2peak} – relative peak oxygen uptake.

Subjects (n = 10)	Age, yrs	Weight, kg	Height, m	Body fat, %	Free fat mass, kg	Maximal power, W	VO_{2peak} ml/kg/min
Mean (SD)	21.5 (1.9)	60.8 (4.5)	1.70 (0.06)	25.9 (3.8)	44.9 (2.3)	198 (20)	36.48 (5.00)

bar electrodes, diameter 10 mm, centre-to-centre distance 20 mm) of the long head of the right leg mVL and mVM (DataLog type No. P3X8 USB, Biometrics Ltd, Gwent, UK). The skin at the electrode site was shaved and cleaned with alcohol wipes. To be sure, that electrode was precisely at the same place for each testing session, the electrode location was marked on the skin with an indelible marker. The electrodes were placed 2/3⁻¹ on mVL and 80% way on mVM of line between ischial tuberosity and fibula head. The ground electrode was positioned on the wrist of right hand. The RMS of sEMG values were calculated during 10 last seconds of every MCE and HCE minutes. The RMS of sEMG results are represented as group means response.

Experimental protocol. Subjects reported to the laboratory on four separate days within a two-three week period. Exercise testing was performed at approximately the same time of day for each subject. The first session was used to familiarize subjects with the testing equipment and procedures. In the same session, each subject performed an ICE test (after five min warm up and five min rest). Subsequently, in the second session (no less than 48 hours rest after ICE) subject performed control (CON) MCE and after five minutes rest HCE. On the third occasion subject performed PDJ and after 45 minutes (45' PDJ) they performed the same MCE and HCE. On the fourth occasion subject performed MCE and HCE 24 hours after PDJ (24h PDJ). The [La] was taken at five min and 20 min after ICE test and at the end of MCE and HCE tests. At the end of MCE and HCE, each subject was asked to rate her

perceived exertion. CK activity in was measured and DOMS was rated 24 h after PDJ.

Statistical analysis. RMS of sEMG, [La] and RPE were analyzed using two-way repeated measures ANOVA design evaluating time and testing conditions (CON; 45' PDJ; 24h PDJ) as the main effects. Significant results were further analyzed using Turkey HSD post hoc test. Statistical significance was accepted when $p < 0.05$. All data are reported as the mean (SE).

RESEARCH RESULTS

The power output of MCE and HCE was 82 (16) W and 130 (17) W, respectively, which corresponds to 40.8 (5.1) and 66.6 (4.5)% of maximal power.

The RMS of mVL (Figure 1) significantly increased 24 h PDJ compared with CON ($p = 0.03$) during MCE with no changes in mVM (Figure 2). No significant differences in RMS of mVL (Figure 3) and mVM (Figure 4) were observed during HCE between CON, 45' PDJ and 24h PDJ, but RMS of mVL statistically increased minute 5 compared with minute 1 ($p = 0.02$) and minute 2 ($p = 0.03$) under CON (Figure 2). There were significant differences of RMS of mVL between minute 1 and minute 4 ($p = 0.02$) under 45' PDJ, and minute 5 compared with minute 1 ($p = 0.02$) and minute 2 ($p = 0.03$) under 24 h PDJ condition.

The [La] did not differ 45' PDJ (3.61 (0.94) mmol/L) and 24h PDJ (3.48 (0.66) mmol/L) compared with CON (3.43 (0.92) mmol/L) at the end of MCE. There was no significant difference in [La] at the end of HCE between different testing

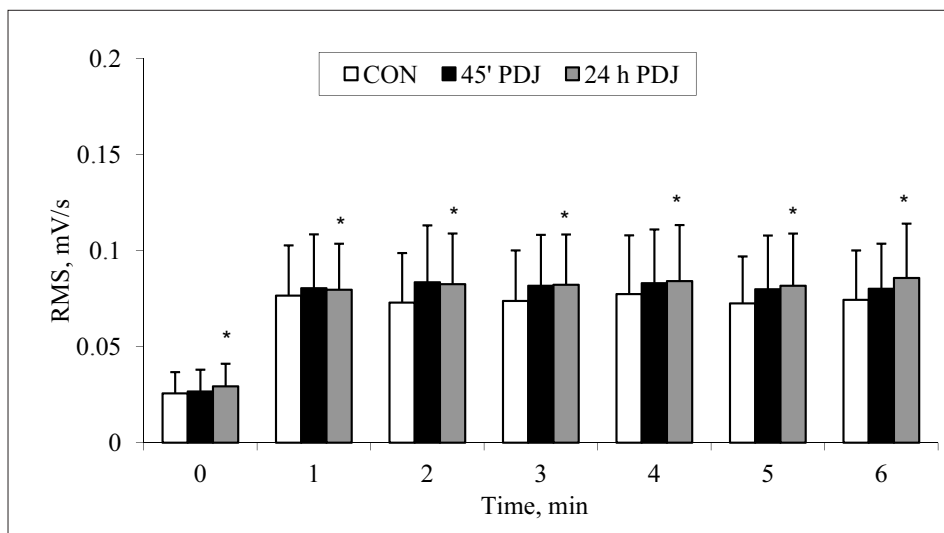
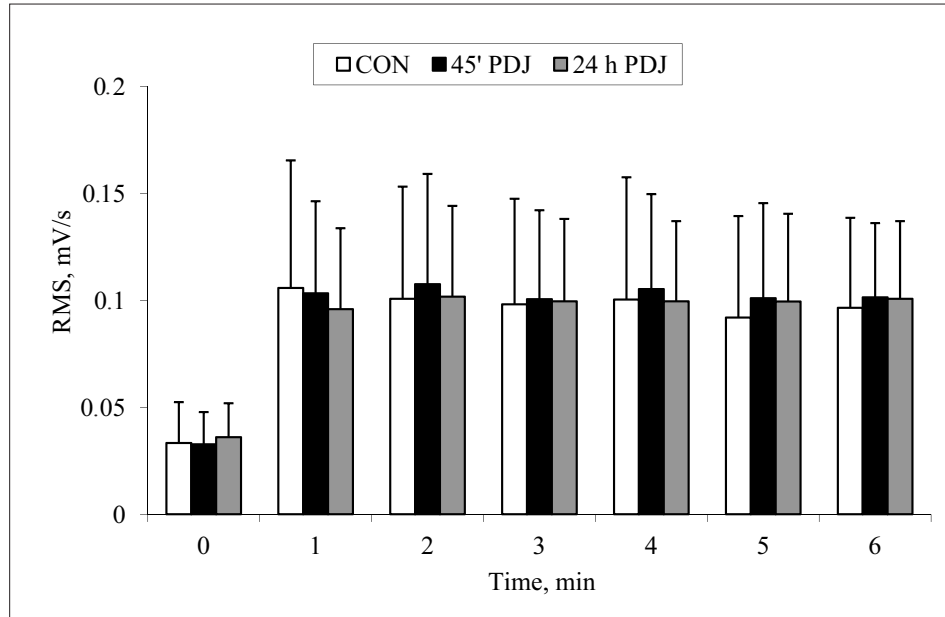


Figure 1. Group mean response of *m. vastus lateralis* in RMS of sEMG during moderate cycling exercise under control condition (CON); 45 minutes after prior drop jumps (45' PDJ) and 24 hours after prior drop jumps (24 h PDJ)

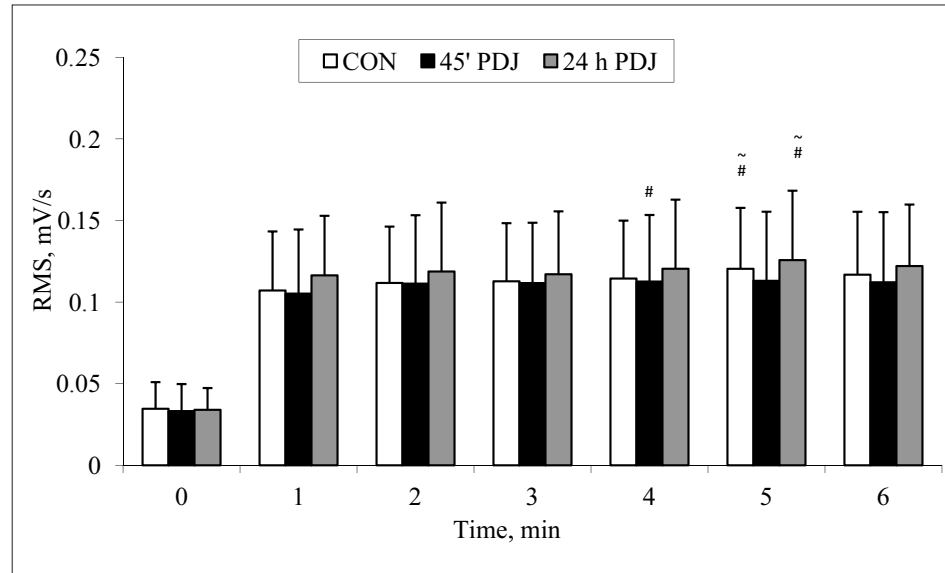
Note. 0 represents base line (20 W) cycling. *—significant difference between 24 h PDJ and CON.

Figure 2. Group mean response of *m. vastus medialis* in RMS of sEMG during moderate cycling exercise under control condition (CON); 45 minutes after prior drop jumps (45'PDJ) and 24 hours after prior drop jumps (24 h PDJ)



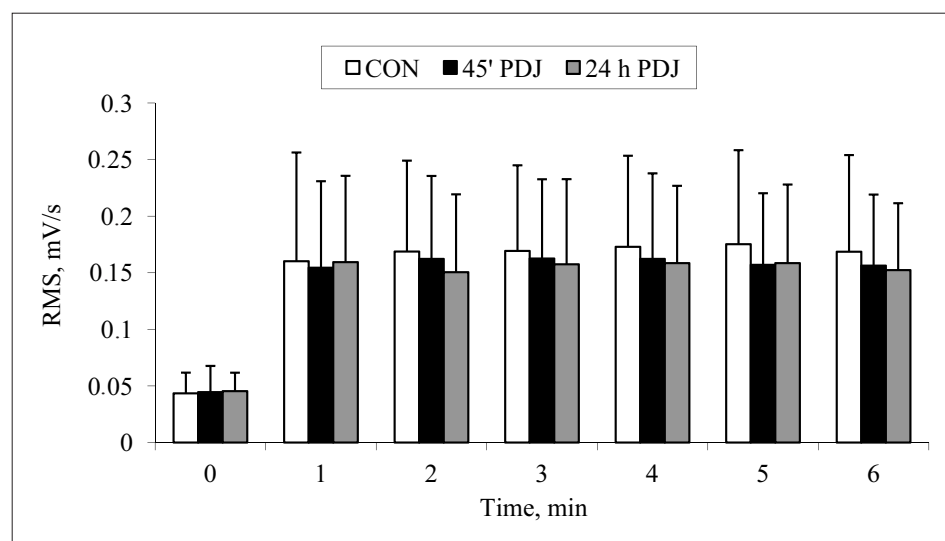
Note. 0 represents base line (20 W) cycling.

Figure 3. Group mean response of *m. vastus lateralis* in RMS of sEMG during heavy cycling exercise under control condition (CON); 45 minutes after prior drop jumps (45'PDJ) and 24 hours after prior drop jumps (24 h PDJ)



Note. 0 represents base line (20 W) cycling. # – significant differences from 1 min; ~ – significant differences from 2 min.

Figure 4. Group mean response of *m. vastus medialis* in RMS of sEMG during heavy cycling exercise under control condition (CON); 45 minutes after prior drop jumps (45'PDJ) and 24 hours after prior drop jumps (24 h PDJ)



Note. 0 represents base line (20 W) cycling.

conditions (CON – 7.25 (2.06); 45' PDJ – 7.05 (2.46); 24 h PDJ – 7.58 (2.55)). The CK activity was 308.1 (283.0) IU/L 24 hours after PDJ.

The ratings of perceived exertion during MCE (CON – 11.6 (1.4); 45' PDJ – 11.9 (1.5); 24 h PDJ – 11.6 (1.3)) and HCE (CON – 14.8 (1.4); 45' PDJ – 15.7 (1.81); 24 h PDJ – 15.7 (2.2) did not differ between testing conditions. The mean values of DOMS was 5.09 (2.59) points of 10 point scale.

DISCUSSION

The mVM and mVL has been commonly studied as most active muscles during cycling exercises (Burnley et al., 2002; Gonzales, Scheuermann, 2008; Hug, Dorel, 2009). In the present study the RMS of sEMG increased of mVL 24 h after PDJ induced moderate DOMS with no alteration of mVM during MCE. The moderate DOMS confirms muscle damage in the present study sustaining a strong relationship between muscle soreness within 24–48 h after thigh muscle stretch shortening exercises and decrease in neuromuscular performance (Skurvydas et al., 2007). The increases in sEMG amplitude during isometric contractions of biceps brachii after eccentric exercises (Semller et al., 2007) suggest that the muscle damage from eccentric exercise produces changes in the central nervous system that act to increase motor unit activity during voluntary contractions for at least 24 hours. However, in the present study muscle damage was induced on thigh muscles and there is evidence that the arm muscles are equally more susceptible to muscle damage than leg muscles associated with the use of muscles in daily activities (Chen et al., 2011). Anyway, despite of work load and muscle group differences, the residual effect of eccentric exercise is similar. The rise of sEMG amplitude during fatiguing constant-load exercise could be mainly attributed to progressive recruitment of additional motor units, as fatigue occurs and there is assumption that fatigue induces changes of the coordination of the lower limb muscles (Hug, Dorel, 2009). In addition, after heavy exercise the increase in iEMG early in the second heavy exercise represents additional motor units' recruitment and fatigued fibres may be activated, but they may fail to produce any tension, resulting in the need to recruit more muscle fibres to maintain the power output (Hughson et al., 2000). Moreover, the increase in motor units' recruitment for the same power output could reduce the work efficiency (Burnley et al., 2002). Nevertheless, the RMS of sEMG reflects

overall motor unit recruitment and does not provide information regarding the type of motor units contributing to the measured myoelectrical signal (Gonzales, Scheuermann, 2008). However, all muscle fibres showed a shift length – tension relation, indicative of damage, but type I fibres showed a smaller shift than type II fibres after a series of eccentric contractions (Proske, Morgan, 2001). Therefore, it is possible to suppose that increased RMS of sEMG 24 h PDJ has been effected by additional type I fibres recruitment of *m. VL* during MCE in the present study because of deficits in force measured at two hours or later after the eccentric contractions are likely to be only caused by the damage (Proske, Allen, 2005).

The increases of RMS of *m. VL* at the fifth minute of the HCE compared with exercise beginning (1 and 2 minutes) both CON and fatigue conditions in the present study possibly could be explained by the fact that composition of muscle fibres type that make up the RMS signal may change following heavy exercise as type I fibres are progressively replaced by type II fibres in the presence of muscle fatigue during cycling (Gonzales, Scheuermann, 2008). The unaltered RMS of sEMG during HCE after PDJ could be explained by preceding MCE, which dominant mode was eccentric and this supposition confirms recent finding suggesting that the eccentric training of thigh muscle resulted in a switch to oxidative metabolism, which may be associated with protection from DOMS (Hody et al., 2011). Moreover, the RMS of mVM has been unaffected by PDJ during both MCE and HCE in the present study, and possibly could be explained by different muscle feedback on PDJ.

In the present study participants rated their perceived exertion as “moderate” during MCE and “heavy”, but PDJ seems to have no residual effect on RPE. In addition, the unaltered [La] during MCE and HCE demonstrate similar ATP glycolysis under different testing (CON; 45' PDJ and 24 h PDJ) conditions.

CONCLUSIONS AND PERSPECTIVES

In conclusion, prior drop jumps seem to have significant residual (within 24 h of recovery) effect on RMS of sEMG of *m. vastus lateralis* during moderate cycling exercise without any causes during heavy cycling exercise in female students. The *m. vastus lateralis* possibly is more vulnerable than *m. vastus medialis* to prior eccentric – concentric exercise.

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ŠUOLIŲ PRIEŠKRŪVIO POVEIKIS ŠLAUNIES RAUMENŲ EMG RODIKLIAMS ATLIEKANT VIDUTINIO IR DIDELIO INTENSYVUMO KRŪVIUS VELOERGOMETRU

Neringa Baranauskienė, Loreta Stasiulė, Sandra Raubaitė, Arvydas Stasiulis
Lietuvos kūno kultūros akademija, Kaunas, Lietuva

SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Ekscentriniai-koncentriniai pratimai sukelia ilgai trunkantį raumenų nuovargį ir vėluojantį raumenų skausmą. Be to, esant nuovargiui, raumenų elektrinis aktyvumas padidėja krūvio metu. Manoma, kad atliekant pastovaus intensyvumo krūvius veloergometru po ekscentrinį pratimą, sukeliančių vėluojantį raumenų skausmą, šlaunies raumenų elektrinis aktyvumas padidėja.

Tikslas – nustatyti 100 nušokimų vertikaliu šuoliu (NVŠ) poveikį šlaunies raumenų elektromiogramos pokyčiams atliekant vidutinio ir didelio intensyvumo krūvius veloergometru.

Metodai. Skirtingų testavimų metu 10 merginų atliko vieną nuosekliai didinamą krūvį, per kitus tris kartus (kontrolinį testavimą praėjus 45 minutėms ir 24 valandoms po NVŠ) tiriamosios atliko vidutinio ir didelio intensyvumo krūvius veloergometru („Ergotone-800“, Vokietija). Mynimo dažnumas – 70 k./min. Vidutinio ir didelio krūvio metu buvo registruojamas dešinės kojos šlaunies išorinio ir vidinio raumens EMG. Praėjus 24 valandoms po NVŠ, tiriamosios vertino skausmą ir buvo nustatomas kreatinkinazės aktyvumas kraujyje.

Rezultatai. Tiriamosios jautė vidutinį šlaunies raumenų skausmą praėjus 24 valandoms po NVŠ (5,0 (2,79) balo). Atliekant VK išorinio šlaunies raumens EMG amplitudės vidutinė kvadratinė reikšmė padidėjo praėjus 24 valandoms po NVŠ, tačiau DK metu šlaunies raumenų EMG reikšmingai nepakito.

Aptarimas ir išvados. Apibendrinant galima teigti, kad 100 nušokimų vertikaliu šuoliu, praėjus 24 valandoms po jų, padidina šlaunies raumenų EMG amplitudę vidutinio intensyvumo krūvio metu.

Raktažodžiai: vėluojantis raumenų skausmas, pastovus krūvis, EMG amplitudės vidutinė kvadratinė reikšmė.

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Corresponding author **Neringa Baranauskienė**
Lithuanian Academy of Physical Education
Sporto str. 6, LT-44221 Kaunas
Lithuania
Tel +370 615 80008
E-mail neringa_baranauskienė@yahoo.com

NUTRITION PECULIARITIES AND ADDICTIONS OF YOUNG WOMEN WITH DIABETES MELLITUS TYPE 1 AND HEALTHY PERSONS AGED 18–25 YEARS AND THEIR INTERPLAY WITH BODY COMPOSITION

Sandrija Čapkauskienė, Daiva Vizbaraitė, Joana Garlavičiūtė, Nilana Vaitkevičiūtė
Lithuanian Academy of Physical Education, Kaunas, Lithuania

ABSTRACT

Research background and hypothesis. Nutrition therapy is important for the prophylaxis of diabetes, managing existing diabetes, and preventing or at least slowing the rate of development of diabetes complications. We suppose that nutrition peculiarities and addictions of young diabetic women interplay with their body composition.

Research aim was to determine nutrition peculiarities and addictions of young girls with diabetes mellitus type 1 and healthy persons aged 18–25 years and their interplay with body composition.

Research methods. The study included 24 healthy young women (mean age: 20.2 ± 1.2), and 14 young women with type 1 diabetes (mean age: 21.9 ± 0.8). Anthropometric measurements were performed, and a questionnaire to determine nutrition peculiarities and addictions was used.

Research results. The values of BMI, waist circumference, waist to hip ratio index were statistically significantly higher in women with type 1 diabetes ($p < 0.05$). Vegetable oil for cooking was reported by 86% of diabetic and 58% of healthy women ($p < 0.05$). 50% of diabetics responded that they always had their meals at regular hours, and only 4% of healthy women pointed out irregular hours of their meals ($p < 0.05$). Evaluations of addictions did not reveal any significant difference ($p > 0.05$). Nutrition peculiarities and addictions did not have any effect on the body composition of the research participants.

Discussion and conclusions. BMI was within normal limits, however, this indicator was significantly higher in women with type 1 diabetes. Waist circumference and waist to hip ratio were also significantly higher in women with type 1 diabetes mellitus. Young diabetic women reported having meals at regular hours more often. Vegetable oil for cooking was used in both groups; additionally, healthy women were more likely to consume home-grown foods. When evaluating addictions, a significant difference between groups was not observed. Nutrition peculiarities and addictions did not have any effect on body composition.

Keywords: anthropometrical data, questionnaire, smoking, alcohol.

INTRODUCTION

Diabetes belongs to a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. Chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of different organs, especially the eyes, kidneys, nerves, heart, and blood vessels (ADA, 2011).

Nutrition therapy is important for the prophylaxis of diabetes, managing existing

diabetes, and preventing or at least slowing the rate of development of diabetes complications. For individuals with type 1 diabetes, insulin therapy should be integrated into an individual's dietary and physical activity pattern. (ADA, 2008). Central to dietary management in type 1 diabetes mellitus is monitoring carbohydrate intake and balancing carbohydrate intake and insulin levels (Bantle et al., 2008). Close adherence to carbohydrate intake recommendations is

associated with better glycemic control (Patton et al., 2007; Mehta et al., 2008). Moreover, a mismatch between carbohydrate intake and insulin can result in immediate and long-term complications from hypo- and hyperglycemia (Silverstein et al., 2005). It is also important for patients to consume a healthy diet. Although there are no disease-specific nutrition guidelines for youth with type 1 diabetes mellitus, the young are at risk for dyslipidemia and cardiovascular disease. Several epidemiology studies have demonstrated that many young people with type 1 diabetes mellitus already had abnormal lipid levels and other risk factors for cardiovascular disease (Kershner et al., 2006; Overby et al., 2007; Margeisdottir et al., 2008). Thus, it is recommended that youth with type 1 diabetes mellitus eat a healthy diet according to the American diabetes association (ADA, 2008). It calls for a diet that incorporates fruits and vegetables, whole-grain foods, and foods low in fat. The American Diabetes Association further recommends that all youth with type 1 diabetes mellitus should attempt to consume no more than 7% of energy from saturated fat (Bantle et al., 2008).

RESEARCH METHODS

The object of the study and contingent. The study group included 24 healthy young women (mean age: 20.2 ± 1.2 , height 1.70 ± 0.1 cm, body mass – 59.6 ± 8.0 kg) and 14 young women with type 1 diabetes (mean age: 21.9 ± 0.8 , height 1.70 ± 0.1 cm, body mass – 68.1 ± 7.5 kg).

Methods. *Anthropometric measurements* were performed. Height and weight of the research participants were measured according to the recommendations of the World Health Organization (WHO) using equipment suitable for medical studies. Body mass index (BMI) was defined body mass in kilograms dividing by height in meters squared. Measurements of byceps, triceps, subscapular and suprailiac skinfold thickness were performed, and then, sums of the skinfold thickness according to N. D. Muth (2011) were calculated. Waist and hip circumference were also measured. The results of waist circumference were evaluated according to G. A. Bray (2004) method. Calculated waist to hip ratio allowed to evaluate a risk for cardiovascular diseases (Welborn, 2003).

Questionnaire. The studied filled in a factual nutrition and lifestyle questionnaire (Kadziauskienė

et al., 1999) which contained 31 questions including the following domains: 7 questions – the place of residency, marital status, 11 questions – nutrition, 5 questions – smoking, 3 questions about alcohol consumption, 3 questions about physical activity, 2 questions about anthropometric data. Six questions involved demographic data.

Statistics. Statistical analysis was performed using *Microsoft Office Excel 2003* and the software SPSS package. The following statistical parameters were analyzed: mean indicators and standard deviations, the percentage of maximal values, Spearman's rho correlation coefficient. Differences were considered as statistically significant if $p < 0.05$.

RESEARCH RESULTS

Body composition. A value of BMI was statistically significantly higher in women with type 1 diabetes compared to healthy controls 23.3 kg/m^2 vs. 20.7 kg/m^2 ($p < 0.05$) (Figure 1). However, according to the WHO criteria, BMI in both groups was within normal limits.

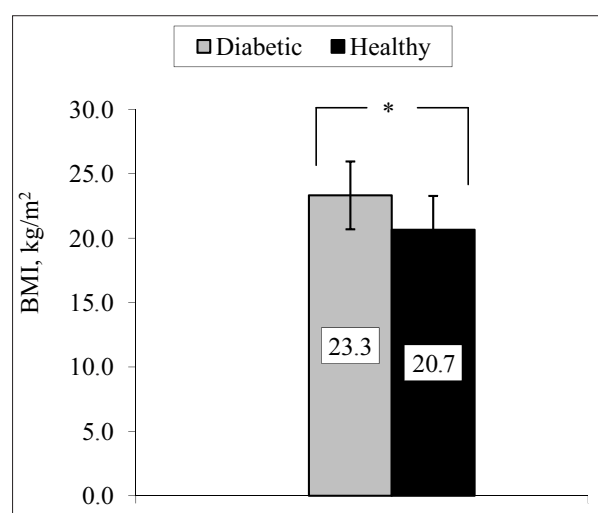


Figure 1. Body mass index (kg/m^2) in diabetic and healthy women
Note. * – $p < 0.05$.

Calculation of the fat body mass percentage revealed that in women with type 1 diabetes it was 31.8%, in healthy – 29.5% ($p > 0.05$). Based on N. D. Muth method (2001), the body fat percentage in all subjects was evaluated as moderate. Given waist circumference, it was 70 cm in diabetic women, and 62 cm in healthy young women ($p < 0.05$) (Figure 2). It suggests that insufficient weight was found in healthy controls (Bray, 2004), and women with type 1 diabetes had normal weight.

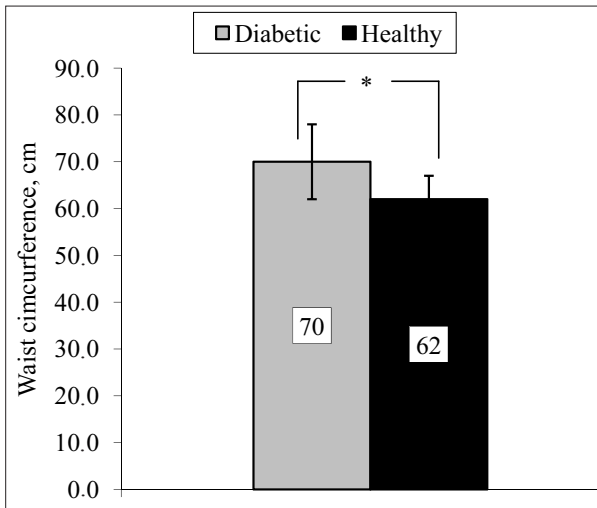


Figure 2. Waist circumference (cm) of diabetic and healthy young women

Note. * – $p < 0.05$.

Low waist to hip ratio showed that diabetic and healthy young women were not at risk for cardiovascular diseases. Waist to hip ratio in diabetic women was 0.78, in healthy controls – 0.75 ($p < 0.05$). The results are presented in Figure 3.

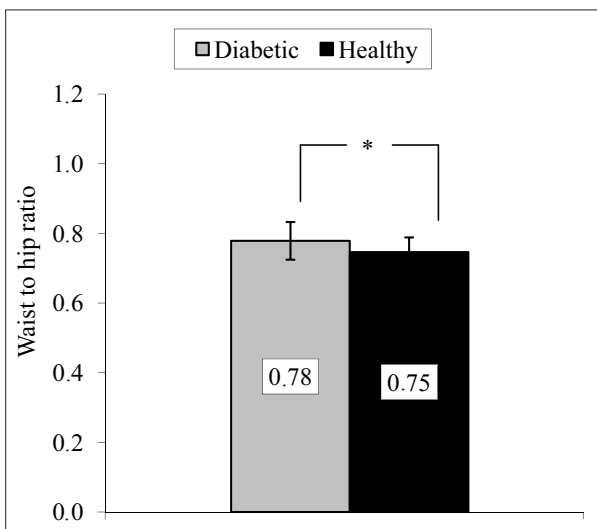


Figure 3. Waist to hip ratio in diabetic and healthy women

Note. * – $p < 0.05$.

Nutrition. The majority of women used vegetable oil for cooking: 86% of women with type 1 diabetes and 58% of healthy women ($p < 0.05$). Fewer participants chose butter – 7% of diabetic and 38% of healthy women ($p < 0.05$). The lowest part of all fats accounted for animal fats in both groups. In diabetic group only 7% of women reported using animal fats, and in control group – 4% of respondents (Figure 4).

Given eating frequency, 1–2 times per day was not reported by diabetic women, whereas in the

control group 21% of women stated that they had meals 1–2 times per day. Intake of food 3–4 times per day was pointed out by 57% of women with type 1 diabetes and 46% of healthy respondents. Diabetic women (43%) had meals 5–6 times per day while such eating frequency was indicated by 33% of healthy women ($p < 0.05$).

Women with type 1 diabetes (50%) responded that they always had their meals at regular hours, another equal part of diabetic women reported not always having meals at the same time. The answer to the same question was positively marked by 96% of healthy women and only 4% pointed out irregular hours of their meals ($p < 0.05$) (Figure 5).

Analysis of correlation between nutrition and home-grown foods showed that 50% of women with type 1 diabetes responded that their nutrition did not include any of such products. Nobody in diabetic group responded that their nutrition depended on home-grown foods very much, whereas the positive answer was given by 25% of healthy women ($p < 0.05$) (Figure 6).

Addictions. Fewer than 20 cigarettes per day were smoked by 7% of women with type 1 diabetes, whereas a positive answer was received by 29% of healthy respondents. In diabetic group 93% were non-smokers, and in control group – 71% ($p > 0.05$). Neither diabetic, nor healthy women reported smoking more than 20 cigarettes per day.

Consumption of strong alcohol beverages 2–3 times per month were surprisingly reported by 57% of women with type 1 diabetes. Healthy women (29%) responded having strong alcohol beverages once per week. Strong alcohol beverages were not used by 14% diabetic and 8% healthy respondents ($p > 0.05$).

Given frequency of wine intake between groups, 57% of young women with type 1 diabetes and only by 21% of healthy respondents reported consuming wine 2–3 times per month. Healthy young women (17%) and nobody in diabetic group reported never consuming wine.

There was a statistically significant correlation between indicators of body composition in young women with type 1 diabetes and healthy women. A strong and statistically confident correlation between BMI and fat body mass percentage was determined: $r = 0.752$, $p < 0.01$ vs $r = 0.702$, $p < 0.01$. Interplay between BMI and waist circumference in diabetic group was moderate and strong, statistically significant in healthy group: $r = 0.629$, $p < 0.05$ vs $r = 0.781$, $p < 0.01$. There

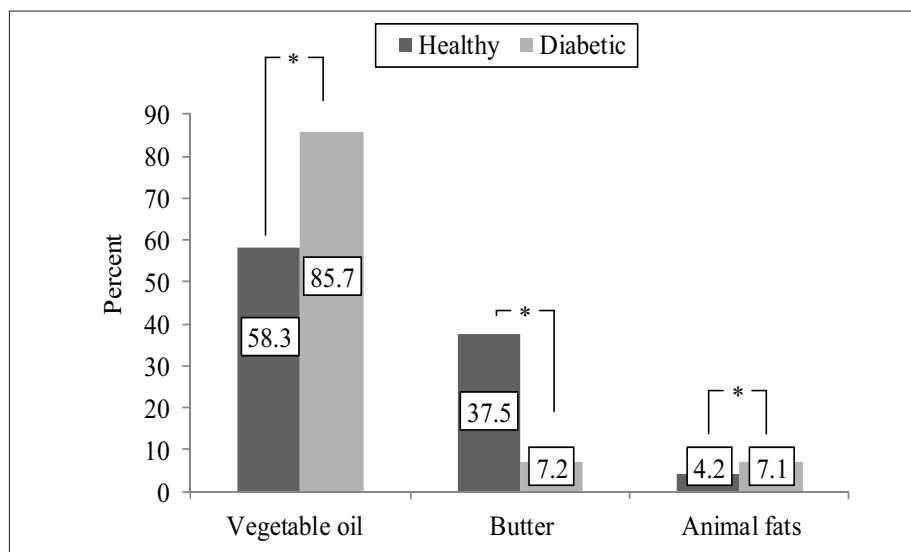


Figure 4. Structure of fat use by diabetic and young women

Note. * – $p < 0.05$.

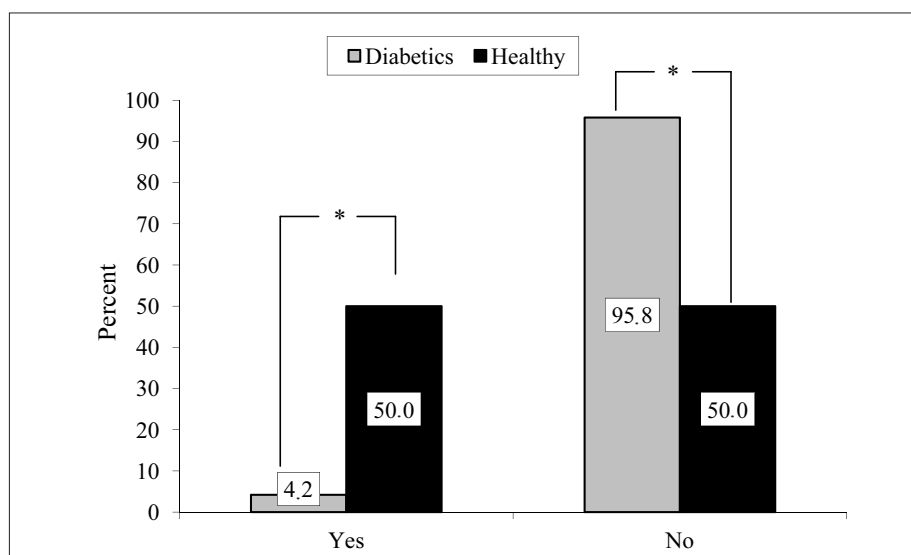


Figure 5. Percentage of diabetic and healthy women having their meal at regular hours

Note. * – $p < 0.05$.

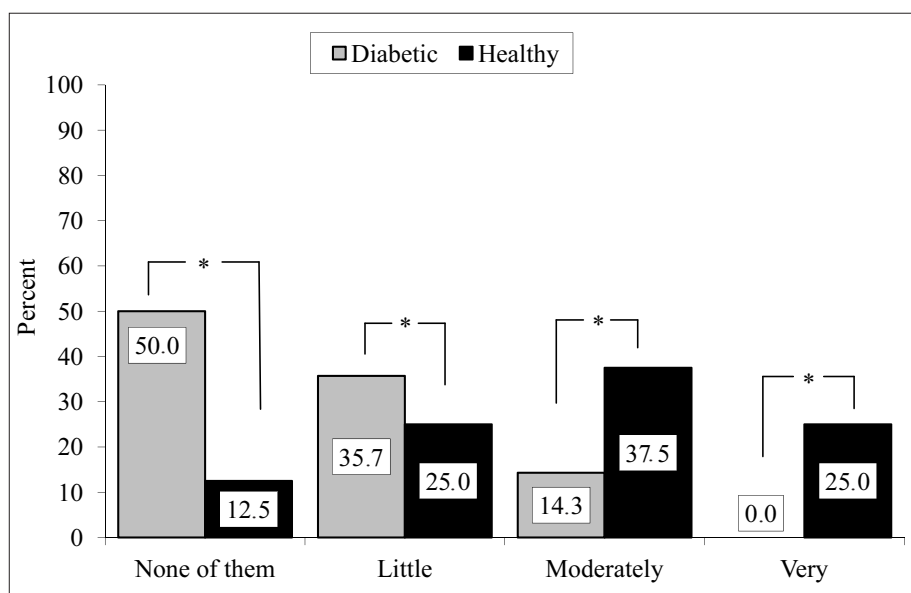


Figure 6. Correlation between nutrition and home-grown foods in diabetic and healthy women

Note. * – $p < 0.05$.

Figure 7. Frequency of strong alcohol beverages in diabetic and control groups

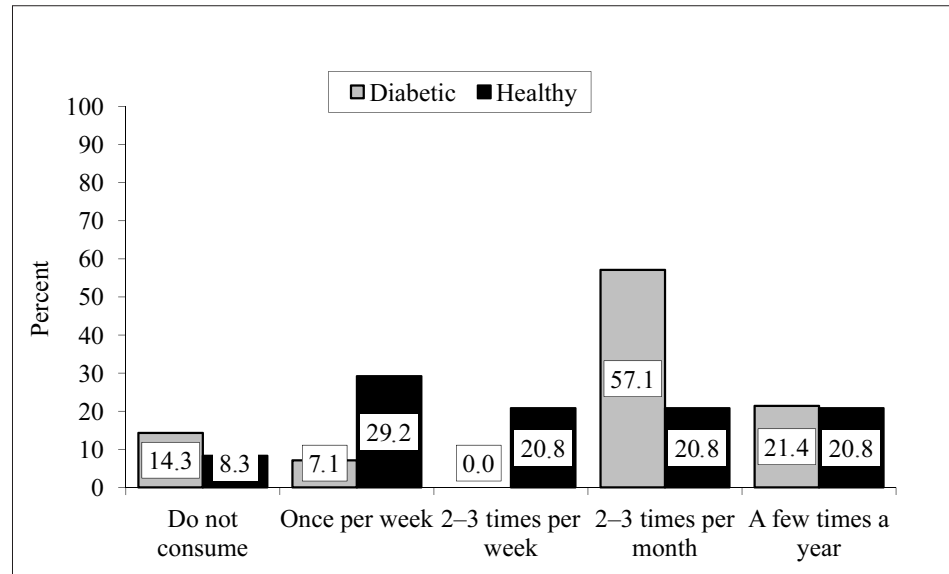
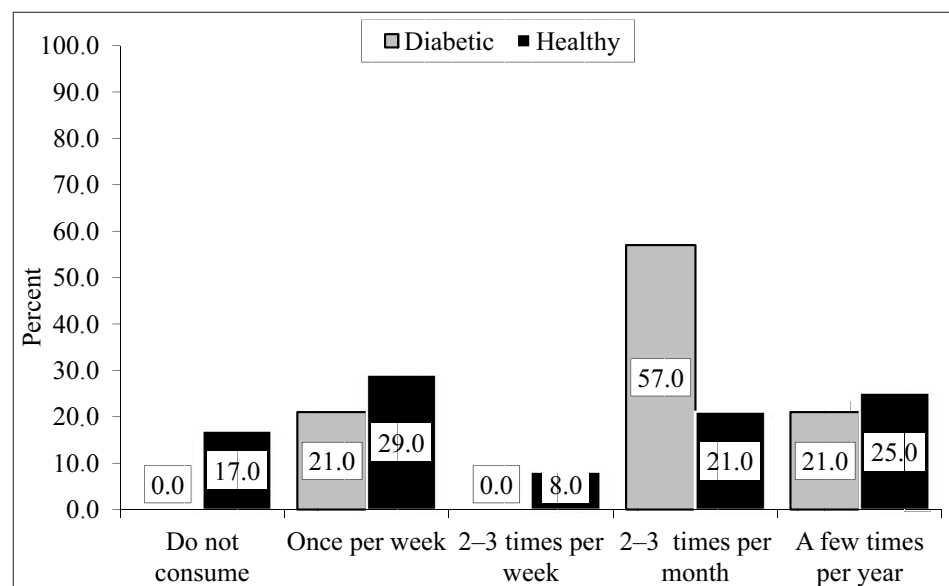


Figure 8. Frequency of wine intake by diabetic and healthy women



was a moderately strong correlation between fat body mass percentage and waist circumference in both groups: $r = 0.536$, $p < 0.05$ vs $r = 0.610$, $p < 0.01$. A statistically strong correlation between waist to hip ratio was found in diabetic group: $r = 0.803$, $p < 0.01$. Relationship between nutrition peculiarities, addictions and body composition in both groups was not determined.

DISCUSSION

According to the WHO recommendations, means of body mass index (BMI) of women in both groups were attributed to the second category – normal body weight – from 18.5 kg/m^2 to 24.9 kg/m^2 ($p < 0.05$). Although BMI of diabetic women was higher, it was still within normal limits. This was also confirmed by other researchers, as

S. Särnblad (2006) and C. M. Ingberg (2003). When comparing the values of BMI with the results of the questionnaire, a negative correlation between BMI and eating frequency as well as meals at regular hours was determined suggesting that BMI value of the subjects who had meals more frequently and followed regular hours of eating was lower. As L. D. Ritchie (2012) states, lower eating frequency is associated with bigger absorption of fats. Such correlation between healthy young women was not observed. Most young women with type 1 diabetes had meals more times per day compared with healthy women: we did not determine diabetic women who had meals only 1–2 times a day, whereas in healthy group 21% of women reported having meals 1–2 times per day. Moreover, the majority (96%) of diabetic women had daily regular hours of eating, and only 50% of healthy

Table. Interplay between anthropometric parameters and the data of the questionnaire for diabetic and healthy women by Pearson's correlation coefficient

Indices	Diabetic women				Healthy women			
	BMI	Percentage of fat body mass	Waist circumference	Waist to hip ratio	BMI	Percentage of fat body mass	Waist circumference	Waist to hip ratio
BMI	1.00	0.752**	0.629*	0.30	1.00	0.702**	0.781**	-0.01
Percentage of fat body mass	0.752**	1.00	0.536*	0.43	0.702**	1.00	0.610**	0.03
Waist circumference	0.629*	0.536*	1.00	0.803**	0.781**	0.610**	1.00	0.32
Waist to hip ratio	0.30	0.43	0.803**	1.00	-0.01	0.03	0.32	1.00
Use of fat	-0.21	0.10	-0.09	-0.10	0.08	-0.11	0.20	-0.10
Eating frequency (times per day)	-0.46	-0.28	0.04	0.23	-0.40	-0.18	-0.37	-0.19
Having meal at regular hours	-0.47	-0.12	-0.31	0.10	-0.03	0.22	-0.21	0.23
Nutrition correlation there was between	-0.13	-0.22	0.03	-0.08	-0.23	-0.10	-0.18	-0.13
Mean number of cigarettes smoked per day	-0.22	-0.18	-0.17	0.06	0.04	0.06	0.01	0.07
Consumption of strong alcohol beverages	0.29	0.05	0.43	0.14	0.34	0.36	0.30	0.14
Frequency of wine intake	-0.30	-0.10	-0.34	0.02	0.20	0.408	0.28	0.19

Note. * – $p < 0.05$, ** – $p < 0.01$.

women followed regular eating pattern. Similar data were obtained by researchers R. Stukas and V. Dobrovolskij (2009), who studied nutrition of the Estonian students – the study results showed that their nutrition pattern was irregular. Only 43.4% of the subjects had meals 3 times per day, and 90% of Estonian students had snacks between meals.

Fat body mass percentage of young women with type 1 diabetes was higher than that of healthy controls (31.0% compared with 29.5%, respectively ($p > 0.05$)). However, the evaluation of fat mass percentage according to Natalie Digate Muth (2011) method showed that both groups were attributed to the fourth category – the moderate value. It was also determined that there was a linear correlation between the fat mass percentage and waist circumference of all women – young women who had higher fat body mass percentage, had also a greater waist circumference. A linear correlation between fat body mass percentage and waist to hip ratio was found in diabetic women ($p < 0.05$). However, a similar correlation in healthy controls was not determined.

Mean waist circumference was greater in diabetic women (70 cm) compared with healthy participants (62 cm) ($p < 0.05$). Evaluation of the

results obtained according to G. A. Bray (2004) method showed that diabetic young women had a normal body weight, whereas in healthy controls it was insufficient. A positive correlation in diabetic group between consumption of strong alcohol beverages and waist circumference was determined; women who had strong alcohol beverages more frequently had also higher value of waist circumference. The study revealed that 57% of diabetic women had intake of strong alcohol 2–3 times per month. Most healthy women (29%) consumed strong alcohol once per week. Strong alcohol intake was not pointed out by 14% of diabetic and 8% of healthy young women. However, this difference was not statistically confident ($p > 0.05$), therefore, a hypothesis that consumption of strong alcohol beverages may have an effect on waist circumference was rejected. This fact was also confirmed by A. Norkus et al. (2007): A patient with type 1 diabetes who has a normal body weight, and well controlled diabetes may occasionally have alcohol, but it should not be included into nutrition plan. If alcohol is daily consumed, its energetic value should be included into nutrition plan. A correlation between alcohol and waist circumference was not found in healthy

controls. The study performed in Brasilia (Ferreira et al., 2008) showed that there was a relationship between alcohol intake for a long period and waist circumference – waist circumference was the largest in individuals who consumed more alcohol. This relationship was the strongest in the subjects who had intake of beer. Although a correlation between waist circumference and intake of strong alcohol was observed, it was the weakest compared with other alcohol beverages.

Evaluation of waist to hip ratio is associated with cardiovascular diseases – the study performed in the United States of America revealed that 35% of individuals with type 1 diabetes died of coronary artery disease under the age of 55 years compared with 4–8% of persons without diabetes. Type 1 diabetes is one of the risk factors for cardiovascular diseases (Krishnan et al., 2011). Waist to hip ratio significantly correlated with percentage of fat body mass and waist circumference in diabetic women – the greater the waist to hip ratio, the higher the values of percentage of fat body mass and waist circumference.

Addictions. Apart from alcohol intake, another addiction that is common among youth – smoking – was evaluated. It was determined that 7% of diabetic and 29% of healthy women smoked ($p < 0.05$). Although a significant difference of smoking women between diabetic and control

groups (the number of smoking women was 4 times bigger than that of diabetic women), a significant correlation between smoking and body composition was not found. In 2008 the study carried out in central Thailand showed that BMI and waist circumference of smoking young people were smaller compared to non-smoking research participants of the same age (Jitnarin, 2008).

CONCLUSIONS AND PERSPECTIVES

1. Body mass index of all studied women aged 18–25 years was within normal limits, however, this indicator was higher in young women with type 1 diabetes. Waist circumference and waist to hip ratio were also significantly higher in diabetic women.

2. Eating frequency of women with type 1 diabetes was also significantly higher than that of healthy controls. The majority in both groups used vegetable oil for cooking. Healthy young women were more dependent on home-grown foods. Evaluation of addictions did not reveal any significant difference.

3. Nutrition peculiarities and addictions did not have any relation to body composition in young women with type 1 diabetes and healthy controls.

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SERGANČIŲJŲ 1 TIPO CUKRINIŲ DIABETU IR SVEIKŲ 18–25 METŲ AMŽIAUS MERGINŲ MITYBOS YPATUMAI IR ŽALINGI ĮPROČIAI BEI JŲ SAŠAJA SU KŪNO KOMPOZICIJA

Sandrija Čapkauskienė, Daiva Vizbaraitė, Joana Garlavičiūtė, Nilana Vaitkevičiūtė
Lietuvos kūno kultūros akademija, Kaunas, Lietuva

SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Mitybos terapija yra svarbi cukrinio diabeto prevencija ir cukrinio diabeto kontrolės dalis, diabeto komplikacijų išvengimo ar sumažinimo prevencinė priemonė. Manoma, kad mityba ir žalingi įpročiai turi įtakos merginų, sergančių 1 tipo cukriniu diabetu, kūno kompozicijai.

Tikslas – įvertinti sergančiųjų 1 tipo cukriniu diabetu ir sveikų 18–25 metų merginų kūno kompoziciją, mitybos ypatumus ir žalingus įpročius, nustatyti jų tarpusavio sąsajas.

Metodai. Buvo tiriamos 24 sveikos (amžiaus vidurkis – $20,2 \pm 1,2$ m.) ir 14 1 tipo cukriniu diabetu sergančių merginų (amžiaus vidurkis – $21,9 \pm 0,8$ m.). Atlikti antropometriniai matavimai, anketa įvertinti faktinės mitybos ir gyvenamosios ypatumai bei žalingi įpročiai.

Rezultatai. KMI reikšmė, liemens apimtis ir klubų santykis statistiškai reikšmingai didesni buvo sergančiųjų 1 tipo CD ($p < 0.05$). 86% sergančiųjų 1 tipo CD ir 58% sveikų merginų maistui gaminti vartoja augalinį aliejų ($p < 0.05$). 50% 1 tipo diabetu sergančiųjų ir tik 4% sveikų merginų valgo reguliariai ($p < 0.05$). Žalingų įpročių pasireiškimas tarp grupių nesiskyrė ($p > 0.05$). Visų tiriamųjų kūno kompozicijai mitybos ypatumai ir žalingi įpročiai įtakos neturėjo.

Aptarimas ir išvados. KMI buvo normalus, tačiau merginų, sergančių 1 tipo cukriniu diabetu, šis rodiklis buvo reikšmingai didesnis nei sveikų bendraamžių. Liemens apimtis bei liemens ir klubų santykis taip pat reikšmingai didesnis buvo merginų, sergančių 1 tipo cukriniu diabetu. Sergančiosios 1 tipo diabetu valgo dažniau nei sveikos merginos. Maistui gaminti abi tiriamųjų grupės vartoja augalinį aliejų. Sveikos merginos buvo reikšmingai labiau priklausomos nuo produktų, išaugintų asmeniniame ūkyje. Vertinant žalingus įpročius, reikšmingo skirtumo tarp tiriamųjų grupių nepastebėta. Visų tiriamųjų kūno kompozicijai mitybos ypatumai ir žalingi įpročiai įtakos neturėjo.

Raktažodžiai: antropometriniai duomenys, klausimynas, rūkymas, alkoholis.

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Corresponding author **Sandrija Čapkauskienė**
Lithuanian Academy of Physical Education
Sporto str. 6, LT-44221 Kaunas
Lithuania
Tel +370 65515636
E-mail capkauskiene@gmail.com

CHARACTERISTICS OF YOUNG LEARNERS' PSYCHOLOGICAL WELL-BEING AND SELF-ESTEEM IN PHYSICAL EDUCATION LESSONS

Rolandas Jančiauskas

Klaipėda University, Klaipėda, Lithuania

ABSTRACT

Research background and hypothesis. The learners experience stress and anxiety at school because of bullying, and routine stressors are perceived as the dangerous ones. Therefore, they even do not want to go to school. Young learners' psychological well-being and self-esteem is good, and the children experience positive emotions in physical education lessons.

Research aim. The aim of the research was to analyze young learners' self-esteem and psychological well-being in physical education classes.

Research methods. Young learners' self-esteem and psychological well-being in physical education lessons were analyzed in Klaipėda city schools using an anonymous questionnaire survey method.

Research results. Summarizing the research results of learners' psychological well-being, it can be noted that psychological well-being of 41.0% of learners in physical education lessons was good or very good. Analysis of the results of young learners' self-esteem in physical education lessons showed that 41.0% of learners estimated themselves as the average ones.

Discussion and conclusions. Although young learners like attending physical education lessons, and they find the lessons easy, interesting, pleasant, good and useful, they feel unsafe in physical education lessons because they suffer from other children's bullying. There were cases when they did not want to go to physical education lessons at all.

Keywords: bullying, stress and anxiety, reluctance to go to school.

INTRODUCTION

According to L. Rupšienė and J. Andriukonienė (2002), we usually tend to think that all the children want to learn and gladly attend lessons in the primary school, but it is not true. Attribution of primary school learners' reluctance to learn is characterized by three features related to pupils' evaluation and fear, to the fatigue as well as the need for alternative activities. Primary school learners' unwillingness to learn at school is related to the evaluation at school and the desire to maintain positive self-evaluation. According to L. Rupšienė (1996), most children (95.0%) want to go to the first class, but after four years of education their willingness to learn reduces significantly. Even

15.0% of the fourth class learners say they do not feel well at school. However, it is important to create favorable psychological atmosphere that protects children from psychological stress and negative environment in order to develop a free and creative learner's personality, his/her mental strength and intelligence. When a child begins attending school, it is very important how other people treat him or her, whether he or she is recognized by adults and children. However, it is important for the child to evaluate himself/herself adequately because an inadequate self-evaluation distorts the personality, makes favorable conditions for the formation of negative features and complicates a normal mental

development of the child. Evaluating oneself too well, a child may overlook the shortcomings, ignore failures and blame others for mistakes. A mistrustful child is sensitive to criticism and feels upset about failures. It is important that every child in the class felt safe and loved by others, and the promoting their independence and individuality. If a child is viewed negatively by other people, he/she develops anxiety and fear of failure. If a child constantly suffers from school teachers and classmates' negative evaluations, he/she can develop emotional and behavioral disorders and aggressive behavior. Young learners begin to organize themselves into groups and defend their group interests as their own ones. Thus, it awakens a strong motivation to belong and it increases children's aggressiveness, which often manifests as violence towards other children. According to V. Pursues and G. Tuzienė (2011), aggressive behavior with fellow learners not only impedes positive communication and educational process itself, but also lays the foundation to further spread of aggression in society. Violence at school and beyond its boundaries is a widespread and complex social phenomenon now, and the most common form of violence at school is bullying among pupils. According to the survey data of I. C. Overholser, E. H. Nasser (2000), learners experience stress and anxiety at school because of bullying, and routine stressors are perceived as the dangerous ones. Therefore, they even do not want to go to school. A. S. Hall and I. Torres (2002) point out that learners estimating themselves as funny and happy are inclined to unadaptive behavior, and learners with low self-esteem are characterized by a disadaptive avoidance style more often than the learners with moderate self-esteem (Natvig et al., 1999). However, little research analyzing young learners' self-esteem and psychological well-being in physical education lessons has been carried out in Lithuania.

The aim of the research was to analyze young learners' psychological well-being and self-esteem in physical education lessons.

The object of the research was young learners' psychological well-being and self-esteem in physical education lessons.

Hypothesis: Young learners' psychological well-being and self-esteem is adequate, and the children experience positive emotions in physical education lessons.

RESEARCH METHODS

Pedagogical and psychological literature was reviewed and psychological well-being and self-esteem in physical education lessons was analyzed. Young learners' self-esteem and psychological well-being in physical education lessons was analyzed in Klaipėda City schools using an anonymous questionnaire survey method. The consent for the research was obtained from the school management, teachers, children and their parents. The respondents had the right to withdraw from the research at any time. They were chosen at random. It was attempted to choose a homogenous sample of respondents according to the age of respondents. The number of questionnaires distributed to the respondents was 250. The children were instructed how to fill them in. As many as 222 respondents answered the questions. Research results were processed using *SPSS 10.0* software.

The research of young learners' psychological well-being in physical education lessons was carried out using the assessment scale based on D. Beresnevičienė (1995) psychological well-being profiles. Six questions were included, such as "Do you like attending physical education lessons?" Response scale was formulated as follows: I like it very much, I like it, I somehow like it, I do not like it, I do not like at all. The respondents had to select the answer to the statements by choosing one of the five possible answers (answers were scored from -2 to 2). An overall index of psychological well-being in physical education lessons was determined by calculating the average evaluation of all six components.

A semantic differential scale modified according to the respondents' age was used to carry out a research on learners' psychological self-esteem in physical education lessons. The scale was formed on the basis of A. Suslavičius (1988) semantic differential method. Eight statements were used to analyze learner's self-esteem in physical education lessons. The beginning of statements was "I am". The statement ended as "Very friendly", "Friendly", "Almost friendly", "Unfriendly", "Very unfriendly". The respondents had to finish each statement by choosing the right ending. Self-evaluation is a process when an attitude towards oneself is formed (Adamonienė, 2003). According to B. Bitinas (2004), the adequate self-evaluation is not pedagogically optimal; the learner has to evaluate oneself slightly better than he/she really

is. However, this overestimation must not cross the reasonable boundaries, a correct self-assessment is only possible when people do not raise themselves above others, underestimate their merits or positive characteristics, or on the contrary do not humiliate themselves, or depreciate their achievements and merits.

RESEARCH RESULTS

The survey showed that most children liked attending physical education lessons very much (64.0%). Physical education lessons were easy, useful and interesting ($p < 0.05-0.01$). It was determined that although children liked attending physical education lessons, they felt unsafe there because they suffered from other classmates' bullying and aggression. However, parents and teachers were not always informed about learners' grievances; they used to talk about it with friends. There were cases when they did not want to go to physical education lessons at all ($p < 0.05-0.01$). Therefore, the children without expecting teachers or parents' help, tried to solve problems themselves by responding to bullying and aggression in the same way.

Many respondents found physical education lessons easy (45.5%); the children enjoyed attending these lessons because they were interesting, nice, successful and useful ($p < 0.05-0.01$). However, some children found physical education lessons not always easy, they felt insecure because other learners did not talk or communicate with them, and there were cases of bullying that caused their reluctance to attend these lessons ($p < 0.05-0.01$). Physical education lessons were very interesting (52.3%), children liked attending classes, and they found the lessons easy and funny, they performed well in the lessons and the lessons were useful ($p < 0.05-0.01$), but the children felt insecure in physical education lessons because of other classmates' bullying. It is very important for teachers to timely notice children's communication gaps in physical education lessons, to teach children tolerance and understanding, to develop their humanistic attitudes and to create a friendly environment where children interacted with each other in a friendly manner, felt happy and did not feel anxious about possible situations of bullying.

Some of respondents (45.0%) felt happy in physical education lessons and they liked attending these lessons because they were easy, interesting and the learners performed well, the lessons

were useful ($p < 0.05-0.01$), but the children felt unsafe because of other learners' bullying. Abused children told their friends, teachers, and parents about their classmates' behavior and expected compassion and understanding. With no help provided, the children tried to show their abusers that the harassment did not bother them, and they did not talk or communicate with their abusers. There were cases when learners did not want to go to physical education lessons because of bullying, but 47.7% of children performed well in physical education lessons, they liked attending the lessons, found them easy, funny, interesting, and useful ($p < 0.05-0.01$). However, they felt insecure in physical education lessons because of other classmates' bullying. There were cases when they did not want to go to physical education lessons because of it ($p < 0.01$).

Even 53.6% of respondents found physical education lessons very useful and liked attending them, because the lessons were easy, interesting, pleasant and the children performed well ($p < 0.05-0.01$), but the children did not feel safe in physical education lessons because of classmates' bullying. Children's opinion that physical education lessons were beneficial had a statistically significant inverse correlation with the children's views that they felt safe in the lessons ($p < 0.01$). We can judge about the children's good or very good psychological well-being in physical education lessons by considering an overall psychological well-being index, where the majority of the responses were divided between zero and two.

A survey of young learners' self-esteem showed that 56.8% of children considered themselves as unfriendly. The survey revealed that children who considered themselves as unfriendly were humiliating other pupils in the class ($p < 0.01$), they were pushing, kicking, slandering, calling names and teasing ($p < 0.05-0.01$). However, the children who considered themselves as strong, cheerful and happy did not humiliate others, they interacted with other children sensitively and with dignity.

As many as 48.2% of children considered themselves to be moderately strong. Children's opinion that physical education lessons were easy had a statistically significant inverse correlation with the children's evaluation as strong ones ($p < 0.05$). Physically weaker children felt unsafe and underestimated in physical education lessons. They were worried that other learners would laugh at them in case of failure. Children's opinion that

physical education lessons were useful had a statistically significant inverse correlation with children's self-evaluation as strong ones ($p < 0.05$). Children's self-evaluation as strong ones had a statistically significant inverse correlation with their well-being in physical education lessons ($p < 0.01$). Children who considered themselves physically strong were in a good mood in physical education lessons. Children's opinion that the lessons were pleasant had a statistically significant inverse correlation with their self-evaluation as strong ones ($p < 0.01$). The study shows that the children who considered themselves friendly, strong, beautiful, smart, funny, happy and talented ($p < 0.05-0.01$) did not feel safe and were worried about their failure, mockery and bullying in physical education lessons. They could not experience positive emotion and were feeling depressed. Therefore, teachers who notice a child failing to do a physical exercise or task must be supportive and encouraging. Also, teachers must involve the whole class into doing this, in this way teaching children sensitivity and humanity. A delicate interaction between a teacher and a learner may be disturbed failing to notice by child's failure when accomplishing a physical exercise in physical education lessons. The same might happen with an interaction between learners and their classmates who failed. A child who had suffered a failure, felt lonely, outcast and insulted begins to distrust himself/herself, to feel hatred for the teacher and classmates, which later turns into aggression.

Children (50.5%) considered themselves to be somewhat beautiful, and 33.8% of them considered themselves to be ugly. The survey found out that children who considered themselves to be beautiful felt unsafe in physical education lessons because of their classmates' bullying. Children's opinion that physical education lessons were easy had a statistically significant inverse correlation with the self-evaluation as beautiful ($p < 0.01$). Children who evaluated themselves as beautiful made fun of their classmates in defense for their dignity ($p < 0.05$) and threatened them ($p < 0.01$).

Even 58.6% of children considered themselves as moderately intelligent. Children's self-evaluation as intelligent had a statistically significant inverse correlation with an overall psychological well-being index ($p < 0.01$). The study showed that children who considered themselves as smart, as well as children who considered themselves beautiful felt unsafe in physical education lessons because

of children's bullying. They also used to protect their dignity by mocking at other children in class. Children who considered themselves smart used to mock at other classmates by beating, kicking and threatening them ($p < 0.05-0.01$).

As many as 53.2% of children considered themselves to be sad. Children's self-esteem as happy ones had a statistically significant inverse correlation with an overall psychological well-being index ($p < 0.01$). Children who self-evaluated themselves as cheerful did not feel safe and happy in physical education lessons. In their point of view, the lessons where bullying and violence existed were useless.

Some of children (23.9%) considered themselves to be moderately happy and 55.4% of children treated themselves as unhappy ones. Our research results differ from R. Bakutyte (2002) survey results which show that many respondents felt very happy and happy (respectively 45.2% and 42.8%). Children's self-evaluation as happy had a statistically significant inverse correlation with an overall psychological well-being index ($p < 0.01$). Children who felt happy stated that physical education lessons were not easy and interesting ($p < 0.01$) because they did not receive after children's support and compassion in case of their failure. Children who considered themselves as happy were abused in physical education lessons ($p < 0.05$), they felt unhappy and said that such lessons were useless.

Even 44.6% of children considered themselves as calm and 39.6% of children considered themselves as nervous. The survey shows that children who evaluated themselves as calm felt safe in physical education lessons ($p < 0.05$), but if their classmates abused them, the children protected their dignity by kicking offenders. Children's self-evaluation as talented had a statistically significant inverse correlation with an overall psychological well-being indicator ($p < 0.01$). The survey determined that children who were gifted did not find physical education lessons easy, interesting and pleasant ($p < 0.01$). Children who considered themselves as gifted did not find physical education lessons beneficial because of other classmates' bullying. The average number of children's self-esteem had a statistically significant inverse correlation with an overall psychological well-being indicator ($p < 0.01$). Summarizing children's self-esteem research results, we suggest that most respondents self-evaluated themselves as average.

DISCUSSION

Summarizing the results of learners' psychological well-being, we can state that psychological well-being of 41.0% of children was good or very good in physical education lessons. Although the majority of children liked attending physical education lessons, but the remaining children did not feel happy in the lessons because of other children's bullying. Taking into consideration the results we can say that it is necessary to develop children's mutual understanding and humanistic values, so that all the children wanted to attend physical education lessons and felt happy there.

According to A. Palujanskienė (2005) survey data, direct aggression occurs irrespective of sex because of different accentuations of character. The decline of values exists across the globe. Victims of bullying experience injustice, tension, feeling of helplessness (Targamadžė, Valeckienė, 2007). More than half of the learners feel a large increase in anxiety at school (Martišauskienė, 2004). Only 68.0% of learners willingly attend school after four years of learning at the primary school because of children's bullying and harassment (Rupšienė, 1996). Our survey found out that although children liked attending physical education lessons, and they found these lessons easy, useful and interesting, felt happy and did well, they felt unsafe in physical education lessons because they suffered from other children's bullying and aggression. There were cases when they did not want to go to physical education lessons. Feeling unsafe, being absent-minded and defensive against other learner's insults in physical education lessons, they behave impulsively and thoughtlessly, which negatively affects the learning process and encourages behavioral problems at the primary school (Giannopulu et al., 2008).

Our survey results coincide with the findings of V. Targamadžė and D. Valeckienė (2007) which show that learners suffer from harassment, intimidation and indirect forms of bullying –peer ignorance and rejection. It can be stated that children lack security. It is important for a child to be seen and accepted as he/she actually is. Being unable to meet these needs, the child loses the opportunity to love and to be loved. Thus, children having communication problems often become aggressive and demanding and are rejected by their peers (Pileckaitė-Markovienė, 2005). Bullying among primary schoolchildren is a primary manifestation

of behavior which leads to violent behavior when the learners get older (Targamadžė, Valeckienė, 2007). Therefore, if members of the community tolerate children's violence and observe its manifestation in children's behavior indifferently, children grow up more aggressive in such environment.

However, children's aggressiveness can be adjusted by helping to realize their conflicting emotions, creating conditions for children where they can understand themselves and control their behavior. Thus, teachers must not tolerate inappropriate learner's behavior in physical education lessons and respond to it immediately, as well as discuss and analyze such behavior with all the learners in the class. Victims of bullying experience injustice, tension, and feeling of helplessness, which negatively affects both physical and emotional health of children. Such children have low self-esteem (Targamadžė, Valeckienė, 2007).

Discussing children's self-esteem results, it was determined that 41.0% of children considered themselves as the average ones. Most children liked attending physical education lessons and they felt happy there if other learners in class did not abuse them and helped them in case of failure.

The survey shows that learners who considered themselves unfriendly, bullied other pupils. Our survey data confirm M. Pileckaitė-Markovienė (2001) statement that a child's failure to communicate causes a sense of inferiority which only enhances suffering from an internal disharmony and reveals itself through aggressive behavior with others. Children who considered themselves strong, beautiful, smart, funny, happy, and talented in physical education lessons did not like attending lessons because of other learners' bullying. They did not receive other children's support and compassion in case of failure, felt unhappy and said that physical education lessons were useless.

Children who evaluated themselves as beautiful, intelligent and gifted felt unsafe in physical education lessons because of other children's bullying. They also used to abuse other children in defense against bullying. Analyzing children's self-evaluation as the happy ones, our survey did not coincide with R. Bakutytė research results (2002) indicating that many respondents felt happy or very happy. The survey showed that only the children who considered themselves as calm

felt secure in physical education lessons. However, if other children used to bully them they defended their dignity and used to abuse their offenders as well. In summary, it can be stated that although children like and find physical education lessons interesting, on the other hand, they are not always willing to attend physical education lessons because of other children's aggression and misbehavior. Therefore, in order to eliminate bullying and other negative behavior among young learners in physical education lessons, it is necessary to create a safe and functional learning environment where sincere relations among teachers and learners would be cherished and behavior of children with their classmates and teachers would change towards humanistic values.

CONCLUSIONS AND PERSPECTIVES

Although young learners like attending physical education lessons, and they find the lessons easy, interesting, pleasant, good and useful, they feel unsafe in physical education lessons because they suffer from other children's bullying. There were

cases when they did not want to go to physical education lessons at all.

Children who considered themselves as strong, beautiful, intelligent, funny, happy and gifted felt unpleasant in physical education lessons because of other children's bullying. They did not receive other children's support and compassion in case of failure, and found such physical education lessons useless.

Our hypothesis was not proved because young learners most often evaluated themselves as the average ones. Psychological well-being in physical education lessons was not always good because of frequent cases of bullying which caused unwillingness to attend physical education lessons.

In order to eliminate bullying and other negative behavior among young learners in physical education lessons, it is necessary to develop educational programs and to implement them in practice. Also, it is important to develop humanistic values for children belonging to this age group by combining cognitive and emotional elements of learning, by providing a possibility to experience humanistic values and to put them into practice using active and playful activities.

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JAUNESNIOJO MOKYKLINIO AMŽIAUS VAIKŲ PSICHOLOGINĖS SAVIJAUTOS IR SAVIVERTĖS KŪNO KULTŪROS PAMOKOSE YPATUMAI

Rolandas Jančiauskas
Klaipėdos universitetas, Klaipėda, Lietuva

SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Dėl vaikų patyčių mokiniai mokykloje jaučia stresą ir nerimą, o įprastinius stresorius išgyvena kaip pavojingus, dėl to net nenori eiti į mokyklą. Jaunesniojo mokyklinio amžiaus vaikų psichologinė savijauta ir savivertė gera, o kūno kultūros pamokose jie patiria teigiamas emocijas.

Tikslas – ištirti jaunesniojo mokyklinio amžiaus vaikų psichologinę savijautą ir savivertę kūno kultūros pamokose.

Metodai. Klaipėdos miesto mokyklose anoniminės anketinės apklausos būdu buvo tiriama jaunesniojo mokyklinio amžiaus vaikų psichologinė savijauta ir savivertė kūno kultūros pamokose.

Rezultatai. Apibendrinant vaikų psichologinės savijautos tyrimo rezultatus galima teigti, kad 41,0% vaikų psichologinė savijauta kūno kultūros pamokose gera arba labai gera. Analizuojant jaunesniojo mokyklinio amžiaus vaikų savivertės kūno kultūros pamokose tyrimų rezultatus nustatyta, kad apie 41,0% vaikų save vertina vidutiniškai.

Aptarimas ir išvados. Nors jaunesniojo mokyklinio amžiaus vaikams patiko lankyti kūno kultūros pamokas, jų metu jiems buvo lengva, įdomu, malonu ir gerai sekėsi, pamokos vaikams buvo naudingos, tačiau jie jautėsi nesaugiai. Dažnai mokiniai patirdavo kitų klasės vaikų patyčias ir yra buvę, kad dėl to net nenorėjo eiti į šias pamokas.

Raktažodžiai: patyčios, stresas ir nerimas, nenoras eiti į mokyklą.

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Corresponding author **Rolandas Jančiauskas**
Klaipėda University
S. Nėries str. 5, LT-92227 Klaipėda
Lithuania
Tel +370 687 86830
E-mail roland.jan@balticum-tv.lt

ANALYSIS OF MOTOR COORDINATION ALTERATION AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

Vilma Jurevičienė¹, Dovilė Kielė¹, Ričardas Jurevičius², Tadas Česnaitis³

Lithuanian Academy of Physical Education¹, Kaunas, Lithuania

Hospital of Lithuanian University of Health Sciences Kauno Klinikos², Kaunas, Lithuania

Lithuanian University of Health Sciences³, Kaunas, Lithuania

ABSTRACT

Research background and hypothesis. The Anterior cruciate ligament (ACL) is the most commonly injured ligament of the knee and its injuries result in significant functional impairment. Injury to the ACL is associated with altered knee joint loading and impaired neuromuscular control, which defined as the ability to produce well controlled movements and dynamic balance.

Research aim. The aim of this study was to evaluate motor coordination and functional capacity of patients who received rehabilitation program following ACL reconstruction.

Research methods. The study included 15 males aged 33.7 ± 2.49 years who had undergone unilateral ACL reconstruction with a semitendinosus/gracilis (STG) graft in Kaunas Clinical hospital. For objective functional testing, we used figure-of-eight movement coordination test. The Lysholm questionnaire was included as a disability outcome measure following ACL injury and reconstruction. The patients were assessed preoperatively and after 5 and 21 weeks postoperatively.

Research results. The results of this study indicated that motor coordination timescale showed significant differences ($p < 0.05$) between the injured and the healthy legs before surgery and after 5 and 21 weeks. The movement coordination test data showed that there the timescale significantly longer on the injured knee compared with the noninjured knee. After 21 weeks of rehabilitation we found significantly lower ($p < 0.05$) values in injured knees compared with the preoperative data. In injured knee the timescale after 21 weeks of rehabilitation was significantly ($p < 0.05$) longer compared with noninjured knee.

The Lysholm questionnaire scale indicated that there was a significant difference in the results for values ($p < 0.05$) before surgery and after 21 weeks of rehabilitation. The questionnaire scale data showed that after 21 weeks of rehabilitation results for values was significantly ($p < 0.05$) highest compared with before surgery and after 5 weeks.

Discussion and conclusions. There was improvement in the injured leg in mean motor coordination timescale 21 weeks after ACL reconstruction, but the timescale was higher than in the uninjured leg. After 21 weeks of ACL reconstruction knee functional status in most patients was good or excellent.

Keywords: knee joint, the Lysholm questionnaire, movement coordination test.

INTRODUCTION

Powerful, precise, controlled movements are an integral part of sports activities and daily functional activities (Myer et al., 2006). The Anterior cruciate ligament (ACL) is the most commonly injured ligament of the knee and its injuries result in significant functional

impairment (Krych et al., 2008; Kessler et al., 2008; Almqvist et al., 2009). Injury to the ACL is associated with altered knee joint loading and impaired neuromuscular control, defined as the ability to produce well controlled movements and dynamic balance (Risberg et al., 2004;

Ageberg, 2002). All these deficiencies contribute to the development of osteoarthritis and ACL re-injury (Lohmander et al., 2007). The ACL injury is commonly managed by orthopaedic surgeons, physical therapists, and athletic trainers. A variety of surgical techniques and rehabilitation protocols is used to treat the ACL injury. Knee surgery may alter the neuromuscular response to unexpected perturbations during functional, dynamic tasks. After surgery, knee function recovery depends on many factors, including muscle control and coordination, muscle contraction speed, effort, imbalances between the two legs (Krych et al., 2008). The rehabilitation usually emphasises normalisation of bilateral symmetries in joint mobility, motion and neuromuscular control, muscle strength, and functional activity (D'Amato, Bach, 2003). The underlying problem must be identified and addressed during rehabilitation if the athlete is to return to participation at the preinjury level (Voight, Cook, 1996). Functional performance based evaluation is important to assess the effectiveness of surgery, rehabilitation and individual assessment of progress. Function in subjects with ACL injury may be evaluated with self-reported outcome scores (Gustavsson et al., 2006; Risberg et al., 2004; Lysholm, Gillquist, 1982). Motor coordination is one of the factors creating a functional knee joint stability (Myer et al., 2006).

All voluntary movements are controlled by the central nervous system. The so-called "team", i. e. nerve impulses sent to muscles, strength, order and harmony, are awarded with the information from the integrated analysis of multiple receptors (Poderys, 2004). It has been found that the management of complex movements requires coordination of many muscles (Kelso, 1999). Therefore, it may form a temporary coordination structure which works as a cohesive whole. One of the 10 principles of biomechanics that affect movement control is coordination principle – it shows the ability of the body or its parts to co-ordinate with the environment and oneself. The human body is a physiological system that is capable of achieving (central nervous system support) the desired time, speed, acceleration, and a peak movement. This principle has been studied the least (Skurvydas, 2008). The aim of this study was to evaluate motor coordination and functional capacity of patients who received a rehabilitation program following ACL reconstruction. We hypothesized the

following: After 21 weeks of ACL reconstruction and rehabilitation knee function assessed by motor coordination and self-assessment questionnaires would significantly improve.

RESEARCH METHODS

Subjects. The research sample included 15 males aged 33.7 ± 2.49 years, body weight 78.93 ± 4.31 kg, height 177.93 ± 3.37 cm (mean \pm SD) who had a diagnosis of ACL rupture. Inclusion criteria were: 1) unilateral, non-acute ACL deficiency without associated lesions of other structures of the knee, 2) an uninjured contralateral extremity, back and neck, and 3) no history of neurological, metabolic disease, vestibular or visual disturbance, knee, ankle, and hip osteoarthritis. These patients had undergone unilateral ACL reconstruction with a semitendinosus/gracilis (STG) graft in Kaunas Clinical Hospital. All subjects followed the traditional rehabilitation program for ACL reconstruction. Rehabilitation goal was to increase the knee range of motion and muscle strength, develop balance and proprioception. The patients were assessed preoperatively and at 5 and 21 weeks postoperatively. The uninjured contralateral knees of these patients were used as an internal control.

Each subject read and signed a written informed consent form consistent with the principles outlined in the Declaration of Helsinki. All subjects gave informed consent according to the requirements of the Kaunas Regional Ethics Committee of Biomedical Research (Protocol No. BE-2-30).

Assessment of motor coordination. For objective functional testing, we used figure-of-eight movement coordination test. The floor was marked by two parallel lines, 5 cm apart from each other. Two stamens were put on one line 40 cm apart from each other. The subject stood sideways to the stamens with both feet on the line without stamens. The subject was asked to perform five figure-of-eight movements as fast as possible around the stamens and put the leg to the starting position on the line (Poderys, 2004). The stopwatch was started concurrently with the starting signal and was stopped when the subject completed the course. The time was recorded in seconds. The test was performed 3 times for each leg with a short resting period between each trial. The means of each limb were calculated and used to determine limb symmetry. Limb symmetry was calculated dividing the mean score of the involved limb by the

score of the uninvolved side and multiplying the result by 100 (D'Amato, Bach, 2003).

Lysholm scale. The Lysholm questionnaire was included as a disability outcome measure following ACL injury and reconstruction. The modified Lysholm scale, as described by Y. Tegner and J. Lysholm (1985), is an eight-item questionnaire that was originally designed to evaluate patients following knee ligament surgery. It is scored on a cumulative 100-point scale (representing normal knee function), with 25 points for knee stability, 25 points for pain, 15 points for locking, 10 points each for swelling and knee function with stair-climbing, and 5 points each for limb, use of a support, and knee function with squatting. The Grading the Lysholm Knee Scoring scale was as follows: excellent condition (95–100 points); good condition (84–94 points); fair condition (65–83 points); poor (< 64 points). This scale has been used extensively in clinical research studies (Lysholm, Gillquist, 1982).

Statistical analysis. Descriptive data are presented as means \pm standard deviation (SD). Data were analyzed using a repeated measure analysis of variance (ANOVA) with time as the repeated measure factor for the outcome measures at the 5 and 21-weeks follow-ups. SPSS (SPSS Inc., Version 10.0, Chicago, IL) was used to calculate the ICC. A difference between injured and uninjured knee was analyzed using one way ANOVA. The t-test for paired samples was used to determine whether there was a difference between the mean values for the same measurements on the operated and normal knee joints. The difference of $p < 0.05$ between the means of the same measurements for the operated and normal knees was considered to be statistically significant.

RESEARCH RESULTS

Motor coordination deficits of the knees were determined by measuring the ability of the patient to reproduce functional movement coordination test. The results of this study indicated that motor coordination timescale indicated a significant differences ($p < 0.05$) between the injured and the healthy legs before surgery and after 5 and 21 weeks. The movement coordination test data showed the timescale was significantly longer on the injured knee compared with the uninjured knee. There were significant differences ($p < 0.05$) in both legs after 21 weeks of rehabilitation (Table 1). After 5 weeks after surgery we found higher

difference for timescale between legs compared with the values before surgery and 21 weeks after rehabilitation. After 21 weeks of rehabilitation we found significantly lower ($p < 0.05$) values in injured knees compared with the preoperative data. In injured knee, the timescale after 21 weeks of rehabilitation was significantly ($p < 0.05$) longer compared with uninjured knee.

The Lysholm questionnaire scale indicated that there was a significant difference in the values ($p < 0.05$) before surgery and after 21 weeks of rehabilitation. The questionnaire scale data showed that after 21 weeks of rehabilitation the values were significantly ($p < 0.05$) higher (mean values $- 89.4 \pm 0.35$) compared with the ones before surgery (mean values $- 65.5 \pm 8.7$) and after 5 weeks (mean values 62.1 ± 9.2) (Figure). There were no significant differences in the values before surgery and after 5 weeks of rehabilitation (Table 2).

DISCUSSION

The principal role of the anterior cruciate ligament (ACL) is to resist anterior displacement of the tibia on the femur. During the knee extension, it is tense and protects some of knee joint hyperextension. The ACL is strong and stiff, yet because of its unique structure, it is precariously susceptible to injury (Cabaud, 1983). ACL rupture is one of the most common knee pathologies. Then the patient feels the knee to be unstable. ACL reconstruction is of major importance as it maintains knee stability and prevents osteoarthritic alterations which can develop rapidly (Ageberg, 2002). Our study has shown that motor coordination timescale was significantly longer in injured ACL-deficient knee than in the contralateral knee (normal knee) before surgery and after 5 and 21 weeks of rehabilitation. Receptors responsible for detecting movement and providing feedback to the central nervous system are found in the skin, ligaments, joints, muscles and tendons. If receptors or pathways become damaged (after ACL injury), the ability to detect body movement and position is affected. As balance and movements depend on an intact sensorimotor system, functional limitations in activities such as walking and climbing stairs can occur when receptors are damaged or destroyed. Reduced sensation, lower extremity muscle weakness, and damage of receptors can affect motor coordination (Myer et al., 2006).

After 21 weeks of rehabilitation we found significantly lower values in injured knees

Figure. Changes in Lysholm Functional Scale scores over time ($p < 0.05$)

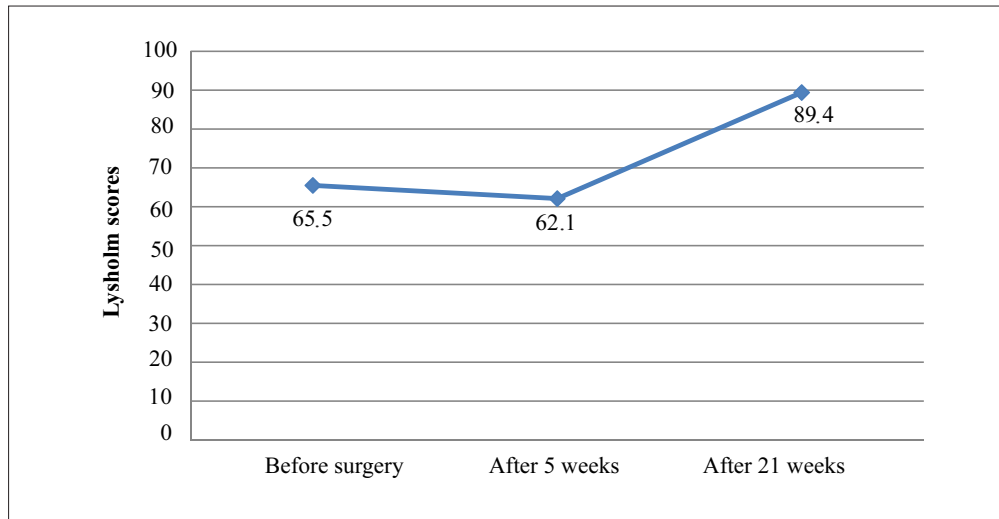


Table 1. Difference in seconds (%) in movement coordination test for timescale mean (averages \pm SD) between injured knee and uninjured knee

Knee	Before surgery (averages \pm SD)	After 5 weeks (averages \pm SD)	After 21 weeks (averages \pm SD)
Injured knee	7.4 \pm 1.1	8.6 \pm 1.3	6.9 \pm 1.1
Uninjured knee	7 \pm 0.8	6.7 \pm 0.6	6.3 \pm 0.46
Difference of s (%)	5.8*	18.2*	7.2*

Note. * – $p < 0.05$, injured and uninjured knee compared.

Table 2. Lysholm Knee Functional Scale scores (means, SD, percentage (%)) and number of patients with knee functional condition)

Grading Lysholm Knee Functional scale scores	Before surgery		After 5 weeks		After 21 weeks	
	Averages \pm SD	Averages % (n)	Averages \pm SD	Averages % (n)	Averages \pm SD	Averages % (n)
Excellent condition (95–100 points)	–	–	–	–	97.2 \pm 2.6*	60% (9)
Good condition (84–94 points)	–	–	–	–	89.6 \pm 0.5*	33.3% (5)
Fair condition (65–83 points)	71.7 \pm 6.8	67% (10)	68.6 \pm 5.1	33.3% (5)	81	6.7% (1)
Poor, < 64 points	59.4 \pm 4.8	33.3% (5)	55.6 \pm 6.5	67% (10)	–	–

Note. * – $p < 0.05$, compared before surgery and after 21 weeks.

compared with the preoperative data. One of the most interesting questions in neuroscience concerns the manner in which the nervous system can modify its organization and ultimately its function throughout an individual's lifetime based on sensory input, experience, learning and injury (Donoghue et al., 1996) The most advanced motion coordination is based on the interpretation of complex dynamical systems theory. According to the coordination mechanism, the elements of the system depend on the spontaneous self-adjustment movement task, the conditions of the motor system

and the specificity of the environment. There is no doubt that this self-adjustment takes place under certain physiological and biomechanical principles or rules which are being intensively studied. Coordination mechanism characterized by the fact that if one element is out of order other try to correct it immediately. There are several well-known main causes of errors in movement performance. Some of them are: a) specific motor programming errors (e.g., excessive movement speed), b) errors in the realization of a specific motor program (for example, influence by muscle

fatigue and weakness, etc.) (Skurvydas, 2008). R. A. Schmidt and T. D. Lee (1999) have suggested that a fast and accurate motion duration is longer when more complex movements by larger muscles are performed. Scientists do not yet know the main reason why more people control movements and change their duration and movement speed. It has been noted that in order to perform precise movements, people tend to choose neither very high nor very low speed, just moderate. Everyone has a particular speed of movement.

Recovery of knee joint function and successful return of the patients to preinjury activities are crucial factors in assessing clinical outcomes. For this purpose, we used the Lysholm score. The rating system of Lysholm questionnaire has been well established, as an alternative mechanism to gather outcomes data when evaluating knee ligament injuries on a disability questionnaire, significant results were shown on subjective scores of

disability in ACL reconstructed patients (Williams et al., 1999). We found a significant improvement in Lysholm activity scores postoperatively ($p < 0.05$). H. Ödzemir et al. (1999) and S. Karasel et al. (2010) found similar results following rehabilitation of patients undergoing ACL reconstruction. Our study has shown that the mean Lysholm score for 15 patients after an 21 weeks follow-up was reported to be 89.4.

CONCLUSIONS AND PERSPECTIVES

In conclusion, our study shows that there was an improvement in the injured leg in mean motor coordination timescale 21 weeks after ACL reconstruction, but it was higher than in the uninjured leg. After 21 weeks of ACL reconstruction, achieved knee functional status in most patients was good or excellent.

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JUDESIŲ KOORDINACIJOS POKYČIAI PO PRIEKINIŲ KRYŽMINIŲ RAIŠČIŲ REKONSTRUKCIJOS

Vilma Jurevičienė¹, Dovilė Kielė¹, Ričardas Jurevičius², Tadas Česnaitis³

Lietuvos kūno kultūros akademija¹, Kaunas, Lietuva

Lietuvos sveikatos mokslų universiteto ligoninė Kauno klinikos², Kaunas, Lietuva

Lietuvos sveikatos mokslų universitetas, Medicinos akademija³, Kaunas, Lietuva

SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Dažniausiai yra pažeidžiamas kelio sąnario priekinis kryžminis raištis (PKR). Pažeidus PKR, padidėja kelio sąnario apkrovimas ir pablogėja neuroraušmeninė kontrolė, kuri apibūdinama kaip gebėjimas gerai kontroliuoti judesius ir dinaminę pusiausvyrą.

Tikslas – nustatyti judesių koordinacijos ir funkcinių gebėjimų pokyčius po atliktos PKR rekonstrukcijos ir reabilitacijos.

Metodai. Buvo tiriama 15 vyrų ($33,7 \pm 2,49$ m.), kuriems Kauno klinikinėje ligoninėje atlikta vieno kelio PKR rekonstrukcija panaudojant pusgyslinio/grakščiojo raumens sausgyslės transplantą. Judesių koordinacijai (JK) ištirti naudotas „Kojos mojavimo aštuonetu“ funkcinis testas. Kelio sąnario funkinei būklei nustatyti buvo naudojamas *Lysholm* klausimynas. Testavimai atlikti prieš operaciją ir praėjus 5 ir 21 savaitėms po jos.

Rezultatai. Prieš operaciją bei praėjus 5 ir 21 savaitėms po jos pažeistos ir sveikos kojos JK trukmės rezultatai buvo skirtingi, o pažeistos kojos judesių trukmė statistiškai reikšmingai ilgesnė nei sveikos kojos ($p < 0,05$). Praėjus 5 savaitėms po operacijos, JK trukmės rezultatų skirumas tarp sveikos ir traumotos kojų buvo didžiausias. Praėjus 21 savaitėms po operacijos ($p < 0,05$), pažeistos kojos judesio trukmė statistiškai reikšmingai sutrumpėjo, lyginant su rezultatais prieš operaciją, bet trukmė išliko statistiškai reikšmingai ilgesnė, lyginant su sveika koja ($p < 0,05$). *Lysholm* klausimynas parodė statistiškai reikšmingą rezultatų skirtumą prieš operaciją ir praėjus 21 savaitei po jos ($p < 0,05$). Klausimyno rezultatai po 21 savaitės buvo statistiškai reikšmingai aukščiau palyginus su rezultatais prieš operaciją ir praėjus 5 savaitėms po jos ($p < 0,05$).

Aptarimas ir išvados. Praėjus 21 savaitei po PKR rekonstrukcijos, pažeistos kojos judesių koordinacija pagerėjo, bet judesio trukmė liko ilgesnė nei sveikos kojos. Daugumos tiriamųjų kelio sąnario funkcijos būklė buvo puiki arba gera.

Raktažodžiai: kelio sąnarys, *Lysholm* klausimynas, judesių koordinacijos testas.

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Corresponding author **Jurevičienė Vilma**
Lithuanian Academy of Physical Education
Sporto str. 6, LT-44221 Kaunas
Lithuania
Tel +370 62062623
E-mail vilmaij@one.lt

THE ANALYSIS OF FACTORS RELATED TO CREATIVITY IN THE SAMPLE OF PHYSICAL EDUCATION TEACHERS

Dalia Lapėnienė¹, Audronė Dumėienė¹, Tomas Lapėnas²
Lithuanian academy of Physical Education¹, Kaunas, Lithuania
Joint Stock Company TS Construction², Kaunas, Lithuania

ABSTRACT

Research background and hypothesis. There are many obstacles for creativity in physical education teachers' work but majority of physical education teachers tend to work creatively so it is worthwhile to explore which variables predict creativity. The hypothesis of the study: Personal factors are more important for physical education teachers' creativity in comparison to social factors.

Research aim was to identify individual and social factors, predicting creativity in the sample of physical education teachers.

Research methods. Quantitative study. The questionnaire survey was used to establish the level of creativity, creative self-efficacy, motivation, emotions and the microclimate characteristics. The sample involved 120 physical education teachers.

Research results. Creativity was predicted by self-efficacy and intrinsic process motivation. Extrinsic motivation inhibited creativity in physical education teachers' work. Supervisory encouragement for creativity has the only social factor facilitating creativity.

Discussion and conclusions. The obtained data confirmed interrelation between creativity and self-efficacy and validated results obtained by D. F. De Moulin (1993). Intrinsic process motivation also predicts creativity. It is in agreement with Y. Ommundsen and S. Eikanger Kvalo's (2007) results. Extrinsic motivation has negative impact towards creativity. It is possible that teachers motivated intrinsically create task-involving motivational climate which leads to competitiveness (Ommundsen, Eikanger Kvalo, 2007). Supervisory encouragement is the only social variable predicting teachers' creativity. The data revealed that supervisors' behavior was more important than that of colleagues (Laker et al., 2008; Blankenship, Coleman, 2009).

Keywords: creativity, personal and social factors.

INTRODUCTION

Relelevance. Creativity is defined as essential competence in contemporary knowledge society, that is why educational system seeks to develop creativity in youth. Teachers' creativity as an important factor of educational progress is mentioned in European and Lithuanian educational documents. Creative teaching is defined as teachers' ability to make educational process more interesting using students' emotions, imagination and other abilities related to creativity

(NACCCE, 1999). In educational literature it is defined as effective teaching because it develops students' creative abilities and intrinsic interest in the curriculum (Jeffrey, Craft, 2004).

Creativity is important, because it is a good way to make the curriculum interesting and it enhances students' efforts in learning. The ways of students' engagement are determined by the goals of different subjects. Creativity is different in various subjects, but it has the same essence,

i. e. teachers seek to solve professional issues innovatively and to motivate students.

Manifestations of physical education teachers' creativity receive more and more interest in scientific literature. During the lessons, creative physical education teachers organize educational activities to facilitate students' desire for movement, freedom to experiment and search for new movements or game strategies. R. Nicholson (1999) indicated fundamental teachers' competencies which lead to the creativity: ability to convey subject knowledge, ability to stimulate students' curiosity and desire to study, ability to engage or enhance intrinsic motivation, ability to encourage students to risk, ability to express trust in students' abilities, ability to create environment for choice and discovery, and ability to develop students' self-control skills.

Considering the importance of creativity in physical education teachers' work, it is important to emphasize the challenges for creativity. Macro level challenges come from social environment: general attitudes toward health and activity in nowadays society. Mezo level factors are associated with schools' institutional barriers. Micro level can be defined as personal and interpersonal factors or lack of encouragement.

Appreciating barriers for physical education teachers' creativity, it is important to emphasize personal and social factors, facilitating creativity in the workplace. Literature reveals that creativity comes from personality and unrolls in social environment.

Considering personal factors facilitating creativity, it is worthwhile to start from self-efficacy. According to D. F. De Moulin (1993), self-efficacy level differentiates effective teachers from less effective. Self-efficacy is defined as person's trust in his/her ability to work successfully in the selected field. Self-efficacy is essential in the environment, where persons hold responsibility for the outcomes and are aware of the meaning of their job.

Self-efficacy is correlated with work motivation. Both self-efficacy and motivation derive from self concept. N. H. Leonard et al. (1999) proposed theory of work motivation explaining the influence of self-concept. Traditionally creativity is correlated with intrinsic and extrinsic motivation (Amabile et al., 1996). Extrinsic motivation is defined as "the motivation to work primarily in response to something apart from the work itself, such as reward or recognition or the dictates of other

people" (Amabile et al., 1994, p. 950). Intrinsic motivation is "the motivation to engage in work primarily for its own sake, because the work itself is interesting, engaging, or in some way satisfying" (Amabile et al., 1994, 950 p.). N. H. Leonard et al. (1999) sophisticated the concepts of work motivation and introduced five sources of motivation: instrumental, intrinsic process, goal internalization, extrinsic and intrinsic self-concept motivation. Instrumental motivation can be defined as engagement expecting tangible outcomes, such as pay, praise, etc. Intrinsic process motivation can be defined as engagement because of fun and enjoyment, e. g. motivation comes from the work itself and feels rewarded simply by performing the task. Goal internalization motivation can be defined as engagement because of congruence between behavior and ones' value system. Intrinsic self-concept motivation can be defined as engagement because of inner-directedness, e. g. an individual behaves in a certain way because of internal standard which becomes the basis for the ideal self. Extrinsic self-concept motivation is primary other-directed, e. g. individual attempts to meet the expectation of other people (Leonard et al., 1999). According to the definition of creativity and the studies in the area of social psychology of creativity intrinsic process motivation is considered as facilitating creativity, and instrumental/extrinsic motivation may be a barrier for creativity.

Intrinsic process motivation has much in common with positive emotions. According to M. Chang (2010), teachers often encounter stress, emotional exhaustion, and burnout at their job. Scientists distinguish five emotions which have the most disruptive effect: anxiety, anger, shame, guilt, and sadness. Teachers' emotions are interrelated with their work motivation. Intrinsic process motivation determines persons' involvement and efforts (Ommundsen, Eikanger Kvalo, 2007). Persistence and seeking to participate in the social life of the school are named as essential factors contributing to successful adaptation of novice physical education teachers (Blankenship, Coleman, 2009). Intrinsic process motivation may serve as a protective factor determining teachers' resilience to job related stress and negative emotions.

In the scientific literature social environment is considered as a source of challenges for physical education teachers, but it also enhances teachers' creativity. Positive characteristics, such as school

policy, colleagues and supervisors' support help to reduce the level of stress and obtain trust in collective ability to overcome obstacles (Klassen, 2010). According to A. Laker et al. (2008) supervisory support and encouragement are the main factors contributing to novice teachers' educational and professional development. Supervisory encouragement manifests as a supply of sufficient recourses, settlement of standards for high quality and consultation when teachers face obstacles in their everyday work.

Physical education teachers' creativity is linked to individual and social factors. The estimation of these factors discloses possibilities for the enhancement of teachers' creativity in the work place.

The **object** of the study was relations of creative self-efficacy, motivation, emotions and organizational climate factors to physical education teachers' creativity.

The **aim** of the study was to identify individual and social factors, predicting creativity in the sample of physical education teachers.

Hypothesis: Personal factors are more important for physical education teachers' creativity in comparison to social factors.

RESEARCH METHODS

Participants. One hundred twenty physical education teachers participated in the study. All participants worked in various schools of Kaunas region, Lithuania. The mean age of the participants was 42 years. 32.4% of participants were men, and 66.7% were woman. The mean year of work experience in the sample was 19 years. 19.1% of the participants were teachers, 48.5% – senior teachers, and 32.4% – supervisor teachers. None of these characteristics had statistically significant impact for the ratings of the scales.

Procedure. Participants were surveyed during the seminars of professional development after obtaining permission from relevant institutions and from participants. The questionnaires were administered by one of the authors who encouraged participants to answer truthfully and to ask if they had difficulty in understanding instructions or items in the questionnaire. It took teachers approximately 30 minutes to complete the questionnaire.

Instrument. The anonymous questionnaire was used. The questionnaire was composed of three parts.

The first part was designed to measure perceived creativity in the domain of teaching physical education. It was designed in accordance with the work of S. M. Farmer et al. (2003). The scale was adapted according secondary school teachers' work characteristics. The scale consisted of ten items. Each item was rated on a 5-point scale ranging from 1 (not at all true to me) to 5 (absolutely true to me). Example of the statement: "I constantly try to make something differently".

The second part of the questionnaire was designed to measure individual factors, which theoretically correlated with creativity: creative self-efficacy, positive and negative emotions, goal internalization motivation, intrinsic process motivation, and extrinsic motivation. Creative self-efficacy scale was designed in accordance with the work of P. Tierney and S. M. Farmer (2004). The scale consisted of seven items. Each item was rated on a 5-point scale, ranging from 1 (not at all true to me) to 5 (absolutely true to me). Example of the statement: "I trust my abilities to solve problems creatively". Positive and negative emotion scale consisted of ten primary emotions. Participants were asked to rate the frequency of the emotions on the scale ranging from 1 (never) to 5 (always). Work motivation scales were designed according to the work of N. H. Leonard et al. (1999). Three types of work motivation were measured using eighteen items. Each item was rated on a 5-point scale, ranging from 1 (it is not important to me) to 5 (it is very important to me). The example of the statement in goal internalization motivation scale: "Professional expertise is a value to me". The example of the statement in intrinsic process motivation scales: "Working process for me is more important than the pay for it". The example of the statement in extrinsic motivation scales "I work driven by the desire to get higher pay".

The third part of the questionnaire was designed to measure social factors which theoretically correlated with creativity: work group support, co-worker expectations towards creativity, organizational encouragement, supervisory encouragement, sufficient resources and creativity encouragement. Work group support scale was designed in accordance with the work of T. M. Amabile et al. (1996). The scale consisted of seven items indicating behavior of co-workers. Each item was rated on a 5-point scale ranging from 1 (rarely) to 5 (always). The example of the statement: "My colleagues are

able to resolve conflicts constructively". The co-worker expectation towards creativity scale was designed in accordance with the work of S. M. Farmer et al. (2003). The scale consisted of six items indicating behavior of co-workers. Each item was rated on a 5-point scale ranging from 1 (rarely) to 5 (always). The example of the statement: "My colleagues expect from me important insights, when we try to find solutions to various problems". Organizational encouragement scale was designed in accordance with the work of G. R. Oldham and A. Cummings (1996). The scale consisted of seven items, indicating behavior of supervisor. Each item was rated on a 5-point scale ranging from 1 (rarely) to 5 (always). The example of the statement: "My supervisor publicly recognizes the efforts to work creatively". Supervisory encouragement scale was designed in accordance with the work of T. M. Amabile et al. (1996). The scale consisted of four items indicating behavior of supervisor. Each item was rated on a 5-point scale ranging from 1 (rarely) to 5 (always). The example of the statement: "My supervisor emphasizes the importance of cooperation with colleagues". Sufficient resources scale was designed in accordance with the work of T. M. Amabile et al. (1996). The scale consisted of four items indicating sufficiency of resources for creative work. Each item was rated on a 5-point scale ranging from 1 (rarely) to 5 (always). The example of the statement: "My supervisor provides the necessary tools to work". Creativity encouragement scale was designed in accordance with the work of G. R. Oldham and A. Cummings (1996). The scale consisted of four items indicating behavior of supervisor. Each item was rated on a 5-point scale ranging from 1 (rarely) to 5 (always). The example of the statement: "My supervisor encourages seeking for innovative goals".

Analysis. The data was processed using *SPSS 16 for Windows*.

The reliability of the scales was estimated by calculating Cronbach's alpha coefficients. Hierarchical regression analysis was employed to estimate prognostic values for independent variables.

RESEARCH RESULTS

The reliability of the scales was checked by calculating Cronbach's alpha coefficients. The data are presented in Table 1.

The analysis confirmed the reliability of the scales which was used for further analysis.

Table 1. Cronbach's alpha coefficients of the scales used in the study

	Scales	Cronbach's alpha coefficient value
1.	Perceived creativity	0.792
2.	Creative self-efficacy	0.774
3.	Negative emotions	0.603
4.	Positive emotions	0.701
5.	Goal internalization motivation	0.791
6.	Extrinsic motivation	0.835
7.	Intrinsic process motivation	0.612
8.	Work group support	0.886
9.	Co-worker expectations towards creativity	0.829
10.	Organizational encouragement	0.902
11.	Supervisory encouragement	0.847
12.	Sufficient resources	0.833
13.	Creativity encouragement	0.626

Hierarchical regression analysis was used to identify prognostic values for independent variables (creative self-efficacy, negative emotions, positive emotions, goal internalization motivation, extrinsic motivation, intrinsic process motivation, work group support, co-worker expectations towards creativity, organizational encouragement, supervisory encouragement, sufficient resources, and creativity encouragement). The data are presented in Table 2.

The results indicate that there are three factors statistically significantly predicting creativity in a positive way. These are creative self-efficacy, intrinsic process motivation and supervisory encouragement. Extrinsic motivation statistically significantly predicts creativity in the negative way, i. e. inhibits creativity of physical education teachers. Other factors have no statistically significant impact on physical education teachers' creativity.

DISCUSSION

The obtained data confirmed interrelation between creativity and self-efficacy. Creative self-efficacy has the highest predictive values to creativity in the sample of physical education teachers. It validates the results of D. F. De Moulin's (1993) study and allows drawing the conclusion that teachers who trust their abilities choose to work creatively. The results are in accordance with findings in the scientific literature. The person's high self-efficacy is manifested as positive attitude towards the self and duties (De Moulin, 1993).

Independent variables		1 st model	2 nd model	3 rd model	4 th model
1.	Positive emotions	2.68*	2.30*	2.22*	-0.45
2.	Negative emotions	-1.01	-1.66	-1.37	-1.25
3.	Organizational encouragement		-1.87	-1.67	-0.42
4.	Supervisory encouragement		0.24	0.32	0.27
5.	Sufficient resources		-1.47	-1.34	-0.81
6.	Creativity encouragement		3.54**	3.28**	3.16**
7.	Work group support			-0.27	0.51
8.	Co-worker expectations			0.38	-0.94
9.	Extrinsic motivation			0.56	-2.24*
10.	Creative self-efficacy				3.74**
11.	Goal internalization motivation				0.36
12.	Intrinsic process motivation				2.10*
	R ²	0.24	0.50	0.50	0.77

Table 2. Main results of hierarchical regression analysis: t values and statistical significance

Note. * – statistically significant difference $p < 0.05$ (2-tailed); ** – statistically significant difference $p < 0.01$ (2-tailed).

There is positive correlation between teachers' self-efficacy and attitudes towards students, their accomplishments, job satisfaction, attitudes towards professional development, creativity in the workplace (De Moulin, 1993), application of innovative teaching tools, teaching style diversity, enthusiasm, openness to new ideas, and variety of teaching methods (Stephanou, Tsapakidou, 2007). It is not surprising that physical education teachers who demonstrate high creative self-efficacy indicate higher levels of professional creativity.

Intrinsic process motivation predicts creativity in the sample of physical education teachers. These data prove predictions that intrinsic motivation enhances creativity, because it is interrelated with interest, activity, positive emotions, positive attitudes towards the work (Ommundsen, Eikanger Kvalo, 2007). On the other hand, extrinsic motivation has negative impact towards creativity. The data of the study encourage considering the concept of motivational climate.

Creative teaching is manifested as teachers' ability to create task-involving motivational climate. Foreign studies disclose that students' motivation and efforts are determined by the motivational climate in a lesson (Liukkonene et al., 2010). According to the way how students define achievements, motivational climate can be characterized as task-involving or ego-involving. Ego-involving motivational climate is characterized as emphasizing outcomes and social comparison of students according to their results.

This environment enhances extrinsic motivation and students' anxiety due to their results, but it suppresses interest and joy of movement (Duda, Whitehead, 1998). The results of teachers' ability to create task-involving motivational climate is that students learn to associate activity with personal development and to consider participation, activity and efforts as the main outcomes of physical education. According to J. Liukkonene et al. (2010), task-involving motivational climate is preferred because students learn such skills as self-evaluation and goal establishment. Behavior of physical education teachers determines the kind of motivational climate during the educational activities. The application of cooperative learning methods, focusing on positive roles of students, and concern in the personal development of every student are correlated with task-oriented motivational climate (Newton, Duda, 1993). Fostering students' responsibility for their productivity (Papaioannou, 1994) and joy, satisfaction, intrinsic interest, efforts during the lessons is also related to task involving motivational climate (Liukkonene et al., 2010). On the other hand, the teacher who punishes students for their mistakes promotes interpersonal competition atmosphere in the class (Newton, Duda, 1993), takes personal responsibility for learning outcomes (Papaioannou, 1994), creates ego-involving motivational climate. This kind of climate might be characterized as concern about personal image, pressure, anxiety, the reluctance to participate (Liukkonene et al., 2010). According

to Y. Ommundsen and S. Eikanger Kvalo (2007), lesson planning, evaluation system and sharing the responsibility for outcomes are the key elements of a lesson which determine motivational climate in the class. It is purposeful to draw the conclusion that there are two main ways to organize physical education lessons: to create ego-involving climate characterized as competitive or to create task-involving climate, characterized as creativity enhancing. Physical education teachers personally motivated by intrinsic process motivation tend to create task – involving climate and facilitate students' creativity. It is also possible that physical education teachers personally motivated by extrinsic motivation tend to create ego – involving climate and encourage pupils' competitiveness. The data confirmed that extrinsic motivation was opposite to teaching creatively (Ommundsen, Eikanger Kvalo, 2007).

Supervisory encouragement is the only social characteristics predicting physical education teachers' creativity. It confirms the data of other research indicating the importance of supervisory encouragement for professional development. The data allow drawing the conclusion that supervisors' behavior is more important than that of colleagues (Laker et al., 2008; Blankenship, Coleman, 2009). Three other characteristics analyzed in the current study have no statistically significant impact. It contradicts to the results of scientists who emphasize the role of resources (McCaughtry et al., 2006), creativity encouragement (Laker et al., 2008; Klasser, 2010), and organizational encouragement (Blankenship, Coleman, 2009). It is possible that social factors are not favorable for creative physical education teaching.

Scientists emphasize that teachers face the challenges of negative social environment during the work and it can be an important reason why the majority of them do not evaluate organizational encouragement as favorable for creativity. Considering global issues K. Hardman (2008) concludes that nowadays there are three main social challenges for physical education teachers. It is the cult of slim body between youth, children obesity and adolescents' physical passiveness. K. B. Bevans et al. (2010) emphasize that physical passiveness as well as disengagement in sports is the issue of a whole family, not only an adolescent. According to V. Rakauskienė and L. Kardelienė (2009), students' health related behavior is determined by the health related knowledge and understanding about the

importance of physical activity. Unfortunately, it has been stated that students' physical activity nowadays is the means to improve body shape, but not to improve their general culture (Jankauskienė, 2008). The scientists' state that the need for physical self development as well as positive attitude towards physical education and healthy life style is not emphasized enough at schools (Dumčienė et al., 2007). It has been estimated that teachers' creativity during physical education lessons might change students' negative attitude towards physical activity (Rakauskienė, Kardelienė, 2009).

Physical education teachers face many day-to-day work barriers in the workplace. According to K. DeCorby et al. (2005), one of the most important problems derives from the attitudes that physical education discipline is thought to be not essential in the curriculum. The social reality, such as a decrease of financial resources, demands to give priority for the so-called essential curriculum (math, languages, etc.). The decrease of resources for physical education results in the negative attitude of students and their families towards the importance of physical education in comparison to other disciplines (DeCorby et al., 2005; Hardman, 2008; Bevans et al., 2010), the lack of teachers professional competence (DeCorby et al., 2005; McCaughtry et al., 2006; Hardman, 2008), the lack of essential resources and tools (Hardman, 2008; McCaughtry et al., 2006; Bevans et al., 2010), the increase in class size because of retrenchment (DeCorby et al., 2005; McCaughtry et al., 2006), the emphasis of teachers' responsibility for the outcomes and not attaching them to students' parents (Boyle et al., 2008) – these are the main barriers for creativity of physical education teachers.

These negative factors inhibit physical education teachers' creativity, efforts, motivation and trust in their competence in the micro level. The study of B. T. Blankenship and M. M. Coleman (2009) disclosed that the lack of possibilities and tools as well as negative image of the subject and the lack of respect from the students, conditioned the attitudes to quit the job in the sample of the novice physical education teachers. The teachers of physical education are often marginalized in the workplace. Such condition inhibits the development of professional mastery and creativity. That is the reason why physical education teachers do not see organizational encouragement as resource for creativity. On the other hand supervisory efforts to

facilitate creativity are appreciated – it makes the difference. Supervisory encouragement helps to overcome the majority of micro level barriers for creativity that physical education teachers face in the job.

Other possible reason of supervisory encouragement importance is the style of leadership covered by the concept. Supervisory encouragement manifests as supervisors' ability to communicate and give feedback in a positive and constructive way, to express clear expectations about the quality of professional activity and the place of creativity in it. According to Y. Ommundsen and S. Eikanger Kvalo (2007), the teacher who creates task-oriented motivational climate has ability to give positive feedback, emphasizes efforts and progress, praises pupils who make visible progress, emphasizes the need for development, clearly defines the goals of learning, lets the pupils choose the means for learning. Supervisory encouragement involves similar kinds of behavior. It is possible that creativity encouraging managers are personally motivated by intrinsic process motivation and are able to create task-involving and creativity facilitating climate in the teachers' teams. These kinds of professional teams may be key factor in overcoming institutional barriers for creativity.

The role of the emotions in teachers' work is discussed in scientific literature emphasizing its impact to teaching methods and effectiveness (Chang, 2010; Klassen, 2010). The analysis did not confirm the predictive influence of emotions to creativity. The same can be said about the age of participants. There are some predictions that work experience increases with the age, so it is an important variable influencing teachers' mastery and creativity (De Moulin, 1993; Zeng et al., 2010).

The novice teachers are considered to be most sensitive for the barriers to professional mastery (Laker et al., 2008; Gurbuzturk, Sad, 2009). The obtained data did not confirm the role of age to the creativity of physical education teachers.

CONCLUSIONS AND PERSPECTIVES

The barriers of physical education teachers' creativity are widely discussed in the current scientific literature. It is also important to analyze factors facilitating creativity in the domain of professional activity. The presented study disclosed that creative self-efficacy and intrinsic process motivation positively predicted creativity in the sample of physical education teachers. These individual characteristics mentioned above are of primary importance, but there is only one social characteristic, i. e. supervisory encouragement, which predicts creativity of physical education teachers.

The results encourage offering some ideas for further research. There are three possible directions of scientific explorations. First of all, further studies of creativity and human agency are needed because they might clarify interrelations between creativity and self-efficacy. The second area of interest is intermediate variables between creativity and motivation, e. g. positive emotions, self-regulation mechanisms, teaching style, motivational climate preference, etc. The last area of possible interest might be the role of leadership and management for physical education teachers' creativity: which leadership style is the most suitable for creative teachers and what psychological and managerial mechanisms determine it.

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KŪNO KULTŪROS MOKYTOJŲ KŪRYBINGUMO VEIKSNIŲ ANALIZĖ

Dalia Lapėnienė¹, Audronė Dumčienė¹, Tomas Lapėnas²

*Lietuvos kūno kultūros akademija¹, Kaunas, Lietuva
Uždaroji akcinė bendrovė TS statyba², Kaunas, Lietuva*

SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Kūno kultūros mokytojai dirba kūrybingai nepaisydami daugelio kliūčių, todėl tikslinga tyrinėti, kokie asmenybiniai ir socialiniai veiksniai skatina mokytojus dirbti kūrybingai. Tyrimo hipotezė – kūno kultūros mokytojų asmeninės savybės yra svarbesnės kūrybingumui, lyginant jas su socialiniais veiksniais.

Tikslas – nustatyti, kokie asmenybiniai ir socialiniai veiksniai prognozuoja kūno kultūros mokytojų kūrybingumą.

Metodai. Atliktas kiekybinis tyrimas naudojant anoniminį klausimyną. 120 kūno kultūros mokytojų įsivertino kūrybingumą, kūrybinį savaveiksmiškumą, motyvaciją, emocijas ir įvertino darbovietės mikroklimato ypatumus.

Rezultatai. Kūrybingumą prognozuoja kūrybinis savaveiksmiškumas ir vidinė proceso motyvacija. Išorinė motyvacija slopina kūno kultūros mokytojų kūrybingumą. Vadovo drąsinimas kūrybingai dirbti yra vienintelis socialinis veiksnys, prognozuojantis kūrybingumą.

Aptarimas ir išvados. Gauti rezultatai patvirtina D. F. De Moulin (1993) tyrimo rezultatus ir pagrindžia savaveiksmiškumo svarbą kūrybingam mokytojo darbui. Nustatyta vidinės proceso motyvacijos prognoztinė įtaka kūrybingumui. Ši ryši tikslinga aiškinti remiantis Y. Ommundsen ir S. Eikanger Kvalo (2007) teigimu, kad vidinė motyvacija neatsiejama nuo domėjimosi, aktyvumo, pozityvaus nusiteikimo, pasitenkinimo darbu, taigi ir kūrybingumo. Išorinė motyvacija neigiamai prognozuoja kūrybingumą. Tai galima paaiškinti tuo, kad išorinės motyvacijos vedami mokytojai formuoja ego orientuotą mikroklimatą ir skatina mokinių konkuravimą tarpusavyje (Ommundsen, Eikanger Kvalo, 2007). Vadovo drąsinimas yra vienintelis socialinis veiksnys, prognozuojantis kūno kultūros mokytojų kūrybingumą. Tai atitinka tyrimų duomenis, nurodančius, kad vadovas turi išskirtinių galimybių skatinti kūrybines mokytojų iniciatyvas (Lake ir kt., 2008; Blankenship, Coleman, 2009).

Raktažodžiai: kūrybingumas, asmeniniai ir socialiniai veiksniai.

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Corresponding author **Dalia Lapėnienė**
Lithuanian Academy of Physical Education
Sporto str. 6, LT-44221 Kaunas
Lithuania
Tel +370 37 209050
E-mail d.lapeniene@lkka.lt

SOCIOCULTURAL IDEAL INTERNALIZATION, BODY DISSATISFACTION AND WEIGHT CONTROL BEHAVIOR AMONG ADOLESCENT ATHLETES AND NON-ATHLETE ADOLESCENTS. DOES THAT NEED EDUCATION?

Simona Pajaujienė, Rasa Jankauskienė

Lithuanian Academy of Physical Education, Kaunas, Lithuania

ABSTRACT

Research background and hypothesis. Many young people are concerned about their body size and shape because of the social pressures to conform to a thin body ideal. Athletes face additional pressures related to performance and, for some of them, aesthetic and weight category demands. Modification of body build is often attempted via diet and exercise, so the data were also gathered on attitudes toward eating and weight control – exercising behavior.

Research aim was to examine media influence, body dissatisfaction, unhealthy weight loss behavior (UWL) and unhealthy exercising behavior (UEB), risk of eating disorders (DE) in the sample of non-athletic and athletic adolescents. We proposed a hypothesis that adolescents aiming at matching social expectations of body image were more likely to be dissatisfied with their appearance as well as have worse weight control behavior and higher risk of eating disorders. We expected that these associations would not differ among athletic and non-athletic adolescents.

Research methods. 11th grade students (n = 805, mean age – 17.23 (0.6) years, 476 (58.9%) females, 233 (28.9%) athletes) filled in anonymous questionnaires, which consisted of *Sociocultural Attitudes Towards Appearance Scale* (SATAQ-3, Thompson et al., 2004), *Body Areas Satisfaction Scale* from MBSRQ-AS (Cash, 2004), *EAT-26* (Garner et al., 1982) and specially for this study created *Unhealthy Weight Loss Behavior Scale*.

Research results. Nearly half of adolescents reported using at least one UWL or/and UEB, 87 adolescents (more girls, $p < 0.05$) full into ED risk group with no differences between athletes and non-athletes ($p > 0.05$). Media influence did not differ between groups, but non-athletes were more dissatisfied with their body ($p < 0.05$), had more expressed UWL ($p < 0.05$), although adolescents who participated in sports demonstrated more UEB ($p < 0.05$).

Discussion and conclusions. Adolescents who more dramatically internalized the social body standards were more dissatisfied with their appearance, had worse weight control behavior and higher risk for eating disorder. These associations basically did not differ between athletes and non-athletes.

Keywords: body dissatisfaction, weight control, adolescence, athletic activities.

INTRODUCTION

The role of socio-cultural influences in determining young people's standards of beauty has been well-established. Many young people are concerned about their body size and shape because of the social pressures to conform to a thin body ideal (Vogt Yuan, 2010). Weight-related concerns of adolescents and weight pressures from their social environments predict the use of unhealthy weight control behavior

(Neumark-Sztainer et al., 2006 a). Mass media are saturated with multiple, overlapping, and unhealthy messages about ideal body sizes and shapes in relation to attractiveness, self-control, food, weight management, diets and quick fixes for weight loss. Ironically, these behaviors then lead to weight gain, instead of weight loss, over time (Neumark-Sztainer et al., 2006 b). Another source of body image pressures comes from significant

others, such as parents, coaches, teammates, who send messages about weight, body size and shape, and appearance. These messages sometimes may be positive, however, most comments are negative and can contribute to youth engaging in unhealthy eating and exercise behaviors in order to lose weight (Petrie, Greenleaf, 2011).

Athletes may practice weight-control methods during the sport season only or year-round. American -Academy of Pediatrics Committee on Sports Medicine and Fitness (2005) investigated the problem of weight loss in sport. They found that the practices which were used to reduce weight included food restriction, vomiting, over exercising, diet-pill use, use of stimulants, nicotine use, voluntary dehydration. These practices can impair athletic performance, increase injury risk, result in delayed physical maturation, amenorrhea (in female athletes), development of eating disorders and other medical dysfunctions. It has been reported that sports with an emphasis on aesthetics, a lean body build, and sports with weight classes have higher incidences of participants with eating disorder symptoms (Sundgot-Borgen et al., 2004) and worse weight control behavior (Turocy et al., 2011). Leaner athletes in some sports are often perceived by coaches and peers to perform better, they are viewed as more attractive and successful and perceived to demonstrate better body symmetry, position, and fluidity of motion (Turocy et al., 2011). Although safe weight gain is also a concern for athletic trainers and their athletes, that topic is outside the scope of this position statement.

The association of the use of products or weight loss behavior to improve appearance with media influences, body dissatisfaction, and participation in youth sports has not been well understood. To assess these associations, we conducted a cross-sectional analysis. Therefore, **the aim of our study** was to examine media influence, body dissatisfaction, unhealthy weight loss behavior and unhealthy exercising behavior, risk of eating disorders, in the sample of non-athletic and athletic adolescents. We proposed a hypothesis that adolescents aiming at matching social expectations of body image were more likely to be dissatisfied with their appearance as well as to have worse weight control behavior and higher risk of eating disorders. In the present study we expected that these associations would not differ among athletic and non-athletic adolescents.

RESEARCH METHODS

Participants and procedure. The permission to conduct the study was given by the Department of Education of Kaunas Municipality. Sixteen randomly selected schools ($n = 10$) and gymnasiums ($n = 6$) of Kaunas were contacted, informed about the study and asked for the permission to conduct the research. All of them agreed to participate in the study. Two-three 11th grade classes from each school were chosen randomly to participate in study. Participants were informed that participation was voluntary. All students ($n = 856$) who were asked to participate in study agreed to fill in questionnaires. The participants completed the anonymous questionnaires in the classrooms during a class period. Out of 856 questionnaires, 44 were damaged, therefore, the data of 805 adolescents (mean age – 17.23 (0.6) years, 476 (58.9%) of them were females) were used for the analysis.

Instruments. The study used the anonymous questionnaire which included general questions on exercise behavior, participation in sports, intentions and aspirations related to body image and weight control, and the risk of eating disorders.

Sociocultural Attitudes Towards Appearance Scale (SATAQ-3, Thompson et al., 2004) was initially developed to assess media influences on feminine body image. Original SATAQ – 3 forms four subscales: Internalization-General, Pressures, Information, and Internalization-Athlete. The internal consistency of the *Internalization-General* subscale (Cronbach's $\alpha = 0.88$) was good. This scale reflects the acceptance (internalization) of media influence on body image. *Internalization-Athlete* subscale (Cronbach's $\alpha = 0.78$) reflects the athletic body image idealization. *Pressures* subscale (Cronbach's $\alpha = 0.85$) reflects media pressure to have a perfect appearance and seek the behavior which contributes to achieving this look. *Information* subscale (Cronbach's $\alpha = 0.75$) describes the importance of media in shaping the standards of appearance. The scale is composed of the Likert-type scale of 5-points, where 1 means definite disagreement and 5 means definite agreement. The higher score, the greater acceptance or internalization of the prevailing socio-cultural standards for appearance is.

Body dissatisfaction (BD) was assessed using *The Multidimensional Body-Self Relations Questionnaire* (MBSRQ-AS, Cash, 2004) *Body Areas Satisfaction Subscale* (BASS). This scale

aims at assessing the level of body satisfaction. The scale consists of ten items listing body areas, muscular development, body mass and overall appearance. Participants rated each item using a 5-point scale that ranged from 1 to 5. Lower values of the scale indicated lower satisfaction with body areas (Cronbach's $\alpha = 0.87$).

Disordered Eating (DE) was realized by the *Eating Attitude Test (EAT-26)*, Garner et al., 1982). The EAT is a 26 – item scale, measuring cognitions, emotions, and behaviors associated with anorexia and bulimia nervosa. Participants rated each item using a 6-point scale that ranges from 0 (never, rarely, sometimes) to 3 (always). Higher scores reflect stronger disordered eating attitudes. Subjects who scored above a cut – off score of 20 may have been at risk of eating disorders (Cronbach's $\alpha = 0.89$).

Attitude Towards Unhealthy Weight Loss Behavior (UWLb) and *Attitude Towards Unhealthy Exercising Behavior (UEB)* was analyzed using specially designed for this study questionnaire. For assessing UWLb the adolescents were asked “If you are engaged in aiming to lose or maintain your body weight which of the following practices have you had?” There were 9 practices with unhealthy body mass control, such as “I skip my meals (breakfast, dinner or supper)”, “I eat a low calorie diet (< 800 kcal)”, “I use laxatives or diet-pills”. UEB scale comprised six practices reflecting the dominating fallacies related to physical activity in aiming to control body mass. The individual responses “strongly disagree” (1) through “strongly agree” (3) were provided in the Likert-type scale. The higher scores reflect more common unhealthy exercising behavior. The scale internal consistency was positive in this sample, respectively, Cronbach's $\alpha = 0.85$ and Cronbach's $\alpha = 0.79$.

Body Mass Index (BMI) (weight (kg)/height (m)²) was calculated using values of weight and height indicated by the studied. Mean BMI of sample – 20.77 (2.62) kg/m².

Data analysis. The Statistical Package for Social Sciences (SPSS, version 17.0) was used for the statistical analyses. Results were expressed as a mean value (*M*) and standard deviations (*SD*). Chi-square tests examined categorical frequencies. To examine differences in the pattern of relationships between variables we conducted Pearson correlations. The differences were valued as statistically significant, if $p < 0.5$ (CI 95%).

RESEARCH RESULTS

We distinguished two groups of adolescents: athletes who aim at achieving results (28.9%) and non-athletes or only exercising in their leisure time (71.1%). More boys than girls were engaged in competitive sports (36.2% and 23.9%, $\chi^2 = 14.09$, $df = 1$, respectively, $p = 0.001$). We divided all sports into four groups: appearance-related sports (gymnastics, bodybuilding, figure skating, dancing) – 10.7%, ball games (basketball, football, handball, volleyball) – 9.1%, endurance sports (skiing, cycling, swimming, athletics) – 6.3%, and weight category sports (boxing, judo, wrestling) – 6.3%. A comparison of the type of activities chosen by gender revealed that sports related to appearance and aesthetics were most popular among girls, whereas ball games – among boys ($\chi^2 = 59.35$, $df = 4$, $p = 0.001$).

One – way ANOVA showed that sedentary students and athletes did not differ in their mean BMI, but better physical self-assessment was characteristic of athletes compared to non-athletes (Table 1). Media influence, measured from 3 SATAQ subscales did not differ between sport groups, only Internalization-Athlete was more significantly expressed among athletes. Non-athletes had worse weight loss behavior, although adolescents participating in sports demonstrated worse exercising behavior.

Analysis of the data by gender showed that reliable differences were received almost with all variables. Girls more internalized sociocultural ideals towards appearance, exhibited poorer physical self-assessment and weight control behavior as well as higher risk for eating disorders (Table 1). The analysis of the groups of girls and boys by sport status did not reveal significant differences from the trends of total sample.

Out of 805 adolescents, 87 (10.8% of total sample) (respectively 6.7% of boys and 13.9% of girls; $\chi^2 = 10.33$, $df = 1$, $p = 0.001$) fell into ED risk group with no differences between athletes and non-athletes (8.2% and 12.1%; $\chi^2 = 2.47$, $df = 1$, $p = 0.116$).

Only 20.6% of adolescents were satisfied with their weight, 43.1% – wanted to lose weight, and 36.3% - wanted to gain weight. More girls than boys wanted to lose weight (83.6% and 16.4%, $\chi^2 = 177.299$; $df = 2$, respectively, $p < 0.00$). The highest number of adolescents who wanted to loose weight accounted for aesthetic sports (51.2%),

compared to endurance sports (46.9%), weight category sports (36.8%), ball games (27.8%) and non-athletes (43.6%); $\chi^2 = 23.39$; $df = 8$, $p = 0.003$.

The study revealed that aspiration of weight loss was associated with different variables (Table 2). Adolescents who were aiming to lose weight had higher scores in all scales, their physical self-assessment was the poorest ($p < 0.001$). Body ideal internalization was more expressed among those who wanted to lose weight in both athlete and non-athlete groups ($p < 0.001$), UWLB ($p < 0.001$) ir DE ($p < 0.001$). Athletes who aimed at losing weight significantly more internalized the sport ideal and felt pressure to attain an ideal body ($p < 0.001$), whereas non-athletes more relied on media for weight loss practices ($p < 0.001$). UEB was more

significant only in weight loss group of athletes ($p < 0.05$).

Even 38.2% of teenagers reported using at least one UWLB and 46% – UEB. The study evaluated the distribution of unhealthy weight loss behavior in different physical activities (Table 3). Poor understanding about the dosage of physical load and weight loss behavior was more prevalent among participants in combat sports. These adolescents were more likely to tolerate long lasting load ($\chi^2 = 21.51$, $df = 4$, $p = 0.000$) or participate in even more than one training session in series ($\chi^2 = 9.89$, $df = 4$, $p = 0.042$) and limit fluid intake ($\chi^2 = 38.86$, $df = 4$, $p < 0.001$) when trying to achieve high intensity in training of endurance sports ($\chi^2 = 15.18$, $df = 4$, $p = 0.004$), compared to

Table 1. Means and standard deviations for all variables for sport status and gender groups

Variables	Sport status		Level of significance		Gender		Level of significance	
	Non-athletes n = 572	Athletes n = 233	F	p	Male n = 329	Female n = 476	F	p
BMI	20.68 (2.61)	21.00 (2.60)	2.34	0.126	21.56(2.67)**	20.22 (2.45)	52.51	0.000
IG	2.65 (0.92)	2.72 (0.90)	0.79	0.372	2.55 (0.68)	2.93 (0.66)**	58.26	0.000
IA	2.73 (0.86)	2.99 (0.91)**	14.52	0.000	2.85 (0.79)	2.80 (0.71)	1.76	0.185
PP	2.31 (0.84)	2.25 (0.78)	0.94	0.331	2.22 (0.70)	2.53 (0.73)**	35.88	0.000
INFO	2.69 (0.69)	2.72 (0.69)	0.26	0.613	2.63 (0.61)	2.83 (0.54)**	23.35	0.000
BASS	3.40 (0.69)	3.62 (0.69)**	16.05	0.000	3.57 (0.71)	3.39 (0.68)**	12.81	0.000
UWLB	2.49 (4.08)	2.28 (4.52)	0.41	0.522	1.55 (3.72)	3.00 (4.36)**	23.70	0.000
UEB	2.03 (2.82)	3.19 (0.76)**	22.81	0.000	2.62 (3.60)	2.16 (2.82)*	3.98	0.046
DE	7.72 (9.97)	6.78 (8.68)	1.54	0.215	5.60 (9.29)	8.74 (9.61)**	21.33	0.000

Note. * – $p < 0.05$; ** – $p < 0.001$. BMI – body mass index (kg/m^2), GI – Internalization General, IA – Internalization-Athlete, PP – Pressure, INFO – Information subscales, BASS – Body Areas Satisfaction subscale, UWLB – Unhealthy Weight Loss Behavior, UEB – Unhealthy Exercising Behavior, DE – Disordered Eating.

Table 2. Means and standard deviations for all variables for desired weight groups in athletes and non-athletes

Variables	Non-athletes			Athletes		
	Weight gain group n = 188	Satisfied with weight group n = 132	Weight loss group n = 252	Weight gain group n = 99	Satisfied with weight group n = 36	Weight loss group n = 98
BMI	19.85 (2.22)	20.04 (2.24)	21.68 (2.69)**	20.54 (2.17)	20.51 (2.37)	21.61 (2.83)*
IG	2.43 (0.87)	2.39 (0.85)	2.97 (0.91)**	2.59 (0.85)	2.41 (0.91)	3.02 (0.87)**
IA	2.76 (0.88)	2.65 (0.80)	2.77 (0.87)	3.06 (0.86)	2.49 (0.81)	3.15 (0.89)**
PP	2.07 (0.73)	2.18 (0.77)	2.57 (0.88)	2.09 (0.68)	1.97 (0.64)	2.53 (0.84)**
INFO	2.59 (0.72)	2.65 (0.67)	2.79 (0.69)**	2.68 (0.66)	2.62 (0.60)	2.84 (0.71)
BASS	3.57 (0.60)	3.62 (0.66) **	3.14 (0.69)	3.67 (0.69)	3.97 (0.66) **	3.45 (0.65)
UWLB	1.11 (2.86)	1.73 (2.93)	3.80 (4.42)**	1.00 (3.19)	2.24 (5.18)	3.43 (4.55)**
UEB	1.84 (2.71)	1.82 (2.31)	2.09 (2.75)	2.47 (3.61)	3.18 (3.70)	3.63 (3.41)*
DE	5.22 (8.15)	6.19 (7.89)	10.52 (11.47)**	5.43 (7.78)	4.38 (6.44)	9.60 (9.85)**

Note. * – $p < 0.05$; ** – $p < 0.001$. IG – Internalization General, IA – Internalization-Athlete, PP – Pressure, INFO – Information subscales, BASS – Body Areas Satisfaction subscale, UWLB – Unhealthy Weight Loss Behavior, UEB – Unhealthy Exercising Behavior, DE – Disordered Eating.

participants of other activities and non-athletes. UWLB was more frequently expressed among sports related to appearance. These adolescents more significantly than participants engaged in other activities justified skipping meals ($\chi^2 = 9.89$, $df = 4$, $p = 0.042$), using diet pills ($\chi^2 = 11.1$, $df = 4$, $p = 0.025$) or bulimic behavior ($\chi^2 = 9.11$, $df = 4$, $p = 0.05$).

The correlation analysis revealed that all variables significantly intercorrelated among

non-athletes (Table 4). In this group sociocultural internalization towards appearance was related with poorer physical self-assessment, and higher UWLB, UEB and DE scores. Poorer self-assessment was also linked to more expressed scores of UWLB, UEB and DE. Less significant correlations were found among athletes; these relationships were weaker. Appearance internalization directly correlated only with UWLB and DE. The strongest correlation was determined between UWLB, UEB and DE variables in both groups.

Table 3. Expression of weight control behavior in sport groups (%)

Unhealthy behavior related with weight loss	Total n (%)	Non-athletes	Appearance-related sports	Sport games	Weight category sports	Endurance sports
Unhealthy weight loss behavior						
Skip meals	181 (22.5)	24.3	24.4*	10.8	9.5	17.6
Fast	101 (12.6)	13.6	10.6	9.6	4.8	9.8
Low calorie diet (< 800 kcal)	78 (9.7)	10.6	10.5	5.4	0	9.8
One product diet	58 (7.2)	7.4	10.5	5.4	0	5.9
Increase cigarettes smoked	68 (8.4)	8.7	9.3	8.1	4.8	5.9
Purge	39 (4.8)	4.4	10.5	4.1	0	3.9
Use diet pills	38 (4.7)	4.2	11.6*	2.7	0	3.9
Use diuretics	35 (4.3)	4.1	8.1	2.7	0	5.9
Vomit after meal	26 (3.2)	3	8.1*	2.7	0	0
Unhealthy exercising behavior						
Exercising longer than 2 hours	156 (19.5)	16.1	27.9	21.6	42.9**	33.3
Participating in more than one training session in series	97 (12.2)	10.2	19.8	9.5	23.8*	17.6
Exercising several times per day more than 2 hours	95 (11.9)	3.6	10.5*	6.8	10	5.9
Wearing impermeable warm clothes for bigger sweating	69 (8.6)	7.5	14	8.1	19	9.8
Trying to exercise in the highest intensity of HR	68 (8.5)	6.3	12.8	10.8	14.3	19.6*
Avoiding drinking fluids during workouts	39 (4.9)	8.2	25.6	12.2	38.1**	19.6

Note. * – $p < 0.05$; ** – $p < 0.001$.

Table 4. Intercorrelations (Pearson's correlation rate), means, and standard deviations of variables

Variables	SATAQ	BASS	UWLB	UEB	DE
1. SATAQ	1	-0.13	0.15*	0.11	0.27**
2. BASS	-0.27**	1	-0.86	-0.02	-0.20**
3. UWLB	0.36**	-0.32**	1	0.48**	0.47**
4. UEB	0.16**	-0.11*	0.54**	1	0.37**
5. DE	0.35**	-0.29**	0.61**	0.38**	1
Means	2.59	3.46	2.40	2.35	7.44
Standard deviations	0.69	0.70	4.19	3.16	9.60

Note. * – $p < 0.05$; ** – $p < 0.001$. Upper triangle of table = athletes; lower triangle of table = non-athletes. SATAQ – Sociocultural attitudes towards appearance scale, BASS – Body Areas Satisfaction subscale, UWLB – Unhealthy Weight Loss Behavior, UEB – Unhealthy Exercising Behavior, DE – Disordered Eating.

DISCUSSION

We aimed at finding out whether acceptance of body ideal, physical self-assessment, weight control behavior and risk of eating disorders differed among adolescent athletes and non-athletes. The study determined that the influence of socio-cultural environment on ideal internalization did not differ between groups. Athletes were more likely to internalize the sport ideal, moreover, they rated their physical appearance higher than their non-athlete peers. Given the body's centrality in sport, it is not surprising that athletes are highly aware of their body's functionality and appearance. It is also not surprising that research has found that athletes, particularly at the more competitive levels of sports, report a more positive body image than non-athletes (Petrie, Greenleaf, 2011).

Although studies show that body image concerns and DE have been frequently reported within the athletic (especially competing in leanness-dependent and weight-dependent sports) population (Sundgot-Borgen et al., 2004; Holm-Denoma et al., 2009; Jankauskienė et al., 2010; Petrie, Greenleaf, 2011), in our research athletes did not exhibit more unhealthy weight loss behavior and disordered eating symptoms than non-athletes, however, unhealthy exercising behavior was more expressed. Improper training behavior was characteristic of athletes of weight category sports. Representatives of aesthetic sports were more likely to skip meals, use diet pills or supplements and even demonstrate bulimia behavior to lose weight.

Although weight classification in sports was designed to ensure healthy, safe, and equitable participation, these sportsmen along with aesthetic sports used the most unhealthy weight control behavior (De Bruin et al., 2007; Rouveix et al., 2007; Jankauskienė et al., 2008).

Our study revealed that almost half of adolescents reported desire to lose weight. Weight loss as in other studies (Zaborskis et al., 2008; Pajaujienė et al., 2011) was significantly associated with unhealthy weight control behavior; unhealthy weight loss behavior was more common in non-athlete group in which diets, supplements and other unhealthy habits were used, whereas in athlete group – unhealthy exercising behavior, where weight loss related to exercising was revealed. It is important to stress that adolescents who wanted to lose weight were prone to higher risk of eating disorders. This fact was also found in many studies

(Neumark-Sztainer et al., 2006 a; Pajaujienė et al., 2011; Turocy et al., 2011) suggesting that aspiration of weight control is an important factor for disordered eating.

R. Jankauskiene et al. (2010) study revealed that the main idea of weight loss in athletes was not an improvement of shape but body image. Our study also found that adolescents desiring to loose weight significantly stronger internalized sociocultural body ideal and tried to attain this ideal. However, athletes additionally stronger internalized the sport body ideal, whereas non-athletes relied on body ideals from media.

In both groups we found correlation between all variables: higher media influence were related with higher body dissatisfaction, unhealthy weight control behavior and risk of eating disorders. Similar to non-athletes, body dissatisfaction was related directly to disordered eating and may be a primary risk factor. This coincides with the findings in other studies (Neuman-Szteiner et al., 2006 a; Jankauskienė et al., 2008; Petrie, Greenleaf, 2011). Since appearance internalization in athletes directly correlated only with unhealthy weight loss behavior and disordered eating, unhealthy exercising behavior seemed not to have depended on sociocultural environment and body dissatisfaction; it stemmed more from their sport specificity and coach's role. Studies show that athletes may adhere recommendations made by coaches without understanding the nutritional requirements of the sport (Bonci et al., 2008).

The analysis by gender confirmed that girls were more likely to internalize body ideals, they were dissatisfied with their body (Kerremans et al., 2010), had poorer weight control behavior and higher risk of eating disorders (Neumark-Sztainer et al., 2012).

Improper and unhealthy weight loss practices in our study and other studies had the strongest correlation with disordered eating (Neumark-Sztainer et al., 2006 a). Compulsive exercise or excessive exercise that were demonstrated by some participants of our study, in addition to the normal training regimen could be considered a form of purging (*American Academy of Pediatrics*, 2005). Extreme exercise in itself has previously been cited as a potential causal factor in anorexia nervosa (Sundgot-Borgen et al., 2004). P. S. Turocy et al. (2011) stressed that disordered eating to lose weight is a definite cause for alarm, even among seemingly healthy, athletic individuals. They explored that the most common unsafe methods for achieving

weight-loss goals include mixing dehydration with food restriction and improper dieting to reduce body fat. It is crucial to find ways to steer young people away from these ineffective and potentially harmful weight-loss behaviors, and provide support for the adoption of health eating and physical activity behaviors (Neumark-Sztainer et al., 2012). Coaches, peers, and family members should not provide information on diet, body composition, weight, or weight management practices and should refrain from making comments on or participating in the monitoring of body composition and weight (Bonci et al., 2008).

The strength of our study – representative sample. The weakness – the survey was done in spring, and seasonality may have resulted in physical self-assessment and related weight control. We were not able to find out the causes of adolescent weight loss, distinguish the elite level and provide the same conditions due to the different competitive calendar. It is recommended that more research be undertaken to examine the role of coaches, teachers and teammates in the development of body dissatisfaction, weight control behavior and disordered eating.

CONCLUSION AND PERSPECTIVES

1, The study confirmed the proposed hypothesis that adolescents who more dramatically internalized the social body standards were more dissatisfied with their appearance, had worse weight control behavior and higher risk for eating disorder. These associations basically did not differ between athletes and non-athletes.

2. Body ideal internalization, disordered eating did not differ between athletes and non-athletes. Although athletes were more satisfied with their physical appearance, weight control related with unhealthy exercising behavior was poorer.

3. Adolescents trust body weight control techniques from media and have poor understanding about the dosage of physical activity and exercising behavior related to weight loss program. They need education in this area. Parents, coaches and school health educators should emphasize skill and talent instead of weight and body image and educate adolescents about the negative health effects of extreme weight control.

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SIEKIMAS ATITIKTI SOCIALINIUS IŠVAIZDOS LŪKESČIUS, NEPASITENKINIMAS KŪNU BEI SVEIKATAI ŽALINGA SVORIO KONTROLĖ TARP SPORTUOJANČIŲ IR NESPORTUOJANČIŲ PAAUGLIŲ. AR REIKIA TAI UGDYTI?

Simona Pajaujienė, Rasa Jankauskienė

Lietuvos kūno kultūros akademija, Kaunas, Lietuva

SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Dėl sociokultūrinio spaudimo atitikti liekną kūno idealą dauguma jaunų žmonių yra susirūpinę savo kūno svoriu ir forma. Sportininkai jaučia papildomą spaudimą būti geros formos ir atitikti sporto šakos išvaizdos lūkesčius. Kadangi svorio kontrolė dažniausiai lydimą dietų ir mankštinimosi elgsenos, mūsų tyrimas siekė atskleisti šias elgsenas.

Tikslas – nustatyti paauglių išvaizdos idealų priėmimo, nepasitenkinimo savo kūnu, sveikatai žalingos svorio kontrolės ir mankštinimosi elgsenos bei valgymo sutrikimų rizikos sąsąjas tarp sportuojančių ir nesportuojančių paauglių.

Metodai. Tyrimas buvo atliekamas 2009 m. Kauno miesto gimnazijų ($n = 6$) ir vidurinių mokyklų ($n = 10$) vienuoliktokų klasėse taikant apklausos raštu metodą. Tiriamąją imtį sudarė 805 paaugliai (iš jų 476 merginos, 233 sportininkai), kurių amžiaus vidurkis 17,23 (0,6) metų, KMI vidurkis 20,77 (2,61) kg/m². Anketą sudarė išvaizdos idealų priėmimo klausimynas *SATAQ-3* (Thompson et al., 2004), pasitenkinimo savo kūno dalimis subskalė iš *MBSRQ-AS* (Cash, 2004), požiūrio į sutrikusį valgymą skalė *EAT-26* (Garner et al., 1982). Sveikatai žalinga svorio kontrolės (SŽE) bei mankštinimosi elgsena (SŽME) nustatyta specialiai šiam tyrimui sudarytu klausimynu.

Rezultatai. Beveik pusė paauglių taikė bent vieną SŽE ir SŽME metodiką. 87 paaugliai priskirti valgymo sutrikimų rizikos grupei, ir tai nepriklausė nuo sportavimo statuso ($p > 0,05$). Siekimas atitikti išvaizdos idealus taip pat nesiskyrė tarp grupių, tik nesportuojantieji buvo labiau nepatenkinti savo kūnu ($p < 0,05$) ir turėjo labiau išreikštą SŽE ($p < 0,05$), o sportuojantieji turėjo stipresnę SŽME ($p < 0,05$).

Aptarimas ir išvados. Paaugliai, labiau priimančys socialinius išvaizdos standartus, yra daugiau nepatenkinti savo išvaizda, blogesnė jų svorio kontrolė ir mankštinimosi elgsena bei didesnė valgymo sutrikimų rizika. Šios sąsąjos iš esmės nesiskiria tarp sportuojančių ir nesportuojančių paauglių.

Raktažodžiai: nepasitenkinimas kūnu, svorio kontrolė, paauglystė, sportinė veikla.

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Corresponding author **Simona Pajaujienė**
Lithuanian Academy of Physical Education
Sporto str. 6, LT-44221 Kaunas
Lithuania
Tel +370 68223410
E-mail s.pajaujiene@lkka.lt

ANAEROBIC POWER AND REPETITIVE MUSCLE WORK CAPACITY OF OLDER ELITE AND DEVELOPING YOUNG BASKETBALL PLAYERS

Rūtenis Paulauskas, Rūta Dadelienė, Rasa Paulauskienė, Juozas Skernevičius
Lithuanian University of Educational Sciences, Vilnius, Lithuania

ABSTRACT

Research background and hypothesis. Players need to repeat performance of highly intensive work for a particular time combining it with rest intervals. The muscle power and anaerobic repetitive muscle work capacity of elite basketball players is higher than those in young athletes.

Research aim was to investigate anaerobic power and repetitive muscle work capacity of older elite ($n = 13$) and young basketball players ($n = 12$) and to carry out comparative analysis of indicators in these groups.

Research methods. During competition period, laboratory 5×6 s repeated effort test with rest intervals of 24 s was employed. The average indicator of power during each work interval was provided and fatigue index was calculated. Three minutes after the physical load, the concentration of lactate in the blood was measured.

Research results. A statistically significant difference was observed for absolute muscle power of elite and young basketball players in the first sprint ($p < 0.004$). The research on relative indicators for one kilogram of the body mass showed that the power of elite ($13.06 \text{ W}\cdot\text{kg}^{-1}$) and young players ($11.74 \text{ W}\cdot\text{kg}^{-1}$) did not differ statistically ($p < 0.09$). The fatigue index investigated in both groups did not differ ($p < 0.77$).

Discussion and conclusions. The research revealed that relative indicators of muscle power of elite basketball players did not significantly differ from those of young athletes. The same anaerobic repetitive muscle work capacity was observed in both groups.

It was established that the concentration of lactate in the blood increased after physical load more than to $9 \text{ mol}\cdot\text{l}^{-1}$ and did not differ in the two groups. This means that working for 6 seconds at maximum strength and relaxing 4 times longer, repeating this work five times, PCr is not enough for ATP resynthesis and, therefore, anaerobic glycolic reactions are activated.

Keywords: fatigue, lactate, recovery, muscles.

INTRODUCTION

During the basketball game the duration of work may vary from a momentary throw or a pass to repetitive work that lasts for several hours. A player is referred to as possessing high endurance if he/she is able to demonstrate technical-tactical abilities and skills as well as physical possibilities during the match (Bompa, Haff, 2009). Muscular endurance is the capacity to sustain a static contraction or repeated muscle contractions (Wilmore et al., 2008)

Taking into account the content of basketball players' work, that is, duration and intensity of

play actions (Trninić et al., 2000), proportions of breaks with work, emotional effect on the organism (Karipidis et al., 2001), the dominant role is assumed by repetitive work power and specific capacity (Hargreaves et al., 1992). This embraces an ability to cope with fatigue striving for achievement of the best results under specific conditions of play (Mendes, Janeira, 2001).

Players need to repeat performance of highly intensive work for a particular time combining them with rest intervals. This is predetermined by the rules of the game: size of basketball court,

duration of attack, duration of match, timeouts and other breaks during the play (Krause et al., 2008). The biggest role is played by the ability of the player's organism to recover fast (Buceta, 2000; Wissel, 2004). The situations, when players are given different time to play are characteristic of basketball (Carter et al., 2005). Such indicators as speed of recovery of energetic substances in muscles, functional power of circulatory and respiratory systems are among the most important indicators of basketball players' capacity (Foster et al., 1996; Kraemer, 2000). We have established that while playing basketball energy is generated resynthesizing ATP from PCr and from mixed energy source PCr – glycogen, without oxygen, i. e. working very intensively for a short period of time (Paulauskas et al., 2010). However, the repetitive work capacity of players has not been extensively analyzed all over the world. Being aware of repetitive work power and endurance, we could evaluate and more efficiently develop and train players.

The aim of our study was to investigate repetitive muscle work power and specific capacity of elite and young basketball players and to carry out comparative analysis of indicators in these groups.

RESEARCH METHODS

Participants. Elite basketball players ($n = 13$), who regularly trained 8 times per week and played in competitions of Lithuanian Basketball League (LBL) and Baltic Basketball League, were researched. Their age was 25.6 ± 0.6 years, height – 195.9 ± 1.7 cm and body mass – 94.7 ± 4.3 kg.

The sample also included young basketball players ($n = 12$), who regularly trained 4 times a week and played in school learners' competitions. Their age was 14.1 ± 0.2 years, height – 183.7 ± 3.4 cm and body mass – 69.5 ± 2.2 kg. The participants and, if necessary, their guardians were informed about the aims and procedures of the study before providing their written informed consent. The study was approved by Lithuanian Bioethics Committee, according to Resolution #30/2008.

Procedures. During the competition period, laboratory 5×6 s repeated effort test with rest intervals of 24 s was employed (Ward, 1991; Fiszimon et al., 1993). The veloergometer "Monark Ergonomic 894 Ea" was used for this test. The average muscle power during each work interval

was provided in watts (W) and fatigue index (FI) was calculated applying the formula:

$$FI (\%) = 100 - (P5 / P1 \times 100)$$

Three minutes after the physical load, the concentrate of lactate in the blood was measured applying the blood lactate test meter "Lactate Pro".

Statistical analysis. All data were analyzed using *SPSS for Windows v. 14.0*. The results were processed applying methods of descriptive statistics: Mean values were calculated, dispersion was evaluated calculating standard deviation of sample (s) and according to coefficient of variation (CV), providing parameters (Min and Max) of dispersion area. Dispersion analysis (ANOVA) was used to compare the two groups. Statistical significance was set at $p < 0.05$.

RESEARCH RESULTS

Average muscle power was the highest during the first sprint and then gradually decreased in both groups (Figure 1). A statistically significant difference was observed for absolute muscle power of elite and young basketball players in the first sprint ($p < 0.004$) (Table 1). Significant dispersion of indicators was characteristic of both groups: coefficient of variation (CV) exceeded by 20%. The research on relative indicators for one kilogram of the body mass showed that the power of elite ($13.06 \text{ W} \cdot \text{kg}^{-1}$) and young players ($11.74 \text{ W} \cdot \text{kg}^{-1}$) did not differ statistically ($p < 0.09$). The dispersion of indicators of young basketball players totalled 10.5%, whereas it amounted to 18.2% in the group of elite basketball players.

The most significant difference in muscle power was recorded in both groups during the second work interval. The absolute indicators of higher performance basketball players were higher by 436.2 W ($p < 0.0001$), the same tendency was observed in the values of relative indicators, which were by $1.7 \text{ W} \cdot \text{kg}^{-1}$ bigger in the group of elite players ($p < 0.02$).

Power indicators decreased at similar rate in both groups during the third, fourth and fifth work intervals. The absolute muscle power of elite basketball players remained statistically higher during these work intervals, whereas relative power did not differ. Dispersion of power indicators around the mean changed insignificantly in all the intervals of work.

Table 2 presents the values of muscle capacity. The change observed between the first and second

work intervals showed anaerobic ATP-PCr muscle power capacity. The difference in the relative muscle power of elite basketball players totalled by $0.32 \text{ W}\cdot\text{kg}^{-1}$ and that of young players equalled to $0.75 \text{ W}\cdot\text{kg}^{-1}$. Significantly smaller fatigue index ($p < 0.03$) was identified in the group of elite players compared to young players, which revealed greater anaerobic ATP-PCr muscle power capacity.

Evaluating repetitive work capacity, the difference between the first and fifth work interval was calculated. The absolute muscle power of elite basketball players totalled 128.2 W and that of young athletes was lower by 76.9 W. The difference between the two groups was statistically significant

($p < 0.05$). The fatigue index investigated in both groups did not differ.

After the physical load, the lactate concentration in the blood was measured, which was $9.1 \text{ mmol}\cdot\text{l}^{-1}$ in the group of young basketball players, whereas the lactate concentration in the blood of professional basketball players equalled to $9.5 \text{ mmol}\cdot\text{l}^{-1}$. No statistically significant difference was recorded in both groups. As it can be seen from the results, very large dispersion about the mean $\text{CV} = 41.4\%$ was observed in the group of young players. Dispersion of these indicators in the group of professionals was smaller compared to the other group but it still remained large ($\text{CV} = 25.5\%$).

Figure 1. Change in absolute muscle power (W) of elite and young basketball players performing $5 \times 6 \text{ s}$ repeated effort test

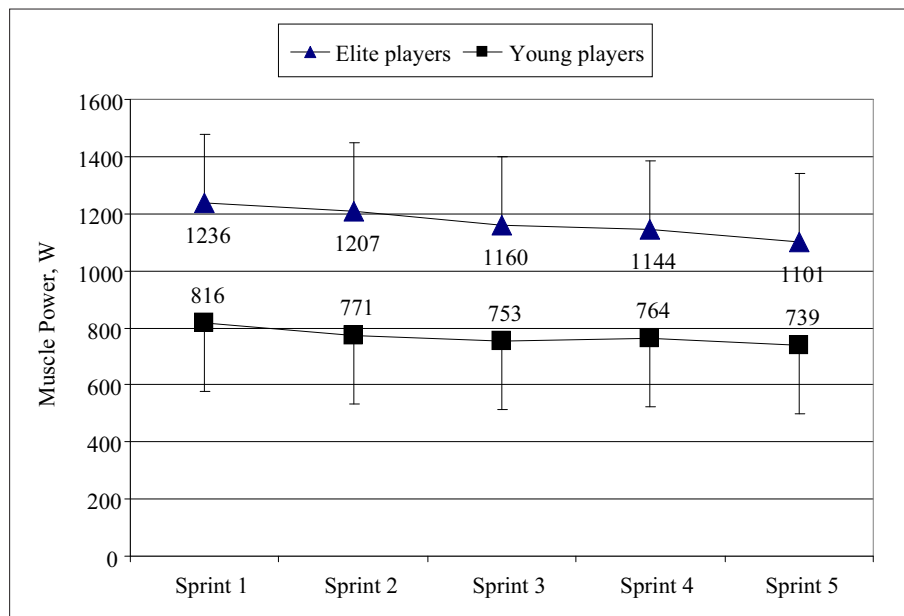


Table 1. Muscle power of elite and young basketball players performing $5 \times 6 \text{ s}$ repeated effort test

Sample		Sprint 1		Sprint 2		Sprint 3		Sprint 4		Sprint 5	
		W	$\text{W}\cdot\text{kg}^{-1}$	W	$\text{W}\cdot\text{kg}^{-1}$	W	$\text{W}\cdot\text{kg}^{-1}$	W	$\text{W}\cdot\text{kg}^{-1}$	W	$\text{W}\cdot\text{kg}^{-1}$
Elite basketball players	Mean	1235.8	13.06	1207.08	12.78	1160	12.28	1144.2	12.11	1101.2	11.65
	S	289.08	2.37	264.24	2.22	272.77	2.33	265.58	2.21	249.15	2.04
	CV%	23.39	18.17	21.89	17.39	23.51	18.97	23.21	18.28	22.62	17.52
	Min	973	9.67	966	9.62	890	8.77	883.00	8.97	842.00	8.87
	Max	1909	16.7	1809	15.87	1846	16.20	1848	16.2	1749.0	15.34
Young basketball players	Mean	816.00	11.74	770.83	11.09	752.75	10.81	763.75	10.94	739.08	10.59
	S	210.61	1.24	203.98	0.99	211.04	1.13	215.50	0.88	216.29	1.13
	CV%	25.81	10.52	26.46	8.91	28.04	10.43	28.22	8.07	29.26	10.66
	Min	598.00	9.83	617.00	9.57	584.00	9.17	579.00	9.57	558.00	9.07
	Max	1392	14.1	1370	13.15	1364	12.66	1388	12.7	1363	12.6
P-value		< 0.004	0.098	< 0.0001	< 0.024	< 0.004	0.061	< 0.0007	0.099	< 0.008	0.12

Note: CV – coefficient of variation.

Table 2. Muscle power decrement of elite basketball players and young players between work interval 1 and 2 as well as between 1 and 5, as well as concentration of lactate in the blood

Sample		Sprints 1–2			Sprints 1–5			La mmol·l ⁻¹
		W	W·kg ⁻¹	FI (%)	W	W·kg ⁻¹	FI (%)	
Elite basketball players	Mean	28.77	0.32	2.05	128.23	1.35	10.11	9.48
	S	31.29	0.27	1.79	71.80	0.70	4.42	2.42
	CV%	108.75	85.69	87.23	55.99	52.33	43.77	25.52
	Min	3.00	0.04	0.36	38.00	0.38	3.85	5.40
	Max	100.00	0.87	6.24	287.00	2.96	18.77	13.30
Young basketball players	Mean	51.67	0.76	6.32	76.92	1.15	9.74	9.12
	S	35.91	0.51	4.02	38.08	0.57	4.65	3.77
	CV%	69.51	67.63	63.62	49.51	49.79	47.77	41.40
	Min	17.00	0.19	1.58	29.00	0.26	2.08	5.60
	Max	128.00	1.83	15.15	143.00	1.92	17.46	15.20
P-value		< 0.143	< 0.003	< 0.031	< 0.038	0.505	0.990	0.772

Note: CV – coefficient of variation.

DISCUSSION

The study shows that absolute indicators of muscle power were higher in the group of elite athletes compared to the same indicators of young players (Figure 1). However, differences in relative muscle power were observed only in the second work interval. This means that 14-year-old players equalled to elite athletes in relative power of short muscle work. It can be stated that the average relative anaerobic alactic muscle power of professionally trained athletes is not sufficient. However, both relative and absolute anaerobic alactic muscle powers are significant because in play situations an athlete has to overcome not only the power of their own body gravity, but also to cope with a personal contact with an opponent.

L. Ellis et al., (2000) point out that in game situations high average indicator is of utmost importance during all the five work intervals. He stated that the average relative muscle power of elite ice hockey players totaled to 13.2 W·kg⁻¹, whereas that of the researched elite basketball players equaled to 12.4 W·kg⁻¹, and the average relative muscle power in the group of young basketball players totalled to 11.1 W·kg⁻¹ (Figure 2).

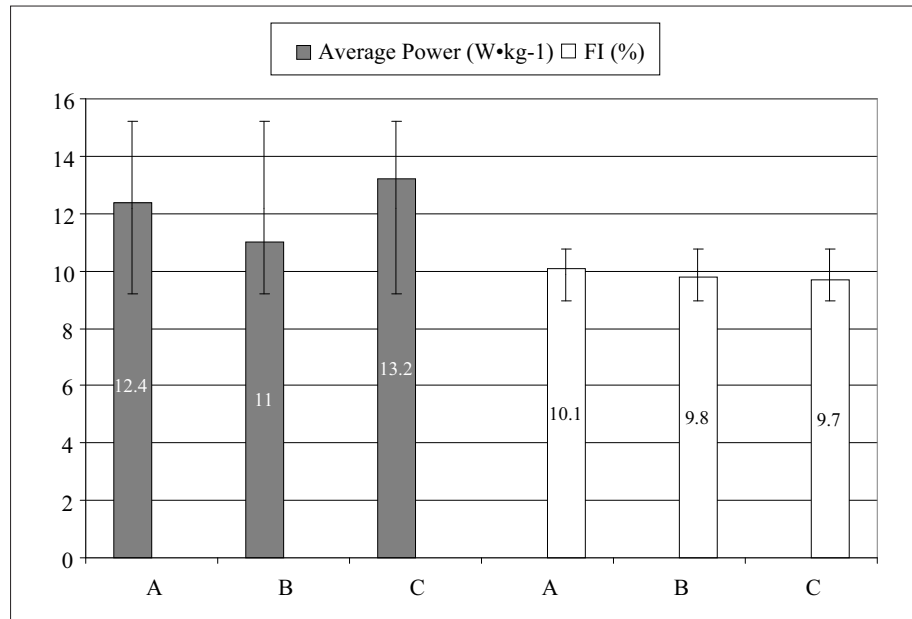
Applying this test it was necessary to evaluate the change in the power of short muscle work under conditions of short recovery time. A decrease in work power is expressed through fatigue index (FI), where lower value refer to better endurance of muscle power. Table 2 contains the fatigue index of anaerobic alactic muscle power, which

is particularly important in basketball and other sports games. It can be seen that young players fall behind adult ones. P. Astrand and K. Rodahl (1986), J. Wilmore et al. (2008) point out that the prevailing duration of anaerobic alactic energy production reactions ranges from 6 to 10 s. Working at maximum intensity for such a period, phosphocreatine (PCr) resynthesizes ATP enough. According to the authors mentioned above, recovery depends on a big number of factors but the main processes occur within 1.5–3 min. During the conducted research, the rest period between work intervals amounted to 24 s. Therefore, the main factor predetermining better capacity of anaerobic alactic muscle capacity could be a bigger reserve of PCr accumulated in muscles as well as higher activity of creatine-kinase (Kraemer, Ratamess, 2005).

The fatigue index was the same in both groups. A. Stapf (2000) suggests that good fatigue index of repetitive work capacity of elite Australian basketball players equaled to 5%. The FI of elite basketball players in the research sample was 10.1%, similar to that of young players (9.7%).

Fatigue index is not correlated with a large number of indicators of physical development and physical fitness (Fitzsimons et al., 1993). Evaluating the effect of repetitive work on the activity of glycolytic reactions in muscles, the concentration of lactate in the blood was measured. The concentration in the blood of all

Figure 2. Average working power during 5×6 s repeated effort test ($W \cdot kg^{-1}$) and fatigue index FI (%)



Note. A – elite basketball players, B – young basketball players, C – elite ice hockey players (Ellis et al., 2000).

the basketball players considerably exceeded lactate accumulation threshold (LAT) and was the same in both groups. This shows that the amount of PCr, which is necessary for ATP resynthesis, starts decreasing during repetitive work and the activity of anaerobic glycolytic reactions increases. However, the dispersion of indicators around the mean show that contribution of energy sources to capacity of repetitive work is very individual.

CONCLUSIONS AND PERSPECTIVES

1. The research revealed that relative muscle power of elite basketball players did not differ from those of young athletes.
2. The same anaerobic repetitive muscle work capacity was observed in both groups.
3. It was established that the concentration of lactate in the blood increased after physical load and did not differ in the two groups.

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DIDELIO MEISTRISKUMO IR JAUNŪJŲ KREPŠININKŲ ANAEROBINIS RAUMENŲ PAJĖGUMAS IR KARTOTINIO DARBO IŠTVERMĖ

Rūtenis Paulauskas, Rūta Dadelienė, Rasa Paulauskienė, Juozas Skernevičius
Lietuvos edukologijos universitetas, Vilnius, Lietuva

SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Žaidėjai darbo metu turi atlikti labai intensyvų kartotinį darbą ir trumpų pertraukėlių metu greitai atsigauti. Manoma, kad didelio meistriškumo krepšininkų anaerobinis darbo galingumas ir kartotinio darbo ištvėrmė yra didesnė nei jaunųjų krepšininkų.

Tikslas – nustatyti didelio meistriškumo ($n = 13$) ir jaunų žaidėjų ($n = 12$) anaerobinį pajėgumą ir kartotinio darbo ištvėrmę bei atlikti lyginamąją analizę.

Metodai. Varžybų laikotarpiu buvo atliktas 5×6 sekundžių kartotinio darbo testas darant 24 s poilsio pertraukas. Buvo paskaičiuotas kiekvieno darbo intervalo vidutinis galingumo rodiklis bei nustatytas nuovargio indeksas. Po fizinio krūvio praėjus trimis minutėms, buvo nustatyta laktato koncentracija kraujyje.

Rezultatai. Absoliutaus raumenų pajėgumo rodikliai didelio meistriškumo žaidėjų buvo statistiškai reikšmingai didesni visų darbo intervalų metu. Tačiau santykiniai darbo galingumo rodikliai, išreikšti viename kilogramui kūno masės, statistiškai nesiskyrė. Pirmuoju darbo intervalu didelio meistriškumo žaidėjų jis buvo $13,06 \text{ W} \cdot \text{kg}^{-1}$, jaunųjų krepšininkų – $11,74 \text{ W} \cdot \text{kg}^{-1}$ (skirtumas $p < 0,09$). Nuovargio indekso rodikliai abiejų grupių tiriamųjų nesiskyrė ($p < 0,77$), statistinio skirtumo tarp laktato koncentracijos rodiklių taip pat nebuvo ($p < 0,778$).

Aptarimas ir išvados. Nors absoliutūs raumenų pajėgumo rodikliai didelio meistriškumo žaidėjų ir buvo didesni, žaidžiant krepšinį svarbūs santykiniai rodikliai (kur reikalinga įveikti kūno masės pasipriešinimą) statistiškai patikimai nesiskyrė. Po krūvio abiejų grupių laktato koncentracija viršijo $9 \text{ mmol} \cdot \text{l}^{-1}$. Vadinasi, dirbant 5 kartus po 6 sekundes ir 4 kartus ilgiau ilsintis KF atsargų ATP resinzei nepakanka, todėl yra aktyvuojamos anaerobinės glikolitinės reakcijos.

Raktažodžiai: nuovargis, laktatas, atsigavimas, raumenys.

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Corresponding author **Rūtenis Paulauskas**
Lithuanian University of Educational Sciences
Studentų str. 39, LT-08106 Vilnius
Lithuania
Tel +370 5 273 4858
E-mail rutenis.paulauskas@vpu.lt

EVALUATION OF PHYSICAL THERAPY EFFECTIVENESS AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

Kęstutis Radžiūnas¹, Vytenis Trumpickas², Jonas Poderys³

*Lithuanian University of Health Sciences, Medical Academy¹, Kaunas, Lithuania
Hospital of Lithuanian University of Health Sciences Kauno Klinikos², Kaunas, Lithuania
Lithuanian Academy of Physical Education³, Kaunas, Lithuania*

ABSTRACT

Research background and hypothesis. The aim of physical therapy after sports trauma is to help patients to restore physical activity as it was before injury. The participants who applied for intensive physical therapy after anterior cruciate ligament reconstructive surgery will achieve better leg muscle strength results.

Research aim was to compare the effectiveness of intensive and traditional rehabilitation of the knee extensor and flexor muscle strength after the surgery for patients after anterior cruciate ligament reconstruction.

Research methods. The method that we used was “Biodex Medical System 3 PRO” for the knee muscle strength. A total of 30 patients were enrolled in this study. The subjects were divided into two groups. The muscle strength was measured while leg was flexed and extended at the knee joint.

Research results. The research results showed that participants who received intensive physical therapy program developed better muscle strength than in standard physical therapy group. Participant’s leg muscles recovered faster in intensive physical therapy group than in standard physical therapy group.

Discussion and conclusions. The participants who received physical therapy before surgery, electrostimulation and intensive physical therapy program after surgery, achieved higher levels of knee extensor and flexor muscle strength after anterior cruciate ligament reconstructive surgery than those patients undergoing a traditional physical therapy program only after surgery.

Keywords: anterior cruciate ligament, intensive physical therapy, muscle strength.

INTRODUCTION

The knee joint is the largest human joint; it has a complex anatomical and biomechanical structure. During the motion this joint not just absorbs force but it also transmits and distributes it to the reference points and allows movement (Escamilla et al., 2012).

During mechanical injuries the knee joint are often injured. Knee injuries take important place in musculoskeletal system injuries. Knee injuries account for 40.7% of all musculoskeletal injuries. The knee cruciate ligament injuries usually occur in 15 to 25-year-old people, especially athletes

(Vitkus et al., 2007). Anterior cruciate ligament injuries are common for basketball, football players, gymnasts, grass hockey, handball, volleyball players, mountain skiers (Lind et al., 2009).

Anterior cruciate ligament (ACL) injuries cause instability, pain, which decrease physical activity and reduce the quality of life. Decreased strain for leg muscle leads to femoral muscle loss, then symptoms become apparent (Escamilla et al., 2012). Improper functioning of the anterior cruciate ligament of the knee develops deforming arthrosis (Ренстрёма, 2003).

Anterior cruciate ligaments are injured 30 times more than posterior cruciate ligaments. In the United States anterior cruciate ligament injuries occur more than 95 thousand times each year. Every year about 65–75 thousand anterior cruciate ligament reconstructive surgeries are performed. It is very important to determine the risk factors and develop prevention strategies (Vitkus et al., 2007).

In Lithuania about 950 anterior cruciate ligament injuries occur and 750 surgeries are performed every year. Most of the reconstructive surgeries are performed using arthroscopy technique. The knee joint is less damaged.

Physical therapy is very important in the treatment of anterior cruciate ligament, especially before surgery. Results of preoperative physical therapy influence better healing, better knee function recovery for patients after knee reconstruction surgery.

Physical therapy focuses on the safe physiological healing terms of reconstructed anterior cruciate ligament. Physical therapy returns the normal knee range of motion, muscle strength, balance and coordination more quickly and effectively (Hensler et al., 2012). A very important element for the effectiveness of physical therapy of athletes is specific movements for specific sport (Ренстрёма, 2003).

Research aim was to compare the effectiveness of intensive and traditional rehabilitation of the knee extensor and flexor muscle strength after the surgery for patients after anterior cruciate ligament reconstruction.

RESEARCH METHODS

Participants and Procedure. A total of 30 patients were enrolled in this study. The research was performed in the period of 2008–2010. Surgeries were performed in Sports Trauma and Arthroscopic Surgery Department of the Hospital of Lithuanian University of Health Sciences, and the Orthopedics and Traumatology Clinic. Rehabilitation was performed in Rehabilitation Clinic. All testing was carried out in the Lithuanian Academy of Physical Education, Laboratory of Human Motorics. The study included only those subjects who met the following criteria: 1) ACL reconstructive surgery was performed for the first time; 2) other knee ligaments, meniscus did not have injuries or reconstructive surgery; 3) non-operated leg did not have surgery or trauma; 4) there was no inflammation or poor general physical condition after surgery; 5) athletes were younger than 35

years old; 6) less than 3 months passed from injury to surgery.

Surgeries were carried out by the same surgeon, the same reconstruction method was applied, using the muscle tendon transplant (*semitendinosus* – *gracilis*). The physical therapy was performed in Rehabilitation Clinic of the Hospital of Lithuanian University of Health Sciences.

The subjects were divided into two groups; each group involved 15 participants, randomly selected according to their birthday. Different physical therapy techniques were applied by different protocols. Intensive physical therapy was applied for the first group of participants. The second group received standard physical activity.

The first group consisted of 13 men and 2 women. Their age was 25.6 ± 7.5 years, height – was 177 ± 9 cm, weight – 81 ± 13.7 kg. The second group consisted of 13 men and 2 women. Their age at the time of surgery was 27.4 ± 7.1 years, height – 175 ± 10 cm and weight – 78 ± 11.4 kg.

The participants completed the questionnaires, after the research aim was explained to them. Leg muscle strength was evaluated twice with “Biodex Medical System 3 PRO” independently of the physical therapy techniques: 1) the first testing was performed about 2 days before the anterior cruciate ligament reconstructive surgery; 2) the second testing – about 6 months after anterior cruciate ligament reconstructive surgery.

Research procedure and program. Leg muscle peak force was measured by three angular speeds – 30, 180, 300°/s. All testing was performed using special equipment for testing and rehabilitation “Biodex Medical System 3 PRO” (Certified ISO 9001 EN 46001). During the test all participants were encouraged to use the greatest force to defeat equipment resistance by the angle of different speed. All testing was performed using isokinetic mode by protocol. First healthily leg was tested and later – the damaged one.

The research protocol:

1) Warming-up: veloergometer for 5 min with 50–60 Watt. Then stretching exercises for 10 min.

2) Five minutes rest before the test. During that period of time participant’s body postural adjustments were determined using a dynamometer.

3) Te participants took five pilot tests of the knee extension and flexion for the amplitude and free speed.

4) Testing of the healthy leg. Angular velocity values 30, 180, 300°/s were taken. Muscle rest between the angular speed test was 60 s.

5) Then the damaged leg was tested.

Physical therapy program. After surgery physical therapy for participants was performed in the ward. The procedures continued at home. Both research groups received different physical therapy techniques.

Electrostimulation was applied for the group which received intensive physical therapy. The protocol is given in the Table. Electrostimulation was performed using „NeuroTrac SPORT XL“ equipment. Electrodes were fixed at the beginning of quadriceps muscle and in the end of the perpendicular to the muscle fibers.

To reduce post-operative pain and swelling, we applied cold procedures for both groups. Cryotherapy was performed immediately after surgery, 3–4 times a day. It took 15–20 minutes.

Physical therapy programs were based on other authors' recommendations.

Important limitations of physical activity:

1) Intensive physical therapy:

- Flexion: the knee flexion is limited to 90 degrees in the first week, in the second week it is limited to 110 degrees. Full range of motion of the knee flexion is achieved after a month.
- Extension: from the first day full knee extension range of motion after ACL surgery is allowed.
- Footing: from the first day after ACL surgery, using all body weight for the participants leg is allowed and elbow crutches are recommended at the beginning for the safety of the participants.
- Stretching exercises.

2) Standard physical therapy:

- Flexion: the knee joint flexion is limited to 30 degrees for two weeks. From the third week the range of motion is increased to 90 degrees. The normal range of motion of

the knee joint flexion is achieved after 7–8 weeks.

- Extension: after ACL surgery full extension range of motion is allowed.
- Footing: two weeks after surgery all participants could use their foot using half of their body weight (Elbow crutches are allowed).
- Stretching exercises: The exercises are performed to discomfort (tension, tightness and pain), 3–4 days a week.

Following the recommendations of G. S. Roi et al. (2006), C. Voigt et al. (2006), A. Vadala et al. (2007), H. J. Silvers et al. (2007), we created a standard physical therapy program for ACL injuries:

1) Before surgery we informed the participants about the preoperative and postoperative period, about the possible occurrence of bruising after reconstructive surgery.

2) After surgery we used the load gradually.

In the first phase (0–14 days) the aim was to walk or to elevate the leg in a standing position, using orthopedic brace while the leg was fully extended. We used soft orthopedic brace which kept the knee joint in the open position; isometric exercises (extended leg raising, quadriceps muscle strained), also in the first two weeks passive flexion and extension in the knee joint (range of motion to 30 degrees) was used. These movements were best performed in a standing position.

In the second phase (2–4 weeks) the aim of therapy was to restore knee flexion to 90 degrees. Muscle strengthening exercises of proprioception – coordination exercises (climbing stairs), 2–3 times a day were used.

In the third phase (1–2 months) the aim of therapy was to achieve a full range of motion. Increased range of motion was used gradually; proprioception training continued; exercises in the pool and leg muscle strengthening exercises for 60 minutes were performed.

Table. The phase of the electrostimulation, frequency and duration of work

Work/Duration of work	The first phase 5 min (Warming-up)	The second phase 15 min (continuous work)	The third phase 10 min (continuous work)	The fourth phase 15 min (continuous work)	The fifth phase 5 min (continuous work)
Frequency of muscle work	10 Hz	20 Hz	30 Hz	20 Hz	5 Hz
Impulse time	250 μ s	300 μ s	300 μ s	300 μ s	250 μ s
Frequency of the rest	–	3 Hz	3 Hz	3 Hz	–
Time of relaxation	–	2.5 s	2.5 s	2.5 s	–

In the fourth phase (2–4 months) the aim was to increase strength and endurance. Strength exercises with weights (60 min) and non-contact exercises were used. If there were no complaints, the loads were increased gradually.

In the fifth phase (4–12 months) the aim was return to specific sport training with the doctor's permission. Proprioception training was continued; then 70–80% of healthy isokinetic leg strength was achieved and training in special sport was allowed. Isokinetic exercises in full range of motion were allowed as well.

Following the recommendation of M. Asik et al. (2007), G. S. Roi et al. (2006), D. K. Shelbourne et al. (2006), C. Voigt et al. (2006), we created intensive physical therapy protocol for ACL injuries.

1) before surgery we used functional and strength training; we informed the participants about preoperative and postoperative period and the possible occurrence of bruising after reconstructive surgery. The muscle training was carried out 4–5 times per week before surgery.

2) After surgery we used the load gradually.

In the first phase (0–14 days) the physical therapy aim was to reach the knee flexion up to 90 degrees. It was used to correct standing while the leg was fully extended; to walk or to elevate the leg in a standing position while leg was fully extended. Electrostimulation was performed on first day after the surgery (Table).

In the second phase (2–4 weeks) the aim was to reach a full range of motion in the knee joint. We used proprioception – coordination training exercises 2–3 times a day, muscle training and strengthening exercises and patella mobilization.

In the third phase (1–2 months) the aim was to reach a full range of motion on the knee joint. We used proprioception training, exercises in the pool, then we started exercises on a treadmill – stationary bike, muscle strengthening exercises for 60 min 3–4 times a week, in order to reach physical activity as it was before injury.

In the fourth phase (2–4 months) the aim was sport specific exercises. It was used different leg movement exercises for 30–60 min 3–4 times a week, muscle strength and endurance exercises (60 min), flexibility exercises, and non-contact exercises. If there was no complaining, the loads were increased gradually.

In the fifth phase (4–6 months) the aim of physical therapy was to go back to sport with

the doctor's permission. Proprioception training was continued, as well as running on treadmill with increasing loads, after achieving 70–80% of healthy isokinetic leg strength, training in special sport was allowed. Isokinetic exercises in full range of motion were allowed as well.

Statistical analyses. The research data were processed using *Microsoft Excel 2007* and *Statistical Package for the Social Sciences (SPSS)*. The data are reported as group mean values \pm standard deviation (SD).

Hypothesis of normal distribution of test characteristics were tested using Shapiro-Wilk test. Comparing the quantity data that is distributed under the normal distribution we used nonparametric rank analysis. For two dependent samples, checking the reliability of the differences, we used Wilcoxon criterion. For the reliability of differences for independent samples we used Mann-Whitney criterion.

The data were statistically significant at $p < 0.05$.

RESEARCH RESULTS

Leg muscle strength results using different physical therapy before ACL reconstructive surgery. The first participant group had physical therapy procedures before surgery. The research results showed that the first group participants' muscle strength was bigger than that in the second group for the injured leg at different angular velocity.

The research results showed that extension muscle strength depended on the speed of muscle contraction and physical therapy technique.

Maximum muscular extension strength for healthy and injured leg before ACL reconstruction surgery. As we see in Figure 1, the participants reached the maximum strength at the lowest angular velocity (30°/s). The healthy leg maximum muscular extension strength was bigger than the injured leg for both groups at all angular velocities ($p < 0.05$).

Figure 1 shows that between injured sides there was the greatest improvement in the intensive physical therapy group compared to standard physical therapy group, when the angular velocities were 30°/s and 180°/s ($p < 0.05$). At the angular velocity of 300°/s no significant difference ($p > 0.05$) was observed.

The results showed that different physical therapy did not have any influence on the healthy leg ($p > 0.05$).

There was a trend in the leg extension at the knee joint, that with the increase of the speed of muscle contraction, muscle contraction strength decrease and the differences between these factors decreased, too.

Muscular flexion strength for healthy and injured leg before ACL reconstruction surgery using different physical therapy techniques showed that participants reached the maximum strength at the lowest angular velocity (30°/s). For both groups healthy leg muscular flexion strength was greater than the injured leg muscle strength at different angular velocities (Figure 2).

Using different physical therapy for all angular velocities there were significant differences between healthy and injured legs ($p < 0.05$).

The participants who applied the intensive physical therapy showed bigger muscle contraction strength in injured leg, compared to standard physical therapy group, for all muscle contraction speed ($p > 0.05$).

During the knee flexion for healthy leg at all angular velocities, the differences between groups were not significant ($p > 0.05$).

There was a trend in the leg flexion in the knee joint, that with the increase of speed of muscle contraction, muscle contraction strength was reduced and the differences between these factors decreased.

Leg muscle strength results using different physical therapy after ACL reconstructive surgery. The second test was performed 6 months after ACL reconstructive surgery. For 6 months different physical therapy techniques were applied.

Figure 3 shows that the participants reached the maximum strength at the lowest angular velocity (30°/s). The result showed, that in both groups the healthy leg muscle extension strength was greater than that of the operated leg muscle strength at all angular velocities ($p < 0.05$) except for 300°/s angular velocity in intensive physical therapy group ($p > 0.05$).

The participants in intensive physical therapy group showed bigger muscle strength improvement for the operated leg than participants who received standard physical therapy ($p < 0.05$).

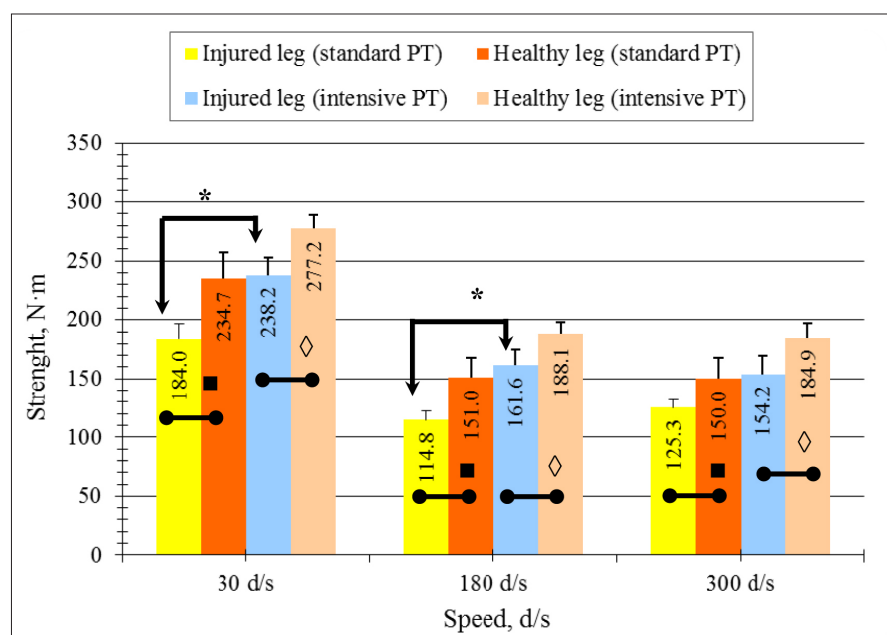
There was a trend in the leg flexion in the knee joint, that with the increase in speed of muscle contraction, muscle contraction strength is reduced and the differences between these factors decreased.

Six months after ACL reconstructive surgery operated and healthy leg flexion muscle strength in both groups participants reached the maximum strength at the lowest angular velocity (30°/s) (Figure 4).

The participants who received the intensive physical therapy showed bigger muscle contraction strength in the operated leg, compared to the standard physical therapy group, for all different angular velocities ($p > 0.05$).

Figure 1. Healthy and injured leg, different physical therapy techniques, maximum muscular extension strength at different speed of muscle contraction before surgery

Note. Statistically significant: ■ – healthy and injured leg, standard physical therapy. ($p < 0.05$); ◇ – healthy and injured leg, intensive physical therapy. ($p < 0.05$); * – injured leg, standard and intensive physical therapy ($p < 0.05$); † – healthy leg, standard and intensive physical therapy ($p < 0.05$).



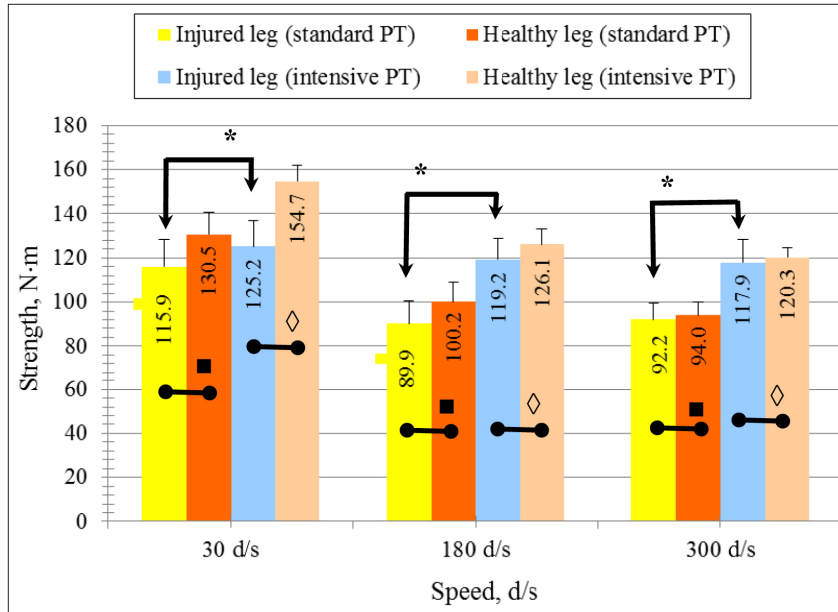


Figure 2. Healthy and injured leg, different physical therapy techniques, maximum muscular flexion strength at different speed of muscle contraction, before surgery

Note. Statistically significant: ■ – healthy and injured leg, standard physical therapy. ($p < 0.05$); ◇ – healthy and injured leg, intensive physical therapy. ($p < 0.05$); * – injured leg, standard and intensive physical therapy ($p < 0.05$); ¥ – healthy leg, standard and intensive physical therapy ($p < 0.05$).

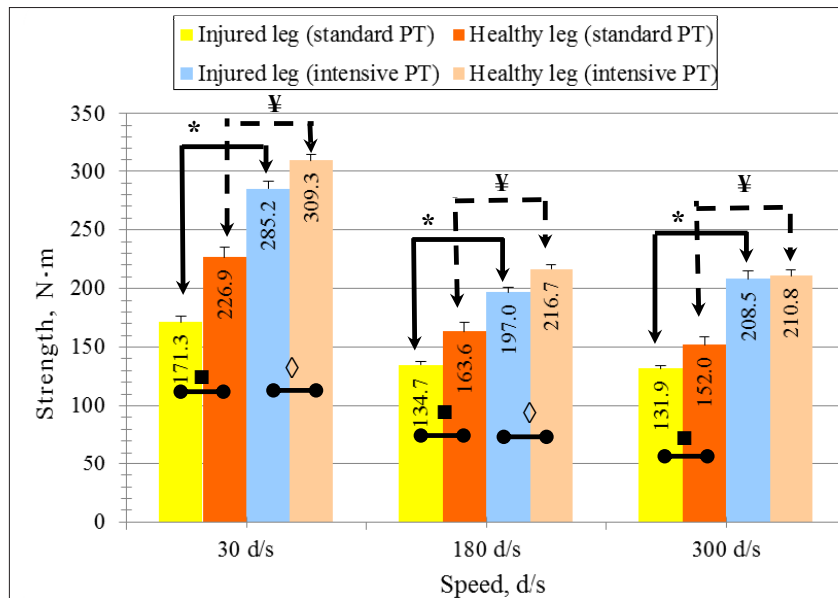


Figure 3. Healthy and injured leg, different physical therapy techniques, maximum muscular extension strength at different speed of muscle contraction, after surgery

Note. Statistically significant: ■ – healthy and injured leg, standard physical therapy. ($p < 0.05$); ◇ – healthy and injured leg, intensive physical therapy. ($p < 0.05$); * – injured leg, standard and intensive physical therapy ($p < 0.05$); ¥ – healthy leg, standard and intensive physical therapy ($p < 0.05$).

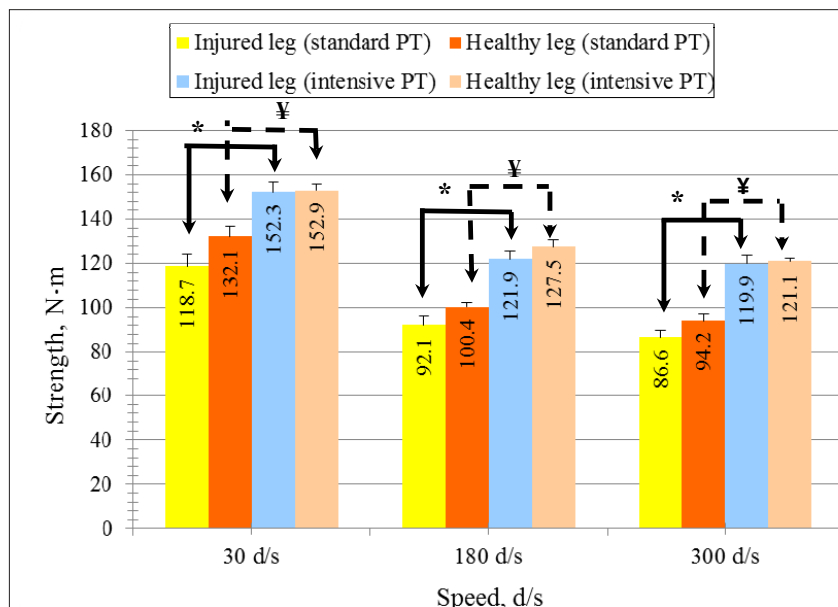


Figure 4. Healthy and injured leg, different physical therapy techniques, maximum muscular flexion strength at different speed of muscle contraction, after surgery

Note. Statistically significant: ■ – healthy and injured leg, standard physical therapy. ($p < 0.05$); ◇ – healthy and injured leg, intensive physical therapy. ($p < 0.05$); * – injured leg, standard and intensive physical therapy ($p < 0.05$); ¥ – healthy leg, standard and intensive physical therapy ($p < 0.05$).

DISCUSSION

Scientific publications analyze the effectiveness of physical therapy after ACL reconstructive surgery. In recent years, one of the most popular and reliable methods to assess the effectiveness of physical therapy has been isokinetic dynamometry (Gobbi, Francisco, 2006; Hiraoka et al., 2008; Almqvist et al., 2009). While analyzing Lithuanian and foreign literature, we did not find evidence about physical therapy effectiveness before and after ACL reconstructive surgery. Thus, our work is different from the earlier research work.

The results obtained during the study showed that the muscle strength was developed depending on the angular velocity. This is particularly evident in both groups in healthy and injured leg extensor muscle strength. Our results coincide with the ones obtained by other authors (Almqvist et al., 2009). The higher the angular speed in leg extension, the lower the maximum muscle strength is developed.

Comparing healthy and injured leg after ACL reconstructive surgery, we see that extensor muscle strength is bigger in intensive physical therapy group than in standard physical therapy group. Our research results coincide with those of other authors who state that quadriceps femoris muscle strength of the operated leg is lower than that of healthy leg independently what physical therapy is applied (Seto et al., 1998; Hoffman et al., 1999). Researcher's results showed that after ACL reconstructive surgery extensor muscle strength fully recovered in 6–12 months after surgery using standard physical therapy (Feller et al., 2004; De Jong et al., 2007), but using intensive physical therapy extensor muscle strength fully recovered after 4–6 months (Roi et al., 2006; Heijne, Werner, 2007). Similar results were obtained by Japanese researchers, who studied participants after ACL

surgeries and found that for 90% of participants quadriceps muscle strength fully recovered 2 years after surgery (Kobayashi et al., 2004). It should be noted that standard physical therapy duration is few months longer than intensive physical therapy duration. Our patients were tested after 6 months after ACL reconstructive surgery. We can assume that after 9 months or after one year muscle strength would be even more similar.

After 6 months after ACL reconstruction surgery in both groups the injured leg reached the healthy leg indicators. However, we noticed the difference between participants in both groups after 6 months after surgery.

According to the majority of authors, after the surgery a patient can resume intensive physical activity, when the difference in muscle strength between the operated lower extremity and another extremity is not greater than 10–15 % (Keays et al., 2000; Hiemstra et al., 2004).

The participants who received physical therapy before surgery, electrostimulation and intensive physical therapy program after surgery, achieved higher levels of knee extensor and flexor muscle strength after anterior cruciate ligament reconstructive surgery than those patients undergoing a traditional physical therapy program only after surgery.

CONCLUSIONS AND PERSPECTIVES

The patients undergoing an intensive physical therapy achieved higher levels of knee extensor and flexor muscle strength than those patients undergoing a traditional rehabilitation program. We recommend to use preoperative physical therapy; after anterior cruciate ligament reconstruction surgery electrostimulation and water physical therapy should be used.

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KINEZITERAPIJOS VEIKSMINGUMO ĮVERTINIMAS BLAUZDOS RAUMENŲ JĖGAI PO KELIO SĄNARIO PRIEKINIO KRYŽMINIO RAIŠČIO REKONSTRUKCINĖS OPERACIJOS

Kęstutis Radžiūnas¹, Vytenis Trumpickas², Jonas Poderys³

Lietuvos sveikatos mokslų universitetas, Medicinos akademija¹, Kaunas, Lietuva

Lietuvos sveikatos mokslų universiteto ligoninė Kauno klinikos², Kaunas, Lietuva

Lietuvos kūno kultūros akademija³, Kaunas, Lietuva

SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Kompleksinio gydymo metu po judamojo aparato traumų kineziterapijos procedūrų tikslas – padėti ligoniams greičiau atgauti buvusį fizinį aktyvumą. Šio tyrimo hipotezė buvo tokia: taikant intensyvios kineziterapijos programą ligonių po priekinio kryžminio raiščio rekonstrukcinės operacijos blauzdos raumenų jėgos atsigavimo tempai bus greitesni.

Tikslas – palyginti intensyvios ir įprastinės kineziterapijos veiksmingumą, blauzdos tiesiamųjų ir lenkiamųjų raumenų jėgai po priekinio kryžminio raiščio rekonstrukcinės operacijos.

Metodai. Buvo tiriama 30 Lietuvos sveikatos mokslų universiteto Kauno klinikų ligonių. Skirtingos kineziterapijos programos taikytos pagal atskirus protokolus. Buvo naudojamas šis tyrimo metodas: blauzdos raumenų jėga vertinama naudojant „Biodex Medical System 3 PRO“ aparatūrą – lenkiant ir tiesiant koją per kelio sąnarį.

Rezultatai. Nustatyta, kad tiriamieji, kuriems buvo taikyta intensyvi kineziterapijos programa, išugdė didesnę blauzdos tiesiamųjų ir lenkiamųjų raumenų jėgą nei tie, kuriems buvo taikyta įprastinė kineziterapijos programa. Taikant intensyvią kineziterapijos programą, blauzdos tiesiamieji ir lenkiamieji raumenys atsigauja greičiau nei taikant įprastinę kineziterapijos programą.

Aptarimas ir išvados. Tiriamųjų, kuriems buvo taikyta priešoperacinė kineziterapija, elektrostimuliacija ir intensyvi pooperacinė kineziterapijos programa, blauzdos tiesiamųjų ir lenkiamųjų raumenų jėga po priekinio kryžminio raiščio rekonstrukcinės operacijos yra didesnė nei tų, kuriems buvo taikoma įprastinė kineziterapijos programa tik pooperaciniu laikotarpiu.

Raktažodžiai: priekinis kryžminis raištis, intensyvi kineziterapijos programa, raumenų jėga.

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Corresponding author **Kęstutis Radžiūnas**
Lithuanian University of Health Sciences,
Medical Academy
Jankaus str. 2, LT-50275 Kaunas
Lithuania
Tel +370 865 184252
E-mail filatelistas@yahoo.com

EFFICACY OF EARLY PHYSICAL THERAPY FOR DIFFERENT BIRTH WEIGHT INFANTS AND ASSESSMENT OF THEIR MOTOR SKILL DEVELOPMENT

Margarita Senkutė, Ernesta Sendžikaitė, Alfonsas Vainoras
Lithuanian University of Health Sciences, Medical Academy, Kaunas, Lithuania

ABSTRACT

Research background and hypothesis. The survey was conducted to determine impact of physical therapy on different birth weight babies with specific motor development function delay and muscle spasticity. Our research hypothesis was that physical therapy would affect baby motor development regardless of their birth weight.

Research aim. The aim of this study was to assess motor development of the infants with different birth weight before and after early physical therapy.

Research method. Forty nine infants were assessed with Munich Functional Development Diagnostic Assessment during their first year of life. This scale helps to assess the basic motor functions: crawling, sitting, walking, grasping, language speech, perception and social development in the first months of infant life. Also, this method helps to identify potential problems and to give the infant the required support. The results were compared with the standard.

Research results. The results indicated that the motor function (crawling, sitting, walking and grasping) of infants with very low and normal birth weight statistically significantly differed before physical therapy. Walking motor development differences for infants with very low and low birth weight were statistically significant ($p < 0.05$). The results showed that after physical therapy there was no significant difference in the motor development of infants with very low and normal weight in crawling and sitting ($p > 0.05$). After physical therapy we noticed that there was no significant difference between walking and grasping development in babies with very low, low and normal weight ($p > 0.05$).

Discussion and conclusions. Summarizing the results we suggest that specific motor development function delay and muscle spasticity in babies with different birth weight before physical therapy was significantly different in such motor functions as crawling, sitting, walking and grasping dependently on birth weight. After physical therapy, we also observed 80% of motor development improvement for very low birth weight, 45% development improvement for low birth weight, and 60% development improvement for normal weight infants.

Keywords: spastic muscle, specific motor function development delay.

INTRODUCTION

One of the most important periods in child development is infancy. The behavioral and lifestyle characteristics of this period determine the quality of future life. M. Schertz et al. (2008) say that early childhood skills are the basis of future life, so early disease prevention is very important. The first year of life is particularly important for child development. Development of each child is individual, but development in general follows certain patterns. The genetic and emotional

factors, social environment, diet influences baby movements, sensations, feelings and thinking, which is the psychomotor development. The internal factors are very important too. The most important factor is muscular activity. Muscular activity stimulates nerve center activity which produces an impact on brain weight and susceptibility to information. Movement is an important way of understanding the world. It promotes the growth of child's physical and mental development (Schertz et al., 2008).

In the first year of life, it is very important to develop the correct performance of movements because motor skills are very important in the development of mental abilities. Good mobility influences fine motor training, develops will and discipline. There is a new capacity that arises every month, so it is recommended to check baby's psychomotor development from neonatal period during the first year of life. Knowing normal development helps to understand developmental delays. With regard to the normal development stages, the motor retardation can be noticed; you may plan correction programs and monitor the progress of development (Symington, Pinelli, 2006).

All over the world people pay much attention to research on the evaluation of child development. Almost all development delays can be observed during the first year of life in infants, the pediatricians and families are most attentive, and they are the ones to notice the problems first (Zeitlin et al., 2001).

Solving problems like treatment, rehabilitation, health promotion and disease prevention includes applying physical therapy. Many authors argue that the proper selection of exercises reduces the symptoms of disease progression (Docherty, 2002; Koscielny, 2004). All the time we question what the appropriate exercises are. It is always difficult to answer what physical exercise is the best for babies.

Contemporary research literature suggests that the development of motor functions and the importance of education is a holistic approach. It is very important to find development delays at the right time and to give the right correction according to baby's development. Physical therapist is responsible for the development of motor training, but they should collaborate with other specialists in early rehabilitation services team (neurologists, speech therapists, psychologists, social workers) (Mockevičienė, 2003).

Normal physiological spastic muscle stays still till 4 months of age (Hellbrigge, 2001), but sometimes, because of prematurity, very low birth weight, mother's medical condition during pregnancy, infections, malnutrition, environmental factors, genetic disorders, muscle spasticity can persist for a longer period of time (Tecklin, 2008; Ahmadpour-Kacho, 2011).

Different authors have different opinions about motility. M. Montessori (2000) states that motility is

an ability to express feelings and sensation through the muscle. S. A. Manacero et al. (2011) argue that mobility is a conscious interaction between active muscle movements; it depends on the development of nervous system (Manacero et al., 2011). Normal motor development during infancy shows a normal nervous system function, so diagnosing it is very important (Belthur et al., 2003).

Muscle tone is involuntary muscle tension which in fast and passive limb flexion and extension feels resistance. Muscle tone depends on age, condition, central nervous system damage and so on. Muscle tone provides body position in space, creates muscle tension, thus helping to perform the movement (Petrikonis, 2005). It determines the central nervous system and biomechanical properties of muscle. Spasticity is the most common muscle change problem (Futagi, Suzuki, 2010).

Prematurity is a complex problem. C. J. Geldof et al. (2011) point out that as baby is born early, the birth weight is lower and there is a bigger risk of various developmental disorders. The congenital factors and environmental effects influence preterm birth (Geldof et al., 2011).

Premature infant development for babies of all age which are born with low weight is worse in all life periods compared to normal birth weight babies. Motor development disorders correlate with low birth body weight (Rimdeikienė et al., 2008).

We think that motor development of very low birth weight babies is worse than that of normal birth weight babies, and that physical therapy will help to improve motor development for normal, low and very low weight babies.

RESEARCH METHODS

Subjects. The research participants were 49 four – twelve-month-old infants (25 girls and 24 boys). All research participants had spastic muscle and specific motor function development delay. Subjects were divided into three groups (Dunn, 1986):

1. Very low birth weight infants (The birth weight was less than 1500 g (n = 11), age – 31.20 ± 7.91 weeks).

2. Small birth weight infants (The birth weight was more than 1500 and less than 2500 g (n = 9), age – 24.78 ± 5.67 weeks).

3. Normal birth weight infants (The birth weight was more than 2501 g (n = 29), age – 26.33 ± 8.08 weeks).

Procedure. All participants came to the early rehabilitation service. Each of them had 16 individual sessions of physical therapy 2–3 times a week. Physical therapy took about 1.5–2 months. Before and after physical therapy the infants were assessed by the Munich Functional Development scale (this methodology was approved in Lithuania in 2000, December 14, by the Ministry of Health). Physical therapy for all groups was conducted according to the infant's age by a physical therapist. We used Bobath methods while working with babies. The aim of Bobath methods is to teach and to develop correct movement during active motor development and normalize muscle tone. This scale evaluates the baby motility during the first year of life: crawling, sitting, walking, grasping, perception, speech perception, speech and social development. This scale helps to identify potential problems and to provide the required assistance to the child (Hellbrügge et al., 2001). Munich functional diagnostic rate is 0, and if the number is negative, and it means that infant's development is worse than normal.

Mathematical statistics. The research data were processed using *Microsoft Excel 2007* and *Statistical Package for the Social Sciences (SPSS)*. The data are reported as group mean values \pm standard deviation (SD). The means were evaluated using Student's (t) test ($p < 0.05$ level of significance). Hypothesis of normal distribution of test characteristics were tested using Shapir-Wilk test. Comparing the quantity data distributed under the normal distribution we used nonparametric rank analysis. We used Wilcoxon criterion for two dependent samples checking the reliability of signs difference. We evaluated the reliability of difference for independent samples using Mann-Whitney criterion.

RESEARCH RESULTS

As we see in Figure 1, crawling motor development before physical therapy of normal and very low birth weight groups was significantly different ($p < 0.05$). Results after physical therapy for the normal and low birth weight babies showed significant difference ($p < 0.05$) (Figure 1).

The results during first screening of very low and normal birth weight baby's sitting development showed significant different ($p < 0.05$). After physical therapy we noticed that sitting development of low and normal weight babies was significantly different, too ($p < 0.05$) (Figure 2).

The evaluation of the walking development before physical therapy showed that walking development of very low weight babies was statistically significantly different from that of low and normal birth weight babies ($p < 0.05$). After physical therapy walking development did not statistically differ between groups (Figure 3).

The examination of the grasping development before physical therapy showed statistically significant difference between normal and very low birth weight infants ($p < 0.05$). At the end of research the results showed that grasping development after physical therapy improved for all infants ($p < 0.05$).

DISCUSSION

Since 1992 the state reorganization prenatal help programs have been carried out in Lithuania. After those programs more infants with low birth weight survived (Gaižauskienė et al., 1996). Premature infant health problems lead to functional organ and systems immaturity. Motor development

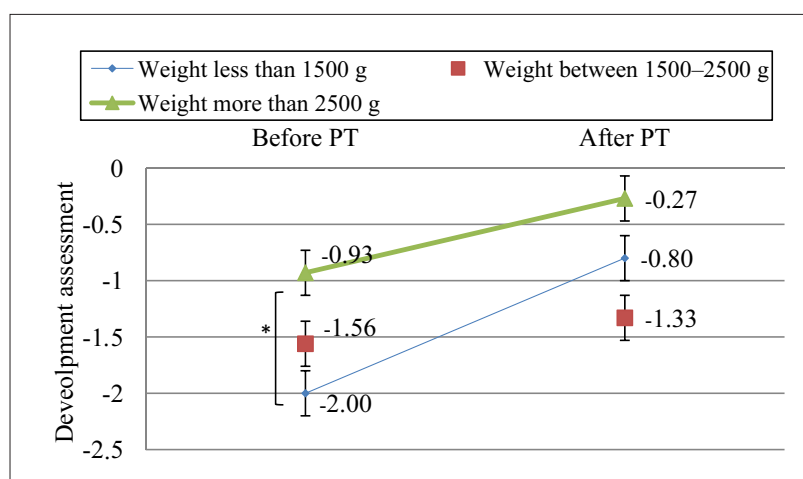


Figure 1. Crawling development evaluation in different birth weight infant groups

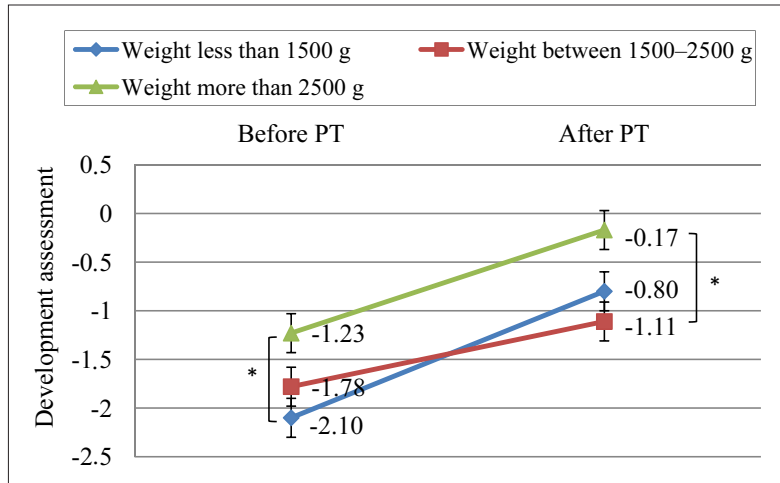
Note. * – significant differences between groups $p < 0.05$.

of very low birth weight infants delay stays till the subsequent periods of growth (Heathcock et al., 2008). In Lithuania there are about 5.3% – 1600

preterm births every year and 0.9% – 300 of them have very low birth weight.

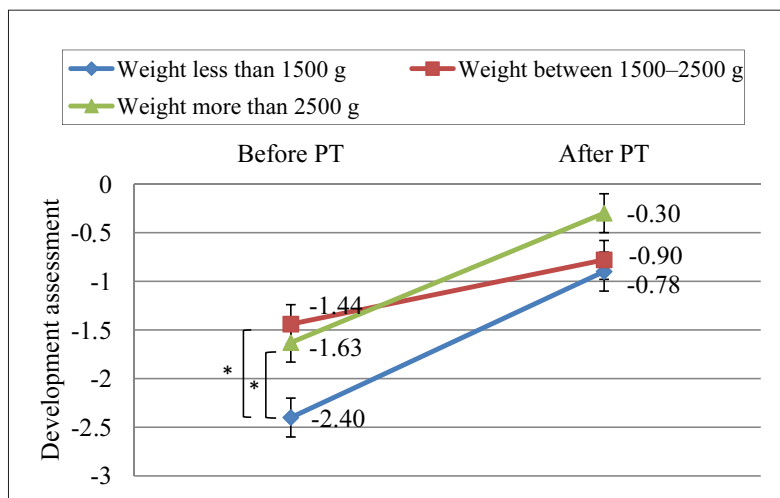
A. Scianni et al. (2009) says that physical therapy is very important complex education in the first

Figure 2. Sitting development evaluation in different birth weight infant groups



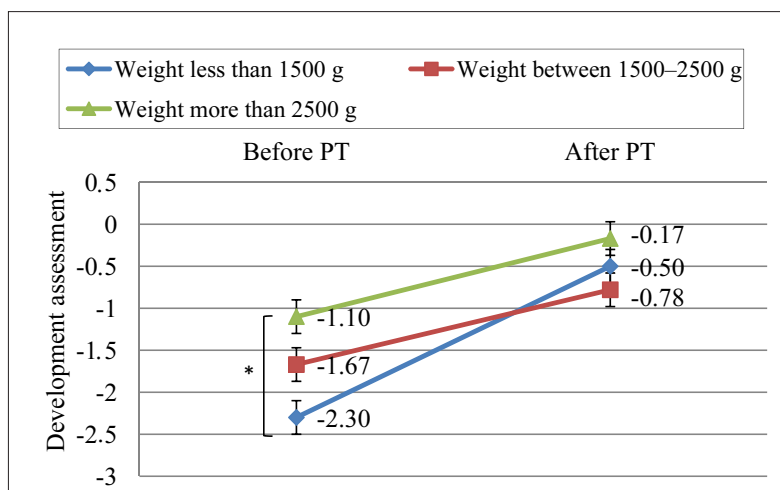
Note. * – significant differences between groups $p < 0.05$.

Figure 3. Walking development evaluation in different birth weight infant groups



Note. * – significant differences between groups $p < 0.05$.

Figure 4. Grasping up development evaluation in different birth weight infant groups



Note. * – significant differences between groups $p < 0.05$.

year of life and it affects psychomotor development. Many authors argue that early physical therapy can produce good results even for babies with severe disorders (Gorter et al., 2009). I. Rimdeikienė et al. (2008) claims that very low and low weight infant development is worse than that of normal birth weight babies, and our research showed the same. A. Scianni (2009), I. Rimdeikienė (2008) proved that motor development accelerated after applying physical therapy for very low, low and normal birth weight babies. Our results showed that physical therapy improved motor development for infants with specific motor development function delay and muscle spasticity.

Many authors agree that physical therapy in first year of life is particularly important for child development. Our results showed that before physical therapy normal birth weight infant's motor development was better than that of very low and low birth weight infant's motor development. However, no one showed normal development according to Munich Function Development Diagnostic Assessment even before or after physical therapy. However, the biggest development changes after physical therapy were observed in very low birth weight infants. We think that motor development of such babies is better because all systems developing very fast, and physical therapy is very important, too.

Motor development of normal and very low weight babies: crawling, sitting, walking and

grasping significantly improved after physical therapy. Low weight group improvement was observed just in grasping development ($p < 0.05$).

Summarizing the results we suggest that specific motor development function delay and muscle spasticity different of birth weight babies before physical therapy was significantly different in motor function – crawling, sitting, walking and grasping was dependent on birth weight). After physical therapy we noticed 80% of motor development improvement for very low birth weight, 45% development improvement for low birth weight, and 60% development improvement for normal weight infants.

Finally we would like to suggest to start physical therapy as soon as possible for babies with very low and low birth weight.

CONCLUSIONS AND PERSPECTIVES

Summarizing the results we noticed 80% motor development improvement for very low birth weight, 45% development improvement for low birth weight, and 60% development improvement for normal weight infants. Future research is needed to ascertain whether a specific developmental disability movement persists in school-age children.

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KINEZITERAPIJOS POVEIKIS SKIRTINGO GIMIMO SVORIO KŪDIKIŲ JUDAMAJAI RAIDAI

Margarita Senkutė, Ernesta Sendžikaitė, Alfonsas Vainoras

Lietuvos sveikatos mokslų universitetas, Medicinos akademija, Kaunas, Lietuva

SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Tyrimas buvo atliekamas norint išsiaiškinti kineziterapijos poveikį skirtingo gimimo svorio kūdikiams, kuriems diagnozuotas specifinis judamosios funkcijos raidos sutrikimas ir raumenų hipertonusas. Iškėlė hipotezę, kad kineziterapija paveiks kūdikių judamąją raidą nepriklausomai nuo jų gimimo svorio.

Tikslas – įvertinti skirtingo gimimo svorio kūdikių judamąją raidą prieš kineziterapiją ir po jos.

Metodai. Buvo taikoma „Miuncheno funkcinė raidos diagnostika. Pirmieji gyvenimo metai“. Ši skalė padeda pirmaisiais gyvenimo mėnesiais įvertinti pagrindines judamąsias funkcijas: ropojimą, sėdėjimą, vaikščiojimą, griebimą ir kalbos suvokimą, kalbėjimą ir socialinę raidą. Taip pat šis vertinimo būdas padeda pakankamai anksti atpažinti galimus sutrikimus ir suteikti kūdikiui reikiamą pagalbą. Mūsų tyrimo rezultatai buvo palyginti su vertinimo standartu.

Rezultatai. Tyrimas parodė, kad prieš kineziterapiją labai mažo ir normalaus gimimo svorio kūdikių ropojimo, sėdėjimo, vaikščiojimo ir griebimo raida statistiškai patikimai skyrėsi, skirtumas pastebėtas ir palyginus labai mažo bei mažo gimimo svorio kūdikių vaikščiojimo raidą ($p < 0,05$). Po kineziterapijos nustatyta, kad ropojimo ir sėdėjimo raidos įvertinimas nesiskyrė labai mažo bei normalaus gimimo svorio kūdikių grupėse ($p < 0,05$), o vaikščiojimo ir griebimo raidos įvertinimas nesiskyrė palyginus tiek labai mažo, mažo, tiek normalaus svorio kūdikių grupes ($p > 0,05$).

Aptarimas ir išvados. Apibendrinus tyrimo rezultatus galima teigti, kad kūdikių, kuriems diagnozuotas specifinis judamosios funkcijos raidos sutrikimas ir raumenų hipertonusas, judamųjų funkcijų (ropojimo, sėdėjimo, vaikščiojimo, griebimo) įvertinimai prieš kineziterapiją skyrėsi priklausomai nuo gimimo svorio, o po kineziterapijos vertintų judamosios raidos komponentų pagerėjimas nustatytas 80% labai mažo gimimo svorio, 45% mažo gimimo svorio ir 60% normalaus gimimo svorio kūdikių.

Raktažodžiai: specifinis judamosios funkcijos raidos sutrikimas, raumenų hipertonusas.

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Corresponding author **Margarita Senkutė**
Lithuanian University of Health Sciences,
Medical Academy
Jankaus str. 2, LT-50275 Kaunas
Lithuania
Tel +370 61187035
E-mail margariux@gmail.com

THE INFLUENCE OF CRYOTHERAPY ON THE LOWER LIMB SPASTICITY FOR CHILDREN WITH CEREBRAL PALSY

Saulė Sipavičienė¹, Antanas Damašauskas², Irina Klizienė³, Gražina Krutulytė¹,
Aiva Karpavičienė¹, Tadas Česnaitis⁴

Lithuanian Academy of Physical Education¹, Kaunas, Lithuania

Vilijampolė Social Care Homes², Kaunas, Lithuania

Kaunas University of Technology³, Kaunas, Lithuania

Hospital of Lithuanian University of Health Sciences Kauno Klinikos⁴, Kaunas, Lithuania

ABSTRACT

Research background and hypothesis. Cryotherapy could reduce spasticity for children with cerebral palsy.

Research aim. The aim of this study was to determine the effect of cryotherapy on the lower limb spasticity for children with cerebral palsy.

Research methods. Fourteen children with cerebral palsy spastic Diplegia aged 6–12 years were examined. The procedures of cryotherapy and physical therapy were applied to children in the test group (n = 7), and only physical therapy – for the members in the control group (n = 7). For all the subjects, the following procedures were performed before and after the research: foot extension measurements, the determination of the spasticity of flexors and selective foot motion, the estimation of balance and gross motor functions.

Research results. After physical exercises foot extension showed improvement, spasticity of foot flexors reduced, foot selective movements, balance and gross motor functions improved. There was no statistical difference between the results in both groups.

Discussion and conclusions. The influence of cryotherapy on the lower limb spasticity for children with cerebral palsy was not statistically significant.

Keywords: spasticity, cryotherapy, physical exercises.

INTRODUCTION

It has been estimated that there are more than 15 million people with cerebral palsy (CP) in the world. According to PSO statistical data, CP is diagnosed for 1–2 cases of 1000 living newborn children. However, the prevalence of CP in different countries varies – 1.5–2.5 cases for 1000 newborns (Paneth et al., 2006).

Spastic CP is the most common type of Cerebral Palsy with about 70–80% of all diagnosed cases (Nordmark et al., 2001). It is the most common cause of children disability that limits movements and thus distorts their social functioning. Therefore,

one of the main challenges in the treatment of such children is the reduction of spasticity.

Despite the fact that CP is incurable, the development of medical technology holds forth a hope that the disability caused by neurological impairment would sooner or later be reduced or overcome. The pursuance of non-pharmaceutical remedies for the treatment of CP leads to an increased consideration of physical factors. Cooling is one of it (Lee et al., 2002). Much information has been recently gathered on the positive dosed direct physical, reflex and neurohumoral effect of cooling

on the human body. Research literature review shows that the method of cryotherapy for reducing spasticity for children with a CP form has not been investigated enough.

The aim of this research was to determine the effect of cryotherapy on the lower limb spasticity for children with cerebral palsy.

RESEARCH METHODS

Subjects. The study included fourteen 6–12-year-old children with CP spastic Diplegia. The subjects were randomly subdivided into two groups. According to the children's age, both the test and the control groups were homogeneous: $p = 0.871$. In accordance with the gross motor functional classification (Palisano et al., 2007), the first and the second functional levels were determined to all research participants. The study was carried out following the ethical principles of biomedical research outlined in the Declaration of Helsinki.

The procedures of cryotherapy and physical therapy were applied to the children in the test group, and only physical therapy – for the members of the control group.

Measuring foot extension. In order to evaluate the subjects' passive shinbone foot joint movements, the foot extension was performed using goniometer. The measures were taken while the subject was sitting on a couch with their legs bent down at 90° angle. The measurement plane was sagittal; the measurement axis was underside the foot, the immobile part of goniometer was placed along the fibula, and the mobile part – along the fifth *ossa pedis*. The initial position of shinbone foot joint was its anatomical position (0° angle movement in a joint) (Latella, Meriano, 2003).

Foot flexing muscle spasticity evaluation. While evaluating the spasticity of foot flexors, the 6-point modified “Ashworth scale of Muscle Spasticity” (MAS) was applied: passive shinbone foot joint flexion and extension movements at the average pace were performed and resistance was estimated (Mutlu et al., 2008).

Selective foot motion determination. For the determination of selective foot motion we applied the methodology suggested by R. Boyd and H. Graham (1999). The voluntary active movement of feet extension was evaluated on a 5-point scale while the subject was lying on his back on a couch (Boyd, Graham, 1999).

Measuring balance. For the evaluation of the subjects' balance, the children's balance scale was used (Franjoine et al., 2003).

Measuring gross motor functions. Gross motor functions were measured applying the gross motor function scale for children with CP (Russell et al., 2002).

Cryotherapy. Massage of the dorsal part of shins using ice-cubes was applied, as well as 10-minute massage for one limb, once a day, 5 times a week.

Physical therapy program applied. All subjects had 30 minutes of physical exercises once a day, 5 times per week (20 procedures in total).

The program of physical therapy included: normalisation of muscle tonicity by mobilising soft tissues (Manheim, 2008), activation of weak muscles emphasizing the intensifying strength of femoral and foot muscles (Damiano et al., 2008); the expansion of movement amplitude, the improvement of joint mobility applying stretching exercises, the improvement of trunk control (the activation of trunk muscles, the stimulation of tone muscles, the inhibition of compensatory movements, the rehabilitation of neutral trunk physiologic position) (Bobath B., Bobath K., 1990), the development of balance reactions and variability of movement under different conditions (Freeman, 2007); the amplification of foot and tarsus stability while standing and walking (training of physical support and step-phase), the development of gait components in a changing environment.

The research protocol. For all the subjects, the following procedures were performed before and after the research: foot extension measurement, determination of the spasticity of flexors and selective foot motion, estimation of balance and gross motor functions.

Statistical analysis. The research data were processed using *SPSS 13.0* computer program. We used the Pearson's Chi square (χ^2) criterion for the verification of qualitative variable relation hypothesis. For the assessment of the target indications arithmetic averages and their errors were calculated. The Shapiro–Wilc test was used to verify the regularity of continuous variable distribution. In order to identify the differences between two independent groups, we used the Mann-Whitney U test; between related groups – Wilcoxon criteria. While verifying statistical hypothesis, the following significance levels were

applied: * – $p < 0.05$ (significant); ** – $p < 0.01$ (very significant).

RESEARCH RESULTS

After the assessment of goniometric measurements it was ascertained that in both the test and the control groups the measurements of foot extension taken before and after the physiotherapy were statistically different (in the test group – $p < 0.01$, and in the control group – $p < 0.05$).

Changes in feet extension measures were observed in the test group: 1.90 ± 0.68 degrees (right foot) and 1.30 ± 0.72 degrees (left foot). The test group after physical exercises and cryotherapy procedures showed greater changes in feet extension measures than the group which had only physical exercises. However, the difference

between the control and the test groups was not statistically significant (Figure 1).

Changes in the spasticity of feet flexors in the test group were greater and statistically significant ($p < 0.05$): 0.4 ± 0.32 points (right foot) and 0.40 ± 0.32 points (left foot). The change in the control group was less and statistically insignificant: 0.2 ± 0.26 points (right foot) and 0.40 ± 0.32 points (left foot). However, the difference between the control and the test groups was not statistically significant (Figure 2).

Changes in selective feet movement measurements in the test group were greater and statistically significant: ($p < 0.05$): 0.40 ± 0.32 points (right foot) and 0.50 ± 0.33 points (left foot). The changes in the control group were less and statistically insignificant: 0.20 ± 0.16 points (right foot) and 0.20 ± 0.16 points (left foot). The

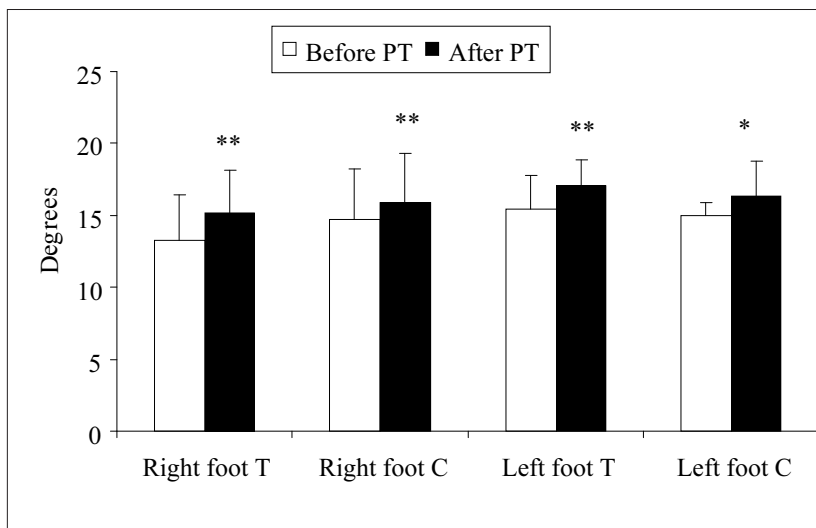


Figure 1. Changes in feet extension measures observed in the control (C) and the test (T) groups

Note. * – $p < 0.05$ and ** – $p < 0.01$ compared to the values before and after physiotherapy (PT).

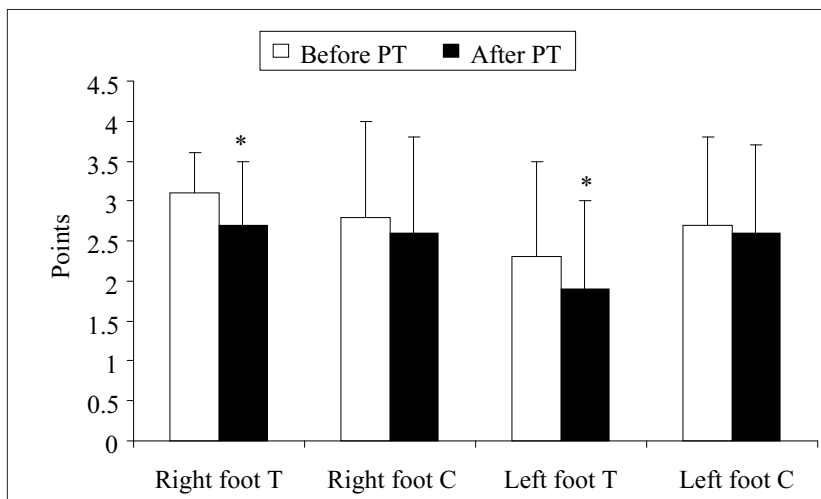
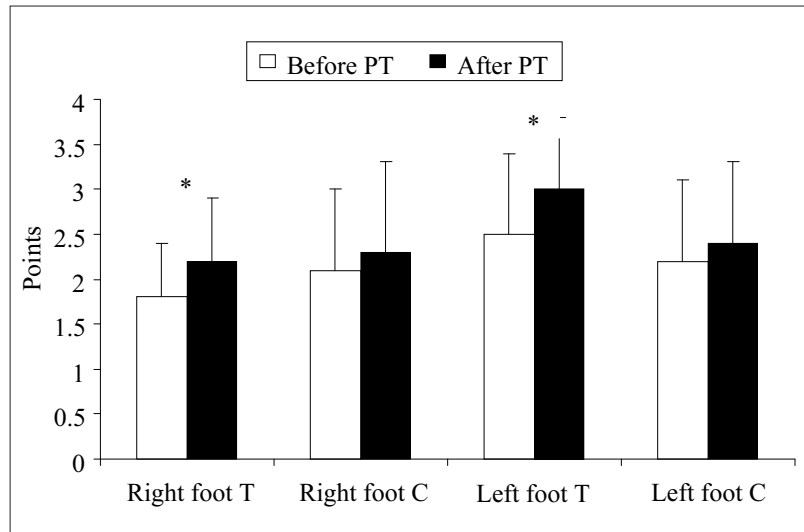


Figure 2. Changes in the spasticity of foot flexors in the control (C) and the test (T) groups

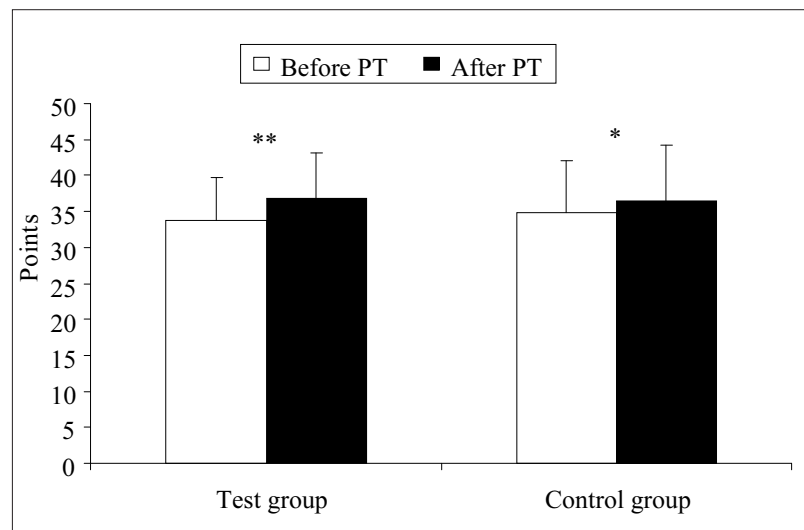
Note. * – $p < 0.05$ compared to the values before and after physiotherapy (PT).

Figure 3. Changes in selective feet movement measurements in the control (C) and the test (T) groups



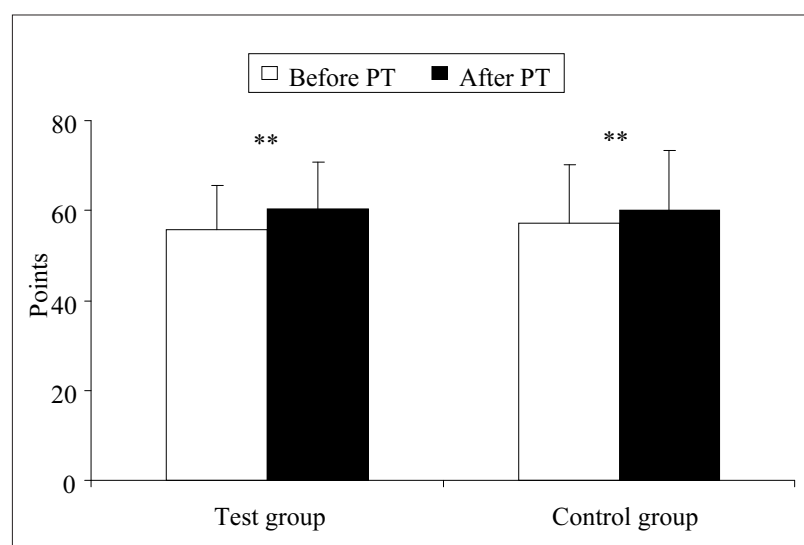
Note. * – $p < 0.05$ compared to the values before and after physiotherapy (PT).

Figure 4. Changes in balance evaluation values in the control and the test groups



Note. * – $p < 0.05$ and ** – $p < 0.01$ compared to the values before and after physiotherapy (PT).

Figure 5. Changes in gross motor function measurements by general scale in the control and the test groups



Note. ** – $p < 0.01$ compared to the values before and after physiotherapy (PT).

difference between the control and the test groups was statistically insignificant (Figure 3).

Changes in the evaluation of balance in the test group were 3.00 ± 0.77 points ($p < 0.01$), whereas in the control group they were 1.60 ± 0.67 points ($p < 0.05$). The test group which had undergone cryotherapy procedures and physical exercises showed greater changes in balance evaluation measurements than the group which had only physical exercises. However, the difference between the control and the test groups was statistically insignificant (Figure 4).

Changes in the gross motor function measurements by general scale were greater in the test group: 4.73 ± 0.85 points ($p < 0.01$), whereas in the control group they were 2.80 ± 0.33 points ($p < 0.01$). However, the difference between the control and the test groups was statistically insignificant (Figure 5).

DISCUSSION

The main findings of our study are: 1) after physical therapy programs foot extension of children with CP showed improvement, spasticity of foot flexors reduced, foot selective movements, balance and gross motor functions improved; 2) comparing the effectiveness of different physical therapy programs it was determined that there was no statistical difference between the results in both groups.

Much research has been carried out to evaluate the influence of physiotherapy on children with spastic CP. It has been shown that physical exercises normalize muscle tone (Akbarak et al., 2005.; Salem et al., 2010), increase the amplitude of movements (Dimitrijevic et al., 2007; Damiano et al., 2010), improve balance (Katz-Leurer et al., 2009) and gross motor functions (Eek et al., 2008; Lee et al., 2008). We were unable to find any research about the influence of cryotherapy on the spasticity of lower limbs of children with spastic CP.

The sample included 1 and 2 functional-level children who were able to move individually or with a little help, and their feet amplitude was slightly irregular. Measures of foot extension increased in both groups, however, no significant and reliable changes were found between the test group which had cryotherapy procedures (cryomassage) combined with physical exercises and the control group which did only physical exercises.

Evaluation measures of balance and gross motor functions improved in both groups; however,

no statistically significant difference between these groups was observed.

The analysis of our results showed that after 20 procedures there was a difference between the influence of different physiotherapy programs on the spasticity of foot flexors and selective foot movements in the test and the control groups. The difference in the research data (before and after physiotherapy) was statistically significant only in the test group. In the control group and between both groups no statistically significant differences were observed. Additional intervention is required when physiotherapy is not effective enough. Spasticity is usually treated when it causes loss of function, contracture, deformations, and pain. Application of cryotherapy for affected muscles at appropriate intervals, time-span and temperature reduces pain and spasticity (Stepanchenko et al., 1988; Allison, Abraham, 2001). When cooling, pain receptors located in the skin reduce sending response to CNS, consequently pain is reduced. The purpose of all healing procedures is to reduce extension reflex. Cryotherapy results in reducing monosynaptic extension reflexes and sensitivity of receptors, shaping mediators' influence on reflex arc synapses, blocking neuromuscular junction or motor nerve, which composes reflex arc. This effect lasts even after the cryotherapy procedure (Draper, Knight, 2007).

To achieve the desired result without any damage, one must know the following about the application of cooling (Knight, 1995): physiological effect, side effect, technique of application, affected area, the length of treatment, the number of procedures per day, per week and the total number of procedures.

CONCLUSIONS AND PERSPECTIVES

To sum up, it is worth noting that both physical therapy programs (combining cryotherapy with physical exercises and performing only physical exercises) had a significant positive effect, however, the effect was not the same.

An important problem in evaluating the effectiveness of physiotherapy is lack of objective research instruments which would help to identify even slight changes in motor function. Children with CP may show an improvement in motor skills but research instruments not always can identify it (Majnemer, Mazer, 1995). Examining

such children, large population heterogeneity and inadequate number of subjects have been noticed which caused statistical inadequacies (Grimm, 2000). The mentioned problem was relevant to this research, too.

In conclusion, our findings suggest that the influence of cryotherapy on the lower limb spasticity for children with cerebral palsy was not statistically significant.

Statement of conflict of interest. The authors report no conflict of interest.

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KRIOTERAPIJOS POVEIKIS VAIKŲ, SERGANČIŲ CEREBRINIŲ PARALYZIUMI, KOJŲ SPAZMIŠKUMUI

Saulė Sipavičienė¹, Antanas Damašauskas², Irina Klizienė³, Gražina Krutulytė¹,
Aiva Karpavičienė¹, Tadas Česnaitis⁴

Lietuvos kūno kultūros akademija¹, Kaunas, Lietuva

Viljampolės socialinės globos namai², Kaunas, Lietuva

Kauno technologijos universitetas³, Kaunas, Lietuva

Lietuvos sveikatos mokslų universiteto ligoninė Kauno klinikos⁴, Kaunas, Lietuva

SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Krioterapija gali sumažinti vaikų, sergančių cerebriniu paralyžiumi, kojų spazmiškumą.

Tikslas – nustatyti krioterapijos poveikį vaikų, sergančių cerebriniu paralyžiumi, kojų spazmiškumui.

Metodai. Tirti keturiolika 6–12 metų amžiaus vaikai, kuriems diagnozuota cerebrinio paralyžiaus spazminė diplegija. Kontrolinei vaikų grupei (n = 7) taikyti fiziniai pratimai, tiriamajai (n = 7) – fiziniai pratimai, derinami su krioterapija. Prieš taikytas procedūras ir po jų matuotas visų tiriamųjų pėdos tiesimas, vertinti pėdos selektyvūs judesiai, pėdos lenkiamųjų raumenų spazmiškumas, pusiausvyra ir stambiosios motorikos funkcijos.

Rezultatai. Po fizinių pratimų pagerėjo tiriamųjų pėdos tiesimas, sumažėjo pėdos lenkiamųjų raumenų spazmiškumas, pagerėjo pėdos selektyvūs judesiai, pusiausvyra ir stambiosios motorikos funkcijos. Tarp tiriamosios ir kontrolinės grupės rezultatų statistiškai patikimas skirtumas nenustatytas.

Aptarimas ir išvados. Krioterapijos poveikis vaikų, sergančių cerebriniu paralyžiumi, kojų spazmiškumui statistiškai nereikšmingas.

Raktažodžiai: spazmiškumas, krioterapija, fiziniai pratimai.

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Corresponding author **Saulė Sipavičienė**
Lithuanian Academy of Physical Education
Sporto str. 6, LT-44221 Kaunas
Lithuania
Tel +370 61117191
E-mail s.sipaviciene@lkka.lt

RELATIONSHIP BETWEEN 12–16-YEAR-OLD ATHLETES' SELF-ESTEEM, SELF-CONFIDENCE AND BULLYING

Iloņa Tilindienė, Giedrė Judita Rastauskienė, Aida Gaižauskienė, Tomas Stupuris
Lithuanian Academy of Physical Education, Kaunas, Lithuania

ABSTRACT

Research background and hypothesis. Previous research has proved that children engaged in sports easier integrate into the society and their psychological well-being is much higher, sports activities can help them resist to the harmful influence of their peers and prevent them from engaging into delinquent behavior. However, there still is a lack of a studies providing evidence about factors that determine the expression of compulsion. *Hypothesis:* The level of self-esteem and self-confidence of adolescent athletes influences the occurrence of bullying and the initiation of it.

Research aim was to disclose the relationship between the level of adolescent athletes' self-esteem, self-confidence and the occurrence of bullying.

Research methods. The study applied I. Shostrom's modified self-esteem scale questionnaire and the adapted Bullying Scale for Schoolchildren.

Research results. Results showed a weak correlation between bullying and self-esteem levels ($\gamma = 0.24$; $p > 0.05$). We found a weak adverse relationship between initiating bullying and self-assessment levels ($\gamma = -0.16$; $p > 0.05$), weak adverse correlation between experienced bullying and self-confidence levels ($\gamma = -0.15$; $p > 0.05$) and a weak linear relationship between initiating bullying and self-confidence ($\gamma = 0.20$; $p > 0.05$).

Discussion and conclusions. Contrary to what we expected, we observed that athlete adolescents with the high levels of self-esteem suffered from bullying sometimes and often. Research findings suggest that adolescents who tend to initiate bullying demonstrated moderate and low levels of self-esteem. Most of athlete adolescents admitted that that did not initiate bullying or if they did, that was done only occasionally. It was found that adolescents with high and moderate self-confidence levels experienced bullying occasionally or not at all. Some athletes with low self-confidence levels professed that they suffered from bullying more often, and they also admitted that they often initiated bullying themselves. In our research we were unable failed to provide evidence which would prove that sports activities impacted or influenced adolescents' bullying initiatives or experiences; therefore further research is needed to determine whether self-esteem and other internal personality qualities could affect the expression of bullying among non-athlete adolescents.

Keywords: aggression, adolescents' self- assessment, self-confidence.

INTRODUCTION

Peculiarities of bullying conception and its manifestation have recently received much attention from scholars in different countries (Olweous, 1993; Arora, 1996), the data on the scope of the prevalence of bullying have been compared (Dake et al., 2003) going deep into the understanding the differences in the aspect of age, gender and classmate intercourse related to bullying experience (Pellegrini, Long, 2002), ethnic reliance

and other differences (Seals, Young, 2003); bullying initiatives and their victim characteristics have been explored (Olweous, 1993). Research literature has evidence of the nature of bullying among adolescents (Due et al., 2005; Fleming, Jacobsen, 2009) as well as its relation with tobacco and alcohol consumption (Morris et al., 2006), probability suicidal behavior (Van der Wal et al., 2003), anxiety, and low self-esteem (Currie et al., 2004, cit. from Širvinskienė et al., 2008).

Thereby research has proved the dependence of self-esteem on the nature of interaction with peers (Burnett, 2006), psychological class environment (Maxwell, Chmielewski, 2007); researchers emphasize that adolescents' wellbeing at school is closely related to self-esteem (Andziulytė, Beresnevičienė, 2005). Dž. Valeckienė (2005) suggests that children's self-esteem decreases while suffering bullying, and to recover their self-esteem they take the same way engaging in bullying on more vulnerable kids than they are.

Meanwhile sport activities are evaluated positively activity while speaking about the development of self-esteem and self-confidence because children involved in such activities are able to know themselves better and they can get better feedback about their skill development while interacting with the peers and adults, especially their coach (Vainienė, Kardelis, 2008). Previous research has proved that children engaged in sports easier integrate into the society and their psychological well-being is much higher, sports activities can help them resist to the harmful influence of their peers and prevent them from engaging into delinquent behavior (Nieman, 2002).

However, there still is a lack of a studies providing evidence about factors that determine the expression of compulsion. Therefore, our *problem question* is whether the level of self-esteem and self-confidence of adolescent athletes influences the occurrence of bullying and the initiation of it.

Hypothesis: The level of self-esteem and self-confidence of adolescent athletes influences the occurrence of bullying and the initiation of it.

The aim of the research was to disclose the relationship between the level of adolescent athletes' self-esteem, self-confidence and the occurrence of bullying. **Research object** was the relationship between level of self-esteem, self-confidence and the occurrence of bullying among adolescents.

RESEARCH METHODS

Instrument. The study applied I. Shostrom's modified self-esteem scale questionnaire which included 26 items (Lester, Lloyd, 1997) and the adapted *Bullying Scale for Schoolchildren* with 11 open and closed questions (United Kingdom, York) (http://www.state.de.us/attgen/main_page/teachers/bullquesti.htm). Participants were told to choose one or several possible answers.

Procedure. The survey was carried out in 2009–2011. Using the random sampling strategy, 1036 athlete adolescents (12–16 years) from various secondary and sports schools of Lithuania were selected for the research after obtaining institutional approval from the schools. The participants no less than two times per week attended sports practice sessions at sports schools or clubs and no less than for one year they had been participating in competitions.

Statistical analysis. The research data were analyzed using Statistical Software Package for Windows SPSS 13.0; χ^2 was calculated to define statistically significant differences between groups. Statistical significance of differences was set at $p < 0.05$. Gamma coefficient was included to assess the level of the relationship between self-esteem, self-confidence and bullying.

RESEARCH RESULTS

Self-esteem scale employed in the research was developed according to I. Shostrom's method modifying the items. Adolescents were asked to evaluate 22 items, but the final analysis included 16 qualities statistically significantly describing adolescents' self-esteem and self-confidence peculiarities.

Factor analysis revealed two factors which were significant and explained 20.14% of variance (Table). Based on these factors components of self-esteem and self-confidence were disclosed.

Contrary to what we expected, we found that adolescent athletes with high levels of self-assessment suffered from bullying sometimes or often, whereas subjects who had low self-esteem suffered from bullying sometimes or not at all (Figure 1) ($\chi^2(2) = 8.420$; $p > 0.05$). A weak correlation was found between bullying and the level of self-esteem ($\gamma = 0.24$; $p > 0.05$).

Our findings showed that adolescents who tended to initiate bullying demonstrated medium and low levels of self-assessment although there were not many of such respondents. The majority of athlete adolescents indicated that they would never initiate bullying or they did that occasionally. Statistically significant difference in self-assessment levels between these adolescents was established (Figure 2) ($\chi^2(2) = 0.831$; $p > 0.05$). However, we found a weak adverse correlation between initiating bullying and the level of self-assessment ($\gamma = -0.16$; $p > 0.05$).

It was established that most adolescents characterized by medium and high self-confidence levels indicated that they suffered from bullying occasionally, although those denied being bullied had little confidence in themselves. About eight percent of athlete adolescents with low levels of self-confidence stated that they suffered from bullying quite often (Figure 3) ($\chi^2 (2) = 3.47$;

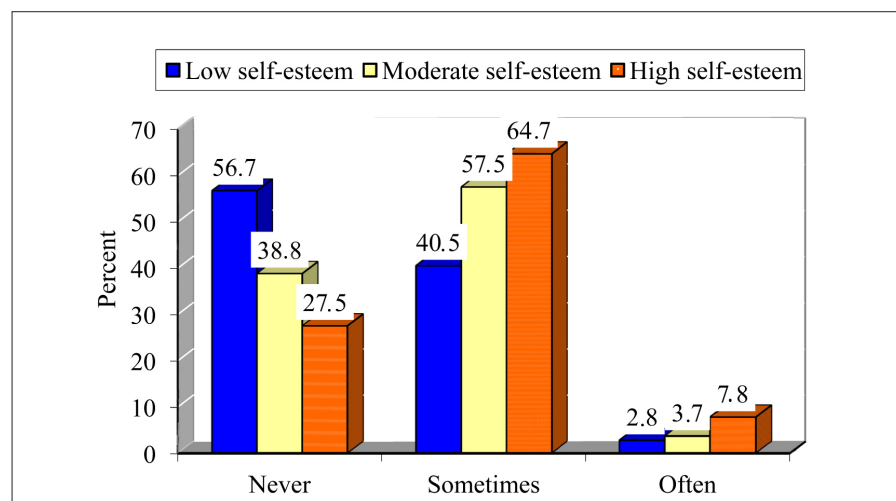
$p > 0.05$). We found a weak adverse correlation between being bullied and self-confidence levels ($\gamma = -0.15$; $p > 0.05$).

The study showed that adolescents characterized by both low and high levels of self-confidence admitted that they never initiated bullying. Among those who initiated bullying occasionally mostly were athletes with moderate self-confidence levels, and most adolescents with

Table. Items featuring self-esteem and self-confidence, factor loadings

Items	Factor 1	Factor 2
I am not afraid of difficulties, I believe I can solve all problems while achieving my goals	0.653	
I believe I will do everything perfectly whatever I have to do	0.598	
My marks do not say anything about me and my abilities	0.475	
I have enough wisdom and abilities compared to others for implementing my plans	0.738	
My opinion is firm enough compared to that of others	0.641	
I can easily get in to contact with any wise person	0.632	
I believe I am a wise and reliable adviser for myself	0.629	
I live my life independently on my classmates as much as possible	0.501	
Lack of will is the reason I cannot achieve my goals		0.653
I am a confident person, I believe I have control over my destiny	0.580	
In complicated situations I do not expect that problems will be solved by themselves	0.538	
I believe that circumstances are the reason of my failures more often than I myself		0.422
I often ridicule myself		0.461
By peers believe that I am a totally reliable person in serious matters	0.532	
I am not as respected as my peers		0.725
I feel worse than my other classmates		0.665
Factor dispersion	27.16%	13.12%

Figure 1. Percentage distribution of bullying experienced by athlete adolescents demonstrating different self-esteem levels



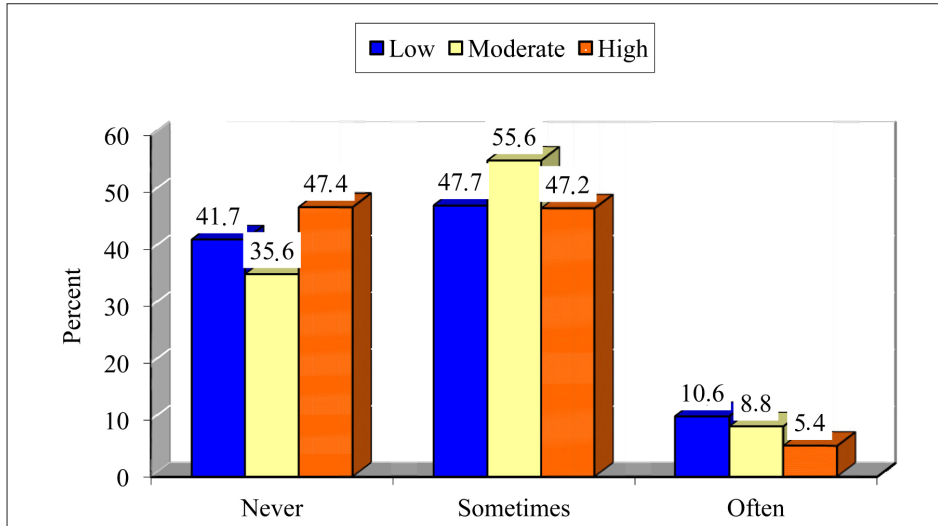


Figure 2. Percentage distribution of bullying initiated by athlete adolescents demonstrating different self-esteem levels

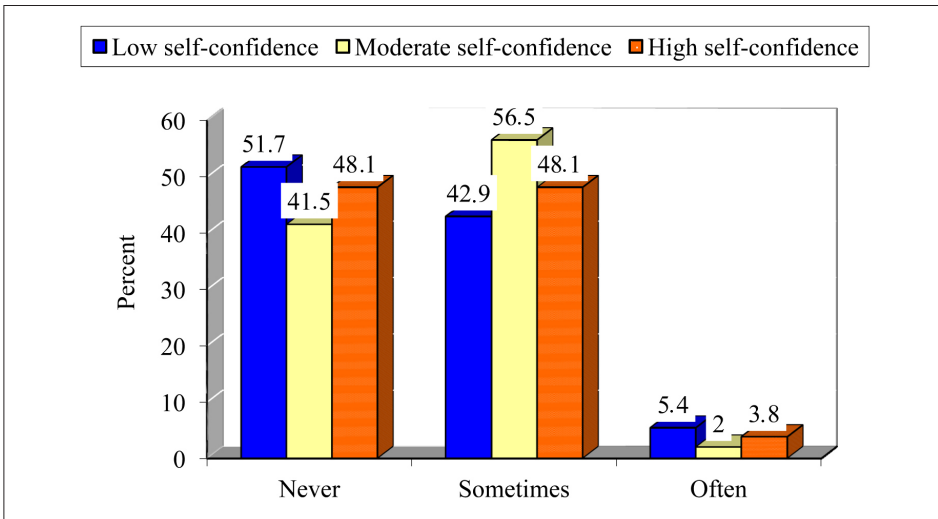
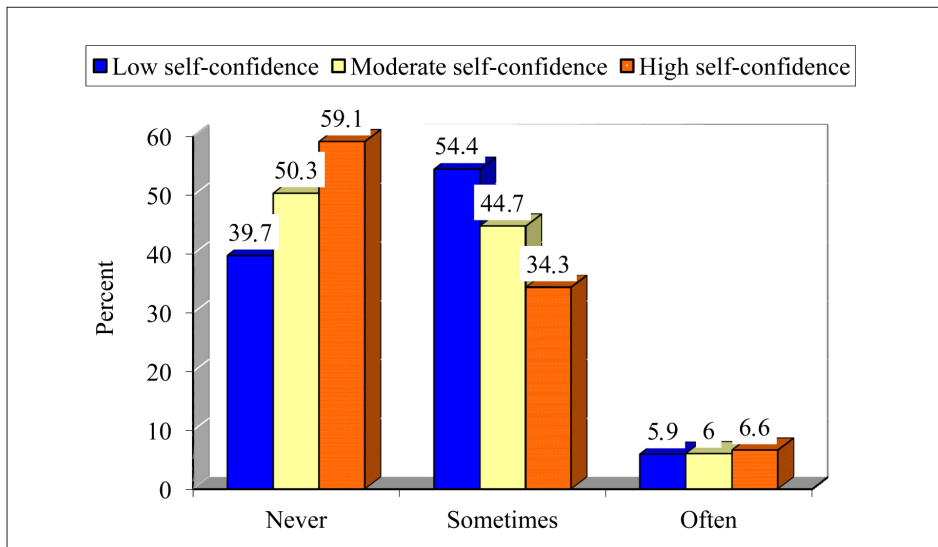


Figure 3. Percentage distribution of bullying experienced by athlete adolescents demonstrating different self-confidence levels



4 figure. Percentage distribution of bullying initiated by athlete adolescents demonstrating different self-confidence levels

low levels self-confidence confessed that they initiated bullying rather often ($\chi^2 (2) = 4.01$; $p > 0.05$) (Figure 4). Our findings suggested a weak linear correlation between initiating bullying and self-confidence levels ($\gamma = 0.20$; $p > 0.05$).

DISCUSSION

The results obtained showed that athlete adolescents characterized by high levels of self-confidence suffered from bullying occasionally or more often. These findings contradict to a lot of studies suggesting that athlete adolescents are more confident in themselves and their popularity levels among classmates are rather high (Dunn Causgrove et al., 2008), therefore appreciation gained consolidate respect for them among their peers (Bump, 2000) as well as higher social integration (Šukys, Jankauskienė, 2008); thus they experience bullying much less. For instance, J. Dunn Causgrove et al. (2008) established that athlete adolescents were ranked high in their popularity among their classmates, therefore they experienced less bullying and they demonstrated better social integration (Šukys, Jankauskienė, 2008).

Researchers have found that most adolescents initiating bullying are distinguished by moderate and low levels of self-esteem. R. Prakapas (2001) observed that pupils expressed aggression because of the fear and un-confidence towards themselves because they did not respect themselves and expecting to earn respect of others in this way.

Most of athlete adolescents stated that they did not initiate bullying or if they did, it was done occasionally. Thus, we can assume that self-confident adolescents understand the harm of bullying to victims and other children, or they are engaged in more meaningful activities than bullying. A. Pellegrini, J. D. Long (2002) established that adolescents with higher levels of self-esteem significantly more seldom tended to get involved into bullying because they knew other ways to earn respect from other people.

In our research we were unable failed to provide evidence which would prove that sports activities impacted or influenced adolescents' bullying initiatives or experiences. Research carried out by R. Jankauskienė et al. (2008) showed that involvement in sports activities had no effect on bullying behavior; however, more victims of bullying were found among non-athlete adolescents than athletes.

Some athletes with low levels of self-confidence admitted that they suffered from bullying often, but they also confessed that they often initiated bullying themselves. This research once again has confirmed the assumption proposed in research literature (Nixon, 1997; Stephens, 2001) that athletes tend to transfer their aggression developed in sports activities into the daily life. On the basis of this finding we can reasonably hypothesize that persons involved in sports activities could be more aggressive outside their sports activities as well.

CONCLUSIONS AND PERSPECTIVES

Contrary to what we expected, we observed that athlete adolescents with the high levels of self-esteem suffered from bullying sometimes and often. Research findings suggest that adolescents who tend to initiate bullying demonstrated moderate and low levels of self-esteem. Most of athlete adolescents admitted that that did not initiate bullying or if they did, that was done only occasionally. It was found that adolescents with high and moderate self-confidence levels experienced bullying occasionally or not at all. Some athletes with low self-confidence levels professed that they suffered from bullying more often, and they also admitted that they often initiated bullying themselves. In our research we were unable failed to provide evidence which would prove that sports activities impacted or influenced adolescents' bullying initiatives or experiences; therefore further research is needed to determine whether self-esteem and other internal personality qualities could affect the expression of bullying among non-athlete adolescents.

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SAVĖS VERTINIMO, PASITIKĖJIMO SAVIMI IR PATYČIŲ SĄSAJOS TARP 12–16 METŲ SPORTININKŲ

Ilona Tilindienė, Giedrė Judita Rastauskienė, Aida Gaižauskienė, Tomas Stupuris
Lietuvos kūno kultūros akademija, Kaunas, Lietuva

SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Tyrimais įrodyta savęs vertinimo priklausomybė nuo bendravimo pobūdžio su bendraamžiais, klasės psichologinės aplinkos. Teigiama, kad kęsdamas patyčias vaikas pradeda žemai save vertinti, norėdamas susigrąžinti savęs vertinimą, jis tyčiojasi iš silpnesnių nei jis pats. Tyrimai rodo, kad fiziškai aktyvūs vaikai lengviau integruojasi į visuomenę ir geriau psichologiškai jaučiasi, sportinė veikla gali padėti paaugliams atsispirti žalingai bendraamžių įtakai bei stabdyti išitraukimą į nusikalstamą veiklą. Deja, prievartos raišką lemiančių veiksnių analizės tyrimų vis dar trūksta. *Hipotezė* – sportuojančių paauglių savęs vertinimo bei pasitikėjimo savimi lygmuo turi įtakos patyčių patyrimui ir jų inicijavimui.

Tikslas – nustatyti sportuojančių paauglių patyčių, savęs vertinimo ir pasitikėjimo savimi sąsajas.

Metodai. Tiriamesiems buvo pateikta I. Shostrom savęs vertinimo anketa ir adaptuota Patyčių anketa.

Rezultatai. Tarp patiriamų patyčių ir savęs vertinimo lygmens nustatyta silpna priklausomybė ($\gamma = 0,23$; $p > 0,05$), tarp inicijuojamų patyčių bei savęs vertinimo lygmens – atvirkštinė silpna priklausomybė ($\gamma = -0,17$; $p > 0,05$), tarp patiriamų patyčių bei pasitikėjimo savimi lygmens – atvirkštinė silpna priklausomybė ($\gamma = -0,15$; $p > 0,05$), tarp inicijuojamų patyčių ir pasitikėjimo savimi lygmens – tiesinė silpna priklausomybė ($\gamma = 0,19$; $p > 0,05$).

Aptarimas ir išvados. Aukšto savęs vertinimo sportuojantys paaugliai patyčias patiria kartais ir dažnai. Pastebėta, kad paaugliai, linkę tyčiotis iš kitų, yra vidutinio ir žemo savęs vertinimo. Daugiausia aukšto ir vidutinio pasitikėjimo savimi paauglių patyčias patiria kartais arba jų nepatiria. Dalis nepasitikinčių savimi sportininkų teigia, kad iš jų dažnai tyčiojamosi, jie pripažįsta ir patys dažnai inicijuojantys patyčias. Tyrimo metu nepavyko nustatyti, kad savęs vertinimo bei pasitikėjimo lygis turi įtakos patiriamoms bei inicijuojamoms patyčioms, todėl verta tęsti tyrimus norint patikrinti, ar savęs vertinimas bei kiti vidiniai asmenybės dariniai turės įtakos patyčių raiškai nesportuojančių paauglių populiacijoje.

Raktažodžiai: agresija, paauglių savimonė, pasitikėjimas savimi.

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Corresponding author **Ilona Tilindienė**
Lithuanian Academy of Physical Education
Sporto str. 6, LT-44221 Kaunas
Lithuania
Tel +370 37 302657
E-mail i.tilindiene@lkka.lt

PHYSICAL LOAD INTENSITY IN STANDARD AND LATIN AMERICAN SPORTS DANCING PROGRAMMES FOR JUVENILE DANCERS

Aistė Barbora Ušpurienė, Algirdas Čepulėnas
Lithuanian Academy of Physical Education, Kaunas, Lithuania

ABSTRACT

Research background and hypothesis. Sports dances at the contest intensity demand great athletic fitness and functional capacity from dancers. We still lack research about changes in the heart rate in the group of juvenile dancers' while dancing Standard and Latin American dances. The present study aims at verifying the hypothesis that while juvenile dancers dancing contest programmes, the heart rate is changeable and can reach to 160–190 beats/min and above, sports dancers consume much energy.

Research aim was to investigate changes in the heart rate and energy consumption in the group of juvenile dancers while dancing Standard and Latin American dances.

Research methods. The research participants were 16 dancers (8 girls and 8 boys). The age of girls was 9.88 (0.83) years, and that of boys – 9.86 (1.07) years. We established changes in the heart rate dancing Standard and Latin American dances. During continuous dancing we registered the heart rate using “Polar S 610” Heart Rate Monitor (Finland) with computer data registering system. According to the indices received from the heart rate monitor we calculated the average, maximal and minimal heart rate values and energy consumption (kcal) during the period of sports dancing programme.

Research results. The data of HR analysis showed that during a 10-min model practice session dancing Standard and Latin American dances, the heart rate which remains the longest is 160–190 beats/min. During Latin American dances, energy outlay for girls was greater than that for boys ($p < 0.05$), but lower compared to those when the girls danced the Standard programme.

Discussion and conclusions. In contest programmes of sports dancing, physical loads are of changing intensities and thus they have a big impact on the cardiovascular system of young dancers. At the threshold of anaerobic intensity, some moments of the dance are performed at greater intensity than the anaerobic threshold, and even critical intensity limit is reached.

Keywords Standard dances, Latin American dances, intensity of physical load, heart rate, energy consumption.

INTRODUCTION

Sports dancing is becoming more and more popular among children and adolescents. Even children start participating in sports dancing contests. Dance is one way of human communication, cognition and expression (Bannon, Sanderson, 2000; Lavender, Predock-Linnell, 2001; Smith-Autard, 2003). Dance offers a unique and rich world of meanings and values and develops children's aesthetic and artistic experience (Banevičiūtė, 2007). Sports dancing is a sport, but it is also an art. It

develops children's physical, aesthetic and musical abilities (Карпенко, Сивицкий, 2009). Dancers must be able to perform different movements, express themselves in space, express the rhythm and pace (Banevičiūtė, 2007). Movements are performed both in a locomotor way – while moving dancers move from one space to another – and in a non-locomotor way – staying in one place. Sports dances danced at the contest intensity demand good athletic fitness and functional capacity from dancers

(Faina, Bria, 2000; Kostić et al., 2003; Klonova, Klonovs, 2010; Радионов, 2011). In sports dancing athletes perform nonstandard dynamic movements at the changeable intensity, and their performance needs the mobilization of intensive activities of the cardiovascular and respiratory systems (Ekblöm et al., 1968; Blanksby, Reidy, 1988; Faina, Bria, 2000).

In the assessment of the impact of physical load in competitive activities, we should know the peculiarities of changes in the heart rate (HR) during the practice sessions and the competitions.

There is not much research analysing changes in the heart rate of dancers of different ages when they dance sports dances.

Research aim was to investigate changes in the heart rate and energy consumption in the group of juvenile dancers while dancing Standard and Latin American dances.

RESEARCH METHODS

The research sample included 16 juvenile dancers (eight pairs of dancers). The mean age (\bar{x} (SD)) of girls was 9.88 (0.83) years, and that of boys – 9.86 (1.07) years. The subjects corresponded to the mastery level of E6-D class. Some body composition indices of dancers are given in Table.

The intensity of the load during sports dancing practice was established using pulse meter “Polar S610i” (Finland). The heart rate (HR) of juvenile sports dancers was taken during the model practice sessions. We registered the heart rate at the intervals of 5 s and the energy outlay (kcal). The dancers performed the contest program of Standard and Latin American dances which lasted

for 10 min. Four dances were performed lasting 2 min with short breaks between them (up to 20 s). In the model practice sessions the dancers had to perform the contest programme not only at a high technical level, but also very artistically.

Research data were processed using methods of mathematical statistics and *Microsoft Office 2003* (Excel programme). We calculated arithmetic mean (\bar{x}), standard deviation (SD), the index of significance of difference *t* (Student’s *t* test), index of significance *p*, the level of significance – 95 %, when $p < 0.05$.

RESEARCH RESULTS

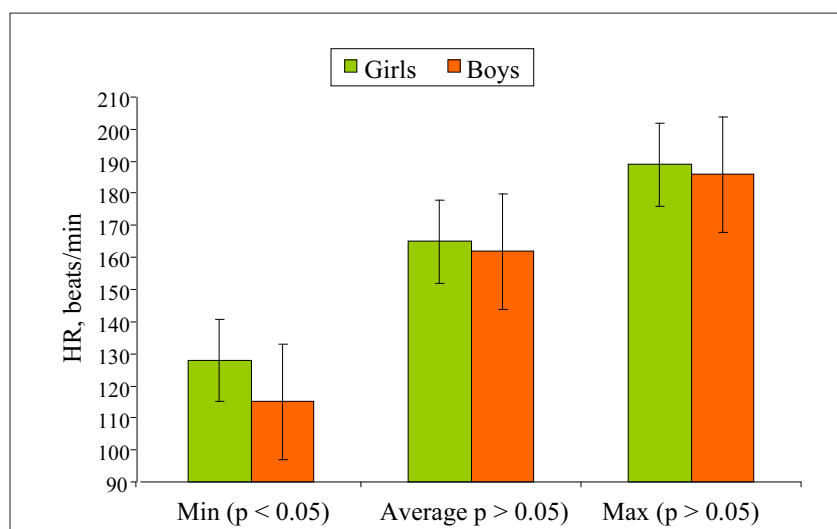
The body composition indices of dancers corresponded to the norms of children involved in sports (Волков, 2002).

Table. Body composition indices of juvenile sports dancers (\bar{x} (SD))

Dancers	Height, cm	Weight, kg	Body mass index, kg/m ²	Ketle index, g/cm
Girls	141.50 (6.28)	31.13 (5.14)	15.51 (2.08)	219.46 (31.71)
Boys	143.29 (7.70)	37.43 (7.32)	18.12 (2.62)	260.15 (43.08)

We established (Figure 1) that when four Standard sports dances were performed during the model practice session, 2 min each with short breaks between them, imitating the contest, HR increased to 189.50 (12.90) beats/min for juvenile girls dancers, and 186.75 (18.45) beats/min for boys. The mean value of the girls’ HR during a 10-min practice session was 165.45 (12.00) beats/min, and that of boys was 162.34 (13.22) beats/min.

Figure 1. Heart rate indices of juvenile sports dancers during the Standard dance contest programme



Energy outlay (Figure 2) differed during the 10-min dancing. Girls consumed 157.13(13.44) kcal, and boys – 109.22 (18.45) kcal.

The data of HR analysis (Figure3) show that during a 10-min model practice session dancing Standard dances HR was between 160 beats/min and 190 beats/min.

Girls compared to boys danced with a higher heart rate. The highest percentage distribution of girls' heart rate during Standard dances was as follows: 160 beats/min – 19.25 (1.07)%; 170 beats/min – 18.30 (5.14)%; 180 beats/min – 21.65 (7.07)% and 190 beats/min – 17.85 (1.17)%.

The highest percentage distribution of boys' heart rate was as follows: 160 beats/min – 45.65

(9.05)%; 170 beats/min – 17.45 (5.21)% and 180 beats/min – 11.70 (2.28)%.

During four Latin American dances, 2 min each, imitating the contest with short breaks (Figure 4), the HR values of juvenile girls increased to 188.00 (16.40) beats/min, and those of boys – to 188.40 (17.11) beats/min. The mean HR of girls during a 10-min practice session amounted to 162.6 (16.56) beats/min, for boys it was 160.63 (17.44) beats/min.

Research (Figure 5) showed energy outlay for boys and girls in Latin American dances. Girls consumed 126.66 (15.44) kcal, and boys – 109.00 (17.87) kcal.

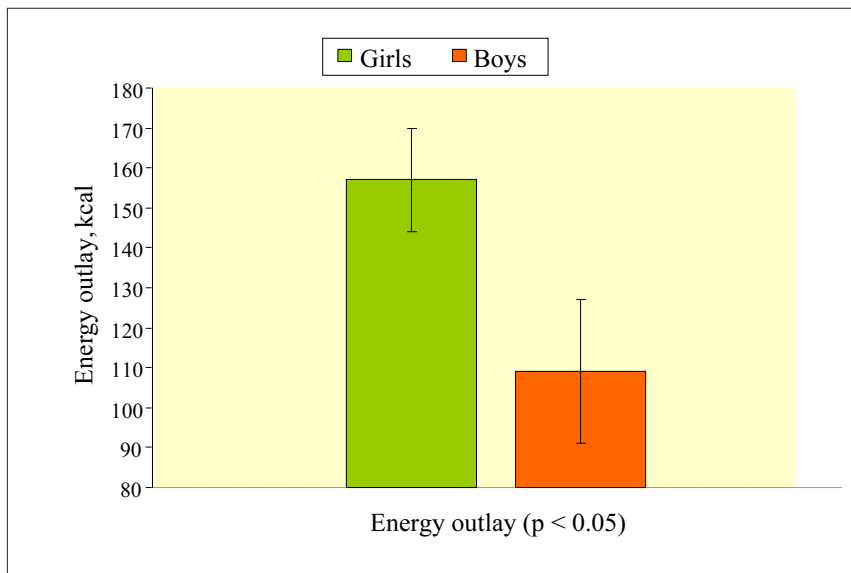


Figure 2. Energy outlay of juvenile sports dancers (kcal) during a 10-min Standard dance programme

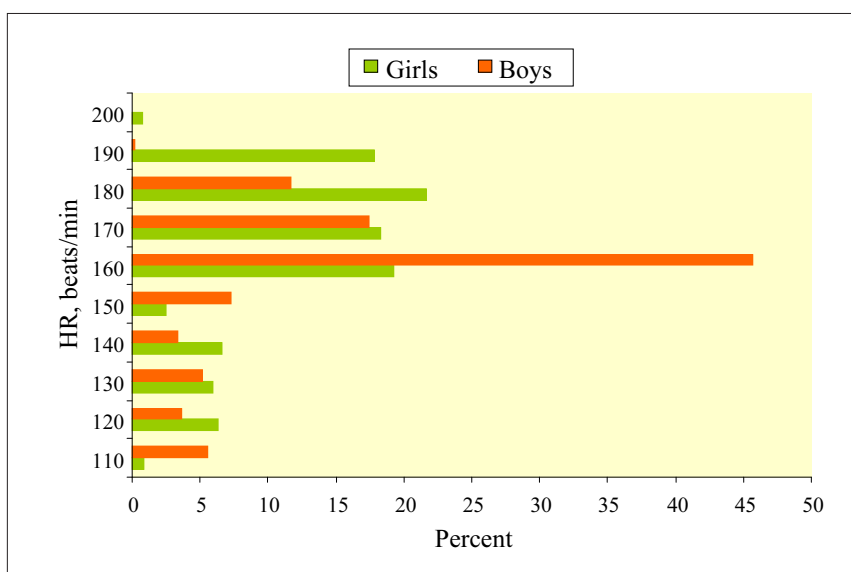


Figure 3. Percentage distribution of juvenile sports dancers' heart rate during 10-min standard dances

Figure 4. The indices of the heart rate for juvenile sports dancers during Latin American contest programme

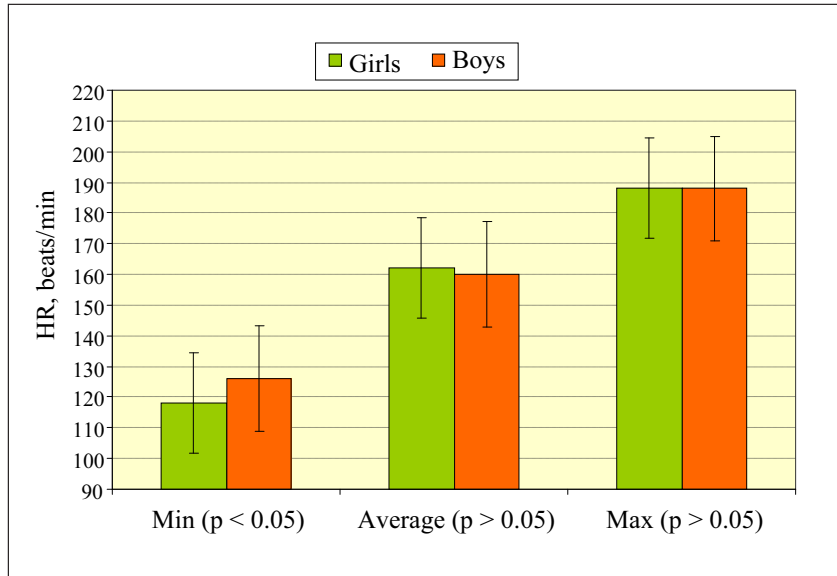


Figure 5. Energy outlay (kcal) for juvenile sports dancers in Latin American dances in 10 min

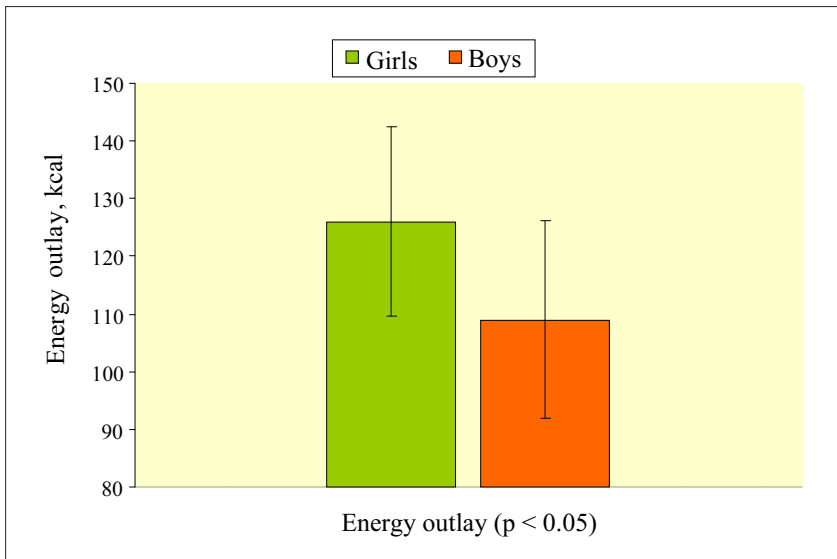
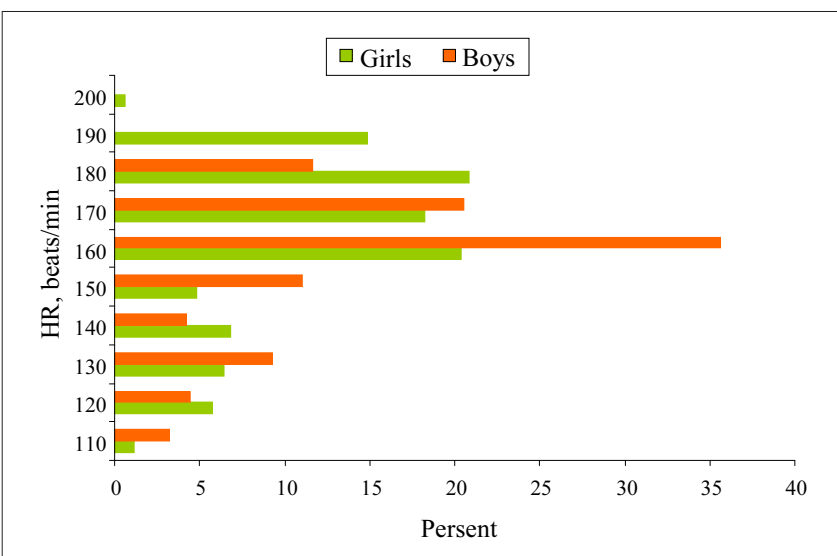


Figure 6. Percentage distribution of juvenile sports dancers' heart rate during 10 min Latin American dances



We established (Figure 6) that during a 10-min model practice session, dancing Latin American dances, the HR which remained the longest was between 150 beats/min and 190 beats/min.

Girls had higher HR values and the boys' HR values did not exceed 180 beats/min during the whole period of dancing.

The highest percentage distribution of girls' heart rate during Latin American dances was as follows: 160 beats/min – 20.40 (2.14)%; 170 beats/min – 18.25 (4.21)%; 180 beats/min – 20.85 (8.25)% and 190 beats/min – 14.90 (3.15) %.

The highest percentage distribution of boys' heart rate was as follows: 160 beats/min – 35.60 (5.28)%; 170 beats/min – 20.55 (4.35)% and 180 beats/min – 11.65 (2.21)%.

DISCUSSION

The processes of metabolism and energy balance in sports dancing are closely related to the heart rate and oxygen supply to working muscles (Faina, Bria, 2000; Klonova, Klonovs, 2010; Vissers et al., 2011). Changes in children's heart rate during the dance show the response of their cardiovascular system to physical load. When children grow, their heart rate becomes less frequent: for 9-10-year-old children HR at rest is 76–86 beats/min, for 11–12-year-old children – 78–80 beats/min (Cited from Milašius, 1997).

Children's anaerobic reactions become more active at higher HR, in contrast to adults, thus children reach anaerobic threshold at higher HR compared to adults not engaged in sports.

Researchers (Сонькин, 1978) found that 9–10-year-old children's HR (\bar{x} (SD)) at the anaerobic threshold amounted to 179.00 (3.20) beats/min and, compared to HR at rest, it increased by 94.00 (3.40) beats/min. The threshold of anaerobic metabolism is a limit where anaerobic reactions become more active in energy production with the increase in the work intensity (Skernevičius et al., 2011). Ten-year-old girls reach the critical limit of physical work intensity ($VO_2\max$) when their HR is 184.00 (13.90) beats/min, and boys – 185.00 (3.80) beats/min. Eleven-year-old boys and girls reach $VO_2\max$ limit when their heart rate is respectively 190.00 (8.40) beats/min and 185.00 (4.20) beats/min (Гуминский, 1973).

HR of our researched juvenile sports dancers (Figures 1, 4), dancing Standard and Latin American contest programme, exceeded the limits of anaerobic threshold at some moments of the dance and reached the limit of critical intensity ($VO_2\max$).

Dancing a 10-min (with short breaks between dances) Standard dance programme, girls danced 77.15% of the time with the heart rate of 160–190 beats/min, but at certain moments their heart rate amounted to 200 beats/min.

Boys danced 74.8% of the time with the heart rate of 160–180 beats/min. Research literature (Радионо́в, 2011) contains evidence that during 2-min vigorous dance sports dancers consume as much energy as if they ran 20–400 m putting maximal efforts, and during 1 hour of practice their energy outlay is 300–400 kcal.

During a 10-min Latin American dance programme, girls danced 77.05% of the time with the heart rate of 160–190 beats/min, (180 beats/min – 21.65%, 190 beats/min – 17.8%), but at certain moments their heart rate amounted to 200 beats/min. Boys danced 67.8% of the time with the heart rate of 160–180 beats/min (180 beats/min – 11.65%).

It has been established (Ušpurienė, Čepulėnas, 2010) that during Latin American dances, the HR values of adult D class sports dancers reach 183.50 (11.45) beats/min for women and 182.75 (10.87) beats/min for men.

During Latin American dances, energy outlay for girls was greater than that for boys ($p < 0.05$), but lower compared to those when the girls danced the Standard programme (Figures 2, 5). During Latin American dances, women's energy outlay amounts to 43.20 (3.30) kJ/min., those of men – 54.00 (9.60) kJ/min. (Blansby, Reidy, 1988).

On the basis of our research results we claim that juvenile sports dancers perform their contest programme at the intensity anaerobic threshold, higher intensity than the anaerobic threshold and reach the critical limit. During the practice sessions of juvenile sports dancers, it is very important to improve the adaptation of their body functions to physical loads corresponding to the intensity of sports contest activities.

CONCLUSIONS AND PERSPECTIVES

In contest programmes of sports dancing, physical loads are of changing intensities and thus

they have a big impact on the cardiovascular system of young dancers. At the threshold of anaerobic intensity, some moments of the dance are performed at greater intensity than the anaerobic threshold, and even critical intensity limit is reached.

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JAUNUČIŲ GRUPĖS SPORTINIŲ ŠOKIŲ ŠOKĖJŲ FIZINIO KRŪVIO INTENSYVUMO YPATUMAI ŠOKANT STANDARTINIUS IR LOTYNŲ AMERIKOS ŠOKIUS

Aistė Barbora Ušpurienė, Algirdas Čepulėnas
Lietuvos kūno kultūros akademija, Kaunas, Lietuva

SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Sportiniai šokiai, šokami varžybų intensyvu, iš šokėjų reikalauja gero atletinio parengtumo ir funkcinio pajėgumo. Tyrimu, analizuojančių jaunučių grupės šokėjų širdies susitraukimų dažnio kaitą šokant standartinius ir Lotynų Amerikos šokius, trūksta. Tyrimu siekiama patikrinti hipotezę, kad šokant sportinius šokius varžybų intensyvu jaunučių grupės šokėjų širdies susitraukimų dažnis gali siekti 160–190 tv./min ir bus sunaudojama daug energijos.

Tikslas – ištirti jaunučių grupės sportinių šokių šokėjų širdies susitraukimų dažnio kaitą ir energijos sąnaudą šokant standartinius ir Lotynų Amerikos šokius.

Metodai. Buvo tiriama 16 šokėjų (8 mergaitės ir 8 berniukai). Mergaičių amžius – 9.88 (0.83) m., berniukų – 9.86 (1.07) m. Šokant standartinius ir Lotynų Amerikos šokius varžybų intensyvu, širdies susitraukimų dažnio kaita buvo registruojama pulso matuokliais „Polar S 610“ (Suomija) su kompiuterine duomenų registracija, taip pat analizuojamos širdies susitraukimų dažnio vidutinės, didžiausios ir mažiausios reikšmės bei energijos sąnaudą (kcal) per šokių programos atlikimo laiką.

Rezultatai. Per 10 minučių modelines pratybas, šokant standartinius ir Lotynų Amerikos šokius, ilgiausiai šokama, kai širdies susitraukimų dažnis siekia 160–190 tv./min. Šokant Lotynų Amerikos šokius, mergaičių energijos sąnaudą buvo didesnė negu berniukų ($p < 0,05$), bet mažesnė negu joms šokant standartinius šokius.

Aptarimas ir išvados. Šokant sportinius šokius varžybų intensyvu, fizinis krūvis nuolat kinta ir smarkiai veikia jaunųjų šokėjų širdies ir kraujagyslių sistemą. Šokama anaerobinio slenksčio intensyvu, atskirais šokimo momentais – didesniu intensyvu už anaerobinio slenksčio ribą ir net pasiekiami kritinio intensyvu riba.

Raktažodžiai: standartiniai šokiai, Lotynų Amerikos šokiai, fizinio krūvio intensyvumas, širdies susitraukimų dažnis, energijos sąnaudą.

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Corresponding author **Aistė Barbora Ušpurienė**
Lithuanian Academy of Physical Education
Sporto str. 6, LT-44221 Kaunas
Lithuania
Tel +370 61269645
E-mail a.b.uspuriene@gmail.com

PHYSIOLOGICAL CORRELATES OF CYCLING PERFORMANCE IN AMATEUR MOUNTAIN BIKERS

Donvina Vaitkevičiūtė, Kazys Milašius

Lithuanian University of Educational Sciences, Vilnius, Lithuania

ABSTRACT

Research background and hypothesis. Aerobic fitness of high-performance mountain bikers explains about 40% of variance in performance. This suggests that other factors such as anaerobic power and capacity as well as technical abilities need to be considered in the physiological assessment (Impellizzeri et al., 2005 a). We found a lot studies investigating track and road cyclists, but there are no studies concerning the relationship between physiological tests and cycling performance in Lithuanian mountain bikers.

The aim of this study was to investigate the physiological correlates of cycling performance in amateur mountain bikers.

Research methods. Fifteen Lithuanian mountain bikers participated in the study. The 10-second test was performed to estimate special alactic anaerobic power output, whereas a 30-second Wingate test was performed to estimate composite alactic anaerobic glycolytic power output. For the evaluation of the aerobic capacity, a progressive incremental laboratory cycling test to exhaustion was performed.

Research results. We found a significant negative correlation between cycling performance and alactic anaerobic relative peak power output ($r = -0.534$, $p < 0.05$) and lactate concentration after the progressive incremental cycling test to exhaustion ($r = -0.625$, $p < 0.05$). However, we did not find a significant correlation between cycling performance and VO_{2max} ($r = -0.024$, $p > 0.05$) and composite alactic anaerobic glycolytic power output ($r = -0.269$, $p > 0.05$).

Discussion and conclusions. Our findings suggest that alactic anaerobic power output and active glycolysis play a very important role in off-road cycling performance. This is essential because of the fast starting phase of the race and steep climbs.

Keywords: mountain bike, cycling, performance, power output, maximal oxygen uptake.

INTRODUCTION

Mountain biking (off-road cycling) is becoming increasingly popular in Lithuania. The most popular mountain biking events are cross-country (XC) and marathon, often referred to as cross-country marathon (XCM). Both events are a mass-start endurance competition. Cross country involves completing several laps of an off-road circuit, typically the course is between 6 km and 9 km long and winning time is about 120–135 minutes for men and 105–120 minutes for women (Impellizzeri, Marcora, 2007). Marathons cover at least 40 kilometers of trail. Mountain biking events include repeated descents and hill climbs on gravel roads and wilderness trails.

Mountain biking is a physically demanding sport (Baron, 2001). The duration of these events suggest that high aerobic power and the ability to sustain high intensity exercises for a prolonged period is required and the fast starting phase, as well as fighting against gravity during the steep climbs, (up to 500 W) suggest that anaerobic metabolism plays a significant role (Impellizzeri et al., 2002). VO_{2max} is considered to be a standard indicator of the integrated function of cardiovascular, respiratory and muscular systems during exercise and an important determinant of endurance performance (Bassett, Howley, 2000). T. Cramp et al. (2004) reported VO_{2max} values

in amateur mountain bikers at 60.0 ml/min/kg, whereas elite mountain bikers have VO_2max value at 78.3 ml/min/kg (Lee et al., 2002). Aerobic fitness of high-performance mountain bikers explains about 40% of variance in performance. This suggests that other factors as anaerobic power as well as capacity and technical abilities need to be considered in the physiological assessment of these athletes (Impellizzeri et al., 2005 b).

During mountain biking competitions, different terrain conditions require mountain bikers to have a high degree of technical ability to control and stabilize the bicycle. Riders might increase their speed downhill and can gain advantage or decrease the time lost in other parts of the course (Wang, Hull, 1997).

We found a lot studies investigating the track and road cyclists, but there are very few studies on Lithuanian mountain biker's physiological profile (Vaitkevičūtė, Milašius, 2011) and none on the relationship between physiological tests and cycling performance.

The aim of this study was to investigate the physiological correlates of cycling performance in amateur mountain bikers.

RESEARCH METHODS

Participants. Fifteen Lithuanian mountain bikers (19–29 years old) who participated in mountain biking marathons were tested during the

competitive phase of their season. The marathon was a mass start event and took part in Vilnius (19 06 2011), with the course *consisting of a 26-kilometer lap* and all participants completing two *laps*.

Anthropometry. These indices of physical development were measured: body mass, muscle and fat body mass, BMI, hand grip strength and vital lung capacity (Table 1).

Laboratory tests. Muscle power in different zones of energy production was studied. The 10-second test was performed to estimate the special alactic anaerobic power output, whereas the 30-second Wingate test was performed to estimate composite alactic anaerobic glycolytic power output *using a Monark 894E veloergometer*. For the evaluation of aerobic capacity, a progressive incremental laboratory cycling test to exhaustion was performed using Oxycon Mobile, a telemetric breath-by-breath system. During this test, pulmonary ventilation (VE), heart rate (HR), oxygen uptake (VO_2) and power output (W) was continuously registered at the anaerobic threshold and intermittent critical power intensity (PCi).

Statistical analysis. The data were analysed using descriptive statistics and are presented as the mean (\pm) standard deviation (s), coefficient of variation (V%) and range. We used a Pearson's correlation coefficient (r) to calculate the correlation between cycling performance and physiological

Indices	Mean	Standard deviation (S)	Coefficient of Variation (V%)	Min	Max
Height, cm	181.90	5.45	3.00	173.00	192.00
Body mass, kg	71.61	7.21	10.07	58.30	85.50
BMI	21.62	1.67	7.72	18.90	24.45
Muscle mass, kg	37.95	4.40	11.59	28.30	45.50
Fat mass, kg	7.45	2.38	31.95	4.20	12.30
Hand grip strength, kg	63.07	5.11	8.10	50.00	71.00
VLC, l	5.81	0.64	11.02	4.40	6.70

Table 1. Anthropometric and physiometric characteristics of amateur mountain bikers

Indices	Mean	Standard deviation (S)	Coefficient of Variation (V%)	Min	Max
10 s max, W/kg	21.10	1.92	9.08	18.47	24.43
10 s mean, W/kg	14.00	1.04	7.41	12.61	16.20
30 s mean, W/kg	9.40	0.66	7.01	8.38	10.37
Race time, s	7837.51	572.66	7.31	6903.35	9004.30

Table 2. Relative anaerobic power output and race time values

capacities ($r = 0.514$, $p < 0.05$; $r = 0.641$, $p < 0.01$). For performing statistical analyses we used *Microsoft Office Excel 2007* and *SPSS Statistics 17.0*.

RESEARCH RESULTS

Table 2 shows that the calculated coefficients of variations for the 10 s test, 30 s – Wingate test and cycling performance remained low ($< 10\%$ coefficient of variation). We found that the alactic anaerobic relative peak power output was 21.10 W/kg, the alactic anaerobic relative power output was 14.00 W/kg, the composite alactic anaerobic glycolytic power output was 9.40 W/kg and the average race time was 7837.51 s.

The data of aerobic capacity (Table 3) had different coefficients of variation. The V% of HR at intermittent critical power (PCi) intensity and anaerobic threshold was low, $< 10\%$ just as VO_{2max} at PCi. All other data (except La, which had $< 30\%$ coefficient of variation) had medium coefficient of variation ($< 20\%$). The VO_{2max} at the PCi was 58.51 (48.18–73.56) ml/min/kg and at the anaerobic threshold it was 43.84 (34.90–55.20) ml/min/kg. Respectively the power output was 411.33 W and 271.33 W. *The blood lactate concentration after the progressive incremental laboratory cycling test to exhaustion was 12.40 mmol/l (8.10–16.20 mmol/l).*

We found a significant negative correlation between cycling performance and alactic anaerobic relative peak power output ($r = -0.534$, $p < 0.05$) and lactate concentration after the progressive incremental cycling test to exhaustion ($r = -0.625$, $p < 0.05$) (Table 4). Also alactic anaerobic relative power output had a significant negative correlation with VO_{2max} at anaerobic threshold ($r = -0.516$, $p < 0.05$). However, we did not find a significant correlation between cycling performance and VO_{2max} ($r = -0.024$, $p > 0.05$) and composite alactic anaerobic glycolytic power output ($r = -0.269$, $p > 0.05$). Composite alactic anaerobic glycolytic power output had no significant positive correlation with lactate concentration ($r = 0.255$, $p > 0.05$), either.

Oxygen pulse (OP) had strong significant positive correlation with power output at intermittent critical power (PCi) intensity and anaerobic threshold ($r = 0.721$, $p < 0.01$; $r = 0.682$, $p < 0.01$). VO_{2max} at intermittent critical power (PCi) intensity was significantly positively correlated with VO_{2max} at anaerobic threshold ($r = 0.761$, $p < 0.01$).

DISCUSSION

We believe this is the first time physiological correlates of cycling performance are reported in amateur mountain bikers. A few studies investigated correlations between physiological

Table 3. Responses to progressive incremental laboratory cycling test to exhaustion at anaerobic threshold and PCi

	Indices	Mean	Standard deviation (S)	Coefficient of Variation (V%)	Min	Max
Response to exercise at intermittent critical power intensity (PCi)	VE, l/min	159.80	22.71	14.21	122.00	203.00
	HR, bpm	187.07	10.09	5.39	163.00	200.00
	VO_{2max} , l/min	4.19	0.56	13.48	3.27	5.48
	VO_{2max} , ml/min/kg	58.51	5.80	9.91	48.18	73.56
	O ₂ pulse, O ₂ /HR	22.52	3.84	17.06	16.35	30.61
	W	411.33	45.65	11.10	330.00	510.00
	La, mmol/l	12.40	3.00	24.16	8.10	16.20
Response to exercise at anaerobic threshold	VE, l/min	75.33	11.16	14.81	55.00	95.00
	HR, bpm	166.73	9.73	5.83	153.00	185.00
	VO_{2} , l/min	3.14	0.52	16.65	2.03	3.91
	VO_{2} , ml/min/kg	43.84	5.95	13.58	34.90	55.20
	O ₂ pulse, O ₂ /HR	18.92	3.67	19.40	11.47	25.56
	W	271.33	45.65	16.82	170.00	330.00

Table 4. Correlations (Pearson's r) between race time and physiological variables

No.	Muscle power			Exercise response at intermittent critical power (Pci) intensity							Exercise response at anaerobic threshold						
	10 s max, W/kg	10 s mean, W/kg	30 s mean, W/kg	VE, l/min	HR, bpm	VO ₂ max, l/min	VO ₂ max, ml/min/kg	O ₂ pulse, O ₂ /HR	W	L.a, mmol/l	VE, l/min	HR, bpm	VO ₂ , l/min	VO ₂ , ml/min/kg	O ₂ pulse, O ₂ /HR	W	Race time, s
1	0.915**	0.795**	0.771**	0.270	0.083	-0.169	-0.349	-0.158	0.140	0.232	-0.038	-0.246	-0.381	-0.242	-0.159	-0.534*	
2	0.915**	0.771**	0.771**	0.309	0.117	-0.047	-0.388	-0.076	0.282	0.078	-0.236	-0.236	-0.516*	-0.182	-0.142	-0.336	
3	0.795**	0.771**	0.771**	0.470	-0.033	-0.118	-0.103	-0.086	0.242	0.255	-0.186	-0.324	-0.347	-0.244	-0.242	-0.269	
4	0.270	0.309	0.470	0.316	-0.105	0.316	0.230	0.276	0.500	0.237	0.125	-0.302	-0.092	0.105	-0.002	-0.156	
5	0.083	0.117	-0.033	-0.105	-0.495	-0.495	-0.357	-0.732**	-0.478	0.076	-0.313	-0.489	-0.390	-0.674**	-0.602*	0.296	
6	-0.169	-0.047	-0.118	0.316	-0.495	0.316	0.701**	0.953**	0.741**	-0.101	0.551*	0.862**	0.617*	0.901**	0.796**	-0.161	
7	-0.349	-0.388	-0.103	0.230	-0.357	0.701**	0.679**	0.679**	0.278	0.164	0.540*	0.577*	0.761**	0.584*	0.421	-0.024	
8	-0.158	-0.076	-0.086	0.276	-0.732**	0.953**	0.679**	0.721**	0.721**	-0.124	0.549*	0.841**	0.618*	0.936**	0.816**	-0.217	
9	0.140	0.282	0.242	0.500	-0.478	0.741**	0.278	0.721**	0.159	0.159	0.181	0.596*	0.258	0.682**	0.739**	-0.317	
10	0.232	0.078	0.255	0.237	0.076	-0.101	0.164	-0.124	0.159	0.159	-0.159	-0.241	-0.060	-0.261	-0.073	-0.625*	
11	-0.038	-0.236	-0.186	0.125	-0.313	0.551*	0.540*	0.549*	0.181	-0.159	0.057	0.749**	0.797**	0.629*	0.580*	-0.237	
12	0.103	-0.061	-0.108	-0.302	0.809**	-0.524*	-0.242	-0.682**	-0.630*	0.123	0.057	-0.337	-0.094	-0.598*	-0.475	0.050	
13	-0.246	-0.236	-0.324	0.014	-0.489	0.862**	0.577*	0.841**	0.596*	-0.241	0.749**	0.749**	0.834**	0.954**	0.929**	-0.121	
14	-0.381	-0.516*	-0.347	-0.092	-0.390	0.617*	0.761**	0.618*	0.258	-0.060	0.797**	0.834**	0.743**	0.743**	0.709**	-0.021	
15	-0.242	-0.182	-0.244	0.105	-0.674**	0.901**	0.584*	0.936**	0.682**	-0.261	0.629*	0.954**	0.743**	0.925**	0.925**	-0.103	
16	-0.159	-0.142	-0.242	-0.002	-0.602*	0.796**	0.421	0.816**	0.739**	-0.073	0.580*	0.929**	0.709**	0.925**	0.925**	-0.294	
17	-0.534*	-0.336	-0.269	-0.156	0.296	-0.161	-0.024	-0.217	-0.317	-0.625*	-0.237	-0.121	-0.021	-0.103	-0.294		

Note. * - p < 0.05; ** - p < 0.01

variables and performance in elite off-road cyclist (Impellizzeri et al., 2005 a, b; Costa, De-Oliveira, 2008; Costa et al., 2011). Cross country marathon (XCM) is a mass-start competition. Starting position is defined according to UCI (International Cycling Union) points during international events or national points system during national events. This system lets the best athletes start the race at the front of the group, so they are not being slowed down by lower performing bikers. Different starting positions have influence on race time and its correlation to the physiological variables.

Up to now, there have been no studies investigating the alactic anaerobic peak power relationship to cross country marathon (XCM) performance. As we know, only one study reports about the correlation between Wingate test and cross country (XC) performance (Costa, De-Oliveira, 2008). During Wingate test both the phosphagen and glycolytic systems are fully activated (Boobis et al., 1982), and during a 10 s test the phosphagen system plays the most important role (Gaitanos et al., 1993). V. P. Costa, F. R. De-Oliveira (2008) and we found no significant correlation between Wingate test variables and cycling performance. Still we discovered that alactic anaerobic relative peak power is significantly correlated to cycling performance.

F. M. Impellizzeri et al. (2005 a) reported that VO_2max , power output, anaerobic threshold expressed both in absolute terms and relative to body mass were significantly correlated to race time. Thirteen national and international off-road cyclists (under 23 in the UCI classification) participated there. Later, F. M. Impellizzeri et al. (2005 b) studied fifteen elite off-road cyclists and the results were different. This group was more homogeneous, but they found no significant correlation between VO_2max and power output. They concluded that the physiological predictor of performance in a heterogeneous group of athletes cannot be applied to elite athletes who are characterized by a more homogeneous performance ability.

Aerobic fitness of high-performance mountain bikers explains about 40% of the variance in performance. This suggests that other factors such as anaerobic power and capacity and technical abilities need to be considered in the physiological assessment of these athletes (Impellizzeri et al., 2005 b). Our results are similar, we found no significant correlation between aerobic fitness and cycling performance, except for lactate concentration after a progressive incremental laboratory cycling test to exhaustion. V. P. Costa et al. (2008) notified that the intermittent nature of cross country could promote larger demand and utilization of anaerobic metabolism during training and/or races. B. Stapelfeldt et al. (2004) quantified the intensity during cross country races and indicated that 42% of the race time was above anaerobic threshold. This explains that *active glycolysis plays a very important role in off-road cycling performance*.

Our further studies should investigate the influence of physiological parameters and the technical ability in the cycling performance of homogeneous mountain bikers' group.

CONCLUSIONS AND PERSPECTIVES

Significant negative correlation between alactic anaerobic relative peak power output and race time ($p < 0.05$) proves that alactic anaerobic power output is crucial for amateur mountain bikers because of the quick starting phase and steep climbs during race time.

Significant negative correlation between lactate concentration after a progressive incremental cycling test to exhaustion and race time ($p < 0.05$) suggests that glycolysis plays a very important role in off-road cycling performance, which requires high anaerobic power and capacity of amateur mountain bikers.

This group of amateur mountain bikers should be characterized by heterogeneous performance level.

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MĖGĖJŲ KALNŲ DVIRATININKŲ FIZIOLOGINIŲ RODIKLIŲ IR VARŽYBŲ REZULTATO KORELIACINIAI RYŠIAI

Donvina Vaitkevičiūtė, Kazys Milašius

Lietuvos edukologijos universitetas, Vilnius, Lietuva

SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Didelio meistriškumo kalnų dviratininkų aerobinė ištvėrmė varžybų rezultatai lemia tik 40%. Tai rodo, kad tokie veiksniai kaip anaerobinis pajėgumas ir ištvėrmė, techniniai gebėjimai turi būti vertinami atliekant šių sportininkų fiziologinius tyrimus (Impellizzeri et al., 2005 a). Nors Lietuvos plento ir treko dviratininkų klausimais mokslinių publikacijų yra paskelbta nemažai, Lietuvos kalnų dviratininkų fiziologinių rodiklių ryšių su varžybų rezultatu mokslinių tyrimų duomenų literatūros šaltiniuose neaptikome.

Tikslas – ištirti mėgėjų kalnų dviratininkų fiziologinių rodiklių ryšius su varžybų rezultatu.

Metodai. Tirta 15 Lietuvos kalnų dviratininkų. Specialiajam anaerobiniam alaktatiniam pajėgumui nustatyti buvo taikomas 10 s trukmės didžiausių pastangų testas, o mišriam anaerobiniam alaktatiniam-glikolitiniam pajėgumui – Vingeito 30 s trukmės didžiausių pastangų testas. Aerobinis pajėgumas nustatytas atliekant nuosekliai didinamo krūvio testą veloergometru.

Rezultatai. Nustatyti statistiškai patikimi atvirkštiniai koreliaciniai ryšiai tarp varžybų rezultato ir santykinio didžiausiojo anaerobinio alaktatinio pajėgumo ($r = -0,534$; $p < 0,05$) bei laktato koncentracijos po nuosekliai didinamo krūvio testo ($r = -0,625$; $p < 0,05$). Visgi neaptikome statistiškai patikimo ryšio tarp varžybų rezultato ir $VO_2\max$ ($r = -0,210$; $p > 0,05$) bei mišraus anaerobinio alaktatinio-glikolitinio pajėgumo ($r = -0,269$; $p > 0,05$).

Aptarimas ir išvados. Tyrimo duomenys leidžia teigti, kad santykinis anaerobinis alaktatinis pajėgumas ir aktyvi glikolizė yra būtini kalnų dviračių sporte, kuriam būdinga greito starto fazė ir stačios įkalnės varžybų metu.

Raktažodžiai: kalnų dviračių sportas, varžybų rezultatas, pajėgumas, didžiausiasis deguonies suvartojimas.

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Corresponding author **Donvina Vaitkevičiūtė**
Lithuanian University of Educational Sciences
Studentų str. 39, LT – 08106 Vilnius
Lithuania
Tel +370 5 273 4858
E-mail v.donvina@gmail.com

SHOOTING DIVERSITY IN LITHUANIAN YOUTH FEMALE BASKETBALL PLAYERS IN CENTRE POSITION DEPENDING ON THE RANK OF COMPETITION LEVEL

Šarūnė Valinskaitė, Aurimas Jasilionis, Antanas Skarbalius
Lithuanian Academy of Physical Education, Kaunas, Lithuania

ABSTRACT

Research background and hypothesis. Higher levels of competition rank have significant influence on the structure and shooting performance in youth basketball.

The aim of the study was to investigate the interaction of shooting and match results of Lithuanian female youth national team players dependent on the competition level.

Research methods. The basketball players ($n = 7$) of the Lithuanian Basketball Centre were investigated. The performance indicators of those players were analyzed on the basis of the data collected during the Lithuanian Women "A" league and European Basketball Championship of 2011. We analyzed the statistics of six selected key indicators: 2- and 3- point field goal attempts, free-throws. The data were processed by *SPSS 17.0 for Windows*. Person's correlation coefficients were calculated to determine the relationships between the match results within all shooting types and different players.

Research results. The top efficacy of shooting was found in Lithuanian Championship (LC), the lowest – in European Championship (EC). The highest efficiency of free throws was found in the IInd period (62.53%), two-points (44.74%) and three-points (19.45%) shooting efficacy in the Ist period in LC. Seven players of LBC in Lithuanian Championship earned the majority part of all points i. e. 74% in the Ist period and 75% in the IInd period. However, the contribution of 7 players of LBC in the international competition level of EC was less, 59% of total team points.

Discussion and conclusions. Though the players performed successfully and efficiently in both stages of LC and won all matches with a great difference in points, remarkable decrease in shooting efficacy and winning one match only (out of 9) in EC might be considered as not adequate level of mastership in the opponents' teams in LC or not adequate individual level of sport performance. Lithuanian basketball federation should rethink the system of targeted training of the Lithuanian youth team during the preparatory period in order to manage suitable local competition level for better advance in the performance at the international level.

Keywords: sport performance, sport games, sport contest model, shooting efficacy in basketball.

INTRODUCTION

Match analysis is common in performance sport to guide training and competition. However, it is not as common at the youth level. Most studies about match analysis have studied the variables of technique and tactics in relation to final actions of a team's ball possession (Ortega et al, 2006).

The more complex the sport, the more attention should be given to what would be analyzed: the

team or individual (athlete), and the aspects to be analyzed: individual actions or the most relevant key indicators of the team (Hughes, Franks, 2006).

Basketball match research has shown that winning teams outperform losing teams in shooting field – goals and securing defensive rebounds (Sampaio, Janeira, 2003; Sampaio et al., 2010).

The information that is available during a game is diverse and extensive. Continuous action

and a dynamic environment make objective data collection difficult. Any quantitative analysis must be structured (Hughes, Franks, 2006).

The pattern of seasonal variation in game statistics is likely to depend on team quality because the best teams will have the best players in enhanced training environments, which will have an impact on game performance (Sampaio et al., 2010).

Permanent quantitative (Karipidis et al., 2001; Stonkus, 2002, 2003) and qualitative (Sampaio, Janeira, 2003) analysis enable to assess sport performance in basketball and predict future tendencies (Hughes, Franks, 2006; Reilly, 2007).

Some studies analyze the shot from a multifactorial focus, with samples from different competition levels. S. J. Ibáñez et al. (2009) studied the American professional league (NBA), Ibáñez et al. (2008) analyzed the professional Spanish league (ACB), and G. Tsitskaris et al. (2002) analyzed the Greek professional league.

The number of points scored is the key indicator characterizing basketball teams' offensive character and game performance. It certainly depends on objective factors: the opponents' playing style, number of capable team players, team tactics in competitions (Sampaio, Janeira, 2003).

Playing in high performance women's teams, the outcome of the match determines the accuracy of the shots, especially shots from near and mid-distance positions (these shots make the greatest number of all shots) (Klimantovicz, 1999; Stonkus, 2002, 2003; Jeličić et al., 2010).

Only a few studies have analyzed youth teams (Sampaio et al., 2004). In both cases of analysis, the majority of the authors analyzed the variables related to the final actions of ball possessions such as shots, efficacy percentage, assists, turnovers, steals, personal fouls received, points scored, or other variables like rebounds or even fast breaks (Sampaio et al., 2004). Most of these studies

conclude that two-point shots by the team and the efficacy percentage of them are the key indicators of winning (Taxildaris et al., 2001; Fotinakis et al., 2002; Ibanez et al., 2003; De Rose, 2004).

Shooting efficacy and match results dependence on the shooting position according to age and mastership of players require more research (Sampaio et al., 2004).

The aim of the research was to investigate the interaction of shooting and match results of Lithuanian female youth national team players depending on the competition level.

Subject of research: interaction of shooting and sports results.

RESEARCH METHODS

Participants. In order to improve the pattern of playing style, the best 14 players from Lithuania were selected in the Lithuanian Basketball Centre (LBC). The team took part in different Lithuanian basketball leagues (Table 1), all players took part in the Lithuanian Women Basketball League "A" (LWBAL) as a team, but only 7 players from the LBC took part in the European Championship'2011 (U-18).

Measurement. At the beginning of the season in September, 2010, players were measured (height – 1.79 ± 0.01 m, body mass – 66.14 ± 6.09 kg). Players were divided into guards, forwards and centers (Table 1).

Data collection. Data sets were gathered from publicly available sources at the Lithuanian Women's Basketball "A" league website (<http://www.lmkal.lt>), student's (<http://www.mk1.lt>), and LWBL (<http://www.lmk1.lt>) of the 2010–2011 season. Statistics of matches ($n = 19$) were registered according to the regulations of the Federation International Basketball Association (FIBA). Competitive period started on October 17, 2010, and lasted until May 15, 2011, its final stage ($n = 9$) started on August 4

Table 1. The number of Lithuanian basketball players in different basketball leagues

Leagues Players	LSBL *	LWBAL	LWBL	Total
Centers				
1.	n = 6	n = 18	n = 29	n = 53
2.		n = 15		n = 15
Guard	n = 18	n = 17		n = 35
Forwards				
1.	n = 15	n = 19	n = 24	n = 58
2.	n = 18	n = 19		n = 37
3.	n = 18	n = 18		n = 36
4.	n = 18	n = 18	n = 21	n = 57

Note. LSBL – Lithuanian Students Basketball League.

and lasted until August 14, 2011 (<http://u18women.fibaeurope.com/en/>). The age of players altered during the season (Table 2).

Table 2. Participant's age in different playing periods

	2010 September	2011 March	2011 August
Age	16.93 ± 0.45	17.60 ± 0.67	17.91 ± 0.42

We analyzed statistics of six selected key indicators: 2 – and 3 – point field-goal attempts (both successful and unsuccessful), free-throws (both successful and unsuccessful).

Statistical analysis. To ensure a normal sample distribution, the Kolmogorov-Smirnov test was applied. Kruskal-Wallis test was applied to analyzed nonparametric data. The data are presented as means (\bar{x}) and standard deviations (s). Statistical significance was set at $p < 0.05$. The data were processed by *SPSS 17.0 for Windows*. Person's correlation coefficients were calculated to determine the relationships between match result within all shooting types and different players. Correlation coefficients (r) above 0.5 were considered as representing large correlations, 0.3 to 0.5 – moderate, 0.1 to 0.3 – small, and < 0.1 – insubstantial/trivial according to Cohen (1988).

RESEARCH RESULTS

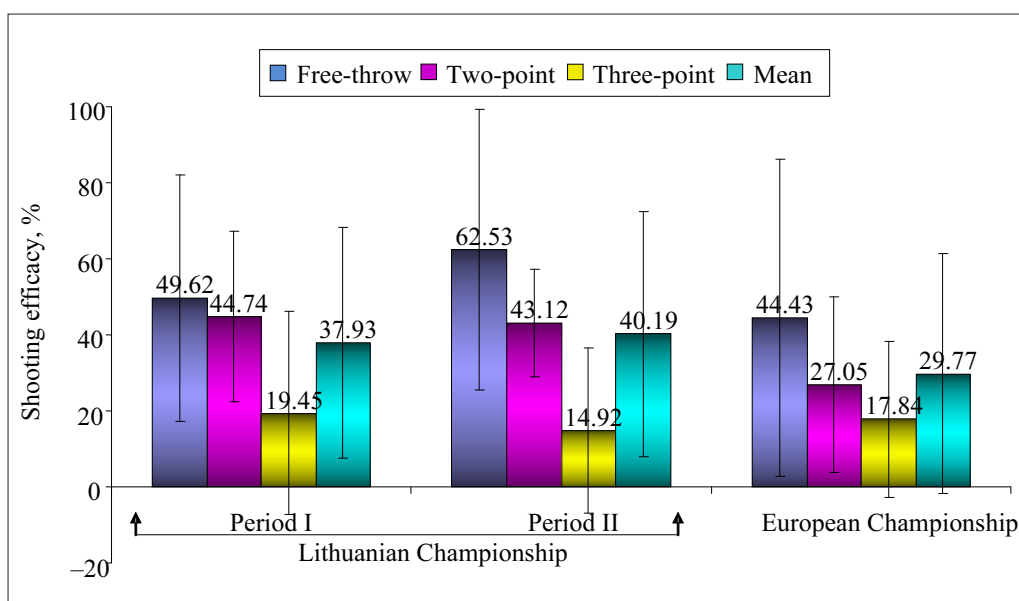
Shooting efficacy. The highest efficacy of shooting was found in Lithuanian Championship (LC), the lowest in European Championship (EC).

The highest efficiency of free-throw shooting was found in the IInd period (62.53%), two-point shooting efficacy – in the Ist period (44.74%), three-point efficacy – Ist period (19.45%) in LC (Figure 1).

We found different levels of correlation when analyses was made for 12 players and for the main 7 players who scored 58% of total points in EC. Correlation of all 12 players ranged from trivial to large at all levels of competition. The significant interaction was found between the scored points and successful two-point field goal and two-point field goals efficacy in the Ist period of LC and in EC. However, significant interaction between the scored points and successful free throw and free throws efficacy was found for 7 players in EC only. Significant interaction of playing efficacy by guard player was found between scored points and free throws in the IInd period of LC. Significant interaction was found between scored points and two-point field goals efficacy in LC and between scored points and made free throws in EC by forwards, as by centers between scored points and made two-point field goals and free throw efficacy in EC, between scored points and made two-point field goals and efficacy in I period.

Shooting efficacy from various playing positions. A significant difference ($p < 0.05$) between free-throws and three-point shooting efficacy was found in the Ist period, between free-throws in the IInd period in LC, and between two-points and three-points in EC compared to players from all different positions (Figure 2).

Figure 1. Shooting efficacy of LBC and Lithuanian national youth female team depending on competition level ($\bar{x} \pm s$)



Structure of points scored per match.
Two-point field goals were the major in points composition independently of competition level (Ist period – 60.91%, IInd period – 60.78%, EC – 54.19%). Free-throws composed the least part in point structure (Figure 3). The more three-point field goals (24.45%) were performed in EC than in LC both periods.

Contribution in the number of points by LBC players. Seven players of LBC in Lithuanian Championship (Ist and IInd period) made the major part of all points i. e. 74% in the Ist period and 75% in the IInd period. However, contribution of LBC players in international competition level EC was not significant compared to the national one: 7 players mentioned before scored 59% of total team points.

Table 3. LBC players' correlations of different evaluated points and playing positions

Number of players	Rank of competition level	Scored points and successful two-point field goals	Scored points and two-point field goal efficacy	Scored points and successful three-point field goals	Scored points and three-point field goal efficacy	Scored points and successful free throws	Scored points and free throw efficacy
12	EC	r = 0.53*	r = 0.64*	r = 0.71***	r = 0.31	r = 0.53	r = 0.56
	Period I of LC	r = 0.83*	r = 0.76**	r = 0.18	r = 0.31	r = 0.34	r = 0.16
	Period II of LC	r = 0.85*	r = 0.64	r = 0.67	r = 0.13	r = 0.06	r = 0.35
7	Ec	r = 0.38	r = 0.42	r = 0.32	r = 0.36	r = 0.79**	r = 0.69*
	Period I of LC	r = 0.69***	r = 0.80**	r = 0.11	r = 0.07	r = 0.15	r = 0.06
	Period II of LC	r = 0.74*	r = 0.93**	r = 0.43	r = 0.17	r = 0.25	r = 0.45
Guard	Ec	r = 0.17	r = 0.08	r = 0.06	r = 0.06	r = 0.1	r = 0.15
	Period I of LC	r = 0.15	r = 0.23	r = 0.23	r = 0.16	r = 0.35	r = 0.03
	Period II of LC	r = 0.68	r = 0.42	r = 0.23	r = 0.34	r = 0.67	r = 0.79**
Forwards	Ec	r = 0.05	r = 0.02	r = 0.18	r = 0.02	r = 0.73*	r = 0.53
	Period I of LC	r = 0.43	r = 0.58*	r = 0.23	r = 0.07	r = 0.03	r = 0.21
	Period II of LC	r = 0.78*	r = 0.89***	r = 0.31	r = 0.07	r = 0.31	r = 0.02
Centers	Ec	r = 0.67*	r = 0.41	r = 0.34	r = 0.34	r = 0.41	r = 0.74***
	Period I of LC	r = 0.56*	r = 0.65***	Not shooting	Not shooting	r = 0.06	r = 0.4
	Period II of LC	r = 0.03	r = 0.04	Not shooting	Not shooting	r = 0.45	r = 0.33

Note. * – p < 0.05, ** – p < 0.005, *** – p < 0.01. Level of correlation: < 0.1 – insubstantial/trivial; 0.1–0.3 – small; 0.3–0.5 – moderate; > 0.5 – large.

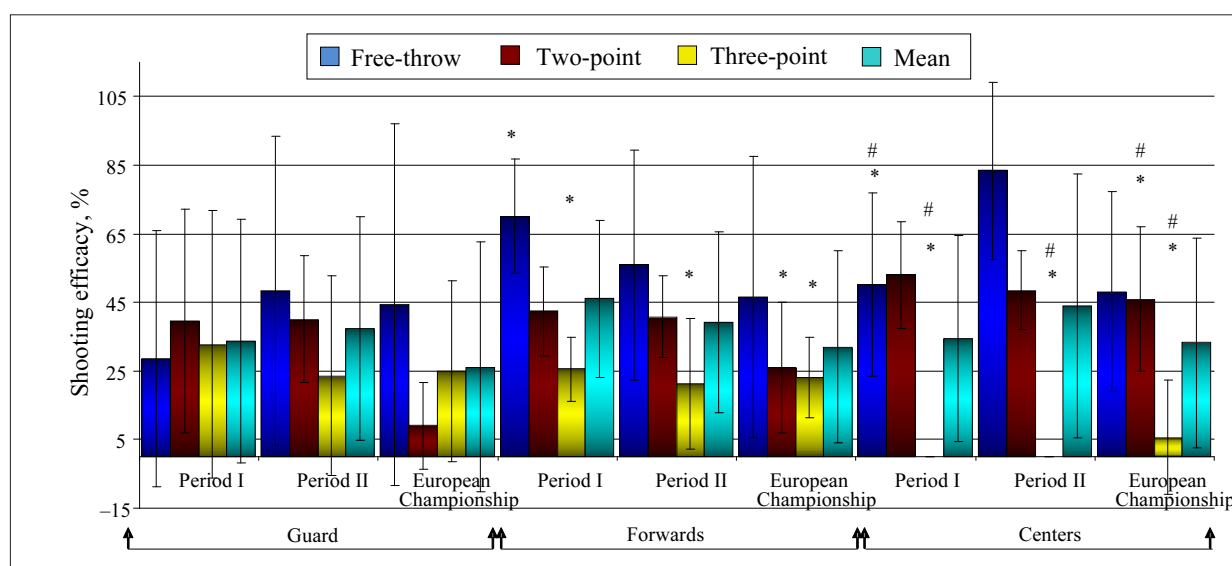


Figure 2. Efficiency of shooting from different positions in LC'2011 and EC'2011 by LBC and Lithuanian national youth female team

Note. * – p < 0.05 between guard and others (forwards and centers), # – p < 0.05 between forwards and centers

Figure 3. Structure of points scored per match in different competition ranks

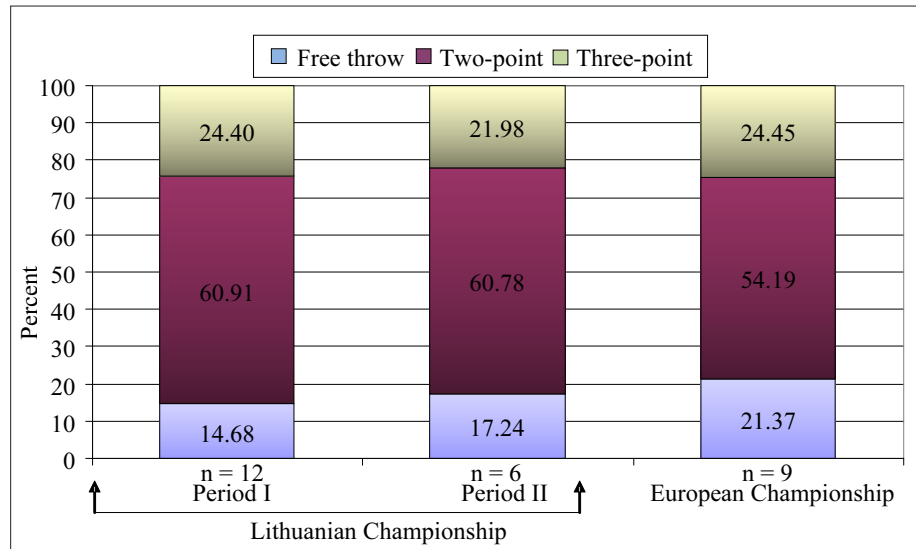
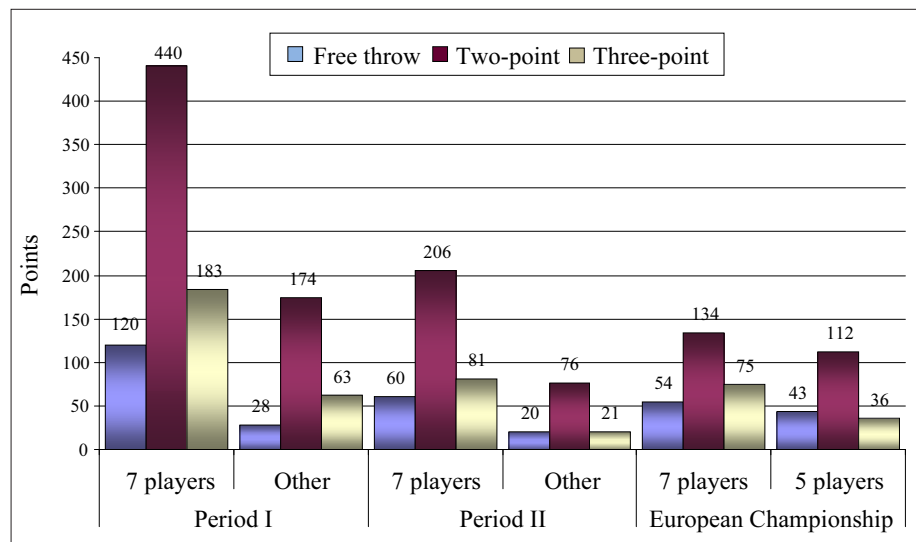


Figure 4. Contribution of LBC players at Lithuanian championship (period I and period II) and at European Championship compared to total team points



DISCUSSION

Points per match. Researchers suggest (Trninić et al., 2002; Sampaio, Janeira, 2003; Sampaio et al., 2010) that points scored per match are the key indicators in basketball as *per se* in order to win. We found high correlation between scored points and winning points 0.868 ($p < 0.01$) in EC.

Elite women's winning teams scored (68.2 ± 7.9) 10 points more compared to losing teams (57.7 ± 8.3) at the European Women Basketball Championship'2009 (Kreivytė, Čižauskas, 2010). Male youth teams of the same age (17–18 years) as we observed scored nearly the same points (71.7 ± 2.3) in the European Championship'2008, but Lithuanian Youth Male national team scored less 69.6 ± 4.6 (Matulaitis, Stonkus, 2009).

Maintaining high performance during the season is a complex but key target for all team ball sports (Sampaio et al., 2010), especially depending

on the level of competition. The fact that points scored per match decreased in the end of season more than by 30 points might be considered as the factor of mastership the Lithuanian youth team at the EC, or limitation of players' fitness (Trninić et al., 2002). Basketball as a complex sport should be given to what will be analyzed (Hughes, Franks, 2006). The opponents' playing style, number of capable team players, team tactics in competitions might have essential influence on the outcome of match (Sampaio, Janeira, 2003).

We found high correlation ($r = 0.54$; $p < 0.05$) between scored points and missed points, between scored points and the difference in scored and missed points ($r = 0.91$; $p < 0.05$) in the Lithuanian championship (period I and II), but small correlation was observed ($r = 0.127$; $p > 0.05$) in the EC. The same tendency of relationship between scored and missed points to winning points was found in EC.

Those findings allow asserting that successful team actions in defense make positive prerequisite for counterattacks and scoring more points (Šeparović, Nuhanović, 2008). Concerning the Lithuanian youth team case, we can make presumption by different levels of competing teams in Lithuanian championship and higher level in EC.

Structure of points related to shooting position. Basketball match analysis research has shown that winning teams outperform losing teams in shooting field-goals (Sampaio, Janeira, 2003; Trninić et al., 2002). M. Jeličić and co-authors (2010) analyzed European Basketball Championship in 2000 and found that the number of two-point field goals was the primary situational parameter for the overall successfulness in the game, whose efficiency was averaging between 50 and 60%, and comprised 55 to 60% of the total number of points at a basketball match. The interaction between scored points and performance in 2-point field-goals suggests limited differences between important players from all teams, but marked differences between less important players from all teams (Sampaio et al., 2006). In our research the number of two-point field goals per match was less by 5%, efficacy of two-point field goals was less by 17% in EC than in the Ist and IInd periods of LC. Reducing number of two-point field goals per match and two-point field goals efficacy might be considered as a fact that Lithuanian national girl youth team in EC were forced to miss a lot of shoots from two-point field because of opponent teams' defense applied. On the other hand, we can assume that models of different playing styles were not applied in the preparation period.

The most interesting finding was that free-throws composed the quarter of points per match in EC, but they were less significant in LC. The greatest changes of free-throws can allow asserting active defense system by opponents in EC. The number of points scored in the key indicator characterizing basketball teams' offensive character, game performance, and it depends on objective factors: the opponents' playing style, number of capable team players, team tactics in competitions (Sampaio, Janeira, 2003). The opportunity to stop a team from scoring with defense pressure can be a key determinant of success of a team (Trninić et al., 2000). The pattern of seasonal variation in game statistics is likely to depend on team quality because the best teams will have the best players in enhanced training environments, which will have an impact on game performance (Sampaio et al., 2010).

The highest level performances are typically very consistent across a variety of sports and the level of competition. Athletes are able to maintain consistency in their performance (Hopkins, Hewson, 2001). The fact that players performed successfully and efficiently in both stages of LC and won all matches with great difference in points, remarkable decrease in of shooting efficacy and winning one match only (out of 9) in EC, might be considered as inadequate level of mastership by opponent teams in LC or inadequate individual level of sport performance. Since the highest level of performers has the highest fitness, there may be a link between fitness and consistency of performance late in the season and the level of competition (Drinkwater et al., 2007). Lithuanian Basketball Federation should rethink the system of targeted training of the Lithuanian youth team in order to manage suitable competition level for better advance performance in the future. *Those findings by mentioned researchers allow asserting unpredictable influence on the performance of the Lithuanian Youth Girls' team in EC because of the higher results but lower levels of competition in both periods of LC.*

Effectiveness of scored points by players of different positions. The most important and primary role of the guards is to organize the game flow in the phase of offence. S. Trninić et al. (1999) suggest that **guards** have executed the greatest number of attempted throws from the three-point field goal area most often; they have the fewest shooting attempts from the two-point goal area. The higher level of competition gives the higher level of defense and the lower level of shooting efficacy (Sampaio et al., 2010). Three-point field goal efficacy was less by 7% than in the Ist period, by 2% more than in the IInd period, but free throw efficacy was better by 16% in EC compared to the Ist period. The fact that two-point field goals efficacy by guard player was less by 30% in EC compared to the Ist and IInd periods of LC might be considered as not enough level of opponents in LC.

Forwards are in almost all variables interposed between guards and centers. Forwards are generally considered to be the creators of play. The additional features of their performance are: many attempted throws from both the half-distance and distance (although having fewer three-point goals than the guards); a significant contribution to the flow of performance by a great number of passes (Trninić et al., 1999). The performance of Lithuanian youth team forwards was less in EC (two-point field goals

efficacy was less by 14%, three-point field goals efficacy was less by 15%, and free throw efficacy was less by 24%) and that might be considered as low level of mastership.

Centers of Lithuanian team attempted two-point field goals contrary to the fewest three-point goal throws, and two-point field goals efficacy was less by 8% in EC. Centers in EC showed the highest level of mastership in shooting efficacy compared to forwards and guard. Centers are above average in shooting from the two-point goal area with good efficiency, they make a great number of free throws (Trninić et al., 1999). However, two-point goal efficacy of our centers was lower than average. In the phase of offence play they are mostly under their basket, so they execute many inside throws. When playing one-on-one and/or one-on-two with their back to the basket they forced the opponents' personal foul, but free-throw efficacy of centers was less 35% in EC compared to LC. Due to the fact of not enough international experience, centers missed possibilities to score the points.

CONCLUSIONS AND PERSPECTIVES

The results make clear that shooting characteristics are different with regard to competition level of the players. Coaches should know the specific characteristics of their competition to adequately prepare their players. Likewise, the knowledge of these differences should help orientate the formation process of the inexperienced players in order to facilitate their transition to peak performance. Those findings allow asserting unpredictable influence for the performance of the Lithuanian Youth Girl Team in EC because of the higher results but lower level of competition in both period of LC. Lithuanian Basketball Federation should rethink the system of targeted training in the Lithuanian youth team in order to manage suitable competition level during preparation period. Permanent sport performance monitoring should be applied in order to assess the right targeted training process in preparation period.

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LIETUVOS JAUNIŲ MERGINŲ KREPŠINIO CENTRO ŽAIDĖJŲ METIMŲ Į KREPŠĮ YPATUMŲ PRIKLAUSOMUMAS NUO VARŽYBŲ RANGO

Šarūnė Valinskaitė, Aurimas Jasilionis, Antanas Skarbalius
Lietuvos kūno kultūros akademija, Kaunas, Lietuva

SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Aukštesnio rango varžybos reikšmingai veikia merginų jaunių krepšininkų metimų struktūrą ir veiksmingumą.

Tikslas – ištirti Lietuvos merginų jaunių rinktinės žaidėjų metimų ir rungtynių rezultatų priklausomumą nuo varžybų rango.

Metodai. Buvo tirtos Lietuvos krepšinio centro (LKC) krepšininkės ($n = 7$). Žaidėjų varžybinės veiklos rodikliai buvo analizuojami iš surinktų duomenų per Lietuvos moterų krepšinio „A“ lygos pirmo ir antro etapo ir Europos čempionato 2011 rungtynes. Analizuoti 6 rodikliai: dvitaškiai, tritaškiai ir baudos metimai. Duomenys apdorojami SPSS 17.0 programa. Pirsono koreliacijos koeficientas buvo skaičiuojamas nustatant ryšius tarp rungtynių rezultato ir metimų į krepšį bei žaidėjų ampluą.

Rezultatai. Didžiausias metimų veiksmingumas buvo Lietuvos čempionato (LČ) metu, mažiausias – Europos (EČ). Didžiausias baudos metimų veiksmingumas – II LČ etapo metu (62,53%), dvitaškių metimų veiksmingumas – I LČ etapo metu (44,74%), tolimų metimų – I LČ etapo metu (19,45%). Septynios LKC žaidėjos LČ pelnė didžiausią dalį komandos taškų: 74% I ir 75% II etape. Tačiau tarptautinio lygio rungtynėse LKC septynių žaidėjų indėlis sudarė 59% visų komandos pelnytų taškų.

Aptarimas ir išvados: Žaidėjų metimų veiksmingumas LČ leido LKC komandai laimėti visas rungtynes dideliu taškų skirtumu, tačiau dėl ryškiai mažesnio metimų veiksmingumo EČ Lietuvos rinktinėi pavyko laimėti tik vienas rungtynes iš devynerių. Nesėkmingo Lietuvos rinktinės žaidimo EČ priežastimi galėjo būti arba nepakankamas varžovių lygmuo LČ, arba nepakankamas individualus žaidėjų meistriškumas. Lietuvos krepšinio federacija turėtų permąstyti Lietuvos jaunųjų krepšininkų komandos tikslinio rengimo sistemą pasirengimo laikotarpiu sudarydama tinkamą varžybų lygmenį, kad būtų garantuotas ir komandos, ir žaidėjų individualaus meistriškumo tobulėjimas.

Raktažodžiai: parengtumas, sportiniai žaidimai, varžybinės veiklos modeliai, metimų į krepšį veiksmingumas.

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Corresponding author **Antanas Skarbalius**
Lithuanian Academy of Physical Education
Sporto str. 6, LT-44221 Kaunas
Lithuania
Tel +370 68216807
E-mail a.skarbalius@lkka.lt

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Jucevičienė, P. (Red.) (1996). *Lyginamoji edukologija*. Kaunas: Technologija.

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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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Vytautas Streckis, Albinas Grūnovas, Viktoras Šilinskas

LENGVOSIOS ATLETIKOS VYRŲ DAUGIAKOVĖS PAGRINDAI



Vadovėlyje pateiktos apibendrintos, susistemintos žinios apie lengvosios atletikos daugiakovės treniruotės metodiką, priemones ir sistemas, daugiakovės treniruotės struktūrą, rengimąsi varžyboms, techninį, taktinį ir psichologinį sportininko rengimą, daugiakovės rungčių technikos mokymo metodiką. Šios žinios padės nuodugniau susipažinti su lengvosios atletikos daugiakovės didaktiniais (visapusiškumo, laipsniškumo, individualizavimo, sąmoningumo) principais, struktūra ir treniruotės metodais.

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Lietuvos kūno kultūros akademijos doktorantę **Birutę Zakarienę**, 2012 m. balandžio 13 d. Lietuvos kūno kultūros akademijoje apgynusią biomedicinos mokslų (biologijos) daktaro disertaciją tema „Centrinių ir periferinių širdies ir kraujagyslių sistemos funkcinių rodiklių kaitos ypatybės, atliekant globalaus, regioninio pobūdžio bei lokaliuosius fizinius krūvius”.

Mokslinis vadovas prof. habil. dr. Jonas Poderys.

We congratulate **Birutė Zakarienė**, the student of doctoral studies at the Lithuanian Academy of Physical Education, to have defended her thesis “Peculiarities of changes in central and peripheral functional indices of the cardiovascular system performing global, regional and local physical loads” (Biomedical Sciences, Biology) at the Lithuanian Academy of Physical Education on April 13, 2012.

Scientific advisor Prof. Dr. Habil. Jonas Poderys.



Lietuvos kūno kultūros akademijos doktorantę **Kristiną Motiejūnaitę**, 2012 m. gegužės 4 d. Lietuvos kūno kultūros akademijoje apgynusią socialinių mokslų (edukologijos) daktaro disertaciją tema „Užduoties sudėtingumo poveikis greitų ir tikslų judesių mokymui(si)”.

Mokslinis vadovas prof. habil. dr. Albertas Skurvydas.

We congratulate **Kristina Motiejūnaitė**, the student of doctoral studies at the Lithuanian Academy of Physical Education, to have defended her thesis “Effect of task complexity on speed and accuracy movement learning” (Social Sciences, Education) at the Lithuanian Academy of Physical Education on May 4, 2012.

Scientific advisor Prof. Dr. Habil. Albertas Skurvydas.

