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CONTENTS

EDUCATION OF SOCIALITY IN SMALL COMMUNITIES

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ABSTRACT

Research background and hypothesis. Sociality in small communities leads to accrued social capital of bonding, bridging and linking. Education of community members' sociality increases bonding, bridging and linking social capital of the community.

Research aim of this study was to reveal the links between activity of community groups and community bonding, bridging and linking social capital.

Research methods. The subjects filled in the questionnaire based on the research of F. J. Elgar et al. (2011). The sociality was associated with community social capital, namely its components of bonding social capital, bridging social capital and linking social capital. The subjects were asked to evaluate the items using Likert type 5 point scale.

The participants were divided into two groups: engaged in community activities (240 people, among them 35% males and 65% females, mean age 48.52 years) and not engaged in activities (262 people, 62.6% females and 37.4% males, mean age 46.97 years).

Research results. The estimates of both groups on bonding social capital scale were not statistically significant ($p > 0.05$). Statistically significant differences were found assessing the bridging social capital ($p < 0.05$; $t = 4.56$), and linking social capital ($p < 0.05$; $t = 3.17$) in both groups. Checking the differences of opinions between both groups of men – men and women – women showed statistically significant differences only for women's bridging social capital ($p < 0.05$; $t = 88.19$) and linking social capital ($p < 0.05$; $t = 4.01$).

*Discussion and conclusions.*The data confirmed the hypothesis that bridging and linking social capital was related to community engagement. The engaged participants indicated higher levels of bridging and linking social capital.

Keywords: community, sociality, bonding social capital, bridging social capital, linking social capital.

INTRODUCTION

Community fragmentation and lack of engagement is supported by various studies, so researchers from different fields are encouraged to explore the process of community development. Recent discussions in the literature link community development and community resource mobilization. According to D. V. Rainey et al. (2004), there are three forms of capital: human capital, social capital and financial capital. It helps small communities to compete successfully in the global economy, but all three kinds of resources should be mobilized and continuously developed through active engagement in social networks. Communities' social networks, defined as social capital, are of primary value.

People who are engaged in social networks are active participants in the local economy, so they actively create financial capital and material goods. Social networking also creates an added value because the engagement in community participation is linked to such goods as commitment, satisfaction, collaboration, support and approval, consulting, recommendations, and acknowledgment. Community participation is the source of such social and emotional goods as care,

safety, recognition, shared values, commitment, empathy, etc. (Robison, Ritchie, 2010).

Community engagement is closely related to social capital because it facilitates cooperation and optimal utilization of resources inherent in social networks (Putnam, 1993, 2000; Coleman, 2003). Social capital can be defined and measured in different ways, but people's ability to act collectively and to achieve common goals are two common features in different social capital definitions (Skačkauskienė, Bytautė, 2012).

Probably the most influential social capital concept was introduced by R. Putnam (2000) as well as S. Szreter and M. Woolcock (2004), who distinguished three social capital dimensions: bonding social capital, bridging social capital and linking social capital. The bonding social capital describes trust based social relationships between individuals of similar interest, which are often connected by blood or similar relations. Usually bonding social capital is formed on the basis of social identity: people trust and cooperate with others because they identify themselves as the members of a particular group. The bridging social capital includes confidence in different persons, who usually do not belong to the same family, social group, nationality or race. The bridging social capital is formed when a person starts relations with new colleagues, new neighbours, organizations and staff representatives, and keeps relationship of trust, hoping that those people would never ignore or reject. Linking social capital involve relationship of trust between different people in the society, who have different power and influence. Linking social capital includes public confidence in law enforcement institutions. The society, which has a lot of linking social capital, supports government representatives and fosters goodwill based on democratic relationships.

The concept of modern social capital measurement is based on three traditions: measurement of confidence as individuals' attitude, measurement of participation in social groups and institutions and measurement of confidence in police and law enforcement institutions (Righi, 2013). In the first case, measuring the confidence levels in the community, people bonding social capital can be measured. It is a valuable indicator of how much individuals tend to cooperate with others while creating social welfare. In the second case the bridging social capital can measured. It reveals how individuals tend to join groups, clubs, associations, seeking to solve problems and achieve common goals. In the third case linking social capital is measured. It reveals how much confidence people give to the law and political institutions.

Community engagement and active participation allows the use of social capital in three ways. It is possible, that active engagement in community organizations is related to the trust of other people, different groups of people, as well as law enforcement authorities.

The aim of this study was to reveal the links between community engagement and social capital dimensions.

The hypothesis of the study was to reveal that community engagement predicted the level of social capital of the community.

RESEARCH METHODS

Research participants. The sample of the study was composed of the residents of 12 townships from rural area. According to the study aims, the sample was divided into two groups. The first group included persons engaged in various community groups, the second one was not engaged in any community group activity. The first group was composed of 84 men (35% of the group), and 156 women (65% of the group). The mean age of the first group subjects was 48.52 years. The respondents were selected by the recommendations of a representative of the municipality. The second group was composed of 262 subjects: 98 men (37.4% of the group), and 64 women (62.4% of the group). The mean age of the second group subjects was 46.49 years. Each participant of the second group was asked about their engagement in community activities.

Measures. The subjects filled in the questionnaire based on the research of F. J. Elgar et al. (2011). For social capital assessment in the community, the questionnaire including 15 items was used. After a short introduction of the study aims, the subjects were asked to evaluate how much they could trust their family members, relatives, neighbours, friends and acquaintances. The subjects were asked to evaluate the level of social capital using Likert type five point scale. These questions were interpreted as the scale of bonding

social capital. In the second question the subjects were asked to indicate how much they could trust the person they met for the first time, the person of different religion, different nationality, the person working illegally, and the person not buying a ticket in the bus. These questions were interpreted as the scale of bridging social capital. In the third question the subjects were asked to indicate how much they could trust the local municipality representative, police, court, parliament and government. These questions were interpreted as the scale of linking social capital. The subjects were also asked to indicate their age, gender and social status (employed or unemployed, retired).

Statistical analysis. In order to estimate the reliability of the scales Cronbach's alpha coefficients were calculated. The values were sufficient for the study (i. e. 0.72 for bonding social capital; 0.70 for bridging social capital; 0.65 for linking social capital).

The difference between the groups was considered to be reliable with Student's *t* test statistical significance set at $p < 0.05$. Before the test of means, equality of dispersion was checked up using Fisher F-test. The data were expressed as means ± standard deviations.

Binary logistic regression was used in order to estimate predictive relations between community engagement and social capital dimensions. The engagement in community activities was considered as dependent variable. Participants were divided into two groups: engaged (0) and not engaged (1). The estimates of linking, bridging, and bonding social capital were considered as independent variables. In order to fulfil the requirements of a binary regression, these estimates were converted into binary variables: the social capital scale mean was lower than 2.49 (0) and the social capital scale mean was higher than 2.50 (1).

These calculations were performed using *SPSS Statistics 17.0*.

RESEARCH RESULTS

The main results of the study are presented in Table 1.

The mean groups of the bonding social capital scale did not differ significantly in two groups. This means that family members, relatives, neighbours, friends and acquaintances were the subjects of mutual trust in both cases.

The results obtained during the study (Table 1) showed that statistically significant differences between the groups were estimated in two cases – in the case of bridging social capital ($p < 0.05$; $t = 4.56$) and in the case of linking social capital ($p < 0.05$; $t = 3.17$). The data showed that actively engaged people displayed more confidence in various social groups and law enforcement authorities

In order to evaluate predictive value of community engagement to social capital, binary logistic regression analysis was made. It was found that the level of engagement into community actions determined social capital accumulation ($p < 0.05$). The results of binary logistic regression indicated the relation between the community engagement and social capital. The estimated relations might be explained theoretically. Bridging and linking social capital is developed when people participate in the activities of various social groups and institutions. Mutual trust in the community is the main premise for this participation.

The data allowed drawing the conclusion that community engagement was an important predictor of bridging and linking social capital. The next

Social capital	Engaged (n = 240)	Disengaged (n = 262)	t-test½	p
	M ± SD	M ± SD		
Bonding capital	3.48 ± 0.93	3.12 ± 1.31	t = 0.496	p > 0.05
Bridging capital	2.81 ± 0.65	2.12 ± 0.79	t = 4.56	p < 0.05
Linking capital	2.51 ± 0.55	1.29 ± 0.22	t = 3.17	p < 0.05

Table 1. **Values of scores of three forms of social capital**

Note. Values are expressed as mean ± SD. Significant differences were set by independent samples Student's t-test among groups: 1 – engaged, 2 – disengaged.

Table 2. **Values of the activity estimates of men and women participating and non-participating in community groups**

Social capital and gender		Engaged		Disengaged	
		M ± ST	t-test½ and p	M ± ST	t-test½ and p
Bonding	Men	3.20 ± 1.04	t = 1.00 p > 0.05	2.57 ± 1.49	t = 1.47 p > 0.05
	Women	3.76 ± 0.83		3.72 ± 1.21	
Bridging	Men	2.0 ± 1.02	t = 4.83 p < 0.05	2.33 ± 1.09	t = 2.90 p < 0.05
	Women	4.04 ± 0.35		1.17 ± 0.08	
Linking	Men	1.93 ± 0.99	t = 1.06 p > 0.05	1.29 ± 0.34	t = 0.02 p > 0.05
	Women	2.53 ± 0.90		1.29 ± 0.15	

Note. Values are expressed as mean ± SD. Significant differences were set by independent samples Student's t-test among groups: 1 – men, 2 – women.

important question was to indicate the influence of demographical variables for this relationship.

In order to indicate the main differences in two groups, the means were calculated and statistically significant differences of the means were explored using Student's *t* test for independent samples. The gender emerged as the single statistically significant demographical variable. Data on the gender differences of opinion are presented in Table 2.

Bridging social capital was the only variable when statistically significant mean differences between men and women were estimated ($p < 0.05$; $t = 4.83$). Nevertheless, the data suggested that women might be more likely to engage in community activities. Bridging social capital is defined as trust in various social groups and tendency to engage in their activities. It is possible that women have more sociality and relationship orientation, which increases possibility of community engagement.

Checking the scale mean differences between the two groups of men - men and women - women showed statistically significant differences only for the group of women's bridging social capital ($p < 0.05$; $t = 88.19$), and linking social capital ($p < 0.05$; $t = 4.01$).

DISCUSSION

R. Putnam (2000) and later S. Szreter and M. Woolcock (2004) distinguished three dimensions of social capital: bonding social capital, bridging social capital and linking social capital. The study disclosed the expedience of this distinction. Social capital refers to the resources in social networks. Trust in the community is the primary source of social capital (Putnam, 2000). It is considered that trust is the precondition for community engagement, but the study shows that this relation is more complicated than it seems. The data confirmed the hypothesis that bridging and linking social capital are related to community engagement. This means that people in small rural communities, who come together and organize the same cultural or educational activities, demonstrate more bridging and linking social capital. The question is why they demonstrate that and why there is no similar relationship between community engagement and bonding social capital. It is important to note that both groups tend to indicate higher levels of bonding social capital in comparison with bridging social capital or linking social capital. On the other hand, the mean of bonding social capital scale is 3.48 for engaged participants and 3.12 for disengaged participants. The participants demonstrated moderate levels of trust in people who were relatively significant for them, but confidence in the reference group was not related to the community engagement.

H. Meulemann (2008) describes three types of associations existing in the community: interest based associations, problem based associations and religious associations, which are both interest (value) based and problem based. It would be fruitful

to develop the research exploring the relationship between the dimensions of social capital and engagement in different types of associations in the community.

The results of the studies proved the relationships between social capital and individual/family characteristics, as well as the psychological well-being of adolescents. Indicates that the association between social capital and psychological well-being for adolescents differs in a specific family in regard to individual and family characteristics. Thus, social capital is important for maintaining the psychological well-being of adolescents.

So, it can be assumed that social capital might influence the well-being of adults, but this assumption needs more research to confirm it.

CONCLUSION AND PERSPECTIVES

The hypothesis of the study was confirmed. Sociality of active community members increases the social capital, which is prerequisite for community well-being. To strengthen sociality of the active members in the community, it is appropriate to include more members of the community seeking various community activities.

Social capital might be the source of social and emotional well-being only when community engagement exists. Women tend to indicate the higher level of bridging social capital in comparison to men.

Two major limitations should be considered in the future studies. The first one is related to sampling procedures. Random sampling and larger samples would give more reliable data and more valuable generalizations. The second one is related to important variables related to social capital. It was assumed that social capital was the source of social and emotional well-being, such as individual well-being, shared values, support, approval, etc. It would be useful to investigate the relations of social capital and selected social and emotional well-being of the engaged and disengaged community members.

REFERENCES

Coleman, J. A. (2003). Religious social capital. Its nature, social location, and limits. In C.E. Smidt (Ed.), *Religion as Social Capital: Producing the Common Good*. Baylor University press.

Elgar, F. J., Davis, Ch. G., Wohl, M. J. et al. (2011). Social capital, health and life satisfaction in 50 countries. *Health & Place*, 17, 1044–1053.

Meulemann, H. (2008). Is altruism more effective where it is required more? Collectivity-orientation and involvement in interest, issue, and religious associations. In H. Meulemann (Ed.), *Social Capital in Europe: Similarity of Countries and Diversity of People. Multi-Level Analyses of the European Social Survey 2002*. Brill.

Putnam, R. (2000). *Bowling Alone: the Collapse and Revival of American Community*. New York: Simon and Schuster.

Putnam, R. (1993). *Making Democracy Work: Civic Traditions in Modern Italy*. Princeton. Princeton University Press.

Rainey, D. V., Robinson, K. L., Allen, I., Christy, R. D. (2004). Essential forms of capital for achieving sustainable community development. In. R. D. Christy (Ed.), *Achieving Sustainable Communities in a Global Economy: Alternative Private Strategies and Public Policies*. World Scientific.

Righi, A. (2013). Measuring social capital: Official statistics initiatives in Italy. *Procedia. Social and Behavioral Sciences*, 72, 4–22.

Robinson, L. J., Ritchie, B. K. (2010). *Relationship Economics: The Social Capital Paradigm and Its Application to Business, Politics and Other Transactions*. Gower.

Skačkauskienė, I., Bytautė, S. (2012). Socialinio kapitalo apibrėžties ir matavimo problema. *Verslas: teorija ir praktika*, 13 (3), 208–216.

Szreter, S., Woolcock, M. (2004). Health by association? Social capital, social theory, and the political economy of public health. *International Journal of Epidemiology*, 33, 650–667.

BENDRUOMENIŠKUMO UGDYMASIS MAŽOSE BENDRUOMENĖSE

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Bendruomeniškumas mažose bendruomenėse lemia kaupiamą įsipareigojimo, suartėjimo ir susiejimo socialinį kapitalą. Bendruomenės nariams ugdantis bendruomeniškumą didėja bendruomenės įsipareigojimo, suartėjimo ir susiejimo socialinis kapitalas.

Tikslas – atskleisti bendruomenės grupių veiklos ir bendruomenės įsipareigojimo, suartėjimo ir susiejimo socialiniu kapitalu sąsajas.

Metodai. Tiriant buvo naudojamas klausimynas, sukurtas naudojant F. J Elgar ir kt. (2011) pagrindines mintis. Bendruomeniškumas tyrimo metu siejamas su socialiniu kapitalu, tiksliau jo sudėtinėmis dalimis – bendruomenės įsipareigojimo, suartėjimo ir susiejimo socialiniu kapitalu.

Respondentai buvo prašomi penkių balų *Likert* skalėje įvertinti klausimyne pateiktus teiginius. Buvo išskirtos dvi respondentų grupės: dalyvaujantys bendruomenės veikloje (240 žmonių, tarp jų 35% vyrų ir 65% moterų; amžiaus vidurkis 48,52 metų) ir nedalyvaujantys (262 žmonės, 62,6% moterų ir 37,4%vyrų; amžiaus vidurkis 46,97 metų).

Rezultatai. Abiejų grupių nuomonės vertinant įsipareigojimo socialiniu kapitalu požymius esmingai nesiskyrė ($p > 0,05$). Statistiškai reikšmingai nuomonės skyrėsi vertinant suartėjimą ($p < 0,05$; $t = 4,56$) ir susiejimą socialiniu kapitalu ($p < 0,05$; $t = 3,17$). Tikrinant nuomonių skirtumus tarp abiejų grupių poromis vyrai–vyrai ir moterys–moterys nustatytas statistiškai reikšmingas suartėjimo ($p < 0,05$; $t = 88,19$) ir susiejimo socialiniu kapitalu ($p < 0,05$; $t = 4,01$) požymių moterų vertinimo skirtumas.

Galima teigti, kad mažų miestelių žmonės, menkiau išsiugdę bendruomeniškumo bruožus, mažiau pasitiki ne artimais žmonėmis bei savivaldos ir valstybės institucijomis nei asmenys, veikiantys įvairiose bendruomenės grupėse.

Aptarimas ir išvados. Veikla bendruomenės grupėse palankiai ugdo bendruomeniškumą, taigi ir socialinio kapitalo stiprinimą, kuris yra prielaida bendruomenės narių gerovei. Suartėjimo socialiniu kapitalu požymis būdingesnis moterims nei vyrams.

Raktažodžiai: bendruomenė, bendruomeniškumas, įsipareigojimo socialinis kapitalas, suartėjimo socialinis kapitalas, susiejimo socialinis kapitalas.

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DYNAMICS OF VARIATION IN PHYSICAL CAPACITY OF ELDERLY PEOPLE

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ABSTRACT

Research background and hypothesis. Increase in physical capacity and fitness can lead to additional improvements in health status, which is so important for healthy aging. Most scientists emphasize the physical activity decline in people of all ages. Therefore, it is important to assess health-related physical capacity and encourage people of various ages to improve their health, physical fitness and the quality of their life. Hypothesis – a significant decline in physical capacity of the elderly will be identified during the research period.

Research aim – to identify the variation dynamics of physical capacity indices of elderly people.

Research methods. 60–69-year-old males and females were selected for the data analysis (n = 244). The anthropometric data and the physical capacity test results of trunk flexion, sit ups, balance and 1000 meter run were analysed. Physical capacity tests were carried out on the basis of the 'Eurofit' test methodology. The methods of descriptive statistics were used for the data analysis.

Research results. Body balance (43.8%) and aerobic capacity (20.8%) of the elderly males significantly declined ($p < 0.05$) during the experimental period. However, improvement in the flexibility of males 16.5% ($p < 0.05$) was identified. The capacity of trunk flexor muscles of elderly females improved significantly by 39.3%, while the balance – by 18.1% ($p < 0.05$). Analysis of the results in reference to gender showed that the balance, the capacity of trunk flexor muscles and aerobic capacity of elderly females increased significantly in comparison with males ($p < 0.05$). Nevertheless, the flexibility variation of males was higher than the one of females ($p < 0.05$) at the end of the research period.

Discussion and conclusions. The balance and aerobic capacity of elderly males significantly decreased, whereas the flexibility improved. The capacity of trunk flexor muscles and balance of elderly females resulted in a statistically significant increase. In reference to the gender aspect it was determined that the majority of physical capacity results of elderly females statistically significantly developed more than the physical capacity results of males.

Keywords: physical capacity, elderly people, 'Eurofit'.

INTRODUCTION

At different stages of human life, movement is an integral mechanical and biological process which is monitored by special educational programs and regulations of different sports (Kowalski et al., 2012). The content and forms of sports movement are determined by age, gender and needs (Warburton, Bredin, 2006). Human movement, especially one of elderly people, is a component of an educational system that encourages their social participation, self-expression, self-development, value system, quality of life and healthy ageing by reducing the risk of age-related diseases (Warburton, Bredin, 2006; Xue et al., 2012; Dale et al., 2013; Hobbs et al., 2013). Most scientists emphasize the physical activity decline in people of all ages (Bouchard, Rankinen, 2001; Doherty, 2003; Fitts, 2008). In addition, the authors note that physical activity, even below the recommended level, is directly related to the longer

maintenance of physical fitness and a lower risk of death in early old age (Xue et al., 2012) .

It is observed that more people are engaged in monotonous work activity requiring repeated muscle contractions or prolonged abnormal postural maintenance (Bouchard et al., 2001; Doherty, 2003). Such activities increase local muscle fatigue and even the risk of injuries, promote earlier physical fitness decline, fatigue, senile diseases (Warburton, Bredin, 2006; Xu, Murrell, 2008; Stone et al., 2010).

Most of the fatigue tests are based on muscle strength or capacity measurements during the performance of high-intensity exercises. The ability to activate skeletal muscles can add much importance to fatigue during this kind of exercises (Gandevia, 2001)It is believed that increasing physical activity of the elderly can delay the fatigue originating in central and peripheral nervous systems (Doherty, 2003; Selen et al., 2007; Gates, Dingwell, 2008). But, the effect of physical activity of the elderly on their health and capacity improvement as well as changes in the physical capacity of older people in prolonged period of time have not been fully investigated yet and remain unclear. The problem of how to assess the fitness of the elderly still stays unsolved (Kowalski et al., 2012). Therefore, the hypothetical assumption may be held that a significant decline in physical capacity of the elderly will be identified during the research period. The purpose of the research: to identify the variation dynamics of physical capacity of elderly people.

RESEARCH METHODS

Subjects. 244 elderly subjects volunteered to participate in this study. The participants were healthy, leading similar lifestyle, physically active elderly males and females, ranging from 60 to 69 years of age (anthropometric characteristics are presented in Table). Each subject read and signed a written informed consent form that was consistent with the principles outlined in the Declaration of Helsinki.

Physical capacity tests. For the assessment of physical capacity the methodology of the Eurofit test (Volbekienė, Kavaliauskas, 2002) was applied. We analysed the results of the following tests: trunk flexion, sit up, balance and 1000 meter run:

a) *Trunk flexion test* – the assessment of trunk movement capability. Technical measures: a chair, a ruler. Instructions: an initial position – sitting on a chair, one leg stretched out in the front, the other leg, as usual, bent at a right angle. A performer has to reach the stretched big toe with his one hand and continue. A performer has to place his feet as much as possible in front of himself. Trunk flexion is measured by a ruler's zero mark added to the top of the middle finger to the big toe of the foot. Results of the test are expressed by centimeters.
b) *Sit up test* – the assessment of abdominal muscle endurance. Technical measures: a mattress, a timer, an assistant. Instructions: a performer has to sit on a mattress with a straight back, hands spliced behind the head, legs bent at the knees at the angle of 90 degrees, the soles of feet rest on the mattress. During the test a performer has to lie down on his back, the shoulders have to touch the mattress, and then return to a sitting position so that the elbows touch the knees. After the command 'go' a performer has to repeat the exercise as many times as he can. The test is carried out in 30 seconds. The result of the test is expressed by repeats per 30 seconds.
c) *Balance test* – the level of overall body balance and motor capacity are assessed. Technical measures: a timer, a special metal turnpike. Instructions: a performer stands barefoot on a turnpike (according to its longitudinal axis) on one foot, trying to maintain stability as long as he can. If stability is lost and a performer touches the ground with the other foot, the time of the test is stopped. A performer gets one penalty point. When a performer takes the initial position he can continue the test and time is counted further. The test is carried out in 30 seconds. The result of test is expressed by penalty points per 30 seconds.
d) *1000 meter run test* – the assessment of aerobic capacity. Technical measures: an indoor stadium, a timer. Instructions: 25 participants stand 1 meter behind the start line. After the command 'on your marks' participants hold their positions at the start line. After the command 'go' participants start to complete the course as quick as they can. The result is expressed by minutes.

Experimental protocol. All subjects completed a form about their health condition before participating in the experiment. Then anthropometric measurements (height, weight) were carried out. After the initial measurements had been done, the participants performed the warm-up by themselves and then performed

Group		Subjects, n	Age, yrs	Height, cm	Weight, kg	BMI
Males	Mean (SD)	114	64,3 (4.9)	171.6 (4.7)	73.4 (5.1)	24.6 (3.1)
Females	Mean (SD)	130	64,5 (4.5)	161.3 (5.9)	66.6 (4.8)	25.9 (5.4)

Table. **Descriptive statistics of subjects. Values are means ± SD**

physical capacity tests, as described in paragraph 2.2. Before each test, the testees could make several pilot attempts. Among physical capacity tests the subjects rested approximately 10 minutes.

Data and statistical analysis. Data analysis was performed using the Statistical Package for Social Sciences (SPSS), version 17. All the data was expressed as the mean (x), standard deviation (SD) of the mean. The hypothesis concerning the differences among the means were verified using the Student's *t* test for independent and dependent variables. The differences in the means were regarded as statistically significant when error probability in reference to criteria was $p < 0.05$.

RESEARCH RESULTS

During the research period the results of elderly males performing the sit up test changed gradually (Figure 1), but the statistically significant change was observed only in 2006 and 2010. In recent years, the results of males' group were better, 15.3 and 19.2% compared with initial measurements ($p < 0.05$). Meanwhile, the results of females' group changed gradually during the period of investigation. Although the 2006–2009 year results were not significantly important, the statistically significant 14.5% improvement in performance ($p < 0.05$) was recorded in 2010 as well as in 2011 (25.2%) and 2012 (39.3%) ($p < 0.05$) (Figure 1). In the gender-specific analysis of the sit-up test data, the results of females' group increased significantly more than those of men's group in 2007–2009 and 2011–2012 ($p < 0.05$).

The results of balance test (Figure 2) confirmed that the results of male group significantly worsened 45.6% ($p < 0.05$) from 2005 to 2009. Although the results reached the 2005 level in 2010 but decreased repeatedly to 43.8% ($p < 0.05$) from 2011 to 2012 in comparison to initial measurements. The change dynamics of balance test results of female group was uneven over the experimental period. In 2006, the recorded balance test result decreased in 26.7% more than that of the initial investigation in 2005 ($p < 0.05$). Although minor changes were noticed during the 2007–2011 period, but the difference between the results of the test at the beginning and end of the tests carried out is statistically significant, and the result of balance improvement was 18.1% ($p < 0.05$) in 2012 (Figure 2). The gender-specific analysis revealed that the result dynamics of males' balance test in 2006 was more statistically significant than the one of females ($p < 0.05$) in comparison to initial tests. However, the female's balance results improved significantly during 2007–2009 and 2011–2012

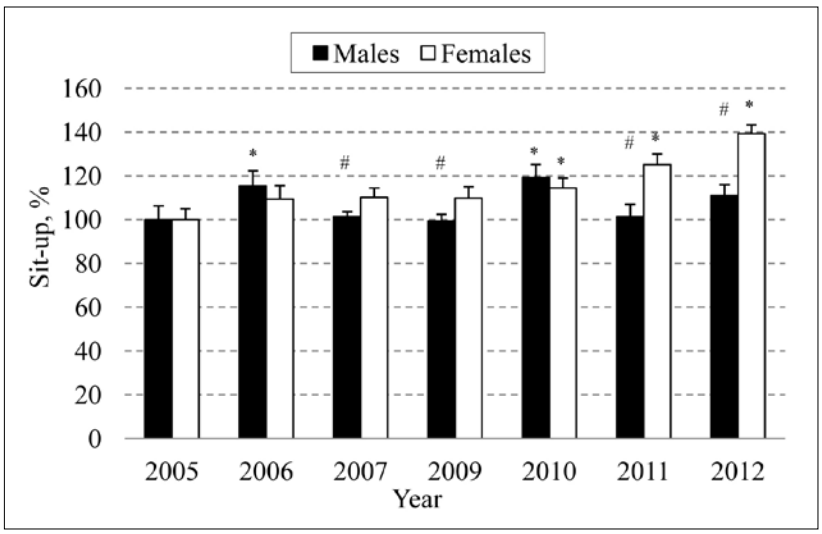


Figure 1. **Sit up test results of males and females**

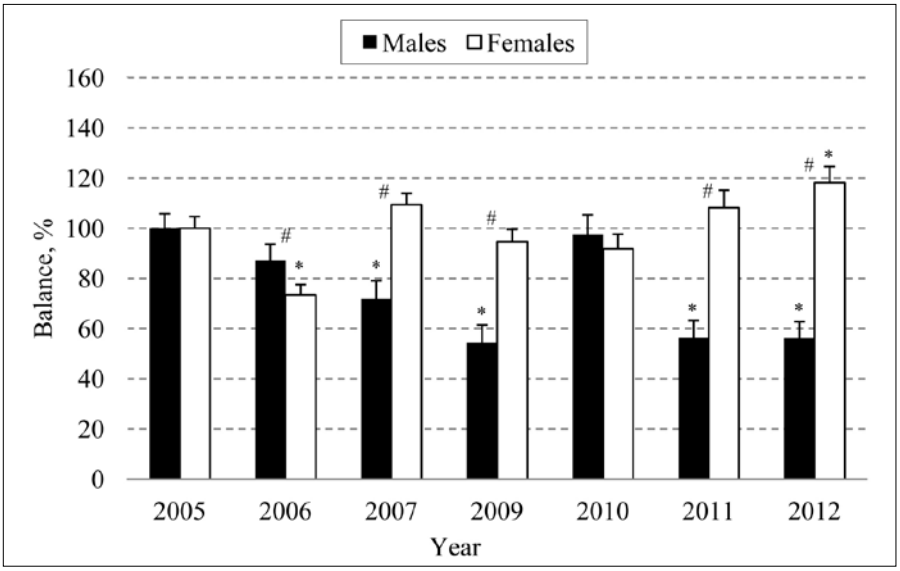
Note. * – $p < 0.05$ – compared to initial measurements; # – $p < 0.05$ – males and females compared.

years, while those of men declined, leading to a statistically significant difference between the genders ($p < 0.05$) (Figure 2).

The males' trunk flexion test results (Figure 3) were also statistically unstable during the research period. While the males' results regressed and progressed in time, the subjects' in 2007, 2010 and 2012, flexibility was significantly bigger 16.5% than one at the beginning of the testing period in 2005 ($p < 0.05$). Females' flexibility during the period remained stable. As a statistically significant 9.4% decrease in the results occurred only in 2011 ($p < 0.05$), no significant change in the results of the dynamics during the period has been established. The gender-specific analysis of the trunk flexion test resulted in the statistically significantly greater improvement in the flexibility of males' group than that of the females ($p < 0.05$) in 2010–2012.

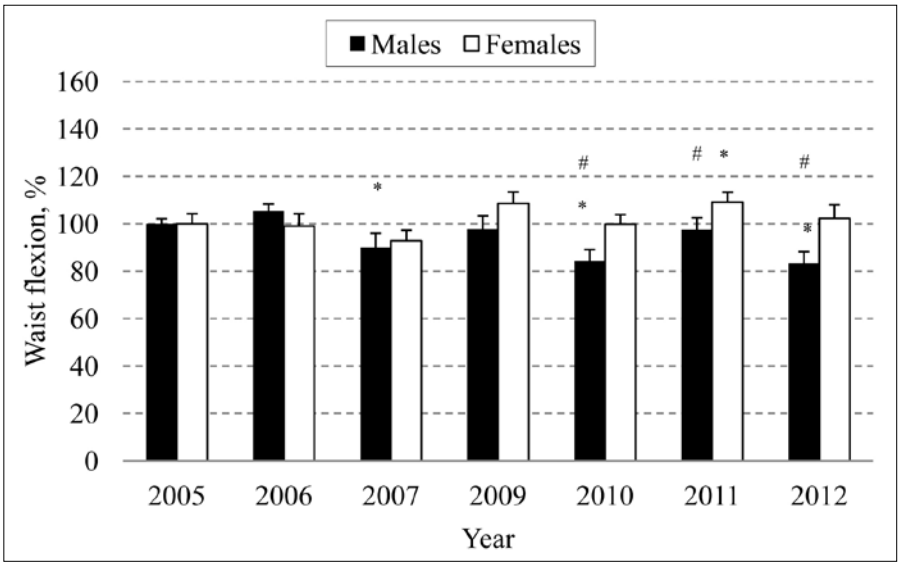
After the result analysis of the 1000-meter run test (Figure 4) it was found out that during the experimental period, the total aerobic capacity was associated with statistically significant changes only in the males' group. At the beginning of the research period (2007), males' run test results did not differ significantly from initial measurements (2006). However, the average aerobic capacity of males was significantly reduced by 20.8% ($p < 0.05$) in 2009 and remained significantly lower in the further experimental period 2010–2012 ($p < 0.05$). Meanwhile, no significant changes were noticed over the trial period in the 1000-meter run results of females and the results remained at the similar level. Gender analysis revealed that the males' aerobic capacity in 2009–2012 was reduced more significantly than the aerobic capacity of females ($p < 0.05$).

Figure 2. **Balance test results of males and females**



Note. * – $p < 0.05$ – compared to initial measurements; # – $p < 0.05$ – males and females compared.

Figure 3. **Trunk flexion test results of males and females**



Note. * – $p < 0.05$ – compared to initial measurements; # – $p < 0.05$ – males and females compared.

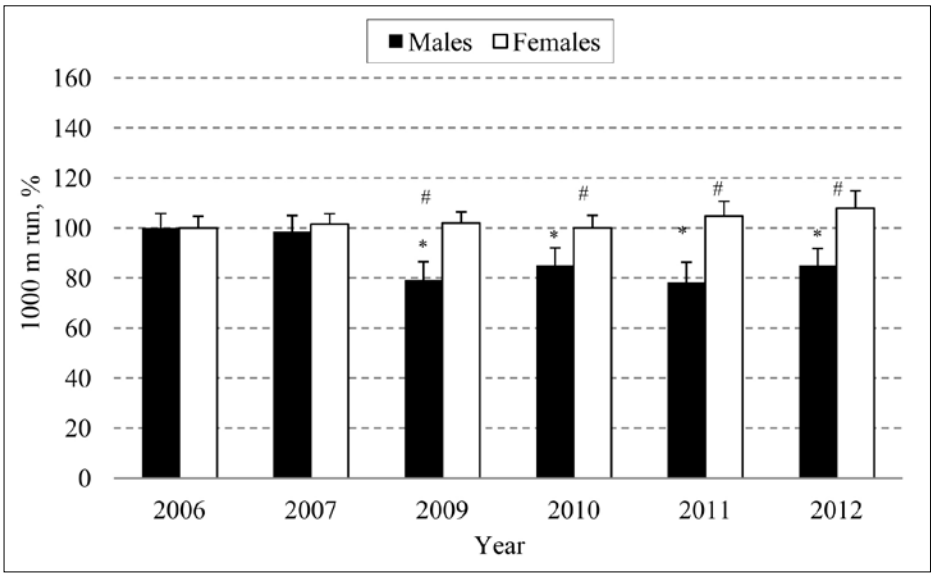


Figure 4. **1000 meter run test results of males and females**

Note. * – $p < 0.05$ – compared to initial measurements; # – $p < 0.05$ – males and females compared.

DISCUSSION

Recently, more researchers raise the hypothesis that increasing the physical activity of the elderly can delay the fatigue originating in central and peripheral nervous systems (Doherty, 2003; Selen et al., 2007; Gates, Dingwell, 2008) For these reasons, we expected to observe the tendencies of variation in the physical capacity of elderly people. However, the results of significantly reduced physical capacity were expressed only in older males, in the balance and 1000 meter run tests ($p < 0.05$).

Most authors emphasize the significant decline in physical activity in people of all ages (Bouchard, Rankinen, 2001; Doherty, 2003; Fitts, 2008). It is also mentioned that the current working conditions may result in physical capacity reduction, early fatigue, sarcopenia and other senile diseases of a lot of people in future (Warburton, Bredin, 2006; Fitts, 2008; Xu, Murrell, 2008; Stone et al., 2010). The research showed that the problem of balance loss is particularly relevant among the elderly, as the loss of balance increases the risk of falls and, consequently, injuries (Kurz et al., 2013) The cause of falls may appear muscle force that can affect the loss of balance, reaction powers, performance of several tasks simultaneously and poor sleep (Boelens et al., 2013).

Our case proved that the males' balance significantly decreased. The studies identified that elderly people who had had a history of falls with injuries, had greater postural fluctuations than those who experienced falls without injuries, and significantly poorer balance than the senior people with no falling history (Kurz et al., 2013). However, the females' balance during the period resulted in a statistically significant improvement ($p < 0.05$). Therefore, we can assume that changing life conditions (Bouchard, Rankinen, 2001) had no negative impact on the balance of senior women, so they were able to maintain and even improve their postural stability.

The performed study illustrated that the aerobic capacity of elderly men was significantly reduced ($p < 0.05$). Meanwhile, the women's aerobic capacity during the period remained at a similar level. Many scientists confirm that there is compelling evidence of the effect of physical activity on the prevention of primary and secondary chronic diseases (e. g, cardiovascular disease, diabetes, cancer, hypertension, obesity, depression or osteoporosis), and premature death (Warburton, Bredin, 2006; Xue et al., 2012; Dale et al., 2013; Hobbs et al., 2013). One of the most important indicators of physical capacity demonstrating the cardiovascular condition is aerobic capacity. According to the researchers, there is a direct correlation between physical activity and health, and thus, increasing physical activity, aerobic and working capacity would increase as well as improve general health status (Warburton, Bredin, 2006). Based on our study data, the males' aerobic capacity was significantly decreased during the research period, but it was a noticeable improvement in the results of sit-ups and flexibility ($p < 0.05$).

Our results confirm the statements made by M. F. Roma et al. (2013) that the nature of aerobic exercise does not have a significant impact on the older people's flexibility. Meanwhile, strength training can have a significant impact on the improvement of flexibility (Roma et al., 2013). While the aerobic capacity of elderly females remained unchanged during the period a significant improvement was noticed in the results of sit up test ($p < 0.05$). Despite the changes in trunk flexor muscle strength, females' flexibility results showed no improvement changes. These results do not coincide with the previously mentioned statements by the scientists M. F. Roma et al. (2013). However, the results confirm the statement by S. T. Sims et al. (2013) that aerobic capacity is not related to the elasticity of the muscle mass tending to decline among older women despite the level of physical activity.

According to the author Z. Milanović et al. (2013) physical capacity decline occurs equally in males and females, and this decline is related to the ageing process. According to the author, the differences among the elderly may be due to an individual's upper and lower limb muscle strength decrease, and the changes in body fat layer, flexibility, mobility and endurance (Milanović et al., 2013). Our survey data noted that most of the physical capacity tests (sit-ups, balance, and 1000 m running) were more significantly important for females than males.

The dynamics of result variation suggests that the physical activity and lifestyle of elderly males is insufficient to maintain the required physical capacity. Meanwhile, the physical activity of the studied elderly females was sufficient to maintain the required level of physical fitness in spite of the changing living conditions during the prolonged period of time. It is well known that both aerobic and strength training exercises can significantly improve the fitness of the elderly and health-related factors despite the age-related processes (Romero-Arenas et al., 2013). Taking into account the importance of physical capacity for life quality at old age, it is important to continue to record the physical capacity of the elderly and to monitor changes in parameters and their effect on the quality of life and old age.

CONCLUSIONS AND PERSPECTIVES

The balance and aerobic capacity of the elderly males have significantly decreased, whereas flexibility improved ($p < 0.05$). The trunk flexion muscle strength and balance of elderly females have significantly increased ($p < 0.05$). The gender-specific analysis showed that the majority of older females' physical capacity results statistically significantly improved more than those of males ($p < 0.05$).

REFERENCES

Boelens, C., Hekman, E. E, Verkerke, G. J. (2013). Risk factors for falls of older citizens. *Technology and Health Care*, Sep 27 [Epub ahead of print].

Bouchard, C., Rankinen, T. (2001). Individual differences in response to regular physical activity. *Medicine and Science in Sports and Exercise,* 33 (6), 46–51.

Dale, C. E., Bowling, A., Adamson, J. et al. (2013). Predictors of patterns of change in health-related quality of life in older women over 7 years: Evidence from a prospective cohort study. *Age and Ageing*. 3 (42), 312–318.

Doherty, T. J. (2003). Invited review: Aging and sarcopenia. *Journal of Applied Physiology,* 95 (4), 1717–1727.

Fitts, R. H. (2008). The cross-bridge cycle and skeletal muscle fatigue. *Journal of Applied Physioloy,* 104 (2), 551–558.

Gandevia, S. C. (2001). Spinal and supraspinal factors in human muscle fatigue. *Physiological Reviews*, 81 (4), 1725–1789.

Gates, D. H., Dingwell, J. B. (2008). The effects of neuromuscular fatigue on task performance during repetitive goal-directed movements. *Experimental Brain Research*, 187 (4), 573–585.

Hobbs, N., Godfrey, A., Lara, J. et al. (2013). Are behavioral interventions effective in increasing physical activity at 12 to 36 months in adults aged 55 to 70 years? A systematic review and meta-analysis. *BMC Medicine,* 1 (11), 75.

Kowalski, K., Rhodes, R., Naylor, P. J., Tuokko, H., MacDonald, S. (2012). Direct and indirect measurement of physical activity in older adults: A systematic review of the literature. *The International Journal of Behavioral Nutrition and Physical Activity*, 9, 148.

Kurz, I., Oddsson, L., Melzer, I. (2013). Characteristics of balance control in older persons who fall with injury: A prospective study. *Journal of Electromyography and Kinesiology*, May 10 [Epub ahead of print].

Milanović, Z., Pantelić, S., Trajković, N. et al. (2013). Age-related decrease in physical activity and functional

fitness among elderly men and women. *Journal of Clinical Interventions in Aging*, 8, 49–56.

Roma, M. F., Busse, A. L., Betoni, R. A. et al. (2013). Effects of resistance training and aerobic exercise in elderly people concerning physical fitness and ability: A prospective clinical trial. *Einstein (San Paulo, Brasil),* 11 (2), 153–157.

Romero-Arenas, S., Martínez-Pascual, M., Alcaraz, P. E. (2013). Impact of resistance circuit training on neuromuscular, cardiorespiratory and body composition adaptations in the elderly. *Aging and Disease*, 4 (5), 256–263.

Selen, L. P., Beek, P. J., van Dieën, J. H. (2007). Fatigue-induced changes of impedance and performance in target tracking. *Experimental Brain Research*, 181 (1), 99–108.

Sims, S. T., Kubo, J., Desai, M. et al. (2013). Changes in physical activity and body composition in postmenopausal women over time. *Medicine and Science in Sports and Exercise*, 45 (8), 1486–1489.

Stone, M. B., Edwards, J. E., Huxel, K. C. et al. (2010). Threshold frequency of an electrically induced cramp increases following a repeated, localized fatiguing exercise. *Journal* of *Sports Science,* 28 (4), 399–405.

Volbekienė, V., Kavaliauskas, S. (2002). EUROFITAS. 2-asis pat. ir papild. leidimas. Vilnius: Lietuvos sporto informacijos centras.

Warburton, D., Bredin, S. (2006). Health benefits of physical activity. *Canadian Medical Association Journal,* 7 (175), 773–776.

Xue, Q. L., Bandeen-Roche, K., Mielenz, T. J. et al. (2012). Patterns of 12-year change in physical activity levels in community-dwelling older women: Can modest levels of physical activity help older women live longer? *American Journal of Epidemiology,* 6 (176), 34–43.

Xu, Y., Murrell, G. A. (2008). The basic science of tendinopathy. *Clinical Orthopaedics and Related Research*, 466 (7), 1528–1538.

PAGYVENUSIŲ ŽMONIŲ FIZINIO PAJĖGUMO RODIKLIŲ KAITA

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Didesnis fizinis pajėgumas gali sukelti bendros pagyvenusių žmonių sveikatos gerėjimą. Autorių nuomone, įvairaus amžiaus žmonių fizinis aktyvumas ir pajėgumas mažėja. Taigi svarbu įvertinti įvairaus amžiaus žmonių fizinį pajėgumą ir skatinti juos gerinti gyvenimo kokybę sveikai gyvenant. Hipotezė: tiriamuoju laikotarpiu bus pastebimas ryškus pagyvenusių žmonių fizinio pajėgumo mažėjimas.

Tikslas – nustatyti pagyvenusių žmonių fizinio pajėgumo rodiklių kaitą.

Metodai. Duomenų analizei pasirinkti 60–69 m. amžiaus vyrai ir moterys. Tiriamoji imtis n = 244. Buvo analizuoti antropometriniai duomenys, „Liemens lenkimo“, „Sėstis ir gultis“, „Pusiausvyros“ ir „1000 metrų bėgimo“ testų rezultatai. Atliekant fizinio pajėgumo testus buvo vadovaujamasi Eurofito metodika. Duomenų analizei atlikti naudoti aprašomosios statistikos metodai.

Rezultatai. Tiriamuoju laikotarpiu pagyvenusių vyrų kūno pusiausvyra statistiškai reikšmingai suprastėjo (43,8%; $p < 0,05$), 20,8% sumažėjo jų aerobinis pajėgumas ($p < 0,05$), tačiau statistiškai reikšmingai pagerėjo (16,5%; $p < 0,05$) lankstumas. Pagyvenusių moterų liemens lenkiamųjų raumenų pajėgumas statistiškai reikšmingai pagerėjo 39,3%, pusiausvyra – 18,1% ($p < 0,05$). Analizuojant rezultatus lyčių požiūriu paaiškėjo, kad pagyvenusių moterų pusiausvyra, liemens lenkiamųjų raumenų ir aerobinis pajėgumas gerėjo statistiškai reikšmingai daugiau nei vyrų ($p < 0,05$). Visgi vyrų lankstumo kaita tiriamojo laikotarpio pabaigoje buvo didesnė nei moterų ($p < 0,05$).

Aptarimas ir išvados. Pagyvenusių vyrų pusiausvyra ir aerobinis pajėgumas statistiškai reikšmingai sumažėjo, lankstumas – pagerėjo. Statistiškai reikšmingai padidėjo pagyvenusių moterų liemens lenkiamųjų raumenų pajėgumas ir pusiausvyra. Lyginant tiriamuosius lyčių požiūriu nustatyta, kad daugumos pagyvenusių moterų fizinio pajėgumo rezultatai statistiškai reikšmingai pagerėjo labiau nei vyrų.

Raktažodžiai: fizinis pajėgumas, pagyvenę žmonės, Eurofitas.

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OBJECTIVELY MEASURED WEEKLY PHYSICAL ACTIVITY AMONG ADOLESCENT BOYS AND ITS RELATION TO HEALTH-RELATED PHYSICAL FITNESS

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ABSTRACT

Research background and hypothesis. The objective methods of measuring physical activity (PA) are used more and more widely in various types of research. However, in Lithuania there is a lack of such studies with adolescents. Thus, we conducted a pilot study to objectively measure boys' PA and to develop a more accurate PA assessment methodology in Lithuania.

The purpose of this study was to analyse the objectively measured adolescent boys' weekly physical activity and its relation to their body composition and physical fitness.

Research methods. The participants of this study were 104 healthy adolescent boys. Physical activity of schoolboys was measured using actigraphs (*Tri-axis ActiTrainer Activity Monitors*). The level of the intensity of physical activity was determined by calculating energy consumption in MET's. Low PA (LPA) equals up to 3 MET's, moderate PA (MPA) – 3–6 MET's, and vigorous PA (VPA) – 8 or more METs. Based on the frequency of VPA and MPA per week, the participants of this study were divided into physical activity groups. For health-related physical fitness assessment the following tests were used: body composition (using TANITA Body Analyser, TBF-300); flexibility (sit and reach test, *Eurofitas,* 2002), power (vertical jump was measured using a jump parameter gauge (SBM-1), muscular strength and endurance (modified push-up test (Suni et al., 1994)).

Research results. All of the schoolboys demonstrated LPA on each day of the assessment. MPA on each day was experienced by 59.6% of the boys. No participants achieved VPA . The most frequent MPA and VPA were observed 5–7 and 1–3 days per week, respectively. Results of body composition indicated that boys experiencing VPA had lower body fat mass compared to those who experienced only MPA and LPA ($p < 0.05$). Analysis of physical fitness results indicated that boys who experienced VPA were better muscular in strength and endurance test ($p < 0.05$), but results of high jump and sit and reach test were not significantly different.

*Discussion and conclusion***.** Boys who experienced VPA at least for 3 days/week demonstrated better muscular strength and endurance results and had lower body fat content (%) ($p < 0.05$). For boys who did not experience MPA at least for 6 days/week, the total amount of weekly physical activity decreased and they could not produce better results in strength and endurance test ($p < 0.05$). Better results of boys' muscular strength and endurance were significantly related to their body lower BMI ($r = 0.279$; $p < 0.05$) and fat mass ($r = 0.387$; $p < 0.01$).

Keywords: physical activity, MET's, actigraphs.

INTRODUCTION

Physical activity is suggested to be an essential part of everyday life, especially during growth and rapid development of school-aged children. The benefits of PA are numerous: it has a positive effect on the prevention of various diseases in schoolchildren (Rankinen, Bouchard, 2002) and on their cognitive development (Burdette, Whitaker, 2005), it increases self-esteem and controls the levels of anxiety and stress, normalizes the state of mind (Burdette, Whitaker, 2005), and certainly it affects the level of physical fitness (PF) (Dencker et al., 2006). It is suggested that physical

fitness is an integrated dimension of most, if not all, functions of the organism related with physical activity (Ortega et al., 2008).

Physical activity plays an important role in the prevention of becoming overweight and obese in children and adolescents, reducing the risk of obesity and positively influencing health status in adulthood (Matton et al., 2006). Puberty and the following adolescent period are acknowledged as particularly vulnerable times for the development of obesity due to sexual maturation and, in many individuals, a concomitant reduction in physical activity (Hills et al., 2011). The prevalence of obesity among children and adolescents has increased dramatically since the mid-1970 s in many countries throughout the world (Lobstein et al., 2004).

Current physical activity recommendations state that adolescents should be active for a total of at least an hour a day, children at the beginning of school age – considerably more (*The National Guidelines on Physical Activity for Ireland*, 2009). Despite all these health benefits many children all over the World do not meet these guidelines (Malina, Katzmarzyk, 2006; Samdal et al., 2007).

Most physical activity data are available for children and adolescents, 10 years of age and older, and are based largely on questionnaires and interviews. Physical activity is very difficult to measure and there is no gold standard measurement for daily physical activity. There are more than 30 different methods of assessing physical activity. Some of them have been identified, but validity, objectivity and reliability of these methods have not been enough established with children and adolescents (Sirard, Pate, 2001; Trost, 2001). M. Dencker and L. B. Andersen (2008) presented an excellent review of the use of accelerometers for the measurement of daily physical activity in children. In recent years, accelerometers (Actigraph) have gained popularity as an objective measurement device for daily physical activity (Ottevaere et al., 2011). The ActiTrainer is the first and most common tool for accurate monitoring of physical activity during 24-hour and longer period, but the data of the duration, intensity and scope of children's and adolescent's every day activity, according to WHO (*World Health Organization*) recommendations are insufficient. Moreover, there is a lot of research devoted to interrelations of not objectively measured physical activity and physical fitness. So, the **purpose** of this study was to analyse the objectively measured adolescent boys' weekly physical activity and its relation to health-related physical fitness.

RESEARCH METHODS

The participants of this study were 104 healthy adolescent boys (15.3 ± 0.06 years of age; 63.0 ± 1.32 kg of weight, and 175.8 ± 0.78 cm in height). The boys were selected using cluster screening, i.e. the schools were randomly selected, and their 9th grade schoolboys were randomly invited to take part in the assessment. Initially, the data was collected from 112 boys, but 8 cases were withdrawn from the final analysis due to incomplete results (not all participants performed physical fitness tests) and failure to wear the monitor throughout the defined period of time. All participants and their parents or legal guardians gave an informed consent to take part in the study. The time and location of the measurements to be taken were agreed upon in advance with the administration of the schools as well as teachers. The volunteers were free to withdraw from the study at any time without any consequences.

Assessment of physical activity (PA). The physical activity of schoolboys was measured using actigraphs (*Tri-axis ActiTrainer Activity Monitors*). The level of the intensity of physical activity was determined by calculating energy consumption in METs; bouts of physical activity (PA) had to last for at least 10 minutes without interruptions. Low PA (LPA) equals up to 3 MET's, moderate PA (MPA) – 3–6 MET's, and vigorous PA (VPA) – 8 or more MET's. Based on the frequency of vigorous (VPA) and moderate physical activity (MPA) per week, the participants of this study were divided into physical activity groups. Boys were asked to wear the monitors for 7 consecutive days, i. e. the whole week.

Assessment of health-related physical fitness was estimated by measuring the following components:

1) *body composition* (body weight, BMI, body fat mass in per cent and kg, lean body mass) was accessed using TANITA Body Analyser (TBF-300);
2) *flexibility* (sit and reach test, *Eurofitas,* 2002),
3) *explosive power* (vertical jump was measured using a jump parameter gauge (SBM-1),
4) *muscular strength and endurance* (modified push-up test, Suni et al., 1994).

Appropriate statistical methods (mean, (x) and the *standard deviation* (SD), *one-way analysis of variance* (ANOVA) and Pearson's correlation based upon the research design were applied.

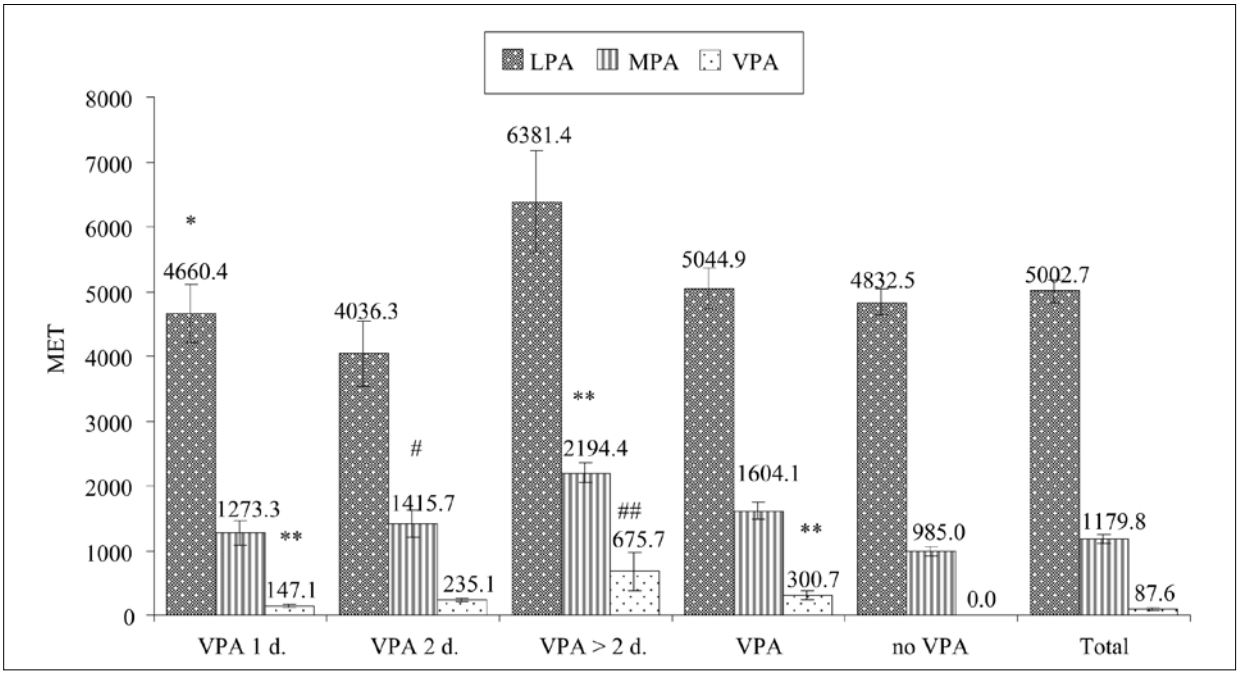
A significance level of 0.05 was used. Statistical analysis was carried out using SPSS 14.0 package for Windows.

RESEARCH RESULTS

All of the schoolboys experienced LPA on each day of the assessment. MPA on each day was experienced by 59.6% of the boys. No participants had achieved VPA. The frequency of MPA and VPA experienced most often was 5–7 and 1–3 days per week, respectively. The total PA measured during the week was largely comprised by LPA, i. e. 79.8%; MPA and VPA were 18.8 and 1.4%, respectively. Results indicated that boys experiencing VPA 3 or more days/week had significantly lower BMI than those who experienced VPA on 1 day/week, not experiencing VPA at all during the week, or than those who experienced MPA 6 days/week ($p < 0.05$) (Figure).

For the analysis of health related physical fitness components the participants were divided into the groups according to the frequency of experienced Vigorous PA during the week (Table 1) and the frequency of experienced Moderate PA during the week (Table 2). Results of body composition indicated that boys experiencing VPA had lower body fat mass and lower BMI compared to those who experienced only VPA and LPA ($p < 0.05$). Body water level (%), on the contrary, were higher in groups were the boys experienced vigorous PA compared to groups with no vigorous PA and moderate PA. Analysis of separate physical fitness results indicated that boys who experienced VPA were better in muscular strength and endurance test – modified push up test ($p < 0.05$), but results of high jump and sit and reach test were not significantly different. Analysis of sit and reach test even showed that boys experiencing vigorous PA once a week demonstrated better results compared to those experiencing vigorous PA 2 times/ week ($p < 0.05$). However, statistical significant differences ($p > 0.05$), were not established, but a tendency was observed that boys experiencing moderate PA 7 days week had lower BMI and body fat content, and they demonstrated better results in sit and reach test ($p > 0.05$) (Table 2).

No significant correlation was found between total amount of PA, time spent for vigorous and moderate PA and health-related physical fitness components. Only high jump test results were closely related to body composition, weak significant correlations were found between BMI, body fat and body water ($r = 0.279–0.387$; $p < 0.05$).



Note. * – $p < 0.05$ comparing with the groups of VPA experienced more than 2 days/week; ** – $p < 0.05$ comparing with all of the groups except VPA 2 days/week; # – $p < 0.05$ comparing with a group having experienced no VPA group; ## – $p < 0.05$ comparing with all groups.

Figure. **The intensity-based weekly physical activity of the adolescent boys (the participants were divided into the groups according to the frequency of the experienced VPA during the week)**

Physical activity	BMI	FAT, %	Body water, %	High Jump, cm	Sit and reach, cm	Push up, n/40 s
Vigorous PA 3 d. and >	18.2#	7.7	67.4**	37.9	19.9	18.2
Vigorous PA 2 d.	20.6	11.0	65.2	36.8	14.8	16.9
Vigorous PA 1 d.	22.0	14,65*	62,6	37.5	23,94***	16.9
Vigorous PA	20.4	11.5	64.8	37.4	19.7	17.24***
no Vigorous PA	21.5	12.6	64.0	38.4	20.1	18.9

Table 1. **Health-related physical fitness of the adolescent boys who experienced/did not experience vigorous PA**

Note. * – $p < 0.05$, comparing with the groups of VPA experienced 3 days/week and more; ** – $p < 0.05$, comparing with the groups of VPA experienced less than 1 days/week; *** – $p < 0.05$, comparing with the groups of MPA experienced more than 2 days/week; # – $p < 0.05$, comparing with "VPA 1 day/week", "no VPA".

Physical activity	BMI	FAT, %	Body water, %	High Jump, cm	Sit and reach, cm	Push up, n/40 s
Moderate PA 7 d.	20.8	11.9	64.5	38.1	20.8	18.2
Moderate PA 6 d.	21.6	12.4	64.2	37.8	19.6	18.9
Moderate PA < 6 d.	21.3	13.2	63.6	38.7	17.3	17.3

Table 2. **Health-related physical fitness of the adolescent boys who experienced/did not experience moderate PA**

DISCUSSION

The purpose of this study was to estimate physical activity levels among 15–16-year-old adolescents by using objective measurement. Most of previous Lithuanian adolescents' physical activity data were largely based on questionnaires and interviews (Rutkauskaitė et al., 2011). It was established that total amount of PA was 7622 MET's/week. In comparison with data based on subjective IPAQ questionnaire, the total amount of PA among adolescents was quite different (Rutkauskaitė et al., 2011). Similar results were presented in HELENA study, where poor to fair correlations between the two methodologies were found for the whole study sample and were stratified by age and gender (Ottevaere et al., 2011).

The use of actigraphy helps accurately quantify not only the total amount of activity, but ideally register the amount of low, moderate, and vigorous habitual physical activity accrued during the daily life. It is well established that regular physical activity (PA) has many short- and long-term benefits for health (Katzmarzyk, Craig, 2006). Despite these benefits many children, adolescents and adults do not engage in recommended amounts of physical activity (Malina, Katzmarzyk, 2006; Samdal et al., 2007). In order to gain benefits for health, all activities have to be at least 10 min duration that can be added up. As optimal development for children and adolescents requires a full variety of exercise and sports, within or in addition to, the daily "minimal hour" activities carried out several times a week for at least 10 minutes, which increases bone strength, stimulates the cardio-vascular system, increases muscle strength, maintains flexibility and body composition (*The National Guidelines on Physical Activity for Ireland*, 2009). In our research boys experiencing VPA were better in muscular strength and endurance, but there were differences in power and flexibility results ($p > 0.05$).

Decreased levels of PA in schoolchildren may be related to their physical fitness levels and number of children with overweight and obesity (Hills et al., 2011). Evidence exists that PA may be positively related with the changes in body composition parameters, which is mainly connected with the decrease of fat mass and increase of lean body mass, but not with the changes of body mass or BMI (Carrel et al., 2005). R. M. Malina and P. T. Katzmarzyk (2006) stated that mostly components of physical fitness change with growth and maturation independently of physical activity, and it is difficult to partition effects of activity from the expected changes. The relationships appear to be confounded to some degree by body fatness (Twisk et al., 2000; Hills et al., 2011) which indicates that physical activity may not provide complete protection from the health risks of obesity in children. As both physical activity and fitness have been found to be related over the lifespan

(Twisk et al., 2000), it is important that children establish positive lifestyle habits and healthy levels of fitness at an early age.

Although overweight or obesity are not common among Lithuanian children yet, evidence exists that overweight in children prevails when acceleration rate is stabilized or even decreased (Jankauskienė, 2008). Results of our research showed that boys experiencing vigorous PA had lower body fat mass and lower BMI in comparison with those who experienced only VPA and LPA ($p < 0.05$).

Findings from this study should be interpreted in light of several limitations. The sample size is small and requires replication with a larger sample. Additionally, while actigraphy is an objective measure of PA, it would be interesting to compare data from not objectively measured PA, e. g. questionnaires.

CONCLUSIONS AND PERSPECTIVES

Boys who achieve VPA have a greater total physical activity during the week than those boys who do not experience VPA. If during the week boys have VPA on more than 2 days, even if it is just for 10 min, there is a significant increase in the total amount of weekly physical activity, which is related to lower fat mass. For boys who do not experience MPA at least for 6 days/week, the total amount of weekly physical activity decreases and they cannot produce better results in strength and endurance test ($p < 0.05$). Better results of boys' muscular strength and endurance were significantly related to lower BMI ($r = 0.279$; $p < 0.05$) and fat body mass ($r = 0.387$; $p < 0.01$).

REFERENCES

Burdette, H. L., Whitaker, R. C. (2005). Resurrecting free play in young children: Looking beyond fitness and fatness to attention, affiliation, and affect. *Archives of Paediatrics & Adolescent Medicine,* 159, 46–50.

Carrel, A. L., Clark, R. R., Peterson, S. E. et al. (2005). Improvement of fitness, body composition, and insulin sensitivity in overweight children in a school-based exercise program: A randomized controlled study. *Archives of Paediatrics & Adolescent Medicine*, 159, 963–968.

Dencker, M., Andersen, L. B. (2008). Health related aspects of objectively measured daily physical activity in children. *Journal of Clinical Physiology and Functional Imaging*, 28, 133–144.

Dencker, M., Thorsson, O., Karlsson, M. K. et al. (2006). Daily physical activity and its relation to aerobic fitness in children aged 8–11 years. *European Journal* of *Applied Physiology*, 96 (5), 587–592.

Eurofitas. Fizinio pajėgumo testai ir metodika, Lietuvos moksleivių fizinio pajėgumo rezultatai. (2002). Sud. V. Volbekienė. Vilnius: LSIC.

Hills, A. P., Andersen, L. B., Byrne, N. M. (2011). Physical activity and obesity in children. *British Journal of Sports Medicine*, 45 (11), 866–870.

Jankauskienė, R. (2008). Lietuvos gyventojų fizinio aktyvumo skatinimo strategija: kūno kultūra ar kūno kultas? *Medicina* (Kaunas), 44 (5), 345–355.

Katzmarzyk, P. T., Craig, C. L. (2006). Independent effects of waist circumference and physical activity on all-cause mortality in Canadian women. *Applied Physiology*, *Nutrition, and Metabolism,* 31 (3), 271–276.

Lobstein., T., Baur, L., Uauy, R. (2004). Obesity in children and young people: A crisis in public health. *Obesity Reviews*, 5 (1), 74–85.

Malina, R. M., Katzmarzyk, P. T. (2006). Physical activity and fitness in an international growth standard for preadolescent and adolescent children. *Food and Nutrition Bulletin*, 27, (4), 295–313.

Matton, L., Thomis, M., Wijndaele, K. et al. (2006). Tracking of physical fitness and physical activity from youth to adulthood in females. *Medicine and Science in Sport and Exercise*, 38 (6), 1114–1120.

Ortega, F. B., Artero, E. G., Ruiz, J. R. et al. (2008). Reliability of health-related physical fitness tests in European adolescents. The HELENA Study. Reliability of fitness assessment in adolescents. *International Journal of Obesity,* 32, 49–57.

Ottevaere, C., Huybrechts, I., de Bourdeaudhuij, I. et al. (2011). Comparison of the IPAQ-A and Actigraph in relation to VO_2max among European adolescents: The HELENA study. *Journal of Science and Medicine in Sport*, 14, 317–324.

Rankinen, T., Bouchard, C. (2002). Genetics and blood pressure response to exercise, and its interactions with adiposity. A review. *Preventative Cardiology*, 5, 138–144.

Rutkauskaitė, R., Emeljanovas, A., Volbekienė, V. et al. (2011). Relationship between physical activity and health-related physical fitness in 16-year-old boys. *Ugdymas. Kūno kultūra. Sportas*, 1 (80), 56–62.

Samdal, O., Tynjälä, J., Roberts, C. et al. (2007). Trends in vigorous physical activity and TV watching of adolescents from 1986 to 2002 in seven European Countries. *European Journal of Public Health*, 17, 242–248.

Sirard, J. R., Pate, R. R. (2001). Physical activity assessment in children and adolescents. *Sports Medicine,* 31, 439–454.

Suni, J., Oja P., Laukkanen, R. et al. (1994). *Test Manual for the Assessment of Health Related Fitness*. Finland, Tampere: President Urko Kaleva Kekkonen Institute for Health Promotion Research.

The National Guidelines on Physical Activity for Ireland. (2009). Department of Health and Children, Health Service Executive.

Trost, S. G. (2001). Objective measurement of physical activity in youth: Current issues, future directions. *Exercise and Sport Science Review*, 29, 6–32.

Twisk, J. W., Kemper, H. C., Mechelen, W. (2000). Tracking of activity and fitness and the relationship with cardiovascular disease risk factors. *Medicine and Science in Sports and Exercise*, 32, 1455–1461.

OBJEKTYVIAI NUSTATYTAS PAAUGLIŲ BERNIUKŲ SAVAITINIS FIZINIS AKTYVUMAS IR JO SĄSAJOS SU SVEIKATA SUSIJUSIU FIZINIU PAJĖGUMU

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Objektyvūs fizinio aktyvumo (FA) nustatymo metodai pasaulyje plačiai naudojami, tačiau Lietuvoje tokio pobūdžio metodika taikoma itin retai. Taigi buvo atliktas bandomasis tyrimas objektyviai nustatant berniukų FA ir norint pradėti plėtoti tikslesnę FA nustatymo metodiką Lietuvoje.

Tikslas – išanalizuoti paauglių berniukų objektyviai nustatytą savaitinį fizinį aktyvumą ir jo sąsajas su sveikata susijusiu fiziniu pajėgumu.

Metodai. Buvo tiriami 104 sveiki paaugliai berniukai. Mokinių FA nustatytas naudojant *Tri-axis ActiTrainer Activity Monitor* prietaisus. Berniukų prašyta prietaisus nešioti savaitę. Jie privalėjo fiksuoti fizinę veiklą kas minutę. Analizuojant fizinio aktyvumo duomenis FA standartizuotas pagal energijos suvartojimą, t. y. intensyvumo lygius. Remiantis tyrimo metu naudojamo fizinio aktyvumo prietaiso (*Tri-axis ActiTrainer Activity Monitor*) rekomendacijomis, analizuojant duomenis naudotos tokios MET'ų reikšmės: mažas FA (MFA) – iki 3 MET'ų, vidutinis (VFA) – 3–6 MET'os ir didelis (DFA) – 8 ir daugiau MET'ų. Tiriamieji buvo suskirstyti į FA grupes pagal patiriamą didelio ir vidutinio FA dažnį per savaitę. Su sveikata susijęs fizinis pajėgumas nustatytas matuojant kūno kompoziciją (*TANITA Body Analyser*, TBF-300 prietaisu), lankstumą („Sėstis-siekti" testu – *Eurofitas,* 2002), staigiąją jėgą (SBM-1 prietaisu), raumenų jėgą ir ištvermę (Modifikuotu atsispaudimų testu – Suni et al., 1994).

Rezultatai. Visi tirti berniukai patiria MFA kiekvieną dieną, VFA – 59,6% tiriamųjų, o DFA kasdien patiriančių nenustatyta. Tiriamieji patiria VFA dažniausiai 5–7 dienas per savaitę, DFA – dažniausiai nuo 1 iki 3 dienų per savaitę. Kūno kompozicijos duomenų analizė parodė, kad berniukai, patiriantys DFA, turėjo mažesnį kūno riebalinio audinio kiekį (%), lyginant su patiriančiais tik VFA ir MFA. DFA patiriantys berniukai demonstravo geresnius raumenų jėgos ir ištvermės rezultatus ($p < 0,05$), tačiau staigiosios jėgos ir lankstumo testų rezultatai statistiškai reikšmingai nesiskyrė.

Aptarimas ir išvados. DFA patiriančių berniukų raumenų jėgos ir ištvermės rezultatai buvo geresni ir jie turėjo mažesnį kūno riebalinio audinio kiekį ($p < 0,05$). Berniukai, nepatiriantys VFA mažiausiai šešis k./sav., tuo pačiu sumažina bendrąją FA apimtį, jų raumenų jėgos ir ištvermės rezultatai prastesni. Geresni raumenų jėgos ir ištvermės rezultatai statistiškai reikšmingai susiję su mažesniu KMI ($r = 0,279$; $p < 0,05$) bei riebalinio audinio kiekiu ($r = 0,387$; $p < 0,01$).

Raktažodžiai: fizinė veikla, metos, aktigrafai.

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THE TIME COURSE OF OXYGEN UPTAKE, AEROBIC CAPACITY AND EMG DURING TWO MONTHS OF MODERATE INTERVAL ENDURANCE TRAINING (A CASE STUDY)

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ABSTRACT

Research background and hypothesis. The low-moderate-intensity continuous endurance training improved body composition, aerobic capacity and overall health-related parameters in healthy persons. However, we could not find publications about the effect of moderate interval aerobic endurance training (IET) on body composition, $\dot{V}O_2$ kinetics, aerobic capacity and EMG parameters.

Research aim. The main purpose of this study was to examine the effect of interval endurance training (IET) on oxygen uptake kinetics, aerobic capacity, body composition and EMG parameters.

Research methods. A 26-year-old, sedentary obese female (stature – 1.80 m; weight – 99.2 kg; VO_2max – 37.2 ml/kg^{-1}/min^{-1}) was involved in two-month moderate interval endurance training (IET). The subject performed three training sessions a week separated by one or two days of rest. The initial intensity of training was 90% of the first ventilation threshold (VT1). The VT1 and second ventilation threshold (VT2) ware estimated after completion of incremental running test until exhaustion on a LE 200 CE treadmill (VIASYS, Germany).

Research results. We determined that after two months IET subject' body mass decreased by 10%, the training had an effect on aerobic capacity parameters as well. The running speed at VT1 and VT2 increased by 8.1% and 10.2% respectively after the two-month IET programme. The heart rate (165.9 beats/min^{-1}) and oxygen uptake (2.583 l/min^{-1}) significantly decreased respectively (150.4 beats/min^{-1}) (2.285 l/min^{-1}) after IET period compared with pre-training testing. To indicate the total muscle activity we measured integrated EMG (iEMG) and root mean square (RMS). We also determined changes on EMG parameters after four, six and eight weeks IET.

Discussion and conclusions. Two-month moderate interval endurance training has significant effect on aerobic capacity, anthropometrics, EMG parameters and VO_2 kinetics.

Keywords: ventilatory thresholds, maximal oxygen uptake, EMG root mean square.

INTRODUCTION

It is well established that low-to-moderate-intensity continuous endurance training has been the most common type of exercise recommended to improve body composition, aerobic capacity and overall health-related parameters in healthy (Donnelly et al., 2009) and obese people (McInnis et al., 2003). Several studies showed that endurance and high intensity training induced similar metabolic, cardiorespiratory system and skeletal muscle molecular adaptations in healthy humans (Burgomaster et al., 2008; Rakobowchuk et al., 2008) and in obese children (Corte et al., 2012). Also, M. J. Gibala et al. (2006) observed that two-week endurance training improved exercise performance and maximal activity. The oxygen uptake (VO_2) at the ventilatory thresholds and maximal oxygen uptake (VO_2max) led to significant improvement after combined (consisting of continuous and interval load) endurance training (Carter et al., 2000).

I. E. Schjerve et al. (2008) demonstrated that high intensity aerobic interval training had a higher effect on VO_2max than moderate intensity training.

Previous studies examining the effect of training on VO_2 kinetics typically used a more "traditional" exercise training regime (i. e. continuous endurance exercise at – 60–65% VO_2max, for 30–120 min) (Philips et al., 1995; Carter et al., 2000). However, different training has various effects on VO_2 kinetics. It was determined that endurance exercise training (4–6 wk.) had an effect on VO_2 kinetics during the transition to moderate intensity exercise, a significant reduction in time constants for VO_2 (tVO_2) was reported after only 4 days of training (Phillips et al., 1995).

The VO_2max, VO_2 kinetics parameters are related to electrical activity of skeletal muscles. The surface electromyography (EMG) signals such as amplitude (integrated EMG (iEMG), root mean square or (RMS)) and power spectrum (mean power frequency (MPF)) are commonly used to assess the level of muscle fatigue or changes in motor units during static and dynamic exercises (Farina et al., 2004). It is already known that the amplitude of iEMG increases and it means that fast-twitch fibres are gradually recruited during exhausting exercises and constant-load exercise (Shinohara, Moritani, 1992). It is likely that both type I and II fibres are recruited at the onset of exercise, and that as intense exercise progresses, a greater proportion of type II fibres are recruited as type I fibres become fatigued (Krustrup et al., 2004 b).

There are several studies which try to explain the effect of different training on aerobic capacity, VO_2 kinetics. For the first time we are trying to explain the effect of moderate intensity interval training on cardiorespiratory system and EMG parameters in **sedentary obese women.** We hypothesized that a two-month interval endurance training would have a positive effect on body composition, VO_2 kinetics, aerobic capacity and EMG parameters in sedentary **obese** subject. Therefore, the purpose of this study was to examine the effect of IET on body composition, oxygen uptake kinetics, aerobic capacity and EMG parameters.

RESEARCH METHODS

Participant. A 26-year-old untrained female (stature – 1.80 m; weight – 99.1 kg; VO_2max – 37.2 $ml/kg^{-1}/min^{-1}$) was involved in 8-week moderate interval endurance training (IET). The experimental protocol was approved by the Lithuanian Ethics Committee of Kaunas University of Medicine (No. BE-2-68).

Training Programmes. The two-month IET session consisted of 8 repetitions of the following intervals: 4 min running of constant moderate intensity followed by 2 min walking (at 5 km/h) and 2 min rest periods. The participant performed 3 trainings sessions a week separated by 1–2 days of rest. The intensity of IRT was 90% of the first ventilation threshold (VT1).

Incremental running test. The participant performed incremental running test (IRT) until exhaustion on a LE 200 CE treadmill (VIASYS, Germany). The subject was standing on the sides of treadmill 2 minutes till the speed increased to 7 km/h^{-1}, then she constantly ran for 4 minutes (7 km/h^{-1}), at the end of this period the load was increased incrementally (0.1 km/h^{-1}per 6 s) to maximum 20 km/h^{-1}speed, then the slope was raised (0.05% per 6 s) until the subject stopped the treadmill due to fatigue.

Pulmonary gas exchange date collection. Pulmonary gas exchange parameters (VO_2; VCO_2 Ve) were measured breath-by-breath throughout all IET and IRT using wireless portable spirometry system "Oxycon mobile" (VIASYS Healthcare; California, USA). Prior to each test, the portable spirometry system was calibrated. The first and second (VT2) ventilation thresholds and VO_2max were evaluated during the IRT on a LE 200 CE treadmill (VIASYS, Germany). The average value of VO_2 over the last 15 s of running was referred to as VO_2max.

Determination of ventilatory thresholds. VT1 ir VT2 were established according to the dependence of pulmonary ventilation as well as ventilation equivalents of oxygen (Ve/VO_2) and carbon dioxide (Ve/VCO_2) at the end of expiration on the work intensity performing IRT. VT1 was considered to be the intensity of the work load when the Ve increase accelerated for the first time, and the Ve/VO_2 started increasing without any changes in the Ve/VCO_2. VT2 was the intensity of the work load when the Ve increase accelerated for the second time, and the Ve/VCO_2 started increasing even faster with the increase in the Ve/VO_2.

Blood lactate concentration. Blood sample (25μl) for the measurement of blood lactate concentration ([La]) (Accutrend Portable Lactate Analyser, Roche, Germany) was taken from fingertips.

Heart rate (HR) was continuously recorded every 5 s using a wireless Polar monitoring system (S810 Polar, Finland) during IET and IRT.

Anthropometric data. The subject's body composition components (body mass, free fat mass and fat mass) were measured using body composition analyser (*Tanita*, Japan).

EMG recording. Bipolar Ag-AgCI surface electrodes were used for surface electromyography (sEMG) recordings (silver bar electrodes, diameter 10 mm, centre-to-centre distance 20 mm) of right leg *m. vastus lateralis* (m. VL), *m. vastus medialis* (m. M) and *m. gastrus lateralis* (m. GL), *m. gastrus medialis* (m. GM) (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 IET, the electrode location was marked on the skin with an indelible marker. The electrodes were placed $2/3^{-1}$ on m. VL and 80% way on m. VM. Respectively m. GL were placed $1/3^{-1}$ of the line between the head of the fibula and the heel and m. GM on the most prominent bulge of the muscle. The ground electrode was positioned on the wrist of the left hand. The EMG parameters integrated electromyogram (iEMG), root mean square (RMS) of sEMG values were consistently taken during the course of IET.

Experimental protocol. The participant was familiarized with the research and signed informed consent to participate in it, she was tested under the same conditions. The participant performed three IRT on a treadmill – a control test, after 1 and 2 months of IET periods. The participant was included in a 2-month IET programme. The training frequency was 3 times per week, separated by 1–2 days of rest. The blood lactate concentration was measured on the 5^{th} and 20^{th} minutes of rest after IRT. VO_2, HR parameters were measured during all tests (IRT, IET). The EMG parameters of right leg muscles and anthropometric parameters (body mass, free fat mass and fat mass) were measured every two weeks.

Statistical analysis. Descriptive data were expressed as mean values and standard deviations (SD). Comparisons between the four tests were made by nonparametric statistics and significant results were further analysed using Friedman ANOVA and Kendall's Concorde test. Statistical significance was accepted when $p < 0.05$.

RESEARCH RESULTS

Anthropometric data. After two months of IET the subject's body mass, fat mass (kg), free fat mass (FFM) (kg) decreased respectively by 8.5, 17.2 and 3.5%, compared to the first testing (Table 1).

Table 2 shows the effect of the two-month IET on the aerobic capacity that was measured during IRT. The maximal running speed, relative VO_2max, HRmax increased respectively by 7.0, 9.4 and 4.9% after IET compared to control testing. The alteration of aerobic capacity parameters at the VT1 and VT2 were different. The speed of running at VT1 and VT2 increased respectively by 8.1 and 10.2% after a two-month IET programme. HR at the VT1 increased by 7.8% and at the VT2 – by 6.3% after one month of IET, but it decreased respectively by 1.7 and 2.1% after two months of IET programme compared to middle testing.

The steady state of VO_2 decreased significantly during the running sessions after two months IET (Figure 1), but the steady state of relative VO_2 was unchanged (Figure 2). Heart rate significantly decreased after IET programmes compared to pre-training testing (Figure 3).

Table 2 shows the changes in EMG parameters during IET sessions every 2 weeks. The iEMG of *m. vastus lateralis* and *m. vastus medialis* during running intervals of training sessions significantly

Table 1. **Changes in the subject's anthropometric parameters during IET period**

Parameters	Pre-training	After 2 weeks	After 4 weeks	After 6 weeks	After 8 weeks	Change of percentages
Weight, kg	99.1	96.4	92.4	90.3	89.6	9.6↓
BMI	30.6	29.8	28.5	27.9	27.7	9.5↓
Fat mass, %	44.7	43.4	41.8	40.8	40.9	8.5↓
Fat mass, kg	44.3	41.8	38.6	36.8	36.7	17.2↓
Free fat mass, kg	54.8	54.6	53.8	53.5	52.9	3.5↓
TBW, kg	40.1	40	39.4	39.2	38.7	3.5↓

Note. ↓ – parameters' percentage decreased after two months of IET compared to Pre-training. BMI – the body mass index; TBW – the total body water.

increased after 6 and 8 weeks, and *m. gastrus medialis* significantly increased after 2, 6 and 8 weeks; *m. gastrus lateralis* significantly chances was determined after 4 weeks compeered with testing after 2 weeks IET. The following significant changes in RMS of EMG during the running intervals of the training session were observed: increase after 6, 8 weeks of *m. vastus lateralis* and *m. vastus medialis*, after 2, 6 and 8 weeks of *m. gastrus medialis* and decrease after 4, 6 and 8 weeks of *m. gastrus lateralis.*

VO_2 kinetics parameters: baseline VO_2; oxygen uptake amplitude (AVO_2) and oxygen uptake time constant (tVO_2) are given in Figure 4. The baseline VO_2 (Figure 4A) significantly decreased after 2–8 weeks of IET compeered to pre-training testing. The AVO_2 (Figure 4 B) significantly increased after 5 weeks, but it decreased after 7–8 weeks of IET compared to pre-training testing. There were no significant differences in tVO_2 under different testing conditions (Figure 4 C).

	Control testing	After one month	After two months
Data at the first ventilation threshold (VT1)			
Running speed at VT1, km/h^{-1}	8.7	9.2	9.4
Heart rate at VT1, beats/min^{-1}	165	178	175
VO_2 at VT1, l/min^{-1}	2.778	2.820	2.594
Data at the second ventilation threshold (VT2)			
Running speed at VT2, km/h^{-1}	10.8	11.7	11.9
Heart rate at VT2, beats/min^{-1}	176	187	183
VO_2 at VT2, l/min^{-1}	3.233	3.356	3.292
Maximal data			
Maximal running speed, km/h^{-1}	12.8	13.5	13.7
Absolute VO_2max, l/min^{-1}	3.683	3.731	3.644
Relative VO_2max, ml/kg/min^{-1}	37.2	40.4	40.7
Heart rate max, beats/min^{-1}	184	192	193
TDmax, l	2.984	2.624	2.758
VEmax, l/min^{-1}	137.3	136.0	136.0

Table 2. **Aerobic capacity parameters during incremental running test**

Note. VT1 – first ventilation threshold; VO_2 – oxygen uptake; VT2 – second ventilation threshold; VO_2max – maximal oxygen uptake; TD – tidal volume; VEmax – maximal ventilation.

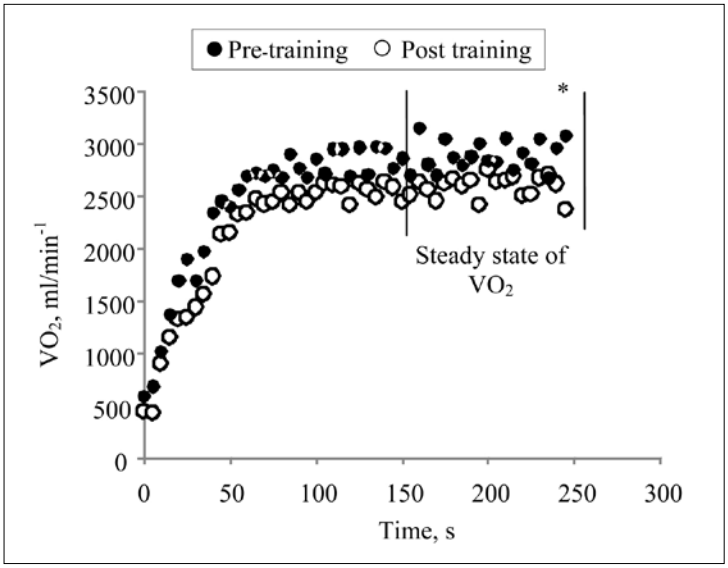
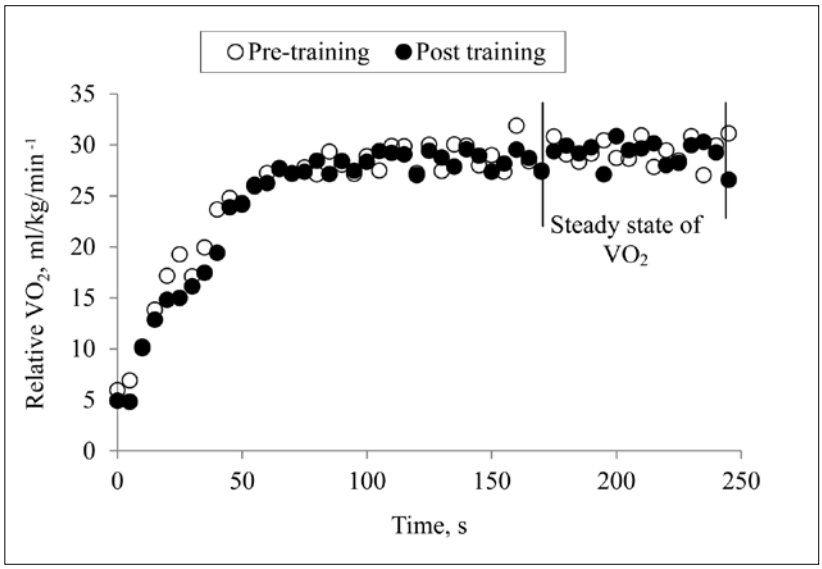


Figure 1. **Oxygen uptake average during 8 repetitions of 4 min running sessions before (●) and after (○) the training period**

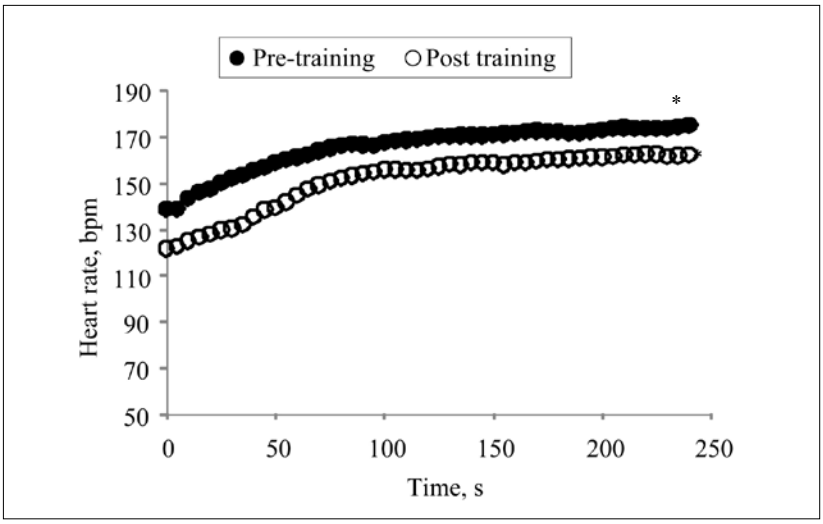
Note. * – significant difference compared to pre-training; VO_2 – oxygen uptake.

Figure 2. **Relative oxygen uptake average during 8 repetitions of 4 min running sessions before (●) and after (○) the training period**



Note. VO_2 – oxygen uptake.

Figure 3. **Heart rate 5 s interval average during 8 repetitions of 4 min running sessions before (●) and after (○) the training period**

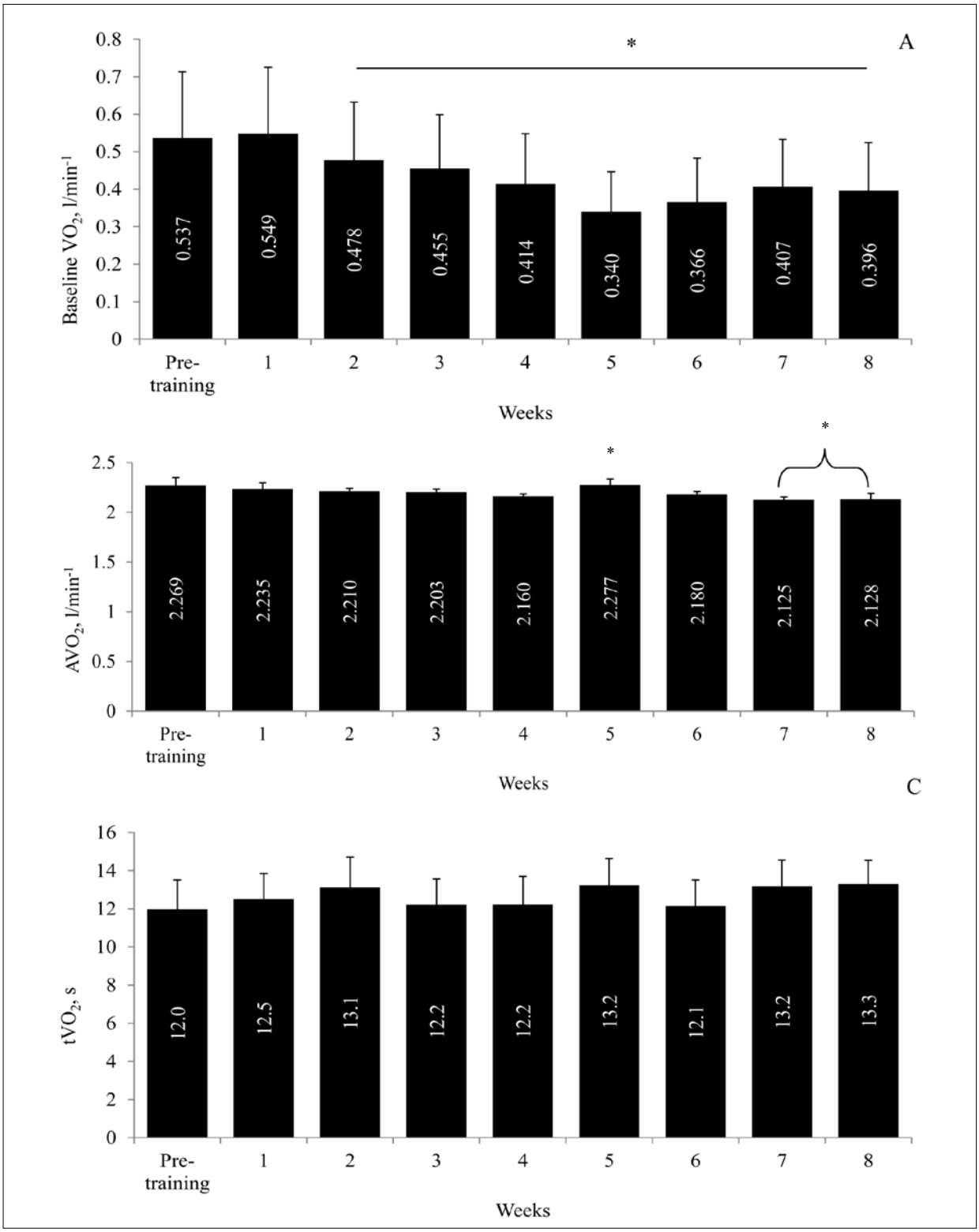


Note. * – significant difference compared to pre-training.

Table 3. **The EMG parameters during interval endurance training every two weeks**

	iEMG, mV/s^{-1}					RMS, mV				
Muscles	**Pre-training**	**After 2 weeks**	**After 4 weeks**	**After 6 weeks**	**After 8 weeks**	**Pre-training**	**After 2 weeks**	**After 4 weeks**	**After 6 weeks**	**After 8 weeks**
Vastus lateralis	0.021 (0.001)	0.021 (0.001)	0.021 (0.001)	0.026 (0.001)*	0.028 (0.001)*	0.079 (0.004)	0.080 (0.005)	0.078 (0.003)	0.094 (0.006)*	0.092 (0.013)*
Vastus medialis	0.028 (0.001)	0.027 (0.001)	0.028 (0.001)	0.034 (0.001)*	0.042 (0.005)*	0.107 (0.007)	0.106 (0.008)	0.099 (0.003)	0.124 (0.006)*	0.137 (0.013)*
Gastrus lateralis	0.026 (0.035)	0.027 (0.001)	0.023 (0.001)#	0.025 (0.002)	0.026 (0.005)	0.095 (0.005)	0.097 (0.002)	0.082 (0.005)*	0.087 (0.005)*	0.079 (0.013)*
Gastrus medialis	0.034 (0.001)	0.040 (0.001)*	0.036 (0.001)	0.041 (0.001)*	0.051 (0.001)*	0.141 (0.006)	0.158 (0.008)*	0.141 (0.007)*	0.159 (0.005)*	0.163 (0.021)*

Note. Values presented are means ± SD. Integrate electromyogram values (iEMG); Root mean square values (RMS). * – significant difference compared to pre-training; # – significant difference compared to 2 weeks of IET.



Note. Oxygen uptake amplitude (AVO_2) and time constant of oxygen uptake (tVO_2); * – significant difference compared to pre-training.

Figure 4. **Baseline oxygen uptake (A), amplitude of oxygen uptake (B) and time constant of oxygen uptake (C) mean values every week during interval endurance training**

DISCUSSION

The main focus of this study was to determine the effects of IET on cardiorespiratory system parameters in sedentary obesity subject. We demonstrated that the two months of IET were equally effective in improving anthropometric, aerobic capacity and EMG parameters.

Different training programmes have various effects on anthropometric parameters. I. E. Schjerve and colleagues (2008) determined that aerobic training regimens had significant effect on body weight; moreover, high intensity sprint and continuous endurance training improved metabolic parameters, BMI and aerobic capacity in children. It was established that aerobic interval training and continuous moderate training led to slight reduction of 3 and 4%, respectively, in body weight (Tjonna et al., 2008). In our study we established that IET had an important effect on the anthropometric parameters (weight, BMI, fat mass, free fat mass). However, the optimal type of training capable of eliciting the most important health benefits and improve the aerobic capacity in untrained people remains debatable. A. Corte de Araujo et al. (2012) affirmed that endurance and sprint training improved aerobic capacity (VO_2max, time to exhaustion) in youth. B. R. McKay and colleagues (2009) suggested that endurance training failed to increase the absolute VO_2max, although the relative VO_2max increased by a small, but significant, amount: 2–3ml/kg^{-1}/min^{-1}. In healthy populations, high intensity training has been shown to improve VO_2max (McManus et al., 2005), maximal velocity in the incremental test, high-intensity intermittent performance, peak and submaximal oxygen pulse, and resting pulmonary function and ventilatory response to exercise. Our results are consistent with previous studies; we also determined decreases in relative VO_2max and time to exhaustion after two months of IET. These changes could be related with a decrease in body mass (McKay et al., 2009). We mentioned earlier that high intensity aerobic interval training had a higher effect on VO_2max than moderate intensity training, but our results showed that IET also improved VO_2max after 2 months. However, several short training studies (i. e. 1–3 weeks), demonstrated an increase in endurance performance and oxidative capacity without significant increases in VO_2max.

In a previous study, S. M. Phillips and colleagues (1995) reported that VO_2 kinetics became faster only after 4 days of continuous endurance training. The phase II $_t VO_2$ was reduced by ~22% after 4 days of training (i. e. from 37 to 29 s), which was similar to the ~30% high intensity training and ~17% endurance training in the present study. However, in the present study, there was a significant reduction in $_t VO_2$ after only 2 training days (~17–20% for both high intensity and endurance training. Our results differ from previous studies, we did not determine significant decrease in $_t VO_2$ after interval endurance training intervention, though baseline VO_2 decreased after 2 weeks and the amplitude of VO_2 – after 7–8 weeks of IET. H. Carter and colleagues (2000) determined that high intensity endurance training program had no effect on the kinetics of the VO_2 response to moderate exercise but it became faster during intense exercise. This tends to support the idea that VO_2 kinetics speed depends on oxygen delivery and muscle mitochondrial density with training. Another explanation is that $_t VO_2$ depends on endurance training intensity. It should be higher than 90% of VT1. Nonetheless this IET intensity is enough to improve aerobic capacity, anthropometric parameters and has effect on muscle electrical activity.

Many researchers explain the increase in EMG amplitude and iEMG as evidence of additional recruitment of motor units in order to compensate the force loss of working muscle fibres (Gandevia, 2001). EMG studies with surface electrodes during dynamic muscle contractions are rarer than those under static conditions (Enoka, Stuart, 1992). There is much disagreement about the effect of fatigue on the EMG parameters during dynamic exercise. EMG activity has been studied in conjunction with investigations of the VO_2 slow component to determine whether there is an increase in iEMG or in MPF (Perrey et al., 2001). The increase in iEMG might reflect greater total muscle fibre recruitment (Shinohara, Moritani, 1992) as fibre fatigue. During exercise, such as running, that involves eccentric and concentric muscle actions, it appears that the magnitude of the VO_2 slow component is reduced when the proportion of concentric exercise is reduced (Jones, McConnell, 1998). J. Mizrahi and colleagues (2000) determined that during 30 min running on treadmill the load was above anaerobic thresholds. In the *tibialis anterior* the average iEMG and the

MPF significantly decreased from the beginning to the end of running. In the *gastrocnemius* iEMG did not change, while MPF increased during the course of running. In the present study, iEMG and RMS significantly increased after six weeks during the IET running period in all muscles except for *m. gastrus lateralis*. The iEMG and RMS of *m. gastrus lateralis* significantly decreased respectively after four, six and eight weeks of IET.

CONCLUSION AND PERSPECTIVES

In conclusion, two months of interval endurance training has a positive effect on anthropometric parameters and aerobic capacity, though VO_2 kinetics parameters have not changed considerably. This training also influences muscle activity, iEMG and RMS significantly increased after four, six and eight weeks.

REFERENCES

Burgomaster, K. A., Howarth, K. R., Phillips, S. M. et al. (2008). Similar metabolic adaptations during exercise after low volume sprint interval and traditional endurance training in humans. *Physiology Journal*, 586, 151–160.

Carter, H., Jones, A. M., Barstow, T. J. et al. (2000). Effect of endurance training on oxygen uptake kinetics during treadmill running. *European Journal of Applied Physiology*, 89, 1744–1752.

Corte de Araujo, A. C., Roschel, H., Picanço, A. R. et al. (2012). Similar health benefits of endurance and high-intensity interval training in obese children. *Public Library of Science*, 7 (8), 427–447.

Donnelly, J. E., Blair, S. N., Jakicic, J. M. et al. (2009). American College of Sports Medicine Position Stand. Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. *Medicine and Science in Sports and Exercise*, 41, 459–471.

Enoka, R. M., Stuart, D. G. (1992). Neurobiology of muscle fatigue. *Journal of Applied Physiology*, 72 (5), 1631–1648.

Farina, D., Merletti, R., Enoka, R. M. (2004). The extraction of neural strategies from the surface EMG. *European Journal of Applied Physiology*, 96, 1486–1495.

Gandevia, S. C. (2001). Spinal and supraspinal factors in human muscle fatigue. *Physiological Reviews*, 81, 1725–1789.

Gibala, M. J., Little, J. P., Wilkin, V. E. M. et al. (2006). Short-term sprint interval versus traditional endurance training: Similar initial adaptations in human skeletal muscle and exercise performance. *Physiology Journal*, 575, 901–911.

Jones, A. M., McConnell, A. M. (1999). Effect of exercise modality on oxygen uptake kinetics during heavy exercise. *European Journal of Applied Physiology*, 80, 213–219.

Krustrup, P., Soderlund, K., Mohr. M., Bangsbo, J. (2004). The slow component of oxygen uptake during intense, submaximal exercise in man is associated with additional fiber recruitment. *Pflügers Archiv European Journal of Physiology*, 447, 855–866.

McInnis, K. J., Franklin, B. A., Rippe, J. M. (2003). Counselling for physical activity in overweight and obese patients. *American Family Physician*, 67, 1249–1256.

McKay, B. R., Paterson, D. H., Kowalchuk, J. M. (2009). Effect of short-term high-intensity interval training vs. continuous training on O_2 uptake kinetics, muscle deoxygenation, and exercise performance. *European Journal of Applied Physiology,* 107, 128–138.

McManus, A. M., Cheng, C. H., Leung, M. P., Yung, T. C., Macfarlane, D. J. (2005). Improving aerobic power in primary school boys: A comparison of continuous and interval training. *International Journal of Sports Medicine,* 26, 781–786.

Mizrahi, J., Verbitsky, O., Isakov, E. (2000). Fatigue-related loading imbalance on the shank in running: A possible factor in stress fractures. *Annals of Biomedical Engineering*, 4, 463–469.

Perrey, S., Tschakovsky, M. E., Hughson, R. L. (2001). Muscle chemoreflex elevates muscle blood flow and O_2 uptake at exercise onset in nonischemic human forearm. *Journal of Applied Physiology,* 91 (5), 2010–2016.

Phillips, S. M., Green, H. J., MacDonald, M. J., Hughson, R. L. (1995). Progressive effect of endurance training on VO_2 kinetics at the onset of submaximal exercise. *European Journal of Applied Physiology,* 79, 1914–1920.

Rakobowchuk, M., Tanguay, S., Burgomaster, K. A. et al. (2008). Sprint interval and traditional endurance training induce similar improvements in peripheral arterial stiffness and flow-mediated dilation in healthy humans. *American Journal of Physiology. Regulatory, Integrative and Comparative Physiology Journal*, 295, 236–242.

Schjerve, I. E., Gjertrud, A., Tyldum, A. E. et al. (2008). Both aerobic endurance and strength training programmes improve cardiovascular health in obese adults. *Clinical Science*, 115, 283–293.

Shinohara, M., Moritani, T. (1992). Increase in neuromuscular activity and oxygen uptake during heavy exercise. *Annals of Physiological Anthropology,* 11, 257–262.

Tjonna, A. E., Lee, S. J., Rognmo, O. (2008). Aerobic interval training versus continuous moderate exercise as a treatment for the metabolic syndrome: A pilot study. *Circulation Journal,* 118, 346–354.

DVIEJŲ MĖNĖSIŲ VIDUTINIO INTENSYVUMO INTERVALINIŲ IŠTVERMĖS PRATYBŲ POVEIKIS DEGUONIES KINETINĖMS YPATYBĖMS, AEROBINIAM PAJĖGUMUI IR EMG RODIKLIAMS (ATVEJO TYRIMAS)

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Vidutinio ar mažo nenutrūkstamo intensyvumo ištvermės krūvis pagerina nesportuojančių asmenų kūno kompozicijos, aerobinio pajėgumo ar kitus su sveikata susijusius rodiklius. Visgi nėra atlikta tyrimų, kokį poveikį dviejų mėnesių vidutinio intensyvumo intervalinės ištvermės pratybos (IIT) turėtų aerobiniam pajėgumui, deguonies kinetinėms ypatybėms (VO_2), antropometriniams rodikliams ir raumenų aktyvumui.

Tikslas – įvertinti dviejų mėnesių IIT poveikį aerobiniam pajėgumui, deguonies kinetinėms ypatybėms, EMG ir kūno kompozicijos rodikliams.

Metodai. Buvo tiriama 26 metų nesportuojanti, turinti antsvorio moteris (ūgis – 180 cm; svoris – 99,1 kg; VO_2max – 37,2 ml/kg/min). Ji buvo įtraukta į dviejų mėnesių IIT ciklą. Tiriamoji turėjo trejas pratybas per savaitę, tarp kurių būdavo viena arba dvi dienos poilsio. Pratybų intensyvumas 90% nuo pirmo ventiliacinio slenksčio. Slenksčiai buvo nustatomi atliekant nuosekliai didinamą krūvį iki visiško nuovargio bėgtakiu LE 200 (VIASYS, Vokietija).

Rezultatai. Tiriamosios kūno masė po dviejų mėnesių IIT sumažėjo 10%, greitis ties pirmu ir antru ventiliaciniu slenksčiu padidėjo atitinkamai 8,1 ir 10,2%. Širdies susitraukimų dažnis (165.9 tv./min) ir absoliutus VO_2 (2.583 l/ min), užfiksuotas pirmos IIT metu, atitinkamai reikšmingai sumažėjo po pratybų ciklo (150.4 tv./min; 2.285 l/min). Reikšmingi EMG pokyčiai nustatyti po keturių, šešių ir aštuonių savaičių IIT pratybų šiuose raumenyse: šlaunies šoninio ir vidinio plačiojo, blauzdos dvilypio raumens vidinės ir šoninės galvos.

Aptarimas ir išvados. Dviejų mėnesių trukmės IIT reikšmingai paveikia aerobinį pajėgumą, kūno kompoziciją ir EMG rodiklius, tačiau tokio intensyvumo pratybos mažiau veikia deguonies kinetines ypatybes.

Raktažodžiai: ventiliaciniai slenksčiai, EMG amplitudės vidutinė kvadratinė reikšmė, maksimalusis deguonies suvartojimas.

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MAXIMAL RESPIRATORY PRESSURES, THEIR ASSOCIATION WITH SPIROMETRIC PARAMETERS, SWIMMING SKILLS AND CHANGES DUE TO IMMERSION IN WATER

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ABSTRACT

Research background and hypothesis. We checked hypothesis that swimming skill improvement is more dependent on inspiratory muscle strength than endurance volume to be ventilated.

Research aim was to determine associations between maximal static inspiratory (MIP) and expiratory (MEP) pressures, swimming skills, parameters of forced spirometry.

Research methods. Investigation involved 62 female students (age 22.13 ± 1.3 years, height 168.4 ± 6.6 cm, and weight 61.3 ± 7.0 kg) of the Latvian Academy of Sports Education. All of them were non-smokers. Swimming skills in four strokes were evaluated by a swimming coach. MIP and MEP were measured at the mouth level outside the swimming pool and repeated in the swimming pool while the subject was immersed up to the neck level. Forced spirometry was performed according ATS guidelines outside the water.

Research results. Average value for MIP outside the water was 109 ± 30 cm H_20 and for MEP it was 147 ± 33 cm H_20. There was positive correlation between peak expiratory flow and MIP, MEP, and the rate of increase of both pressures ($p < 0.05$). Forced vital capacity was not related to maximal pressures. Faster rate of inspiratory pressure increase was positively related to forced inspiratory volume in one second ($p < 0.05$). There was a significant decrease of MIP and the rate of increase of inspiratory pressure in the immersion state while no changes of expiratory parameters were observed.

Discussion and conclusions. Swimming skill improvement is more dependent on inspiratory muscle strength than volume to be ventilated. Students with higher PEF have higher respiratory pressure parameters. Immersion in water decreases MIP, IMRPD and increases IMMRR. Changes of these parameters due to immersion are not related to swimming skills.

Keywords: maximal inspiratory pressure, maximal expiratory pressure, swimming education, immersion in water.

INTRODUCTION

During exercise demand for oxygen increases, which stimulates the increase of volume of air exchanged in lungs. Compared to activities not in the water, in swimming time allowed for inspiration is reduced. Respiratory muscle strength and speed of their contraction should be important to breathe the required amount of air in a short time when swimmers' heads emerge on the surface of the water.

It is known that swimmers can generate greater maximal respiratory pressures and specific training can increase the strength within several weeks (Tzelepis et al., 1999; Sonetti et al., 2001). The effect of specific respiratory muscle training on exercise performance is controversial (Wells et al.,

2005). The information about the relationship between swimming skill development and required respiratory training is not available.

The purpose of this study was to determine the associations of respiratory pressure and spirometric parameters with swimming skills as well as changes of respiratory pressures due to immersion into water to the neck level.

RESEARCH METHODS

Investigation involved 62 female students (the mean age 22.13 ± 1.3 years, height 168.4 ± 6.6 cm, and weight 61.3 ± 7.0 kg) of the Latvian Academy of Sports Education who attended swimming instruction programme, all of them were non-smokers. Competitive swimmers were excluded from the investigation. A written informed consent was obtained from each student. The study was approved by the Ethics Committee of the Riga Stradiņš University.

Swimming skills in four styles (front crawl, back crawl, breaststroke, and butterfly) of each student were evaluated by a swimming coach at the end of 6-week swimming instruction programme. According to the evaluation the students were divided in three groups:

Group 1 – students with the poor swimming skills (n = 14);

Group 2 – students with the moderate swimming skills (n = 32);

Group 3 – students with the good swimming skills (n = 16).

Maximal expiratory and inspiratory pressure measurements at the mouth level were done with Micro RPM (England) at the end of the swimming instruction programme. The MEP, MIP, maximal rate of pressure development during expiration (EMRPD) and inspiration (IMRPD), maximum relaxation rate in expiration (EMRR) and inspiration (IMMR) were used for the evaluation. The test was repeated three times in the room and in the swimming pool, where the subject was immersed into water to the neck level.

Forced spirometry test according ERS/ATS guidelines was performed in the room. Forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and peak expiratory flow (PEF) were analysed.

The data were analysed using SPSS programme. The differences between parameters in the air and the water were evaluated using Mann – Whitney test. Differences of parameters between students with poor and good swimming skills were determined by Kruskal-Wallis and Wilcoxon tests. The relationships between parameters were assessed using Spearman's correlation. The alpha level of $p \leq 0.05$ was required for statistical significance.

RESEARCH RESULTS

Minimum, maximum, mean and standard deviations of respiratory parameters are given in Table 1.

There were no significant differences in spirometric variables between students of three swimming skill groups. The mean MIP for students with moderate and good swimming skills was greater than that for students with poor swimming skills (Figure 1). The observed mean values of IMRPD and EMRPD were higher for students with moderate and good swimming skills (Figure 2). However, these differences were not statistically significant. There were no significant inspiratory and expiratory MRR differences between students with poor and good swimming skills.

Table 1. **Respiratory pressure test and spirometry results**

Parameter	Minimum	Maximum	Mean	SD
MEP, cm H_2O	90	240	147	33
MIP, cm H_2O	55	184	109	30
EMRPD	120	1694	567	325
IMRPD	107	1167	342	192
FVC, l	3.32	5.88	4.46	0.52
FEV1, l	3.16	4.68	3.95	0.35
PEF, l/s	5.10	11.20	7.14	1.15

Note. MIP – maximal inspiratory pressure; EMRPD – maximal rate of pressure development in expiration; IMRPD – maximal rate of pressure development in inspiration; FVC – forced vital capacity; FEV1 – forced expiratory volume in one second; PEF – peak expiratory flow; MEP – maximal expiratory pressure.

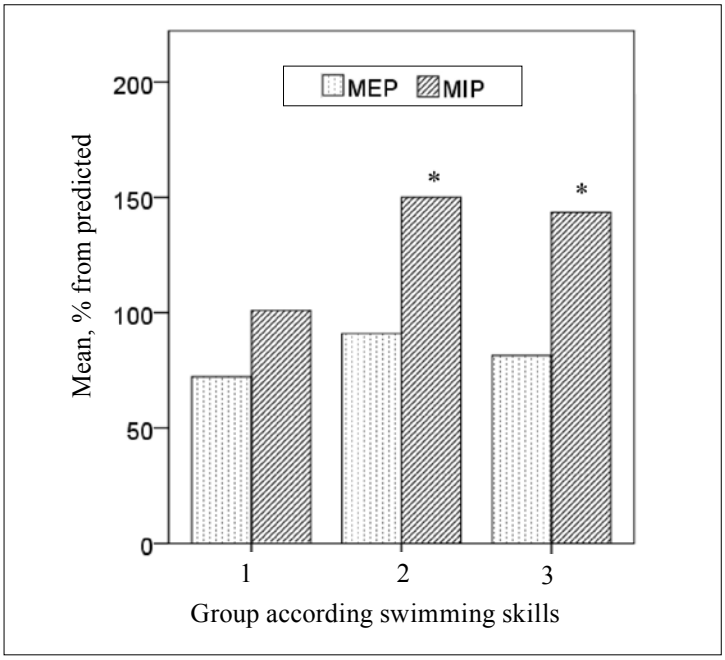


Figure 1. **Mean maximal expiratory (MEP) and inspiratory (MIP) pressures in per cent from the predicted value in the room for students with different swimming skills**

Note. * – $p < 0.05$ against group 1 due to Mann-Whitney test.

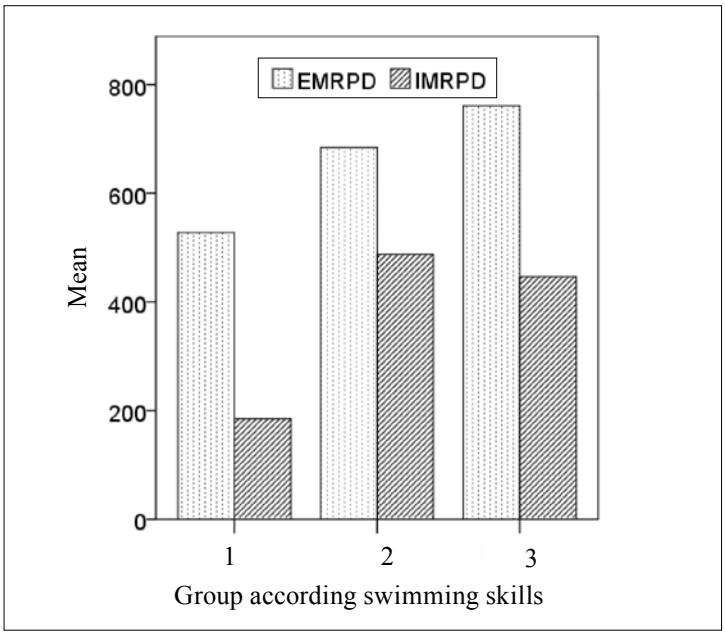


Figure 2. **Mean maximal rates of pressure development in expiration (EMRPD) and inspiration (IMRPD) in the room for students with different swimming skills**

There was a statistically significant positive correlation observed between maximal respiratory pressures and PEF as well as maximal rate of pressure development in expiration and inspiration and PEF (Table 2), but there were no significant correlations between respiratory pressure test parameters and other spirometric variables.

Table 2. **Spearman's correlations between respiratory pressure and spirometric variables**

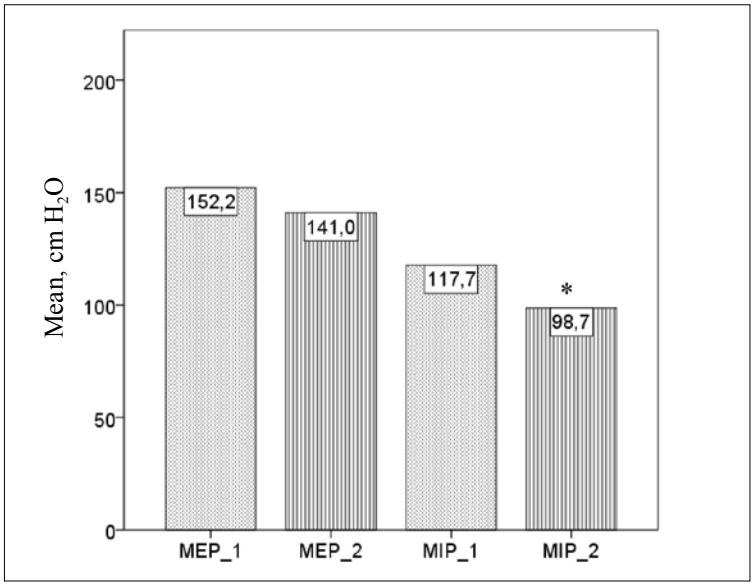
Variables	MEP	EMRPD	MIP	IMRPD
PEF	0.28*	0.32*	0.29*	0.33*
FEV1			0.32*	

Note. * – $p < 0.05$, according to Spearman's correlation test.

At the immersion into the water to the neck level students produced lower MIP, IMRPD and higher IMRR than in the room ($p < 0.05$) (Figures 2, 3 and 4). There was a decrease of expiratory parameters (MEP and EMRPD) observed, however these differences were not statistically significant.

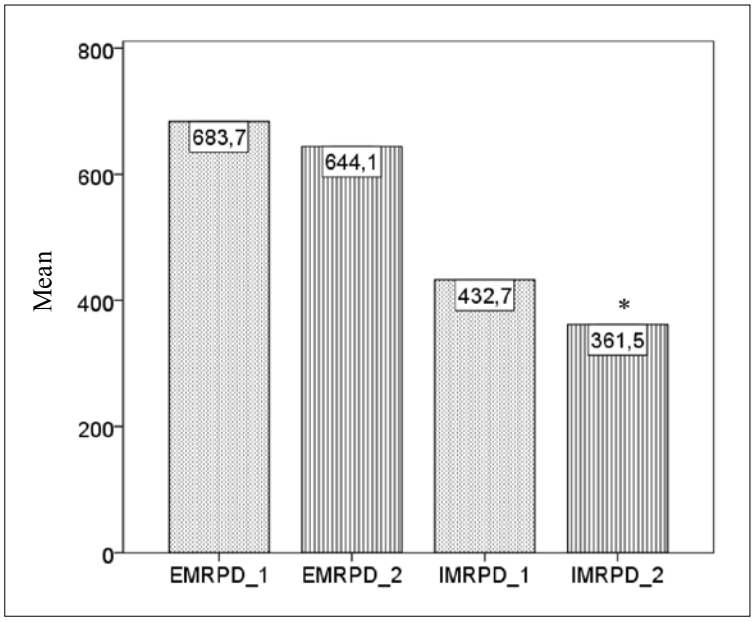
There were no statistically significant differences observed in respiratory pressure test parameters between students of the three groups according to their swimming skills.

Figure 3. **Mean maximal expiratory (MEP) and inspiratory (MIP) pressures in the room (_1) and when immersed into the water to the neck level (_2)**



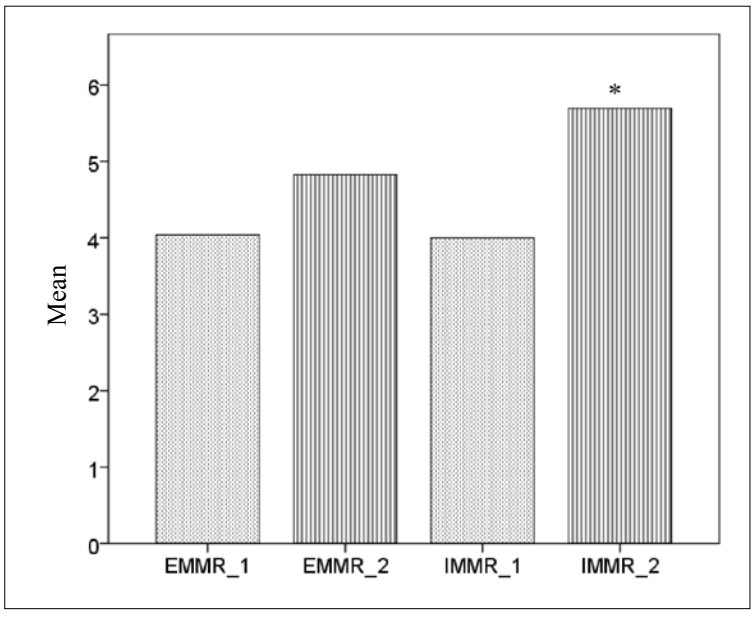
Note. * – $p < 0.05$ compared to MIP_1 according to Wilcoxon paired rank test.

Figure 4. **Mean maximal rates of pressure development in expiration (EMRPD) and inspiration (IMRPD) in the room (_1) and when immersed into the water to the neck level (_2)**



Note. * – $p < 0.05$ compared to IMRPD_1 according to Wilcoxon paired rank test.

Figure 5. **Mean maximal relaxation rates in expiration (EMRR) and inspiration (IMRR) in the room (_1) and while immersed into the water to the neck level (_2)**



Note. * – $p < 0.05$ compared to IMRR_1 according to Wilcoxon paired rank test.

DISCUSSION

The lung volumes and respiratory pressures in our study for all the females were normal in respect to predicted values (ATS/ERS – *Statement on Respiratory Muscle Testing*, 2002). There were no statistically significant differences in lung volumes observed between students with different swimming skills. We observed positive association of PEF with maximal respiratory pressures and maximal rates of pressure development in expiration and inspiration. Even stronger relationships were observed by other authors (Harik-Khan et al., 1998) indicating that respiratory muscle strength is an important indicator of the speed of airflow.

It is known that swimming and diving stimulates development of larger than normal static lung volumes and flow rates. These sports strengthen inspiratory muscles that work against additional resistance of the mass of water compressing the chest and increase maximal respiratory pressures (Phervani et al., 1989; Cordain et al., 1990; Kesavachandran et al., 2001).

Higher inspiratory muscle strength in our study was positively related to swimming skill evaluation estimate. While swimming, compared to running or cycling, athlete uses larger tidal volumes and breathes less frequently (Rodriguez, 2000). Persons with greater inspiratory muscle strength can ventilate lungs properly and improve their stroke mechanics. It is known that swimmers also need faster inspiration to inhale enough air in the limited time when swimmers mouth is above the water level. In our study there was no significant difference in the speed of inspiratory muscle contraction between students of different swimming skills. Probably, for the development of proper swimming skill, it is not necessary to have very fast contractions of respiratory muscles, but if the swimmer wants to achieve the faster speed of swimming, it is crucial (Clanton et al., 1987; Cordain, Stager, 1988; Lomax, Castle, 2011). However, there was a tendency to have faster contractions in the group of students with higher swimming skills. The absence of differences could be explained with small groups of students who had poor and good swimming skills.

The MIP and IMRPD decreased and IMRR increased due to the immersion into the water compared with the values obtained in room. This could be caused by the effect of increased hydrostatic pressure of water on thoracic cavity. The water pressure works against the force created by inspiratory muscles and decreases the absolute value of maximal pressure generated during inspiration as well as the speed of inspiratory muscle contraction. Immersion in upright position causes compression of abdominal cavity, increasing resistance to diaphragm (Schoenhofer et al., 2004) and further decreasing MIP value. The increased pressure from outside increases the pressure in the thoracic cavity, favouring to the faster increase in pressure when inspiratory muscles relax (Cordain, Stager, 1988; Withers, Hamdorf, 1989).

CONCLUSION AND PERSPECTIVES

In conclusion, swimming skill improvement is more dependent on inspiratory muscle strength than volume to be ventilated. Immersion into the water decreases MIP, IMRPD and increases IMMRR. Changes of maximal inspiratory pressure test parameters due to immersion are not related to swimming skills.

REFERENCES

ATS/ERS. (2002). Joint statement on respiratory muscle testing. *American Journal of Respiratory and Critical Care Medicine*, 166, 518–624.

Clanton, T. L., Dixon, G. F., Drake, J., Gadek, J. E. (1987). Effects of swim training on lung volumes and inspiratory muscle conditioning. *Journal of Applied Physiology*, 62 (1), 39–46.

Cordain, L., Stager, J. (1988). Pulmonary structure and function in swimmers. *Sports Medicine*, 6, 271–278.

Cordain, L., Tucke, A., Moon, D., Stage, J. M. (1990). Lung volumes and maximal respiratory pressures in collegiate swimmers and runners. *Research Quarterly for Exercise and Sport*, 61 (1), 70–74.

Harik–Khan, R. I., Wise, R. A., Fozard, J. L. (1998). Determinants of maximal inspiratory pressure. *American Journal of Respiratory and Critical Care Medicine*, 158, 1459–1464.

Kesavachandran, C., Nai, H. R., Shashidhar, S. (2001). Lung volumes in swimmers performing different styles of swimming. *Indian Journal of Medical Sciences,* 55 (12), 669–676.

Lomax, M., Castle, S. (2011). Inspiratory muscle fatigue significantly affects breathing frequency, stroke rate, and stroke length during 200-m front crawl swimming. *The Journal of Strength and Conditioning Research*, 25, 2691–2695.

Phervani, A. V., Desai, A. G., Solepure, A. B. (1989). A study of pulmonary function of competitive swimmers. *Indian Journal of Physiology and Pharmacology*, 33 (4), 228–232.

Rodriguez, F. A. (2000). Maximal oxygen uptake and cardiorespiratory response to maximal 400-m free swimming, running and cycling tests in competitive swimmers. *The Journal of Sports Medicine and Physical Fitness*, 40 (2), 87–95

Schoenhofer, B., Koehler, D., Polkey, M. I. (2004). Influence of immersion in water on muscle function and breathing pattern in patients with severe diaphragm weakness. *Chest*, 125, 2069-2074.

Sonetti, D. A., Wetter, T. J., Pegelow, D. F., Dempsey, J. A. (2001). Effects of respiratory muscle training versus placebo on endurance exercise performance. *Respiration Physiology,* 127, 185–199.

Tzelepis, G. E., Kadas, V., McCool, F. D. (1999). Inspiratory muscle adaptations following pressure or flow training in humans. *European Journal of Applied Physiology*, 79, 467–471.

Wells, G. D., Plyley, M., Thomas, S., Goodman, L., Duffin, J. (2005). Effects of concurrent inspiratory and expiratory muscle training on respiratory and exercise performance in competitive swimmers. *European Journal of Applied Physiology*, 94 (5-6), 527–540.

Withers, R. T., Hamdorf, P. A. (1989). Effect of immersion on lung capacities and volumes: Implications for the densitometric estimation of relative body fat. *Journal of Sports Sciences,* 7 (1), 21–30.

MAKSIMALIOJO VALINGO KVĖPAVIMO SLĖGIO SĄSAJOS SU KITAIS SPIROMETRINIAIS RODIKLIAIS BEI PLAUKIMO ĮGŪDŽIAIS IR JO POKYČIAI KŪNUI PANIRUS Į VANDENĮ

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Tikrinome hipotezę, kad plaukimo įgūdžių tobulėjimas labiau priklauso nuo įkvėpimo raumenų jėgos nei nuo jų ištvermės.

Tikslas – nustatyti maksimaliojo valingo kvėpavimo slėgio ir kitų aktyvios spirometrijos rodiklių bei plaukimo įgūdžių sąsajas.

Metodai. Buvo tiriamos 62 Latvijos sporto pedagogikos akademijos studentės (amžius – 22,13 ± 1,3 m., ūgis – 168,4 ± 6,6 cm, kūno masė – 61,3 ± 7,0 kg). Visos jos nerūkė. Plaukimo įgūdžius vertino jų plaukimo treneris. Maksimalusis statinio įkvėpimo ir iškvėpimo slėgis bei aktyvaus valingo kvėpavimo rodikliai buvo matuojami burnos lygyje, tiriamajam esant sausumoje, paskui maksimalusis statinio įkvėpimo ir iškvėpimo slėgis dar kartą matuotas vandenyje, t. y. plaukikei iki kaklo panirus į vandenį.

Rezultatai. Vidutiniškai maksimaliojo statinio įkvėpimo slėgio rodikliai ne vandenyje siekė 109 ± 30 cm H_20, iškvėpimo – 147 ± 33 cm H_20. Aptikta teigiama maksimaliojo iškvėpimo ir maksimaliojo statinio įkvėpimo bei iškvėpimo slėgio, abiejų slėgio rodiklių didėjimo greičio koreliacija. Aktyvaus valingo kvėpavimo tūris nebuvo susijęs su abiem maksimaliojo slėgio rodikliais. Greitesnis įkvėpimo slėgio padidėjimo tempas buvo teigiamai susijęs su santykiniu aktyvaus valingo kvėpavimo tūriu (per vieną sekundę, $p < 0,05$). Reikšmingai sumažėjo maksimaliojo įkvėpimo slėgis bei jo padidėjimas dėl panirimo į vandenį, tačiau jokių iškvėpimo rodiklių pokyčių nebuvo užregistruota.

Aptarimas ir išvados. Plaukimo įgūdžių tobulėjimas labiau priklauso nuo įkvėpimo raumenų jėgos nei nuo jų ištvermės. Plaukikės, kurioms būdingas aukštas maksimaliojo iškvėpimo greičio rodiklis, geba pasiekti ir aukštesnio lygmens kvėpavimo slėgio rodiklius. Panirus į vandenį, sumažėja maksimalusis statinio įkvėpimo bei iškvėpimo slėgis, didėja kvėpavimo dažnis. Šių rodiklių pokyčiai dėl panirimo į vandenį nėra susiję su plaukimo įgūdžiais.

Raktažodžiai: maksimalusis įkvėpimo slėgis, maksimalusis iškvėpimo slėgis, plaukimo mokymas, panirimas į vandenį.

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RELATIONSHIP BETWEEN ADOLESCENT ATHLETES' VALUES AND BEHAVIOR IN SPORT AND PERCEIVED COACH'S CHARACTER DEVELOPMENT COMPETENCY

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ABSTRACT

Research background and hypothesis. This study examined the relations between reported youth athletes' prosocial and antisocial behavior and personal and social factors in sport context and whether these variables accounted for age and sports experience differences in reported behaviors values in sport and perceptions of coach's character development competency.

The aim of the research was to determine age and sports experience differences in manifestation of youth athletes' values in sport, perceived coach's character development competency and behaviors that occur in sport, and to examine interrelations between these variables.

Research methods. The sample included 201 athletes recruited from Kaunas and Alytus sports schools. The participants completed the Youth Sport Value Questionnaire-2 (YSVQ-2 – Lee et al., 2008), the Prosocial and Antisocial Behavior in Sport Scale (PABSS – Kavussanu, Boardley, 2009), and adapted version of the Coaching Efficacy Scale (CES– Feltz et al., 1999).

Research results. The positive correlation between values in sport, perceived coach's character development competency and prosocial behavior of athletes were established. These values also had negative correlations with antisocial behavior whereas status values correlated negatively with prosocial behavior. Coach's character development competency was perceived stronger by younger athletes ($p < 0.05$). Competence values were more important to these athletes compared to older ones ($p < 0.05$).

Discussion and conclusions. Research revealed the importance of moral and competence values for adolescent athlete's moral behavior in sport. Perceived character-development effectiveness positively correlated with athletes' prosocial behavior; however, it was unrelated to antisocial behavior. Thus, perceiving the coach as being effective in instilling an attitude of good moral character may lead to an increased frequency of desirable behaviors but does not appear to have any effect on antisocial conduct. It was found that athletes' prosocial acts were more frequent than antisocial ones, however, more experienced athletes displayed more frequent antisocial behavior to the teammates. These findings are consistent with the previous presumption that low frequency of engagement in antisocial behaviors does not necessarily mean that one frequently engages in prosocial action, or vice versa.

Keywords: sport, athletes' moral behavior, values in sport, perceptions, coaching effectiveness.

INTRODUCTION

Sport is a social environment where athletes interact with each other and there they can gain negative sports experience if they seek to win by any means being unfair to other athletes, appealing referees' decisions or taking revenge on an opponent after a rough tackle. Though, at the same time, the sports social context allows them to create the conditions for positive sports experiences, when a teammate is supported after unsuccessful performance, or an opponent is helped when injured (Boardley, Kavussanu, 2009). Despite the durability of sports existence and consistent views about its positive impact on the development of athletes, only recently attention has been paid to the issues

of moral behavior in sport (Kavusanu, 2006). It is claimed that there is a lack of the empirical evidence in order to prove this fact (Shields, Bredemeier, 2007; Lee et al., 2008; Šukys, 2010).

Behavior in sport is not only a perfect example of an athlete's character, but it can also have positive or negative effect on other participants (Kavussanu, 2008). In this context the prosocial behavior of athletes is most relevant. It should be noted that such behavior has not been studied yet and in the scientific literature it is described as voluntary actions to help another person (Eisenberg, Fabes, 1998; Eisenberg, Müssen, 1989). Examples of this behavior in sport could be offering help to an injured opponent or verbal encouragement to a teammate. Prosocial behavior is possible for various reasons, e. g. such behavior is beneficial to another person (Eisenberg, Müssen, 1989), thus, such forms of behavior are important and expected (Kavussanu, 2005). Aiming at showing that sport can be an effective agent of educating athletes' character, it is necessary to determine how pro-social behavior occurs in sports context and what could lead to such behavior (Kavussanu, 2008).

The most investigated factors that predetermine athletes' behavior are goal orientations and their motives. Over the past decade, research has demonstrated well enough what psychological consequences on athletes' behavior raise from the interpretation of success in sports activities as well as what should be emphasized in order to reduce these behavioral problems (Boardley et al., 2008; Kavussanu et al., 2006). More often paying attention to the prevailing values in sports context, researchers emphasize that their influence on athletes' behavior is still not known enough (Šukys, Jansonienė, 2012; Šukys, 2010; Lee et al., 2008). Values are human priorities based on feelings, beliefs and practices which will guide people through their lives (Vasiliauskas, 2005). Values act as a motivating factor which provides the action with its direction and intensity, serves as standards for the assessment of behavior (Schwartz, 1994). Therefore, if the values influence our decisions in certain situations, then they should determine the behavior in sports' activities.

Much attention has been also paid to the effect of sports social environmental factors on positive and negative behaviors of athletes (Boardley, Kavussanu, 2009). It was found that the motivational climate of the practice session could have both positive and negative effect on athletes' moral behavior variables (Kavussanu, 2006) but the research shows, that this factor can have more significance for athletes' behavior within a team, but not the opponents. On the other hand, educational activity of the coach should fully involve young athletes' personality development aspects (Miškinis, 2011). Coach is said to be the most influential personality in athlete's life (Horn, 2002), he/she is responsible for the development not only of the training climate, but for athlete's character as well. Skilled coaches can influence various aspects of athletes' sports experience, social skills and character qualities; and the coaches are competent to develop athletes' character. Competence in character development is coach's faith in his/her personal capacity to develop personality and positive attitudes to sport (Feltz et al., 1999). Coaches who have high character development expertise often show a positive example for athletes demonstrating honorable sports behavior and respect for other sports participants. The trainees of these coaches are more motivated, more self-confident, their sports results are higher, they are more in favor of their coach and more likely to act according to the principles of honorable sports behavior and express positive attitudes to sport (Feltz et al., 1999; Kavussanu, 2008).

It is also worthwhile to note that the investigation of athletes' honorable behaviors and the factors influencing them in sports requires valid and reliable research instruments. Although a number of studies have been conducted in this area in Lithuania and abroad during the last decade, some researchers (Kavussanu et al., 2008; Šukys, 2010) argue there is still a lack of research applying reliable and valid research instruments adapted in sports context. Referring to these statements about the athletes' behavioral problems in the context of sport as well as new research instruments presented in the academic research journals (Šukys, 2010), we set our *research aim* to reveal athlete students' value orientations and behaviors in sports activities and their attitudes towards their coach's competence in character development (depending on their age and experience in sport) and their interrelations.

RESEARCH METHODS

Subjects. The study sample consisted of 201 selectively chosen 15–19-year-old students from team sports. Their average age was (M = 17.22 SD = 22.1). The subjects were divided into groups according to the median students' age: 15–17

(n = 105) and 18–19 (n = 96) years. The interviewed students played basketball (n = 105), handball (n = 21), football (n = 44), ice hockey (n = 16) and rugby (n = 15). Students were in their selected sports for (M = 5.78; SD = 2.38) years on average. Subjects were divided into two groups according to the median of sports experience: those in sports for less than six years (n = 101), and those in sports for six or more years (n = 100).

Methods. Questionnaire survey method was used in the study. The questionnaire consisted of social-demographic (gender, age, sports experience) and diagnostic parts. *Diagnostic part* included a number of scales and questionnaires to collect information on the dependent variables in the study: values in sports activities, expressions of athletes' prosocial and antisocial behaviors in sports, attitude to coach's competence to develop athletes' character.

In clarifying what values are most important for students in sports activities Youth Sport Values Questionnaire (*Youth Sport Values Questionnaire* – Lee et al., 2008) was used. It consisted of thirteen statements, each of which had to be assessed by the students choosing one of seven response options from *especially important to me* (5) to *contrary to what I believe* (-1). All thirteen statements formed three groups of values: moral, skill development and status values. Lithuanian version of this scale was adapted in the previous studies (Šukys et al., 2011) using a sample of student athletes.

Aiming at establishing students' behaviors in sports activities, Prosocial and Antisocial Behavior in Sport Scale was applied (*The Prosocial and Antisocial Behavior in Sport Scale* – Kavussanu et al., 2008), which consisted of 20 behavioral examples. Students had to answer how often during the past year they had to do the following actions which were specified by choosing one of five response options from *never* (1) to *very often* (5). It should be noted that there were two behavior factors of prosocial (prosocial behavior with team mates and rivals) and two factors of antisocial behavior (antisocial behavior with team mates and rivals) in this sale. Lithuanian version of this scale was adapted in the previous studies (Šukys et al., 2011) using a sample of student athletes.

Aiming at establishing how student athletes evaluate coaches' character development competency, coaching competency scale of four statements was applied (*Coaching Competency Scale* – Myers et al., 2006). The respondents rated four statements that began with "How does your coach manage …" selecting one of the nine response options from *completely failing* (1) to *absolutely being able* (9).

Research process. The survey was carried out in Kaunas and Alytus city sports schools in February, March and April of 2012. The cities were chosen for the survey because of a sufficiently large popularity of team sports, rich number of adolescents engaged in sports and the dominance of children teams from these cities in various national championships. Having received the permission of the director and the coach of sports school, the students were explained the objectives of the study and guaranteed anonymity of participation in the research before the practice session, then they were asked to complete questionnaires. The study complied with the ethical and legal research principles.

Statistical analysis. Data processing was carried out using *SPSS-17.0 for Windows OS*. After the data distribution and descriptive statistics procedures, the average response value and the standard deviation was determined. Aiming at evaluating the structure of the questionnaire, exploratory factor analysis was used applying the essential components and orthogonal varimax rotation methods. The adequacy of the data for factor analysis was tested using Bartlett's test of sphericity. Derived factor (scale) internal consistency was assessed by calculating the internal consistency (Cronbach's alpha) values. In order to determine the connection between the variables the Spearman's rank correlation method was applied. To determine the differences of the means between the groups, Mann and Whitney U test for independent samples was used.

RESEARCH RESULTS

Analyzing the results of student athletes' values in sports activities, we attempted to identify factors using the mathematical model of the exploratory factor analysis. Factor analysis was applied as a Lithuanian version of the scale was adapted on the basis of a sample of student athletes. It was found that the values of youth sports activities questionnaire results were suitable for the factor analysis – KMO = 0.86, Bartlett's test of sphericity value was $p < 0.001$. Data of the derived factor eigenvalues and explanatory dispersion are given in Table 1. It should be noted that all of the statements

Table 1. **Items and factor loading for Youth Sport Values Questionnaire (YSVQ) (n = 201)**

Behaviors Factors	Factor loads		
	COM	MRL	STT
6. I strive to become a good athlete	0.89		
7. I seek to reveal my physical activity skills	0.86		
8. For me it is important to set a goal that I want to achieve during physical activity	0.82		
9. For me it is important to improve my sporting prowess	0.79		
5. It is important for me to be honest in sport		0.83	
4. While playing sports – always try to follow the rules		0.79	
3. I strive to help others when they need it		0.77	
2. It is important to compete in sports honestly		0.77	
1. During physical activity, I agree to do what I am told		0.65	
13. I find it important to look good			*0.89*
11. I strive to be a team leader			0.84
12. For me it is important to win or defeat			0.78
10. I strive to be better than the other			0.75
Explained dispersion's cumulative %	25.55	51.06	73.16

Note. COM – competence values; MRL – moral values; STT – status values.

composed three factors explaining 73.16 percent of the total dispersion. The internal consistency of all three ranges of values was good (0.70 to 0.85).

It was found that data of prosocial and antisocial behaviors in sport scale is suitable for factor analysis for averaged KMO = 0.78, Bartlett's test of sphericity, $p < 0.001$. Principal components analysis and orthogonal Varimax rotation is used. Data on the derived factors' eigenvalues and explained dispersion are in Table 2. It should be noted that all of the statements make four factors explaining 69.18 percent of the total dispersion. All scales' internal consistency score is appropriate (from 0.79 to 0.85).

Descriptive statistics and correlations for study variables are displayed in Table 3. According to the survey most students doing sports emphasized capacity-building values; less relevant to them were moral values and status values were the least important. Analyzing the data of athletes' behavior in sports activities it was found that prosocial behavior with team members was the most typical, and prosocial behavior with rivals was less typical of them. The results showed that antisocial behavior both with teammates and rivals was not very common, i. e. students rarely acted in this way. Interviewed students valued their coach's competence in developing the athlete's character well. Analysis of the data demonstrated a positive correlation between moral and capacity-building values, as well as the capacity-building and status values. The corresponding correlations between the prosocial behavior with the teammates and opponents, antisocial behavior with the teammates and rivals were determined, as well as a negative correlation between the prosocial behavior with the teammates and antisocial behavior with the rivals. Also the relationship between moral values and prosocial behavior were revealed as well as negative relationships with the antisocial behavior. Capacity-building values were positively related to prosocial behavior and negatively linked with antisocial behavior. These included a negative correlation between the status values and prosocial behavior with the opponents. The study revealed a correlation between the student athletes' expressed opinion about the coach's competence to develop the character and their prosocial behavior, as well as moral and capacity-building values.

Table 2. **Factors indicated by adolescents' prosocial and antisocial behavior in sport and the dispersion explaining them (n = 201)**

Behavior factors	Factor loads			
	ABWR	ABWP	PBWP	PBWR
16. Intentionally annoyed the opponent trying their patience	0.79			
17. Avenged an opponent for his brutal foul in the same way	0.78			
14. Provoked an opponent to perform prohibited actions	0.77			
19. Threatened physically in order to intimidate an opponent	0.74			
18. Intentionally violated the rules of sporting contest	0.71			
15. Intentionally fouled against an opponent	0.67			
13. Tried to injure an opponent	0.66			
20. Criticized a rival	0.61			
12. Showed dissatisfaction with poor game of a team member/members		0.84		
10. Argued with a team member/members		0.83		
11. Criticized a team member/members		0.79		
9. Cursed a team member/members		0.78		
8. Abused a team member/members		0.72		
2. Congratulated a team member/members for a good game			0.89	
1. Encouraged, cheered on a team member/members			0.86	
3. Responded positively about a team member/members			0.83	
4. Advised a team member/members			0.82	
5. Helped the injured opponent				0.87
6. Requested to stop the sports contest after an injury of an opponent				0.87
7. Helped the injured opponent				0.72
Explained dispersion's cumulative %	22.9	41.18	57.19	69.18

Note. ABWR – antisocial behavior with the rivals; ABWP – antisocial behavior with the team; PBWP – prosocial behavior with the team; PBWR – prosocial behavior with the rivals.

Table 3. **Correlations, scale compatibility, and the main results of the study. Cronbach's alpha are reported on the diagonal**

Variables	1	2	3	4	5	6	7	8
1. MRL	(0.86)							
2. COM	0.48**	(0.93)						
3. STT	0,02	0.16*	(0.85)					
4. CC	0.23*	0.17*	–0.11	(0.96)				
5. PBWP	0.29**	0.37**	–0.03	0.34**	(1.89)			
6. PBWR	0.22**	0.15*	–0.14*	0.14*	0.45**	(1.83)		
7. ABWP	–0.24**	–0.14**	–0.08	-0.05	–0.08	0.12	(0.89)	
8. ABWR	–0.38**	–0.19**	0.10	–0.11	–0.16**	–0.002	0.58**	(0.89)
The average score	3.62	3.97	2.77	6.96	4.10	2.90	2.37	2.22

Note. COM – Competence values; MRL – moral values; STT – status values; CC – Coatching competency; ABWR – antisocial behavior with the rivals; ABWP – antisocial behavior with the peers; PBWP – prosocial behavior with the peers; PBWR – prosocial behavior with the rivals. * – statistically significant difference ($p < 0.05$); ** – statistically significant difference ($p < 0.01$).

Table 4. **Athletes' values, prosocial and antisocial behaviors, and the evaluation of coach's competence to develop character in the aspect of their age and sports experience**

	Age			Sports experience		
	Till 17 years	18–19 years	U	Till 6 years	6 and more	U
1. MRL	3.71	3.52		3.76	3.47	4347.0
2. COM	4.25	3.66**	3715.5**	3.95	3.98	
3. STT	2.87	2.66		2.66	2.88	
4. CC	7.03	6.89	4191.5*	7.05	6.88	
5. PBWP	4.03	4.18	4328.5	4.04	4.17	
6. PBWR	2.80	3.01		2.87	2.93	
7. ABWP	2.39	2.34		2.25	2.48	4099.5*
8. ABWR	2.27	2.18		2.13	2.32	

Note. COM – Competence values; MRL – moral values; STT – status values; CC – Coaching competency; ABWR – antisocial behavior with the rivals; ABWP – antisocial behavior with the peers; PBWP – prosocial behavior with the peers; PBWR – prosocial behavior with the rivals. * – statistically significant difference ($p < 0.05$); ** – statistically significant difference ($p < 0.01$).

Differences in the evaluations of value orientations, behavior in sport and coach's competence are determined in the aspects of age and experience (Table 4). The average response values indicate that for younger athletes capacity building values are more important than for the older ones ($U = 3715.5$; $p < 0.01$); younger athletes value their coach's competence to develop character better than their senior counterparts ($U = 4191.5$; $p < 0,05$). However, in the senior group we found a better prosocial behavior tendency with their teammates ($U = 4328.5$; $p = 0.08$). The analysis of the remaining variables among age groups did not reveal significant differences. When analyzing the data in the aspect of sports experience we found that athletes who were engaged in their sports activities longer demonstrated antisocial behavior with their teammates more frequently ($U = 4099.5$; $p < 0.05$), students with lower sports experience emphasized moral values ($U = 4347.0$; $p = 0.09$).

DISCUSSION

Using the mathematical model of an exploratory factor analysis we established three groups of values, thirteen statements were divided into three groups describing moral, capacity building and status values. We also identified four forms of behavior and statements representing them, and the identified correlation between moral and capacity building, capacity building and status values groups matched the trend links established in earlier studies (Šukys, 2010; Šukys, Jansonienė, 2012). Also the communication tendencies between the two positive and two negative behaviors match with these studies, but, unlike the authors of these studies, we found a weak negative relationship between pro-social behavior with the teammates and antisocial behavior with the rivals. In assessing the reliability of the questionnaire, the scales showed a good internal consistency scores.

The analysis of our research results on the athletes' values, behaviors in sport and the evaluation of the coach's competence in the development of character showed that the moral and competence values in sport positively correlated with the prosocial behavior in a team and with competitors, however, they negatively correlated with the antisocial behavior in a team and the opponents. Moral group of values had the strongest link with the four forms of athletes' behavior in sport; the strongest was their negative link with antisocial behavior and with the rivals. The relationship of moral values confirmed previous findings (Šukys, 2010). The latter interface can be explained by the fact that the athletes' fairness and the emphasis on the compliance to the rules are the expression of moral values, so athletes should demonstrate less disgraceful behavior when competing (Lee et al., 2008). The group of capacity building values had weaker links than moral values, but the interface of prosocial behavior with the teammates was the strongest. The emphasis of sportsmanship can be seen as an expression of the capacity building values (Lee et al., 2008). In team sports, success in personal sports results can vary depending on the relationships in a team (Meidus, 2007), probably because these values have the maximum interface with prosocial behavior with teammates as the encouragement and support of the teammates may

lead to better team as well as individual sports results (Meidus, 2007). The strength of this interface is also consistent with the previous research findings (Šukys, 2010). Group of status values had a weak negative link with the prosocial behavior with the opponents. Scientists explain this link by the fact that the emphasis of victory could lead to less friendly behavior (Lee et al., 2008). Evaluation of coach's competence in developing character is positively associated with prosocial behavior forms and moral values as well as and capacity building values. However, a negative relationship with the status values and forms of antisocial behavior has not been identified. These research findings are adequate to the results of the research carried out earlier (Boardley et al., 2008). We suggest that competent and targeted coach's work, developing athlete's positive attitudes towards honorable sport behavior and respect for others, can bring positive results in the desirable athletes' behavior but it is not significant to the negative behavior of people in sport. According to scientists, such research method of the coach's competence explains the fact that there is no connection with the antisocial variables. The statements of these scales talk about the positive aspects of morality, such as a positive attitude towards the noble sport contest and behavior. Meanwhile, statements in the antisocial behavior scale describe actions that cause injustice to other sports participants and include the negative aspects of morality. According to I. D. Boardley (2008), less recurrent athletes' antisocial behavior shows the functioning of higher morality in sports context.

The study also sought to determine the value orientations of youth athletes, behavioral expressions in sports activities and the attitude towards coach's competency of character development in the aspect of age and sports experience. According to the data of our study, the capacity-building values are more important for the group of younger athletes. These results are contrary to the findings produced in previous studies (Lee et al., 2000; MacLean, Hamm, 2008) which stated that for the younger athletes moral values are more important than their capacity, scientists suggest that younger athletes lack sports skills and a sense of competence, thus they are not very much involved in sports, that is why their personal development of sportsmanship may still not be as relevant as for their counterparts in higher levels of sportsmanship. Although our study found the opposite, attention is drawn to the fact that in the younger group there could be quite enough experienced athletes attending practice sessions for six or more years. This controversial question arising from our study can be answered by our research data of sports experience indicating that less experienced athletes tended to emphasize moral values. It should be noted that other researchers (Lee et al., 2000; MacLean, Hamm, 2008) have found that not the age of athletes but the successful practice in sport leading to ever growing involvement in sport activities have more significant impact on sports value orientation.

In the research of sports behavior expression, respondents said that during the past year in sports they acted prosocially more often than antisocially; senior athletes demonstrated more friendly behavior with the teammates than the younger ones. Amicable tendency of such behavior can be explained (Meidus, 2007) by several assumptions that during intensive communication in a team sport, players form their emotional relationships and group interaction skills. It may be assumed that older study participants have better developed their relationships than the younger ones, so they are friendlier with their teammates. Although the survey participants said that over the past year they behaved antisocially less frequently, the study results suggest that more experienced athletes behave antisocially with their teammates more often. The research shows (Kavussanu et al., 2008) that when sport experience is increasing athletes take a more positive look on certain forms of antisocial behavior; that is why antisocial behavior may become more frequent. It was also found (Šukys et al., 2011) that during highly psychologically stressful competition athletes' relationships can become more aggressive. Thus, the research data of prosocial and antisocial behavior confirm the results of the previous studies and the assumptions raised by the scientists that prosocial and antisocial behavior reflects two independent dimensions of morality, mean that not necessarily antisocial behavior of prosocially acting athletes should be less common, and vice versa (Kavussanu, 2006).

According to the survey, coach's ability to develop the positive attitudes towards the honorable sports behavior is valued by younger athletes more favorably than by the older ones, but in the aspect of sports experience no significant difference was found. Young athletes' approach to coach's competencies can be explained by similar assumptions concerning age and sports experience, but with increasing experience in sport athletes can

become more critical to the coach (Kavussanu et al., 2008). Although according to our study we found a more favorable evaluation of younger athletes, which could possibly mean that older athletes value their coach more critically because of their athletic experience, but the study data did not confirm this assumption on the basis of athletic experience. The results of our study did not confirm the assumptions made in the research (Kavussanu et al., 2008) due to the fact that these authors included children of various ages and sports experience.

CONCLUSION AND PERSPECTIVES

According to our study, moral values and capacity building values are of the highest importance to athletes' behavior. A positive relation was established between the coach's competence and athletes' positive behavior, moral, capacity building values, which shows that competent and targeted coach's work in developing positive attitudes towards the honorable athlete's sports behavior, respect for others, can bring positive results for the desired athletes' behavior, however, it does not affect negative athletes' behavior.

For younger athletes, capacity building values are more important than for the older ones, younger athletes also more positively value coach's ability to develop virtuous character of an athlete as well as positive attitudes towards sport. It has been found that adolescent athletes behave prosocially more frequently than antisocially, but the latter behavior is more specific for more experienced athletes. The results confirm the fact that prosocially acting athletes' antisocial behavior may not necessarily be less common, so in order to know the behavior in the sports context better, in the future pro-social behavior should be examined together with the antisocial behavior.

REFERENCES

Boardley, I. D., Kavussanu, M., Ring, C. (2008). Athletes' evaluations of coaching effectiveness and psychosocial outcomes in rugby union. *The Sport Psychologist*, 22, 269–287.

Boardley, I. D., Kavussanu, M. (2009). The influence of social variables and moral disengagement on prosocial and antisocial behaviours in field hockey and netball. *Journal of Sports Sciences*, 27 (8), 843–854.

Eisenberg, N., Fabes, R. A. (1998). Prosocial development. In N. Eisenberg (Ed.), *Handbook of Child Psychology*, *Vol 3: Social, emotional, and personality development* (pp. 701–778). NY: Wiley.

Eisenberg, N., Müssen, P. H. (1989). *The Roots of Prosocial Behaviour in Children*. Cambrige: Cambrige University Press.

Feltz, D. L., Chase, M. A., Moritz, S. E., Sullivan, P. J. (1999). A conceptual model of coaching efficacy: Preliminary investigation and instrument development. *Journal of Educational Psychology*, 91, 765–776.

Horn, T. S. (2002). Coaching effectiveness in the sport domain. In T. S. Horn (Ed.), *Advances in Sport Psychology* (pp. 309–354). Champaign, IL: Human Kinetics.

Kavussanu, M., Boardley, I. D., Jutkiewicz, N., Vincent, S., Ring, C. (2008). Coaching efficacy and coaching effectiveness: Examining their predictors and comparing coaches' and athletes' reports. *The Sport Psychologist*, 22, 383–404.

Kavussanu, M. (2008). Moral behavior in sport: A critical review of the literature. *International Review of Sport and Exercise Psychology*, 1 (2), 124–138.

Kavussanu, M. (2006). Motivational predictors of prosocial and antisocial behaviour in football. *Journal of Sports Sciences*, 24 (6), 575–588.

Kavussanu, M., Seal, A., Phillips, D. (2006). Observed prosocial and antisocial behaviors in male soccer teams: Age differences across adolescence and the role of motivational variables. *Journal of Applied Sport Psychology*, 18 (4), 326–344.

Lee, M. J., Whitehead, J., Balchin, N. (2000). The measurement of values in youth sport: Development of the Youth Sport Values Questionnaire. *Journal of Sport and Exercise Psychology,* 22, 307–326.

Lee, M. J., Whitehead, J., Ntoumanis, N., Hatzigeorgiadis, A. (2008). Relationships among values, achievement orientations, and attitudes in youth sport. *Journal of Sport and Exercise Psychology*, 30 (5), 588–610.

MacLean, J., Hamm, S. (2008). Values and sport participation: Comparing participant groups, age, and gender. *Journal of Sport Behavior*, 31 (4), 352–360.

Meidus, L. (2007). Pedagoginis sporto poveikis sportininkų bendravimui ir sąveikai. *Sporto mokslas*, 3 (49), 21–24.

Miškinis, K. (2011). Daugybos lentelė treneriui. *Treneris*, 3, 3–8.

Myers, N. D., Feltz, D. L., Maier, K. S., Wolfe, E. W., Reckase, M. D. (2006). Athletes'evaluations of their head coach's coaching competency. *Research Quarterly for Exercise and Sport, 77,* 111–121.

Šukys, S., Jansonienė, A. J. (2012). Relationship between athletes values and moral disengagement in sport and differences across gender level and years of

involvement. *Ugdymas. Kūno kultūra. Sportas*, 1 (84), 55–61.

Šukys, S. (2010). Prosocialaus ir antisocialaus elgesio skalės bei jaunimo vertybių sportinėje veikloje klausimyno adaptavimas lietuviams. *Ugdymas. Kūno kultūra. Sportas*, 3 (78), 97–104.

Šukys, S., Zakrasienė-Stanevičiūtė, V., Nickus, E., Šukienė, E. (2011). Manifestation of prosocial and antisocial behavior in a basketball match. *Ugdymas. Kūno kultūra. Sportas*, 4 (83), 69–76.

Vasiliauskas, R. (2005). Vertybių ugdymo teoriniai ir praktiniai aspektai. *Acta Paedagogica Vilnensia*, 14, 45–54.

SPORTUOJANČIŲ PAAUGLIŲ VERTYBINIŲ ORIENTACIJŲ, SPORTINIO ELGESIO IR TRENERIO KOMPETENCIJOS UGDYTI SPORTININKŲ CHARAKTERĮ VERTINIMO SĄSAJOS

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Straipsnyje analizuojama sportuojančių paauglių prosocialaus bei asocialaus elgesio sąsajos su asmeniniais, socialiniais veiksniais sportuojant ir kaip šie kintamieji priklauso nuo amžiaus ir sportinės patirties, vertybinių orientacijų bei trenerio kompetencijos ugdyti sportininko charakterį vertinimo.

Tikslas – atskleisti sportuojančių moksleivių vertybinių orientacijų ir elgesio sportinėje veikloje bei trenerio kompetencijos ugdyti sportininko charakterį vertinimo sąsajas atsižvelgiant į amžių ir sportinę patirtį.

Metodai. Tiriamąją imtį sudarė 201 tikslines komandines sporto šakas kultivuojantis moksleivis iš Kauno ir Alytaus sporto mokyklų. Aiškinantis, kokios vertybės sportuojantiems moksleiviams yra svarbiausios sportinėje veikloje, taikytas Jaunimo vertybių sportinėje veikloje klausimynas (*Youth Sport Values Questionnaire* – Lee et al., 2008). Aiškinantis sportuojančių moksleivių elgesį sportinėje veikloje taikyta Prosocialaus ir antisocialaus elgesio sportinėje veikloje skalė (*The Prosocial and Antisocial Behavior in Sport Scale* – Kavussanu, Boardley, 2009) ir adaptuota Trenerio charakterio ugdymo kompetencijos skalė (CES – Feltz et al., 1999).

Rezultatai. Nustatyta teigiama koreliacija tarp sporto vertybių, trenerio kompetencijos ugdyti sportininko charakterį ir prosocialaus sportininkų elgesio. Šie kintamieji neigiamai koreliuoja su asocialiu elgesiu, o statuso vertybės – su prosocialiu elgesiu. Trenerio kompetenciją ugdyti charakterį labiau suvokia jaunesni sportininkai ($p < 0,05$). Taip pat kompetencijos vertybės buvo svarbesnės šiems sportininkams, lyginant su vyresniaisiais ($p < 0,05$). *Mann-Whitney U* testas parodė skirtumą tarp nevienodą sportinę patirtį turinčių sportininkų asocialaus elgesio su komandos draugais – dažniau taip elgiasi didesnę patirtį turintys sportininkai ($p < 0,05$).

Aptarimas ir išvados. Tyrimo duomenimis, moralinių ir gebėjimų ugdymo vertybių grupės turi didžiausią reikšmę sportininko elgesiui. Teigiamas trenerio kompetencijos vertinimo ryšys su pozityviu sportininkų elgesiu, moralinėmis ir gebėjimų ugdymo vertybėmis rodo, kad kompetentingas bei kryptingas trenerio darbas ugdant sportininko garbingo sportinio elgesio nuostatas ir pagarbą kitiems gali išugdyti pageidautiną sportininko elgesį ir neturi reikšmės neigiamam sportuojančiųjų elgesiui.

Jaunesniems sportininkams gebėjimų ugdymo vertybės svarbesnės nei vyresniems, jaunesnieji palankiau vertina trenerio gebėjimą ugdyti dorą sportininko charakterį bei teigiamą požiūrį į sportą. Nustatytas sportuojančių paauglių prosocialus elgesys dažnesnis nei antisocialus, tačiau pastarasis būdingesnis labiau patyrusiems sportininkams. Tyrimo rezultatai patvirtina faktą, kad prosocialiai besielgiančių sportininkų antisocialus elgesys nebūtinai turi būti retesnis. Taigi norint geriau pažinti sportinį elgesį ateityje prosocialus elgesys turėtų būti tiriamas kartu su antisocialiu.

Raktažodžiai: sportas, moralus sportininkų elgesys, sporto vertybės, trenerių teigiamos veiklos suvokimas.

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THE ATTITUDE TOWARDS OLYMPISM VALUES OF PUPILS IN SCHOOLS IMPLEMENTING AND NOT IMPLEMENTING INTEGRATED OLYMPIC EDUCATION

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ABSTRACT

Research backround and hypothesis. The research focuses on school pupils' attitudes towards Olympism values and Olympic education. We hypothesised that in schools implementing integrated Olympic education programme, pupils more associated human values with Olympism than pupils in schools where this education programme was not implemented.

Research aim was to ascertain the attitude towards Olympism values of pupils in schools implementing and not implementing integrated Olympic education.

Research methods. The sample included 2335 (1095 males and 1240 females) young adolescents between the ages of 13 and 18 years. Pupils' attitudes towards Olympism values were determined using the Olympic Questionnaire (Telama et al., 2002).

Research results. Research results revealed statistically significant differences towards human values of Olympism ($p < 0.001$) and social virtues of Olympism ($p < 0.001$) of pupils depending on applied Olympic education programme in schools.

Discussion and conclusions. Our study revealed that pupils at schools implementing Integrated Olympic Education Programme more often emphasized the importance of human and social values of Olympism compared to pupils from schools not implementing this programme. The similar differences were found when assessing the results separately for girls. Research results did not reveal differences among 13–14-year-old pupils. However, the differences were established comparing the data of older pupils. Older pupils in schools with integrated Olympic education programme more emphasized the social virtues of Olympism and the human values of Olympism.

Keywords: Olympism, attitudes towards values, Olympic education.

INTRODUCTION

In the development of an independent, creative personality, revealing their skills as much as possible, it is necessary to look for ways to make the school more interesting and attractive. In Lithuania, one of the innovative and attractive content forms of education is the Olympic education (Žilionytė, Poteliūnienė, 2012). Many researchers (Binder, 2001, 2005; Bronikowski, 2006; Parry, 2006; Naul, 2008; Patsantaras, 2008; Georgiadis, Syrigos, 2009; Culpan, Wigimore, 2010) maintain that Olympic education is an effective means of education, based on the philosophy of Olympism, which is directly related to the educational function, and is reflected in the basic principles of Olympism (*Olimpinė chartija*, 2006). Philosophy of Olympism focuses not only on a professional athlete, but also on every person, not just for a short period of time, but throughout the whole life, not just on the competition and victory, but also on the participation and cooperation, not only on sports activities, but also on the improvement of personal and social life (Parry, 2006). In this respect, Olympic education is seen as the value education (Binder, 2005), which not only introduces the Olympic Movement, Olympic ideals and values, but also encourages to apply them both in sports and

everyday activities (Pawlucki, 2006; Żukowska, Żukowski, 2010). The ideological foundation of the Olympic education comprises humanistic values, including mutual understanding, friendship, solidarity, keeping to fair play rules (Лубишева, 2007; Patsantaras 2008).

It should be noted that a number of scientists dealt with the theoretical aspect of Olympic education issues (Parry, 2006; Lenskyj, 2012; Teetzel, 2012). Empirical research has focused on pupils' knowledge of the Olympic Movement, the Olympic ideals, Olympic champions (Rychtecky, Naul, 2005), pupils' attitudes towards the Olympic values (Bronikowski, Bronikowska, 2009), approach to fair play as a fundamental value of Olympic education (Żukowska, Żukowski, 2010), Olympians' opinions about the role of the Olympic Games in the development of their personal identity (Baker et al., 2012). In the context of research carried out, there is a lack of studies focused on the effect of a targeted Olympic education programme on pupils. It is worth mentioning a few studies that have addressed the issues of the development of pupils' moral values based on the Olympic education (Budreikaitė, 2012) as well as factors of the realization of Olympic education at schools (Žilionytė, Poteliūnienė, 2012). As the Integrated Olympic education programme has been implemented in dozens of schools in the country since 2002, and its content has been integrated in both formal and non-formal education, it is relevant to evaluate the programme's impact on pupils' approach to the values of Olympism. In this research the hypothesis was raised that in schools implementing integrated Olympic education programme, pupils more associate human values with Olympism than pupils in schools where this education programme is not implemented.

The aim of the research was to ascertain the attitude towards Olympism values of pupils in schools implementing and not implementing integrated Olympic education.

RESEARCH METHODS

Research participants. The sample was drawn from Lithuanian schools representing the main schools, secondary schools and gymnasiums by applying stage sampling methods, i. e., we selected a number of schools at random, and from each of these schools, selected a number of classes at random. In total 30 schools were randomly selected. The total sample consisted of 2335 (1095 males and 1240 females) young adolescents between the ages of 13 and 18 years. All the pupils were divided into the three groups by age: 13–14 years (n = 875), 15–16 year (n = 960) and 17–18 year (n = 518). Males and females were equally represented across the age groups. 1186 pupils from the schools participating in the programme of the Olympic education and accordingly 1149 from those not participating in this programme.

Measures. Pupils' attitudes towards Olympism values were determined using Olympic Questionnaire (Telama et al., 2002). It should be noted that the questionnaire consisted of three parts. In this analysis we used data from the second part aimed at the study of pupils' attitudes towards the values of Olympism (The Assessment of Olympic Ideals). The study of attitudes towards the values of Olympism included a list of 52 values, which in original version consisted of four groups of values: *social virtues of Olympism* (such item as *peace, solidarity, equality, rejection of discrimination,* etc.); *personal profit of professionalism* (such item as *richness, popularity, victory at all costs,* etc.), *human values of Olympism* (such item as *mutual respect, fair play,* etc.) *and personal profit of professionalism* (such item as *victory, self-control, physical capacity,* etc.). When evaluating each statement pupils had to choose one of four answer options (from 1 *strongly disagree* to 4 – *absolutely agree*). Internal consistency index of the full scale was good – Cronbach's alpha 0.87.

Procedure. The survey was done during the classes upon written consent by Lithuanian Olympic Academy, Education Departments of different Lithuanian cities, and with prior agreement with school directors, teachers and pupils. Participation of pupils was based on principles of anonymity and goodwill. The survey was carried out with the participation of the school social pedagogue or psychologist. Before the survey pupils were always explained the research aim and filling instructions. Pupils were given as much time as they needed. Completed questionnaires were collected at once.

Data analysis. All analyses were conducted with *SPSS 13.0*. The questionnaire structure of pupils' attitudes towards the Olympism values was assessed using factor analyses. Internal consistency of questionnaire scales was determined by calculating the Cronbach's alpha coefficient. Correlations between the factors were measured by Spearman's correlation coefficient. Hypotheses about the equality between two independent groups were verified using Mann-Whitney U

test. Hypotheses about the equality between more than two groups were tested using Kruskal-Wallis H test. In calculating the effect size (r) for independent samples in a Mann-Whitney U test the following formula was used: $r = Z/\sqrt{N}$ N. r = 0.10 meant small effect, r = 0.30 – medium effect, and r = 0.50 – large effect.

RESEARCH RESULTS

Analysing the results of pupils' approach to the values of Olympism, first the principal components analysis with Varimax rotation and Kaiser Normalization was conducted. After the factor analysis (KMO = 0.78, Bartlett's test of Sphericity p = 0.001) four factors were identified explaining 39.56% of the total variance. These four factors are in compliance with the originally distinguished four groups of values assigned. However, it should be noted that five items were removed for the following reasons: they did not fall into any of the four factors, their loading was lower than 0.40, or they fell into a group which had the opposite meaning. The authors of the questionnaire (Telama et al., 2002) also note that using the survey data of different countries it is not always possible to distinguish identical factor structure.

Correlations between factors showed that social virtues associated with Olympism related positively to human values associated with Olympism ($p < 0.01$) and individual pursuit of excellence ($p < 0.01$). Human values of Olympsim positively related to individual pursuit of excellence ($p < 0.01$). Research results showed that pupils assessed item in factor of individual pursuit of excellence more positively, and much more seldom totally agreed with items in personal profit of professionalism factor (Table 1).

The applied Mann-Whitney U test revealed statistically significant differences between the attitudes to Olympism values by gender, i. e. the importance of social values of Olympism ($U = 564170.0$; $z = –7.03$; $p < 0.001$; $r = 0.15$) and personal benefit of professionalism ($U = 606266.0$; $z = –4.44$; $p < 0.001$; $r = 0.09$) were emphasized more by boys than girls. Statistically significant differences were received comparing the survey data by age, i. e. younger pupils more emphasized social virtues of Olympism ($H = 16.02$; $p < 0.001$; $r = 0.34$), and older pupils – human values of Olympism respectively ($H = 19.08$; $p < 0.001$; $r = 0.40$) and individual pursuit of excellence ($H = 19.91$; $p < 0.001$; $r = 0.41$).

The main analyses were related with comparing attitudes to Olympism values of pupils from the schools participating and not participating in the integrated programme of the Olympic education. The applied Mann-Whitney U test revealed statistically significant differences in pupils' attitudes to the values of Olympism depending on the school implementing or not implementing integrated Olympic education programme (Table 2). Pupils from schools where the Olympic education programme was applied assigned human values of Olympism ($U = 612096.5$; $z = 4.24$; $p < 0.001$; $r = 0.09$) and the social virtues of Olympism ($U = 599953.0$; $z = 4.93$; $p < 0.001$; $r = 0.10$) to the most important values. The similar differences were found when assessing the results separately for girls. Mann-Whitney U test showed that girls from schools where the Olympic education programme was applied much more stressed the human values of Olympism ($U = 165404.5$; $z = –4.26$; $p < 0.001$; $r = 0.12$) and the social virtues of Olympism ($U = 161581.0$; $z = –4.86$; $p < 0.001$; $r = 0.14$). Comparing the results of the boys, only one statistically significant difference was found, i. e. boys from the school where Olympic education programme was applied much often agree with items in factor social virtues of Olympism ($U = 139097.0$; $z = –1.98$; $p < 0.05$; $r = 0.06$).

Table 1. **Correlation and descriptive statistics of Olympsim values scale**

Values of Olympism	M	Cronba's alpha	SVO	PPP	HVO	IPE
Social Virtues of Olympism	3.00	0.89				
Personal Profit of Professionalism	2.68	0.72	0.25**			
Human Values of Olympism	3.32	0.83	0.59**	0.13**		
Individual Pursuit of Excellence	3.52	0.83	0.54**	0.20**	0.62**	

Note. SVO – social virtues of Olymism; PPP – personal profit of professionalism; HVO – human values of Olympism; IPE – individual pursuit of excellence; M – mean score; ** – $p < 0.01$.

Values of Olympism	Schools participate in the programme of the Olympic education	Schools do not participate in the programme of the Olympic education
	M	M
Social Virtues of Olympism	3.05	2.95***
Personal Profit of Professionalism	2.68	2.68
Human Values of Olympism	3.36	3.29***
Individual Pursuit of Excellence	3.52	3.52

Table 2. T**he mean score of pupils' attitudes towards Olympic values depending on the school participating and non-participating in the programme of Olympic education**

Note. *** – $p < 0.001$.

Values of Olympism	15–16 years of age		17–18 years of age	
	Schools participate in the programme of the Olympic education	Schools do not participate in the programme of the Olympic education	Schools participate in the programme of the Olympic education	Schools do not participate in the programme of the Olympic education
	M	M	M	M
Social Virtues of Olympism	3.06	2.93***	3.02	2.87***
Personal Profit of Professionalism	2.68	2.64	2.68	2.68
Human Values of Olympism	3.39	3.31***	3.40	3.33*
Individual Pursuit of Excellence	3.52	3.55	3.60	3.58

Table 3. **The mean score of differently aged pupils' attitudes towards Olympic values depending on the school participating and non-participating in the programme of Olympic education**

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

The analysis of the differences between the attitudes towards the values of Olympism in the aspect of age showed no statistically significant differences among the youngest pupils (aged 13–14 years) depending on the school implementing or not implementing the integrated Olympic education programme. However, the differences were established comparing the data of older pupils (Table 3). 15–16-years-old pupils in schools with integrated Olympic education programme more emphasized the social virtues of Olympism ($U = 96638.5$; $z = -4.12$; $p < 0.001$; $r = 0.13$) and the human values of Olympism ($U = 99840.5$; $z = -3.43$; $p < 0.001$; $r = 0.11$). The similar differences were found comparing 17–18-years-old pupils attitudes (the social virtues of Olympism; $U = 27670.0$; $z = -3.45$; $p < 0.001$; $r = 0.15$ and the human values of Olympism $U = 30023.0$; $z = -2.07$; $p < 0.05$; $r = 0.09$).

DISCUSSION

Analysing pupils' views of the Olympic values in schools implementing and not implementing the Olympic education programme we can claim that the hypothesis raised at the beginning of the study has been confirmed. Our questionnaire survey data revealed that in schools implementing integrated Olympic education programme, pupils more associated human values with Olympism than pupils in schools where this education programme was not implemented. This is not surprising because researchers dealing with the issues of Olympic education point out that these values should receive most attention in the Olympic education process (Patsantaras, 2008; Peneva, 2009). Research by A. Budreikaitė (2012) showed that pupils participating in the integrated

Olympic education programme recognized as more important such values as dignity, responsibility and honesty, justice. Similarly investigated teachers in the country also argued that the Olympic education programme implemented in secondary schools encouraged pupils to talk about the Olympic values and their manifestations in everyday life (Žilionytė, Poteliūnienė, 2012).

Although we did not raise any more hypotheses at the beginning of the study, statistical analysis revealed differences in the assessment of pupils' attitudes towards social values associated with Olympism as well. According to our research data, those values are more linked to Olympism by those pupils who learn at schools where the Olympic education programme is being integrated. As peace, solidarity, togetherness, non-discrimination and similar values are attributed to the social values, the obtained differences were also not unexpected. Even the *Olympic Charter* (Olimpinė chartija, 2006) highlights these values in the discussion of its second principle. They are also highlighted by scientists who list the Olympism goals and talk about them (Булкина, Максимова, 2010). The *Integrated Olympic Education Programme for Children and Youth* (Puišienė et al., 2007) also indicates that one of the Olympic education goals is to help develop a peaceful society. Therefore, it is reasonable to argue that schools implementing the Olympic education programme address these values as well.

The analysis of the results of pupils' attitudes by gender showed that girls in the sample differently assessed human and social values associated with Olympism. However, no differences were observed in individual children's results. It can be assumed that boys in general put less emphasis on these values. However, in the total sample (not distinguishing schools implementing or not implementing the Olympic Education Programme), differences by gender in the assessment of human values were also not found. On the other hand, girls' and boys' approaches to social values associated with Olympism are different. In addition, research literature contains data that girls, compared to boys, place more emphasis on the social importance of the values of Olympism (Tomik et al., 2012). Thus, while assessing pupils' approach to human values we can assume that the implementation of the Olympic education programme content more effectively changes the girls' approach to Olympism.

The age factor analysis showed that the 13–14-year-old pupils' approach to the values of Olympism does not differ in both types of schools: implementing or not implementing the Olympic Education Programme. However, differences were found in comparing the senior pupils' answers. Pupils in schools implementing the Integrated Olympic Education Programme placed more emphasis on human and social values in Olympism. It can be explained by greater experience of pupils of this age in the Olympic Education Programme. Otherwise stated, many schools have been implementing this programme for many years. Therefore, its effects are more likely to occur for those pupils who are more involved in it.

CONCLUSION AND PERSPECTIVES

Pupils at schools implementing Integrated Olympic Education Programme more often emphasized the importance of human and social values of Olympism compared to pupils from schools not implementing this programme.

The study carried out not only proved that the Olympic education programme could be used as a means of developing pupils' positive attitudes to socially important values, but also allowed foreseeing future research perspectives. We think that analysing the effectiveness of the Olympic education programme while educating children, it is important to assess programme content, which may be different at each school. Thus, when evaluating the effectiveness of an Olympic education programme it is appropriate to carry out qualitative content analysis of specific school programmes. Although the survey data revealed statistically significant differences in the data of pupils' approaches to the values of Olympism, the effect size was low. The value of the effect size was due to the relatively large number of subjects. It would be therefore expedient to choose several schools where the Olympic education programme was just starting, and for several years to observe pupils in those schools. This would allow research to assess changes in children depending on the content of the Olympic education programme at a certain school.

REFERENCES

Barker, D., Barker-Ruchti, N., Rynne, S. B. et al. (2012). Olympism as education: Analysing the learning experiences of elite athletes. *Educational Review*, 64 (3), 369–384.

Binder, D. (2001). Olympism revisited as context for global education: Implications for physical education. *Quest*, 53 (2), 14–34.

Binder, D. (2005). *Teaching Olympism in schools: Olympic education as a focus on values education. A paper presented at the Centre for Olympic Studies, University of Barcelona.* Barcelona: Centre d'Estudis (UAB).

Bronikowski, M. (2006). Achievements in teaching olympism in Polish schools. *Research Yearbook*, 12 (2), 184–189.

Bronikowski, M., Bronikowska, M. (2009). Can Olympic education be among the pacemakers? In K. Georgiadis, A. Sirygos (Eds.), *Olympic Truce Sport as a Platform for Peace* (pp. 93–107). Athens: The International Olympic Truce Centre.

Budreikaitė, A. (2012). Olimpinio ugdymo poveikis 6 klasės mokinių dorovinių vertybių raiškai. *Sporto mokslas*, 4 (70), 8–14.

Culpan, I., Wigimore, S. (2010). The delivery of Olympism education within a physical education context drawing on critical pedagogy. *International Journal of Sport and Health Science*, 8, 67–76.

Georgiadis, K., Syrigos, A. (2009). Introduction. In K. Georgiadis, A. Syrigos (Eds.), *Olympic Truce Sport a Platform for Peace* (pp. 17–21). Athens: The International Olympic Truce Centre.

Lenskyj, H. (2012). Olympic education and Olympism: Still colonizing children's minds. *Educational Rewiew*, 64 (3), 265–274.

Naul, R. (2008). *Olympic Education*. Oxford: Meyer & Meyer.

Olimpinė chartija. (2006). Vilnius: Lietuvos tautinis olimpinis komitetas.

Parry, J. (2006). Sport and Olympism: Universals and multiculturalism. *Journal of the Philosophy of Sport*, 33, 188–204.

Patsantaras, N. (2008). Olympic messages: Olympic ideology and Olympic social reality. *Sport Management International Journal*, 4 (1), 45–55.

Pawlucki, A. (2006). Olympic education as an intergenerational relation of the third degree. *Research Yearbook*, 12 (2), 280–286.

Peneva, B. I. (2009). Functions of Olympic education in the contemporary school. *Sport Science*, 2, 31–34.

Puišienė, E., Deksnys, V., Majauskas, P., Kazlauskas, A., Statuta, P. (2007). *Integruojančios olimpinio ugdymo programos bendroji dalis ir Olimpinio švietimo programa.* Vilnius: Lietuvos sporto informacijos centras.

Rychtecky, A., Naul, R. (2005). Goal orientation and perception of Olympic ideals in the Czech and German youth. *ACTA Universitatis Carolinae, Kinanthropologica,* 41 (2), 35–48.

Teetzel, S. J. (2012). Optimizing Olympic education: A comprehensive approach to understanding and teaching the philosophy of Olympism. *Educational Rewiew*, 64 (3), 317–332.

Telama, R., Naul, R., Nupponen, H., Rychtecky, A., Vuolle, P. (2002). *Physical Fitness, Sporting Lifestyles and Olympic Ideals: Cross-Cultural Studies on Youth Sport in Europe.* Schorndorf: Hofmann.

Tomik, R., Olex-Zarychta D., Mynarski, W. (2012). Social values of sport participation and their significance for youth attitudes towards physical education and sport. *Studies in Physical Culture and Tourism,* 19 (2), 99–104.

Žilionytė, V., Poteliūnienė, S. (2012). Olimpinio ugdymo programos realizavimą Lietuvos bendrojo lavinimosi mokyklose skatinantys ir apsunkinantys veiksniai. *Sporto mokslas*, 1 (67), 45–51.

Żukowska, Z., Żukowski, R. (2010). Fair play as a moral value in the Olympic education: Fair play in the Olympic education. *Polish Journal of Sport and Tourism,* 17 (3), 139–146.

Булкина, Н. П., Максимова, Н. В. (2010). Концептуалъное понятие олимпийского образования и его принципов. *Вісник ЛНУ імені Тараса Шевченка*, 17 (204), 12–17.

Лубишева, Л. И. (2007). Интеграция спортивного и олимпийского воспитания в образовательном пространстве школы. *Наука в олимпийском спорте*, 2, 36–40.

INTEGRUOTĄ OLIMPINIO UGDYMO PROGRAMĄ ĮGYVENDINANČIŲ IR NEĮGYVENDINANČIŲ MOKYKLŲ MOKSLEIVIŲ POŽIŪRIS Į OLIMPIZMO VERTYBES

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Tyrimu analizuojamas moksleivių požiūris į olimpizmo vertybes ir integruotos olimpinio ugdymo programos mokykloje klausimas. Keliama hipotezė, kad mokyklų, kuriose įgyvendinamas integruotas olimpinis ugdymas, moksleiviai labiau su olimpizmu sieja žmogiškąsias vertybes nei tie, kurių mokyklose toks ugdymas neįgyvendinamas.

Tikslas – nustatyti moksleivių požiūrį į olimpizmo vertybes mokyklose, kuriose įgyvendinamas ir neįgyvendinamas integruotas olimpinis ugdymas.

Metodai. Tiriamųjų kontingentą sudarė 2335 (1095 vaikinai ir 1240 merginos) moksleiviai, parinkti iš įvairių šalies mokyklų. Jų amžius – nuo 13 iki 18 metų. Moksleivių požiūris į olimpizmo vertybes tirtas naudojant Olimpinį klausimyną (Telama et al., 2002).

Rezultatai. Moksleiviai, kurių mokyklose įgyvendinama Olimpinio ugdymo programa, labiau pabrėžė su olimpizmu susijusių žmogiškųjų vertybių ($p < 0,001$) ir socialinių dorybių ($p < 0,001$) svarbą.

Aptarimas ir išvados. Tyrimas atskleidė, kad moksleiviai, kurių mokykloje įgyvendinama Integruota olimpinio ugdymo programa, svarbesnėms priskyrė žmogiškąsias vertybes ir socialines dorybes, susijusias su olimpizmu, nei tie, kurių mokykloje minėta programa neįgyvendinama. Analizuojant moksleivių požiūrio rezultatus pagal lytį pastebėta, kad tarp merginų taip pat nustatyti skirtumai vertinant žmogiškąsias vertybes ir socialines dorybes, susijusias su olimpizmu. Tarp berniukų tokių skirtumų nenustatyta. Gilinantis į amžiaus veiksnį nustatyta, kad 13–14 metų moksleivių požiūris į olimpizmo vertybes nesiskiria, nelygu mokykloje vykdoma olimpinio ugdymo programa ar ne. Aptikta skirtumų palyginant vyresnių moksleivių atsakymus – tie, kurių mokyklose vykdoma Integruota olimpinio ugdymo programa, labiau pabrėžė žmogiškųjų vertybių ir socialinių dorybių, susijusių su olimpizmu, svarbą.

Raktažodžiai: olimpizmas, požiūris į vertybės, olimpinis ugdymas.

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EARLY ISOMETRIC EVERSION AND INVERSION CHANGES AFTER ACUTE ANKLE SPRAINS

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ABSTRACT

Research background and hypothesis. Most of the methods used to monitor ankle condition after acute ankle sprains do not provide knowledge about the functional state of the ankle, which is mostly dependent on muscles and proprioception. For this purpose we used isometric testing.

Research aim: to detect early isometric eversion and inversion peak torque changes after acute ankle sprains, and to compare them to the usual methods.

Research methods. The subjects were 80 athletes with acute grade II ankle sprain. All subjects were randomized into Isometric Testing Group (40 subjects), and Control Group (40 subjects). Both groups underwent the same rehabilitation programme. We measured isometric peak torque and peak torque differences between the healthy and injured legs in eversion and inversion movements of the ankle. The outcome measures were pain on activity, swelling, Lower Extremity Functional Scale score, isometric eversion and inversion strength, Square hop test, and Figure of Eight hop test.

Research results. There were no significant differences between parameters measured in both groups. Statistical analysis indicated significantly lower eversion and inversion strength of the injured limb, significant eversion and inversion deficit changes during the whole study. Pain on activity, and swelling changes were significant only on the first two weeks. Lower Extremity Functional Scale score changes were significant all three weeks. Eversion and inversion deficit correlated with Lower Extremity Functional Scale score.

Conclusion. Isometric testing detects early eversion and inversion changes and helps monitoring rehabilitation after acute lateral ankle sprains.

Keywords: peak torque, rehabilitation, monitoring.

INTRODUCTION

Lateral ankle sprain is one of the most common injuries in sports (about 15% of all sports traumas), and various recreational activities (Hubbard et al., 2008). About ten per 1000 people per year suffer from this pathology (Bleakley et al., 2010; Rogier et al., 2008). Ankle sprains result in loss of playing or working time as well as in medical expenditure (Fong et al., 2009), about a quarter of injured people are unable to participate in social activities for more than seven days. Without adequate treatment and rehabilitation ankle sprains may lead to various complications including re-sprains, chronic ankle instability, persistent swelling or even arthrosis (Anandacoomarsamy, Barnsley, 2005; Struijs, Kerkhoff, 2010).

In acute phase ankle sprains are associated with pain, swelling, loss of function, and/or instability, there is also a decrease in ankle evertor and invertor muscle strength due to neuromuscular regulation impairment (Richie, 2001).

There have been studies published which monitored pain, swelling, and self-reported function after acute ankle sprains (Mawdsley et

al., 2000; Bleakley et al., 2007; Rogier et al., 2008; Bleakley et al., 2010). The problem is that most of these methods are quite subjective; they do not provide knowledge about the functional state of the ankle, which is mostly dependent on muscles and proprioception (Richie et al., 2001). We suggest monitoring early eversion and inversion changes after acute ankle sprains, and by doing that to prevent further complications, such as chronic or functional ankle instability. A few studies, that used ankle eversion and inversion measurement, focused on symptom-free patients or patients with residual problems like chronic ankle instability. This basically means dealing already with ankle sprain complications (Willems et al., 2002; Arnold et al., 2009). These studies used isokinetic testing.

In order to measure ankle eversion and inversion strength after acute ankle sprains, when there is a swelling and a significant loss of range of motion and function, isokinetic testing would not be recommended because eversion and inversion movements would be painful, and they would put an additional stress to the already injured ligaments. In these cases isometric testing can be helpful - the tested leg is immobilized by several straps, there is no movement during testing, and therefore the injured ligaments are not stressed.

A few studies used isometric ankle testing (Kaminski et al., 1999; Webber, Porter, 2010; Smith et al., 2012), but they were investigating patients with residual problems like functional ankle instability. E. Holme et al. (1999) performed isometric ankle strength measurement six weeks post ankle injury. There was one study in which isometric testing (eccentric-isometric) was used three weeks following acute ankle sprain (Konradsen et al., 1998). We have not found any data published about isometric testing during the acute phase after ankle sprains. We think isometric ankle eversion and inversion strength measurement would be a very helpful tool to determine the extent of functional impairment after acute ankle sprains. It would be useful in monitoring the whole rehabilitation process – knowing whether eversion or inversion (or both) is mostly affected enables us to adjust rehabilitation programme for each patient individually, and thus to ensure the progress.

The **aim** of this study was to detect early eversion and inversion changes after acute ankle sprains, and to compare them to the usual methods.

RESEARCH METHODS

Subjects. During the period between August, 2011 to August, 2012, 139 athletes with ankle trauma were evaluated for eligibility. They filled in a questionnaire involving questions about previous ankle traumas and athlete's training intensity. They also had to fill in the Lower Extremity Functional Score questionnaire. Clinical measurements were performed by the doctors. In total 80 athletes (53 males, mean age 25.29 ± 4.46 years, mean height 182.72 ± 5.58 cm, mean weight 82.5 ± 4.6 kg, and 27 females, mean age 26.03 ± 4.61 years, mean height 170.93 ± 6.24 cm, mean weight 61.87 ± 5.12 kg) met inclusion criteria and were included in the trial. The sample size was limited by our capabilities to enrol more patients during this period. Before injury all subjects had been exercising at least three times per week for the last year, each exercising session lasting at least one hour. Inclusion criteria were: recent (up to five days) grade II ankle sprain, no tendon ruptures, no detected bone fractures, no ankle trauma (of either leg) within the last year. The differentiation between ankle sprain grades was based on pain, swelling, mechanical stability (anterior drawer test and talar tilt test) and ability to bear weight (fully or partially) on the injured leg.

All subjects signed Informed Patient Consent Form, and were randomly assigned to two groups – Isometric Testing Group (40 subjects, mean age 26.55 ± 5.15 years, mean height 178.1 ± 8.15 cm, mean weight 73.43 ± 11.02 kg), and Control Group (40 subjects, age 24.63 ± 3.57 years, height 177.93 ± 7.34 cm, weight 75.08 ± 11.25 kg).

Rehabilitation protocol. All patients in both groups underwent the same rehabilitation programme- functional AIRCAST (Air-stirrup) type ankle brace, home based exercise programme, and cryotherapy. We preferred not to use non-steroidal anti-inflammatory drugs because of their healing reducing effect. They were prescribed only in order to prevent secondary damage in cases of intense inflammation, and used only up to five days (Mehallo et al., 2006).

Functional ankle brace was chosen in order to protect ankle from eversion and inversion movements (to protect the injured ligaments), but to allow mobility (Kerkhoffs et al., 2002; Beynnon et al., 2006; Lin et al., 2010). Each subject was shown how the brace should be put on, and they could try putting the brace on themselves, to make

sure the brace would be worn properly. It was recommended to wear the brace during weight bearing (walking, going out).

Home based exercise programme included stretching exercises, proprioception training, muscle strength and endurance exercises (Petersen et al., 2013). On baseline home based programme included mild stretching exercises, performed with no pain (mainly to maintain ankle dorsiflexion), and proprioception exercises – standing on even surface three-four sets of one minute on each leg with as little support as possible, four-five times per day. Every week the programme was gradually complemented with proprioception exercises using elastic bands, proprioception exercises on soft even surface, and progressing stretching, muscle strength and endurance exercises. Each subject was shown how to do all exercises, and also received written instructions.

After exercising, cryotherapy was recommended because of its pain, swelling, and inflammation reducing effect (Bleakley et al., 2007; Petersen et al., 2013), all subjects received a verbal explanation on proper ice application – ice cubes mixed with water, and applied for 15–20 minutes three-four times per day (maintaining at least three hour intervals between each application). It was recommended to keep the injured limb elevated while applying cold.

Isometric testing. We have introduced monitoring of eversion and inversion during rehabilitation, this being an objective way to evaluate the functional state of the ankle. Isometric mode was chosen for testing because of its safety – no movement allows to measure muscle strength without posing any tension to the injured ligaments; therefore the testing is possible in early stages of rehabilitation process.

We used a Biodex System 4 Pro Dynamometer and Biodex Advantage Software Package (*Biodex Medical Systems Inc, Shirley*, NY) to determine isometric peak torque and peak torque differences between the healthy and injured legs in eversion-inversion movements of the ankle. Subjects were tested in a semi recumbent position. In order to minimize substitution from other muscles the knee was in extension, and to avoid additional movements two straps-one proximal to the knee and one around the hips-were wrapped, patients were asked to rest their arms on their chest. Subjects wore their own flat shoes during testing; each shoe was tightly fastened with 2 straps to the dynamometer footplate to minimize movement between the shoe sole and the footplate surface (Figure 1).

Protocol. Before testing, each subject had to perform a five minute warm up on a stationary bicycle with low resistance (50 watts) at average speed (60–70 rpm). After five minutes of warm up, the patient was positioned on the dynamometer chair, the first tested leg being the healthy one. Each subject could see the screen with torque curve, and was given a verbal explanation on how to carefully and gradually increase effort to reach a visible torque curve plateau on the screen. With this biofeedback every subject performed three warm-up eversion and inversion repetitions, and

Figure 1. **Patient positioning during testing**

three submaximal repetitions with ten seconds rest period in between.

We used our own created testing protocol. The test consisted of three maximal repetitions of isometric eversion and inversion at seven degrees of ankle inversion. The dynamometer footplate position of seven degrees of inversion was chosen because in the natural ankle range of motion inversion is greater than eversion, and measuring at this angle best represents both eversion and inversion (Tankevicius et al., 2013). In order to reach a visible eversion and inversion torque curve plateau ten seconds were given. Between every repetition ten second rest period was given. Peak torque was determined by calculating the average peak torque of all three repetitions. All subjects received consistent verbal encouragement. The difference of eversion and inversion peak torques between both legs was chosen as the main outcome measure.

Outcome Measures. The outcome measures for both Control group and Isometric Testing group were pain on activity (while standing on the injured leg); swelling, measured in the "figure of eight" method; Lower Extremity Functional Scale (LEFS) score; Figure of Eight hop test, and Square hop test. Additionally, Isometric Testing group underwent isometric eversion and inversion muscle strength measurement every week.

- *Pain* was assessed using Visual Analogue Scale (VAS). All subjects were asked to stand on the injured leg for one minute, trying to use as little support as possible. After one minute they were asked to draw a vertical line on a horizontal scale to indicate a point that corresponded to the intensity of the pain while standing on the injured leg. The length from the left end to the vertical mark made by the patient was measured in millimetres (Phan et al., 2011).
- *Ankle circumference* was measured on both legs using the "figure of eight" method, which is a reliable tool to measure ankle swelling (Rohner-Spengler et al., 2007). Swelling was defined as the difference of circumference between the unaffected and the injured legs.
- *Lower Extremity Functional Scale* (LEFS) is a self-completed questionnaire containing 20 questions about severity of symptoms, the maximum score being 80 (Binkley et al., 1999).
- *Isometric ankle eversion and inversion testing.* The difference of eversion and inversion peak torques between both legs (deficit) was chosen as the main outcome measure.
- In order to evaluate functional performance, and to compare the results between the groups, two hop tests were carried out on the last visit- Figure of Eight, and Square hop tests (Sharma et al., 2011). For the *Figure of Eight hop test* all subjects were asked to hop on one leg around two cones placed five meters apart as fast as possible.
- For the *Square hop test*, a square of dimensions 40 x 40 centimetres was marked on the floor with tape, and all subjects were instructed to hop in and out of the square moving in a circle for five times. Before hop tests, all subjects warmed up on a stationary bicycle for five minutes with small resistance. Then each of them received an explanation of the tests, and had five minutes to familiarize with performance. After that all subjects were asked to perform each test three times on each leg, average of two best times was chosen as outcome measure. Each subject was given one minute relaxation time after every test.

Since isometric testing have been used for the first time in acute stages after ankle sprains all these outcome measures were also used in order to assess isometric testing safety. Pain, swelling, functional scale score, isometric testing results on the third week, and hop tests results were compared between the two groups to see whether isometric testing, used in early days after acute ankle sprain, had caused any alteration in these measures during rehabilitation.

Study Protocol. All subjects were asked to come four times in total: the first visit (baseline) was from three to five days after acute ankle sprain. Another three visits were performed respectively every week. The exact schedule and outcome measures taken on each visit are shown in Table 1.

Data analysis. Descriptive data are presented as means and standard deviation (SD). Statistical Package for the Social Sciences (SPSS) for Windows (version 17.0) was used for statistical analysis. Paired t-test was used to determine statistically significant differences within each group, Independent Sample t-test was used to determine statistically significant differences between the two groups, $p < 0.05$ was considered statistically significant. Reliability of hop tests was assessed using intraclass correlation coefficient (ICC 2, 1), and Standard Error of Measurement (SEM).

Outcome measures	Baseline	Week 1	Week 2	Week 3
Isometric Testing Group				
Pain with activity	+	+	+	+
Swelling	+	+	+	+
Lower Extremity Functional Scale	+	+	+	+
Isometric testing	+	+	+	+
Figure of Eight, and Square Hop tests	–	–	–	+
Control Group				
Pain with activity	+	+	+	+
Swelling	+	+	+	+
Lower Extremity Functional Scale	+	+	+	+
Isometric testing	–	–	–	+
Figure of Eight, and Square Hop	–	–	–	+

Table 1. **Visit schedule and outcome measures taken on each visit**

RESEARCH RESULTS

Statistical analysis showed no differences between Isometric Testing and Control group age, height and weight. The summary of the main outcome measures in both groups is shown in Table 2.

Pain with activity gradually decreased throughout the rehabilitation period in both groups, however statistically significant changes in pain intensity were only found on the 1st ($p < 0.01$) and 2nd ($p = 0.04$) week after ankle trauma. No significant changes were detected between the results of Isometric Testing and Control groups ($p > 0.05$).

Ankle circumference of the affected limb gradually returned to normal in both groups. The changes of swelling were statistically significant on the first two weeks ($p < 0.01$). The swelling did not differ between Isometric testing and Control groups ($p > 0.05$).

The Lower Extremity Functional Scale (LEFS) scores from baseline till Week 3 gradually increased, each week the increase being statistically significant ($p < 0.01$). There were no statistically significant differences between Isometric Testing and Control groups ($p > 0.05$).

Isometric muscle testing in Isometric Testing group on baseline showed eversion and inversion deficits – eversion and inversion strength of the injured limb was significantly lower, $p < 0.01$. Muscle strength deficits gradually decreased during rehabilitation period and within three weeks returned to normal (eversion and inversion differences between both legs normally can be up to 10%), each week the changes were statistically significant, $p < 0.01$ (Figure 2).

On Week 3, patients of Control Group underwent isometric ankle eversion and inversion testing. Compared to the results of Isometric Testing group, no statistically significant differences were detected ($p > 0.05$).

In order to make sure hop tests are safe for each patient, we relied on isometric testing results. Only those subjects, whose eversion and inversion strength deficit did not exceed 15%, were allowed to perform hop tests because strength deficit of 15% or less indicated sufficient eversion and inversion support for the injured ankle (normally there is no muscle imbalance between the two limbs (Lin et al., 2009). Eight people from the Isometric Testing group, and ten people from the Control group were excluded from hop tests because of this reason.

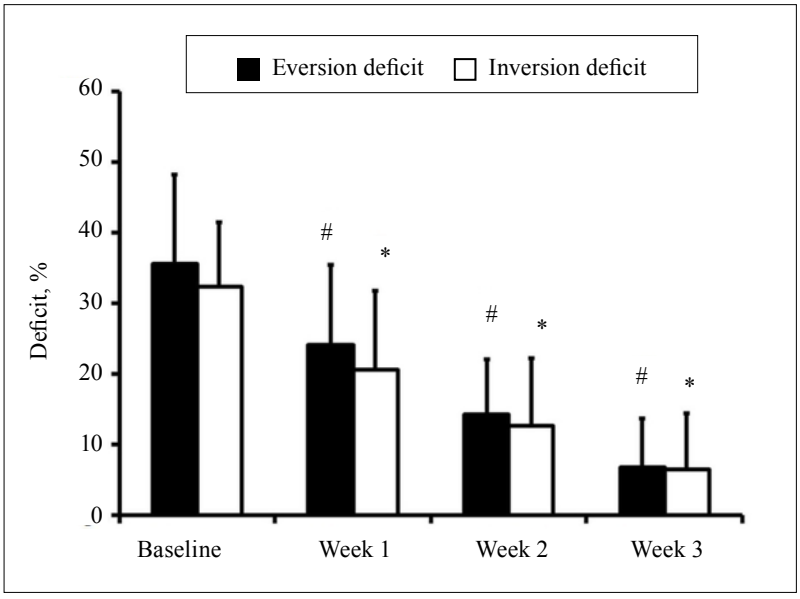
Hop tests results showed moderate to high intraclass correlation coefficients (ICC 2, 1), shown in Table 3, no statistically significant differences between the groups were observed ($p > 0.05$).

Eversion deficit correlated with the Lower Extremity Functional Scale scores on Baseline, Week1, and Week 2, correlation (–0.50)–(–0.33), $p < 0.05$, inversion deficit correlated with the Lower Extremity Functional Scale score on Baseline and Week1, correlation (–0.63)–(–0.52), $p < 0.05$.

Table 2. **Summary of the main outcome measures in both groups, all data presented as means ± standard deviation**

The main outcome measures	Isometric Testing Group			
Outcome Measures	**Baseline**	**Week 1**	**Week 2**	**Week 3**
Pain with activity, VAS: Isometric Testing Group Control Group	 3.99 ± 1.02 3.94 ± 0.80	 2.60 ± 0.60 2.59 ± 0.51	 2.41 ± 0.46 2.40 ± 0.58	 2.31 ± 0.54 2.32 ± 0.58
Swelling, cm: Isometric Testing Group Control Group	 1.98 ± 0.65 1.97 ± 0.38	 1.18 ± 0.56 1.16 ± 0.30	 0.76 ± 0.53 0.74 ± 0.36	 0.64 ± 0.43 0.70 ± 0.38
LEFS: Isometric Testing Group Control Group	 23.55 ± 3.70 24.33 ± 6.91	 40.15 ± 9.97 40.25 ± 7.04	 57.13 ± 7.51 55.50 ± 6.24	 72.50 ± 5.12 70.48 ± 4.59
Eversion Peak Torque, Healthy Leg, Nm: Isometric Testing Group Control Group	 29.04 ± 7.13 –	 29.10 ± 7.39 –	 29.05 ± 7.26 –	 29.08 ± 7.35 27.21 ± 6.09
Eversion Peak Torque, Injured Leg, Nm: Isometric Testing Group Control Group	 18.38 ± 4.73 –	 21.64 ± 4.73 –	 24.73 ± 5.79 –	 27.01 ± 6.70 24.54 ± 5.57
Inversion Peak Torque, Healthy Leg, Nm: Isometric Testing Group Control Group	 30.25 ± 7.37 –	 30.53 ± 7.76 –	 30.83 ± 7.27 –	 30.90 ± 7.56 29.13 ± 5.91
Inversion Peak Torque, Injured Leg, Nm: Isometric Testing Group Control Group	 20.31 ± 5.29 –	 23.98 ± 6.25 –	 26.82 ± 6.67 –	 28.85 ± 7.42 26.90 ± 5.50
Square Hop Test, Healthy Leg, s: Isometric Testing Group Control Group	 – –	 – –	 – –	 14.57 ± 2.05 14.73 ± 1.99
Square Hop Test, Injured Leg, s: Isometric Testing Group Control Group	 – –	 – –	 – –	 15.90 ± 2.48 15.99 ± 2.42
Figure of Eight Hop test, Healthy Leg, s: Isometric Testing Group Control Group	 – –	 – –	 – –	 7.11 ± 0.61 7.13 ± 0.55
Figure of Eight Hop test, Injured Leg, s: Isometric Testing Group Control Group	 – –	 – –	 – –	 7.66 ± 0.63 7.71 ± 0.67

Figure 2. **Changes of eversion and inversion deficit during rehabilitation**



Note. # – statistically reliable eversion changes ($p < 0.05$); * – statistically reliable inversion changes ($p < 0.05$).

Table 3. **Hop test reliability**

Reliability	Square Hop Test		Figure of Eight Hop Test	
	Healthy Leg	Injured Leg	Healthy Leg	Injured Leg
ICC (95% confidence interval):				
Isometric Testing Group	0.857 (0.727–0.927)	0.889 (0.786–0.944)	0.889 (0.786–0.944)	0.651 (0.399–0.813)
Control Group	0.962 (0.912–0.983)	0.949 (0.894–0.976)	0.777 (0.581–0.887)	0.759 (0.554–0.878)
Standard Error of Measurement (SEM):				
Isometric Testing Group	0.77	0.83	0.19	0.37
Control Group	0.39	0.55	0.26	0.33

DISCUSSION

Even though ankle sprains may recover within a relatively short period, A. B. Aiken et al. published a study where they concluded that one month after ankle sprain clinical findings suggested full recovery, however laboratory measures (active and passive mobility, plantarflexion and dorsiflexion tests,) detected residual deficits (Aiken et al., 2008). Results of our study match with such data – clinical findings, such as swelling, and pain subsided during the first two weeks. However isometric testing showed significant changes during all three weeks.

Safety. Our main findings show that isometric testing can be safely applied in early stages of ankle sprains – all measured parameters (pain, swelling, LEFS score, hop tests) did not differ between the two groups. No harmful effects were noticed, the improvement was the same in both groups.

Eversion and inversion deficit. Results of our study show there is a significant loss of eversion and inversion strength in the injured limb after acute ankle sprains. On baseline, eversion is about 36%, and inversion is about 32% smaller in the injured limb than it is in the healthy one. This is most probably caused by soft tissue damage, hematoma, local inflammation, and neuromuscular impairment. When measured every week after the injury, this strength deficit gradually decreased, representing improvement of functional state of the ankle. In our practice we noticed that in such cases when the deficit remains the same or increases, it might be a hint of more severe pathology or a complicated course. Such patients should be treated with more cautions and additional diagnostic tests (MRI, ultrasound, etc.) should be considered. In our study the 18 subjects, whose isometric testing results on Week 3 testing showed greater than 15% deficit, were referred to more detailed diagnosing and additional pathology (bone oedema, osteochondral lesions, syndesmotic injury, peroneal tendon retinaculum injury, etc.) was diagnosed for seven patients. Further research is needed to investigate isometric testing results connection with MRI findings.

Isometric testing advantages. We found that another reliable tool was Lower Extremity Functional Scale, its score changes being statistically significant every week. However, Lower Extremity Functional Scale result only represents a self-reported function, and it is not specific. Isometric testing shows how much eversion or inversion (or both) is affected. Thus it is possible to approach each patient very individually, basing the progress of rehabilitation programme on the results of isometric muscle testing.

Sufficient eversion and inversion strength ensures functional stability of injured ankle. It provides objective reason to allow patients to gradually increase intensity and complexity of exercises. We chose it as a criterion for allowing patients to perform hop tests. Isometric testing can be a helpful tool for accelerating and personalizing athlete rehabilitation. For example, in our study we noticed that some patients in Isometric Testing group had eversion and inversion deficit smaller than 15% even in first weeks after injury (4 patients on Week I, 13 patients on Week II). We think their rehabilitation program could have been accelerated, and recovery time shortened by approaching them individually. Further research is planned for setting guidelines based on isometric testing results.

Biofeedback. During testing each patient can see their results, which help them better understand their situation, and validity of their rehabilitation. Obtained objective data motivate the patient, and they feel closely involved in the whole rehabilitation process.

Availability. Many sports centres in the world have dynamometers and could use them for isometric eversion and inversion testing. We are introducing this method as a safe and objective tool to be used together with the usual ones. Testing data should be assessed taking into consideration all other ankle function parameters.

Limitations. We focused on safety and implementation issues in order to introduce this method. Our study was performed in a limited period of time and further research should include long-term follow up, more detailed eversion and inversion deficit analysis, search for correlations between deficits and recovery time. We would like to further investigate the relationship between isometric testing results and possible underlying pathology (functional reflection of organic pathology).

CONCLUSIONS AND PERSPECTIVES

Isometric testing detects early eversion and inversion changes. We suggest that isometric eversion and inversion testing is safe and helpful in monitoring rehabilitation after acute lateral ankle sprains. It provides more information about the functional state of the injured ankle, and enables the physician to better understand the extent of the injury. Isometric testing helps to closely follow-up the rehabilitation progress, and it has positive biofeedback. We have also noticed that isometric testing is a very useful tool in individualising rehabilitation programs.

REFERENCES

Aiken, A. B., Pelland, L., Brison, R. et al. (2008). Short-term natural recovery of ankle sprains following discharge from emergency departments. *Journal of Orthopaedic & Sports Physical Therapy,* 38 (9), 566–571.

Anandacoomarasamy, A., Barnsley, L. (2005). Long term outcomes of inversion ankle injuries. *British Journal of Sports Medicine*, 39 (3), e 14.

Arnold, B. L., Linens, S. W., de la Motte, S. J. et al. (2009). Concentric Evertor Strength Differences and Functional Ankle Instability: A Meta-Analysis. *Journal of Athletic Training,* 44 (6), 653–662.

Beynnon, B. D., Renström, P. A., Haugh, L. et al. (2006). A prospective, randomized clinical investigation of the treatment of first-time ankle sprains. *American Journal of Sports Medicine,* 34 (9), 1401–1412.

Binkley, J. M., Stratford, P. W., Lott, S. A. et al. (1999). The Lower Extremity Functional Scale (LEFS): Scale development, measurement properties, and clinical application. *Physical Therapy,* 79 (4), 371–383.

Bleakley, C. M., O'Connor, S. R., Tully, M. A. et al. (2010). Effect of accelerated rehabilitation on function after ankle sprain: Randomised controlled trial. *British Medical Journal*, 340, c 1964.

Bleakley, C. M., O'Connor, S., Tully, M. A. et al. (2007). The PRICE study (Protection Rest Ice Compression Elevation): Design of a randomised controlled trial comparing standard versus cryokinetic ice applications in the management of acute ankle sprain. *BMC Musculoskeletal Disorders,* 19 (8), 125.

Fong, D. T., Chan, Y. Y., Mok, K. M. et al. (2009). Understanding acute ankle ligamentous sprain injury in sports. *Sports Medicine, Arthroscopy, Rehabilitation, Therapy & Technology,* 30 (1), 14.

Holme, E., Magnusson, S. P., Becher, K. et al. (1999). The effect of supervised rehabilitation on strength, postural sway, position sense and re-injury risk after acute ankle ligament sprain. *Scandinavian Journal of Medicine & Science in Sports,* 9 (2), 104–109.

Hubbard, T. J., Hicks-Little, C. A. (2008). Ankle ligament healing after an acute ankle sprain: An evidence-based approach. *Journal of Athletic Training,* 43 (5), 523–529.

Kaminski, T. W., Perrin, D. H., Gansneder, B. M. (1999). Eversion strength analysis of uninjured and functionally unstable ankles. *Journal of Athletic Training*, 34 (3), 239–245.

Kerkhoffs, G. M., Struijs, P. A., Marti, R. K. et al. (2002). Different functional treatment strategies for acute lateral ankle ligament injuries in adults. *Cochrane Database of Systematic Reviews*, (3), CD002938.

Konradsen, L., Olesen, S., Hansen, H. M. (1998). Ankle sensorimotor control and eversion strength after acute ankle inversion injuries. *American Journal of Sports Medicine,* 26 (1), 72–77.

Lin, C. W., Hiller, C. E., de Bie, R. A. (2010). Evidence-based treatment for ankle injuries: A clinical perspective. *Journal of Manual & Manipulative Therapy,* 18 (1), 22–28.

Lin, W. H., Liu, Y. F., Hsieh, C. C. et al. (2009). Ankle eversion to inversion strength ratio and static balance control in the dominant and non-dominant limbs of young adults. *Journal of Science and Medicine in Sport*, 12 (1), 42–49.

Mawdsley, R. H., Hoy, D. K., Erwin, P. M. (2000). Criterion-related validity of the figure-of-eight method of measuring ankle edema. *Journal of Orthopaedic & Sports Physical Therapy,* 30 (3), 149–153.

Mehallo, C. J., Drezner, J. A., Bytomski, J. R. (2006). Practical management: Nonsteroidal anti-inflammatory drug (NSAID) use in athletic injuries. *Clinical Journal of Sports Medicine,* 16 (2), 170–174.

Petersen, W., Rembitzki, I. V., Koppenburg, A. G. et al. (2013). Best R. Treatment of acute ankle ligament injuries: A systematic review. *Archives of Orthopaedic and Trauma Surgery,* 133 (8), 1129–1141.

Phan, N. Q., Blome, C., Fritz, F. et al. (2011). Assessment of pruritus intensity: Prospective study on validity and

reliability of the Visual Analogue Scale, Numerical Rating Scale and Verbal Rating Scale in 471 patients with chronic pruritus. *Acta Dermato Venereologica,* 92, 502–507.

Richie, D. H. Jr. (2001). Functional instability of the ankle and the role of neuromuscular control: A comprehensive review. *Journal of Foot and Ankle Surgery,* 40 (4), 240–251.

Rogier, M., van Rijn, R. M., van Os, A. G. et al. (2008). What is the clinical course of acute ankle sprains? A systematic literature review. *American Journal of Medicine,* 121 (4), 324–331.

Rohner-Spengler, M., Mannion, A. F., Babst, R. (2007). Reliability and minimal detectable change for the figure-of-eight-20 method of, measurement of ankle edema. *Journal of Orthopaedic and Sports Physical Therapy,* 37 (4), 199–205.

Sharma, N., Sharma, A., Singh Sandhu, J. (2011). Functional performance testing in athletes with functional ankle instability. *Asian Journal of Sports Medicine,* 2 (4), 249–258.

Smith, B. I., Docherty, C. L., Simon, J. et al. (2012). Ankle strength and force sense after a progressive, 6-week strength-training program in people with functional ankle instability. *Journal of Athletic Training,* 47 (3), 282–288.

Struijs, P. A., Kerkhoffs, G. M. (2010). Ankle sprain. *Clinical Evidence (Online)*, May 13, pii: 1115.

Tankevicius, G., Lankaite, D., Krisciunas, A. (2013). Test-Retest Reliability of Biodex System 4 Pro for Isometric Ankle Eversion and Inversion Measurement. *Journal of Sport Rehabilitation*, 22, 212–215.

Webber, S. C., Porter, M. M. (2010). Reliability of ankle isometric, isotonic, and isokinetic strength and power testing in older women. *Physical Therapy,* 90 (8), 1165–1175.

Willems, T., Witvrouw, E., Verstuyft, J. et al. (2002). Proprioception and muscle strength in subjects with a history of ankle sprains and chronic instability. *Journal of Athletic Training,* 37 (4), 487–493.

ANKSTYVIEJI IZOMETRINĖS EVERSIJOS IR INVERSIJOS JĖGOS POKYČIAI PO ŪMIŲ ČIURNOS RAIŠČIŲ TRAUMŲ

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Dauguma metodų, naudojamų stebėti čiurną po ūmių raiščių traumų, nesuteikia pakankamai duomenų apie funkcinę čiurnos būklę, kuri labiausiai priklauso nuo raumenų funkcijos ir propriorecepcijos. Šiuo tikslu pritaikėme izometrinį testavimą.

Tikslas – išmatuoti ankstyvus izometrinės eversijos bei inversijos jėgos pokyčius po ūmių čiurnos raiščių traumų ir palyginti juos su įprastai naudojamų metodų rodiklių pokyčiais.

Metodai. Buvo tirta 80 sportininkų, patyrusių ūmią II laipsnio čiurnos raiščių traumą. Visi tiriamieji suskirstyti į dvi grupes: izometrinio testavimo grupę (40 tiriamųjų) ir kontrolinę (40 tiriamųjų). Abi grupės turėjo vienodą reabilitacijos programą. Matuota sveikos bei pažeistos kojos izometrinės eversijos bei inversijos jėga ir šios jėgos skirtumai. Buvo nustatomas čiurnos skausmas apkrovos metu, čiurnos patinimas, kojos funkcija įvertinta skalės balais, fiksuoti kvadrato ir aštuoneto formos šuolių testų rezultatai.

Rezultatai. Tyrimo rodikliai tarp grupių statistiškai nesiskyrė. Statistinė analizė atskleidė patikimai mažesnę pažeistos kojos eversijos bei inversijos jėgą, patikimus šios jėgos deficito pokyčius viso tyrimo metu. Čiurnos skausmo apkrovos metu ir patinimo pokyčiai buvo statistiškai patikimi tik pirmąsias dvi savaites. Kojos funkcinės skalės balai kito statistiškai patikimai viso tyrimo metu. Eversijos bei inversijos jėgos deficitas koreliavo su kojos funkcinės skalės balais.

Aptarimas ir išvados. Izometriniu matavimo būdu galima aptikti ankstyvus eversijos bei inversijos jėgos pokyčius po ūmių čiurnos raiščių traumų. Tai leidžia visapusiškiau stebėti reabilitacijos eigą.

Raktažodžiai: jėgos momentas, reabilitacija, stebėsena.

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Jucevičienė, P. (Red.) (1996). *Lyginamoji edukologija*. Kaunas: Technologija.

Miškinis, K. (1998). *Trenerio etika: vadovėlis Lietuvos aukštųjų mokyklų studentams*. Kaunas: Šviesa.

Ostasevičienė, V. (1998). Ugdymo teorijų istorinė raida. A. Dumčienė ir kt. (Red. kol.), *Ugdymo teorijų raidos bruožai: teminis straipsnių rinkinys* (pp. 100–113). Kaunas: LKKI.

Šveikauskas, Z. (1995). Šuolių technikos pagrindai. J. Armonavičius, A. Buliuolis, V. Butkus ir kt., *Lengvoji atletika: vadovėlis Lietuvos aukštųjų m-klų studentams* (pp. 65–70). Kaunas: Egalda.

Valiulytė, I. (2000). Išlaidos krašto apsaugai, jų pagrįstumas ir tikslingumas. *Sociumas,* vasaris [2001 12 12]. Prieiga internetu: http://www.sociumas.lt/lit/nr12/krasto_apsauga.asp

Večkienė, N., Žalienė, I., Žalys, L. (1998). Ekonominis švietimas – asmenybės ugdymo veiksnys. *Asmenybės ugdymo edukologinės ir psichologinės problemos: respublikinės moksl. konferencijos medžiaga* (pp. 159–163). Kaunas: LKKI.

Vitkienė, I. (1998). Kai kurių mikroelementų pokyčiai lengvaatlečių kraujyje fizinio krūvio metu. *Sporto mokslas,* 1 (10), 12–13.

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3.3. The title page should contain: a) a short and informative title of the article; b) the first names and family names of the authors; c) the name and the address of the institution and the department where the work was done; d) the name, address, phone number, E-mail number, etc. of the author to whom correspondence should be sent. If a blind review is requested a second title page that contains only the title is needed. The title page should be signed by all authors of the article.

3.4. Abstracts in the Lithuanian and English languages are supplied on separate sheets of paper. This sheet also should contain keywords.

3.5. Every table (no more than three – four tables are recommended) should have a short subtitle with a sequential number given above the table (the tables are numbered in the same sequence as that of references given in the text). All explanations should be in the text of the article or in a short footnote added to the table. The symbols and abbreviations given in the tables should coincide with the ones used in the text. The location of the table should be indicated in the left-hand margin (in pencil).

3.6. All figures (no more than four-five figures) are to be numbered consecutively giving the sequential number in Arabic numerals, e. g. Figure 1. The location of the figure should be indicated in the left-hand margin of the manuscript (in pencil). The figures should be presented in open file formats so that they could be edited.

3.7. References should be listed in alphabetical order taking account of the first author. First the references in Latin characters are given, then – in Russian (Cyrillic) characters. For journal (research) articles the following information should be included: a) author names (surnames followed by initials), b) the date of publication, c) the title of the article with the same spelling and accent marks as in the original, d) the journal title in full, e) the volume number, f) inclusive page numbers. When five or more authors are named, list only the first three adding "et al."

For books the chapter title, chapter authors, editors of the book, publisher's name and location (institution, city) should be also included.

In the case when there are several references of the same author published in the same year, they must be marked by letters, e. g. 1990 a, 1990 b, etc. in the list of references and in the article, too.

Examples of the correct format are as follows

Bergman, P. G. (1993). Relativity. In *The New Encyclopedia Britannica* (Vol. 26, pp. 501–508). Chicago: Encyclopedia Britannica.

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.

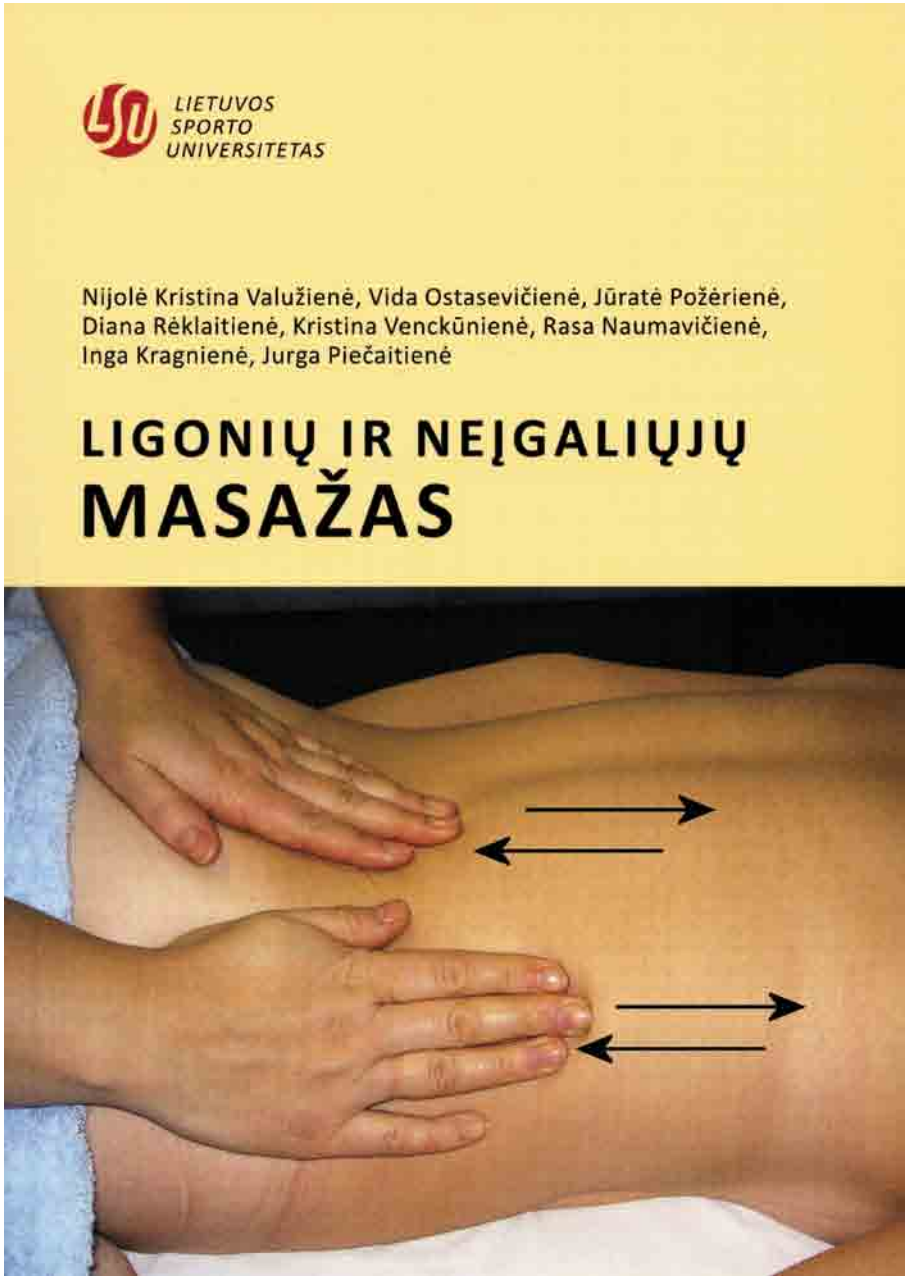
Deci, E. L., Ryan, R. M. (1991). A motivational approach to self: Integration in personality. In R. Dientsbier (Ed.), *Nebraska Symposium on Motivation: Vol. 38. Perspectives on Motivation* (pp. 237–228). Lincoln: University of Nebraska Press.

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

McDonald, C., Chenoweth, L. (2009). Leadership: A crucial ingredient in unstable times. *Social Work & Society, 7* [04 08 2006]. Internet link: http://www.socwork.net/2009/1/articles/mcdonaldchenoweth

Ratkevičius, A., Skurvydas, A., Lexell, J. (1995). Submaximal exercise-induced impairment of human muscle to develop and maintain force at low frequencies of electrical stimulation. *European Journal of Applied Physiology,* 70, 294–300.

Town, G. P. (1985). *Science of Triathlon Training and Competition.* Champaign, Illinois: Human Kinetics.



Studijų knygoje aprašomas ligonių ir neįgaliųjų masažas taikant klasikinę masažo sistemą, dėstomi higieninio savimasažo pagrindai.

Skiriama Lietuvos sporto universiteto taikomosios fizinės veiklos ir kineziterapijos specialybių studentams, treniravimo sistemų specialybių studentams, kuriems dėstoma masažo disciplina, kineziterapeutams, masažuotojams, taip pat visiems sveikatos specialistams, besidomintiems masažu.

Nuoširdžiai sveikiname!
Congratulations!

Lietuvos sporto universiteto doktorantą **Kęstutį Matulaitį**, 2013 m. rugsėjo 27 d. Lietuvos sporto universitete apgynusį socialinių mokslų (edukologijos) daktaro disertaciją tema „Sabonio krepšinio centro jaunųjų krepšininkų treniravimas(is)“.
Mokslinis vadovai: prof. habil. dr. Stanislovas Stonkus, prof. habil. dr. Antanas Skarbalius.
Mokslinis konsultantai: prof. dr. Kazimieras Pukėnas, dr. Mindaugas Balčiūnas.

We congratulate **Kęstutis Matulaitis**, the student of doctoral studies at the Lithuanian Sports University, to have defended his thesis “Coaching of the young basketball players of Sabonis basketball center” (Social sciences, Education Science) at the Lithuanian Sports University on September 27, 2013.
Scientific advisors: Prof. Dr. Habil. Stanislovas Stonkus, Prof. Dr. Habil. Antanas Skarbalius.
Scientific consultants: Prof. Dr. Kazimieras Pukėnas, Dr. Mindaugas Balčiūnas.

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Mokslinis vadovas prof. dr. Arvydas Stasiulis.

We congratulate **Neringa Baranauskienė**, the student of doctoral studies at the Lithuanian Sports University, to have defended her thesis “The residual effect of eccentric concentric prior exercise on pulmonary gas exchange and muscle electrical activity during cycling of different intensity” (Biomedical Sciences, Biology) at the Lithuanian Sports University on September 30, 2013.
Scientific supervisor Prof. Dr. Arvydas Stasiulis.

Lietuvos sporto universiteto doktorantę **Laurą Straubegaitę**, 2013 m. rugsėjo 30 d. Lietuvos sporto universitete apgynusią biomedicinos mokslų (biologijos) daktaro disertaciją tema „Jojimo ir pratimų ant didžiojo kamuolio poveikis sveikų vaikų ir vaikų, sergančių cerebriniu paralyžiumi, bendrajai motorikai, raumenų aktyvumo simetriškumui ir psichoemocinei būsenai“.
Mokslinis vadovas prof. habil. dr. Kazimieras Muckus.
Mokslinė konsultantė doc. dr. Vilma Juodžbalietė.

We congratulate **Laura Straubegaitė**, the student of doctoral studies at the Lithuanian Sports University, to have defended her thesis “The effect of horseback riding and exercises on a therapeutic ball on gross motor function, symmetry of muscle activity and psycho-emotional state of healthy children and children with cerebral palsy” (Biomedical Sciences, Biology) at the Lithuanian Sports University on September 30, 2013.
Scientific supervisor Prof. Dr. Habil. Kazimieras Muckus.
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