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IMPACT OF STRENGTH TRAINING PROGRAM ON PHYSICAL FITNESS AND PSYCHICAL CONDITION FOR ELDERLY WOMEN

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ABSTRACT

Research background and hypothesis. There is a lot of research proving that physical activity improves psychical condition when there are symptoms of psychical illness. There is also a wide range of studies carried out investigating the impact of physical activity on physical abilities, but little is known how strength training program as a factor improves psychical condition and, at the same time, body composition, strength and endurance for elderly woman.

Research aim was to study the impact of an 8-week strength training program on physical fitness and psychical condition for elderly women.

Research methods were literature review, HADS to evaluate anxiety and depression symptoms, anthropometry, strength and endurance testing, statistical analysis of physical fitness and psychical condition indices.

Research results. In the period of 8-week strength training program we found that it had a positive impact on the indices in the experimental group compared to those in the control group. Psychical condition and strength results in experimental group were statistically significant ($p < 0.05$); a significantly different change in aerobic endurance was measured during the 2 min step test. BMI and the body composition measures did not change statistically significantly.

Discussion and conclusions. The main finding is that an 8-week strength training period had a significant impact on psychical condition for elderly women. Moreover, strength training exercises improved upper and lower body muscle strength. Endurance improvement was observed during 2-min step test, but 6-min test results were insignificant ($p > 0.05$). After the 8-week training period, no significant differences in BMI and body composition were observed, although there was a slightly tendency of decrease in the experimental group.

Keywords: elderly women, physical fitness, psychical condition, 8-week strength training programme, HADS, BMI.

INTRODUCTION

According to the population census of 2011, carried out by the Department of Statistics of the Republic of Lithuania, over the recent decade, the population decreased by 440.6 thousand or by 12.6%. At present, the population of Lithuania totalled to 3 million 43 thousand. As many as 650 934 people in Lithuania are of the retirement age. Among them 215 718 are men and 435 216 are women. According to the Lithuanian Department of Statistics, there are 50% more women of retirement age than men. Since 2001 the number of retired population has increased, respectively, from 20.2 per cent to 21.4 (*Lietuvos statistikos departamentas*, 2011).

It has been found that health related problems, living alone, poor communication and activity in social life, feeling of loneliness lead people to social disjuncture. Usually social disjuncture is the result of a certain psychical condition (Cornwell, Waite, 2009).

Clinical tests investigating the impact of physical activity on psychical conditions identified that constant physical loads had a positive impact on psychical condition, improved wellness and had

a positive impact on mood and personal motivation. Inconsistent physical loads had a little impact on psychical condition and did not improve personal motivation. It was found that physically active adults had a lower risk of depression and cognitive decline compared with inactive or less physically active adults (Dunn et al. 2002; Elsawy, Higgins, 2010).

It is well known that aging is related with muscle atrophy. Aging is associated with the loss of muscle mass, muscle strength and muscle fibre mass. Scientific studies have shown that muscle mass tends to decrease gradually, the largest changes are observed from 50 up to 80 years of age. It has been found that muscle strength decline is much faster and more dramatic rather than the decline in muscle mass. The decline in strength and muscle mass has a tight relation with functional limitations and worsening of health condition (Williams et al., 2002; Faulkner et al., 2007; Koster et al., 2011).

The **aim** of the current research was to study the impact of an 8-week strength training program on physical fitness and psychical condition for elderly women.

RESEARCH METHODS

Research sample included twenty five volunteering women at the age of retirement, from 64 up to 85 years of age (anthropometry characteristics are presented in Table). All participants were divided into two groups: experimental (n = 13) who underwent strength training program and control group (n = 12). Experimental group underwent an 8-week strength training program three times a week for one and half an hour. Participants of both groups were tested at the beginning and at the end of the study.

Research methods. At a baseline and after the 8-week training period, participants were weighted using scales (Tanita TBF 300, JAV), the height of the participants was measured using wooden meter ruler. Body Mass Index (BMI) was measured according the formula: BMI = mass (kg)/ height $(m)^2$ (Janssen et al., 2002).

Body composition indices were taken using a centimetre measuring tape. For all participants the measures were made at crank web of the dominant hand, chest, waist, hip and femur at the dominant side of the body.

To evaluate the psychical condition of the participants, we used HADS (Hospital Anxiety and Depression Scale – HADS), which was developed to identify anxiety disorders and depression among patients in non-psychiatric hospital clinics (Bjelland et al., 2002).

To measure upper body muscle strength, we used JAMAR® hydraulic hand dynamometer, hand grip strength was measured in kilograms. We also used a 30 s arm curl test hanging 2 kg weight (Rikli, Jones, 2001).

Lower body muscle strength was measured performing 30 s chair stand test (Rikli, Jones, 2001).

To assess aerobic endurance of legs, we used a 6-min walk test (Rikli, Jones, 2001; Reguero et al., 2009) and a 2-min step test (Rikli, Jones, 2001).

Statistical analysis of the research data was carried out using *Microsoft Excel* and SPSS (*Statistical Package for the Social Science*) version 17.0.

The following parameters were calculated: arithmetic mean (x), standard deviation (± SD), ANOVA single factor analysis and index p for statistical significance. The level of significance was set when $p < 0.05$.

Table. **Anthropometric characteristics of the participants**

Participants / Index	Experimental group n = 13	Control group n = 12
Age, years	73.5 ± 7.2	74.7 ± 6.6
Height, cm	157.9 ± 5.5	158.1 ± 6.4
Wight, kg	58.5 ± 8.4	54 ± 6.4

RESEARCH RESULTS

Research results showed that in the experimental group BMI at the beginning was 25.1 (4.5) and after an 8-week strength training program it was 24.8 (3.8), in the control group it was respectively 22.1 (3.5) and 22.1 (3.4). There was no statistically different change in the both groups in BMI. Evaluating body composition measure, we observed only slight changes ($p > 0.05$).

After the 8-week training period, significant changes were observed in psychical condition in the experimental group. Results showed that anxiety symptoms decreased from 12.0 (2.3) to 9.8 (1.6) after the training period ($p = 0.009$) and depression symptom values were 11.2 (2.9) at the beginning, and after the 8-week strength training period they decreased to 9.2 (1.6), ($p = 0.04$) (Figure 1). At the same time the results in the control group slightly improved, but the changes were insignificant ($p > 0.05$).

Analysis of variance showed a statistically significant difference between the right ($p = 0.00001$) and left ($p = 0.0004$) hand dynamometry measurements in the experimental group. Right hand grip results at the beginning were 21.3 (3.35) kg and after the strength training period they were 27.4 (2.2) kg, left hand – 20 (3.7) kg and 25.4 (2.9) kg (Figure 2). In the control group test results were insignificant ($p > 0.05$).

30 s arm curl test results showed statistically significant changes ($p = 0.01$) only in the right hand results. Results were 13 (3.3) before the training program and 16 (3.2) after an 8-week strength training (Figure 3). There were no changes recorded in the control group.

Assessment of lower body strength showed that in the experimental group results improved statistically significantly ($p = 0.003$). From the 10.5 (2.3) starting strength program and at the end of it 13.3 (2.2) (Figure 4). There was seen the decreasing tendency on the results at the control group, bet there was no statistical different changes.

6-min walk test results showed no significant changes in the aerobic endurance improvement in both groups.

Statistically significant improvement was measured in the experimental group results during a 2-min step test ($p = 0.01$). At the beginning the result was 63.2 (13.6) and after an 8-week strength training program it was 76.1 (11.3) (Figure 5). We observed decreasing results in the control group – from 62.1 (14.8) and to 60.8 (13.4) after the 8-week period, but the change was insignificant ($p > 0.05$).

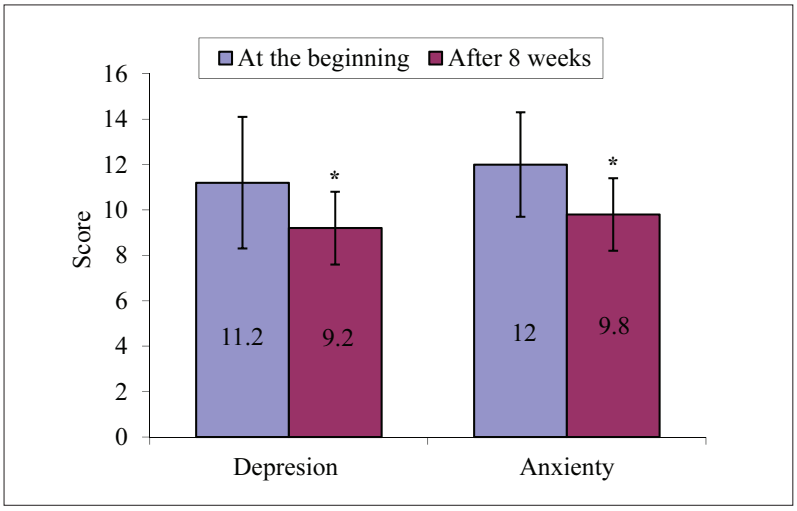


Figure 1. **Depression and anxiety symptoms in the experimental group at the beginning and after an 8-week strength training program**

Note. * – statistically significant difference ($p < 0.05$).

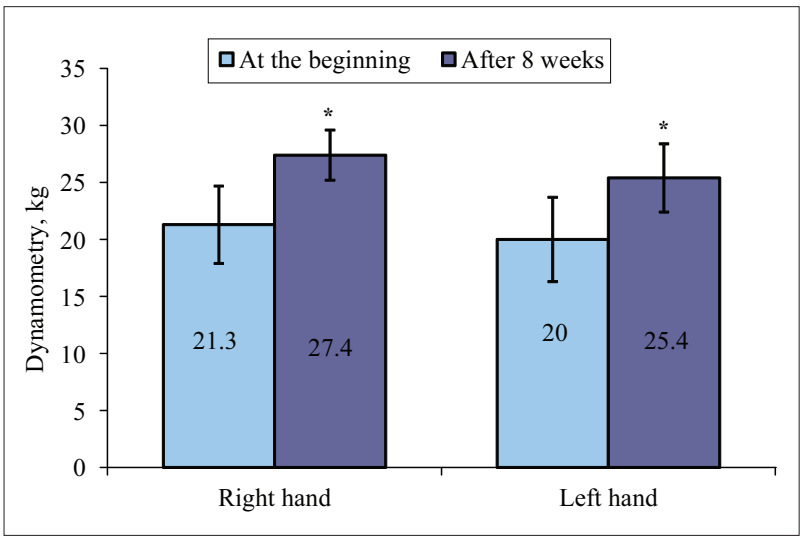
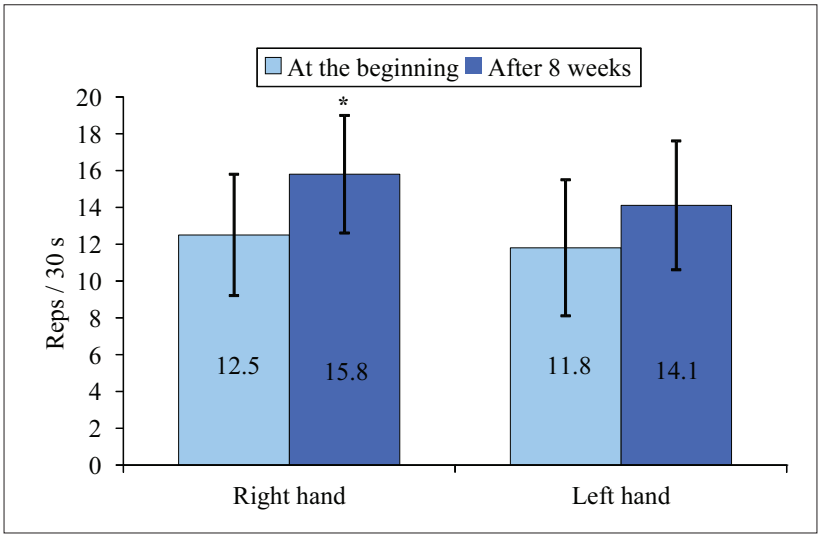


Figure 2. **Hand dynamometry results in the experimental group at the beginning and after an 8-week strength training program**

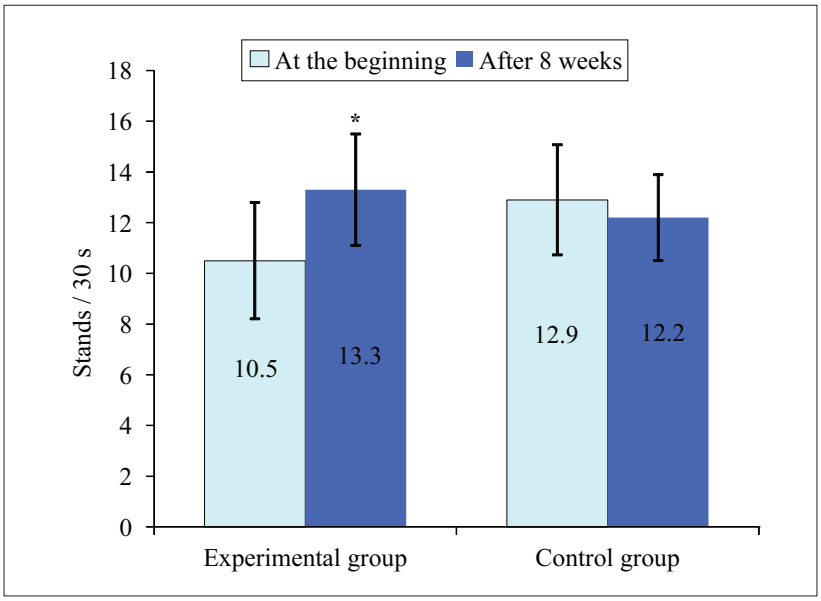
Note. * – statistically significant difference ($p < 0.05$).

Figure 3. **30 s arm curl test results in the experimental group at the beginning and after an 8- week strength training program**



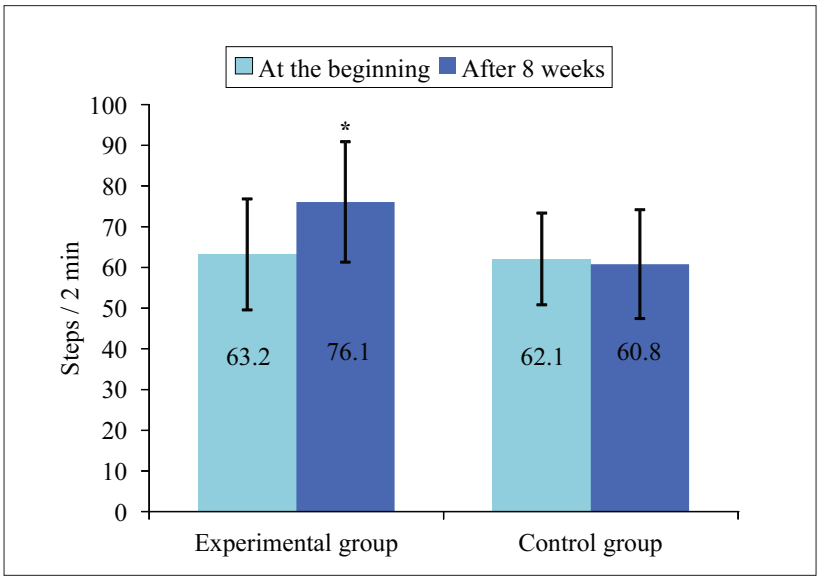
Note. * – statistically significant difference ($p < 0.05$).

Figure 4. **30 s chair stand test results at the beginning and after 8-week period in the experimental and control groups**



Note. * – statistically significant difference ($p < 0.05$).

Figure 5. **2-minute step test results at the beginning and after an 8-week period in the experimental and control groups**



Note. * – statistically significant difference ($p < 0.05$).

DISCUSSION

Numerous studies note that physical activity is the one of the methods for elderly people to improve their independent life from other people (Williams et al., 2002; Faulkner et al., 2007; Elsawy, Higgins, 2010; Koster et al., 2011). Adapted strength training program for elderly people improves muscle strength and endurance. An 8-week strength training program results in physical fitness go together with the results of the research made by T. R. Henwood and colleagues (2008). Strength training programs for elderly people gives significant increscent in strength participating 30 s arm curl test, 30 s chair stand test and 2-min step test (Bates el al., 2008). Results of 8-week strength training period showed statistical significant differences in the experimental group results in these tests.

Scientific studies have shown that muscle mass and strength slightly start to decrease from 50 to 80 years of age, but muscle endurance remains unchanged for a longer period of time (Faulkner et al., 2007; Koster et al., 2011). 2-min step test and 6-min walk test purpose is to assess aerobic endurance. Strength training program made positive impact on lower body strength, but there were fewer exercises to improve aerobic endurance. We believe that this is the reason why the results of the 2-min step test increased statistically significant while 6-min walk test results were insignificant in both groups.

A. L. Dunn and colleagues (2002) identified that constant physical loads had a positive impact on psychical condition, improved wellness and had a positive impact on personal motivation. B. Elsawy and K. E. Higgins (2010) found that physically active older adults had lower depression symptoms compared with inactive adults. All these results are similar with our results on the strength training program impact for elderly women's physical condition; we found significant decrease in anxiety and depression symptoms in the experimental group, in this group participants communicated with each other during the training sessions, after each training session there was a discussion about the impact of the exercises and the participants noted that they were in a better mood after the training session. At the same time, we observed slightly improving results in the control group.

After the strength training period, no significant difference in BMI and body composition indices were observed. We believe that this is because of the short time of training period and the impact of nutrition. According to B. Strasser's et al. (2009) 6-month strength and endurance training programme results, there were no significant changes in body weight, but the difference was observed in the percentage of body fat.

CONCLUSIONS AND PERSPECTIVES

The main finding is that an 8-week strength training period made a significant impact on psychical condition for elderly women. Moreover, strength training exercises improved upper and lower body muscle strength. Endurance improvements were seen during 2-min step test. After the 8-week training period no significant difference in BMI and body composition indices were observed, although there was seen a tendency of slight decrease in the experimental group.

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JĖGOS PRATYBŲ POVEIKIS SENYVO AMŽIAUS MOTERŲ FIZINIAM PAJĖGUMUI IR PSICHOLOGINEI SAVIJAUTAI

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Atlikta nemažai mokslinių tyrimų, kurie įrodo fizinio aktyvumo poveikį asmenų psichinei būklei esant tam tikrai simptomatikai ar ligai. Labai plačiai tyrinėjamas ir fizinės veiklos įtaka asmenų fiziniams gebėjimams, tačiau mažai žinoma tyrimų, kurie nustatytų jėgos pratybų poveikį senyvo amžiaus moterų psichosocialinei būsenai ir kūno kompozicijos, raumenų jėgos ir ištvermės pokyčius.

Tikslas – nustatyti jėgos pratybų poveikį senyvo amžiaus moterų fiziniam pajėgumui ir psichologinei savijautai.

Metodai: literatūros šaltinių analizė, HADS skalė nerimo ir depresijos simptomatikos poreiškiui nustatyti, antropometrija, raumenų jėgos ir ištvermės testavimas, rodiklių statistinė analizė. Jėgos ir ištvermės testai buvo taikomi pagal senjorų normatyvines skales.

Rezultatai. Nustatyta, kad aštuonių savaičių jėgos pratybos teigiamai veikia senyvo amžiaus moterų psichologinę būseną. Visų jėgos nustatytmo testų rezultatai tiriamojoje grupėje statistiškai reikšmingai pagerėjo ($p < 0,05$), statistiškai reikšmingi ištvermės pokyčiai užfiksuoti atliekant dviejų minučių žygiavimo vietoje testą. KMI ir kūno apimtys kito mažai ($p > 0,05$).

Aptarimas ir išvados. Jėgos pratybos senyvo amžiaus tarpsniu teigiamai veikia moterų psichologinę būseną. Tyrimo rezultatai parodė statistiškai reikšmingus pokyčius. Tiriamojoje grupėje KMI ir kūno apimčių rodikliai statistiškai reikšmingai nepakito, tačiau buvo matoma šių rodiklių mažėjimo tendencija. Nustatyta, kad jėgos pratybos teigiamai veikia senyvo amžiaus moterų viršutinės ir apatinės kūno dalių raumenų jėgą. Statistiškai reikšmingi ištvermės pokyčiai užfiksuoti atliekant dviejų minučių žygiavimo vietoje testą.

Raktažodžiai: senyvo amžiaus moterys, jėgos pratybos, psichologinė būsena, fizinis pajėgumas, aštuonių savaičių jėgos pratybų programa, HADS skalė, KMI.

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INTERDEPENDENCE-BASED MODEL OF CONSISTENCY AMONG COMPETITION, COOPERATION AND COLLABORATION

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ABSTRACT

Research background and hypothesis. Social interdependence is evident in everyday human life situations; sports industry is based on it as well. Athletes often compete for higher achievements; however, a possibility for cooperation can be envisioned in competitions as well. The research problem is as follows: is it possible to harmonize social interrelations which manifest in competition, cooperation and collaboration at the same time, and how this consistency can be achieved.

The research aim was to elaborate the conceptual model of consistency among competition, cooperation and collaboration based on the premise of social interdependence.

Research methods were theoretical analysis and synthesis. The results of theoretical analysis were generalized and incorporated into the conceptual model.

Discussion and conclusions. Scientific literature suggested a few insights. First, social interaction may occur at two levels: intra-group (group level) and inter-group (community level). Second, the nature of social interdependence depends on the level of goals being achieved; three levels of goals can be distinguished: individual goals, group goals, and community goals. Third, based on the type of the interaction and the level of goals, individuals tend to engage into a particular form of interrelation: competition, cooperation, or collaboration; moreover, the form of interdependence is not restricted – a combination of a few (or even all) forms is possible. Based on scientific literature, an implication can be made that interrelation among competition, cooperation, or collaboration can result in coopetition as a higher form of interdependence.

Keywords: coopetition, social interaction, social interrelations.

INTRODUCTION

Relevance of the problem. Traditionally human social relationships are based on interactions. M. Deutsch (1949) argues that human social interactions are based on their interdependence. Furthermore, the essence of interdependence can manifest in positive, as well as in negative form. While analysing the phenomenon of social interdependence, D. W. Johnson and R. T. Johnson (2009) highlight that its positive manifestation can be envisioned in cooperation, whereas negative – in competition among individuals.

Both forms of social interdependence are evident in everyday human life situations; moreover, people face it at home, workplace, studies, or entertainment. It can be stated that sports industry is based on social interdependence as every other environment of human social self-expression. Athletes often compete for higher achievements; however, a possibility for cooperation can be envisioned in competitions as well. Scientific literature (e. g. Johnson, R. T., Johnson, D. W., 1999) suggests that competitors achieve better results when they cooperate in competition-based

environment, rather when they compete without collaborating.

The scientific problem solved in the article was as follows: Is it possible to harmonize social interrelations which manifest in competition, cooperation, and collaboration in sport at the same time, and how this consistency can be achieved?

Accordingly, the **research aim** was to elaborate the conceptual model of consistency among competition, cooperation and collaboration based on the premise of social interdependence.

RESEARCH METHODS

Aiming at achieving the aim of the article, theoretical analysis and synthesis were carried out: scientific insights into the theory of Social Interdependence were analysed, interrelation between cooperation and competition was revealed, and afterwards, the theoretical implications on competition, cooperation and collaboration were provided. Consequently, the obtained results of theoretical analysis were generalized and incorporated into the conceptual model.

Social interdependence theory. Interdependence theory (IT) expands the formula proposed by K. Lewin (1946) that behaviour is a function of the person and the environment. In the context of social relationship, the interaction (I) that occurs between persons A and B is a function of both persons' respective tendencies in relation to each other in the particular situation of interdependence (S) in which the interaction occurs (Holmes, 2002). According to N. Parolia et al. (2011), social interdependence theory provides a structure to examine whether collaborative efforts promote behaviours that result in higher levels of success.

While analysing intergroup conflicts in team games, G. Bornstein (2003) emphasizes that the tension between the collective interest of the group and the interests of its individual members is unavoidable. D. W. Johnson and R. T. Johnson (2009) argue that *social interdependence* exists, when the outcomes of individuals are affected by their own and others' actions. Social interdependence theory can be named as a classic research background for human collaborating interrelations. Accordingly, the main premise of the theory is that: (1) individuals' interactions are being determined by the way in which *goals* are structured; (2) desired outcomes are obtained on the basis of these *interactions*. According to J. G. Holmes (2002), the two components together can be thought of as comprising the social situation.

Moreover, the application of social interdependence theory to education has become one of the most successful and widespread applications of social and educational psychology to practice (Johnson, 2003). E. g. S. Jowett and J. Nezlek (2011) propose that coach–athlete relationships contain the elements of interdependence, and analyse it in a framework of social interrelation theory. M. Deutsch (1949) can be named as the founder and leading developer of the theory, who has made a huge contribution into the field. According to D. W. Johnson and R. T. Johnson (2005), the theory was widely applied in practice with imperative to education.

Analysing human interrelations, D. W. Johnson and R. T. Johnson (2005, 2009) state that there are four possible situations occurring based on the relation between individuals' goal achievement and related actions (see Figure 1).

The typology provided in Figure 1 shows that besides social interdependence the authors identify social dependence (when individual's goal achievement is being affected by other individual's actions, but the reverse is not true), independence (when individuals' goal achievements are unaffected by each other's actions), and helplessness (when individuals cannot influence their or other's goal achievement). According to J. G. Holmes (2002),

Figure 1. **Interrelations among individuals (Johnson, D. W., Johnson, R. T., 2005)**

		Own actions facilitate one's goal achievement	
		Yes	No
Other's actions facilitate one's goal achievement	Yes	Interdependence	Dependence
	No	Independence	Helplessness

individual's own goals are consequent on social interaction.

In his initial theory, its founder M. Deutsch (1949) identified two types of social interdependence: *positive* and *negative*. According to D. W. Johnson and R. T. Johnson (2009), *positive interdependence* exists when there is a positive correlation among individuals' goal attainments; individuals perceive that they can attain their goals if and only if the other individuals with whom they are cooperatively linked attain their goals. Positive interdependence results in promotive interaction. J. Choi et al. (2011) state that positive interdependence can be seen in cooperation situations. *Negative interdependence* exists when there is a negative correlation among individuals' goal achievements; individuals perceive that they can obtain their goals if and only if the other individuals with whom they are competitively linked fail to obtain their goals (Johnson, D. W., Johnson, R. T., 2009). Negative interdependence results in oppositional or contrient interaction. J. Choi et al. (2011) propose that negative interdependence results in competition.

Furthermore, there is a possibility for a situation of *no interdependence* to occur (Johnson, Johnson, 2009). *No interdependence* exists when there is no correlation among individuals' goal achievements; individuals perceive that the achievement of their goals is unrelated to the goal achievement of others. According to J. Choi et al. (2011), no interdependence results in individualistic efforts.

Accordingly, the type of interdependence (i. e. positive or negative, or its absence) is determined by the structure of the goals of individuals in a particular situation; moreover, the outcomes of the situation are dependent on goal structure as well; because a goal is a desired future state of a situation. D. W. Johnson and R. T. Johnson (2005) propose that "a *goal structure* specifies the type of interdependence among individuals' goals. The type of interdependence determines how individuals must interact to achieve their goals." Therefore, an individual can influence and modify the concurrent situation by taking a particular course of actions: promote and facilitate the goal attainment of others (positive interdependence) or obstruct and block goal attainment of others (negative interdependence). D. W. Johnson et al. (2012) suggest that individual can ignore efforts of other people to achieve goals (no interdependence); such situation detaches a person from others, thereby creating non-substitutability, no inducibility or resistance, and cathexis only to one's own actions.

B. Enjolras and R. H. Waldahl (2007) propose that in sports, relationship exists when both sides of the relationship derive advantages from it. D. W. Johnson and R. T. Johnson (2005) argue that it is not enough to perceive positive or negative interdependence. People have to take actions to achieve a goal. As indicated before, latter actions result in cooperation (promotive actions) or competition (contrient actions). A situation resulting in taking individualistic efforts is also possible; however such situation is considered as being out of framework of current research because of its manifestation in the absence of interdependence.

Interrelation between cooperation and competition. The scientific analysis of social interdependence theory reveals cooperation and competition as two marginal opposite points of human interrelations. S. Attle and B. Baker (2007) highlight, that both competition and cooperation potentially impact student performance. Therefore, the insight can be made that consistency between two contraries may occur. T. Cerny and B. Mannova (2001) argue that the competition and cooperation among individuals will support the overall work; as the individual success benefits the whole team.

J. Decety et al. (2004) emphasize that cooperation and competition are two basic modes of social cognition that necessitate monitoring of both one's own and others' actions, as well as adopting a specific mental set. Analysing human evolution, the authors state that social cognition "arose out of a complex and dynamic interplay between two opposite factors: on the one hand, cooperation among individuals to form groups can provide enhanced security against predators, better mate choice, and more reliable food resources; on the other hand, competition between group members provides individuals with selective advantages in terms of mate selection and food procurement".

In a recent study on competitive and cooperative learning in senior secondary schools, E. B. Kolawole (2008) agrees with A. O. Akinbobola's (2006) findings that current educational system is based upon competition among students for grades, social recognition, scholarship and admission to top schools. The authors state that in our society and current educational framework, competition is valued over cooperation. However, when competition occurs

between well-matched competitors, this is done in the absence of a norm-referenced grading system, and it is not used too frequently, it can be an effective way of motivating students to cooperate with each other (Cohen, 1994). K. Alexander and J. Luckman (2001), analysing the existing structures of Physical education programmes, propose combining the content (sport) and pedagogy (less teacher-directed; more student-managed) can emphasize collaboration and cooperation within a competitive structure. Taking the idea into consideration, S. Attle and B. Baker (2007) carried out research creating a team-like cooperation in a competitive business-like environment. By structuring learning activities the students are driven to cooperate in teams that compete against one another.

D. W. Johnson and R. T. Johnson (1994) describe three possibilities for student-to-student interaction: 1) a competition about who is the best; 2) an individual work where students do not need to pay attention at other students; 3) team cooperation where the students explore each other's contribution to the goal. T. Cerny and B. Mannova (2001) state that competition and cooperation among students will support the overall work, as the individual success benefits the whole team: the team cooperation encourages each other to do the assigned work; and learn to work together. After several analyses, D. W. Johnson and R. T. Johnson (1999) recognized the necessity to integrate cooperative learning and competitive individual learning. J. M. Tauer and J. M. Harackiewicz (2004) found that by combining cooperative group learning with inter-group competition intrinsic motivation of participants consistently improved. The findings suggest that a combination of cooperation and competition facilitates motivation, enjoyment, and performance of participants; students benefit from combining cooperative team learning strategies structured in an inter-group competition.

According to J. Decety et al. (2004), cooperation and competition involve executive functions and mentalizing abilities, both of which play a crucial role during social interactions. Executive functions encompass several aspects of generating flexible behaviour, including the ability to (a) choose a course of action in novel situations, (b) suppress a prepotent course of action that is no longer appropriate, and (c) monitor current ongoing action; mentalizing manifests in the ability to explain and predict the behaviour of the other by attributing independent mental states to them, such as thoughts, beliefs, desires, and intentions, which are different from our own. Acknowledging the touch-points of the two dimensions, E.A. Wynne (1995) proposed a synthesized cooperation-competition instructional strategy, where positive aspects of both cooperative learning and motivational competition using inter-group competition between collaborative teams were combined.

While analysing the consistency between cooperation and competition, K. G. Ricketts and J. A. Bruce (2009) use a term *coopetition* to maintain the idea of the interrelation existence. Accordingly, the term comes from the business and management field, and is used to describe: "a business situation in which independent parties *co-operate* with one another and *co-ordinate* their activities, thereby *collaborating* to achieve mutual goals, but at the same time *compete* with each other as well as with other firms" (Zineldin, 2004). Y. Luo (2004) has developed a conceptual and typological framework of coopetition in which cooperation and competition simultaneously coexist; the model was modified by B. Bigliardi et al. (2011) (see Figure 2).

Considering the possibility of the consistency between positive and negative interdependence and endeavouring to proof the possibility of coopetition, detailed analysis of cooperation and competition were provided.

Implications on cooperation. D. W. Johnson et al. (2012) suggest that positive interdependence is a result of cooperation. S. Attle and B. Baker (2007) define cooperation as "a social process through which performance is evaluated and rewarded in terms of the collective achievements of a group of people working together to reach a particular goal".

M. Deutsch (2000) proposes that cooperation induces and is induced by perceived similarity in beliefs and attitudes, readiness to be helpful, openness in communication, trusting and friendly attitudes, sensitivity to common interests and de-emphasis of opposed interests, orientation toward enhancing mutual power rather than power differences, and so on.

D. W. Johnson and R. T. Johnson (2009) propose five variables which mediate the effectiveness of cooperation: (1) positive interdependence (structured by outcome, means, and boundary), (2) individual accountability (i. e. the lack of individual accountability may reduce feelings of

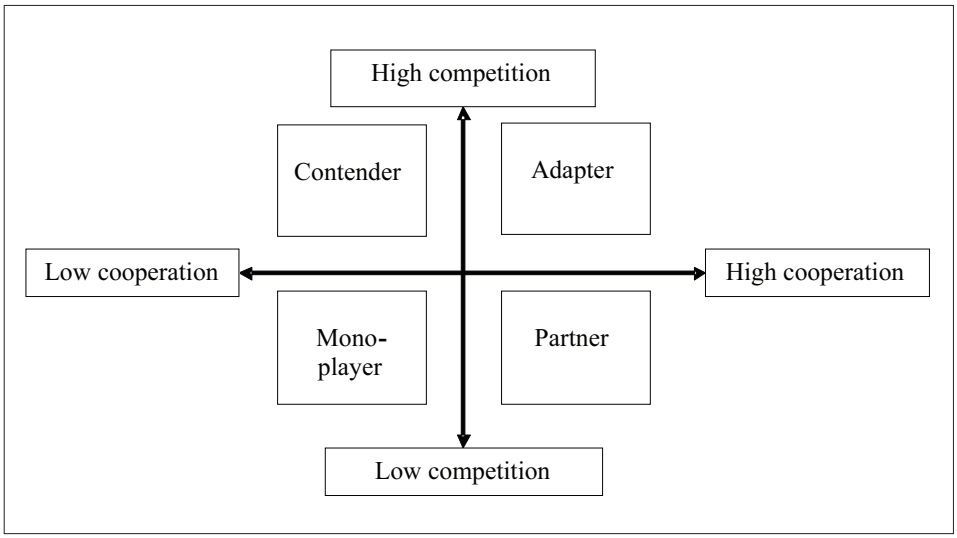


Figure 2. **A typology of coopetition proposed by Y. Luo (Bigliardi et al., 2011)**

personal responsibility), (3) promotive interaction (occurs as individuals encourage and facilitate each other's efforts to accomplish the group's goals), (4) the appropriate use of social skills (unskilled group members cannot cooperate effectively), and (5) group processing (clarifies and improves the effectiveness with which members carry out the processes necessary to achieve the group's goals). Successful cooperation is based on trust, commitment, and voluntary and mutual agreement that can be set out in a formal and documented contract or an informal contract aimed at achieving common goals (Osarenkhoe, 2010).

However, A. M. Thomson and J. L. Perry (2006) argue that cooperation for a mutual goal moves this to collaboration. Accordingly, collaboration is defined as a process in which autonomous actors interact through formal and informal negotiation, jointly creating rules and structures governing their relationships and ways to act or decide on the issues that brought them together; it is a process involving shared norms and mutually beneficial interactions. Moreover, collaboration was sometimes defined as needs of sharing, responsibility, getting more cooperation, constructing network and team working (Lucas, 1998).

As a group benefit, collaboration would create better teamwork as a result of mutual understanding through interpersonal interaction (Tschanen-Moran, 2001). Greater collaboration can foster greater trust as partners have experience with one another over time and have opportunities to witness benevolence, reliability, competence, honesty and openness of their partners.

Analysing differences between the two terms (often used as synonyms in scientific literature), O. Kozar (2010) indicates that *cooperation* can be achieved if all participants do their assigned tasks separately and bring their results to the table; *collaboration*, in contrast, implies direct interaction among individuals to produce a product and involves negotiations, discussions, and accommodating others' perspectives. Moreover, based on M. Zineldin's (2004) definition of coopetition, it can be envisioned that collaboration encompasses cooperation and coordination. Therefore, the major implication here is that cooperation is possible within a team, whereas collaboration occurs between two or more teams to reach their specific, as well as mutual goals.

Implications on competition. D. W. Johnson et al. (2012) suggest that negative interdependence results in oppositional or contrient interaction (such as obstruction of each other's goal achievement efforts, hiding resources and information from each other, acting in distrustful and distrusting ways); such negative interaction is called competition.

The definition of competition provided by J. J. Coakley (1997) is a social process that occurs when rewards are given to people on the basis of how their performances compare with the performances of others doing the same task or participating in the same event. The competition is evident throughout our society, our lives, and our recorded history. Of the three interaction patterns, competition is presently the most dominant.

M. Deutsch (2000) suggests that competition can vary from destructive to constructive. In constructive competition, the losers as well as the winners gain. Therefore, competition induces and is induced by use of tactics of coercion, threat, or deception; attempts to enhance the power differences between oneself and the other; poor communication; minimization of the awareness of similarities in values and increased sensitivity to opposed interests; suspicious and hostile attitudes; the importance, rigidity, and size of issues in conflict; and so on.

D. W. Johnson and R. T. Johnson (2009) argue that competition tends to be more constructive when three conditions are met:

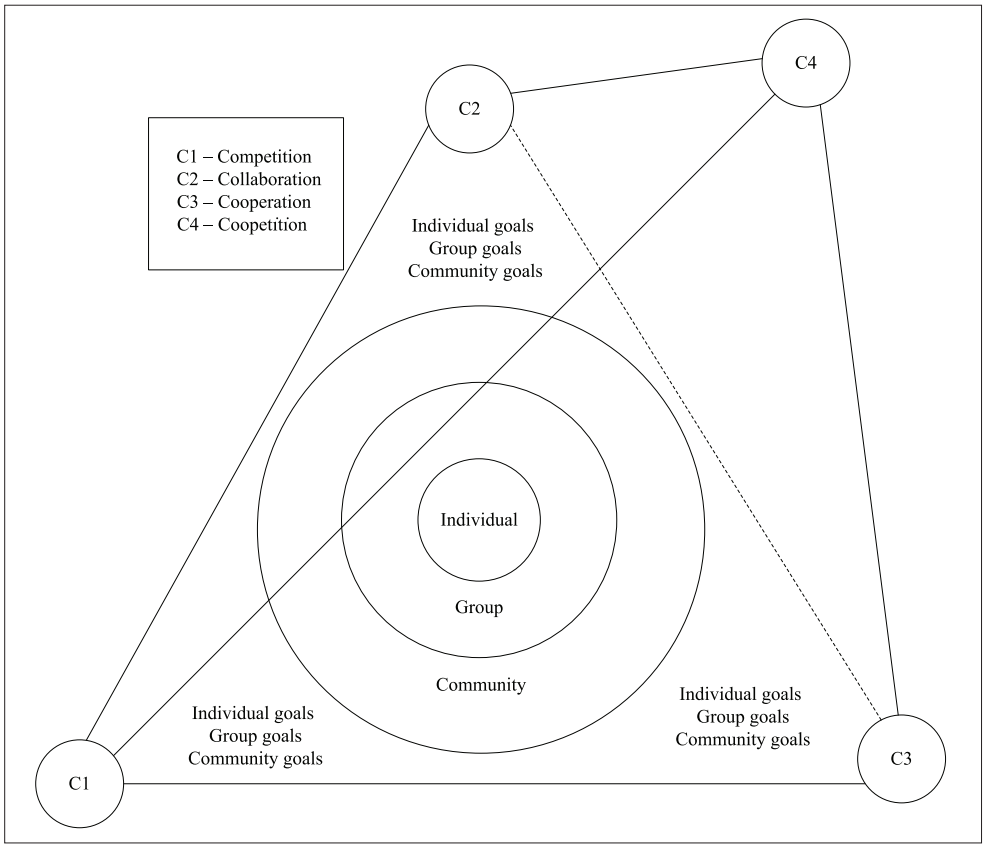
1. Winning is relatively unimportant;
2. All participants have a reasonable chance to win;
3. There are clear and specific rules, procedures, and criteria for winning.

Summarizing, it can be argued that constructive competition can be considered as a form of positive interrelation rather than negative.

Conceptualization of consistency between Cooperation, Collaboration and Competition. Scientific literature analysed, suggests a few insights into the field. First, social interaction may occur at two levels: intra-group (group level) and inter-group (community level). Second, the nature of social interdependence depends on the level of goals being achieved; three levels of goals can be distinguished: individual goals, group goals, and community (formation of few interrelated groups) goals. Third, based on the type of the interaction and the level of goals, individuals tend to engage into a particular form of interrelation: competition, cooperation, or collaboration; moreover, the form of interdependence is not restricted – a combination of a few (or even all) forms is possible. Moreover, based on scientific literature, an implication can be made that interrelation among competition, cooperation, or collaboration can result in coopetition as a higher form of interdependence.

Latter insights can be incorporated into an interdependence-based conceptual model of consistency among competition, cooperation and collaboration (see Figure 3). In a proposed model it can be seen that Individual (e. g. athlete) is a part of a Group (e. g. sports team), and the Community (e. g. two or more competing teams). Community encompasses Group as its component. Actions and interdependence of members within a particular

Figure 3. **A model of consistency among competition, cooperation and collaboration**



community (i.e. among individuals as group members; among groups as community members) are dependents on the goals. Moreover, depending on a level of a goal (individual, group, or community) a most appropriate form of interrelation is chosen: Competition, Cooperation, or Collaboration. Assuming an existence of multiple goals (e. g. an athlete may want (1) his team to win a competition, and (2) to be the best in his team at the same time), few forms of interdependence can occur at a time; their consistency results in coopetition.

The proposed model can be seen as conceptual; therefore, the level of consistency and its essential structural parts have to be revised depending on a particular situation of social interaction (e. g. model structure may differ in a team game and individual game situation). Moreover, structural components of competition, cooperation and collaboration have to be established and adjusted to the environmental conditions of the situation.

CONCLUSION AND PERSPECTIVES

Scientific analysis has revealed a high possibility of consistency among competition, cooperation and collaboration in social interrelations. Various discussions about an impact of the form of interdependence on goal achievement have been found. Moreover, a huge scientific substantiation for a synergy among the latter three forms of interrelations has been found in the fields of psychology, sociology, management and education. It can be stated that sport is being affected by all the above mentioned fields of science and their insights. Moreover, sport is often related to competition; however, team members are likely to cooperate inside the team.

A vast majority of researchers suggest that competition alone is not substantial for goal attainment. However, a constructive competition is often more productive in terms of achievements than destructive. Considering a constructiveness of competition, structural features of cooperation or collaboration can be envisioned. The constructiveness results in advising a competitor, or even helping to recognize former mistakes (e. g. made during the tennis match).

The analysis of goals of interaction has revealed an eventual goal typology. Depending on their subject and object, goals can be classified into individual level (athlete's goals), intra-group level (team goals), and inter-group level (game goals) goals. Individual goals are being achieved by a person acting alone or within a group, streaming to fulfil personal expectations (most often to excel over others); intra-group (group) level goals are those of group members working together (to attain a common group excellence in some specific field or in comparison to other groups); inter-group (community) level goals are those being achieved by several groups working together (either for better results in the field or for group's excellence in a context of other groups). Considering the essence of the goals being attained, the level of consistency and its structural parts can be modified. Various researchers suggest a term "coopetition", which reflects a possibility and even advantage of harmonization of competition, cooperation, and collaboration.

However, despite numerous research and substantial theoretical and practical insights, many obscurities and ambiguities in scientific literature concerning social interdependence in forms of cooperation and collaboration have been detected, as well. Terms of cooperation and collaboration are often used as synonyms, without paying attention to their conceptual difference. Therefore, other researchers emphasize the existence of such difference. Scientific analysis enabled to distinguish the following forms of interdependence; accordingly, cooperation was considered as a form of positive interrelation within a group (intra-group level), whereas collaboration – as a form of positive interrelation among two or more groups (inter-group level).

Considering the implications for further research, few imperatives can be suggested. Aiming at harmonizing competition, cooperation and collaboration, it is necessary to determine essential human skills and abilities for every category; their main touch-points have to be established. Moreover, prerequisite and optional environmental conditions have to be defined. In a framework of sport, empiric research is to be made in different kinds of sport: individual, pair or team-based.

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TARPUSAVIO PRIKLAUSOMYBE PAGRĮSTAS KONKURAVIMO, KOOPERACIJOS IR BENDRADARBIAVIMO DERINIMO MODELIS

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Kasdienis žmonių gyvenimas yra neįsivaizduojamas be jų socialinės tarpusavio priklausomybės. Tai pažymėtina ir apie sportinę veiklą. Sportininkai dažniausiai konkuruoja siekdami aukštesnių ir geresnių rezultatų, tačiau jų susivienijimas (kooperacija) taip pat gali reikštis ir konkuruojant. Mokslinė problema keliama klausimu, kaip galima suderinti socialinius tarpusavio santykius, kuriuos tuo pačiu metu lemia konkuravimas, kooperacija ir bendradarbiavimas, kaip šio suderinimo pasiekti.

Tikslas – sukurti konceptualų socialinės tarpusavio priklausomybės prielaidomis pagrįstą konkuravimo, kooperacijos ir bendradarbiavimo derinimo modelį.

Metodai: teorijos analizė ir sintezė. Teorinių tyrimų rezultatai yra apibendrinti ir susisteminti konceptualiu modeliu.

Aptarimas ir išvados. Mokslinė literatūra pateikia keletą įžvalgų. Pirma, socialinė sąveika gali pasireikšti dviem lygiais: grupės viduje (grupinis lygis) ir tarp grupių (bendruomenės lygis). Antra, socialinės tarpusavio priklausomybės prigimtis priklauso nuo siekiamų tikslų lygio (galimi trys tikslų lygiai – tikslai gali būti individualūs, grupiniai ir bendruomeniniai). Trečia, priklausomai nuo socialinės sąveikos tipo ir tikslų lygio asmenys siekia konkrečių tarpusavio ryšių formų pasitelkdami konkuravimą, kooperaciją ir bendradarbiavimą. Be to, tokios sąveikos formų gali būti įvairių – galimas kelių ar net visų formų derinys. Mokslinė literatūra teigia, kad derinant konkuravimą, kooperaciją ir bendradarbiavimą galima pasiekti koopeticijos, kaip aukštesnės sąveikos formos.

Raktažodžiai: koopeticija, socialinė sąveika, socialiniai savitarpio santykiai.

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RELATIONSHIPS BETWEEN 16-18-YEAR-OLD STUDENTS' PARTICIPATION IN EXTRACURRICULAR ACTIVITIES AND THEIR PRO-SOCIAL BEHAVIOUR AS WELL AS THEIR VALUE ORIENTATIONS

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ABSTRACT

Research background and hypothesis. Extra-curricular activities are concurrent with personality development, often named as assumption to pro-social behaviour and analysed considering value orientation. The following hypothesis was set in the study: indexes of expression of pro-social behaviour and value orientation were more characteristic of students involved in extra-curricular activities in comparison with non-active (after school) students. Type of extra-curricular activities was included in the analysis.

Research aim. The aim of the study was to analyse relationships between students' participation in extra-curricular activities and expression of pro-social behaviour as well as their value orientation.

Research methods. The sample consisted of 179 students (82 girls and 97 boys) at the age of 16–18 years. Written survey was applied for the research. The participants completed the Pro-social Tendencies Measure (Carlo et al., 2003) and S. H. Schwartz's (1992) value orientation methodology. Participation in extra-curricular activities was assessed by asking question with a detailed list of structured activities.

Research results. Results of the study revealed that there were no links between students' participation in extra-curricular activities and pro-social behaviour. However, it was determined that public assistance was more characteristic of students participating in artistic extra-curricular activities in comparison to students that attended sports activities after school. The same situation was with value orientation: there was absence of correlations between students' participation in extra-curricular activities and value orientation, but significant differences related to the type of extra-curricular activities were found. Self-transcendence was more important to students that attended artistic extra-curricular activities in comparison with students participating in sports activities after school.

Discussion and conclusion. Tendencies of results of this research are comparable to those in other scientific studies. Studies that examined participation in extra-curricular activities and value orientations of interfaces in Lithuania are still missing.

Keywords: value orientation, students' participation in extra-curricular activities, pro-social behaviour.

INTRODUCTION

Currently, the Lithuanian education system pays great attention to the development of extra-curricular activities to increase its diversity and to assure quality. Extra-curricular activities are identified as very important area of occupation of pupils which gives possibilities to unfold their talents, to deepen and to use practical knowledge acquired in the classroom (*Popamokinės veiklos veiksmingumas* [Effectiveness of extracurricular activities], 2003). After-school activities are also an integral part of the student's personality development which strengthens their independence, creativity, initiative, citizenship, imagination and communication skills (Sprindžiūnas, 2002; Barkauskaitė, 2004).

Participation in extra-curricular activities is particularly important in adolescence. This period is very important and full of changes, especially the middle adolescence. The Lithuanian education system includes all students of 9–12th grades to this age period (Šarakauskienė, Bagdonas, 2010). Teenagers can make independent decisions how to spend their time after school and these self-selected decisions of extracurricular activities may have important implications for their future trajectories. Participation in maintained and organized extracurricular activities may have a positive effect the formation of the sense of responsibility, clear articulation of life goals and orientation to their achievements and behavior in everyday situations (Cooper et al., 1999; Mahoney, Stattin, 2000; Feldman, Matjasko 2005). Extra-curricular activities are emphasized as an important factor in social skills formation and development (Burton, Marshall, 2005).

Positive, constructive and useful behaviour is defined as pro-social behavior and anti-social behavior is the opposite (Myers, 2000). According to S. Šukys (2010), our behavior depends on the perception of the situation and accepted decisions of behavior. Therefore, there are several forms of pro-social behavior, depending on the situation: public pro-social behavior (help when others see), anonymous pro-social behavior (the helper remains unknown), assistance in critical situation (when someone is injured and needs help), help in emotional situations (when someone cries), altruistic behavior and response to request for help (helping someone who asks for help). Participation in after-school activities leads to the increase of social understanding which is associated with self-understanding and pro-social behavior (Bosacki, 2003).

Firstly, pro-social behavior is fostered in families and their environment. A person can foster factors that stimulate pro-social behavior by himself, too. S. H. Schwartz (1992) claims that personal values are "criteria used by people when selecting and justifying actions and evaluating themselves, people and events" (p. 3). Recently, more and more attention is paid to spiritual development of young people and development of personality that is well-rounded, spiritually mature and capable of critical thinking. In the Concept of Lithuanian Education and the National Education Strategy of 2003–2012, the most important educational goal was raised: to help to foster human values and to fill out life with them. In general programmes and educational standards the defined goal is to set conditions for students to foster their valuable views.

Values are desirable goals or leading life principles of a person and they have different meanings for a particular individual. Values are socially supported and may be distinguished according to the consequences of participation in after-school activities (Imbrasienė, 2004). However, more often they are mentioned as preconditions of participation in extra-curricular activities and pro-social behavior.

To sum up, insights of different researchers are presented in this study which aims at establishing participation links with he expression of pro-social behaviour and value orientations of 16–18-year-old students who participate in after-school activities. The main hypothesis of the research is: students who participate in after-school activities tend to have higher pro-social and life value scores compared to those who do not participate in such activities. Study of children's behavioural expression of social life and value orientations draws attention not only to the extra-curricular activities, but also to the nature of this action. It is, therefore, likely that the social life behaviour and values scores will vary depending on the nature of extracurricular activities.

RESEARCH METHODS

Research subjects. The sample consisted of 179 students group (82 girls and 97 boys) aged 16–18 years. Students were selected using convenient and purposive sampling methods. They were taken from Kaunas city schools and extracurricular educational institutions. Using convenient sampling method, students were selected from Kaunas secondary schools. Using purposive sampling method, students were selected from extracurricular educational institutions. Purposive selection was applied additionally because the aim was to include pupils who regularly attend certain after-school activities. Thus, the study emphasizes not the size of samples, but rather the selection of specific subjects required by the study aim.

Research methods. Method of written survey was applied, subjects were given questionnaires. One part of the questionnaire was designed for socio-demographic characteristics of students (gender, class, family composition, parents' emigration to work in a foreign country), the other part of the questionnaire was related to problematic

questions. The study purpose was introduced in questionnaire instructions. The institution carrying out the research was indicated as well. The order of questionnaire answers was explained and it was mentioned that the survey was anonymous. In order to ensure the anonymity of respondents, the schoolchildren were asked not to indicate their personal data, school and class. Although the latter data can be identified, it is not used in this study.

Studying pro-social behaviour of students, pro-social behaviour assessment scale was used (PTM-R) (Carlo et al., 2003) which had already been applied in research with Lithuanian students (Šukys, 2010). The scale consists of 21 statements. Assessing every statement the participants had to choose one of five options (1 – it is uncommon to me and 5 – typical of me). In the original scale six social life forms of pro-behaviour are identified: public assistance to others (3 statements), support in emotional situations (five statements), assistance in a disaster (3 statements), anonymous support (4 statements), altruistic behaviour (4 statements) and help when asking for it (2 statements). After factor analysis (that was performed for this research data), four factors were identified: Factor I – helping others in distress and asking for help (Cronbach's alpha – 0.80), Factor II – anonymous support (Cronbach's alpha – 0.71), Factor III – altruistic behaviour (Cronbach's alpha – 0.55) and Factor IV – public assistance to others (Cronbach's alpha – 0.86). Internal coherence of all scale is Cronbach's alpha score of 0.78.

S. H. Schwartz's value methodology was used to determine pupils' value orientations. Students were given a list of 48 values, each of which had to be valued according to how important it was to them (from 1 to 9, where 1 – is adverse to the principles of my life, 9 – this is very important to me). S. H. Schwartz (1992) reported that participants who equally (by assigning the same score) assessed more than 62.5% of the listed values or who rated more than 37.5% of the listed values by 9 points (this was the maximum possible score) did not put any serious efforts to distinguish the relative importance of their values, and they had to be eliminated from the analysis. To get as accurate results as possible, this provision was applied for this research, too. Therefore, 30 respondents were eliminated from the research. Looking further, the data analysis was based on 179 questionnaires (209 questionnaires were collected in total). As the abovementioned methodology of values had been applied in several studies in Lithuania (Butkevičienė et al., 2009), additional scale factor analysis was not done. In data analysis, four types of classification of higher values were used (Schwartz, 1992): self-transcendence (Cronbach's alpha – 0.77), conservatism (Cronbach's alpha – 0.65), emphasis on self (Cronbach's alpha – 0.67), openness to change (Cronbach's alpha – 0.78).

Students' participation in extra-curricular activities was determined by asking a question with possible alternatives. Students could choose the activities they attended or to indicate other unmentioned clubs that they attended. Based on their responses, the students were divided into groups of those who participated in extra-curricular activities (n = 142, 79.3%) and those who did not (n = 37, 20.7%). Those who participated in extra-curricular activities were divided into groups according to the extracurricular activity type: attending only sports groups (n = 54, 38%), attending only clubs related to artistic activities (n = 60, 42.3%), attending science clubs (n = 9, 6.3%), and attending a number of several different clubs (n = 19, 13.4%). Some types of activities were attended by fewer students, therefore, when analyzing the data according to extracurricular activity type, two groups could be distinguished: pupils who attended sports clubs only and pupils who attended art clubs only. Types of these clubs are different according to their goals and activities.

Procedure of the reseach. The study was conducted in 2011, in May and October. The survey was coordinated with Kaunas city Department of Education and school administrators. After agreement on the survey time, researchers went to schools. The survey took place in the classrooms during the lessons. School teachers or the psychologist participated during the survey. Before each survey the students were explained the research purpose and filling instructions, the study emphasized anonymity and opportunity to refuse to participate in the survey.

Statistical analysis. The data were processed using *SPSS 16.0* software. Cronbach's alpha reliability coefficient was used to check the reliability of scales as well as their internal consistency, factor analysis was used to ground the structure of scales. The analysis of variance showed that distribution of all variables had statistically significant distance from the normal distribution, therefore, non-parametric criterion was chosen for further analysis (Vaitkevičius, Saudargienė, 2006).

Descriptive statistics were used for the description of participants and general trends of the analyzed phenomena, for differences between the two treatment groups – Mann Whitney criterion. The chosen level of significance was $\alpha = 0.05$.

RESEARCH RESULTS

Firstly, an overview of data of students' participation in extra-curricular activities was performed. The results showed that 63.0 per cents of students were involved in extra-curricular activities (Table 1). Students preferred sports and artistic clubs. 10.6 per cent of students attended several different clubs at the same time. However, sports clubs were more popular among boys and art clubs – among girls. Besides, girls attended several different clubs more often than boys. Technical type clubs were not popular among the analysed students. Thirty seven students stated that they had not participated in any extra-curricular activities, but they formed only one fifth of the subjects in our sample.

Gender-based differences of pro-social behavior and value orientation were not identified, therefore, in further analysis they are not discussed.

Although the expression of pro-social behaviour did not differ in groups of pupils who attended or did not attend after-school activities, statistically significant differences were ~~noticed~~ observed when evaluating the groups of those who attended different clubs (Table 2). Students who participated in artistic type clubs showed more public assistance compared to students who were athletes.

There were no statistically significant differences of individual values comparing students who attended after-school activities and who did not. However, a tendency was observed in the differences of self-transcendence values among students who attended different type clubs (Table 3). That is, self-transcendence values were more important to students who attended artistic clubs compared with the athletes.

Table 1. **Distribution of pupils according to their participation in extra–curricular activities**

Activity type	Girls (n = 82)	Boys (n = 97)	In total (n = 179)
Sports clubs	13 (7.3%)	41 (22.9%)	54 (30.2%)
Artistic type clubs	41 (22.9%)	19 (10.6%)	60 (33.5%)
Technical type clubs	3 (1.7%)	6 (3.3%)	9 (5.0%)
Participate in extra–curricular activities	13 (7.3%)	6 (3.3%)	25 (10.6%)
Do not participate in extra–curricular activities	12 (6.7%)	25 (14%)	37 (20.7%)

Table 2. **Differences in the expression of pro-social behaviour components according to participation in extra-curricular activity and its type**

Groups of pro-social behavior	Participation in extra-curricular activities		Mann Whitney U	Participation in extra-curricular activities		Mann Whitney U
	Do not participate in extra-curricular activities	Participate in extra-curricular activities		Attend sports clubs	Attend artistic clubs	
	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
Anonymous support	2.7 (1.0)	2.6 (1.0)	2376.5	2.5 (1.0)	2.7 (1.0)	1395.5
Public assistance to others	3.0 (1.0)	3.0 (0.9)	2592.5	2.7 (0.7)	3.1 (1.0)	1250.5 *
Altruistic behaviour	2.8 (0.9)	2.9 (0.9)	2537.0	2.8 (0.8)	2.9 (0.9)	1609.0
Help others in case of emergency and when others ask for help	3.6 (0.8)	3.5 (0.8)	2404.5	3.4 (0.7)	3.6 (0.8)	1309.0

Note. * – $p < 0.05$.

Table 3. **Differences in the importance of higher range values groups according to participation in extra–curricular activity and its type**

Value types/ groups	Participation in extra-curricular activities		Mann Whitney U	Participation in extra-curricular activities		Mann Whitney U
	Do not participate in extra-curricular activities	Participate in extra-curricular activities		Attend sports clubs	Attend artistic clubs	
	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
Self-transcendence	6.9 (1.1)	6.9 (1.2)	2593.0	6.6 (1.4)	7.1 (0.9)	1308.5 #
Conservatism	6.7 (1.1)	6.5 (1.2)	2430.0	6.5 (1.4)	6.6 (1.0)	1544.0
Emphasis on self	6.5 (1.0)	6.5 (1.2)	2551.0	6.5 (1.3)	6.5 (1.1)	1575.5
Openness to change	7.1 (1.2)	7.2 (1.3)	2490.5	7.0 (1.4)	7.3 (1.1)	1425.5

Note. # – $p < 0.1$.

DISCUSSION

The obtained study results about students' participation in extra-curricular activities overlapped with the results of other researchers (Dzenuškaitė1991; Barkauskaitė, 2004; Šukys, 2010): the most popular extra-curricular activities remained various sports clubs, less popular – art clubs. Similarly, it was noticed that sports clubs were more popular among boys, artistic clubs – among girls. However, after conducted study, S. Dzenuškaitė (1991) concluded that choices of clubs among girls and boys were similar.

When analysing the links of students' participation in extra-curricular activities with the expression of pro-social behaviour and value orientations it was not established that pro-social behaviour ~~is~~ was more typical for of those who participated in extra-curricular activities than those who did not. Most authors (Cooper et al., 1999; Mahoney, Stattin, 2000; Feldman, Matjasko, 2005; Šukys, 2010) argue that extra-curricular activities have a positive impact on pupil's behaviour. J. Cooper, the co-authors (1999), found that students who attended extra-curricular activities demonstrated better learning outcomes, a stronger sense of responsibility, clear life goals and their trajectories of achievements.

Data analysis revealed links between students' chosen type of extra-curricular activity and expression of their pro-social behaviour. It was found that provision of public assistance/help was more common for students ~~of~~ in artistic clubs rather than for those who attended sports clubs. The findings conflict with Lithuanian authors' (Šukys, 2010) results of research. According to S. Šukys (2010), students who participate in sports groups tend to have hedonistic motives: they are more likely to do that when they get approval or that is related to self-interest and they get benefits for themselves. However, foreign researchers (Hansen et al., 2003; Larson et al., 2006) found that students who attended artistic groups tended to behave more pro-socially. G. Carlo et al. (2002) divided pro-social behaviour into altruistic (voluntary helping motivated primarily by the concern for the needs and welfare of another), public (in front of others and self-interested), anonymous (tendency to help others without other people's knowledge), dire (helping others in emergency or crisis situations), emotional (behaviours intended to benefit others enacted under emotionally evocative situations), and compliant (helping others when asked) behaviour. In addition, foreign literature indicates that participation in sports clubs may have not only a positive impact, such as the development of initiative, but also a negative experience, such as stress and use of alcohol (Scanlan et al. 2005; Larson et al., 2006).

The study revealed relations between the chosen type of after-school activities and students' value orientations. Self-transcendence values were more important to students who attended artistic clubs than to those who did sports. On the dimension of self-enhancement vs. self-transcendence, power and achievement values opposed universalism and benevolence values. The other dimension was openness to change vs. conservation. Here self-direction and stimulation values opposed security, conformity and tradition values. Both of the former ones emphasized independent action, thought and feeling and readiness for new experience, whereas all of the latter ones emphasized self-restriction,

order and resistance to change (Schwartz, 1992). Dedication to others is incompatible with the pursuit of victories in sport which is the aim of sports extra-curricular activities. Meanwhile, competition in artistic groups is not encouraged. However, further studies are needed for the investigation of the relations between the type of extracurricular activities and participating students' value orientations. In addition, too small sample size did not allow using more sophisticated techniques of statistical analysis which could lead to assumption of causality (values as assumptions or implications of extra-curricular activity analysis). Further studies of more diverse design are needed to determine causality.

CONCLUSIONS AND PERSPECTIVES

Results of the research, that took place in Kaunas city, did not reveal differences in the expression of pro-social behaviour and value orientation among students who participated in extra-curricular activities and who did not. The data analysis has revealed links between students' chosen type of extra-curricular activities and expression of pro-social behaviour, value orientation. It was found that public assistance to others and self-transcendence values were more characteristic of students who attended artistic clubs in comparison with athletes.

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16–18 METŲ MOKSLEIVIŲ DALYVAVIMO POPAMOKINĖJE VEIKLOJE SĄSAJOS SU JŲ VERTYBĖMIS IR PROSOCIALIU ELGESIU

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Popamokinė veikla yra neatsiejama moksleivio asmenybės ugdymo dalis, dažnai įvardijama kaip prosocialaus elgesio prielaida ir analizuojama atsižvelgiant į joje dalyvaujančiųjų vertybines orientacijas. Daroma prielaida, kad popamokinėje veikloje dalyvaujantiems moksleiviams būdingi aukštesni prosocialaus elgesio išreikštumo ir vertybių svarbos rodikliai, lyginant su nedalyvaujančiais šioje veikloje. Į analizę įtraukiamas ir popamokinės veiklos pobūdis.

Tikslas – išsiaiškinti 16–18 metų moksleivių dalyvavimo popamokinėje veikloje sąsajas su jų prosocialaus elgesio raiška ir vertybinėmis orientacijomis.

Metodai. Tiriamųjų imtį sudarė 179 moksleivių grupė (82 mergaitės ir 97 berniukai), kurių amžius 16–18 metų. Tiriant moksleivius taikytas apklausos raštu metodas, kurį sudarė socialinė-demografinė ir diagnostinė dalys. Moksleivių prosocialus elgesys tirtas naudojant Prosocialaus elgesio vertinimo skalę (Carlo ir kt., 2003). Vertybinėms orientacijoms nustatyti pasirinkta S. H. Schwartz (1992) metodika. Moksleivių dalyvavimas popamokinėje veikloje nustatytas pateikiant apie tai klausimą su galimomis alternatyvomis.

Rezultatai. Tyrimo rezultatai neatskleidė moksleivių dalyvavimo popamokinėje veikloje ir prosocialaus elgesio raiškos sąsajų. Analizuojant tyrimo duomenis buvo atskleistos sąsajos tarp moksleivių pasirinktos popamokinės veiklos pakraipos ir jų prosocialaus elgesio raiškos. Nustatyta, kad meninės veiklos būrelius lankantiems moksleiviams būdingesnis viešosios pagalbos teikimas, palyginus su sportuojančiais. Vertybinės orientacijos taip pat statistiškai reikšmingai nesiskyrė popamokinę veiklą lankančių ir nelankančių moksleivių grupėse. Tyrimas atskleidė dalyvavimo pasirinktos popamokinės veiklos pakraipos sąsajas su moksleivių vertybinėmis orientacijomis. Meninės veiklos būrelius lankantiems moksleiviams būdingesnės savitranscendencijos vertybės nei sportuojantiems.

Aptarimas ir išvados. Pastebėtos dalyvavimo konkrečioje popamokinėje veikloje ir prosocialaus elgesio sąsajų tendencijos panašios į kitų tyrėjų gautus rezultatus. Tyrimų, kurie nagrinėtų dalyvavimo popamokinėje veikloje ir vertybinių orientacijų sąsajas Lietuvoje vis dar trūksta.

Raktažodžiai: vertybinės orientacijos, moksleivių dalyvavimas popamokinėje veikloje, prosocialus elgesys.

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DIFFERENCES OF AGE AND GENDER RELATED POSTURE IN URBAN AND RURAL SCHOOLCHILDREN AGED 7 TO 10

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ABSTRACT

Research background and hypothesis. Postural disorders appear to be one of the biggest health threats in Lithuania. Especially significant alterations in children's health-related behaviour emerge when they start going to school. These changes in their daily routine are often faulty and may lead to the deteriorating health condition. Postural abnormalities need to be corrected as early as possible before they become permanent. According to some authors, rural children are more physically active compared to city children, therefore it is interesting to identify is there is any difference in body posture in rural and urban schoolchildren.

Research aim was to assess and compare posture in urban and rural schoolchildren aged 7 to 10.

Research sample: 248 schoolchildren (109 – from urban area; 139 – from rural area).

Research methods. Posture of rural and urban schoolchildren was assessed using W. K. Hoeger's method. Alignment of ten body segments was visually evaluated in a frontal (head, shoulders, spine, hips, knees and ankles) and sagittal (neck and upper back, trunk, abdomen, lower back, legs) planes.

Research results. There were no significant differences ($p > 0.05$) in total posture score between girls (41.80 ± 6.87) and boys (40.62 ± 7.13). Girls and boys from the rural area had significantly ($p < 0.05$) higher total posture score than their counterparts from the urban area.

Discussion and conclusions. There were no significant differences in total posture score between girls and boys. Regardless of age and gender, schoolchildren from rural area had better posture than children from urban area.

Keywords: alignment of body segments, area of residence, children's posture.

INTRODUCTION

Posture refers to the body alignment and positioning with respect to the ever-present force of gravity. Good posture entails distributing the force of gravity through the body so no one structure is overstressed. Correct upright posture is considered to be an important indicator of musculoskeletal health (McEvoy, Grimmer, 2005), overall health and well-being. Literature reviews indicate that faulty spinal posture can be correlated to back pain in children (Vidal et al., 2012). Prevention of back pain may be very important because back pain during childhood is known to be a predisposing factor for experiencing back pain into adulthood (Brattberg, 2004).

For children, upright posture measurements might be a useful clinical tool to identify acute spinal postural changes and prevent of potential risk to induce back pain (Hong, Cheung, 2003). Postural analysis is aimed at identifying abnormal deviation from a referenced vertical alignment in the frontal and sagittal planes (Kendal et al., 2005).

Childhood and adolescence are the most important periods in human growth and development. Some authors point out to the

postural evolution during childhood (age 4–12) as an increase in forward translation displacements of head, shoulders, pelvis and knees in the sagittal plane (Lafond et al., 2007). Especially significant changes in children's health-related behaviour emerge when they start going to school. These changes in their daily routine are often faulty and may lead to deterioration of health conditions. Hence it is necessary that schools should be provided furniture that is fit to the requirement of school children (Shivarti, and Kiran, 2012). Postural control is an important factor in primary schoolchildren. There is a growing public concern about postural alterations found in children and teenagers. According to the information of Lithuanian Health Information Centre, postural disorders appear to be one of the biggest health threats in Lithuania. Reports on children's health status state that postural disorders are diagnosed to almost every fourth of the schoolchildren, while spinal deformity is diagnosed to every tenth of them (Kaušylienė, 2008). Children only seek care when the deformity is visible and therefore represents a serious problem (Nery et al., 2010).

Between the age 7 and 12, a child's posture undergoes a big transformation to reach a compatible balance with the new corporal proportions (Penha et al., 2005). S. McGill (2004) reported that children's modern way of life negatively affects their postural status, especially their lumbar-abdominal region. The influence of the level of urbanization on the place of residence place, and on the biological features of a human, is of an indirect nature (Drzał-Grabiec, Snela, 2012).

The reduction of physical activity, caused by the urban way of life and inadequate exercise in physical education classes, and not being involved in certain sport activities, leads to a weakening of the entire muscular system (Bogdanović, Marković, 2010; Koničanin et al., 2010).

Therefore, we hypothesize that posture of rural children should be better to compare to urban children.

The main aim of the present study was to assess and compare posture in urban and rural schoolchildren aged 7 to 10.

RESEARCH METHODS

Design: cross-sectional. **Setting:** urban and rural schools.

Sample selection. Schoolchildren ranging in age from 7 to 10 years (n = 248; urban – Kaunas city; n = 109; rural – Kaišiadorys district; n = 139; boys: n = 116; girls: n = 132) were invited to participate in the study; two of the schools were in urban areas and two were in rural areas. Schools were chosen based upon their location (rural versus urban). One class from each year level of a different location was chosen to be involved in the study. Written parental consent was obtained prior to the commencement of the study and the study was conducted in accordance with the Declaration of Helsinki.

Anthropometric data. The weight (kg) and height (cm) of children were taken from the students' medical certificate (No. 027–1/a). Table 1 shows the general characteristics of the present sample. There were no significant differences in body anthropometrics between boys and girls, as well as between rural and urban area children.

Postural Assessment. Evaluation of posture was taken of all pupils who attended classes on a testing day. Posture was evaluated by commonly used clinical assessment technique in the school gymnasium and efforts were made to control for

Table 1. **Characteristics of study population**

Children's characteristics	Boys (n = 116)	Girls (n = 132)	Total (n = 248)
Age ($\bar{x}$ ± SD)	9.45 ± 1.10	9.35 ± 1.05	9.40 ± 1.07
Height ($\bar{x}$ ± SD)	134.71 ± 8.62	134.69 ± 8.77	134.70 ± 8.69
Weight (kg, $\bar{x}$ ± SD)	29.81 ± 6.00	29.94 ± 6.60	29.88 ± 6.30
BMI ($\bar{x}$ ± SD)	16.28 ± 1.85	16.34 ± 2.25	16.32 ± 2.07
Urban, %	49.14	39.39	
Rural, %	50.86	60.61	

temperature, noise and distractions. In an attempt to minimize data collection error, one experienced examiner evaluated children's posture. The examiner was blind to the scope of the study and to the group of the schoolchildren belonged to.

Equipment: plumb line, posture evaluation grid.

For positioning, the child was instructed to stand comfortably barefooted in a normal standing position wearing shorts or swimming trunks between a grid (160 × 70 cm) placed on the wall, calibrated into squares (5 × 5 cm) and a plumb line suspended overhead. Facing the screen, the plumb line should pass directly up the middle of the back, and from the side, the plumb line should pass through the ear lobe and shoulder joint.

Each child had to look straight ahead without touching either grid or plumb line. Alignment of ten body segments was visually evaluated in a frontal (from the subject's back: head (1), shoulders (2), spine (3), hips (4), knees and ankles (5)) and sagittal (from the subject's left side: neck and upper back (6), trunk (7), abdomen (8), lower back (9), legs (10)) planes (12). The observer was in a 2.8 m distance from the standing subject.

Each body segment was rated on a scale from one to five with one corresponding to poor body alignment, three – fair, and five – good. A final score was obtained by summing the points given for each body segment and looking at the posture evaluation standards, where more than 45 scores mean excellent posture, between 40–44 – good, 30–39 – average, 20–29 – fair, and less or equal 19 – poor posture (Hoeger, Hoeger, 2010).

Statistical analysis. All data were expressed as a mean (SD) or percentage. Chi-square was used to determine whether there were significant differences in the posture evaluation according to the evaluation standards depending on subjects' gender and residence area. All statistical analysis was performed with Stata 9.0 (at alpha = 0.05).

RESEARCH RESULTS

Posture evaluation. There were no significant differences ($p > 0.05$) in total posture score between girls (41.80 ± 6.87) and boys (40.62 ± 7.13). Posture of our subjects can be evaluated as "good" (40–44 of total points). Girls and boys from rural area had significantly ($p < 0.05$) better posture (higher total scores of posture evaluation) than their counterparts from urban area (Figure 1). Total scores of posture evaluation in rural girls was significantly ($p < 0.05$) higher than in rural boys (Figure 1).

Posture analysis of separate body segments showed that city girls had significantly ($p < 0.05$) worse alignment of head, spine, hips, neck and upper back, trunk, abdomen and lower back than rural girls (Figure 2).

Alignment of head, spine, hips, knees and ankles, neck and upper back, trunk, abdomen and lower back in boys from rural area was evaluated by significantly ($p < 0.05$) higher scores than posture of body segments mentioned above in boys from urban area (Figure 3).

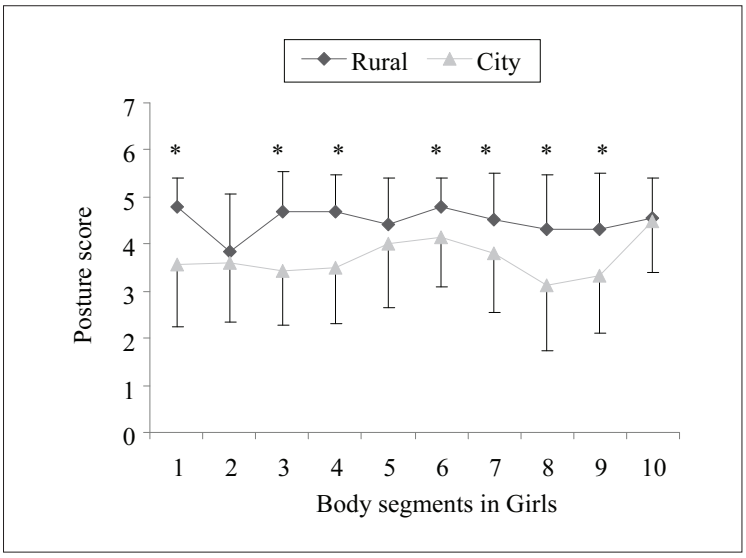
Posture analysis according to pupils' age showed that 7, 8 and 10 years old children from rural area had significantly ($p < 0.05$) higher total posture score than their contemporaries from city area. There was no significant difference in total posture score between 9 years old rural and city children (Figure 4).

The percentage of pupils from urban and rural area who had "poor", "fair", "average", "good" and "excellent" posture is presented in Table 2.

Figure 1. **Total posture score in girls and boys according to their area of residence**

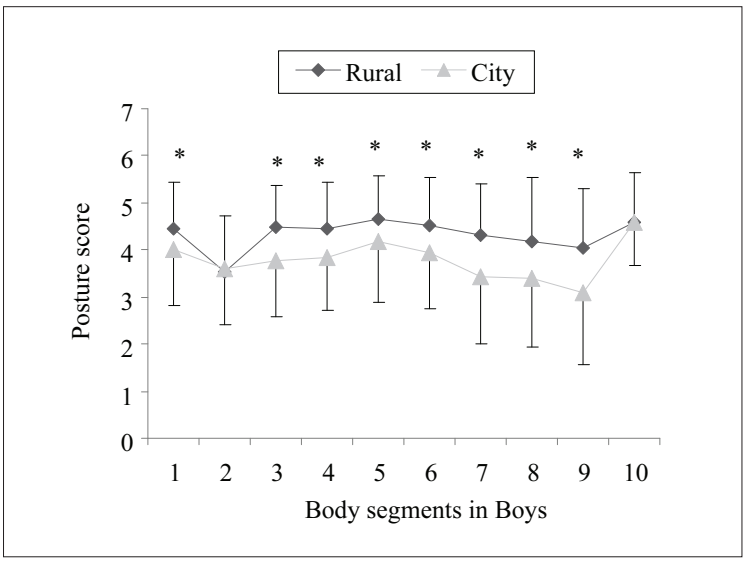
Note. * – $p < 0.05$ compared to total posture scores in rural girls and rural boys.

Figure 2. **Alignment of different body segments in rural and city girls**



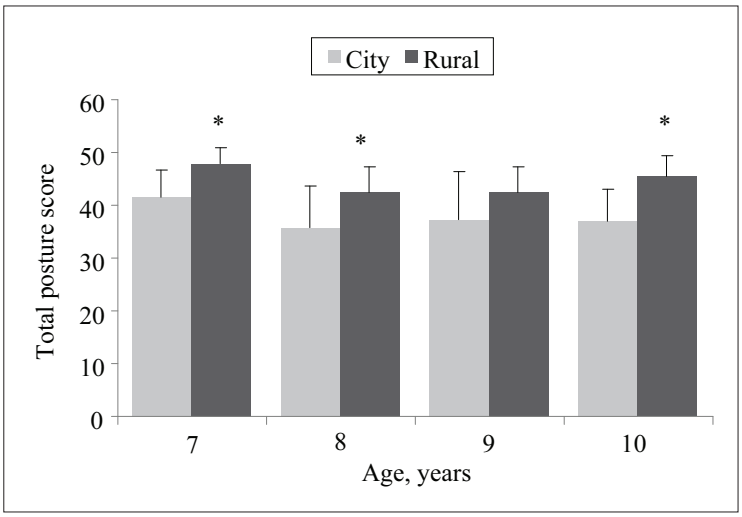
Note. * – difference between groups is significant ($p < 0.05$); 1 – head, 2 – shoulders, 3 – spine, 4 – hips, 5 – knees and ankles, 6 – neck and upper back, 7 – trunk, 8 – abdomen, 9 – lower back, 10 – legs.

Figure 3. **Alignment of different body segments in rural and city boys**



Note. * – difference between groups is significant ($p < 0.05$); 1 – head, 2 – shoulders, 3 – spine, 4 – hips, 5 – knees and ankles, 6 – neck and upper back, 7 – trunk, 8 – abdomen, 9 – lower back, 10 – legs.

Figure 4. **Total posture score in city and rural children aged 7 to 10**



Note. * – $p < 0.05$ compared to total posture scores in rural and urban schoolchildren.

Posture evaluation	Area				
	Urban		Rural		p-value
	n = 109	%	n = 139	%	
Poor	2	1.83			0.001
Fair	21	19.27	1	0.72	
Average	46	42.20	30	21.58	
Good	20	18.35	39	28.06	
Excellent	20	18.35	69	49.64	

Table 2. **Distribution of subjects' posture evaluation according to their area of residence**

DISCUSSION

The present study evaluated postures of the young population from different areas of Lithuania aged from 7 to 10 years in order to identify postural disorders. The scores of postural assessment showed that posture in girls was very similar to that in boys. It is also important to highlight that some postural disorders like "shoulders", "abdomen", and "low back" were the most prevalent in all children despite gender. A recent study by G. Krutulytė et al. (2007) led to different findings since in that study girls had better posture than boys, but the rates of disorders in separate body segments were similar in both genders. The similarities between the rates of disorders in separate body segments in both genders were also identified in our study; however, the mean scores in participants coming from urban and rural areas were different. Higher mean scores of separate body segments in children from rural area show that their posture is better compared to that of children from urban area. Besides, the posture evaluation showed that shoulder line deformities were most prevalent in children from both areas and in both genders. Our data coincide with S. Tecco et al. (2006) findings who reported that shoulder line deformities were diagnosed for most of the kids aged 8 to15.

The scores obtained from the posture evaluation of different body segments were summed up and compared with the posture evaluation standards. In this respect, it is important to note that 9.68% of children had incorrect posture, since their posture was evaluated as "poor" or "fair". With regard to gender distribution, poor posture was determined in 1.7% of boys, while fair posture was determined in 8.6% of boys and 9.1% of girls. The results of Krutulytė et al. (2007), where the same methodology was used for posture evaluation of children aged 11–12 years, showed the slightly higher percentage of children with poor and fair posture (24.4%). There were 2.5% of boys and 2.5% of girls with poor posture, while fair posture was determined in 25.6% of boys and 18.3% of girls. This might be influenced by growth spurts occurring in 9-12 years olds (Bloomfield et al., 1994), which might cause significant alterations in body shape and might have influence on muscle strength and mobility. All these factors could have influence on kids' postural development (Geldhof et al., 2007). N. Jing et al. (2003) argue that incorrect posture is developed also because of the concomitant trunk bending forward. This might be caused by the increasing weights of backpacks.

According to our findings 35.89% of children had their posture evaluated as "excellent". It has to be noted that excellent posture was more prevalent in girls (42.4%) than boys (28.45%). Posture alterations depend on age: older schoolchildren have worse posture than younger once. This is in line with findings from D. Lafond et al. (2007) and further supports the hypothesis of larger postural segmental displacement from the vertical reference in children as they grow and age.

With regard to subjects' area of residence, it was determined that children from urban area had more posture disorders than children from rural area. Poor posture was determined in 1.83% and fair posture was determined in 19.27% of children from urban area. In contrast to these results, poor posture was not detected in the group of

children from rural area at all and fair posture was determined only in one student, comprising 0.72%.

The results of our study demonstrate that rural schoolchildren have better posture than their counterparts from urban area. This could be explained by findings from R. R. Joens-Matre et al. (2008) and J. Dolman et al. (2012) that rural children are more physically active than city children.

CONCLUSION AND PERSPECTIVES

There were no significant differences in total posture scores between girls and boys. Regardless of age and gender, schoolchildren from rural area had better posture than children from urban area.

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MIESTE IR KAIME GYVENANČIŲ 7–10 METŲ VAIKŲ LAIKYSENOS SKIRTUMŲ PRIKLAUSOMUMAS NUO AMŽIAUS IR LYTIES

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Vaikų laikysenos sutrikimai yra viena svarbiausių sveikatos problemų Lietuvoje. Daugiausia pokyčių, galinčių sutrikdyti vaikų sveikatą, atsiranda jiems pradėjus lankyti mokyklą. Dienotvarkės pokyčiai dažnai yra kenksmingi ir gali sukelti sveikatos pablogėjimą. Laikysenos sutrikimus reikia koreguoti kaip galima anksčiau, kol jie netampa nuolatiniais. Kai kurių autorių teigimu, kaimo vietovėse gyvenantys vaikai yra fiziškai aktyvesni nei jų bendraamžiai, gyvenantys mieste, todėl įdomu, ar skiriasi mieste ir kaime gyvenančių moksleivių laikysena.

Tikslas – įvertinti ir palyginti mieste ir kaime gyvenančių 7–10 metų vaikų laikyseną.

Metodai. Įvertinta 248 (109 – miesto; 139 – kaimo) jaunesniojo mokyklinio amžiaus vaikų laikysena. Pagal W. K. Hoeger vizualinio laikysenos vertinimo metodiką vertinta 10 kūno segmentų frontalioje (galvos, pečių lanko, stuburo, dubens, kelių ir čiurnos) ir sagitalioje (kaklo ir viršutinės stuburo dalies, liemens, pilvo, apatinės stuburo dalies, kojos) plokštumoje.

Rezultatai. Mergaičių (41,80 ± 6,87) ir berniukų (40,62 ± 7,13) laikysenos suminis balas nesiskyrė ($p > 0,05$). Kaimo vietovėje gyvenančių berniukų ir mergaičių laikysena buvo įvertinta reikšmingai ($p < 0,05$) aukštesniais balais nei jų bendraamžių, gyvenančių mieste.

Aptarimas ir išvados. Reikšmingų skirtumų tarp bendros mergaičių ir berniukų laikysenos nenustatyta. Kaimo vietovėje gyvenančių vaikų laikysena buvo geresnė nei miesto vaikų nepriklausomai nuo amžiaus ir lyties.

Raktažodžiai: kūno segmentai, gyvenamoji vieta, vaikų laikysena.

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EXPRESSION OF CAREER SELF-EFFICACY OF STUDENTS ENROLLED IN UNIVERSITY PHYSICAL EDUCATION AND SPORTS STUDY PROGRAMMES

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ABSTRACT

Research background and hypothesis. An assumption that the fourth-year students of university physical education and sports study programmes have greater career self-efficacy than the first-year students is made in the article.

Research aim was to reveal peculiarities of the expression of the career self-efficacy of the students enrolled in university physical education and sports study programmes.

Research methods. The random sample size consisted of 278 first and fourth-year full time students of physical education and sports study programmes from Lithuanian Sports University and Šiauliai University. Two methods were used to carry out the survey: *Career Self-Efficacy Sources Scale* (CSESS) and *Career Decision-Making Self-Efficacy Scale-Short Form* (CDMSE-SF).

Research results. The research showed that there was a statistically significant difference ($t(276) = -1.96$; $p < 0.05$) between the first and fourth-year students of university physical education and sports study programmes in respect of the level of career self-efficacy. The fourth-year students were able to make a better use of occupational information (4.08 ± 0.54) than the first-year students (3.95 ± 0.56). It was determined that indicators of goal selection and career planning were higher ($p < 0.05$) in the case of the fourth-year students than in the case of the first-year students.

Discussion and conclusions. It was determined that, in comparison with the first-year students, the career self-efficacy of the fourth-year students of university physical education and sports study programmes was more based ($p < 0.05$) on the following sources: vicarious experience, verbal persuasion and performance accomplishments. Comparison of the levels of career self-efficacy of the first and fourth-year students of university physical education and sports study programmes revealed that the fourth-year students had greater career self-efficacy ($p < 0.05$) and that indicators of the components of their career self-efficacy – occupational information, goal selection and career planning were higher ($p < 0.05$) than those of the first-year students.

Keywords: career education, self-efficacy, career self-efficacy, university studies, physical education and sports.

INTRODUCTION

In the context of today's globalization and modernization of the society, the situation in the national and regional labour market is changing, skills required to prepare for competition, continuous training and retraining are becoming more relevant. Therefore, education institutions must assume responsibility not only for the general education and training of skilled specialists but also for establishing conditions for acquiring expertise required for career development – systematic and focused career education. At the moment young people in Lithuania with extremely popular university education do not meet the specific professional competence requirements set by employers as a result of too academic and theoretical training. Moreover, there is still a gap to business. In the past career planning was limited only to a situation of choosing a certain profession,

whereas recently the need for continuous career education during the whole life has increased (Stanišauskienė, Večkienė, 1999; Rosinaitė, 2008).

The dynamics of social development and new social-educational conditions require changes in the role of the senior students of physical education and sports study programmes. Sports and sporting activities as a certain feature of a healthy lifestyle here acquire a particular form of expression that generalizes the experience of young people, shapes forms of their thinking and behaviour and defines their future objectives and orientations (Bobrova, 2009). Sports universities begin to carry out a new function – to help students to understand themselves and to strengthen the students' career self-efficacy.

A career is usually defined as a sequence of various socially significant roles of a person which is related to self-expression and individual professional improvement and which reflects a life vision and style of the person (Kučinskienė, 2003; Laužackas, 2005). Self-efficacy is understood as a person's belief in his/her abilities to effectively direct his/her actions to achieve the goals set. Self-efficacy is an individual's expectations or beliefs about how successfully he/she can perform a certain task. In this sense self-efficacy can be considered as a prerequisite for productive and effective activities of an individual (Bandura, 1997). Career self-efficacy plays an important role when analysing career objectives of young people and peculiarities of choosing a career (Bandura et al., 2001; Gianakos, 2001; Turner, Lapan, 2002; Wang et al., 2010). Strengthening career self-efficacy is extremely important for the students of university physical education and sports study programmes as many students who actively go in for sports divide their everyday life into two social environments: academic activities and active training and sports competitions (Bobrova, 2008). This can be called a situation of double socialization (Dencik, 2005). It is a difficult task to perform in two contexts – academic studies and sports – because this means a continuous adjustment to each context separately by combining them at the same time, i. e. a student's alternative activity in two fields (even in three in the case of working students) must become an integral academic activity. The ability to perform in two-three social contexts in parallel is the essential requirement for a student who goes in for sports. This model of double socialization forces students to choose landmarks and values for their future career in a very rational way (Bobrova, 2008). Thus, a high level of career self-efficacy is extremely important for the students of university physical education and sports study programmes.

The career self-efficacy indicator helps to determine how an individual will behave in different situations when planning his/her career. High self-efficacy helps to overcome doubts, various troubles and conflicts more easily in difficult situations. Career self-efficacy is one's self-confidence when performing actions related to choosing one's further career (Anderson, Betz, 2001). It is important to analyse career self-efficacy because the analysis of problems related to self-efficacy has shown that this construct can predict professional interests and career objectives and is related to the perceived career opportunities. In addition, it has been determined that career self-efficacy is related to many psychosocial variables, e. g. self-respect, anxiety, inner control focus (Muris, 2002).

A. Bandura (1993) defined four major self-efficacy sources (i. e. performance accomplishments, vicarious experience, verbal persuasion, emotional state). It was determined that self-efficacy could be changed successfully by manipulating the sources of efficiency-related information and performing tasks (McAulley et al., 2001; Malinauskas, Brusokas, 2010; Wang et al., 2010). However, we did not manage to find any papers where the components and sources of career self-efficacy were analysed in a complex manner. Therefore, the question what sources and components of career self-efficacy are typical of the students of university physical education and sports study programmes remains unanswered. The aim of this research was to find out which one of the four self-efficacy sources was emphasized the most by the students of university physical education and sports study programmes. This research is important as it can help understand what motivates the students of university physical education and sports study programmes to look for better career opportunities.

Low career self-efficacy can be based on poor abilities or a lack of personal experience. Awareness of the lack of abilities usually leads to low career self-efficacy which reduces one's willingness to pursue a career (Betz, Hackett, 1981). On the other hand, those who have high career self-efficacy usually have great career ambitions (Bandura, 1993). Persons with high career self-efficacy tend to set more ambitious career goals and objectives

and to commit to them stronger (Bandura, 1993, 1997).

A level of career self-efficacy can be changed as low career self-efficacy can be increased and high one can be strengthened even more. Furthermore, career self-efficacy is necessary in order to perform successfully and this can affect a person's behaviour irrespectively of the person's knowledge and skills (Bandura, 1993; Chung, 2002). This research is based on a belief that a person with high career self-efficacy will tend to look for such further life's road where he/she could pursue a career. The relevance of the research raises no doubts as there is still a lack of scientific papers on this topic, especially taking into consideration the fact that we failed to find any complex researches into career self-efficacy of students enrolled in university physical education and sports study programmes.

Scientific novelty and originality. This research is new in the sense that, in the absence of detailed researches into career self-efficacy of students of university physical education and sports study programmes, this paper analyses it in a complex manner by including the sources and components of career self-efficacy into the analysis. **The problem question of the research is:** what are the current characteristics of the expression of career self-efficacy of the first and fourth-year students of university physical education and sports study programmes? The problem question enabled the raising following **hypothesis** of this research: the fourth-year students of university physical education and sports study programmes have greater career self-efficacy than the first-year students.

Research object – the career self-efficacy of the students enrolled in physical education and sports study programmes.

Research aim was to reveal peculiarities of the expression of the career self-efficacy of the students enrolled in university physical education and sports study programmes.

Research objectives:

1. To reveal the sources of career self-efficacy of the first and fourth-year students of university physical education and sports study programmes.

2. To assess the level of the components of career self-efficacy of the first and fourth-year students of university physical education and sports study programmes.

RESEARCH METHODS

Instruments: data collection and analysis. *Career Self-Efficacy Sources Scale* (CSESS; Anderson, Betz, 2001) was used to assess the sources of career self-efficacy (i.e. performance accomplishments, vicarious experience, positive emotional arousal and negative emotional state). The method consists of 20 statements. Each statement is scored from 1 to 5. A respondent must choose one the most suitable variants (very often – 5, often – 4, sometimes – 3, very seldom – 2, never – 1). The scale consists of five sub-scales (4 statements each): performance accomplishments, vicarious experience, verbal persuasion, positive emotional state, negative emotional state. When analysing the data, the average score of each sub-scale which means the indicator of the source of career self-efficacy was calculated. Internal consistency of the method was calculated according to Cronbach's alfa coefficient (0.76) and internal consistency of each sub-scale was also tested. Cronbach's alfa coefficients varied from 0.69 to 0.84.

Career Decision-Making Self-Efficacy Scale-Short Form consists of 25 statements (CDMSE-SF; Betz et al., 1996). This scale shows peculiarities of a person's self-confidence in performing actions related to choosing his/her further career. The method helps to reveal the following components of career self-efficacy: self-appraisal, occupational information, goal selection, planning and problems solving. Each statement is scored on the Likert-type scale from 1 to 5. A respondent must choose one the most suitable variant (no confidence at all – 1, very little confidence – 2, moderate confidence – 3, much confidence – 4, complete confidence – 5). Internal consistency of the questionnaire was calculated according to Cronbach's alfa coefficient (0.64). When analysing the data, the average score collected by each respondent meaning the indicator of career self-efficacy level was calculated. Distribution of the indicator values corresponded to the normal distribution.

Methods of statistical analysis. Internal consistency of the questionnaires used in the research was evaluated according to Cronbach's alfa criterion. Student's t-criterion was used to test statistical hypotheses because the data were distributed according to the normal distribution.

Sample and procedure. Two-stage random selection was used to draw the sample of respondents: first of all, two universities that had

accredited physical education and sports study programmes were selected from a list of Lithuanian universities on the basis of random number tables. The first and fourth-year full time students of the selected Lithuanian Sports University and Šiauliai University were surveyed. The survey took place in 2012 after agreeing upon with lecturers and obtaining a verbal consent of the respondents. The random sample size consisted of 278 full time students of physical education and sports study programmes as full time studies provide a more solid basis and direction for a student's career designing mechanisms.

When the population size is known, the following formula is used to determine the sample size (Schwarze, 1993):

$$n = \frac{N \cdot 1.96^2 \cdot p \cdot q}{\varepsilon^2 \cdot (N-1) + 1{,}96^2 \cdot p \cdot q},$$

where N – the population size; the value 1.96 corresponds to 95% confidence level of the standard normal distribution; p is the predicted result probability that the analysed attribute will be evident in the surveyed population (usually, the worst scenario probability – the attribute is typical of the half of the population, i. e. 50% – is taken and then p = 0.5); q is the probability that the analysed attribute will not be evident in the surveyed population (q = 1 – p = 0.5); ε is the required accuracy, usually ε = 0.05. Whereas the population size of the students enrolled in physical education and sports study programmes is approximately n = 1,000 persons, hence, the sample size calculated according to this formula is n = 278. Therefore, it can be stated that the sample of 278 respondents is a representative one.

RESEARCH RESULTS

After the sources of career self-efficacy of the first and fourth-year students of university physical education and sports study programmes were analysed and the average scores of the indicators were calculated, it was determined that the fourth-year students were able to make a better use of vicarious experience (3.31 ± 0.68), whereas the first-year students' vicarious experience*, which is gained by observing successful performance of other people (so-called modelling) was poorer* (3.16 ± 0.59). This was also confirmed by the statistically reliable difference received (t (276) = –1.99; p < 0.05) (Table 1).

Application of Student's *t*-test revealed that, in comparison with the first-year students, career self-efficacy of the fourth-year students of university physical education and sports study programmes was more based (p < 0.05) on the other following sources: verbal persuasion and performance accomplishments. No statistically reliable difference was found between the career self-efficacy of the first and fourth-year students of university physical culture and sports study programmes in respect of positive and negative emotional arousal (p > 0.05).

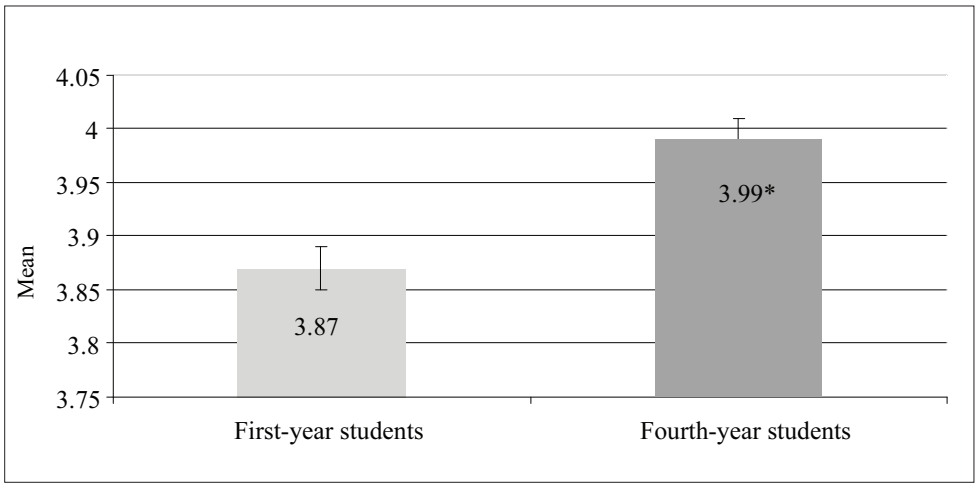
The analysis of the survey data revealed that there were no students with low self-efficacy level (from 1 to 2.9 scores) among the fourth-year students of university physical education and sports study programmes. The average career self-efficacy of the first-year students was 3.87 ± 0.49 scores, whereas the average career self-efficacy of the fourth-year students was 3.99 ± 0.53 scores (Figure).

Table 1. **Statistical indicators of the career self-efficacy sources of respondents (M ± SD)**

Sources of career self-efficacy	First-year students (n = 142)	Fourth-year students (n = 136)	t, p
Vicarious experience	3.16 ± 0.59	3.31 ± 0.68	–1.96 p < 0.05
Verbal persuasion	3.11 ± 0.69	3.28 ± 0.73	–1.99 p < 0.05
Positive emotional arousal	3.26 ± 0.77	3.29 ± 0.75	–0.35 p > 0.05
Negative emotional arousal	2.69 ± 0.82	2.74 ± 0.86	–0.50 p > 0.05
Performance accomplishments	3.69 ± 0.59	3.84 ± 0.61	–2.08 p < 0.05

Note. M = mean; SD = standard deviation.

Figure. **Mean scores of the level of career self-efficacy among the first and fourth-year students**



Note. * – $p < 0.05$.

The research showed that there was a statistically reliable difference ($t(276) = –1.96$; $p < 0.05$) between the levels of career self-efficacy of the first and fourth-year students of university physical education and sports study programmes.

After the components of career self-efficacy of the first and fourth-year students of university physical education and sports study programmes were analysed and the average scores of the indicators were calculated, it was determined that the fourth-year students were able to make a better use of occupational information (4.08 ± 0.54) than the first year students (3.95 ± 0.56). This was also confirmed by a statistically significant difference received ($t(276) = –1.97$; $p < 0.05$) (Table 2).

Application of Student's *t*-test revealed that the indicators of goal selection and career planning were higher ($p < 0.05$) in the case of the fourth-year students of university physical education and sports study programmes that in the case of the first-year students.

DISCUSSION

The hypothesis was confirmed: the fourth-year students of university physical education and sports study programmes had greater career self-efficacy than the first-year students. The results of this research correspond to the data of other researchers confirming that career self-efficacy differs among different study year students (Luzzo, 1993; Creed et al., 2002; Bubany, 2008): senior students have greater career self-efficacy. Just like in the case of other researchers (Işık, 2010), a conclusion is made that the indicators of the components of career self-efficacy – occupational information, goal selection and career planning – are higher ($p < 0.05$) in the case of the final-year students than in the case of the first-year students because the former have wider experience and greater expertise. This proves the significance of the data we obtained.

This paper has shown that research into career self-efficacy is a complex process. However, the

Table 2. **Statistical indicators of the components of career self-efficacy of respondents (M ± SD)**

Components of career self-efficacy	First-year students (n = 142)	Fourth-year students (n = 136)	t, p
Self-appraisal	3.98 ± 0.62	3.91 ± 0.67	0.90 $p > 0.05$
Occupational information	3.95 ± 0.56	4.08 ± 0.54	–1.97 $p < 0.05$
Goal selection	3.92 ± 0.51	4.05 ± 0.59	–1.96 $p < 0.05$
Planning	3.86 ± 0.53	3.99 ± 0.57	–1.97 $p < 0.05$
Problem solving	3.57 ± 0.66	3.61 ± 0.71	–0.48 $p > 0.05$

Note. M = mean; SD = standard deviation.

information gathered can help to understand to which sources and components of career self-efficacy the attention should be paid so that the students could be more successful in achieving their career goals. We believe that only complex research that analyses many sources and components of career self-efficacy has practical benefits because conclusions of such research can help choose the most suitable career education models (Jepsen, Dickson, 2003; Taveira, Moreno 2003; Bubany, 2008). We agree with D. Blustein's position (1997) that research into career self-efficacy of students is the most relevant as the respondents of namely this age group make decisions that determine their further career. On the other hand, when the respondents are persons pursuing double career (in our case it is academic and sports career), the experience of such persons enriches research in career education even more.

It can be stated that this research revealed a reliable correlation between the ability to make use of the sources of career self-efficacy demonstrated by the students of university physical education and sports study programmes and career self-efficacy in the youth period. This does not contradict to the data of similar research conducted by other researchers (Foltz, Luzzo, 1998; Dawes et al., 2000). Although other researchers did not study the students engaged in sports activities, the results of their researches are similar to the results of this research. M. Dawes et al. (2000) and P. Creed et al. (2006) found out that low career self-efficacy could limit career development. B. Foltz and D. Luzzo (1998), M. Thompson and L. Subich (2006) revealed that career self-efficacy could determine a person's behaviour when pursuing a career.To sum up, it can be stated that many variables are analysed during research in career self-efficacy, thus, we believe that such research could include not only the sources of career self-efficacy, level of career self-efficacy and components of career self-efficacy but also search for career opportunities. We believe that it would be useful to continue research in this field and to analyse characteristics of career self-efficacy of students not only of different age but also of different sex who are enrolled in physical education and sports study programmes.

CONCLUSIONS AND PERSPECTIVES

1. It was determined that, in comparison with the first-year students, career self-efficacy of the fourth-year students of university physical education and sports study programmes was more based ($p < 0.05$) on the following sources: vicarious experience, verbal persuasion and performance accomplishments.

2. The comparison of the levels of career self-efficacy of the first and fourth-year students of university physical education and sports study programmes revealed that the fourth-year students had higher career self-efficacy ($p < 0.05$) and higher scores ($p < 0.05$) of the components of career self-efficacy – gathering occupational information, selecting career goals and career planning – in comparison with the first-year students.

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UNIVERSITETINIŲ KŪNO KULTŪROS IR SPORTO STUDIJŲ PROGRAMŲ STUDENTŲ KARJEROS SAVAVEIKSMIŠKUMO RAIŠKA

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Straipsnyje kelta prielaida, kad universitetinių kūno kultūros ir sporto studijų programų ketvirto kurso studentams būdingas didesnis karjeros savaveiksmiškumas nei pirmo kurso studentams.

Tikslas – atskleisti universitetinių kūno kultūros ir sporto studijų programų studentų karjeros savaveiksmiškumo raiškos ypatumus.

Metodai. Atsitiktinės imties tūrį sudarė 278 kūno kultūros ir sporto studijų programų nuolatinių (dieninių) studijų pirmo ir ketvirto kurso studentai iš Lietuvos sporto universiteto bei Šiaulių universiteto. Apklausos metu pasitelktos dvi metodikos: *Karjeros savaveiksmiškumo šaltinių skalė* (CSESS) ir *Karjeros savaveiksmiškumo komponentų tyrimo skalė* (CDMSE-SF).

Rezultatai. Tyrimas parodė, kad tarp universitetinių kūno kultūros ir sporto studijų programų pirmo bei ketvirto kurso studentų pagal karjeros savaveiksmiškumo lygį yra statistiškai patikimas skirtumas ($t(276) = -1,96$; $p < 0,05$). Ketvirto kurso studentai geba geriau pasinaudoti profesine informacija ($4,08 \pm 0,54$) nei pirmo kurso studentai ($3,95 \pm 0,56$). Ketvirto kurso studentų karjeros tikslų užsibrėžimo ir karjeros planavimo rodikliai yra aukštesni ($p < 0,05$) nei pirmo kurso studentų.

Aptarimas ir išvados. Nustatyta, kad universitetinių kūno kultūros ir sporto studijų programų ketvirto kurso studentų karjeros savaveiksmiškumas yra labiau ($p < 0,05$) grindžiamas netiesiogine patirtimi, aplinkinių įtikinėjimu ir asmeniniais laimėjimais nei pirmo kurso studentų. Palyginus universitetinių kūno kultūros ir sporto studijų programų pirmo ir ketvirto kurso studentų karjeros savaveiksmiškumo lygį paaiškėjo, kad ketvirto kurso studentai turi daugiau karjeros savaveiksmiškumo savybių ($p < 0,05$), jų karjeros savaveiksmiškumo komponentų – profesinės informacijos, karjeros tikslų užsibrėžimo ir karjeros planavimo – rodikliai yra aukštesni ($p < 0,05$) nei pirmo kurso studentų.

Raktažodžiai: ugdymas karjerai, savaveiksmiškumas, karjeros savaveiksmiškumas, universitetinės studijos, kūno kultūra ir sportas.

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EFFECT OF TWO DIFFERENT METHODS REDUCING BODY MASS (RAPID AND MEDIUM RAPID) ON PROFESSIONAL WRESTLERS' CHANGES IN BODY COMPOSITION AND FORCE

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ABSTRACT

Research background and hypothesis. Wrestlers often want to reduce body mass during a short period of time. According to literature, it is important not to change body composition when reducing body mass. It has been intended to examine muscle force changes when reducing body mass rapidly and averagely rapidly.

Research aim was to estimate the effect of methods reducing body mass (rapid, averagely rapid) on wrestlers' changes in body mass components and force.

Research methods. Groups of research participants: one – wrestlers who did not reduce body mass (n = 47), two – wrestlers who reduced body mass rapidly (n = 16), three – wrestlers who reduced body mass averagely rapidly (n = 9). Muscle force (dynamometer MMT) and mass components (bio-impedance method Tanita 300) were estimated before and after reducing body mass.

Research results. Before reducing body mass (rapidly, averagely rapidly) wrestlers' body mass was greater ($p < 0.05$) than after reducing it. Wrestlers lost 4.5% of body mass when reducing it rapidly (24–72 hours), when averagely rapidly (72 hours – 2 weeks) – 4.03%. After reducing body mass fat free body mass decreased tendentiously. Using rapid method, wrestlers' force of both legs diminished ($p < 0.05$), when using averagely rapid method, force of left leg diminished ($p < 0.05$). Force of arms decreased ($p < 0.05$) after reducing body mass by both methods.

Discussion and conclusions. Subjects used aggressive method of reducing body mass. They need appropriate training about athlete nutrition, optimal reduced body mass. Tendentious decrease in free body mass shows decrease in muscle force.

Force in arms and legs significantly decreased for wrestlers using rapid and averagely rapid methods for reducing body mass.

Keywords: reducing body mass, mass components, change in force, judo.

INTRODUCTION

Fine physical qualification and good functional fitness are important in every type of sport. Wrestlers start reducing body mass before competitions in order to get into appropriate weight category disregarding techniques of reducing body mass and their influence on health. It is very important to avoid dehydration when reducing body mass. K. Vodopalas and others (2008) state that the reason why physical efficiency of muscles decreases is loss of liquids – dehydration. Due to dehydration the state of heart and blood vessels declines. Frequently, when reducing body mass and not drinking enough liquids (which is important during intense training), body mass falls due to liquids loss and decrease in muscles force. Dehydration of about 3–4 per cent of body mass

definitely reduces muscle endurance during high intensity exercise because muscle strength usually becomes smaller (Lambert, Jones, 2010).

R. Kordi and co-authors (2012) state that during rapid method of reducing body mass athletes lose liquids that can cause loss of glycogen. More than a half of wrestlers who participated in the research started reducing body mass for 3 days or less, the average was 4.0 ± 2.1 days. Gradually reducing body mass (several weeks or months) it decreases due to fat loss (Kordi et al., 2012).

According to American Dietetic Association and co-authors (2009) proper food and liquids should be used before, during and after physical activity to help keeping blood glucose concentration levels during physical activity (*American Dietetic Association*, 2009). If optimal method of reducing body mass is chosen, the energy should be used from the fatty tissue. Scientists states that choosing the proper diet is more important than reducing body mass rapidly in order to lose less force until competition (Lambert, Jones, 2010). During dehydration, when 1–2% of body mass decrease due to loss of liquids, the body temperature increases. After 3–5% decrease of body mass, the body temperature increases more, physical aerobic and anaerobic efficiency and strength decrease, after 6% decrease of body mass muscle spasms and cramps start. After 10% or more decrease of body mass, the body temperature increases more and can harmfully affect heart and blood vessels, the risk of heat stroke increases and can cause death (Baranauskas, 2010).

Usually wrestlers reduce body mass rapidly (during 24–72 hours) and averagely rapidly (from 72 hours until 2 weeks) and expect good results during competitions without losing force. Consequently, the objective of this paper was to estimate the influence of rapid and averagely rapid methods of reducing body mass on wrestlers' force.

The aim of research was to estimate the effect of two different methods (rapid and averagely rapid) on professional wrestlers' changes in body composition and force.

RESEARCH METHODS

There were three groups distinguished: the first group (control group) – wrestlers who did not reduce body mass n = 47, the second group – wrestlers who reduced body mass rapidly (from 24 to 72 hours) n = 16, the third group – wrestlers who reduced body mass averagely rapidly (from 72 hours to 2 weeks) n = 9.

The testing of wrestlers were accomplished before training and 24 hours after the last training without consuming liquids 4 hours before testing. The first testing was accomplished during the cycle of training when wrestlers did not reduce body mass. All three groups were tested. The second testing was carried out on the last day before competition where all three groups were tested as well.

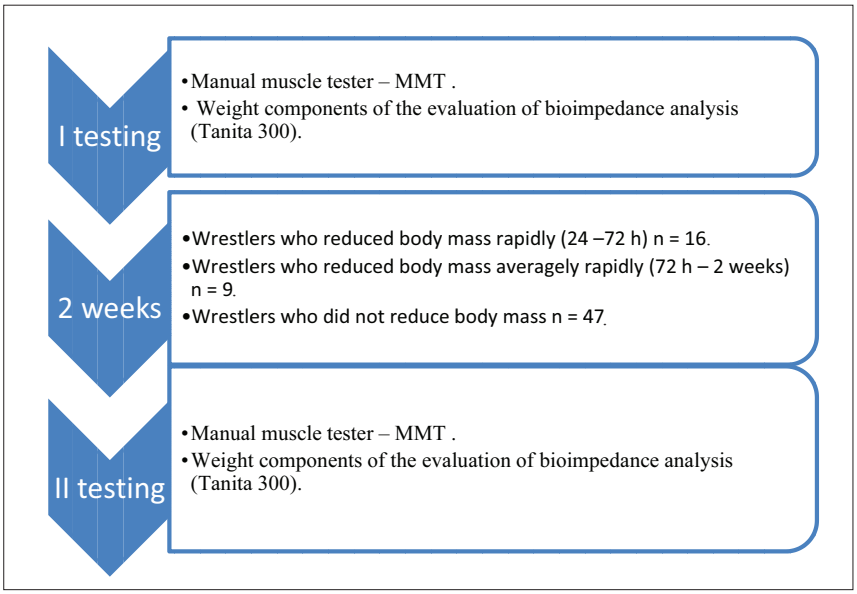
Body mass components were estimated by bioelectrical impedance analysis method using body composition analyzer TBF-300'(TANITA). Subject stood on special scales with electrodes. During the analysis low-level (50 Hz) constant electric current was passed through subject's body and special device measured impedance. The accuracy and reliability of the method is similar to skinfold analysis (Ostojic, 2006; Žumbakytė, 2006). The indicators used were: body mass index (BMI, kg/m^2), body mass (kg), body fat mass (%), fat free body mass (kg), body water mass (kg).

Muscle force testing was accomplished using Nicholas Manual Muscle Tester. Dynamometer measured force with 0.1 kg accuracy in 0.9–199.9 kg range (Sisto, Dyson-Hudson, 2007). The maximum force of hip flexion and shoulder

Table. **Characteristics of groups**

Group	Sample	Age, years	Height, cm	Body mass, kg	Body mass index, kg/m^2
Wrestlers who reduced body mass rapidly	16	20.25 ± 1.22	179.38 ± 1.27	80.53 ± 2.74	24.79 ± 0.63
Wrestlers who reduced body mass averagely rapidly	9	21 ± 0.84	180.78 ± 3.37	76.78 ± 2.95	23.2 ± 0.54
Wrestlers who did not reduce body mass	47	20.79 ± 0.6	180.68 ± 1.02	79.89 ± 2.41	24.37 ± 0.6

Figure 1. **The course of investigations**



abduction was measured. The test was carried out so that not more than two joints would be used to perform a movement. The primary position of the subject was sitting on a couch with shoulder abduction of 90 degrees, straight back and legs not reaching the ground. The tester countervailed in the distal forearm zone.

When testing hip flexion, subject also sat on a couch, with a straight back and legs not reaching the ground, the leg bent to 90 degrees. The tester countervailed by putting dynamometer in the distal zone of hip. If athlete used compensatory muscles during the testing movement, the testing was stopped and repeated from the beginning. There were three tests with breaks among them. The average of those three results was calculated (Sisto, Dyson-Hudson, 2007).

Mathematical statistics. SPSS software package was used for data analysis. For comparison of independent samples (for groups which did not reduce body mass and reduced body mass using rapid and averagely rapid methods), non-parametric Mann-Whitney-Wilcoxon test was used. For comparison of dependable sample (for the first and second test results), non-parametric Wilcoxon test was applied. Differences were considered statistically significant when $p < 0.05$ was set. The results are represented as arithmetic mean ± the standard error of the mean (SEM).

RESEARCH RESULTS

Before reducing body mass by rapid and averagely rapid methods, wrestlers' body mass was statistically significantly greater ($p < 0.05$) than after reducing body mass. The body mass of wrestlers who did not reduce body mass did not change (Figure 2).

Wrestlers who reduced body mass rapidly had higher percentage of fat mass after reducing body mass but it was not statistically significant ($p > 0.05$) (before – 9.44%, after – 10.48%). Before reducing body mass the percentage of body fat mass for averagely rapid method group and for those who did not reduce body mass did not change.

Changes of fat free body mass are represented in Figure 3. Fat free body mass changed insignificantly after reducing body mass rapidly and averagely rapidly ($p > 0.05$). For wrestlers who did not reduce body mass, fat free body mass did not change.

The force of the left and right legs before reducing body mass in the group of wrestlers who reduced body mass rapidly was statistically signifantly ($p < 0.05$) greater than after reducing body mass. For wrestlers who reduced body mass using averagely rapid method the force of the left leg was statistically significantly lower ($p < 0.05$). The force of the right leg had a tendency to get lower ($p > 0.05$) after reducing body mass. The force remained the same for those who did not reduce body mass ($p > 0.05$). The force of both legs was statistically significantly greater ~~of~~ for wrestlers who reduced body mass rapidly than for those who did not reduce body mass ($p < 0.05$). After reducing body mass the force was not statistically significantly different. Change in force is represented in the Figure 4.

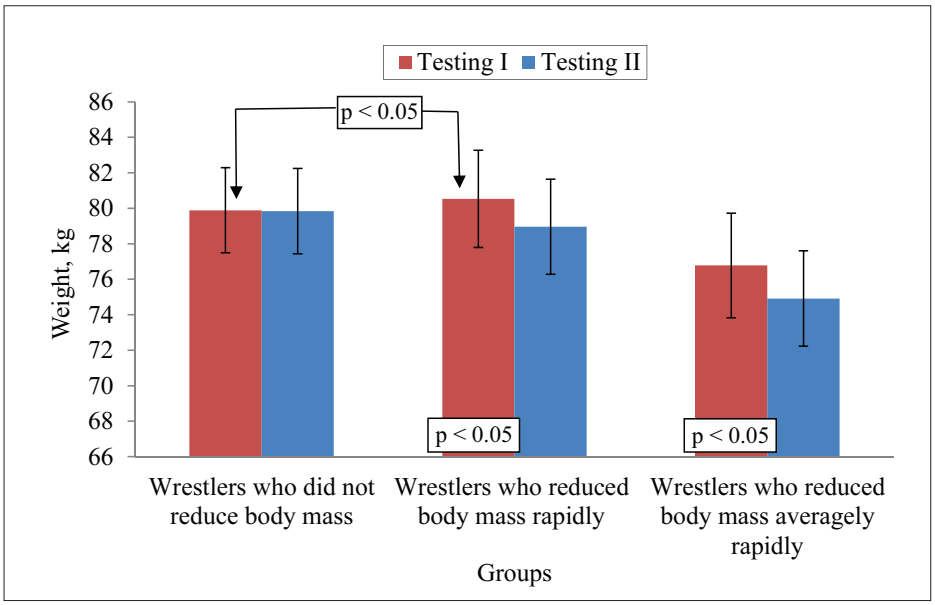


Figure 2. **Wrestlers' body mass changes**

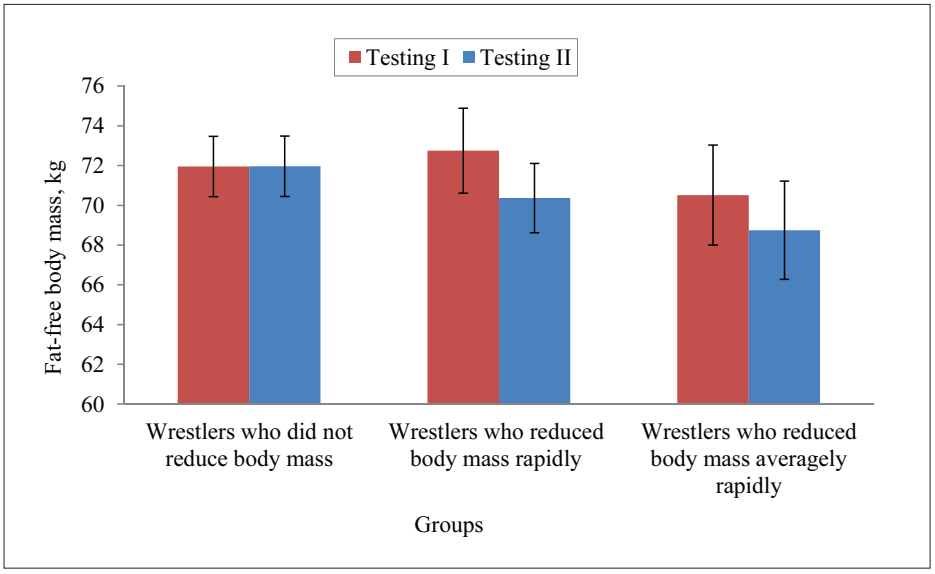


Figure 3. **Wrestlers' fat-free body mass changes**

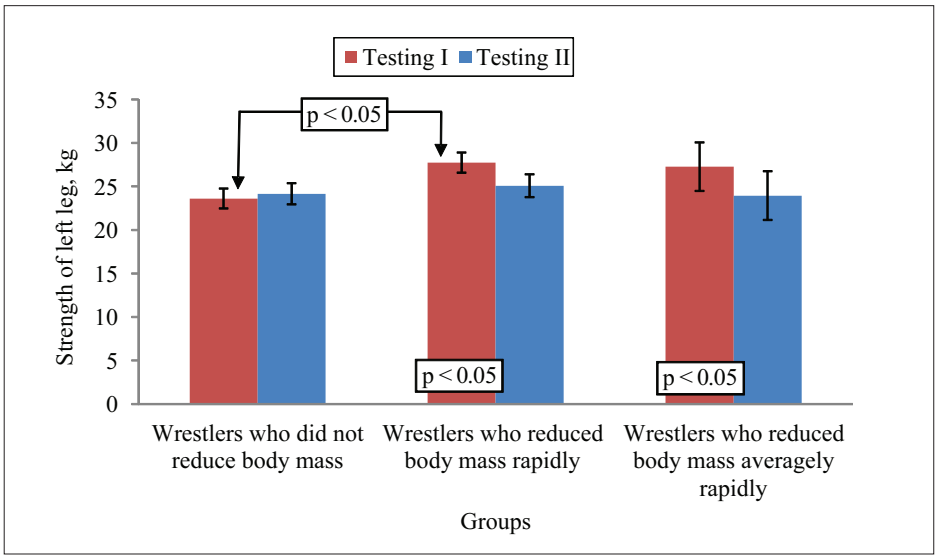
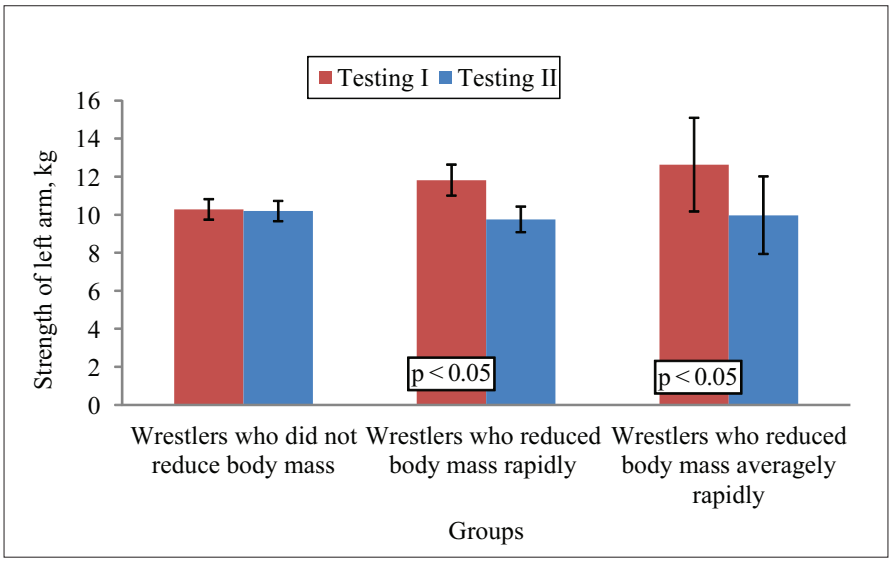


Figure 4. **Wrestlers' left leg changes**

Figure 5. **Wrestlers' left arm force changes**



Force in the right and left arms for wrestlers who did not reduced body mass did not change ($p > 0.05$). Force in both legs became statistically significantly ($p < 0.05$) lower for those wrestlers who reduced body mass rapidly. After reducing body mass for wrestlers who reduced body mass averagely rapidly force in both hands became statistically significantly lower ($p < 0.05$). Change in hand force can be observed in the Figure 5.

DISCUSSION

In the pre-competition period wrestlers usually start reducing body mass in order to get into appropriate weight category. Aiming at winning is not always related to athlete's health and wellbeing. Athletes not always can find the best method for reducing body mass independently. In their research R. B. Kiningham and D. V. Gorenflo (2001) show that 2% of wrestlers out of 2532 used diuretics, vomiting, diet pills and laxative medications. We also noticed a trend that athletes used to overeat after reducing body mass.

Judo wrestlers often lose a lot of mass which is connected with deep dehydration (Matias et al., 2010). Stopping eating and dehydration are some of the most popular methods of reducing body mass among wrestlers (Kiningham, Gorenflo, 2001).

Often wrestlers use rapid body mass reduction method. According to I. Garthe, fat free body mass increased more during slow method than rapid method, but fat mass (%) and body water mass remained the same (Garthe et al., 2011). It shows that athletes reduced body mass getting less energy needed from nutrients. Our research shows that in averagely rapid method, fat free body mass had the tendency to get lower and body fat mass did not change. During the rapid method fat free body mass had the tendency to get lower, but body fat mass had the tendency to grow. It is possible that it was caused by inappropriate nutrition before reducing body mass.

A lot of athletes decrease their body mass by 5–10% in a week in the pre-competition period. Aggressive methods of reducing body mass are popular among athletes who participate in high level competitions. G. Artioli and co-authors (2010) state that an athlete should not lose more than 1.5% body mass. M. Baranauskas (2010) states that 37% of duelists lose from 4.6% to 6% body mass during 24–72 hours and do it insecurely. Therefore all the athletes who want to reduce their body mass and to keep their health and physical efficiency rates have to set their outlines (plans) for reducing body mass, to consult nutrition specialists and to reduce body mass slowly, i. e. in two weeks or more.

During our research wrestlers lost 4.5% body mass reducing body mass by a rapid method (24–72 hours), and averagely rapid method (from 72 hours to 2 weeks) lost 4.03%. It shows that wrestlers who participated in our research used aggressive rapid method. Age is also very important when an athlete has started to control it (Artioli et al., 2010 b).

Following three deaths in 1997, the National Collegiate Athletic Association implemented a program which prevents wrestlers from wrestling below a minimum weight of 5% body fat (Loenneke et al., 2011).

Reducing body mass by 5 % using rapid method (3 days) did not change vertical jump with strain significantly for experienced athletes whereas using average rapid method (3 weeks) jump even increased by 6–8% (Fogelholm et al., 1993). J. Koral and F. Dosseville (2009) state that reducing 2–6% body mass one day before competition caused several disorders but judo movements during 5 s were not affected (Koral, Dosseville, 2009). According to I. Garthe and co-authors, when reducing body mass slowly, fat free body mass and upper limbs muscle force increase more than when reducing body mass rapidly when body mass in both groups decreases without changes in body composition (Garthe et al., 2011). In our research force in arms and legs decreased statistically significantly for wrestlers using rapid and averagely rapid methods reducing body mass. Therefore both rapid and averagely rapid methods reducing body mass caused changes in body composition and muscle force. It can be considered that wrong nutrition could have influence for such result which is a matter of great concern. Appropriate training about athlete nutrition is essential for wrestlers who reduce body mass. In our case tendentious fat free body mass shows diminishing muscle force. Therefore coaches and operating personnel have to seek that wrestlers would reduce body mass without changes in body composition.

CONCLUSIONS AND PERSPECTIVES

1. Force in arms and legs decrease for both wrestlers using rapid and averagely rapid methods reducing body mass.

2. Tendentious decrease in fat free body mass indicates diminishing force in arms and legs.

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DVIEJŲ SKIRTINGŲ SVORIO METIMO BŪDŲ (GREITO IR VIDUTINIO GREITUMO) POVEIKIS PROFESIONALIŲ IMTYNININKŲ KŪNO MASĖS KOMPONENTŲ IR JĖGOS KAITAI

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Dažnai imtynininkai nori per labai trumpą laiką mažinti kūno svorį iki jiems reikiamo. Literatūroje rašoma: reguliuojant kūno masę svarbu, kad nekistų kūno kompozicija. Norėta patikrinti, ar mažinant kūno masę greitai ir vidutiniškai greitai kinta imtynininkų raumenų jėga.

Tikslas – nustatyti skirtingų kūno masės mažinimo būdų (greito, vidutinio greitumo) poveikį imtynininkų masės komponentų bei jėgos kaitai.

Metodai. Tiriamųjų grupės: pirma – nemažinę kūno masės imtynininkai (n = 47), antra – imtynininkai, mažinę kūno masę greituoju būdu (n = 16), trečia – imtynininkai, mažinę kūno masę vidutinio greitumo būdu (*n* = 9). Raumenų jėga (dinamometru MMT) ir masės komponentai (bioimpedanso metodu, *Tanita* 300) įvertinti prieš kūno masės mažinimą ir po jo.

Rezultatai. Prieš kūno masės mažinimą (greitai ir vidutiniškai greitai) imtyninkų kūno masė buvo didesnė ($p < 0,05$) nei sumažinus kūno masę. Imtynininkai prarado 4,5% kūno masės mesdami ją greitai (24–72 h), o vidutiniškai greitai (nuo 72 h iki 2 savaičių) – 4,03%. Po kūno masės mažinimo imtynininkų liesoji kūno masė grupėse turėjo tendenciją mažėti. Imtynininkų, mažinusių kūno masę greitai, abiejų kojų jėga sumažėjo ($p < 0,05$), o mažinusių vidutiniu greičiu – sumažėjo kairės kojos jėga ($p < 0,05$). Tirtų imtynininkų po kūno masės mažinimo (greitai ir vidutiniškai gtreitai) kairės ir dešinės rankų jėga sumažėjo ($p < 0,05$).

Aptarimas ir išvados. Tiriamieji naudojo agresyvų kūno masės mažinimo būdą. Juos būtina mokyti, kaip tinkamai maitintis ir optimaliai sumažinti kūno masę. Tendencingas liesos kūno masės mažėjimas rodo raumenų jėgos mažėjimą.

Imtynininkų, mažinusių kūno masę greitu ir vidutinio greitumo kūno masės mažinimo būdu, kojų ir rankų raumenų jėga reikšmingai sumažėjo.

Raktažodžiai: kūno masės mažėjimas, dehidratacija, kūno masės komponentai, dziudo.

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EFFECT OF HOME PHYSIOTHERAPY ON BALANCE AND DYNAMIC AS WELL AS KINEMATIC MOVEMENT CHARACTERISTICS OF THE DOMINANT HAND FOR PEOPLE WITH PARKINSON'S DISEASE

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ABSTRACT

Research background and hypothesis. Parkinson's disease (PD) is a disease of the elderly, characterized by motor symptoms (resting tremor, bradykinesia, rigidity, and postural instability) when the extrapyramidal system lacks dopamine. Studies have shown that physiotherapy together with the usual medication used to treat PD can slow down the increasing immobility.

Research aim was to assess the effect of home physiotherapy on balance and dynamic as well as kinematic movement characteristics of the dominant hand for people with Parkinson's disease.

Research methods. Research group consisted of 8 patients with PD, stage 1–2 of the disease, the symptoms of which were expressed on the right hand. The study was conducted using Fullerton balance test and the human arm and leg movement Dynamic Parameter Analyser DPA-1.

Research results. Balance as well as kinematic and dynamic characteristics of movements for patients with PD statistically significantly improved ($p < 0.05$) after the physiotherapy exercise cycle at home.

Discussion and conclusions. After physiotherapy, coordination of the dominant hand for patients with PD significantly improved: reaction time became shorter, maximum and average task speed increased, balance improved statistically significantly. The results showed that physiotherapy at home was an effective and reliable way for patients with PD to train their balance as well as kinematic and dynamic characteristics of their movements.

Keywords: physiotherapy, Parkinson's disease, reaction time.

INTRODUCTION

Parkinson's disease (PD) is a chronic progressive neurodegenerative disease that begins due to dopamine deficiency in the extrapyramidal system and manifests itself by resting tremor, bradykinesia, rigidity and postural instability (Weintraub et al., 2008). Postural instability is a major risk factor for falls, which may reduce the patient's individual self-esteem and affect the quality of life (Wulf et al., 2009).

PD is the second most common chronic neurodegenerative disease after Alzheimer's disease. Its epidemiology characteristics vary among countries. This disease is prevalent worldwide in all ethnic groups (Danusevičienė, Zibalaitė, 2010).

The causes of Parkinson's disease are not entirely known. The most important risk factor for PD is age (Weintraub et al., 2008).

The main neurochemical defect that causes the PD phenomena is pronounced deficiency of dopamine in the *striatum* system because of salvaged dopaminergic neurons in *substantia nigra (pars compacta)* (Burton et al., 2011). In the absence of dopamine, metabolic product of neurons which regulates movements, the main symptoms of Parkinson's disease develop (Kazlauskas, 2009). Clinically, Parkinson's disease is characterized by the triad of symptoms: tremor, bradykinesia, rigidity (Reinshagen, 2009).

Research hypothesis: balance and dynamic as well as kinematic movement characteristics of the dominant hand for people with Parkinson's disease will improve after the home physiotherapy exercise cycle.

Research aim was to assess the effect of home physiotherapy on balance and dynamic as well as kinematic movement characteristics of the dominant hand for people with Parkinson's disease.

RESEARCH METHODS

Research was carried out in accordance with the principles of the Declaration of Helsinki, concerning ethics of the experimentation with humans. The study was conducted in the LAPE Laboratory of Human Motorics using human arm and leg movement Dynamic Parameter Analyser DPA-1, and Fullerton's balance test.

The study included a total of eight subjects: 4 men and 4 women. According to the modified Hoehn and Yahr stage scale, the symptoms of persons with stage 1–2 of Parkinson's disease are more pronounced on the right side, and the dominant hand is right. The age of the subjects was 65.63 ± 7.42 m, weight 74.20 ± 10.83 kg, height 170.80 ± 5.89 cm.

Persons who, besides PD, had underlying serious illnesses, disturbing movements or causing disability and significantly worsening the quality of life (stroke, severe osteoarthritis, a condition after arthroplasty, rheumatoid arthritis) were excluded from the research. The subjects were familiarized with the study objectives, methods, procedures and possible inconveniences. They were tested two times – before and after physiotherapy. After the evaluation of balance, reaction speed, movement accuracy, a 4-week course of treatment was started. Physiotherapy treatments took place at home of each subject four times a week for one hour. Every patient received 16 procedures. During the procedures, constant rhythmic auditory stimulation was carried out – commands, clapping, counting. Metronome and music were used in the procedures as well.

For balance we applied The Activities-specific Balance Confidence (ABC) Scale. Patients filled in this scale independently. The scale consists of 16 questions, the answer can be estimated from 1 to 10 (1 – completely do not trust, 10 – have full confidence). Subjects select a score that most closely matches their confidence in their balance.

DPA-1 device allows identification of reaction time, movement dynamic (strength, power) and kinematic (amplitude, velocity, acceleration) characteristics.

During the investigation the subjects were sitting in a special chair at the table, with a DPA-1 attached on it. Their back was straight and resting on the chair back, both arms were bent at the elbow joint angle of 90° so that the upper arms were in contact with the sides of the forearms – based on the DPA-1 support plate. DPA-1 chair position was adjusted so that the subject sat comfortably taking the standardized position. The distance from the computer screen to the subject's eye was ~ 0.7 m.

Subjects performed the task with the right hand. According to a pre-defined task, the target – a red circle 0,007 m in diameter – appeared on the screen at the set time. The distance from the starting area to the target is 0.16 m. Hand movement path is reproduced identically on a computer screen. For each task, the subject puts a handle symbol 0.0035 m in diameter on a computer screen in the start zone (the centre of a green circle 0.01 m diameter). The program generates an alternating audible signal every 1–3 and the subject has to respond by pushing the device handle to the target in the same place on a computer screen. The measurement cycle is finished when the handle symbol circle hits the target. Information about the task carried out is stored in the computer memory, which is then transferred to *Microsoft Excel*.

The subjects had to perform three tasks: a) to respond to the audible signal and push the device handle (a simple task), b) to respond as soon as possible (a simple task), c) to respond as soon as possible and as accurately as possible to hit the target on the computer screen (complex task). After explaining the task, the subjects were allowed to perform three trials, the results of which were not recorded. The subjects performed five sets of 20 repetitions. The interval between the sets was 2 min, a set of repetitions was performed continuously and the maximal and average movement speed of the right hand, reaction time and the path of movement were recorded. After each repetition the subject could see their score on a computer screen. They were motivated to perform the task quickly and accurately.

Research data analysis was performed using *SPSS 17.0* software package. Evaluating the research data, arithmetic average values ($\bar{x}$) of the researched indices were calculated, as well as the average standard deviation (s), the coefficient of variance (% VA), Pearson's correlation coefficient (r). Two-factor analysis of variance was used to assess the significance of the results of different factors. The difference was statistically significant at $p < 0.05$.

RESEARCH RESULTS

The analysis of the results showed that the application of physiotherapy for 4 weeks in patients with Parkinson's disease resulted in statistically significant differences between the registered parameters at the end of the study were compared to the results before the study: reaction time (Figure 1), average speed (Figure 2), maximum speed (Figure 3) and balance (Figure 4).

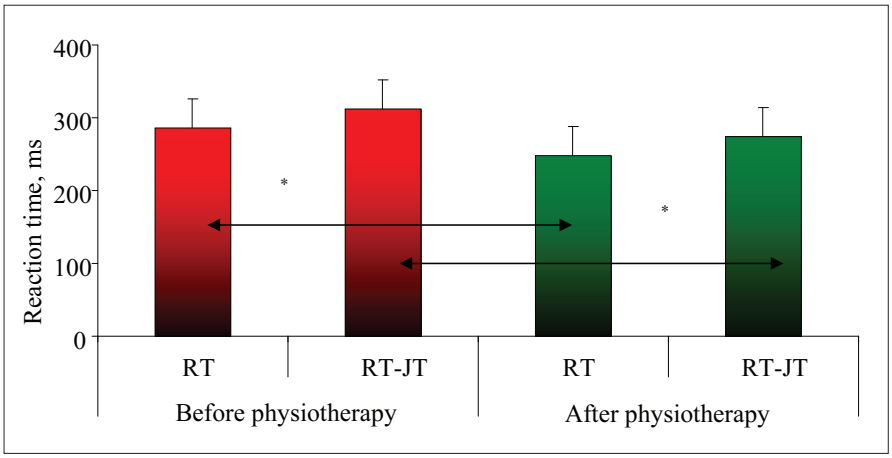

Figure 1. **Reaction time (ms) averages in patients with Parkinson's disease performing a task of 5 sets of 20 repetitions before and after physiotherapy. RT-simple task, RT-JT-complicated task**

Note. * – $p < 0.001$, compared to the results before and after physiotherapy.

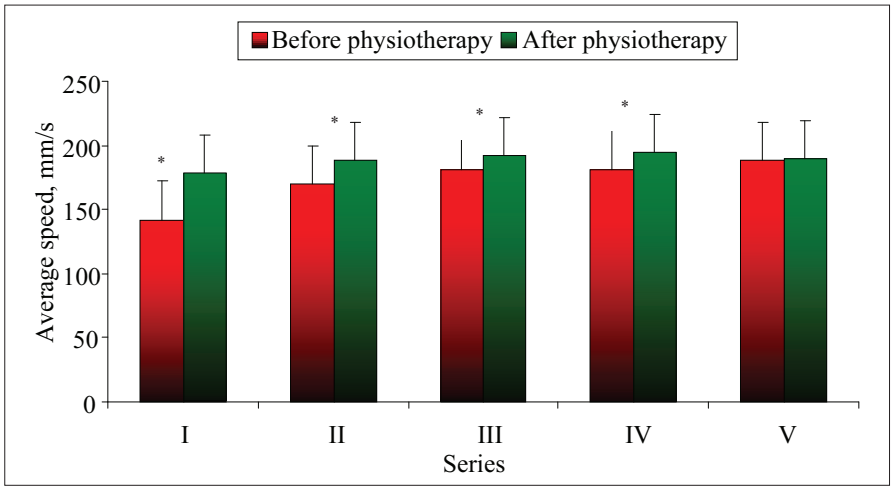

Figure 2. **Average speed (mm/s) in patients with Parkinson's disease performing a task of 5 sets of 20 repetitions before and after physiotherapy**

Note. * – $p < 0.001$, compared to the results before and after physiotherapy.

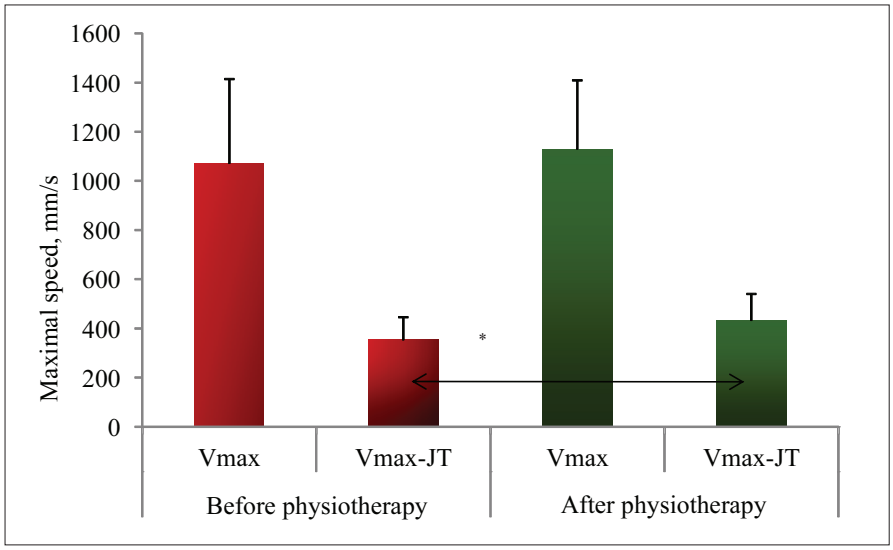

Figure 3. **Maximal speed (mm/s) averages in patients with Parkinson's disease performing a task of 5 sets of 20 repetitions before and after physiotherapy. Vmax -simple task, Vmax-JT -complicated task**

Note. * – $p < 0.001$, compared to the results before and after physiotherapy.

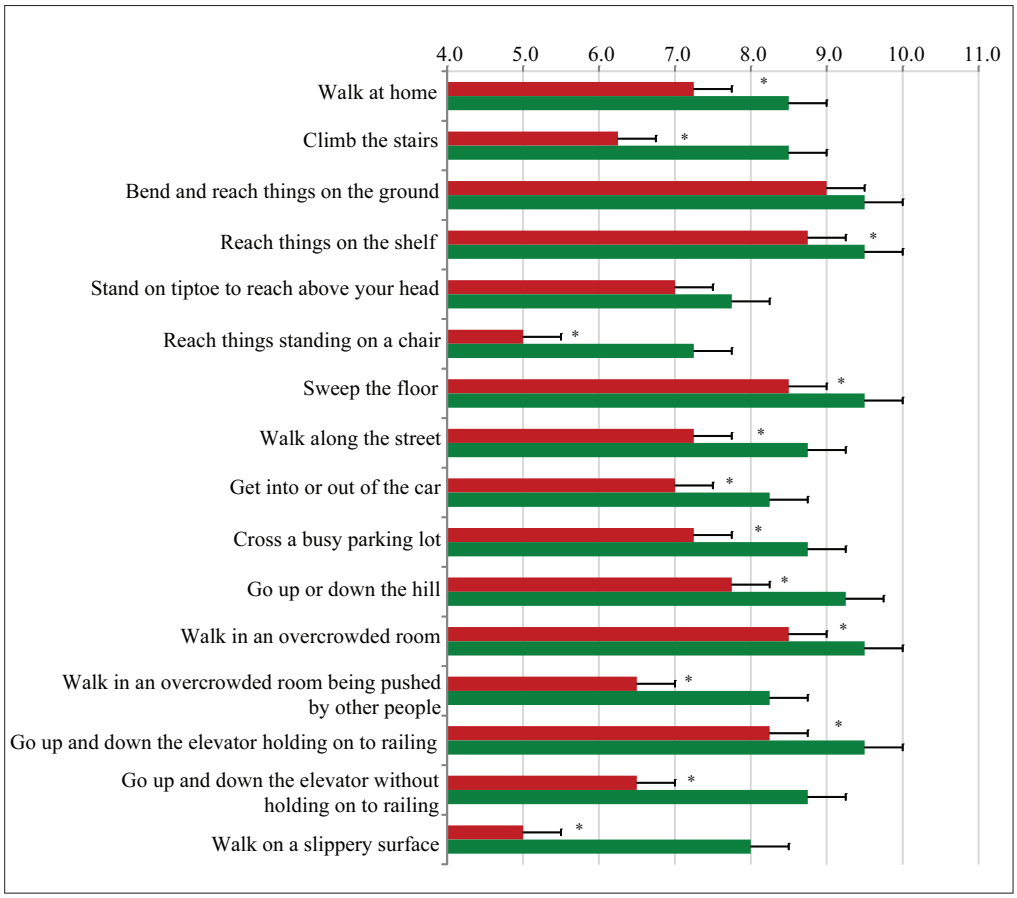

Figure 4. **Averages of individual task performance results of Confidence in Balance Scale before and after physiotherapy**

Note. * – $p < 0.001$, compared to the results before and after physiotherapy.

The results showed that physiotherapy for patients with PD had a significant effect on reaction time ($p < 0.001$), the average speed of movement ($p < 0.001$), the maximum speed of movement ($p < 0.001$) and balance ($p < 0.001$).

While evaluating the maximum speed of movement before and after physiotherapy, a statistically significant difference was established in the accuracy of movement task ($p < 0.001$), when after hearing the sound the participants had to respond as fast as possible and to hit the target as accurately as possible. In the simple task, when the subjects had to push the device handle when they heard the sound, no statistically significant change in the results of the maximum speed before and after physiotherapy has been established.

The overall mean result of the confidence in balance scale prior to the test was 7.23 ± 1.21 points. Prior to physiotherapy, worst of all (5 points) the subjects assessed their ability to maintain balance and preserve stability when they were going on a slippery surface, reaching for an object while standing on a chair. After the investigation the same two questions were rated the worst as well, but the results improved much. When they were asked if they trusted their ability to maintain balance and not lose stability when reaching for something standing on a chair, the result after physical therapy improved by 45%. Their confidence in walking on slippery surfaces improved 60% after physiotherapy. After the investigation the overall average result of the scale of was 8.72 ± 0.71 points. Testing results of the balance scale, comparing the values before and after physiotherapy, improved by 20.52%. At the end of the study, the subjects' balance statistically significantly improved ($p < 0.001$).

DISCUSSION

Based on the obtained data we can claim that this is the first study that examines the effects of physiotherapy at home for patients with Parkinson's disease on their balance and the dynamic and kinematic characteristics of the dominant hand. The aim of the study was to assess the effect of home physiotherapy on balance and dynamic as well as kinematic movement characteristics of the dominant hand for people with Parkinson's disease. The main finding of our research was that physiotherapy proved to be an effective and reliable

way for people suffering from Parkinson's disease to train their balance, as well as kinematic and dynamic characteristics of movements.

M. E. Morris (2000) argues that it is important to start physical therapy as soon as possible when Parkinson's disease diagnosis is established, due to muscle atrophy, weakness, and prevention of the loss of range of movement and physical fitness. Therefore, we chose patients with stages 1–2 of the disease for our research. E. E. Dereli and A. Yaliman (2010) state that physiotherapy treatments are much more effective in patients with Parkinson's disease when the therapist works with the patient at home compared to independent work at home using a special programme. J. Nocera and co-authors (2009) argue that home physiotherapy programmes for patients with Parkinson's disease are effective.

This was confirmed by our results. Our results suggest that physiotherapy at home is effective in patients with Parkinson's disease for training movement accuracy and speed. Movement speed and accuracy of our research participants significantly improved after 16 sessions of physiotherapy. D. Mickevičienė and co-authors' (2008) studies with healthy human subjects suggest that in a complex task reaction is slower, and the maximum speed of movement is lower than in a simple task. Movement speed will be higher when the reaction is faster in a simple task. We found the same trend in our study. Thus, in both healthy subjects and patients with Parkinson's disease, reaction time, movement speed and accuracy depend on the complexity of the task.

Performing the tasks of varying complexity, movement reaction time and movement speed of the right hand significantly differed before and after physiotherapy. M. E. Morris (2000) argues that every week practicing to perform taking tasks that require agility, accuracy and attention as well as concentration can maintain the required level of functionality. It is recommended to perform the task with a greater variety of different purposes, objects of different size or weight, different movement speed and the distance to the object.

In 2004 a stud was carried out which measured the short-term stimulating effects of music for persons with PD and with coordination problems. The results obtained show that the accuracy and walking a straight line improved; the accuracy of performance of the right hand improved as well. The results show that music can improve hand and finger movement accuracy (Bernatzky et al., 2004). We also used in physiotherapy music and got similar results. Our subjects also improved the accuracy of their right arm.

Summing up, physiotherapy proved to be an effective and reliable way for people suffering from Parkinson's disease to train their balance, as well as kinematic and dynamic characteristics of movements.

CONCLUSIONS AND PERSPECTIVES

1. After physiotherapy, coordination of patients with Parkinson's disease in the dominant hand significantly improved: reaction time became shorter, maximum and average speed of task performance increased.

2. After physiotherapy, balance for patients with Parkinson's disease significantly improved.

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KINEZITERAPIJOS NAMUOSE POVEIKIS SERGANČIŲJŲ PARKINSONO LIGA PUSIAUSVYRAI IR DOMINUOJANČIOS RANKOS DINAMINĖMS BEI KINEMATINĖMS JUDESIO YPATYBĖMS

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Parkinsono liga (PL) – vyresniojo amžiaus žmonių susirgimas, pasireiškiantis motoriniais simptomais (drebuliu ramybėje, bradikinezija, rigidiškumu, posturaliniu nestabilumu) trūkstant dopamino organizmo ekstrapiramidinėje sistemoje. Tyrimais nustatyta, kad kineziterpija kartu su PL gydymu įprastai vartojamais vaistais gali sulėtinti vis didėjantį nejudrumą.

Tikslas – įvertinti kineziterapijos namuose poveikį sergančiųjų PL pusiausvyrai, dominuojančios rankos dinaminėms ir kinematinėms judesio ypatybėms.

Metodai. Tiriamųjų grupę sudarė 8 ligoniai, sergantys 1–2 PL stadija, ligos požymiai – dešinėje rankoje. Tyrimas atliktas naudojant *Fullerton* pusiausvyros testą bei rankų ir kojų judesių dinaminių rodiklių analizatorių DPA-1.

Rezultatai. Sergančiųjų PL pusiausvyra, judesių kinematinės ir dinaminės ypatybės po kineziterapijos pratybų namuose ciklo statistiškai reikšmingai pagerėjo ($p < 0,05$).

Aptarimas ir išvados. Po kineziterapijos sergančiųjų PL dominuojančios rankos koordinacija reikšmingai pagerėjo: sutrumpėjo reakcijos laikas, padidėjo maksimalusis ir vidutinis užduoties atlikimo greitis, statistiškai reikšmingai pagerėjo pusiausvyra. Tyrimo rezultatai parodė, kad kineziterapija namuose yra veiksmingas ir patikimas būdas gerinant sergančiųjų PL pusiausvyrą, lavinant judesių kinematines ir dinamines ypatybes.

Raktažodžiai: kineziterapija, Parkinsono liga, judesių greitis ir tikslumas, reakcijos laikas.

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DYNAMICS OF CONCATENATION BETWEEN CARDIAC OUTPUT AND INDICES OF ARTERIAL BLOOD PRESURE DURING GRADED EXERCISE STRESS IN ENDURANCE COHORT

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ABSTRACT

Research background and hypothesis. Potential mechanisms through which muscle perfusion is altered during prolonged exercise are not fully understood. The methods applied in the analysis of human data are very important because many crucial variables are not directly measureble or even identifiable.

Research aim was to find out the peculiarities in concatenation between central and peripheral cardiovascular changes under conditions of increasing fatigue.

Research methods. Well-trained endurance runners underwent a 50 W increase in workload (bicycle ergometry) every 6 minutes and they exercised until inability to continue the task. Dynamics of concatenation between cardiac output and systolic arterial blood pressure (ABP), diastolic ABP and total peripheral resistance were assessed using a method based on matrix theory proposed by Lithuanian scientists.

Research results. The increase of cardiac output during exercising has the same tendency of stepwise increase of workload, but changes of systolic and diastolic ABP with accumulation of fatigue could be characterized as linear type dependent with the time of exercising. The concatenation between the changes in cardiac performance and behaviour of peripheral vasculature increased at onset of exercising and the decrease or loss of the concatenation led up to inability to continue exercising.

Discussion and conclusions. The importance of peripheral factors, i. e. decrease of diastolic blood pressure, reduction of total peripheral vascular resistance plays an increasingly significant role for cardiac output during continuous exercising. The concatenations between the changes of these indices and cardiac output increase and in the case of high-grade fatigue concatenations begin to decline.

Keywords: cardiac output, periferal vascular resistance, concatenation.

INTRODUCTION

It is well known that major portion of cardiac outputs during exercising is diverted to the working muscles but potential mechanisms through which muscle perfusion is altered during prolonged exercise are not fully understood (Saltin, 2007). The interplay of central and peripheral changes of cardiovascular indices is oriented to the same purporse, e. g. to supply the needed amount of blood to active musculature. Since interaction of various cardiovascular parameters reflect important aspects of the regulation of vital processes these interactions need to be understood (Batzel, Bachar, 2010). Mathematical formalism is one of the ways to research the complexity of biological systems (Davis et al., 2010). The methods applied for the analysis of human data are very important because many crucial variables are not directly measureable or even identifiable (Torrents, Balagué, 2006; Poderys et al., 2010; Latash et al., 2010; Pukėnas et al., 2012).

The new methodology for assessment of concatenation between biological procesess was developed by a group of Lithuanian scientists (Vainoras et al., 2008; Bikulčienė et al., 2009). This methodology is based on matrix theory. The aim of this research was to find out the peculiarities in concatenation between central and peripheral cardiovacaular changes under conditions of increasing fatigue.

RESEARCH METHODS

The participants of the study (well trained endurance runners, n = 13) spent 20 min seated and after registration of the base-line values of cardiovascular indices they underwent a 50 W increase in workload (bicycle ergometry) every 6 minutes and they exercised unless distressing cardiovascular symptoms supervened.

The values of cardiac output and arterial blood pressure (ABP) measurements were registered at the end of each minute of the workload. The cardiac output was measured with tetrapolar chest rheography (RPG2-02, Medtekhnika, Moscow, Russia), a convenient and non-interventional method based on the Kubicek procedure (Pushkar et al., 1977). A four-electrode impedance plethysmographic system was used for this purpose. Two band electrodes were placed around the base of the subject's neck, the third band electrode was placed around the thorax 2 cm below the xiphisternal joint, and the fourth band electrode was placed around the abdomen like a belt. The two outer electrodes were placed about 2 cm away from the inner electrodes. The upper neck and abdomen electrodes were excited with a constant 100 kHz sinusoidal current, and the resultant voltage (impedance) changes that occurred in the cardiac cycles were monitored from the two inner electrodes. The stroke volume was calculated from the impedance change information using a formula that related impedance changes to volume changes in a conducting solid (Kubicek et al., 1966).

Indirect arterial blood pressure (ABP) measurements (systolic – S and diastolic – D) were taken from the arm with a sphygmomanometer and standard-size arm cuff. Mean arterial blood pressure (MAP) was calculated: MAP = D + (S – D)/3 and total systemic peripheral resistance (TPR) was calculated by MAP / CO (mmHg · minL^{-1}).

Dynamics of concatenation of registered indices was assessed using a method based on matrix theory proposed by Lithuanian scientists (Vainoras et al., 2008; Bikulčienė et al., 2009). According to this method two synchronous time series (x_n: = 0, 1, 2,..) and (y_n : = 0, 1, 2,..), which represented the results of some measurements were structured and analysed by using the numerical characteristics of the second order matrix and the main components of it:

$$A_n := \begin{bmatrix} x_n & x_{n-1} - y_{n-1} \\ x_{n+1} - y_{n+1} & y_n \end{bmatrix}$$

From the definitions of matrix characteristics, the discriminants of the matrix are of great interest:

$$\text{disk } A_n = ((x_n - y_n)^2 + 4((x_{n-1} - y_{n-1}) \cdot (x_{n+1} - y_{n+1}))$$

The initial data for the analysis of concatenation between parameters were the normalized values of the registered parameters. The parameters were interpolated using cubic splines, and then the discriminants between all investigated relationships were defined. Then the discriminants of all investigated relationships were defined. If discriminants of matrices became close to zero, the matrices from idempotent became to nilpotent, i.e. concatenation came close to maximal and conversely.

RESEARCH RESULTS

Working capacity. The task for the participants of this study was to continue exercising as long as they can, i.e. till the inability to continue it. All the participants of the study were able to perform the workload up to 200 W, and only one participant was able to continue the workload at the stage of 350 W. So the averaged data presented in Figures at the stages of 250 W and 300 W contain descending number of cases.

Dynamics of cardiovascular indices. Figure 1 presents the dynamics of cardiac output during the incremental increase in workload. The initial values of cardiac output obtained with tetrapolar chest rheography before the exercising was 6.1 ± 0.4 l/min and the highest values was observed during the last stages of workout (31.2 l/min, averaged). The increase of cardiac output while performing the workload has the same tendency of stepwise increase with each higher stage. This tendency increased during the first stages of workout and weakened when exercising became subjectively hard, i.e. during the last stages of workout.

Figure 2 presents the dynamics of systolic and diastolic blood pressure. The type of change of these indices was not the same as the changes of cardiac output. The type of increase in systolic and decrease of diastolic ABP was more close to the linear changes, i. e. dependent on the time of exercising. The difference between systolic and diastolic ABP (pulse pressure) was observed while the participant of the study performed the last stages of workout.

At the onset of exercising steep decrease of TPR was observed (15.8 ± 0.9 mm Hg · minL^{-1} – before workload and 10.5 ± 1.0 mmHg · minL^{-1} – at the end of the first minute of the workload). The decrease of TPR was observed till the end of exercising, i. e. the lowest values were registered while performing the last steps of the workload (250 W; 300 W and 350 W) – 2.8 ± 0.3 mm Hg · minL^{-1} (Figure 3).

Dynamics of concatenation between measured indices are presented in Figure 3. At the onset of exercising the values of discriminant had different dynamics. There were relatively small changes of the discriminant while calculating the dynamics of concatenation between cardiac output and systolic ABP (Figure 3 A). The increase of the discriminant from 0.65 ± 0.02 (base–lane) to 0.88 ± 0.13 (maximal values obtained during the workload) was significant ($p < 0.05$). The decline

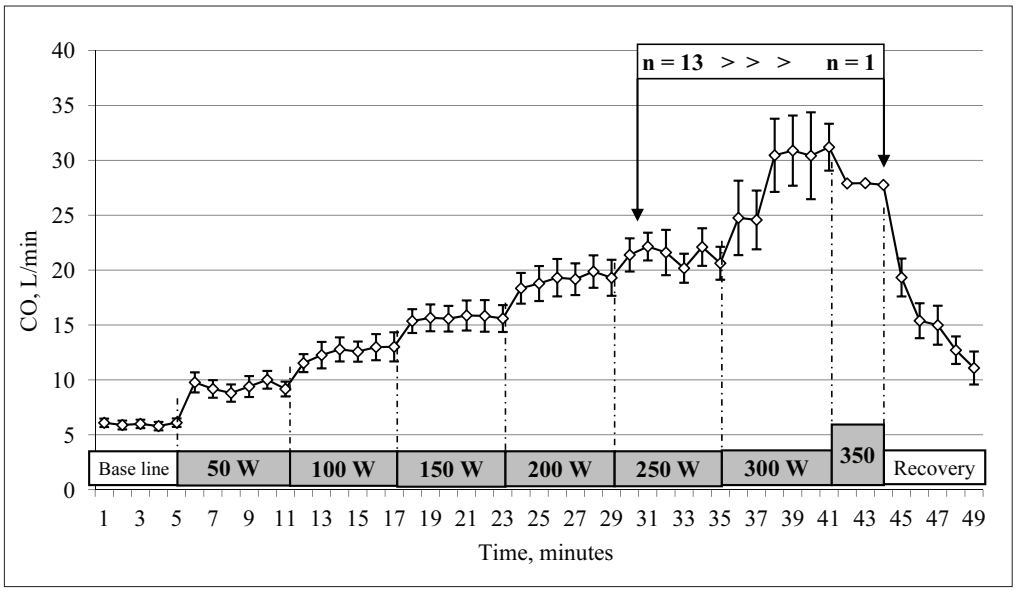

Figure 1. **Cardiac output (CO) changes during incremental exercise stress**

Note. > > > – decreasing numbers of participants were able to perform the workload.

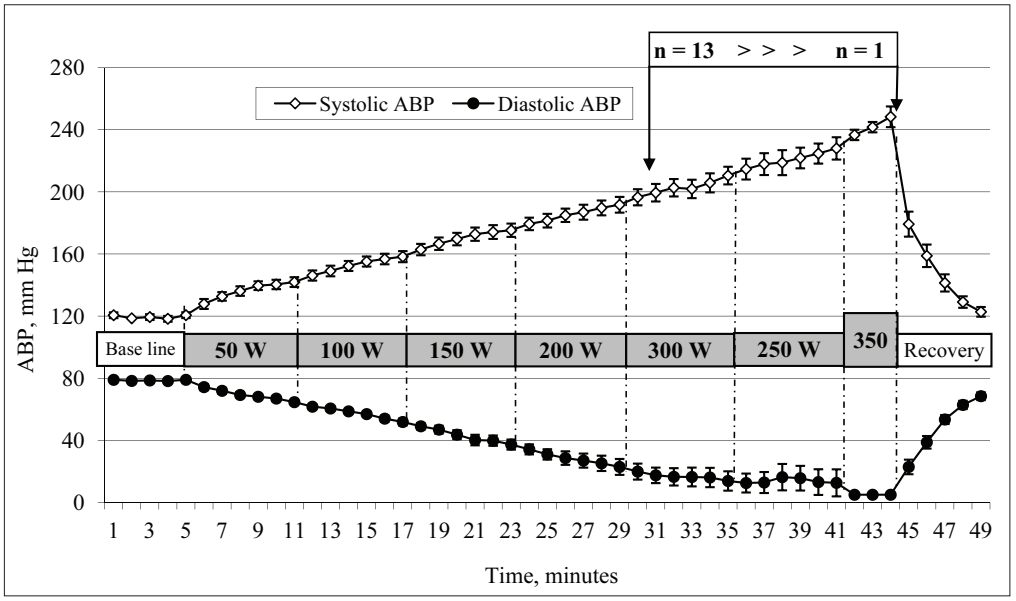

Figure 2. **ABP changes during incremental exercise stress**

Note. > > > – decreasing numbers of participants were able to perform the workload.

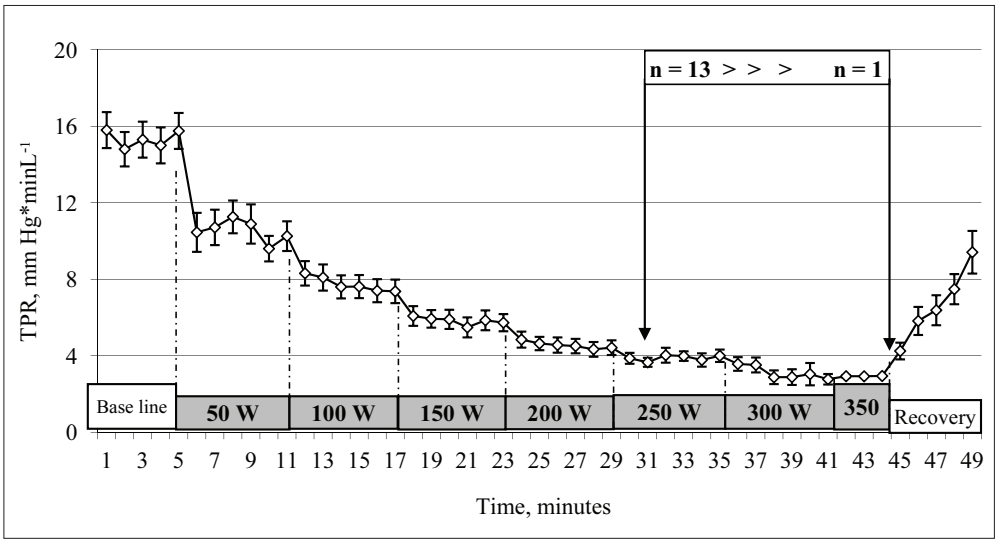

Figure 3. **Total peripheral resistance (TPR) changes during incremental exercise stress**

Note. > > > – decreasing numbers of participants were able to perform the workload.

of the curve at the last stages of the workload in Figure 4A was related to the decreasing number of participants who were able to continue exercising at such intensive stages of the workload.

The initial values of the discriminant between cardiac output and diastolic ABP were 3.26 ± 0.07 and statistically significant decrease from the baseline ($p < 0.05$) was observed at onset of exercising. At each next minute of exercising as it is shown in Figure 4 B we observed further fall-dawn of the discriminant up to 0.13 ± 0.06 ($p < 0.05$). The increase of discriminant was observed while the exercising became subjectively hard and this steep increase was closely related (*led up*) with the inability to continue the performance of the workload.

Figure 4 C demonstrates that reduction of total peripheral vascular resistance plays an increasingly significant role for cardiac output during exercising. The concatenation between the changes of these indices begin to decline at the onset of exercising and in the cases of high-grade fatigue, i. e. during the performance of the last stages of workload the steep increase of discriminant was observed.

DISCUSSION

It is well-known that major portion of cardiac outputs during exercising is diverted to the working muscles but potential mechanisms through which muscle perfusion is altered during prolonged exercise are not fully understood (Saltin, 2007). The aim of the research was to find out the peculiarities in concatenation between cardiac and peripheral cardiovascular changes under conditions of increasing fatigue. Since the analysis of the dynamics of short cardiovascular signal intervals reflects important vital processes, involving complex interactions of the regulatory processes (Batzel, Bachar, 2010), mathematical formalism is one of the ways to research the complexity of biological systems (Davis et al., 2010). A. L. Goldberger and his colleagues' publications (Goldberger, West, 1987; Goldberger et al., 1988) were one of the first publications in which HR variability was determined by non-linear analysis methods. Mathematical point of view in the analysis of biological systems in question – using mathematical analysis techniques – helps to reveal new features of the system, which can be approved or denied by empirical experiments (Demongeot et al., 2009).

Dynamics of concatenation between registered indices was assessed using a method based on matrix theory. The data obtained during such investigations have interpretation difficulties – there are no standard methods developed where we could have a single interpretation. There is still no necessary experience in the application of this methodology and handling the obtained results. As the values of discriminants are very sensitive to initial data (Berškienė, 2009), the main attention in the analysis of changes should be pointed to the trends of the changes and to the moments at which the opposite changes start. Important point in physiological interpretation of these data is to take into account if discriminants of matrices become close to zero, then matrices from idempotent become nilpotent, i. e. concatenation comes close to maximal and conversely.

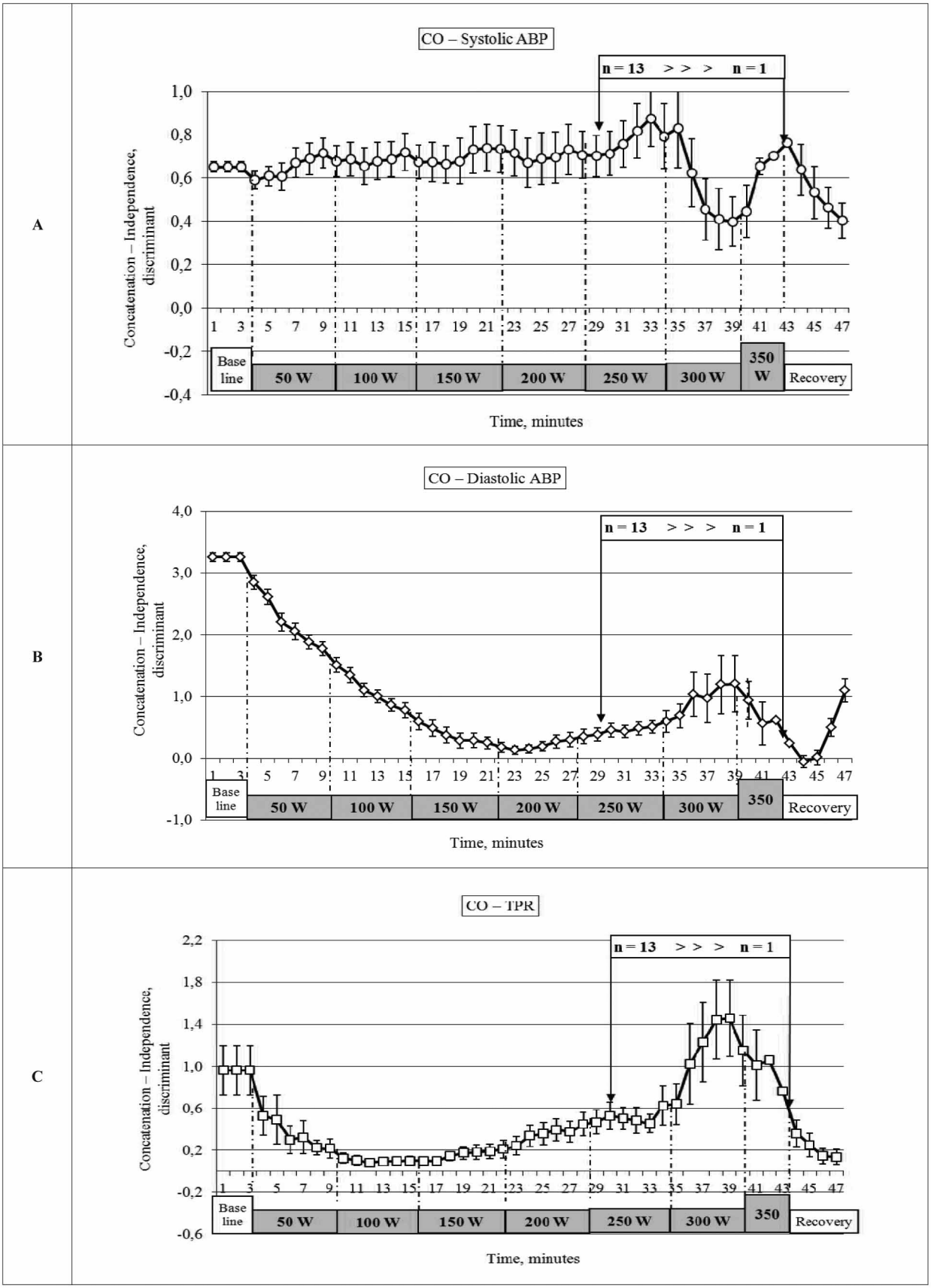

Figure 4. **Dynamics of concatenation between cardiac output (CO) and cardiovascular indices changes during incremental exercise stress**

Note. TPR – total peripheral resistance, > > > – decreasing numbers of participants were able to perform the workload.

The main finding of this study was that the regular and everlasting changes of concatenation between registered indices started at onset of exercising. This type of changes was observed during some stages of workload, and when reaching some functional state (*fatigue*) the increase or decrease of concatenation changed in the opposite direction. This means that the concatenation between the changes in cardiac performance and behaviour of peripheral vasculature increase at onset of exercising and the decrease or loss of the concatenation leads to inability to continue exercising.

The other important finding in this study was that peripheral changes, i. e. decrease of diastolic ABP has an increasingly important role for muscular blood flow under conditions of increasing fatigue. In some studies (Buliuolis et al., 2003; Poskaitis et al., 2007) it was shown that relatively steady state could be observed during the first stages of step-wise incremental increase of exercising intensity while the duration of exercising at the each step of exercising was 6 minutes.

We used the method based on matrix theory proposed by Lithuanian scientists (Vainoras et al., 2008; Bikulčienė et al., 2009) to assess the features of the dynamics of concatenation of some important cardiovascular indices. The results obtained during the study allowed to distinguish some peculiarities in the dynamics of cardiovascular parameters under increasing fatigue and it seems that application of this methodology are promising.

CONCLUSIONS AND PERSPECTIVES

1. The increase of cardiac output during the graded exercise stress has the same tendency of stepwise increase with each higher stage of workout, and the changes of systolic and diastolic blood pressure indices with accumulation of fatigue could be characterized as linear type dependent on the time of exercising.

2. The importance of peripheral factors, i. e. decrease of diastolic blood pressure, the reduction of total peripheral vascular resistance play an increasingly significant role for cardiac output during continuous exercising. The concatenations between the changes of these indices and cardiac output increase and in the case of high-grade fatigue concatenations begin to decline.

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IŠTVERMĘ LAVINANČIŲ ASMENŲ MINUTINIO KRAUJO TŪRIO IR ARTERINIO KRAUJO SPAUDIMO RODIKLIŲ DINAMINĖS SĄSAJOS ATLIEKANT PAKOPOMIS DIDINAMĄ KRŪVĮ

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Ligšiol neišsisaiškinti visi galimi fiziologiniai mechanizmai, lemiantys raumenų kraujotakos kaitos ypatybes ilgos trukmės fizinių krūvių metu. Kita vertus, labai svarbus pasirenkamų analizės metodų informatyvumas, nes daugelis fiziologinių rodiklių negali būti tiesiogiai pamatuojami.

Tikslas – nustatyti dinaminių sąsajų kaitos ypatybes tarp centrinių ir periferinių kraujotakos rodiklių didėjančio nuovargio sąlygomis.

Metodai. Treniruoti ištvermės bėgikai atliko pakopomis kas šešias minutes po 50 W didinamą krūvį veloergometru iki negalėjimo tęsti jį. Dinaminė sąsaja tarp minutinio kraujo tūrio ir kitų kraujotakos rodiklių (sistolinio bei diastolinio kraujo spaudimo ir bendrojo periferinio pasipriešinimo) buvo vertinami pasinaudojant Lietuvos mokslininkų pasiūlyta metodika, kuri grindžiama matricinės analizės teorija.

Rezultatai. Atliekant pakopomis didinamą krūvį minutinio kraujo tūrio reikšmės taip pat padidėja su kiekviena didesnio krūvio pakopa, tačiau sistolinio ir diastolinio AKS didėjimas kaupiantis nuovargiui gali būti nusakomas tiesine priklausomybe su atlikto krūvio laiku. Pradėjus ir tęsiant fizinį krūvį, dinaminė sąsaja tarp minutinio kraujo tūrio ir periferinių kraujotakos rodiklių sustiprėja, tačiau prieš darbo pabaigą prasidedantį reikšmingą sąsajos mažėjimą lydi atsisakymas tęsti fizinį krūvį.

Aptarimas ir išvados. Didėjant nuovargiui, minutinio kraujo tūrio didėjimą vis labiau lemia periferiniai veiksniai: diastolinio kraujo spaudimo mažėjimas, rodantis kraujagyslių vazodilatacijos lemiamą bendrojo periferinio pasipriešinimo mažėjimą. Šių rodiklių dinaminės sąsajos su minutiniu kraujo kiekiu stiprėja, o atsiradus dideliam nuovargiui jos pradeda silpnėti.

Raktažodžiai: minutinis kraujo tūris, bendrasis periferinis pasipriešinimas, dinaminės sąsajos.

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PECULIARITIES OF SPORTS INJURES OF SPRINT AND THROWING COHORTS IN TRACK AND FIELD ATHLETICS

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ABSTRACT

Research background and hypothesis. The severity of recurrence of injuries in track and field athletics gives possibility to adjust training programs for athletes.

Research aim was to analyse which body parts are mostly injured and the severity of recurrence of injuries in track and field athletics gives possibility to adjust training programs for athletes.

Research methods. Thirty six athletes were given questionnaires developed using standardized methodology validated by the IOC and implemented by the IAAF during international track and field competitions.

Research results. There were 64 cases of injuries among 33 athletes: head and trunk cases – 12 (18.8%), upper extremity – 14 (21.9%), lower extremity – 38 (59.4%). In all cases lower extremity injuries dominated. In sprinters lower extremity injuries dominated and there was no upper extremity trauma. In throwers the upper and the lower extremity were equally vulnerable, mild and very mild injuries were observed. There was no difference between both groups in recurrence of the same trauma.

Discussion and conclusions. Estimating which body parts are mostly injured in sports gives the possibility to adjust training programs for athletes, increasing the amount of athletic exercises intended for the functional preparation of those parts. Injuries in track and field are frequent and dominating injuries are of lower extremity; there exist the possibility of recurrence of the injury in the same body part. Injuries prevalent in sprinter cohort are of lower extremities, and injuries prevalent in throwing cohort are of lower and upper extremities.

Keywords: track and field, sports injury, body areas.

INTRODUCTION

Sport requires extreme workloads and skills and each athlete may be hampered by a prolonged absence from competitive activity through injury. Injuries in track and field athletics are an important and relevant problem as well. It is not completely examined, the scientific literature on the risk of injuries in track and field athletes is still scarce (Alonso et al., 2009), and the same problem exists in Lithuania as well. Some authors analysed the frequency characteristics and causes of injuries during the Summer Olympic Games of 2008 (Junge et al., 2009). All sports injuries in competitions and/or training during the 2007 World Athletics Championships (Alonso et al., 2009) were analysed, too. Most of the injuries involved the lower extremity (79.8%) which is similar to previous studies in Athletics. (Watson, Di Martino, 1987; Bennell et al., 1996; Zemper, 2005; Alonso et al., 2009; Graff, Birken, 2009 a, b, c; Junge et al., 2009; Alonso et al., 2012). In the article on sports injuries surveillance during the 2007 IIAF World Athletics Championships the authors (Alonso et al., 2009) write that eighty per cent of athletes affected their lower extremities.

The aim of this study was to analyse which body parts were mostly injured, as the severity of

recurrence of injuries in track and field athletics gives possibility to adjust training programs for athletes. The objects of study were athletes with injuries in Lithuania in 2011.

RESEARCH METHODS

The objects of the study were athletes with injuries in Lithuania in 2011. We used a strategy of random sampling. The questionnaire was given to athletes in their training and competitive places in Lithuania. The sample included 36 athletes, men (n = 26) and women (n = 10), they aged from 18 to 39 years. The mean age of athletes was 21.8 ± 4.8 years. Sports experience in years was 8 ± 4.5. Training sessions were 5.1 ± 1.7 on average per week. The mean duration of one training session was 99.17 ± 24.03 minutes. All 36 athletes had competition experience in Lithuania's Track and Field Championship in 2011. Six athletes had covered the normative requirements of London Olympics games. We examined the injury cases of 15 throwers: 8 javelin throwers, 4 discus throwers, 3 shot putters and 21 sprinters. There were 64 traumatic injury cases.

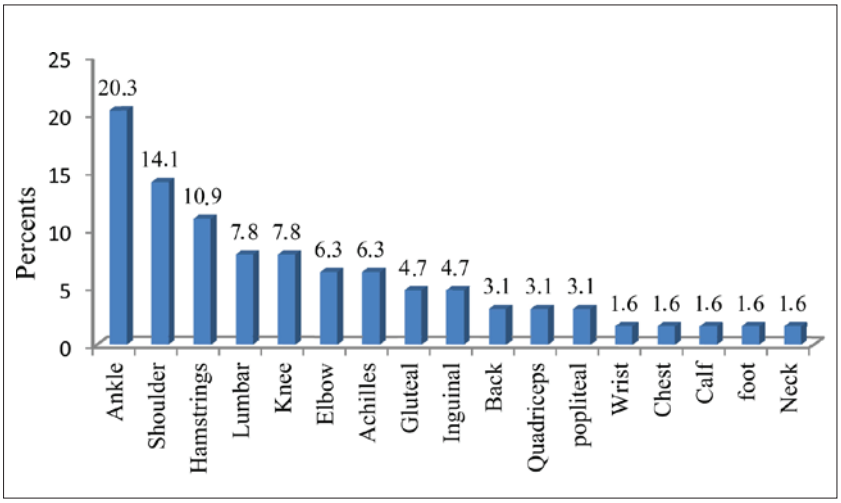
Instruments. Thirty six athletes were given questionnaires developed using standardized methodology (Daily Report on Injuries and Illnesses, codes and classifications) validated by the International Olympic Committee (IOC) and implemented by the IAAF during international track and field competitions, during the period of the Daegu 2011 IAAF World Championships (27 August to 4 September). We applied it in cases of injuries at the track and field all year round in 2011during training sessions and competitions, meanwhile the IOC used it only at the time of Olympic Games, also at the world track and field championships. In our questionnaire, there were 13 questions: 1. Sex; 2. Age and date of birth; 3. Number of training years in track and field; 4. Average number of training sessions per week; 5. Average length of a training session; 6. Event; 7. Are you competing in Lithuanian track and field championships? 8. Have you fulfilled Olympic requirements for London Olympic Games? 9. Number of injuries in 2011; 10. Point out injured body parts on the human silhouette picture (we classified body parts similarly to validated IOC and IAAF standardized classification): *Head and trunk*: a. face. head, c. neck, d. upper back, e. pectoral area, f. lumbar area, g. abdomen, j. pelvis/sacrum/gluteal area. *Upper extremity*: a. Shoulder, b. elbow, c. forearm, d. wrist, e. hand, f. finger. *Lower extremity*: a. Inguinal, b. Quadriceps area, c. Hamstrings area, d. popliteal area, e. Knee area, f. Calf, g. Achilles, h. Ankle, i. Foot. 11. Evaluate the severity of every injury in 5 points as shown below: I very mild injury (no missed training sessions), II. Mild injury (1 to 7 training days missed), III. Moderate injury (about 2 weeks of training missed), IV. Severe injury (from 2 weeks up to 3 months of training missed); V. Very severe (training stopped for 6 months and more). Our questionnaire did not have a question about a kind of trauma and its causes as not all athletes who suffered very mild injuries had turned for medical care. That is why a questionnaire had been given not to doctors but to athletes themselves. Without adding questions about damaged structures and type of injuries we presume that not all athletes can remember the clinical diagnosis. If the athlete with a mild injury did not seek doctors' care, he/she is unable to objectively assess the type of anatomic structure damage and the injury type. We used the silhouette of the figure of the human body upon which an athlete pointed out injured body parts and noted the time when they were in poor health and how much time they could not work out. By the number of missed training and competition days we made the classification of the degree of injury severity. We are investigated how much and what kind of injuries the athlete had suffered as well as a recurrence of the same injury over the period of 2011. As javelin throwers, shot putters and discus throwers' training principles and some technical moments had much in common with each other, we combined them into one group called the Throwers. The same was done with sprint types: 100 m, 200 m, 400 m, 4 × 100 m, 4 × 400 m, we called them the Sprinters, similar event categories were distinguished in the article "Track and field athletics injuries – a one-year survey" written by David D'Souza MB ChB and published by British Journal of Sports Medicine in 1994. Due to this, we suspected to have more accurate results on the injured body parts and the areas of injury.

Data analysis was performed using Statistical Package for Social sciences (SPSS) version 17. Mann Whitney U test was used for nonparametric two independent samples, Student's t-test for independent samples was used for the significance of the difference between the means of groups. We chose the significance level of 0.05

RESEARCH RESULTS

During the chosen study period we examined 36 athletes: 15 throwers (8 javelin, 4 discus, and 3 shot putters), 21 sprinters. Three athletes from 36 (1 thrower and 2 sprinters) did not have injuries. Statistically significantly more athletes experienced injuries ($p < 0.05$). There were 64 injuries cases from these 33 athletes: head and trunk 12 (18.8%): neck 1 (1.6%), chest 1 (1.6%), back 2 (3.1%) lumbar 5 (7.8%), gluteal 3 (4.7%). Upper extremity 14 (21.9%): wrist 1 (1.6%) elbow 4 (6.3%) shoulder 9 (14.1%). Lower extremity 38 (59.4%): foot 1 (1.6%), ankle 13 (20.3%), Achilles 4 (6.3%), calf 1 (1.6%), popliteal 2 (3.1%), knee 5 (7.8%), inguinal 3 (4.7%) quadriceps 2 (3.1%), hamstrings 7 (10.9%) (Figure 1, 2). The lower extremity injuries statistically significantly dominated comparing with upper extremity ($p < 0.05$) and head and trunk ($p < 0.05$) injuries.

Figure 1. **All injuries cases analysed in study**



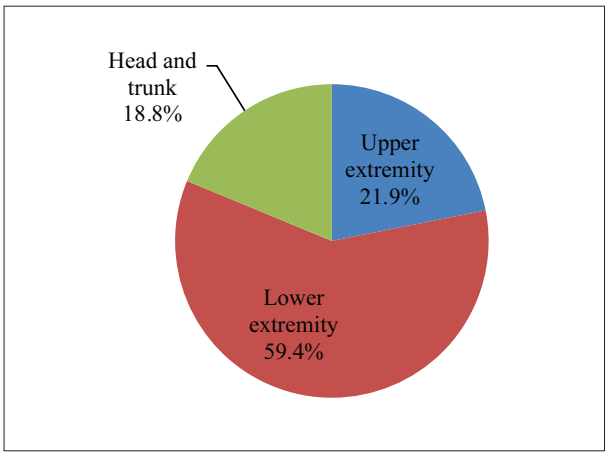


Figure 2. **Distribution of injury cases by body parts in thrower and sprinter cohorts**

In the group of throwers 14 athletes had 33 cases of injuries; from the group of sprinters 19 athletes had 31 injuries, so overall 33 athletes experienced 64 cases of injuries.

From 33 injury cases in the throwers group, body injuries were classified as: upper extremity – 14 (42,4%): shoulder – 9 (27.3%), elbow – 4 (12.1%) wrist – 1 (3%), lower eextremity – 14 (42,4%): ankle – 5 (15.2%), Achilles – 2 (6.1%), hamstrings – 1 (3%), inguinal – 1 (3%), knee – 4 (12.1%), calf – 1 (3%), head trunk – 5 (15.2%): lumbar – 2 (6.1%), back – 2 (6.1%), chest – 1 (3%) (Figures 3, 5). There was no statistically significant difference between lower and upper extremities in this group.

In the sprinters' group, from 31 injuries 24 (77.4%) were in the lower extremity: foot – 1 (3.2%), knee – 1 (3.2%), Achilles – 2 (6.5%), ankle – 8 (25.8%), quadriceps – 2 (6.5%), hamstrings – 6 (19.4%), popliteal – 2 (6.5%), inguinal – 2 (6.5%), head and trunk – 7 (22.6%) injuries: neck – 1 (3.2%), lumbar – 3 (9.7%), gluteal – 3 (9.7%) and no upper extremity injuries (Figures 4, 6).

Comparing upper extremity injuries in throwers and sprinters, upper extremity injuries dominated statistically significantly ($p < 0.05$) in the throwers' group.

Lower extremity was injured in sprint (24 cases) rather than in throwers (14 cases).

There were more very mild and mild injuries – 47 cases (73.4 %) compared with severe and very severe injuries – 11 cases (17.2%) in both groups ($p < 0.05$) (Table).The degree of mild and very mild injuries dominated in both groups of athletes comparing them with very severe and severe injuries.

Recurrence of the same injury:

From 31 injury cases in sprinters, 2 athletes had the same area injury recurrence:

- For 1 athlete trunk injury recurred 2 times;
- For 1 athlete ankle injury recurred 2 times.

- From 33 injury cases in throwers, 2 athletes had the same area injury recurrence:
- For 1 athlete shoulder injury recurred 2 times;
- For 1 athlete knee injury recurred 2 times.

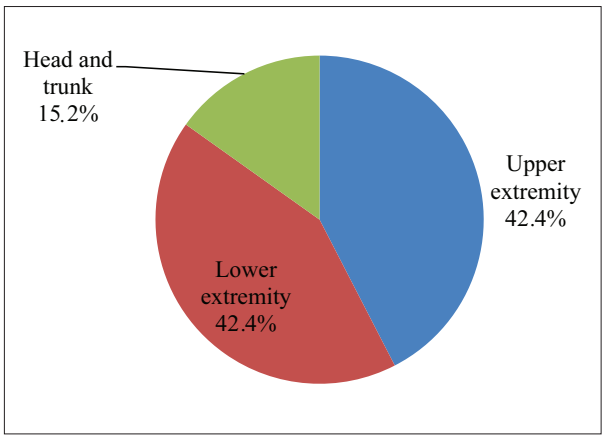


Figure 3. **Throwers' injured body parts**

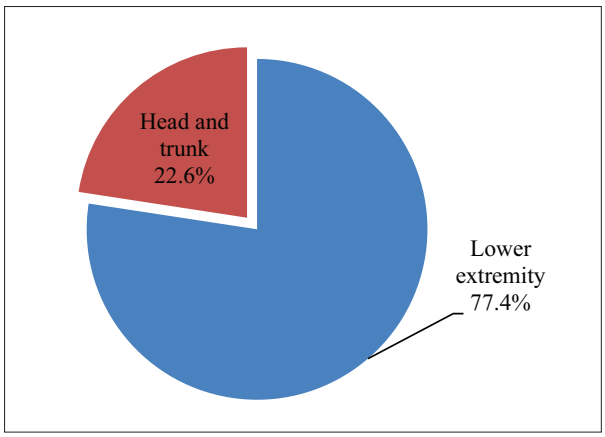


Figure 4. **Sprinters injured body parts**

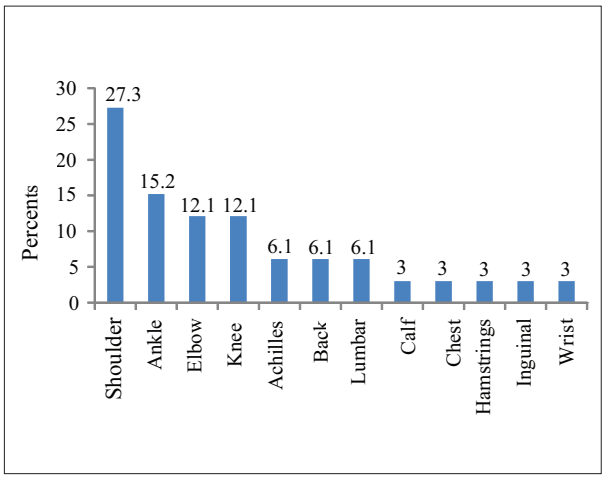


Figure 5. **Injuries in thrower cohort**

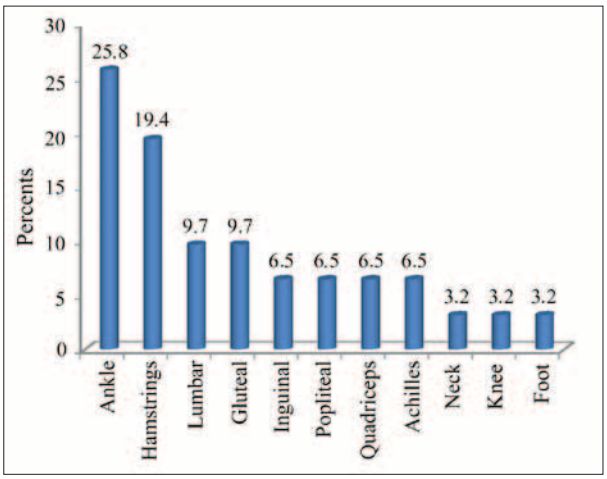


Figure 6. **Injuries in sprinter cohort**

Table. **Severity degree of examined injuries among throwers and sprinters**

Severity degree of injuries	Number of injury cases	Percent of injury cases
Very mild injuries	23	35.9
Mild injuries	24	37.5
Moderate injuries	6	9.4
Severe injuries	9	14.1
Very severe injuries	2	3.1
Totally	64	100

DISCUSSION

Youth have very high participation rates in sport, and sport is the leading cause of youth injury in many countries (Emery, 2010). The injury prevalence is high among Swedish elite track and field athletes (Jacobsson et al., 2012). The most common injury cases in our work were the lower extremity injuries (59.4%). The dominant areas in lower extremity were ankle (20.3%), hamstrings (10.9%) (Figure 1). Similar results were obtained by some authors: most of injuries affect the lower extremities (Watson, Di Martino, 1987; Bennell, Crossley, 1996; Pastre et al., 2004; Zemper, 2005; van Gent et al., 2007; Graff et al., 2009; Owoeye et al., 2009; Alonso et al., 2010; Jacobsson et al., 2012). There is a lack of scientific works about athletes' injuries in track and field in Lithuania. We examined 36 athletes and their 64 injury cases and found that the frequency of injuries in these athletes was high. In our work the most common cases in sprinters' group were the lower extremity injury cases – 24 (77.4%). The dominant areas of lower extremity were ankle – 8 (25.8%), hamstrings – 6 (19.4%). In throwers' group, the lower extremity injuries were most frequent in the areas of ankle – 5 (15.2%), knee – 4 (12.1%) and in upper extremity the most frequent place was shoulder – 9 (14.1%). There were no upper extremity injury cases in sprinters' cohort.

Due to our work, sports physicians in Lithuania can better prepare to provide medical treatment as they know what parts of body are most frequently injured. We expected to find the most common injured body parts in Athletics and we hope that our results will be similar to the ones of foreign authors. Knowing what areas of the body are most injured among the track and field athletes, in the future we will be able to analyze what kind of structure and nature the injury is.

The scientific rigor used in the selection and application of statistical analysis techniques is critical to avoid reporting misleading results (Emery, 2010). One of the limitations in this study was the limited number of cases available for such analysis but the results obtained during the study allow distinguishing the tendencies. It is well known that using specific training programmes, it may be possible to reduce the incidence injuries (Bahr, Krosshaug, 2005). Knowing which body parts could be damaged during active exercising in one or other athletic event we suggest to adjust specific training programs for young athletes, increasing the amount of exercises designed for the functional preparation of those body parts.

CONCLUSIONS AND PERSPECTIVES

1. Estimating which body parts are mostly injured in sports gives possibility to adjust training programs for athletes, increasing amount of athletic exercises intended for the functional preparation of those parts.

2. Injuries in track and field are frequent, and the dominant injuries are in the lower extremity; there is a possibility of recurrence of the same body part injury.

3. Injuries prevalent in sprinter cohort are in lower extremities, and injuries prevalent in throwing cohort are in lower and upper extremities equally.

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LENGVOSIOS ATLETIKOS SPRINTO IR METIMŲ RUNGČIŲ SPORTININKŲ TRAUMŲ YPATUMAI

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Įvertinus, kurios kūno sritys dažniausiai traumuojamos ir koks lengvosios atletikos sportininkų traumų sunkumo laipsnis, galima koreguoti sportinio rengimo programas.

Tikslas – įvertinti, kurias kūno sritis dažniausiai pažeidžia metikai ir sprinteriai, koks pažeidimo sunkumo laipsnis ir kaip dažnai traumos kartojasi.

Metodai. 36 atletams buvo duota anketa, sudaryta remiantis Tarptautinio olimpinio komiteto patvirtinta standartizuota metodologija ir įgyvendinama Tarptautinės lengvosios atletikos federacijos per tarptautines lengvosios atletikos varžybas.

Rezultatai. 33 atletams buvo nustatyti 64 pažeidimų atvejai: galvos ir liemens 12 (18,8%), rankų 14 (21,9%), kojų 38 (59,4%). Taigi kojų pažeidimai dominavo.

Apklausiant sprinterius, vyravo kojų pažeidimai ir nebuvo nė vieno rankų pažeidimo. Tuo tarpu metikai pažymėjo, kad kojos ir rankos buvo traumuojamos vienodai. Labai lengvi ir lengvi pažeidimų atvejai dominavo, palyginti su sunkiais ir labai sunkiais. Tos pačios traumos kartotinumas buvo toks pat abiejose grupėse.

Aptarimas ir išvados. Įvertinus, kurios kūno sritys dažniausiai traumuojamos sportinėje veikloje, galima koreguoti sportininkų rengimo programas didinant atletinio rengimo pratimų apimtis, skirtas šių kūno dalių funkciniam parengtumui ugdyti. Kojų pažeidimai yra dažniausiai pasitaikanti lengvosios atletikos sportininkų trauma. Didelė tikimybė tai pačiai traumai pasikartoti. Tarp sprinterių vyrauja kojų pažeidimai, tarp metikų – kojų ir rankų.

Raktažodžiai: lengvoji atletika, sportinė trauma, kūno sritys.

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DIFFERENCES IN MUSCLE STRENGTH OF THE DOMINANT AND NON-DOMINANT LEG OF HIGH PERFORMANCE FEMALE ATHLETES

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Lithuanian University of Health Sciences, Medical Academy[1], Kaunas, Lithuania
Lithuanian Sports University[2], Kaunas, Lithuania

ABSTRACT

Research background and hypothesis. According research literature, the imbalance of hip muscles in the dominant and non-dominant leg can cause wear and tear of the knee joint or tendinitis. Therefore the study was carried out to determine whether there were differences in muscle strength and if muscle differences had influence on knee joints of dominant and non-dominant legs for high performance women athletes.

Research aim was to compare muscle strength of knee flexor, extensor and hip abductor, adductor muscles of the dominant and non-dominant legs for high performance female athletes.

Research methods. There were 53 high performance female athletes participating in the study, whose maximum strength of flexor and extensor muscles of knee, as well as abductor and adductor muscles of hip had been measured using a dynamometer MMT – *Manual Muscle Tester*.

Research results. The strength of flexor and extensor muscles of knee of the non-dominant leg was significantly higher than that of the dominant leg. There was no statistically significant difference in strength of abductor and adductor muscles of the dominant and non-dominant leg.

Discussion and conclusions. The strength of flexor and extensor muscles of knee of non-dominating leg for high performance female athletes was significantly greater than muscle strength of the dominant leg. There was no statistically significant difference in the strength of the abductor and adductor muscles of hip of the dominant and non-dominant leg. It is advisable to develop exercises to strengthen these muscle groups in order to prevent knee injury in the future.

Keywords: knee flexors, knee extensors, hip abductors, hip adduction.

INTRODUCTION

The difference in strength of the same muscles of one and the other leg depends on each different branch of sports (Coombs et al., 2002). According to K. R. Ford and the co-authors (2003), the dominance of lower limb is a stronger dominance of one limb, manifested by increased dynamic power control, thus causing imbalance of muscles and asymmetries between the two extremities. The load attributable to the dominant limb may increase joint tension of that limb.

According to C. Jacobs and the co-authors (2005), the dominance of one limb may be the cause of weakness of the opposite limb. It has been established that the non-dominant limb reduces the ability to accommodate large external forces during exercise. Therefore, the authors have drawn attention to the dominance of one leg, as it has been related to the strength and function of leg muscles.

However, several studies have shown there has been no significant difference in strength of flexor

and extensor muscles of knee between the dominant and non-dominant leg (Nadler et al., 2002). However, the study carried out by M. Hägglund et al. (2012) has revealed the fact that not only the difference of strength of muscles of the same hip, but also the difference higher by 10 percent of muscle strength between the dominant and non-dominant leg may increase the risk of injury for athletes.

According to C. Jacobs and C. G. Mattacole (2004), there can be differences of muscle strength between the dominant and non-dominant leg in joints of hip and knee seen while performing functional tasks, such as a canter. There is a highly possible functional difference in the abductor and adductor muscles of the dominant leg.

The studies have shown (Lanshammar, Ribon, 2011; Hägglund et al., 2012) that there may be a significant physiological difference between the strength of hip muscles. The majority of athletes, having this difference in muscle strength, have had complaints about it. What is more, in order to address this problem it is very important to create adequate rehabilitation objective. It should also be noted that there are, however, distinguished details in the literature about the difference of strength of the hip muscles between the dominant and non-dominant leg. This fact has encouraged the high performance female athletes to carry out the study.

The aim of the study was to compare muscle strength of knee flexor, extensor and hip abductor, adductor muscles of the dominant and non-dominant leg of high performance female athletes.

RESEARCH METHODS

There were 53 high performance female athletes participating in the study at Kaunas Center of Sports Medicine. The athletes had been engaged in sports (handball and basketball) for 12 ± 4.36 years; 5 times a week for 1.5 hours (Table). The study was carried out in accordance with the Declaration of Helsinki.

Table. **Characteristics of the study group**

Group	Age, yrs	Height, m	Weight, kg	Sports experience, yrs
53 high performance female athletes	22 ± 4.10	1.74 ± 0.07	69 ± 8.19	12 ± 4.36

The strength of hip muscles was measured using Nicholas Manual Muscle Tester (Sisto, Dyson-Hudson, 2007). We measured the maximum strength of flexor and extensor muscles of knee, and abductor and adductor muscles of hip of the dominant and non-dominant leg (Figure 1).

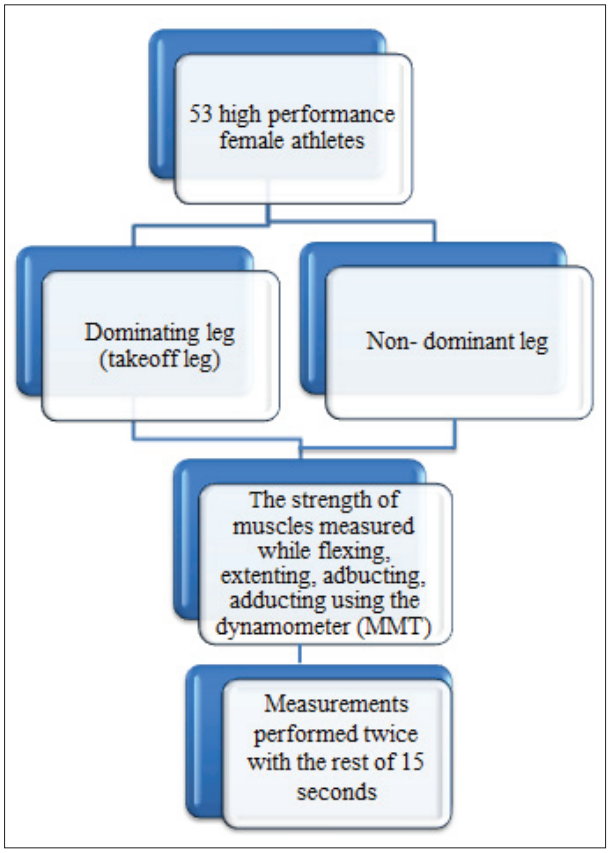

Figure 1. **Course of the study**

The study was carried before the workout. The initial position of the person examined in the knee extension was as follows: the person examined sat on the couch with the leg bent over the knee at the ankle joint at 90 degrees, the back was straight, and feet did not touch the ground. At the moment when the person examined was extending the knee, the tester provided resistance by placing the dynamometer at the distal part of the knee. The person had to overcome the resistance force provided by the tester by extending the knee at the maximum capacity within 3 seconds.

The initial position of the person examined in the knee flexion was as follows: the person examined sat on the couch with the leg bent over the knee at the ankle joint at 90 degrees, the back was straight, and feet did not touch the ground. At the moment when the person examined was flexing the knee, the tester provided resistance by placing the dynamometer at the rear part of the knee. At the moment of knee flexion the tester had to stabilize the back and the leg of the person examined. The person had to overcome the resistance force provided by the tester

by flexing the knee at the maximum capacity within 3 seconds (Dunn, Iversen, 2003).

The initial position of the person examined in the hip adduction was as follows: the person examined lied on the opposite side than the examined leg; one hand was kept under the head, the other was put on the edge of the couch. The other lower leg of the person was bent at 90 degrees, and it was being extended when examined. The researcher captured the hip of the person examined with one hand and provided resistance by placing the dynamometer at the distal end of the fibula. The person had to overcome the resistance force provided by the researcher by pulling back the knee at the maximum capacity within 3 seconds (Fredericdon, Cookingham, 2000).

The initial position of the person examined in the hip abduction was as follows: the persons examined lied on the same side as the leg examined; one hand was kept under the head, the other was put on the edge of the couch. The other lower leg of the person was bent at 90 degrees. The researcher captured the hip of the person examined with one hand and provided resistance by placing the Dynamometer at the distal end of the tibia. The person had to overcome the resistance force provided by the researcher by pulling in the knee at the maximum capacity within 3 seconds. (Fredericdon, Cookingham, 2000). In case the athletes used the surrounding (compensatory) muscles in examination, the testing would be stopped and started over again. The reliability of information remained high until the strength measured 10% less than the force provided by the examiner (Fredericdon, Cookingham, 2000). Every move was performed twice with the rest of 15 seconds. Calculation of the average of two results was performed.

Mathematical Statistics. We used SPSS program for the data analysis. The paired Student's *t* test was applied to compare the dependent samples, when the data did not differ from a normal distribution; and the non-parametric Wilcoxon test was used to compare the data to establish a significant difference. Differences at $p < 0.05$ were considered to be statistically significant. Results were presented as the arithmetic mean (m) ± the standard deviation of the average estimate.

RESEARCH RESULTS

According to the results obtained, the strength of extensor muscles of knee of the non-dominant leg was 4.7 kg ± 0.65 and the dominant leg – 13.8 kg ± 0.62 kg. The study revealed that the strength of muscles of the non-dominant leg was statistically significantly higher ($p < 0.05$) than that of the dominant leg (Figure 2).

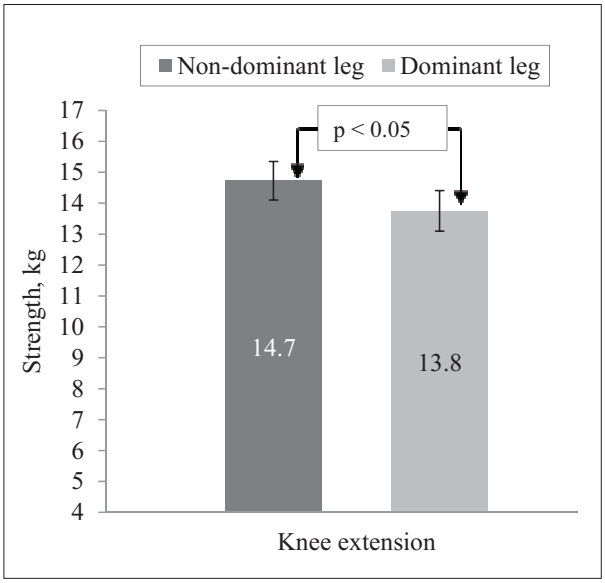

Figure 2. **Change in the strength (kg) of muscles of the dominant and non-dominant leg after the knee extension**

Change in the strength (kg) of muscles of the dominant and non-dominant leg can be seen in Figure 3. According to the results obtained, the strength of flexor muscles of knee of the non-dominant leg was 1.7 kg ± 0.65 and dominant leg – 11 kg ± 0.61. The study revealed that the strength of muscles of the non-dominant leg was statistically significantly higher ($p < 0.05$) than that of the dominant leg.

The strength of adductor muscles of hip of the dominant leg (8 kg ± 0.55) had an insignificant trend to grow compared to the strength of adductor muscles of hip of the non-dominant leg (7.7 kg ± 0.33). There was no significant difference in the dominant and non-dominant leg comparing the strength of the adductor muscles of hip of the dominant and non-dominant leg ($p > 0.05$) (Figure 4).

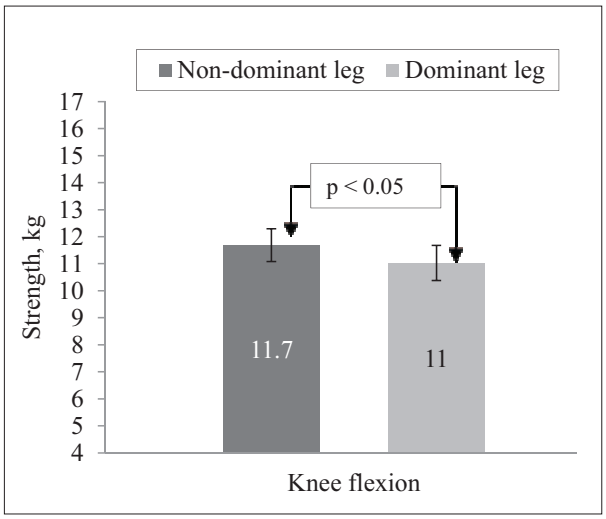

Figure 3. **Change in the strength (kg) of muscles of the dominant and non-dominant leg of the female athletes after the knee flexion**

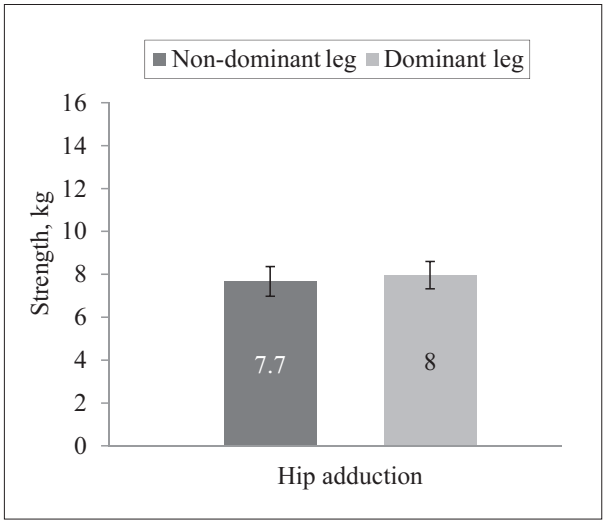

Figure 4. **Change in the strength (kg) of muscles of the dominant and non-dominant leg of the female athletes after the hip adduction**

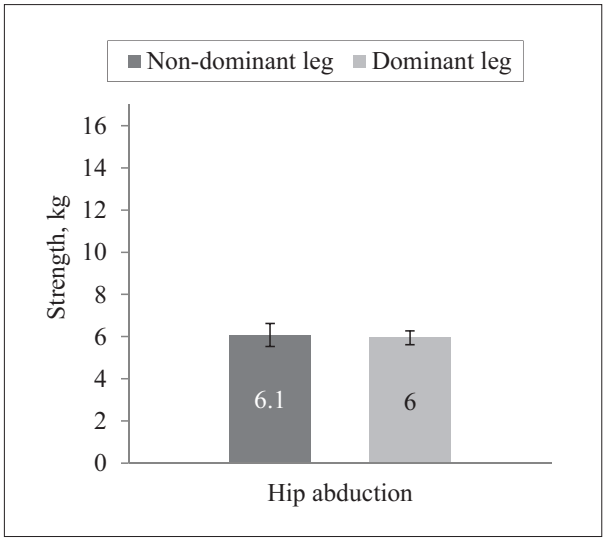

Figure 5. **Change in the strength (kg) of muscles of the dominant and non-dominant leg of the female athletes after the hip abduction**

Change in the strength of muscles of adductor muscles of hip of the dominant and non-dominant leg can be seen in Figure 5. The strength of the abductor muscles of hip of the non-dominant (6.1 kg ± 0.69) and the strength of the abductor muscles of the dominant leg (6 kg ± 0.64) had an insignificant tendency to increase. There was no significant difference in the dominant and non-dominant leg in comparing the strength of the abductor muscles of hip of the dominant and non-dominant leg ($p > 0.05$).

DISCUSSION

Branches of team sports are multifaceted, requiring a well-developed physical condition to be able to play successfully (Chaouachi et al., 2009). A. Chaouachi and the others (2009) have also found the strength, power, agility and speed to be important factors for high performance athletes. According to the study conducted, the basketball players who perform exercise for muscle strength and flexibility do not to face imbalances of flexor and extensor muscles of knee between the dominant and non-dominant leg (Schiltz et al., 2009). It is, therefore, important to track differences in muscle strength and balance of high performance athletes in order to avoid knee injuries in the future.

Our study found out a significant difference of strength of flexor and extensor muscles of knee between the dominant and non-dominant leg of high performance female athletes. The strength of muscles of non-dominant leg was found to be statistically significantly greater than the strength of the dominant leg after the measurement of the flexor and extensor muscles of knee for the athletes. According to K. Lanshammar and E. L. Ribon (2011), there is also statistically significant asymmetry in muscle strength between the dominant and non-dominant leg of female athletes. However, their study revealed the strength of flexor muscles of knee to be greater by 8.6% in the non-dominant leg, while the strength of extensor muscles of knee would be greater by 5.3% in the dominant leg. According to the conducted study, the interrelationship of the hip muscles was greater in the non-dominant leg. Physical activity has been stated to have particularly significant impact on this fact.

The study results may have been apparently affected by excessive exercise and the dominant leg fatigue. Regardless the branch of sports, the dominant leg of all the female athletes examined

is the take-off leg which helps to perform the high jump or long jump. If athletes are right handed, this hand would be used as the fine motor skill hand. Hence, the right leg would also be used as fine motor skills leg (for instance, a ball kicking), these are daily movements performed by the non-dominant leg and not to be performed at the time of some sports event. It is believed that the dominant leg is to be used for skills, while the non-dominant leg is used to achieve those skills (Rahnama et al., 2005).

According to P. W. Kong and the others (2010), however, the conducted study showed that forty physically active women would perform muscle strengthening exercises for quadriceps and biceps for both legs at least 3 times a week. The dominant leg would have a greater difference in the strength of hip muscles, compared to the non-dominating leg. Physical exercise is believed to strengthen the weaker leg and make it dominant while doing the exercises (Kong et al., 2010).

Our study also revealed the fact that the strength of adductor muscle of the hip would be tendentiously increasing in the dominant leg, while there the strength of abductor muscles of the hip would increase, however, there would be no statistically significant differences found in the strength of abductor and adductor muscles of the hip in the dominant and non-dominant leg. According to the study carried out by C. Jacob and the others (2007), the strength of abductor and adductor muscles of the hip would not have any change between the right and left leg. This suggests the athletes examined would not have any muscle imbalances between the one and other leg.

However, the author states, if the hip adductor muscle imbalance in power athletes in the future can lead to chronic knee injuries, including pain in the patellar joint surface of the femur and tibia, the tendon friction syndrome. According to K. McCurdy and G. Langford (2005), the imbalance of the muscles of the lower extremities is related to the increasing risk of damage occurring in a later period of training. According to K. Thorborg and the others (2011), the strength of abductor and adductor muscles of the hip in the dominating leg would be 14% greater than in the non-dominant leg. The results are believed to have been influenced by the nature of sports and specifics of the exercises performed providing workload on the adductor and abductor muscles. The greater workload is possible for adductor muscles of the hip while performing more lateral movement along with abductor muscles of the non-dominant leg. Specificity of sports such as basketball and handball include not only flexing and extension movements within hip (running forward or backward), but abduction and adduction movements as well while performing the leg movements from side to side). In our case, there is imbalance of muscles of the hip visible in the dominant and non-dominant leg, so it is advisable to develop exercises to strengthen these muscle groups in order to prevent knee injury in the future.

CONCLUSIONS AND PERSPECTIVES

1. The strength of flexor and extensor muscles of the thigh of high performance athletes is significantly greater in the dominant leg compared to the non-dominant leg.

2. There is no statistically significant difference in abductor and adductor muscles of the hip in the strength of muscles of the dominant and the non-dominant leg.

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DIDELIO MEISTRIŠKUMO ŽAIDIMO ŠAKŲ SPORTININKIŲ DOMINUOJANČIOS IR NEDOMINUOJANČIOS KOJOS RAUMENŲ JĖGOS SKIRTUMAI

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Literatūroje rašoma, kad dominuojančios ir nedominuojančios kojos šlaunies raumenų disbalansas gali sukelti kelio sąnario nusidėvėjimą ar sausgyslių uždegimą. Todėl norėta patikrinti, ar yra raumenų jėgos skirtumų ir kaip jie veikia didelio meistriškumo sportininkių dominuojančios ir nedominuojančios kojos kelio sąnarius.

Tikslas – palyginti didelio meistriškumo žaidimo šakų sportininkių dominuojančios ir nedominuojančios kojos blauzdos tiesiamųjų, lenkiamųjų ir dubens atitraukiamųjų, pritraukiamųjų raumenų jėgą.

Metodai. Buvo tiriamos didelio meistriškumo žaidimo šakų sportininkės (n = 53), kurioms buvo matuojama dominuojančios ir nedominuojančios kojos maksimalioji blauzdos lenkiamųjų, tiesiamųjų raumenų ir dubens atitraukiamųjų, pritraukiamųjų raumenų jėga (dinamometru MMT – *Manual Muscle Tester*).

Rezultatai. Nedominuojančios kojos blauzdos lenkiamųjų ir tiesiamųjų raumenų jėga (kg) statistiškai reikšmingai didesnė ($p < 0,05$) nei dominuojančios. Sportininkių dominuojančios ir nedominuojančios kojos dubens pritraukiamųjų ir atitraukiamųjų raumenų jėgos (kg) statistiškai reikšmingo skirtumo nebuvo ($p > 0,05$).

Aptarimas ir išvados. Didelio meistriškumo žaidimo šakų sportininkių blauzdos tiesiamųjų ir lenkiamųjų raumenų jėga statistiškai reikšmingai didesnė nedominuojančios kojos nei dominuojančios. Taip pat nėra statistiškai reikšmingo skirtumo tarp dominuojančios ir nedominuojančios kojos dubens atitraukiamųjų ir pritraukiamųjų raumenų jėgos. Norint išvengti kelio pažeidimų, patartina naudoti šių raumenų grupių stiprinimo pratimus.

Raktažodžiai: kelio lenkiamieji, kelio tiesiamieji, klubo atitraukiamieji, klubo pritraukiamieji raumenys.

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PHYSICAL FITNESS RESULTS OF SOLDIERS OF DIFFERENT AGE GROUPS IN THE LAND FORCE OF THE LITHUANIAN PROFESSIONAL ARMED FORCES IN 2010–2011

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ABSTRACT

Research background and hypothesis. Since 2009 Lithuanian Armed Forces have been formed from soldiers in professional service. Research on military physical fitness in the Lithuanian Armed Forces is scarce. This research aims at verifying the hypothesis that physical fitness indices of soldiers in the Land Force of the professional Lithuanian Armed Forces match the established physical fitness normative requirements.

Research aim was to study peculiarities of changes in physical fitness results of soldiers of different age groups in the Land Force of the Lithuanian Professional Armed Forces in the period of two years.

Research methods: literature review, physical fitness testing, statistical analysis of physical fitness indices. Results in each physical fitness exercise were evaluated in points according to physical fitness normative scales. The sum of points for all exercises was the final physical fitness evaluation result.

Research results. In the period of half a year, from spring to autumn and from autumn to spring, physical fitness of soldiers in all age groups changed only slightly ($p > 0.05$). During the period of one year, from testing in spring till testing in spring of the following year, physical fitness indices improved ($p < 0.05$). Even 2–4% of soldiers failed physical fitness normative tests.

Discussion and conclusions. Physical fitness indices of different exercise for soldiers in the Land Force of the professional Lithuanian Armed Forces were higher than the established minimal normative requirements. The highest physical fitness indices were achieved in the age groups of 18–21, 22–26, 27–31 and 30–36 years, however, the differences between the age groups were insignificant.

In perspective, while developing military physical fitness control system, the evaluation of physical fitness should be differentiated according to the normative scale which includes such evaluations as “excellent”, “good”, “fair”.

Keywords: Land Force, physical fitness, testing, physical fitness test, age group, points.

INTRODUCTION

Military physical training is a very important structural part of the military training (Greičius et al., 1998; *Lietuvos gynybos politikos baltoji knyga,* 2002; Sokołovski, 2002; Gorski, 2007; Witkovski, Stefaniak, 2007). After Lithuania entered NATO, physical fitness of soldiers in the Lithuanian Armed Forces has to meet the requirements for soldiers in all NATO Armed Forces (*Karių fizinio rengimo metodinės rekomendacijos,* 2003). In NATO Armed Forces, physical training and physical fitness of soldiers receive much attention; self-training in physical activity is emphasized (Sokolovski, 2002; Dyrstad et al., 2006; Janowski et al., 2009; Kruszkovski et al., 2011). The problem of physical fitness in professional armed forces is a research object for

many researchers (Faff et al., 2002; Dyrstad et al., 2006; Młynarczyk et al., 2007; Dybińska, 2009, 2011; Dobosz, Świercz, 2011).

Since 2009 Lithuanian Armed Forces have been formed from soldiers in professional service. Irrespective of the military rank, age limits and the positions, all soldiers need optimal levels of physical fitness according to their age group. Research on military physical fitness in the Lithuanian Armed Forces is scarce (Savonis, Čepulėnas, 2011, 2012). Physical training systems in the Lithuanian Military Academy as well as changes in physical fitness of cadets during their studies have been studied by other researchers (Radžiukynas, 1999; Radžiukynas, Endrijaitis, 2003; Streckis et al., 2004; Sipavičius et al., 2008).

Changes in physical fitness of compulsory military service conscripts have been studied by A. Vilkas et al. (1994), D. Radžiukynas et al. (2006), E. Trinkūnas (2009), and V. Ivaškienė (2010). Professional armed forces include soldiers of different age, and reference standards of physical fitness are differentiated according to age. Land Force comprises the majority of the Lithuanian Professional Armed Forces.

The **aim** of the current research was to study peculiarities of changes in physical fitness results of soldiers of different age groups in the Land Force of the Lithuanian Professional Armed Forces in the period of two years.

RESEARCH METHODS

Research sample included the professional service land force soldiers of eight age groups: 18–21, 22–26, 27–31, 32–36, 37–41, 42–46, 47–61 and 52–56 years of age. The data of the research participants who passed the standard physical fitness tests are provided in Table 1 and Table 2. The tests were carried out four times – in 2010 and 2011, in spring (April) and autumn (October). Research timetable was approved by the order of the Land Force Commander.

Research participants were soldiers of all military ranks – from enlisted soldiers to Generals. During each study the soldiers performed Army Physical Fitness Test (APFT) which was prepared following the recommendations of the physical fitness and physical training test used in the USA Armed Forces (Physical Fitness Training FM21-20). This test was approved by the Order No. V-980, October 4, 2007, of the Lithuanian Minister of National Defence.

The test included the following physical exercises:

- Arm strength endurance – bending and reaching arms in a lying position for 2 min;
- Abdominal muscle strength endurance – sit ups for 2 min;
- Aerobic endurance – 3000 m run.

The result of each exercise was assessed in points according to Military Physical Fitness Reference Scales (Savonis, Čepulėnas, 2011, 2012). In each age group, the assessment in points for each exercise was different. Minimal results of a control exercise had to reach 60 points (this was the norm for a pass). The highest assessment for a physical exercise was 100 points. Results between 60 and 100 points were evaluated in points according to a reference scale of each age group. The sum of points for all exercises comprised the total APFT result. In each exercise the soldier had to get no less than 60 points according to a reference scale of his age group.

Statistical analysis of the research data was carried out using *Microsoft Excel* and *Statistica – 8* programmes. The following parameters were calculated: arithmetic mean (x), standard deviation (± SD), Student's t test and index p for statistical significance. The level of significance was set at 95%, when $p < 0.05$.

RESEARCH RESULTS

Research results (Tables 1 and 2) showed that the majority of soldiers in the Land Force of the Lithuanian Armed Forces were 22–26, 27–31 and 32–36 years old, 500 soldiers in each age group on average. The age groups of 37–41 and 52–56 years had fewer soldiers. Very few soldiers were in the groups of 47–51 and 52–56 years of age. This can be explained by the fact that for military service this age is the age of retirement. We should note that rather few soldiers were in the group of 18–21 years of age. Young men of this age had finished schools and many of them studied in colleges and universities. At present they are not called for mandatory military service. Few of them choose professional military service. Tables 1 and 2 contain the results of all soldiers who have passed all APFT tests.

The indices of arm strength endurance (bending and reaching arms in a lying position for 2 min) for soldiers in all age groups (Tables 1 and 2) did not change significantly ($p > 0.05$) between the two tests in spring (I) and autumn (II) in 2010. In the course of one year, from spring (I) 2010 till spring

(III) 2011, the indices of arm strength endurance improved significantly ($p < 0.05$) in the age groups of 18–21, 22–26, 27–31 and 32–36 years. In the age groups of 37–41, 42–46, 47–51 and 52–56 years, changes in these indices were insignificant ($p > 0.05$). The highest relative evaluations in points for bending and reaching arms (in regard to the age norms) were given to soldiers in the groups of 18–21, 22–26, 27–31, 32–36 and 37–41years of age. In all age groups the evaluation of this exercise in points was higher than 60 – the minimal norm.

Abdominal muscle strength endurance indices (in sit ups for 2 min) improved significantly ($p < 0.05$) in the period of one year (from spring (I) 2010 till spring (III) 2011) in the age groups of 18–21, 22–26, 27–31 and 32–36 years (Table 1). The greatest relative evaluations in points for exercises were received by soldiers in the group of 18–21 years: from 79.58 ± 13.34 to 82.79 ± 13.27 points. The lowest evaluations were obtained by 47–51and 52–56 year-old soldiers. All soldiers except for the group of 47–51 years improved their results in

Table 1. **Changes in physical fitness indices of soldiers in the Land Force of the Lithuanian Armed Forces in different age groups (from 18 to 36 years of age) in the periods of 2010–2011 ($\bar{x}$ ± SD)**

Age group / p	Phase	n	Hand bending and stretch in lying position 2 min		Sit-ups 2 min		Run 3000 m	
			Result, times	Points	Result, times	Result, times	Points	Result, times
18–21	1	99	56.93 ± 10.28	79.96 ± 12.84	65.66 ± 9.05	79.58 ± 13.34	787.91 ± 53.15	84.51 ± 11.09
	2	132	59.92 ± 11.21	83.14 ± 12.68	67.47 ± 9.78	81.85 ± 13.50	789.18 ± 52.89	84.24 ± 10.97
	3	137	62.23 ± 11.29	86.10 ± 13.10	67.89 ± 9.37	82.79 ± 13.21	781.81 ± 56.95	85.33 ± 11.08
	4	167	60.39 ± 10.02	84.66 ± 12.21	67.81 ± 9.60	82.20 ± 12.61	781.69 ± 58.26	86.01 ± 11.41
p	1–2		< 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
	2–3		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
	1–3		< 0.001	< 0.001	> 0.05	< 0.01	> 0.05	> 0.05
	2–4		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
22–26	1	500	58.05 ± 12.82	79.92 ± 13.54	63.89 ± 10.59	78.08 ± 13.28	807.34 ± 66.64	83.83 ± 11.26
	2	435	58.39 ± 12.01	80.54 ± 13.00	64.32 ± 10.22	78.60 ± 12.70	810.13 ± 64.50	83.59 ± 11.30
	3	474	61.23 ± 12.22	83.49 ± 12.69	65.46 ± 10.35	80.01 ± 12.56	806.92 ± 65.50	84.07 ± 11.33
	4	486	58.33 ± 12.27	80.37 ± 12.55	64.27 ± 10.15	78.54 ± 12.51	817.42 ± 66.00	82.41 ± 11.30
p	1–2		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
	2–3		< 0.001	< 0.001	> 0.05	> 0.05	> 0.05	> 0.05
	1–3		< 0.001	< 0.001	< 0.025	< 0.025	> 0.05	> 0.05
	2–4		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.15
27–31	1	566	56.71 ± 13.05	78.32 ± 13.03	60.72 ± 12.09	76.64 ± 12.46	845.88 ± 68.24	80.87 ± 11.62
	2	509	56.50 ± 13.03	78.05 ± 12.81	60.58 ± 11.58	76.52 ± 11.98	841.96 ± 71.12	81.50 ± 11.82
	3	530	59.06 ± 12.93	80.71 ± 12.87	62.39 ± 11.75	78.47 ± 12.15	833.74 ± 69.65	82.79 ± 11.53
	4	509	57.76 ± 12.51	79.47 ± 12.39	62.16 ± 11.37	78.36 ± 11.98	839.32 ± 70.67	81.97 ± 11.41
p	1–2		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
	2–3		< 0.005	< 0.001	< 0.05	< 0.01	> 0.05	> 0.05
	1–3		< 0.005	< 0.005	< 0.025	< 0.005	< 0.01	< 0.005
	2–4		> 0.05	> 0.05	< 0.05	< 0.025	> 0.05	> 0.05
32–36	1	561	52.21 ± 12.83	76.88 ± 12.57	54.39 ± 11.62	74.16 ± 12.80	882.32 ± 72.31	78.11 ± 10.5
	2	500	52.76 ± 12.85	76.89 ± 12.59	55.06 ± 11.37	75.17 ± 12.93	875.99 ± 69.68	79.56 ± 10.2
	3	574	54.62 ± 13.13	78.81 ± 12.45	57.10 ± 11.80	77.30 ± 12.05	872.69 ± 75.14	80.11 ± 10.65
	4	505	53.14 ± 12.96	77.43 ± 12.40	55.59 ± 11.56	75.63 ± 12.86	873.39 ± 80.55	80.13 ± 11.0
p	1–2		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
	2–3		< 0.025	< 0.025	< 0.005	< 0.01	> 0.05	> 0.05
	1–3		< 0.005	< 0.001	< 0.001	< 0.001	< 0.05	< 0.025
	2–4		> 0.05	> 0.05	< 0.05	> 0.05	> 0.05	> 0.05

Table 2. **Changes in physical fitness indices of soldiers in the Land Force of the Lithuanian Armed Forces in different age groups (from 37 to 56 years of age) in the periods of 2010–2011 ($\bar{x}$ ± SD)**

Age group / p	Phase	n	Hand bending and stretch in lying position 2 min		Sit-ups 2 min		Run 3000 m	
			Result, times	Points	Result, times	Points	Result, s	Points
37–41	1	264	48.51 ± 12.18	74.55 ± 12.04	49.05 ± 11.38	71.38 ± 11.45	914.32 ± 76.62	78.00 ± 10.62
	2	285	48.03 ± 11.16	74.20 ± 11.34	49.67 ± 11.32	72.14 ± 11.71	909.53 ± 79.81	78.64 ± 11.05
	3	322	50.30 ± 11.72	76.66 ± 11.62	50.53 ± 11.62	73.11 ± 12.12	907.28 ± 81.87	79.19 ± 11.23
	4	346	65.21 ± 11.83	74.79 ± 11.62	49.85 ± 11.38	72.38 ± 11.67	911.34 ± 79.15	78.50 ± 11.09
p	1–2		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
	2–3		< 0.025	< 0.01	> 0.05	> 0.05	> 0.05	> 0.05
	1–3		> 0.05	< 0.05	> 0.05	> 0.05	> 0.05	> 0.05
	2–4		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
42–46	1	107	41.71 ± 10.93	72.84 ± 11.80	42.03 ± 10.80	69.92 ± 10.46	955.42 ± 84.64	75.64 ± 10.9
	2	112	42.31 ± 11.13	73.52 ± 11.98	42.82 ± 11.55	70.74 ± 11.32	945.76 ± 80.96	77.15 ± 10.99
	3	123	44.60 ± 11.60	76.00 ± 12.50	44.17 ± 11.59	72.08 ± 11.33	931.26 ± 86.69	79.01 ± 11.6
	4	120	44.30 ± 11.93	75.51 ± 12.63	44.15 ± 11.80	72.03 ± 16.49	926.62 ± 86.99	79.71 ± 11.1
p	1–2		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
	2–3		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
	1–3		< 0.05	< 0.05	> 0.05	> 0.05	< 0.05	< 0.05
	2–4		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
47–51	1	31	34.13 ± 10.09	71.32 ± 10.82	36.64 ± 7.55	67.29 ± 8.41	1004.03 ± 110.15	75.42 ± 11.68
	2	25	37.60 ± 10.94	73.80 ± 9.32	38.72 ± 6.81	69.60 ± 7.66	981.36 ± 103.27	76.14 ± 12.12
	3	39	33.31 ± 8.81	70.82 ± 9.01	37.10 ± 6.89	67.87 ± 7.65	1015.10 ± 109.35	74.31 ± 12.22
	4	35	35.43 ± 11.40	72.20 ± 10.87	37.60 ± 10.19	68.14 ± 10.59	982.94 ± 106.54	77.54 ± 10.91
p	1–2		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
	2–3		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
	1–3		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
	2–4		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
32–36	1	5	28.80 ± 7.25	67.40 ± 8.14	29.00 ± 0.70	61.00 ± 0.70	1020.20 ± 100.95	74.60 ± 13.11
	2	5	23.60 ± 3.85	63.80 ± 4.26	30.20 ± 3.49	62.20 ± 3.49	1038.60 ± 87.44	72.20 ± 11.37
	3	1	30.00 ± 0.00	71.00 ± 0.00	30.00 ± 0.00	62.00 ± 8.00	1118.80 ± 0.00	62.00 ± 0.00
	4	2	27.50 ± 3.53	68.50 ± 3.53	29.00 ± 1.41	61.00 ± 1.41	1105.00 ± 21.22	63.50 ± 20.12
p	1–2		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
	2–3		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
	1–3		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05
	2–4		> 0.05	> 0.05	> 0.05	> 0.05	> 0.05	> 0.05

this exercise, and the best results were obtained during the third testing (spring, 2011). The results of this exercise in points for all soldiers during each testing exceeded the minimal norm of 60 points.

The highest indices in aerobic endurance were achieved by 18–21-year-old soldiers. Their 3000 m running results changed from 787.91 ± 53.15 s during the first testing to 781.69 ± 58.26 s during the fourth testing. In the period of one year (from the first till the third testing), endurance improved statistically significantly for soldiers in the groups of 27–31, 32–36 and 42–46 years. In each testing, the average evaluation points in all those groups exceeded 80. Soldiers in all age groups demonstrated higher results for endurance compared to the results in arm bending exercise and sit ups.

Physical fitness of soldiers is evaluated by a sum of points in all APFT exercises. The maximal sum of points is 300, and the pass is 180 points. Results in all testing periods (Figures 1–8) showed that most points were obtained by soldiers in the

Figure 1. **Physical fitness evaluations in points (x ± SD) of 18–21 year-old soldiers in the Land Forces in the period of 2010–2011**

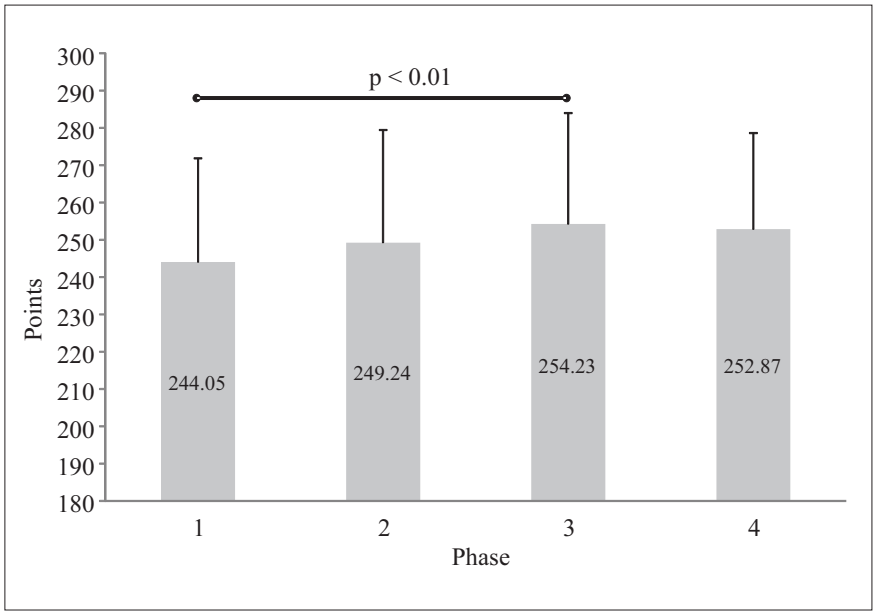


Figure 2. **Physical fitness evaluations in points (x ± SD) of 22–26 year-old soldiers in the Land Forces in the period of 2010–2011**

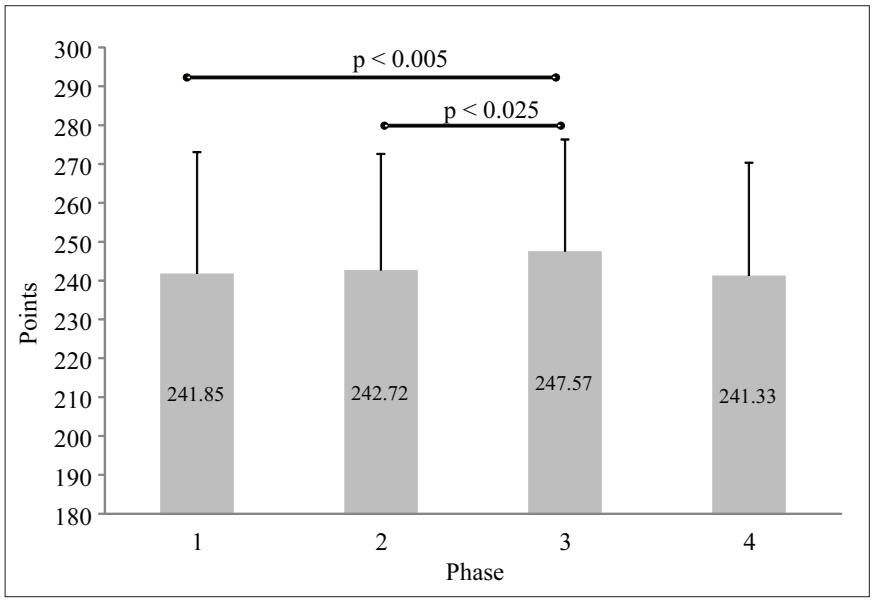
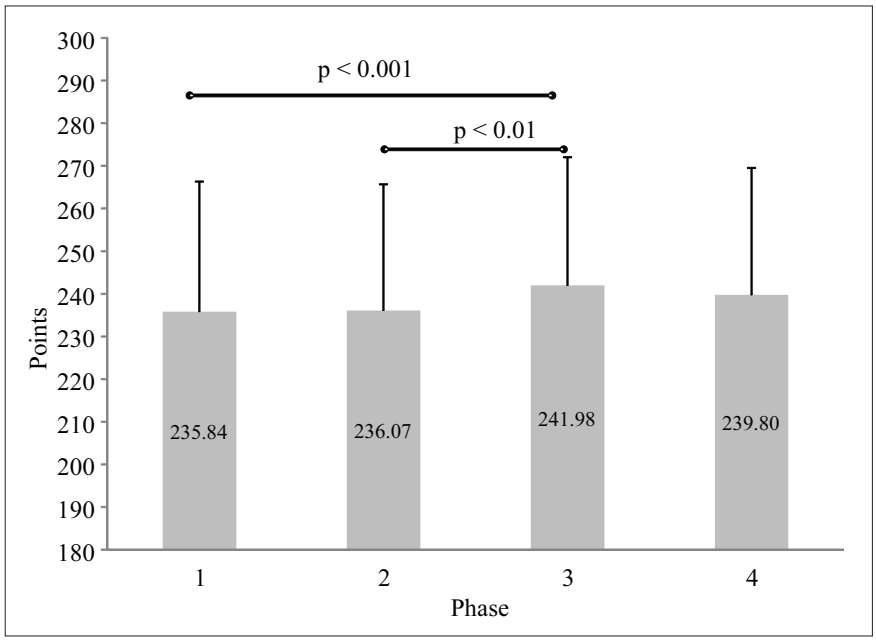


Figure 3. **Physical fitness evaluations in points (x ± SD) of 27–31 year-old soldiers in the Land Forces in the period of 2010–2011**



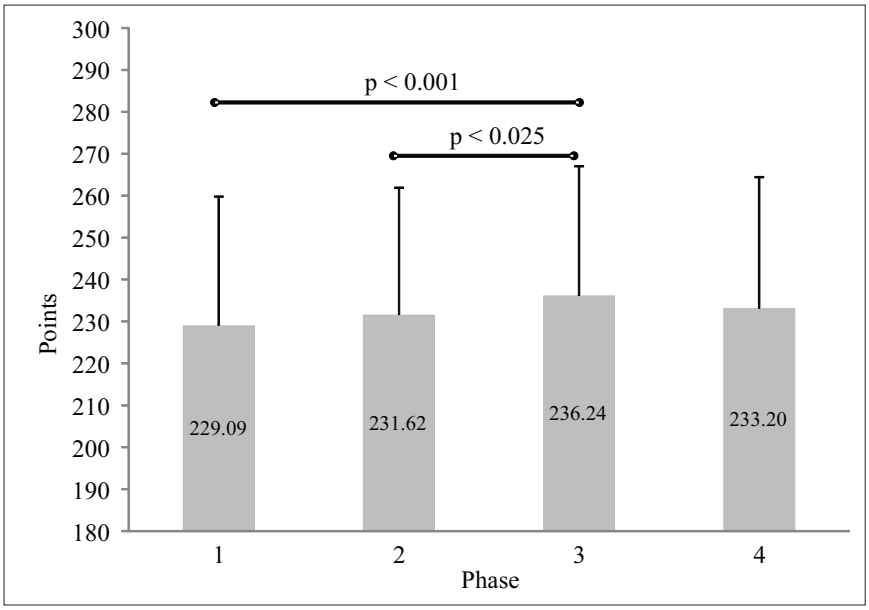


Figure 4. **Physical fitness evaluations in points (x ± SD) of 32–36 year-old soldiers in the Land Forces in the period of 2010–2011**

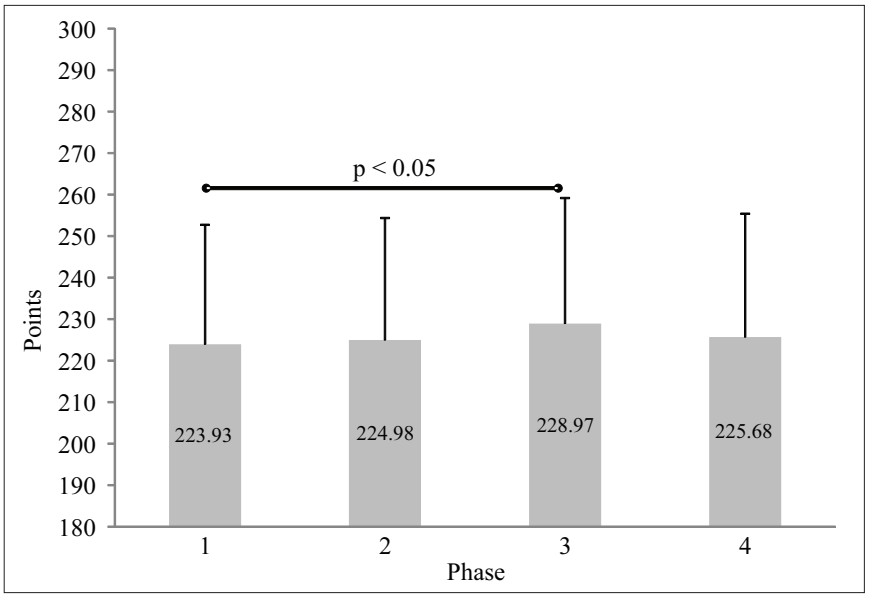


Figure 5. **Physical fitness evaluations in points (x ± SD) of 37–41 year-old soldiers in the Land Forces in the period of 2010–2011**

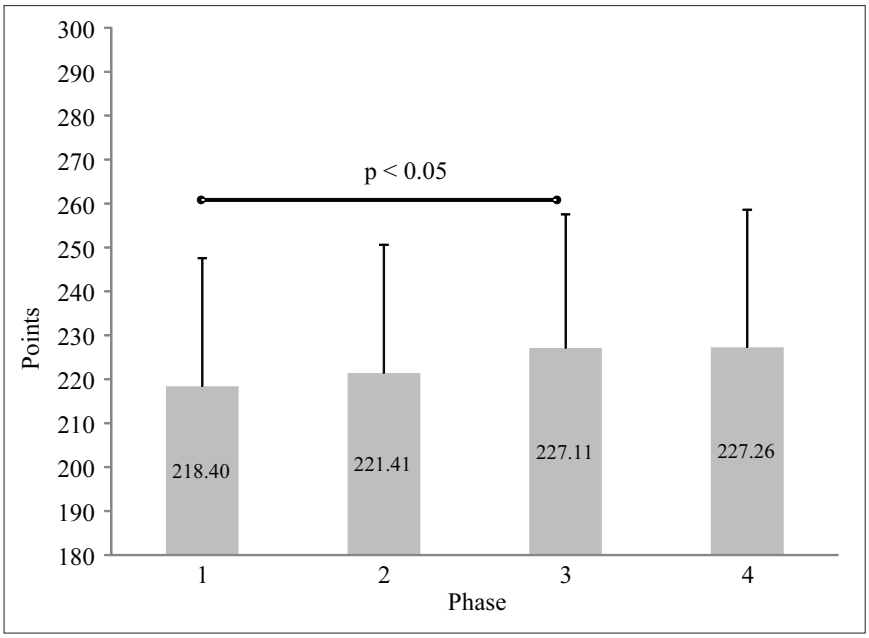


Figure 6. **Physical fitness evaluations in points (x ± SD) of 42–46 year-old soldiers in the Land Forces in the period of 2010–2011**

Figure 7. **Physical fitness evaluations in points (x ± SD) of 47–51 year-old soldiers in the Land Forces in the period of 2010–2011**

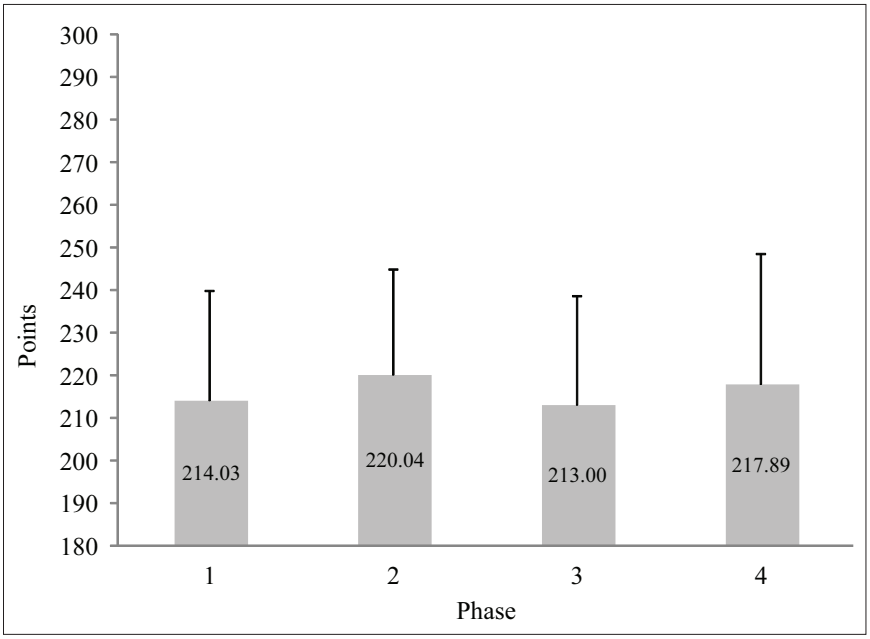
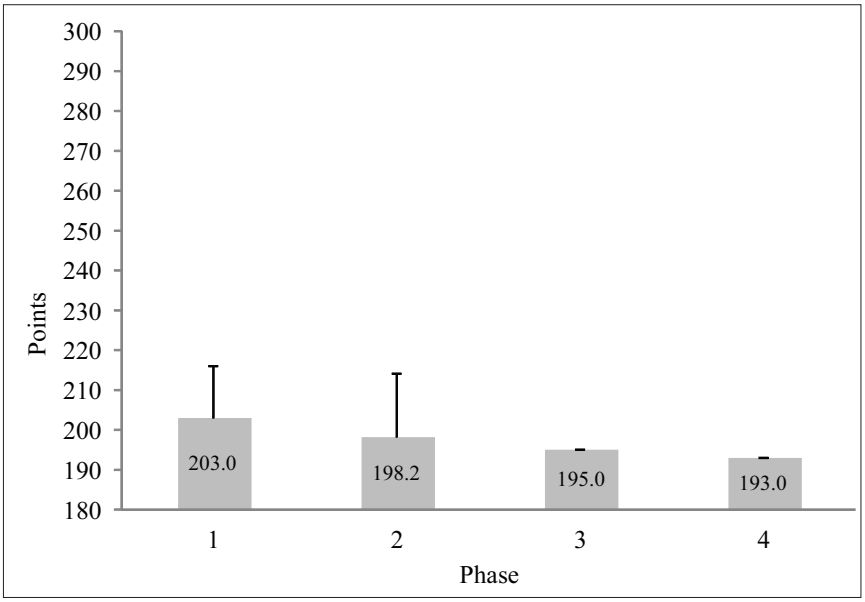


Figure 8. **Physical fitness evaluations in points (x ± SD) of 52–56 year-old soldiers in the Land Forces in the period of 2010–2011**



groups of 18–21, 22–26 and 27–31 years. Their sums of points in all APFT exercises ranged from 235 to 254 points. In the period of one year, from the first to the third testing, complex physical fitness improved in six groups: 18–21 years ($p < 0.01$), 22–26 ($p < 0.005$), 27–31 years ($p < 0.001$), 32–36 years ($p < 0.001$), 37–41 years ($p < 0.05$), and 42–46 years ($p < 0.05$). In the period of half a year, from spring to autumn and from autumn to spring, soldiers' physical fitness changed only slightly ($p > 0.05$). APFT data (Table 3) in the Land Force suggest that 81–86% of soldiers passed the standard norms, 2–3% of soldiers failed the norms, and 12–16% did not take tests at all because they carried out some other military tasks or fulfilled some mission.

Table 3. **Physical fitness testing results of soldiers in the Land Force of the Professional Lithuanian Armed Forces**

Research phases	Passed, %	Failed, %	Did not participate in testing, %
1	84	3	13
2	81	3	16
3	86	2	12
4	82	4	14

DISCUSSION

Military physical fitness is the ability of a soldier to carry out military tasks efficiently, tolerate physical loads in their service or military training, deal with physical and mental tension under the pressure of various factors (*Karių fizinio rengimo metodinės rekomendacijos*, 2003). Soldiers' physical fitness must match specific aims and objectives of a military unit. Irrespective of their military rank, age and position, all soldiers must maintain optimal level of physical fitness. Physical fitness testing carried out in Lithuanian Armed Forces twice a year stimulates soldiers to develop their physical skills systematically.

The armed forces of other NATO states pay much attention to physical fitness control, and physical fitness results are analyzed according to the age groups as in the Lithuanian Armed Forces (Dobosz, Świersz, 2011; Dybińska, 2009, 2011; Kruczkowski et al., 2011).

Abdominal muscle endurance indices of soldiers in the Lithuanian Professional Land Force (sit ups test 2 min) in all age groups were better compared to those of soldiers in Professional Polish Armed Forces (Kruczkovski et al., 2011). The authors' research (Kruczkovski et al., 2011) provides the following data of sit ups test in Professional Polish Armed Forces: for soldiers younger than 29 years of age (n = 49) – 56.61 ± 11.98 times, 30–34 years (n = 108) – 53.95 ± 7.09 times, 35–39 years (n = 117) – 48.82 ± 6.35 times, 40–44 years (n = 80) – 43.98 ± 6.34 times, and 45–49 years (n = 17) – 42.41 ± 8.46 times.

Arm strength endurance indices (bending and reaching arms in a lying position for 2 min) of soldiers in the Lithuanian Professional Land Force in the age groups of 27–31, 32–36, 37–41 and 42–46 years were higher than the same indices of soldiers in Professional Polish Armed Forces, as provided in the research publication by E. Dybińska (2011). Arm strength endurance indices of soldiers in Professional Polish Armed Forces were as follows: 26–30 years (n = 96) – 47.66 ± 4.0 times, 31–35 years (n = 91) – 47.58 ± 4.83 times, 36–45 years (n = 86) – 40.72 ± 4.45 times (Dybińska, 2011).

Aerobic endurance indices (3000 m running) of soldiers in the Lithuanian Professional Land Force and the ones of soldiers in Professional Polish Armed Forces (Kruczkovski et al., 2011) did not differ significantly. Aerobic endurance indices of soldiers in Professional Polish Armed Forces according to the testing results of 2009 (Kruczkovski et al., 2011) were as follows: for soldiers younger than 29 years (n = 45) – 13.81 ± 1.02, 30–34 years (n = 88) – 14.24 ± 2.07, 35–39 years (n = 100) – 14.07 ± 2.49, 40–44 years (n = 65) – 15.27 ± 2.00, 45–49 years (n = 11) – 17.12 ± 4.57.

We compared physical fitness indices of soldiers in the Lithuanian Professional Land Force with the ones of soldiers in the mandatory conscription service of the Lithuanian 160th Motorized Infantry Brigade Honor Guard in 2001 and 2003 (Radžiukynas et al., 2006). Abdominal muscle strength indices (sit ups for 2 min) of our research participants aged 18–21 and 22–26 years were higher compared to those of the Motorized Infantry Brigade Honor Guard soldiers in 2001 and 2003, but the arm strength indices (press ups for 20 min) were higher for soldiers in the Motorized Infantry Brigade Honor Guard. Aerobic endurance indices (3000 m running) of our research participants aged 18–21 and 22–26 years were similar to those of the Motorized Infantry Brigade Honor Guard soldiers.

Physical fitness of soldiers in the Land Force of the Lithuanian Armed Forces matches the normative requirements approved by the Lithuanian Minister of National Defense. Physical fitness indices did not change much in the period of half a year (from spring testing till autumn testing), but in some age groups they tended to decline. From 37 years of age physical fitness indices were worse compared to those of younger soldiers. For this reason it is necessary to encourage soldiers to participate in recreational physical activities and to increase their individual physical activity independently.

CONCLUSIONS AND PERSPECTIVES

1. Physical fitness indices of different exercise for soldiers in the Land Force of the professional Lithuanian Armed Forces who passed that APFT test were higher than the established minimal normative requirements. During each testing, 12–16 percent of soldiers did not participate in testing procedures as they carried out other military official tasks or could not participate due to their poor health, and 2–4 percent failed the APFT tests.

2. Physical fitness indices of soldiers improved during a period of one year – between testing in spring, testing I and testing III. In the period of half a year (from spring to autumn), no significant differences in the changes of physical fitness indices were established ($p > 0.05$).

3. The highest physical fitness indices were achieved in the age groups of 18–21, 22–26, 27–31 and 30–36 years, however, the differences between the age groups were insignificant. The indices of soldiers in the age group of 37–41 and older were worse compared to those for younger soldiers in the age groups mentioned above.

In perspective, while developing military physical fitness control system, the testing programme should be supplemented with tests for psychomotor abilities, and the evaluation of physical fitness should be differentiated according to the normative scale which includes such evaluations as "excellent", "good", "fair".

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LIETUVOS PROFESIONALIOSIOS KARIUOMENĖS SAUSUMOS PAJĖGŲ ĮVAIRAUS AMŽIAUS GRUPIŲ KARIŲ FIZINIO PARENGTUMO REZULTATAI PER 2010–2011 METUS

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Nuo 2009 m. Lietuvos kariuomenė formuojama tik iš profesionaliosios karo tarnybos karių. Mokslo darbų, nagrinėjančių Lietuvos profesionaliosios karo tarnybos karių fizinį parengtumą ir jo kaitos ypatumus tarnybos laikotarpiu, nepakanka. Šiuo tyrimu siekiama patikrinti hipotezę, kad profesionaliosios karo tarnybos karių fizinis parengtumas atitinka krašto apsaugos ministro patvirtintus fizinio parengtumo normatyvus.

Tikslas – ištirti Lietuvos profesionaliosios kariuomenės sausumos pajėgų įvairaus amžiaus grupių karių fizinio parengtumo kaitos ypatumus per dvejus metus.

Metodai: literatūros šaltinių studija, fizinio parengtumo testavimas, fizinio parengtumo rodiklių statistinė analizė. Kiekvieno fizinio pratimo rezultatas buvo vertinamas taškais pagal karių fizinio parengtumo normatyvines skales. Taškų suma už visus atliktus fizinius pratimus – galutinis fizinio parengtumo rezultatas.

Rezultatai. Visų amžiaus grupių karių fizinio parengtumo rodikliai nuo testavimo pavasarį iki testavimo rudenį pakito mažai ($p > 0,05$). Per vienų metų laikotarpį (nuo testavimo pavasarį iki kitų metų testavimo pavasarį) karių fizinio parengtumo rodikliai pagerėjo ($p < 0,05$). Fizinio parengtumo normatyvų neišlaikė 2–4% karių.

Aptarimas ir išvados. Sausumos pajėgų profesionaliosios tarnybos karių, išlaikiusių fizinio parengtumo testą, fizinio parengtumo rodikliai pagal atskirus pratimus yra geresni už nustatytus minimalius įskaitinius normatyvus. Geriausius fizinio parengtumo rodiklius pasiekia 18–21, 22–26, 27–31, 32–36 metų grupių kariai, tačiau rodiklių skirtumai tarp amžiaus grupių karių maži.

Tobulinant karių fizinio parengtumo kontrolės sistemą reikėtų fizinį parengtumą vertinti diferencijuotai pagal įvertinimų „puikiai“, „gerai“, „pakankamai“ normatyvinę skalę.

Raktažodžiai: sausumos pajėgos, fizinis parengtumas, testavimas, fizinio parengtumo testas, amžiaus grupės, taškai.

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OBSTACLES AND POSSIBILITIES FOR PARTICIPATION IN SPORT AFTER SPINAL CORD INJURY

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ABSTRACT

Research background and hypothesis. Studies have shown that persons after spinal cord injury rarely continue participating in sport (Stryker, Burke, 2000; Hanson, Nabavi, 2001; Stephan, Brewer, 2007). This could be caused by the obstacles that the persons face due to the motor disorder after spinal cord injury (Wu, Williams, 2001; Tasiemski et al., 2004). Hypothesis: persons with spinal cord injury while being involved in disabled sport face the same problems irrespectively of gender.

Research aim was to determine the obstacles and possibilities for involvement and participation in sport after spinal cord injury.

Research methods. The questionnaire method was used to collect sport participation data (Tasiemski et al., 2004) and determine socialization agents of persons after spinal cord injury (Williams, 1994). The athletic identity assessment scale (Brewer, Cornelius, 2002) was used in the research.

Research results. Data showed that the majority of the subjects after spinal cord injury were not involved in sport; 11.9% did sports 1 hour per week, 13.2% – 2–3 hours per week, 10.6% – more than 6 hours per week. The value of athletic identity of paraplegic subjects was equal to 23 points, and that of tetraplegic subjects – 18 points (statistically significant data difference between the two groups when $p < 0.05$). It was found that athletic identity value of men after spinal cord injury (22 points) was statistically significantly higher compared to that of women (16 points, $p < 0.05$). Lack of adapted sport facilities – 49.6%, equipment – 53.2%, coaches – 48.4% and financial resources – 42.0% proved to be the major obstacles to participate in sport for persons after spinal cord injury.

Discussion and conclusions. According to the research, only a minority of persons after spinal cord injury identified themselves as athletes. It was found that the main social agents involving disabled persons into the mainstream of sport were other disabled persons, rehabilitation and physical therapists, coaches and other sports professionals. Persons after spinal cord injury believed that the main reasons of non-participation in sport was lack of information about disabled sport, also lack of sports equipment, financial problems and lack of sports professionals. Most persons after spinal cord injury participated or would participate in sport with the aim of getting fit, strengthening the upper body part, socializing, feeling the joy of life. The majority of results of the study were similar to the results of other researchers (Tasiemski et al., 2004) who analyzed disabled persons' problems while involving in sport.

Keywords: involvement in disabled sport, athletic identity, social agents.

INTRODUCTION

Problems of disabled sport have recently been discussed in detail in both scientific and popular literature. The interest has been caused by the active integration of disabled sport into international organizations all over the world. Disabled sport began as a kind of rehabilitation, but nowadays it is acquiring a new meaning and perspectives, which allows it to be perceived in a wider sense – as the right of every citizen, an integral part of the democratic and humanization processes. The 2012 Paralympic Games could be the most outstanding illustration of the phenomenon. The London Paralympics revealed a few new and important aspects of disabled sport

development: disabled sport is becoming more and more professional (the competition among athletes has been increasing), it is becoming more popular all over the world (there appear new sports branches accessible to disabled persons, disabled people get involved in sport more actively), it is becoming an important event not only for disabled persons, but also for the global society (the London Paralympics were the first in Paralympic Games history to sell out), the attitude towards disabled athletes is changing (government representatives do not spare nice epithets for disabled athletes, like "the most gifted part of the humanity", "super-people", etc.). Disabled sport has advanced not only in quantitative, but also in qualitative terms. The constant improvement in the result of Paralympic athletes shows that in most countries disabled sports are well-organized to enable disabled athletes to develop their sports skills. However, the object of scientific research is not only professional disabled sport. New research fields also aim at the problems of participation in disabled sport, as the high performance of disabled athletes depends on the number of participants (Miller, 2009). Studies show that even in countries with high-performing athletes the number of disabled athletes is quite low. Besides, disabled sport in the broad sense promotes social integration and socialization of disabled people, improving their psychosocial health and physical condition (Sherrill, Williams, 1996; Sherrill, 1998; Tasiemski et al., 2000; Skučas, 2010). Participating in sport is an attractive form of self-expression, communication and realization of expectations and aspirations for disabled persons (Hanson, Nabavi, 2001; Tasiemski et al., 2004; Kehn, Kroll, 2009). For these reasons, research on sports participation of disabled persons is highly relevant today.

It has been officially admitted that disabled sport is facing a crisis in Lithuania today. The situation is closely related both to the fact that the number of disabled athletes participating in the Paralympic Games has been decreasing (the Lithuanian participant number in the Beijing 2008 Paralympic Games was 26, while in the London 2012 Paralympic Games – only 11) and the results achieved by disabled athletes. The sparkle of medals won in the Paralympic Games dimmed disabled sport problems until now. For the first time in the mass media Lithuanian Paralympic Committee and Disabled Sports Federation leaders spoke about serious problems faced when organizing disabled sport. Their statements show that Lithuania lacks research on disabled sport issues, which would help improve the situation and develop disabled sport. Questions whether sport is accessible for physically disabled, what encourages disabled persons to participate in sport, possibilities and obstacles to get involved and participate in sport have been little researched, though the issues are very important. Moreover, it is important to look into another problem which has not been discussed in Lithuania yet – the disabled persons' attitude towards sport, whether they find sport attractive, the athletic identity of disabled persons involved in sport, the way they perceive and feel about themselves in the role of an athlete.

Modern athletic identity issues are highly relevant – whether it depends on the severity of disability, history of sport involvement and qualification of athletes (Nasco, Webb, 2006). The article analyzes problems and possibilities for involvement and participation in sport of persons with severe and very severe disability after spinal cord injury.

Spinal cord injury affects motor, sensory and vegetative functions (Sherrill, 1998). After spinal cord injury persons suffer sensory and motor disorders which complicate movement and are the main disability factors (Tasiemski et al., 2000; Skucas, 2010). Studies have shown that persons after spinal cord injury rarely continue participating in sport (Stryker, Burke, 2000; Hanson, Nabavi, 2001; Stephan, Brewer, 2007). This could be caused by the obstacles that the persons face due to the motor disorder after spinal cord injury: such persons have little access to equipment necessary for the involvement in sport (e. g. special sports wheelchairs), poor access to sports facilities which are poorly or not adapted for persons with physical disabilities; acquiring new sports skills necessary for the involvement in disabled sport is also problematic (Wu, Williams, 2001; Tasiemski et al., 2004).

The aim of the research was to determine the obstacles and possibilities for involvement and participation in sport after spinal cord injury.

RESEARCH METHODS

The questionnaire by T. Tasiemski and others (2004) was employed in the research. It contains questions on demographic data of the subjects (age, gender, injury details, education, occupation)

and their participation in sport before and after the injury. The questionnaire on disabled sport socialization by T. Williams (1994) was used to determine sport socialization agents and factors. It submitted questions on sport socialization agents and various organizations providing useful information and encouraging involvement in disabled sport after spinal cord injury.

The athletic identity assessment scale (Brewer, Cornelius, 2002) was used in the research. The scale is a seven-item questionnaire assessing the person's feelings of self-attribution to the athlete's role. The athletic identity grading scale is divided into three sub-categories: social identity (the depth of the athlete's perception of the role), differentiation (the athlete's perception of the role compared with other roles, such as a friend's role, a family member's role, etc.), and negative effects (negative emotional response rates due to inability to practice and participate in sports competitions). The answers to the questions scored from one (answer "strongly disagree") to seven ("strongly agree"). The scores of individual subscales were summed, and the total score of each individual athletic identity score was derived.

During the period of 2011–2012 the research included 106 disabled persons from all over Lithuania (74 men and 32 women), of which 29 men and 14 women participated in sports activity. Athletic identity of the persons only involved in sports was determined. The participants were selected into the research using the improbability objective method of group formation. The group included persons after spinal cord injury. The age of the subjects ranged from 18 to 45 years, the time after spinal cord injury was from 2 to 15 years. The type of disability of the respondents was spinal cord injury. According to the severity of disability two groups of respondents were formed: a very severe disability group – persons with tetraplegia (wheelchair users, paralyzed legs and partially paralyzed hands; 28 subjects), and a severe disability group – persons with paraplegia (wheelchair users, paralyzed legs; 78 subjects).

The research results were processed applying the software program *SPSS 12.0*. The arithmetic mean (x) and the standard deviations (S) were calculated. Data statistical differences between men and women after spinal cord injury and between tetraplegic and paraplegic subjects were assessed using Student's (t) test. Data were considered statistically significant at the significance level of $p < 0.05$.

RESEARCH RESULTS

The questionnaire data showed that the majority of the subjects after spinal cord injury were not involved in sport; 11.9% did sports 1 hour per week, 13.2% – 2–3 hours per week, 10.6% – more than 6 hours per week. Men were more actively involved in sport than women. Persons with severe disabilities were less often involved in sport.

Only a small number of the respondents identified themselves as athletes. Only 10.6% of athletic identity scores equaled to 28 points. The research revealed that athletic identity depended on the severity of disability – the more severe the disability, the less number of disabled persons after spinal cord injury identifying themselves as athletes. The value of athletic identity of paraplegic subjects was equal to 23 points, and that of tetraplegic subjects – 18 points (statistically significant data difference between the two groups when $p < 0.05$). It was found that athletic identity value of men after spinal cord injury (22 points) was statistically significantly higher compared to that of women (16 points, $p < 0.05$). Athletic identity of both men and women depended on the number of hours doing sport per week: the more hours a week the respondents spent doing sport, the higher their athletic identity was. Athletic identity of men depended on sports qualification – athletic identity was highest among athletes with international qualification (29 points). Women's athletic identity was not affected by sports qualification.

The research results revealed that sport socialization agents, which were the first to provide the respondents with the necessary information about disability sport and to encourage participation in sport, were other disabled persons, rehabilitation and physical therapists, coaches and other sports professionals (Table 1). The most useful information about disability sport was provided at rehabilitation centers, at events organized by public organizations; very little information was obtained from the mass media.

Lack of adapted sport facilities, equipment, coaches and financial resources proved to be the major obstacles to participate in sport for persons after spinal cord injury (Table 2).

The research shows that majority of persons after spinal cord injury participated in sport with the aim of getting fit, strengthening the upper body part, socializing, feeling the joy of life. In addition to these reasons, women did sport to regulate weight, and men – to increase self-esteem and to participate in sports competitions (Table 3).

Socialization agents and context	All subjects, %	Men, %	Women, %
Doctors	0.7	0.8	0.6
Educators	0.9	0.9	0.8
Rehabilitation specialists, physical therapists	2.8	2.9	2.8
Other disabled persons	3.5	3.7*	3.3
Coaches, sport instructors	3.4	3.6*	3.1
Rehabilitation centers	3.0	3.1	3.1
Mass media	1.2	1.2	1.1
Public disabled organizations	3.7	3.6	3.7

Table 1. **Socialization environment and agents that provided necessary information about disabled sport**

Note. * – $p < 0.05$, statistically significant difference between men and women after spinal cord injury.

Reasons for non-involvement in sport of disabled persons	All subjects, %	Men, %	Women, %
Lack of adapted sports facilities	49.6	48.8	49.6
Lack of sports equipment	53.2	53.8	52.8
Little choice of disabled sports branches	25.3	24.3	26.9
Limited independence due to lack of daily living skills	30.6	29.5	33.1
Absence of access to favorite sport	25.8	23.6	27.2
Lack of time due to work or other reasons	28.2	29.4	23.5
Financial problems	42.0	43.3	42.7
Transport problems	37.4	38.6	36.3
Lack of coaches and sports specialists	48.4	49.2	47.8
Others (including pain and family obligations)	18.9	19.8	22.5

Table 2. **Reasons for non-involvement in sport of persons after spinal cord injury**

Reasons for involvement in sport of disabled persons	All subjects, %	Men, %	Women, %
Getting fit	74.5	71.3	74.2
Strengthening the upper body part	59.6	58.8	67.6
Socializing	58.4	59.7	52.9
Feeling joy	54.3	53.5	38.2
Increasing self-esteem	46.6	47.1	40.2
Weight watching	42.3	38.4	58.7
Competitions	43.4	44.8	30.1
Travelling	26.8	27.3	17.9
Others	6.1	5.4	10.5

Table 3. **Reasons for involvement in sport of persons after spinal cord injury**

DISCUSSION

Comparison of the research data with the data of similar research works on athletic identity values reveals the fact that Lithuanian athletic identity is lower than that of disabled swimmers (Martin et al., 2005) and able-bodied athletes (Brewer, Cornelius, 2002) from Great Britain. Similar results were obtained comparing athletic identity data in the aspects of gender and hours spent doing sport per week. The results show that athletic identity of persons after spinal cord injury in comparison to that of able-bodied persons is highly affected by injury, social limitations caused by the disability and the absence of status of the disabled athlete.

Comparison of the results with British (Tasiemski et al., 2004) research results shows that in Great Britain sport socialization agents in the order of importance are other disabled persons, coaches or other sports professionals, while in Lithuania they are other disabled persons or physical therapists. Thus, it can be concluded that both in Lithuania and Great Britain disabled sport socialization is influenced by similar agents,

but the opinion about the relevance of specialists differs. Information sources on disabled sport are also different. In Great Britain the necessary information is provided not only at rehabilitation centers, disabled and able-bodied sports organizations and other organizations, but also in the mass media.

Comparison of the situations in Lithuania and Great Britain (Tasiemski et al., 2004) results in the fact that Lithuanian disabled athletes have fewer possibilities for doing sport. The major obstacle to involvement in sport in Great Britain appears to be lack of daily living skills, while in Lithuania it appears to be lack of information, equipment and professionals. It can be concluded that in Great Britain (Tasiemski et al., 2004) disabled athletes do not face financial problems (lack of money, equipment, transport), while in Lithuania disabled athletes alongside with lack of special equipment, information and professionals also encounter financial, transport and other problems. This shows that in Lithuania disabled persons encounter more obstacles to sport involvement due to the economic situation.

Though other research works on reasons for involvement in sport of persons after spinal cord injury show similar results (Tasiemski et al., 2000, 2004), this research confirms that there are no significant differences in the obtained results in aspect of gender.

CONCLUSIONS AND PERSPECTIVES

1. The majority of persons after spinal cord injury are not involved in sport at all, only a very small percentage of women and men with severe disability are involved in sport.

2. Only a small number of persons after spinal cord injury identify themselves as athletes. Athletic identity depends on the severity of disability – the more severe the disability, the less number of disabled persons after spinal cord injury identifying themselves as athletes.

3. The main social agents, involving disabled persons into sport, are other disabled persons, rehabilitation specialists, physical therapists, coaches and other sports professionals.

4. Disabled persons are encouraged to participate in sport at rehabilitation centers and sports clubs, the mass media has a minor influence on the process.

5. Persons after spinal cord injury believe that the main obstacles for non-participation in sport are lack of information about disabled sport, lack of sports equipment, lack of financial resources and sports professionals.

6. Most persons after spinal cord injury participate in sport with the aim of getting fit, strengthening the upper body part, socializing, feeling the joy of life. Also women do sport to regulate weight, and men – to increase self-esteem and to participate in the competitions.

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ASMENŲ, PATYRUSIŲ NUGAROS SMEGENŲ PAŽEIDIMĄ, DALYVAVIMO SPORTINĖJE VEIKLOJE KLIŪTYS IR GALIMYBĖS

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Tyrimais nustatyta, kad asmenys, patyrę nugaros smegenų pažeidimą, retai tęsia sportinę veiklą (Stryker, Burke, 2000; Hanson, Nabavi, 2001; Stephan, Brewer, 2007). Taip atsitinka dažniausiai dėl judėjimo funkcijos sutrikimo (Wu, Williams, 2001; Tasiemski ir kt., 2004). Hipotezė: asmenys, patyrę nugaros smegenų pažeidimą, įsitraukdami į sportinę veiklą susiduria su panašiomis problemomis nepriklausomai nuo lyties.

Tikslas – nustatyti asmenų, patyrusių nugaros smegenų pažeidimą, dalyvavimo ir įsitraukimo į sportinę veiklą kliūtis ir galimybes.

Metodai. Anketavimo metodu surinkti dalyvavimo sportinėje veikloje duomenys (Tasiemski ir kt., 2004) ir nustatyti asmenų, patyrusių nugaros smegenų pažeidimą, sporto socializacijos agentai (Williams, 1994). Tyrimo metu naudota Sportininko identiteto vertinimo skalė (Brewer, Cornelius, 2002).

Rezultatai. Apklausos duomenys rodo, kad dauguma tirtųjų, patyrusių nugaros smegenų pažeidimą, nesportuoja. 11,9% sportuoja vieną valandą per savaitę, 13,2% – 2–3 valandas per savaitę, sportui daugiau nei 6 valandas per savaitę skiria 10,6% tiriamųjų. Paraplegikų sportininko identiteto reikšmė siekė 23 balus, tetraplegikų – 18 balų (gautas statistiškai patikimas skirtumas tarp šių grupių duomenų – $p < 0,05$). Buvo nustatyta, kad vyrų (22 balai), patyrusių nugaros smegenų pažeidimą, sportininko identiteto reikšmė buvo statistiškai patikimai didesnė, lyginant su moterų (16 balų, $p < 0,05$). Didžiausios kliūtys, trukdančios patyrusiesiems nugaros smegenų pažeidimą sportuoti, buvo neįgaliesiems pritaikytų sporto bazių (49,6%), inventoriaus (53,2%), trenerių (48,4%) ir lėšų (42,0%) trūkumas.

Aptarimas ir išvados. Save suvokia kaip sportinininkus tik nedaugelis asmenų, patyrusių nugaros smegenų pažeidimą. Pagrindiniai socialiniai agentai, įtraukę neįgaliuosius į sportinę veiklą, buvo kitas neįgalus asmuo, reabilitologai ir kineziterapeutai, treneriai, kiti sporto specialistai. Asmenys, patyrę nugaros smegenų pažeidimą, mano, kad pagrindinės nedalyvavimo sportinėje veikloje kliūtys yra žinių apie neįgaliųjų sportą stoka, sportinio inventoriaus, lėšų ir sporto specialistų trūkumas. Dauguma asmenų, patyrusių nugaros smegenų pažeidimą, sportuoja arba sportuotų norėdami įgyti gerą fizinę formą, stiprinti viršutinę kūno dalį, išvykti iš namų ir pabendrauti su žmonėmis, pajusti džiaugsmo pojūtį. Dauguma šio tyrimo rezultų buvo panašūs, lyginant su kitų tyrėjų, nagrinėjusių neįgaliųjų įsitraukimo į sportinę veiklą problemas, rezultatais (Tasiemski ir kt., 2004).

Raktažodžiai: įtraukimas į neįgaliųjų sportą, sportininko identitetas, socialiniai agentai.

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OCCUPATIONAL DIFFICULTIES AT WORK OF PHYSICAL EDUCATION TEACHERS

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ABSTRACT

Research background and hypothesis. In recent years, the phenomenon of stress and burnout among physical education teachers has been evidenced by researchers from many countries. It should be noted that all those studies about work difficulties of physical education teachers are individual. However, despite a large number of studies conducted and the progress made in this area, a universally accepted survey identifying five most important difficulties in physical education teachers' work usually defined in contemporary studies still does not exist. This is mainly because there is still no consensus either on the decisive factors causing those difficulties for physical education teachers or what the central symptoms actually are.

Research aim was (a) to review and (b) to identify five most important difficulties in physical education teachers' work usually defined in contemporary studies.

Research methods. This review examines research literature concerning the causes of stress and burnout of physical education teachers from the year 1999 to 2009 applying computer-aided literature search. The keywords used for the electronic search were "stress" and "burnout" or "job satisfaction" and "physical education teacher". The main method of our research was logical deductive research literature analysis.

Discussion and conclusions. Research literature review allowed identifying physical education teachers' work difficulties (we found 24 of them). We established that the five most important difficulties in physical education teachers' work usually defined in contemporary studies were as follows: low status of physical education; limited equipment, facilities and supplies; lack of time; large class sizes and excessive daily workloads.

Keywords: burnout, job satisfaction, physical education teacher, stress.

INTRODUCTION

Difficulty in the work of physical education (PE) teacher is understood as a cause of trouble, struggle, or embarrassment (*Collins English Dictionary,* 2009) and, as an extraneous effect interfering with the pedagogical process and the possibilities of adaptive and adequate behavior and work (Jovaiša, 2007). Depending on the research aim, methods theories and approaches applied (psychological or sociological), authors present difficulties of PE teachers work rather differently.

In psychological research "difficulty" usually refers to the reason of job stress or burnout, for example, H. Selye (1946) identified the stimuli that create stress as "stressors" (cited from: Al-Mohannadi, Capel, 2007); others refer to these simply as "causes of stress" (Smith, Leng, 2003; Lee et al., 2006); "the reasons or causes or sources of burnout" (Mei-juan, 2006); "factors causing burnout" (De Heus, Diekstra, 1999); "the major causes of stress" (Al-Khalefa, 1999); "the highest stressors" (Torres et al., 2009); "critical incident" (Jung, 2010); "number of variables" (Gross, 2009).

The problem issues of difficulties at work are also discussed in studies about job satisfaction and dissatisfaction. In those studies they are described as "sources of job dissatisfaction" (Johansson, Heikinaro-Johansson, 2004) and "the specific

factors which are influential on the teachers' job dissatisfaction" (Yaman, 2009).

In terms of sociology, there are studies referring to PE teachers' job difficulties as problems, such as: "most important problems", "a serious problem" and "greatest problems" (Wong, Louie, 2002); "issues in provision (concerns and/or problems)" (Hardman, 2008 a, b);

In spite of this, all of them refer to one and the same irritant which causes tension, fatigue, poor feelings of well-being, dissatisfaction, stress and burnout in PE teachers work.

In recent years, the PE teacher stress and burnout phenomenon has received increasing attention by researchers from many countries. These international concerns, have been evidenced by research works conducted in the USA (Gross, 2009; Jung, 2010), Poland (Brudnik, 2003; Pec, 2005), Greece (Koustelios, Tsigilis, 2005), Finland (Johansson, Heikinaro-Johansson, 2004), Turkey (Yaman, 2009), the Qatar (Al-Mohannadi, Capel, 2007), the Singapore (Smith, Leng, 2003), Korea (Lee et al., 2006) and China (Mei-Juan, 2006).

It should be noted that all those studies about PE teachers' work difficulties are individual. However, despite a large number of studies conducted, and the progress made in this area, a universally accepted survey identifying five most important difficulties in PE teachers' work usually defined in contemporary studies still does not exist. This is mainly because there is still no consensus either on the decisive factors causing those difficulties for PE teachers or what the central symptoms actually are.

Thus, **the purpose of this study** was (a) to review and (b) to identify five most important difficulties in PE teachers work usually defined in contemporary studies.

RESEARCH METHODS

Procedures for Identifying Articles. This review examines research literature concerning the causes of stress and burnout of PE teachers from the year 1999 to 2009 applying computer-aided literature search. The keywords used for the electronic search were "stress" or "burnout" or "job satisfaction" and "physical education teacher". Various databases were accessed, including SPORTDiscus, Health Medline, ProQuest and PsycINFO. A grand total of 41 articles were sourced from a broad selection of journals. Conscious of the inadequacy of many of the articles' relevance to the literature review, the researcher re-examined the articles and applied a specifically designed five criteria model to increase the focus of the study: (a) they must be published in English, (b) they must be directly related to stress, burnout or job satisfaction with a focus on physical education teacher, (c) they must be an original study; (d) they must be published between 1999 and 2009, and (e) they must be published in journals, thus excluding books, unpublished papers, doctoral dissertations and Master theses. Having sourced 41 articles originally, 15 proved suitable after implementing the selection criteria.

Thus, **the main method of our research** was logical deductive research literature analysis.

RESEARCH RESULTS

On the basis of the research aim and the structure of the article, firstly we will review research literature and identify five most important difficulties in PE teachers work usually defined in contemporary studies.

The purpose of D. Smith and G. W. Leng's (2003) research was to assess the burnout levels of secondary school PE teachers in Singapore and identify some specific work conditions related to burnout. The Work Environment questionnaire (Fejgin et al., 1995), administered to 74 Singapore PE teachers, measured the relationship between burnout and four theoretical dimensions: psychological, structural-physical, social and bureaucratic. It was found that physical education teachers in Singapore experienced only moderate levels of burnout. They perceived bureaucratic, psychological and social to be significant contributors. However, there was no significant relationship between the demographic data (age, gender, race, marital status, position, years of teaching, and educational level) and burnout among teachers.

The reasons for PE teacher burnout consist mainly of the following: 1) physical education is a nonexaminable (not graded) subject and usually takes the second place in schools; 2) school rankings according to the annual physical fitness tests and weight control; 3) PE teacher teaches at least one academic subject; 4) PE teachers are also sometimes required to serve as guardians, disciplinarians, and role models; 5) PE teachers' feeling of monotony because they usually teach the same curriculum

over and over again; 6) excessive and unnecessary paperwork; 7) the dual role conflict of teaching and coaching (between self, school and the Ministry of Education); 8) lack of time (for in-service programs and the requirement to fulfil 100 hours of courses per year; 9) additional work (as going with school teams for several weekends) with no extra pay; 10) the marginal status of PE for negative attitudes toward the PE teacher and his or her profession.

The purpose of the study carried out in Qatar (Arab country in the Middle East) was to identify causes of stress for physical education teachers in at the beginning and end of the school year as well as any changes over the course of the year. A second purpose was to try to explain any differences in causes of stress according to: gender, nationality, type of school, and amount of experience. Results showed that there were different causes of stress for different groups of teachers which could be related to different backgrounds and experiences and different roles and responsibilities in society as a result of different cultural and social expectations and environmental factors (Al-Mohannadi, Capel, 2007). The causes of stress for PE teachers: 1) problems with administration; 2) workload and responsibilities; 3) physical education curriculum; 4) low status of physical education; 5) salaries, bonuses and allowances; 6) poor school facilities; 7) pupils' problems; 8) responsibilities for pupils' safety. Statistically significant stress factor established was "Workload and responsibilities" and the greatest but statistically insignificant factor was "Pupils' problems" at the beginning and end of the academic year for PE teacher.

Researchers A. Wong and L. Louie (2002) attempted to identify what PE *teachers* were doing in secondary schools and what help they needed from professional bodies in the field. In order to collect preliminary data for the purpose of understanding the present situation, questionnaires were responded 209 (including 132 males and 76 females) secondary school PE *teachers* in Hong Kong, China. The data indicating, that *physical* education lessons in Hong Kong secondary schools were skill oriented in general and typically that PE *teachers* were technocratic in nature.

Respondents were also asked to list three most important problems for the teaching of *physical education* in secondary school. Their responses can be summarized in the following five problem areas. They are ranked according to their importance: 1) school-*environment* related, e. g. insufficient facilities/equipment, insufficient curriculum time, a marginal subject and not part of the school assessment; 2) student-related, e. g. poor physical ability, poor attitude and poor motivation, poor discipline; 3) *teacher*-related, e. g. too heavy a workload, incompetent in both skills and knowledge, teacher burn-out; 4) social-*environment* related, e. g. subject not valued by students/parents, subject not valued by the society as a whole related; and 5) subject-matter related, e. g. no text books, no standard comprehensive curriculum, no standard/objective evaluation. As to problems in the school *environment,* facilities and equipment deficiency and low subject status were perceived as the greatest problems.

PE *teachers* in Hong Kong (Wong, Louie, 2002) regarded a serious problem in the present teaching situations: 1) most PE *teachers* were required to teach at least one other subject such as language, history, mathematics, etc.; 2) excessive daily workloads led to low motivation; 3) PE teaches had a great amount of additional workload involving coaching, managerial and non-academic duties. A shortage of manpower was not a problem.

An adverse tendency about the lack of PE teachers was shown in a study by R. M. Ingersol (2003). The author suggests that forty-six per cent of teachers will leave the profession within their first five years of teaching. These data refer to teachers from all disciplines including physical education.

Numerous studies report reasons why new PE teachers feel overwhelmed during their first years of teaching. Such feelings are linked with: a) low status of the subject matter; b) a lack of respect given to PE by members of the school community; c) physical isolation in the school setting; d) fewer colleagues for collaboration; e) the lack of appropriate resources or teaching space (McCormack, Thomas, 2003).

D. Liston et al. (2006) identified different reasons for difficulties in the first years of teaching physical education: heterogeneous and difficult students, large class sizes and sharing space with other physical education classes, is vastly different from the reality of a classroom teacher with a limited number of students who are commonly seated at their desks.

Research by J. Jung (2010), Northern Illinois University, applying the method of "critical incident

interview", which facilitates problem solving, showed that incidents critical to the PE teachers included: a) burn-out, b) marginalization/isolation, c) student injury, d) success of low-skilled students, and e) devaluation of physical education. Those critical incidents influenced their career either positively (e. g. strengthen professional identity, facilitate learning to teach, reframe belief systems) or negatively (e. g. loss of enthusiasm, leaving the profession).

The purpose of the study carried out in Korea (Lee et al., 2006) was to examine the causes and consequences of occupational stress in Korean secondary PE teachers when compared with classroom teachers. Three of these significant differences were for a stressor scales: workload, organizational climate, and home-work balance. Four outcome scales also exhibited significant differences: job satisfaction, energy levels, organizational security, and physical symptoms. It was established that job-related stressors accounted for between 3–30% of the outcome variance for PE teachers, and 12–40% for classroom teachers. The determinants of outcome variables were generally different for the two groups.

Professional burn-out in the activities of PE teachers was research by a Chinese scientist (Mei-Juan, 2006). Research results showed that the causes of professional burn-out appeared in the community, at school, teachers' professional adjustment, interrelations, as well as personal environment.

Aiming at establishing links between burn-out and job satisfaction, 175 PE teachers from Greek schools were interviewed (Koustelios, Tsigilis, 2005, p. 189). It was established that job satisfaction was primarily affected by "job itself" followed by "supervision" and "working conditions", whereas burnout is affected by "personal accomplishment" and "emotional exhaustion". Intrinsic aspects of job satisfaction seemed to correlate stronger to burnout than the extrinsic.

Specific factors associated with job satisfaction and dissatisfaction of male and female PE teachers working at different levels in Finnish schools were studied by N. Johansson and P. Heikinaro-Johansson (2004). On the basis of their evidence the authors established five sources of job dissatisfaction were found: poor working conditions, work under pressure of time, student misbehaviour, large class sizes and lack of resources.

Turkish National Education Ministry initiated a study involving 197 PE teachers: 47 women and 150 men. The aim of the research was to establish teachers' job satisfaction (Yaman, 2009). Determining the factors which are influential on the teachers' job satisfaction, such as the profession and its characteristics, working conditions, social relationships, economic conditions, administration and inspection and social requirements, thus finding out the factors causing job dissatisfaction and helping teachers in working more efficiently and attaining job satisfaction are vitally important in terms of properly raising the future generations as well. Based on the findings, the factors affecting job satisfaction were determined and the suggestions were offered.

A finding from the study „Middle school physical education performance data: school and teacher characteristics" (Hall et al., 2009) was that school poverty index was negatively related to school performance in physical education, suggesting that poverty may be a risk factor for program success.

A study carried out in Poland (Brudnik, 2004) showed that PE teachers experienced the greatest professional burn-out compared to other teachers at school. Professional burn-out of PE teachers was also analysed by K. Pec (2005) and M. Brudnik (2003, 2004). According to S. Tucholska (2003), PE teachers are the group of teachers most unsatisfied with their profession.

PE specialists aiming to conduct high-quality classes come across obstacles which can cause frustrations and stress. Interfering variables were indicated by M. K. Gross (2009): a) limited equipment and supplies (LaFee, 2008), b) large class sizes (Hastie et at., 1999; Barroso, et al., 2005), and c) discipline problems (Kulinna, 2008). Lack of sufficient time and large class size (Siedentop, 2009) (cited from: Gross, 2009) may be the most serious problems that cut across K-12 physical education.

S. M. Al-Khalefa (1999) found the major causes of stress for PE teachers to be: work conditions; salaries, bonuses and allowances; status of physical education; supervision; school facilities; workload; career development (cited from: Al-Mohannadi, Capel, 2007).

DISCUSSION

European Commission official Working Paper "*On the mid-term review of the European strategy 2007–2012 on health and safety at work*" (2011) suggests that the right to health is a fundamental right and all workers must have legal guarantees to have such working conditions that protect their health, safety and dignity. It is also argued there that the problems at work are more often associated with health complaints than financial or family problems, and work-related stress is recognized as a major obstacle to productivity in Europe. Therefore, interest in work stress is a justified theme and attracts more and more researchers' attention.

Physical education teachers represent the occupation, the activities of which are associated with permanent mental and physical stress (Yaman, 2009; Jung, 2010). The specificity of their work is unique and differs significantly from that of other participants of education process (Hardman, 2011) because the latter have to meet certain requirements: control emotions, behave irreproachably, follow the school regulations, rules of work procedures, general hygiene standards, health requirements, safety rules in the gym, which causes difficulties in the professional work of physical education teachers.

Starting with discussion of professional problems of physical education teacher at work, which leads to stress, dissatisfaction with work and exhaustion, it is particularly useful to say that in many countries physical education as a subject that receives too little attention.

K. Hardman (2008 a) presents the situation of physical education in the world schools, comparing it with the data of 1999. This comparison shows that the situation of physical education at school, especially in economically developing and less-developed countries, has changed little since 1999 Berlin meeting on physical education global issues.

The study shows that physical education as a subject is more than any other subjects intended to be removed from the general education curriculum. In many countries it is formally requested that this subject occupied 79%, and in Europe – 89% of time in the curriculum. It should be noted that physical education as an examined school subject is taught in 61 per cent of countries in the world. This means that two-thirds of countries gave physical education the status of the examined subject in the general education curriculum, thus increasing the importance of those lessons. Unfortunately, as the scientist states, despite the formal obligations to take care of physical education in schools, in reality the situation is different from the attention to physical education in the general education curriculum. The "scissors", as the study shows, between official educational policy and educational reality is a geographically widespread phenomenon.

It should be noted that such phenomenon is distinguished when the responsibility of the implementation of this general education program is treated as a condition to devote more time to other subjects which are given priority because of their ranking in the examination system in different countries. Low status of physical education classes is a characteristic phenomenon in general. In addition, it lacks official assessments of the subject quality and student achievements. When various resources are spent for other purposes, when physical education teaching does not receive the available financial resources, and there is a lack of financial support, there is a necessity for suitably qualified staff, careful and responsible approach of school management is of vital importance. In his study K. Hardman (2008 a) considers such phenomenon of physical education lessons as not participating in the lesson on the basis of a medical certificate. It is believed that this also indirectly reduces the status of physical education as a subject. The question is whether there is an exemption from other subjects (with the possible exception of religious education in some countries).

Interesting thoughts are of individuals involved in the study, for example, one of Cyprus school principals acknowledges that the real situation of the subject of physical education teaching contrasts to formal requirements of this subject; according to one Spanish physical education researcher, situation in Spain shows that mandatory physical education classes during the last school year became optional (facultative). In this case, the instructions the government for physical education as a compulsory subject in the compulsory educational curriculum are ignored.

With regard to the status of physical education teachers, in the context of teachers of other subjects it should be noted that physical educators are valued worse than teachers of mathematics, Lithuanian language and other subjects. L. Kardelienė et al. (2009) argue that non-examinable subjects in the educational system are valued worse because they are peripheral in the aspect of the main instrumental

function at school. As a result, the status of teachers who are specialists in non-academic subjects is declining. It is interesting to note that students and parents also more value teachers of academic subjects, especially mathematics, Lithuanian language and literature compared to those of non-academic subjects (music, technologies, moral education (ethics, religion), and physical education).

However, D. Masiliauskas (2011) points out in his study that attention should be drawn to the fact that the students welcome such personal qualities of a physical education teacher as friendliness, calmness, and a sense of humour. Students also identified the characteristics of the teacher and his/her teaching performance features that they did not like. Boys more often than girls do not like the fact that physical education teachers do not always take into account their wishes during the lessons, but require performing the normative exercises. In turn, girls often emphasize teachers' unwillingness to communicate, disparaging remarks, intolerance.

It is worth discussing physical education teachers' opinion (ibid.) of students' characteristics that help and hinder teachers in their creation of educational interaction during physical education classes. It has been established (Masiliauskas, 2011) that all teachers (males and females) appreciate students' curiosity, confidence in their own powers and initiative, and students' characteristics that impede these interactions are their indifference and laziness in physical education classes. In this respect, K. A. Jenkinson and A. C. Benson's (2010) study is relevant, which included 115 physical education teachers (62 men and 53 women) from the State of Victoria (Australia). The researchers were trying to determine the difficulties that arose in the implementation of the physical education educational process in secondary schools. It was revealed that the major challenge for teachers was students' laziness and unwillingness to participate in physical education classes.

An overview study of the professional difficulties reaffirms the need for teachers to accept the view that one of the biggest disturbances for physical education teachers at work is a poor training (learning) environment and inadequate training equipment and facilities. It is worth quoting the claim of the organizers of the population's physical activity promotion strategies about today's physical education teacher's difficulties in the realization of health education due to the infrastructure conditions and poor educational environment as well as the number of pupils in physical education classes in mainstream urban schools (Jankauskienė, 2008). It should be noted that those disturbances of the pedagogical interactions are an argument in discussions with students revealing the benefits of the tasks and exercise to them and showing them the peculiarities of a healthy lifestyle. Other researchers point out that in physical education classes pedagogical interaction is negatively affected by the lack of inventory and educational environment (Al-Mohannad, Capel, 2007; Yaman, 2009; Jung, 2010), which is neither functional, safe nor hygienic. It should be emphasized that *Lithuanian General Programmes of Primary and Basic Education* (2008) state that the development of students' sports skills need safe learning environment, which, according to the above-mentioned foreign scientists, must be functional, hygienic, and tools, equipment and supplies must be ergonomic and orderly, gyms should have showers, rooms must be well lit, ventilated, harmless to health and maintain their optimal temperature.

Research by A. Stočkus and E. Adaškevičienė (2012) confirms the importance of studies on the interfaces between physical education teachers' work stressors and sociodemographic variables. It turned out that the major source of stress for physical education teachers in their work was the amount of various documents and other "paper" work, education reforms and too much responsibility for students. In addition, younger teachers and those with less teaching experience were more stressed by a large number of students in the gym than their older counterparts. Older physical education teachers and those with longer years of experience indicated that their working stressor was a huge responsibility for others, an abundance of various documents and other "paper" work, and when physical education teachers were underestimated. In the aspect of gender, men were more dissatisfied with low salaries, and women indicated that other teachers' attitudes towards physical education caused dissatisfaction with their work. Urban teachers perceived students' disrespect and a large number of students in classes as greater stressors than physical education teachers working in regions. Physical Education teachers working in high schools (gymnasiums) assessed competition in the educational institution as a stronger stressor than teachers who worked in the main or secondary schools.

In conclusion, it may be maintained that the low status of physical education lessons is a characteristic phenomenon because different resources are allocated for other purposes, the available material resources are not suitable for physical education curriculum, and there is a lack of financial support for the realization of the objectives of the subject as well as properly qualified staff. Thus, it is necessary for physical education teachers to accept the most responsible approach to the development of social interaction due to the realization of the social order – the development of pupils' attitudes towards health enhancing physical activity, their skills and systemic physical activity habits not only during physical education classes and in their free time, but also after school and during their whole life.

CONCLUSIONS AND PERSPECTIVES

After research literature review and *identification of PET work difficulties* (we found 24 of them) we suggest that they are as follows: low status of physical education (by the society, students, parents); limited equipment, facilities and supplies; lack of time; large class sizes; excessive daily workloads; no text books; no standard comprehensive curriculum; no standard/objective evaluation; most *PE teachers* were required to teach at least one other subject such as language, history, mathematics, etc.; PE teachers are also sometimes required to serve as guardians, disciplinarians, and role models; PE teachers' feeling of monotony because they usually teach the same curriculum over and over again; excessive and unnecessary paperwork; the dual role conflict of teaching and coaching; additional work (as going with school teams for several weekends) with no extra pay; the marginal status of PE teacher; problems with administration; salaries, bonuses and allowances; pupils' problems (poor physical ability, poor attitude and motivation, misbehaviour); responsibilities for pupils' safety; student injuries; success of low-skilled students; poor working conditions; fewer colleagues for collaboration.

We established that *the five most important difficulties* in PE teachers work usually defined in contemporary studies were as follows: low status of physical education; limited equipment, facilities and supplies; lack of time; large class sizes and excessive daily workloads.

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PROFESINIAI SUNKUMAI KŪNO KULTŪROS MOKYTOJO DARBE

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė. Šiuo metu užsienio tyrinėtojai intensyviai analizuoja kūno kultūros mokytojo streso ir išsekimo sindromo apraiškas ir jų priežastis įvairiose šalyse. Pažymėtina, kad visi šie tyrimai, atskleidžiantys sunkumus kūno kultūros mokytojo darbe, yra pavieniai. Nepaisant didelių studijų ir pažangos šioje srityje, apžvalgos ir sisteminio modelio identifikuojant penkis svarbiausius, kaip dažniausiai pasitaikančius tyrimuose, sunkumus kūno kultūros mokytojo darbe nepavyko rasti. Taip yra dėl to, kad iki šiol nėra aišku, kokie veiksniai sukelia sunkumus ir kurie iš jų yra pagrindiniai.

Tikslas: (a) apžvelgti ir (b) identifikuoti penkis svarbiausius, kaip dažniausiai pasitaikančius tyrimuose, sunkumus kūno kultūros mokytojo darbe.

Metodai. Mokslinė literatūra apie sunkumus kūno kultūros mokytojo darbe apžvelgta nuo 1999 iki 2009 metų naudojant kompiuterinę paiešką. Raktažodžiai, kuriais atlikome mokslinės literatūros paiešką, buvo „stresas“ ir „profesinis išsekimas“ arba „pasitenkinimas darbu“ ir kūno kultūros mokytojas. Pagrindinis tyrimo metodas – loginė dedukcinė mokslinės literatūros analizė.

Aptarimas ir išvados. Apžvelgus mokslinę literatūrą identifikuoti dvidešimt keturi sunkumai kūno kultūros mokytojo darbe. Nustatyta, kad penki svarbiausi (pagrindiniai), kaip dažniausiai pasitaikantys tyrimuose, sunkumai kūno kultūros mokytojo darbe yra: prastas dalyko statusas; ribota ir netinkama mokymo įranga ir priemonės; laiko trūkumas; didelės klasės; pernelyg didelis kasdienis kūno kultūros mokytojų darbo krūvis.

Raktažodžiai: profesinis išsekimas, pasitenkinimas darbu, stresas.

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YOGA PRACTICE HAS MINOR INFLUENCE ON RESPIRATORY FUNCTION AT REST IN MEN AND WOMEN

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ABSTRACT

Research background and hypothesis. Hatha yoga breathing has the potential of training the respiratory system in such a way that it helps an individual to cope with the respiratory demand (Ray et al., 2011).

Research aim was to compare pulmonary function variables between physically inactive subjects and the ones practicing hatha yoga and to evaluate changes after 6 months of yoga practice in the latter group.

Research methods. Pulmonary function was measured by means of the gas analyser "Oxycon Mobile" (Germany) before and after 6 months of yoga training in men (n = 11) (age – 30.8 (7.06), BMI – 25.6 (2.6)) and women (n = 11) (age – 28.9 (6.86), BMI – 22.5 (2.3)) practicing yoga and control subjects (n = 22) of similar age. Measurements included forced vital capacity (FVC), forced expiration volume in one second (FEV(1)), forced inspiratory volume in one second FIV1, vital capacity (VC), peak expiratory flow (PEF), forced expiratory flow rate (FEF (25–75)%), forced inspiratory flow at 50% of the vital capacity (FIF50%), maximum voluntary ventilation (MVV), vital capacity (VC MAX), peak inspiratory flow (PIF), etc.

Research results. Pulmonary function measures FEF 75/85 (L/s) ($p = 0.036$), total volume inspired FVC IN (L) ($p = 0.014$), FIV1 (L) ($p = 0.045$) were significantly higher in the group practicing yoga than in the control group of women, and VC MAX (%) ($p = 0.018$), FEV 1 (%) ($p = 0.041$), FEF 25 (L/s) ($p = 0.017$), FVC IN (L) ($p = 0.002$) in men practicing yoga, than in men not practicing yoga. They also demonstrated higher values of MVV (L/min) ($p = 0.068$) and FVC (L) ($p = 0.050$). After 6 months of practicing yoga we found higher FEF 50 (L/s) ($p = 0.003$), FEF 50% (L/s) ($p = 0.003$) in women's group and VCMAX (%) ($p = 0.028$) in men's group. We also found a tendency of the increase of VCMAX (L) ($p = 0.053$), PIF (L/s) ($p = 0.051$), FVC IN (L) ($p = 0.061$), FIVI (L) ($p = 0.064$) indexes in men and PIF (L/s) ($p = 0.072$), FVC IN (L) ($p = 0.076$) in women.

Discussion and conclusions. Yoga practice appeared to have minor influence on respiratory function at rest in men and women of middle age. Additional studies examining various yoga practices are warranted to gain a more comprehensive understanding of the effects of yoga techniques on pulmonary functions.

Keywords: pulmonary function at rest, yoga training, yoga breathing.

INTRODUCTION

Yoga breathing (pranayama) is an important part of health and spiritual practices (Brown, Gerbarg, 2009). Yoga practices are low intensity exercises within lactate threshold, physical performance improvement is possible owing to both better economy of breathing and to the improvement in cardiovascular reserve (Ray et al., 2011). Yoga induces long-term changes in respiratory function and control (Bernardi et al., 2007). Long-term yoga practice improves the depth of breathing and alters chemoreceptive sensitivity (Stanescu et al., 1981; Bernardi et al., 2001). Yoga improves pulmonary function, as measured by maximum inspiratory pressure, maximum expiratory pressure, maximum voluntary ventilation, forced vital capacity, forced expiratory volume in one second, and peak expiratory flow rate (Abel et al., 2012).

RESEARCH METHODS

Participants. Forty four healthy men (n = 22) and women (n = 22) volunteered to participate in our study. Twenty two subjects were physically inactive: 11 of them men were not practicing yoga (YNM) and 11 – not practicing women (YNW) and the other 22 subjects were practicing yoga for one year: 11 men (YPM) and 11 women (YPW). Statistically significant differences in body mass indexes (BMI) between control and yoga practicing subjects were not found.

Body composition analysis. The height of the subjects was taken using the Height Measuring Scale. The body weight of each subject was measured using electronic scale "Tanita Body Composition Analyzer TBF-300" (Japan). When the subjects stood on a special platform, the device recorded their body mass (kg), body mass index (kg/m²), fat body mass (%, kg) and lean body mass (%, kg).

Spirometry. Aiming at establishing gas metabolism indices, we applied the portable gas analyzer "Oxycon Mobile" (Germany) to register respiration indices for each subject: forced vital capacity (FVC), forced expiration volume in one second (FEV(1)), forced inspiratory volume in one second FIV1 vital capacity (VC), peak expiratory flow (PEF), forced expiratory flow rate (FEF (25–75) %), forced inspiratory flow at 50 % of the vital capacity (FIF 50%), maximum voluntary ventilation (MVV), vital capacity (VC MAX), peak inspiratory flow (PIF), etc. Prior to each testing the respiratory gas analyzer was calibrated according to the automatic calibration method proposed by Jaeger.

Table 1. **Parameters of pulmonary function at rest in women in the control group and in those who were practicing yoga**

Parameters of pulmonary function	Women's control group	YPW	p-level between groups	YPW after 6 months of yoga practice	p-level after 6 months of yoga practice
VC MAX, L	4.08 (0.60)	4.56 (1.22)	0.673	3.83 (0.54)	0.145
VC MAX, %	105.21 (10.39)	116.02 (28,11)	0.336	100.59 (11.82)	0.152
FEV 1, L	3.53 (0.45)	3.74 (0.51)	0.516	3.52 (0.45)	0.367
FEV 1, %	106.13 (10.17)	111.57 (10.49)	0.291	108.01 (11.10)	0.496
FEV 1, %	96.30 (5.07)	97.00 (2.56)	0.826	95.16 (4.1)	0.376
MVV, L/min	126.10 (23.21)	130.54 (9.07)	0.503	134.21 (14.80)	0.718
MVV, L/min	106.25 (18.74)	110.39 (10.34)	0.376	115.69 (12.57)	0.584
FVC, L	3.68 (0.48)	3.77 (0.58)	0.717	3.703 (0.49)	0.755
FVC, L	96.48 (10.92)	100.3 (10.64)	0.448	98.95 (11.02)	0.766
PEF, L/s	6.62 (1.39)	7.25 (1.52)	0.309	7.29 (0.93)	0.944
PEF, L/s	90.66 (16.78)	99.15 (20.85)	0.244	92.68 (29.52)	0.525
PIF, L/s	5.48 (1.14)	6.13 (1.50)	0.491	6.82 (1.35)	0.072
FEF 25, L/s	6.36 (1.39	6.55 (2.00)	0.813	6.62 (0.85)	0.932
FEF 25, L/s	100.67 (20.30)	97.87 (42.34)	0.874	106.21 (11.63)	0.620
FEF 50, L/s	4.87 (0.99)	5.79 (0.93)	**0.058**	4.89 (0.88)	0.003
FEF 50 %, L/s	106.3 (20.7)	123.97 (21.22)	0.091	108.96 (17.73)	0.003
FEF 75, L/s	2.48 (0.80)	2.96 (1.14)	0.331	2.66 (1.01)	0.495
FEF 75, L/s	114.96 (35.13)	127.76 (45.08)	0.520	128.01 (47.10)	0.851
FEF 75/85, L/s	1.87 (0.56)	2.56 (0.79)	**0.068**	2.11 (0.89)	0.288
FEF 75/85, L/s	131.36 (31.50)	181.26 (51.13)	**0.036**	159.07 (61.53)	0.588
FVC IN, L	3.45 (0.45)	4.29 (1.41)	0.144	3.67 (0.64)	0.265
FVC IN, L	89.37 (9.71)	118.39 (30.71)	**0.014**	96.28 (14.81)	0.076
FIV1, L	3.42 (0.44)	4.05 (0.69)	**0.045**	3.646 (0.64)	0.150
FIV1, FVC, %	98.91 (0.66)	93.86 (9.88)	0.130	99.44 (0.31)	0.12
BMI	21.73 (2.26)	22.59 (2.37)	0.446	22.6 (2,00)	0.074

Note. YPW – women practicing yoga.

Organization of the research. The studies were conducted in the Laboratory of Sports Physiology at the Department of Applied Biology and Rehabilitation. The subjects were familiarized with the research and they signed informed consent to participate in the study. The pulmonary parameters were tested under the same conditions at rest, after establishing their BMI. The subjects not practicing yoga were tested once and those who were practicing yoga – twice: they were repeatedly tested after 6 months of yoga practice.

Mathematical statistics. Results were analysed applying the following methods of mathematical statistics: calculating and presenting (in figures and tables) means and standard deviations; comparing the means of the samples using one-way ANOVA. For the reliability of statistical hypothesis, the level of statistical significance was set at ($p < 0.05$).

The data were processed using computer programs: "LAB Manager", "Microsoft Excel", Statistica for Windows.

RESEARCH RESULTS

Pulmonary function measures FEF 75/85 (L/s) ($p = 0.036$), total volume inspired FVC IN (L) ($p = 0.014$), FIV1 (L) ($p = 0.045$) were significantly higher in yoga practicing women than in those in the control group, and VC MAX (%) ($p = 0.018$), FEV 1 (%) ($p = 0.041$), FEF 25 (L/s) ($p = 0.017$), FVC IN (L) ($p = 0.002$) in men practicing yoga, than in men not practicing yoga. They also demonstrated higher values of MVV (L/min) ($p = 0.068$) and FVC (L) ($p = 0.050$).

After 6 months of practicing yoga, we found higher FEF 50 (L/s) ($p = 0.003$), FEF 50% (L/s)

Table 2. **Parameters of pulmonary function of men in the control group and in yoga practice group**

Parameters of pulmonary function	NPJM	PJM	p-level between groups	PJM after 6 months of yoga practice	p-level after 6 months of yoga practice
VC MAX, L	5.50 (0.67)	5.79 (0.76)	0.691	6.04 (0.68)	**0.053**
VC MAX, %	111.08 (16.67)	131.39 (12.64)	**0.018**	136.34 (12.84)	**0.028**
FEV 1, L	4.72 (0.47)	4.83 (0.55)	0.895	4.87 (0.43)	0.279
FEV 1, %	115.69 (14.02)	129.9 (14.29)	**0.041**	130.85 (12.04)	0.513
FEV 1, %	94.38 (6.35)	92.61 (7.48)	0.442	91.028 (5.75)	0.750
MVV, L/min	193.81 (36.60)	201.68 (26.61)	0.643	200.36 (23.91)	0.939
MVV, L/min	137.31 (28.44)	160.3 (22.54)	**0.068**	158.71 (19.16)	0.748
FVC, L	5.04 (0.64)	5.25 (0.68)	0.565	5.368 (0.50)	0.368
FVC, L	104.65 (10.4)	122.32 (15.20)	**0.005**	125.1 (14.87)	0.489
PEF, L/s	9.81 (1.48)	10.30 (2.62)	0.591	10.57 (0.99)	0.797
PEF, L/s	110.21 (22.74)	132.26 (36.35)	0.133	132.97 (15.45)	0.814
PIF, L/s	8.84 (2.34)	8.13 (1.60)	0.433	9.20 (1.11)	**0.051**
FEF 25, L/s	8.59 (1.16)	9.46 (1.76)	0.184	9.87 (0.84)	0.514
FEF 25, L/s	112.31 (20.09)	141.32 (27.55)	**0.017**	147.25 (17.88)	0.567
FEF 50, L/s	6.44 (1.10)	6.45 (1.18)	0.873	6.35 (1.03)	0.821
FEF 50 %, L/s	135.74 (24.74)	124.5 (27.5)	0.477	132.78 (23.04)	0.754
FEF 75, L/s	2.81 (10.79)	2.89 (1.12)	0.702	2.26 (1.31)	0.265
FEF 75, L/s	129.91 (34.78)	120.55 (52.96)	0.850	103.37 (55.13)	0.201
FEF 75/85, L/s	2.079 (0.69)	2.36 (1.06)	0.537	1.63 (1.07)	0.407
FEF 75/85, L/s	148.06 (43.44)	158.6 (75.16)	0.735	118.95 (68.66)	0.391
FVC IN, L	4.77 (0.60)	5.22 (0.71)	0.202	5.51 (0.57)	**0.061**
FVC IN, L	96.05 (11.92)	118.51 (15.22)	**0.002**	125.43 (16.07)	0.095
FIV1, L	4.68 (0.60)	5.05 (0.72)	0.337	5.335 (0.44)	**0.064**
FIV1, FVC, %	98.3 (4.13)	97.14 (7.37)	0.572	97.15 (4.88)	0.828
BMI	24.34 (1.80)	25.62 (2.70)	0.135	25.7 (2.38)	0.415

Note. YPM – men practicing yoga.

(p = 0.003) in women group and VCMAX (%) (p = 0.028) in men. We also found a tendency of an increase of VCMAX (L) (p = 0.053), PIF (L/s) (p = 0.051), FVC IN (L) (p = 0.061), FIVI (L) (p = 0.064) indexes in men and PIF (L/s) (p = 0.072), FVC IN (L) (p = 0.076) in women.

DISCUSSION

In our research men and women practicing Yoga demonstrated higher pulmonary function indices of FEF 75/85, FVC IN, FIV1 in PYW and VC MAX (%) (p = 0.018), FEV 1 (%) (p = 0.041), FEF 25, FVC IN in PYM, than the ones in the control group. YPM also demonstrated higher values of FVC than those in the control group, although we estimated only some differences and tendencies of the increase in pulmonary function indexes during Yoga practice. After 6 months of yoga practice we found higher FEF 50, FEF 50%, in women's group and VCMAX (%) in men's group. We observed a tendency of increase of VCMAX, PIF, FVC IN, FI VI indexes in men and PIF, FVC IN in women.

Yoga training results closely indicated the reduction of sympathetic reactivity and improvement in the pulmonary ventilation by means of relaxation of voluntary inspiratory and expiratory muscles (Khanam et al., 1996). S. Singh and his colleagues (2012) found statistically significant improvement (p < 0.001) in forced vital capacity (FVC), forced expiratory volume in the 1st sec (FEV1), peak expiratory flow rate (PEFR), maximum voluntary ventilation (MVV) and slow vital capacity (SVC) in patients of bronchial asthma before and after yoga intervention of 2 months. The responses of Alternate Nostril Breathing Pranayama on some cardio-respiratory functions were investigated in healthy young adults. The subjects performed ANB exercise (15 minutes in the morning every day) for four weeks. Cardio-respiratory parameters were recorded before and after a 4-week training period. A significant increment in Peak expiratory flow rate (PEFR L/min) and Pulse pressure (PP) was noted. Although Systolic blood pressure (SBP) decreased insignificantly, the decrease in pulse rate (PR), respiratory rates (RR), diastolic blood pressure (DBP) were significant.

A. N. Abel and colleagues (2012) concluded that pulmonary function appeared to improve with a minimum of 10 weeks of regular yoga practice, and the magnitude of this improvement was related to fitness level and/or the length of time the subjects spent practicing pranayama (i. e. breathing exercises). In other words, greater improvements in pulmonary function were more likely to be seen in less-fit individuals and/or those that engaged in longer periods of pranayama.

Respiratory parameters at rest and during graded exercise test in endurance athletes, sprinters and physically active persons were studied by A. Stasiulis and his colleagues (2009). In their research they concluded that respiratory function at rest was not different between subjects, whereas endurance athletes demonstrated higher relative ventilation and higher BF during incremental running test. C. Rong and colleagues (2008) observed that lung function measurements correlated with the indicators of sport, age, gender, height, and weight in various athletes. The lung capacity of swimmers was greater than that of other athletes. Small airway dysfunction was observed in some swimmers and endurance athletes. They observed an association between systemic anaphylaxis and small airway dysfunction after prolonged regular training, particularly following swimming and endurance training. S. Singh and colleagues (2012) suggested that pranayama and yoga breathing and stretching postures were used to increase respiratory stamina, relax the chest muscles, expand the lungs, raise energy levels, and calm the body.

CONCLUSIONS AND PERSPECTIVES

Yoga practice seems, to have minor influence on respiratory function at rest in men and women of middle age. Additional studies examining various yoga practices are warranted to gain a more comprehensive understanding of the effects of yoga techniques on pulmonary functions.

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JOGOS PRATYBOS SILPNAI VEIKIA VIDUTINIO AMŽIAUS MOTERŲ IR VYRŲ KVĖPAVIMO RODIKLIUS RAMYBĖJE

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SANTRAUKA

Tyrimo pagrindimas ir hipotezė: daugeliu studijų įrodyta teigiama jogos nauda žmogaus sveikatai. Jogos kvėpavimo technika gali pagerinti plaučių funkciją ramybėje.

Tikslas – palyginti nesportuojančių asmenų ir praktikuojančių *Hatha* jogą kvėpavimo funkcijos rodiklius ramybėje ir įvertinti jų pokyčius po šešių mėnesių jogos pratybų.

Metodai. Norint įvertinti vyrų (n = 11; amžius – 30,8 (± 7,06) m.; KMI – 25,6 (± 2,6)), moterų (n = 11; amžius – 28,9 (± 6,86) m., KMI – 22,5 (± 2,3)), praktikuojančių jogą, ir kontrolinės tokio pat amžiaus grupės asmenų (n = 22) plaučių funkcinius rodiklius ramybėje buvo naudotas nešiojamas dujų analizatorius „Oxycon Mobile“ (Jaeger, Vokietija).

Rezultatai. Kvėpavimo funkcijos rodikliai, tokie kaip forsuoto iškvėpimo greitis iškvėpus 75/85% tūrio (L/s; p = 0,036), forsuoto įkvėpimo tūris (L; p = 0,014), forsuoto įkvėpimo tūris procentais per 1 s (L; p = 0,045) jogą praktikuojančių moterų grupėje buvo statistiškai reikšmingai didesni nei kontrolinės grupės. Praktikuojančių jogą vyrų maksimalusis gyvybinis plaučių tūris procentais (p = 0,018), forsuoto iškvėpimo tūris procentais per pirmą sekundę (L; p = 0,041), forsuoto iškvėpimo greitis iškvėpus 25% tūrio (L/s; p = 0,017), forsuoto įkvėpimo tūrio (L; p = 0,002) rodikliai buvo didesni už nepraktikuojančių jogos vyrų rodiklius. Po šešių mėnesių jogos pratybų buvo nustatytas didesnis moterų forsuoto iškvėpimo greitis iškvėpus 50% tūrio (L/s; p = 0,003) ir maksimaliojo gyvybinio plaučių tūrio (%; p = 0,028) rodikliai vyrų grupėje. Taip pat buvo pastebimos vyrų maksimaliosios gyvybinės plaučių talpos (L; p = 0,053), maksimaliojo įkvėpimo greičio (L/s; p = 0,051), forsuoto įkvėpimo tūrio (L; p = 0,061), forsuoto įkvėpimo tūrio per 1 s (L; p = 0,064) ir moterų maksimaliojo įkvėpimo greičio (L/s; p = 0,072) bei forsuoto įkvėpimo tūrio (L; p = 0,076) rodiklių didėjimo tendencijos.

Aptarimas ir išvados. Jogos pratybos gali tik silpnai paveikti vidutinio amžiaus vyrų ir moterų kvėpavimo rodiklius ramybėje. Reikalingos papildomos studijos, kurios padėtų geriau įvertinti jogos pratybų poveikį plaučių funkcijoms.

Raktažodžiai: plaučių ventiliacija ramybėje, jogos pratybos, jogos kvėpavimas.

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2.4. **Introduction**. It should contain a clear statement of the problem of the research, the extent of its solution, the new arguments for its solution (for theoretical papers), most important papers on the subject, the aim, the object and the original hypothesis of the study.

2.5. **Research methods.** In this part the choice of specific methods of the research should be grounded. The research participants, methods, apparatus and procedures should be identified in sufficient detail. If the methods of the research used are not well known and widely recognized the reasons for the choice of a particular method should be stated. References should be given for all non-standard methods used. Appropriate statistical analysis should be performed based upon the experimental design carried out. It is necessary to indicate the methods of mathematical statistics applied (statistical reliability, statistical power, confidence interval, effect size), and to explain the estimation of the sample size. Do not include information that will identify human subjects. Research involving human subjects should be carried out following the principles of the Declaration of Helsinki.

2.6. **Research results.** Findings of the study should be presented concisely, consistently and logically, not repeating the chosen methods. The statistical significance and statistical power of the finding should be denoted. We recommend presenting the data in diagrams and not in tables.

2.7. **Discussion.** At the beginning of the discussion section the authors should provide major original research statements (conclusions) that are supported by the data. We recommend structuring the discussion of the findings into subsections (each original research finding should be discussed in a different subsection). The data and the conclusions of the research are compared to the data obtained by other researchers evaluating their similarities and differences. Authors should emphasize the original and important features of the study and avoid repeating all the data presented within the results section.

2.8. **Conclusions and perspectives.** The conclusions provided should be formulated clearly and logically avoiding excessive verbiage. Conclusions supported by the research results should confirm or reject the research hypothesis. The most important requirement for the research conclusions is their originality in the world. It is necessary to indicate the further perspectives of the research.

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

2.10. **References.** Only published materials (with the exception of dissertations) and sources referred to in the text of the article should be included in the list of references. There should not be more than 20 references for original investigations and 30 references for review articles.

3. Requirements for the preparation of manuscripts

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

3.2. **The manuscript should be brief, clear and grammatically correct**. **The typed text should be carefully checked for errors.** It is recommended that only standard abbreviation and symbols be used. All abbreviations should be explained in parentheses after the full written-out version of what they stand for on their first occurrence in the text. Non-standard special abbreviations and symbols need only to be defined at first mention. The results of all measurements and symbols for all physical units should be those of the System International (SI) Units. In the text of the article all numbers up to ten are to be written in words and all numbers starting from eleven on – in Arabic figures.

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).

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

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

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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.

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