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## CONTENT



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# PHYSICAL ACTIVITY AS A DETERMINANT OF SUBJECTIVE HAPPINESS

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## ABSTRACT

*Background.* It is clear that happiness is the aim for individuals living in a highly demanding society. Although much behaviour may result in perceived subjective happiness, it is thought that physical activity is one of such factors. In this respect, the aim of this study was to investigate participants' subjective happiness as a result of their level of the amount of exercise they take part in, as well as other secondary measures (gender, body mass index, sports facilities and sports participation of family members).

*Methods.* The study sample consists of 312 undergraduate students (114 females, 198 males). Exercise Stages of Change Questionnaire (ESOCQ) and Subjective Happiness Scale (SHS) were used as a data collection tool in the study. Data was analyzed using the one-way analysis of variance (ANOVA), Kruskal-Wallis H test, T-test and Chi-Square ($\chi^2$) test.

*Results.* The results indicated that subjective happiness of undergraduate students was dependant on how physically active they were, particular in males, with normal body mass index and also those who were members of sporting facilities and whose parents were also physically active.

*Conclusion.* This study showed that university students who participated in physical activity showed subjectively higher levels of perceived happiness. Furthermore, the factors determining these relationships were supported by gender, body mass index, sports facilities and whether or not their close family members were also physically active.

**Keywords:** exercise, wellbeing, university students.

## INTRODUCTION

There has been an increase in the number of research focusing on positive emotions and experiences with the development of positive psychology in the second half of the 20th century (Gillham & Seligman, 1999; Seligman, 2003). Such research especially has addressed topics of subjective well-being, happiness and life satisfaction (Myers & Diener, 1995). Thus, happiness has been the subject of many research disciplines, primarily biology and psychology; inquiries into happiness can be traced back to ancient history philosophers (Aristotle, Democritus, etc.) (Angner, 2010; Diener, 2000; Hills & Argyle, 2002; Lane, Reiman, Ahern, Schwartz, & Davidson, 1997; Seligman & Csıkszentmıhalyı, 2000; Sin & Lyubomirsky, 2009; Taylor & Brown, 1988). Happiness involves positive emotions, negative emotions and life satisfaction. The positive affective dimension of happiness involves emotions such as joy, excitement and confidence while the negative affective dimension includes emotions such as guilt, sadness, anger and hatred. The life satisfaction dimension consists of an individual's assessments of satisfaction in various areas of life (Myers & Diener, 1995). When examined, physical activity (PA) appears to be closely associated with all these items of positive and negative emotions. This association may be either in the form of reducing the level of negative emotions (depression, anxiety and anger) (Arslan, Güllü, & Tutal, 2011; A. Byrne & D. G. Byrne, 1993; Cameron & Hudson, 1986; Folkins & Sime, 1981; Fremont & Craighead,

1987) or may emerge in the form of increasing the level of positive emotions (happiness, etc.) (Chyi & Mao, 2012; Ferrer-i-Carbonell & Frijters, 2004). Although there are a number of studies that examine the relationship between PA and happiness in the literature (Bloodworth, McNamee, & Bailey, 2012; Fox, 1999; Gauvin & Spence, 1996; Hassmen, Koivula, & Uutela, 2000; Huang & Humphreys, 2012; McAuley et al., 2000; Netz, Wu, Becker, & Tenenbaum, 2005), such studies are very rare in Turkey (Cartel, Bahadır, Saracaloğlu, & Varol, 2015; Yalız Solmaz, 2014). Hence, the purpose of this study is to investigate university students' level of subjective happiness in terms of participation in PA. To this end, answers were sought the following questions:

1. Does students' level of subjective happiness significantly differ by stages of exercise behaviour?
2. Does students' level of subjective happiness and stages of exercise behaviour significantly differ according to gender, body mass index, sports facilities and sports participation of family members?

## METHODS

The study adopted cross-sectional design and self-reported questionnaires were used to collect data.

**Participants.** The study sample consists of 312 undergraduate students (114 females, 198 males) from Karadeniz Technical University (KTU) who completed a questionnaire package that included Exercise Stages of Change Questionnaire (ESOCQ) and Subjective Happiness Scale (SHS). The study was carried out in 2015-2016 academic year in Trabzon.

**Procedure.** Following the approval of the study by KTU, the authors contacted with the instructors of each selected faculty for he convenient time to apply the questionnaire. Questionnaires were administrated before or at the end of the lesson. Before applying the questionnaire, participants were informed about the study, and their informed consents were taken. Then, completed questionnaires were returned to the authors.

**Instruments.** *Exercise Stages of Change Questionnaire (ESOCQ).* ESOCQ is a four-item measure which was developed by Marcus and Lewis (2003) to determine the stage of exercise behaviour of an individual. ESOCQ is a binary type (yes/no) questionnaire. Participants answer each question related to their PA participation as "yes" or "no". Based on their responses, they were classified into five different stages by using a scoring algorithm. Specifically, the stages include Pre-contemplation, Contemplation, Preparation, Action, and Maintenance. Among them, pre-contemplators and contemplators are physically inactive/passive, preparers are physically active but not at the recommended levels and individuals in the action and maintenance stages are physically active. ESOCQ has been translated from English to Turkish and psychometric properties have been examined by Cengiz, Aşçı and İnce (2010). In the Turkish version of ESOCQ the level of PA (low, moderate, and high) were tested among the participants at five different exercise stages. Analyses demonstrated significant differences in the PA level in terms of exercise stages. Analysis also indicated adequate test-retest reliability based on two weeks' interval (ICC = .80). In this study, Turkish version of the ESOCQ was used for the Turkish students.

*Subjective Happiness Scale (SHS).* The Subjective Happiness Scale is a scale developed to evaluate the global subjective happiness. SHS is a 7-point Likert type self-report style measurement tool. The scale consists of 4 items. Lyubomirsky and Lepper (1999) have reported that the internal consistency of SHS varies between .79 and .94 for samples consisting of different ages, cultures, languages and professions. SHS has been translated from English to Turkish and psychometric properties examined by Doğan and Totan (2013). The Turkish version of the SHS was used in this study.

**Statistical analysis.** The data was analysed using the Statistical Package for Social Sciences (SPSS) version 21.0. The one-way analysis of variance (ANOVA), Kruskal-Wallis and *T*-test were used to determine whether there were any significant differences between the means of independent/unrelated groups. Additionally, Chi-Square ($\chi^2$) test was used to determine whether there was a relationship between categorical variables.

## RESULTS

According to the results of the $\chi^2$ test for one sample shown in Table 1a, most of the participants were in the active stage of exercise behaviour

(40.4%), and least of the participants were in the preparation stage of exercise behaviour (23.4%). The results of $\chi^2$ test indicated that there was statistically significant relationship between stages of exercise behaviour, $\chi^2(2, n = 312) = 14.67, p < .01$.

Table 1a. **The distribution of stages of exercise behaviour**

| Stage of Exercise Behaviour | *n* | % |
|---|---|---|
| Passive | 113 | 36.2 |
| Preparation | 73 | 23.4 |
| Active | 126 | 40.4 |
| Total | 312 | 100 |

**Note.** $\chi^2 = 14.67$, $df = 2$, $p = .001$.

Table 1b. **The distribution of SHS scores according to stages of exercise behaviour**

| | **Passive (*n* = 113) (*M* ± *SD*)** | **Preparation (*n* = 73) (*M* ± *SD*)** | **Active (*n* = 126) (*M* ± *SD*)** | ***p*** |
|---|---|---|---|---|
| Subjective Happiness | 4.19 ± 1 | 4.54 ± 1.1 | 5.71 ± 0.7 | .000 |

**Note.** (M ± SD) – Mean and Standard Deviation.

Table 1b shows the results based on Analysis of Variance (ANOVA) between stages of exercise behaviour and students' subjective happiness. The results suggested that the stage of exercise was significantly associated with students' subjective happiness, $F(2, 309) = 84.18$, $p < .01$. Post-hoc analysis using Tukey method showed that passive stage students (4.19 ± 1) were significantly different from preparation stage (4.54 ± 1.1, $p = .038$) and active stage students (5.71 ± 0.7, $p = .000$), and also preparation stage students (4.54 ± 1.1) were significantly different from active stage students (5.71 ± 0.7, $p = .000$) in relations to students' subjective happiness.

Table 2a shows the results of the $\chi^2$ test on whether students' level of exercise behaviour was associated with gender. Considering Table 2a, nearly half of the male students were in the active stage of exercise behaviour, while the majority of the female students were in the passive stage of exercise behaviour. The results of $\chi^2$ test indicated that there was statistically significant relationship between stages of exercise behaviour and gender, $\chi^2(2, n = 312) = 7.38$, $p < .05$. In other words, there was a statistically significant relation between students' exercise behaviour and gender.

Students' subjective happiness scores by gender are shown in Table 2b. The analysis of the subjective happiness of the students showed that there were no significant differences between female (M = 4.8 ± 1.2) and male (M = 4.93 ± 1.14) students ($t(310) = -.95$, $p > .05$).

Table 3a shows the results of the $\chi^2$ test on whether students' level of exercise behaviour was associated with BMI. Based on the rates, the majority of students in the obese category (60%) were in the preparation stage of exercise behaviour. Overweight students were mostly in the passive stage of exercise behaviour, while underweight and healthy students were in the active stage of exercise behaviour (42.1% and 45.9%, respectively). The results of $\chi^2$ test revealed that there was statistically significant difference between the stages of exercise behaviour and BMI, $\chi^2(6, n = 312) = 20.28$, $p < .01$.

According to the BMI of the students, Kruskal-Wallis *H*, taken from SHS scores, was given in Table 3b. Analysis showed that there was a statistically significant differences between

Table 2a. **The distribution of stages of exercise behaviour by gender**

| **Gender** | ***n*(%)** | **Stages of Exercise Behaviour** | | | **Total** |
|---|---|---|---|---|---|
| | | **Passive** | **Preparation** | **Active** | |
| Female | *n*(%) | 46(40.4) | 33(28.9) | 35(30.7) | 114(100) |
| Male | *n*(%) | 67(33.8) | 40(20.2) | 91(46.0) | 198(100) |
| Total | *n*(%) | 113(36.2) | 73(23.4) | 126(40.4) | 312(100) |

**Note**. $\chi^2 = 7.38$, $df = 2$, $p = .025$.

Table 2b. **The distribution of SHS scores according to gen**

| | **Gender** | ***n*** | ***M*** | ***SD*** | ***df*** | ***t*** | ***p*** |
|---|---|---|---|---|---|---|---|
| Subjective Happiness | Female | 114 | 4.8 | 1.2 | 310 | –.95 | .342 |
| | Male | 198 | 4.93 | 1.14 | | | |

**Note.** *M* = Mean; *SD* = Standard Deviation.

| BMI (kg·m$^{-2}$) | *n*(%) | Stages of Exercise Behaviour | | | Total |
|---|---|---|---|---|---|
| | | Passive | Preparation | Active | |
| Underweight | *n*(%) | 6(31.6) | 5(26.3) | 8(42.1) | 19(100) |
| Healthy | *n*(%) | 76(34.5) | 43(19.5) | 101(45.9) | 220(100) |
| Overweight | *n*(%) | 27(46.6) | 16(27.6) | 15(25.9) | 58(100) |
| Obese | *n*(%) | 4(26.7) | 9(60.0) | 2(13.3) | 15(100) |
| Total | *n*(%) | 113(36.2) | 73(23.4) | 126(40.4) | 312(100) |

Table 3a. **The distribution of stages of exercise behaviour by BMI**

**Note.** $\chi^2 = 20.28$, $df = 6$, $p = .002$, (BMI) – Body Mass Index.

| BMI | *n* | Mean Rank | *df* | $\chi^2$ | *p* |
|---|---|---|---|---|---|
| Underweight | 19 | 152.58 | 3 | 12.12 | .007 |
| Healthy | 220 | 167.23 | | | |
| Overweight | 58 | 126.76 | | | |
| Obese | 15 | 119.03 | | | |

Table 3b. **The distribution of SHS scores according to BMI**

**Note.** (BMI) – Body Mass Index.

| Sports Facilities | *n*(%) | Stages of Exercise Behaviour | | | Total |
|---|---|---|---|---|---|
| | | Passive | Preparation | Active | |
| Yes | *n*(%) | 75(32.2) | 51(21.9) | 107(45.9) | 233(100) |
| No | *n*(%) | 38(48.1) | 22(27.8) | 19(24.1) | 79(100) |
| Total | *n*(%) | 113(36.2) | 73(23.4) | 126(40.4) | 312(100) |

Table 4a. **The distribution of stages of exercise behaviour by sports facilities**

**Note.** $\chi^2 = 12.01$, $df = 2$, $p = .002$.

| | Sports Facilities | *n* | *M* | *SD* | *df* | *t* | *p* |
|---|---|---|---|---|---|---|---|
| Subjective Happiness | Yes | 233 | 5.04 | 1.14 | 310 | 4.24 | .000 |
| | No | 79 | 4.42 | 1.13 | | | |

Table 4b. **The distribution of SHS scores according to sports facilities**

**Note.** *M* = Mean; *SD* = Standard Deviation.

subjective happiness by BMI types, $\chi^2(3) = 12.12$, $p < .01$. This finding indicates that the BMI showed different effects on the subjective happiness of the students. Considering the mean rank of the groups, healthy students had the highest scores in subjective happiness, which was followed by underweight, overweight and obese students.

The data were obtained from students who had and did not have sports facilities (Table 4a). As seen in Table 4a, the rate of the students in the active stage of exercise behaviour was 45.9% within the group with sports facilities, while it was 24.1% within the group without sports facilities. Students who did not have sports facilities were mostly in the passive stage of exercise behaviour. The results of $\chi^2$ test revealed that there was statistically significant difference between the stages of exercise behaviour and sports facilities, $\chi^2(2, n = 312) = 12.01$, $p < .01$. Thus, there was a significant relation between sports facilities and stages of exercise behaviour.

Students' subjective happiness scores by sports facilities are shown in Table 4b. The analysis of students' subjective happiness indicated that there was a statistically significant difference between students who had and did not have sports facilities, $t(310) = 4.24$, $p < .01$. The mean subjective happiness score of the students with sports facilities ($M = 5 \pm 1.1$) were higher than the mean subjective happiness score of those without sports facilities ($M = 4.4 \pm 1.1$).

Table 5a. **The distribution of stages of exercise behaviour by sports participation of family members**

| Sports Participation of Family Members | *n*(%) | Stages of Exercise Behaviour | | | Total |
|---|---|---|---|---|---|
| | | Passive | Preparation | Active | |
| Yes | *n*(%) | 25(19.8) | 28(22.2) | 73(57.9) | 126(100) |
| No | *n*(%) | 88(47.3) | 45(24.2) | 53(28.5) | 186(100) |
| Total | *n*(%) | 113(36.2) | 73(23.4) | 126(40.4) | 312(100) |

**Note.** $\chi^2 = 31.9$, $df = 2$, $p = .000$.

Table 5b. **The distribution of SHS scores according to sports participation of family members**

| | Sports Participation of Family Members | *n* | *M* | *SD* | *df* | *t* | *p* |
|---|---|---|---|---|---|---|---|
| Subjective Happiness | Yes | 126 | 5.23 | 1.08 | 310 | 4.4 | .000 |
| | No | 186 | 4.65 | 1.16 | | | |

**Note.** *M* = Mean; *SD* = Standard Deviation.

The data were obtained from students whose family members participated and did not participate in PA (Table 5a). More than half of the students whose family members participated in sports were in the active stage of exercise behaviour whereas most of the students whose family members did not participate in sports were in the passive stage of exercise behaviour. The results of $\chi^2$ test revealed that there was statistically significant difference between the stages of exercise behaviour and sports participation of family members, $\chi^2(2, n = 312) = 31.9$, $p = .00$.

Students' subjective happiness scores by sports participation of family members are shown Table 5b. The analysis of students' subjective happiness indicated that there were statistically significant differences between students whose family members participated and did not participate in physical activity, $t(310) = 4.4$, $p < .01$. The mean subjective happiness scores of the students whose family members participated in sports (M = 5.2 ± 1.1) were higher than the mean subjective happiness scores of those whose family members did not participate in sports (M = 4.7 ± 1.2).

## DISCUSSION

The research found out that university students had a moderate level of subjective happiness. When students' level of subjective happiness was analysed depending on their stages of exercise behaviour, students' active stage of exercise behaviour had the highest average. It was followed by students under the preparation category and students under the passive category, and this difference between the averages was statistically significant (Table 1b). Studies indicate that sports and PA contribute to individuals' levels of positive psychology (Biddle, Fox, & Boutcher, 2003; Weinberg & Gould, 2014). The relationship between participation in PA and subjective happiness levels of individuals has been the subject of study in almost every age group, and such studies have found out that participation in PA positively contributes to subjective happiness/ subjective well-being levels of individuals (Cartel et al., 2015; Fox, 1999; Holder, Coleman, & Sehn, 2009; Huang & Humphreys, 2012; McAuley et al., 2000; Netz et al., 2005; Ruseski, Humphreys, Hallman, Wicker, & Breuer, 2014; Stathi, Fox, & McKenna, 2002; Stubbe, De Moor, Boomsma, & De Geus, 2007; Yalız Solmaz, 2014). The findings of the present study appear to be in parallel with the literature with respect to participation in PA and subjective happiness level.

Considering the relationship between stages of exercise behaviour of university students and gender, the rate of male students was higher in the active stage of exercise behaviour while the rate of female students was higher in the preparation and passive stages (Table 2a). In a large-scale study examining participation in PA by gender in a group of 1032 participants (53% women and 47% of men) with mean age 47.3 years (Lissitsa, Galily, & Chachashvili-Bololotin, 2010), men were more physically active and exhibited positive attitudes towards sports while women were more physically inactive and displayed neutral or negative attitudes. A study examining PA among young people similarly reported that men were more physically active than women (Trost et al., 2002). In another study on leisure time physical activities (Ainsworth, Richardson, Jacobs Jr, & Leon, 1993), the intensity of PA was higher in men. Comparing subjective

happiness by gender, this study has found that although subjective happiness scores of male students are higher than those of female students, this difference is not statistically significant (Table 2b). In a similar way to this study, several studies in the literature also have reported that there is no significant difference between women and men in terms of happiness (Francis, 1998; Kousha & Mohseni, 2000; Mahon, Yarcheski, & Yarcheski, 2005). Huang and Humphreys (2012) suggest that both men and women experienced happiness when they participated in physical activity, and men seemed to benefit more. In the present study, men have a higher level of subjective happiness than women; however, the difference between the means is not significant. Thus, the findings of the present study seem to be in parallel with those of other studies examining physical activity and happiness with respect to gender.

In this study, most of the students under the categories of underweight and healthy were found to be active stage of exercise behaviour. In addition, students under the category of overweight were mostly passive while students under the category of obese were at the preparation stage of exercise behaviour (Table 3a). In a study examining the impact of some factors on BMI (Taylor, Jatulis, Winkleby, Rockhill, & Kraemer, 1994), individuals' BMI-slopes were found to be lower with increased PA. In a similar vein, in a study conducted on 1213 black and 1166 white girls in the USA (Kimm et al., 2005), changes in activity levels of adolescent girls significantly influenced changes in BMI and adiposity. The findings of the present study seem to be similar to those of other studies in the literature on the association between participation in PA and BMI. In the study on PA and BMI, Herman, Craig, Gauvin and Katzmarzyk (2009) stated that "The majority of overweight youth remained overweight as adults; however, the majority of overweight adults were not overweight youth" (p. 281). Based on this conclusion, the present study may highlight the importance of maintaining their state in the following years of their life for university students who are physically active and under the healthy category of BMI. When subjective happiness is compared by BMI in the present study, subjective happiness scores of healthy students are higher than those of underweight, overweight and obese students (Table 3b). Headey, Muffels and Wagner (2010) reported that underweight men had lower life satisfaction and obese women were relatively unhappy. In their study conducted in 2007, Oswald and Powdthavee presented clear evidence that happiness and mental health were worse among fatter British and German people. Blanchflower and Oswald (2011) similarly argued that happy individuals were slimmer. Based on the literature findings, it is safe to say that healthy students generally participate in more physical activity and feel happier. Examining BMI in terms of participation in physical activity and subjective happiness, the present study concluded similar results to previous studies.

Considering the availability of sports facilities, students who had sports facilities in their surroundings participated in sports more actively. In other words, students who did not have sports facilities in their surroundings were found to be rather in the passive and preparation stages of exercise behaviour (Table 4a). Huang and Humphreys (2012) noted that those who had access to sports facilities were more likely to participate in PA. Provision of an exercise environment was also found to maximize the possibility to participate in PA (McAuley et al., 2000). In a study examining genetic and environmental factors in sports participation of male and female twins, environmental factors affected sports participation in young adolescence but stopped to be important in adulthood because of genetic factors (Stubbe, Boomsma, & De Geus, 2005). The present study examined sports facilities with respect to both stages of exercise behavior and subjective happiness. Based on the analysis results, the students with sports facilities have higher scores of subjective happiness than those without sports facilities (Table 4b). Huang and Humphreys (2012) argue that more sports facilities lead to higher happiness. As indicated by a previous study, for older adults, exercise environment is a significant determinant of subjective well-being (McAuley et al., 2000). Thus, it seems that there is an association between sports facilities and happiness. In the present study, sports facilities are of importance for both stages of exercise behaviour and subjective happiness.

Another focus of this study is the importance of parental modelling in young people's participation in sports and PA. Cote (1999) indicated that parents' participation in sports could be taken as a model by children, and further noted that the role of the family in youth's participation in sports was a complex phenomenon because of the diversity of family context. In this study, the assessment of

sports participation of family members revealed that students whose family members participated in sports also participated in sports more actively (nearly 60%). Students whose family members did not participate in sports were found to be in the passive stage of exercise behaviour (Table 5a). A number of studies indicated that family served as a role model in girls' participation in PA and sports (Colley, Eglington, & Elliot, 1992; Gregson & Colley, 1986). Another study that examined the impact of parents on Chinese children's PA highlighted the importance of parental role modelling (Lijuan, Jiancui, & Suzhe, 2016). In a study focusing on parental perceptions about the importance of children's participation in PA, physically active parents emphasised the importance of children's participation in PA more than physically inactive parents (Hein, 2015). When students' subjective happiness is analysed in terms of sports participation of family members, students whose family members participate in sports have a higher level of subjective happiness than those whose family members do not participate in sports (Table 5b). Taking into consideration that nearly 60% of students whose family members participate in sports are in the active stage of exercise behaviour, sports participation of family members seems to be associated with students' subjective happiness.

## CONCLUSION

All in all, the present study has two important results. Firstly, university students who show active participation in physical activity have a higher level of subjective happiness; and secondly gender, body mass index, sports facilities and sports participation of family members except for gender are determinants of university students' participation in physical activity and subjective happiness. Further studies can examine the association between students' stages of exercise behaviour and subjective happiness in different age groups. Students' stages of exercise behaviour and subjective happiness can also be analysed in a longitudinal study.

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# DEATH ANXIETY AND EMPATHY AMONG MALE AND FEMALE MEDICAL STUDENTS

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## ABSTRACT

*Background*. Research reveals that death anxiety affects physicians' quality of work when he/she faces a patient suffering from a fatal disease (Field & Howells, 1988, Thiemann, Quince, Benson, Wood, & Barclay, 2015), while empathy leads to medical decision making and a better patient's healing process (Lor, Truong, Ip, & Barnett, 2015; Chen, Kiersma, Yehle, & Plake, 2015). The *aim* of this study was to investigate the relationship between death anxiety and empathy by gender among students of the medicine program in the Lithuanian University of Health Sciences.

*Methods.* The study involved 233 students of the medical program from the Faculty of Medicine in the Lithuanian University of Health Sciences. The sample consisted of 167 women (71.1%) and 56 men (24%), 10 participants have not specified their gender (4.9%). A questionnaire designed for the study consisted of demographic questions, *Interpersonal Reactivity Index* (IRI) (Davis, 1980) and *Revised Collet-Lester Fear of Death and Dying Scale* (Lester, 1990).

*Results*. Medical students that show higher than others anxiety about death of self[1], dying of self[2], death of others[3] and dying of others[4] also show greater personal distress ($r = .211^1$; $r = .217^2$; $r = .248^3$; $r = .219^4$), empathetic concern ($r = .205^1$; $r = .241^2$; $r = .246^3$; $r = .136^4$), emotional ($r = .27^1$; $r = .294^2$; $r = .319^3$; $r = .236^4$) and overall $r = .237^1$; $r = .262^2$; $r = .254^3$; $r = .227^4$) empathy and also had better fantasy ($r = .149^1$; $r = .173^2$; $r = .149^3$; $r = .184^4$) than others. Weak correlation in men sample was between death anxiety subscales and empathetic concern ($r = .532^1$; $r = .279^2$; $r = .3^3$; $r = .306^4$), emotional ($r = .48^1$; $r = .364^2$; $r = .373^3$; $r = .458^4$) and overall ($r = .369^1$; $r = .399^2$; $r = .32^3$; $r = .453^4$) empathy. Very weak correlation in women sample was found between emotional empathy and death of self ($r = .164$), dying of self ($r = .188$) and death of others ($r = .206$) anxiety. Personal distress subscale in women sample was associated with death of self ($r = .186$) and death of others ($r = .179$) anxiety.

*Conclusion.* It was found that medical students showing greater personal distress, empathetic concern, fantasy, emotional and overall empathy have a stronger sense of death anxiety. Correlations between death anxiety and empathy found in men sample were specified as weak, meanwhile correlations found in women sample were specified as very weak.

**Keywords:** cognitive empathy, emotional empathy, fear of death.

## INTRODUCTION

Death anxiety concept in the science of psychology is traditionally defined as emotional discontent or helplessness that manifests itself when confronted with death. Usually, this phenomenon is operationalized with four indexes: 1) anxiety about dying of self; 2) anxiety about death as a phenomenon; 3) anxiety about dying of others; 4) anxiety about death of others as a phenomenon (Sherman, Norman, & McSherry, 2010).

Meanwhile, the well-known and widely used in the science of psychology concept of empathy is being treated ambiguously. Therefore, in the present article, empathy will be defined as cognitive attribute of a person, which consists of ability

to understand internal experiences of another person and his or her attitude towards the said experiences as well as possibility to communicate based on this awareness (Hojat et al., 2002, cit. from Hojat et al., 2005). Empathy consists of two functionally different components – cognitive and emotional empathy. Cognitive empathy is the ability to understand feelings of another person, while emotional empathy is defined as ability to experience emotions evoked by an emotional stimulus (Cuff, Brown, Taylor, & Howat, 2016).

Research reveals that anxiety about death influences the quality of work of a medical person when he or she encounters a patient suffering from lethal illness (Field & Howells, 1988; Thiemann et al., 2015), therefore, it would be beneficial to apply appropriate methods for inhibition of the said psychological phenomenon as early as the student years. No less significant for work of a medical person is empathy, which influences aspects related to treatment: creation and maintaining appropriate medical person–patient communication (Lor et al., 2015), adequate care for the patient (Chen et al., 2015), better prognosis of illness (Caruso & Bernstein, 2014), improved satisfaction of the patient regarding treatment (Regehr, Goldberg, & Hughes, 2002), and better observation of the treatment plan (Wimmers & Stuber, 2010). Research also shows that anxiety about death and empathy relation depends on the gender (Kastenbaum, 2006; Polat, Alemdar, & Gurol, 2012; Velea, Cercel, & Popp, 2012), however, the obtained regularities are ambiguous. In some studies stronger correlation of the said constructs was determined in the men sample (Velea et al., 2012), while other studies showed stronger correlation in women sample (Kastenbaum, 2006).

Currently, in Lithuania more and more research of death anxiety is coming up. Nurses are most frequently studied while medical students are researched rarely. There are some studies of death anxiety correlation with empathy done abroad, but analysis of literature has revealed that obtained results are controversial (Claxton-Oldfield & Banzen, 2010; Garbay, Gay, &Claxton-Oldfield, 2014; Kastenbaum, 2003; Servaty, Krejci, & Hayslip, 1996). No such studies have been found in Lithuania; therefore, it may be maintained that research of death anxiety and empathy could provide significant information about medical students in Lithuania.

*The purpose of the present study* was to determine death anxiety correlation with empathy by gender among Lithuanian medical students.

Objectives of the study:

1. Investigate correlation between death anxiety and empathy;
2. Determine correlation between death anxiety and empathy peculiarities by gender.

## METHODS

The study was performed in the Lithuanian University of Health Sciences in the period of 2015–2016. Samples were selected based on convenient sampling strategy.

Participants of the study were 233 students of the Medical Academy of Lithuanian University of Health Sciences, 167 of which were females, 56 – males, and 10 participants did not specify their gender. The average age of subjects was 21.83 years ($SD$ = 2.24).

Females comprised 71.1% of the sample, the average age of them was 21.83 years ($SD$ = 2.41). The youngest subject was 18 years old, the oldest – 36. Males respectively comprised 24% of the sample, the average age of them was 21.71 years ($SD$ = 1.61). The oldest subject was 25 years old, the youngest – 19.

A questionnaire, which consisted of *Interpersonal Reactivity Index* (IRI, Davis, 1980), the *Revised Collet-Lester Fear of Death and Dying Scale* (Lester, 1990), and questions of demographic attributes of medical students, was developed for the study.

To determine student empathy, *Interpersonal Reactivity Index Scale* was used. Each subscale consisted of 7 items that subjects were asked to evaluate from 1 to 6, where 1 meant that the item did not describe well feelings of the subject, whereas 6 indicated that feelings and attitudes of the subject were described very well. Subscale scores were calculated totalling item points (Naujokaitienė, 2010). The higher score indicated that the attribute characterizing the subscale was more typical of the subject. As it has been established by research, the said scale is distinguished by strong correlation with other questionnaires for empathy determination (Nenortienė, 2012). The determined internal reliability of used subscales showed that all subscales were appropriate (Table 1).

Table 1. **Internal reliability of subscales of Interpersonal Reactivity Index**

| Subscale | Chronbach's alpha | Maximum score |
|---|---|---|
| Perspective | .721 | 42 |
| Fantasy | .781 | 42 |
| Empathetic concern | .578 | 42 |
| Personal distress | .817 | 42 |
| Cognitive empathy | .774 | 84 |
| Emotional empathy | .734 | 84 |
| Overall empathy | .780 | 168 |

To determine death anxiety experienced by medical students *Revised Collet-Lester Fear of Death and Dying Scale* was used. Each of subscales consisted of 8 items that respondents were asked to evaluate from 1 to 5, where 1 indicated that the subject is absolutely indifferent to the specific aspect of death, 3 – the subject is partially concerned about the specific aspect of death, and 5 indicated that the subject is very concerned about the specific aspect of death. Subscale scores were calculated by totalling item scores, the greater subscale total score indicated greater experienced anxiety about the specific death aspect (Vonžodienė, 2010). As it has been established by research the said scale is distinguished by sensitivity and strong correlation with other methods for determining the death anxiety (Mooney & O'Gorman, 2001). The determined internal reliability of used subscales showed that all subscales are appropriate (Table 2).

Table 2. **Internal reliability of subscales of Revised Collet-Lester Fear of Death and Dying Scale**

| Subscale | Chronbach's alpha | Maximum score |
|---|---|---|
| Death of self | .804 | 40 |
| Dying of self | .798 | 40 |
| Death of others | .699 | 40 |
| Dying of others | .799 | 40 |

Normally distributed samples were described by the mean and the standard deviation. Those samples that were not normally distributed were described by the mean, the standard deviation, the median, and the interquartile range. Based on Central Limit Theorem, to determine correlation between two continuous magnitudes parametric Pearson's correlation factor was applied. The determined significance level was $p \leq .05$.

## RESULTS

To determine correlations between death anxiety and empathy among medical students, each death anxiety and empathy subscale score distribution was firstly determined. The lowest mean score on the *Collet-Lester Fear of Death and Dying Scale* among medical students was obtained on the anxiety about death of self as a phenomenon subscale; meanwhile mean scores of the remaining three subscales were higher (Table 3).

In the *Interpersonal Reactivity Index Scale*, the highest mean scores of medical students were determined in perspective, empathic concern, and cognitive empathy subscales (Table 4).

In correlation between death anxiety and empathy analysis based on Central Limit Theorem,

| Death anxiety subscale | Criteria of normality | Mean | Mean percentage | Standard deviation | Median | Interquartile range |
|---|---|---|---|---|---|---|
| Death of self | $p > .05$ | 23.70 | 59.25 | 6.77 | | |
| Dying of self | ***p < .05*** | 27.83 | 69.58 | 6.27 | 29 | 24–33 |
| Death of others | ***p < .001*** | 27.64 | 69.1 | 5.15 | 29 | 25–31 |
| Dying of others | ***p < .05*** | 27.37 | 68.43 | 6.32 | 28 | 23–32 |

Table 3. **Descriptive statistics of Subscales of Collet-Lester Fear of Death and Dying Scale**

Table 4. **Descriptive statistics of Subscales of Interpersonal Reactivity Index**

| Empathy subscale | Criteria of normality | Mean | Mean percentage | Standard deviation | Median | Interquartile range |
|---|---|---|---|---|---|---|
| Perspective | ***p* < .05** | 28.16 | 67.05 | 5.33 | 28 | 24–32 |
| Fantasy | ***p* < .05** | 26.54 | 63.19 | 6.68 | 26 | 22–32 |
| Empathetic concern | ***p* < .05** | 29.8 | 70.95 | 4.53 | 30 | 27–33 |
| Personal distress | *p* > .05 | 21.09 | 50.21 | 5.92 | | |
| Cognitive empathy | *p* > .05 | 54.7 | 65.12 | 9.54 | | |
| Emotional empathy | *p* > .05 | 50.89 | 60.58 | 8.09 | | |
| Overall empathy | *p*> .05 | 105.59 | 56.77 | 13.68 | | |

Table 5. **Correlation matrix of subscales of Interpersonal Reactivity Index Scale and Revised Collet-Lester Fear of Death and Dying Scale**

| | P. | F. | E.c. | P.d. | C.e. | E.e. | O.e. | A.s. | A.s.y. | A.o. | A.o.y. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **P.** | 1 | | | | | | | | | | |
| **F.** | ***.253**** | 1 | | | | | | | | | |
| **E.c.** | ***.351**** | ***.283**** | 1 | | | | | | | | |
| **P.d.** | ***–.195**** | .112 | ***.186**** | 1 | | | | | | | |
| **C.e.** | ***.736**** | ***.841**** | ***.394**** | –.03 | 1 | | | | | | |
| **E.e.** | .054 | ***.24**** | ***.696**** | ***.835**** | ***.198**** | 1 | | | | | |
| **O.e.** | ***.545**** | ***.729**** | ***.686**** | ***.473**** | ***.815**** | ***.73**** | 1 | | | | |
| **A.s.** | .012 | ***.149**** | ***.205**** | ***.211**** | .111 | ***.27**** | ***.237**** | 1 | | | |
| **A.s.y.** | .008 | ***.173**** | ***.241**** | ***.217**** | .126 | ***.294**** | ***.262**** | ***.558**** | 1 | | |
| **A.o.** | –.021 | ***.149**** | ***.246**** | ***.248**** | .093 | ***.319**** | ***.254**** | ***.458**** | ***.528**** | 1 | |
| **A.o.y.** | –.005 | ***.184**** | ***.136**** | ***.219**** | .126 | ***.236**** | ***.227**** | ***.394**** | ***.553**** | ***.618**** | 1 |

**Notes.** **p* ≤ .05, ***p* ≤ .001; applied Pearson's correlation factor; P.: Perspective; F.: Fantasy; E.c.: Empathetic concern; P.d.: Personal distress; C.e. Cognitive empathy, E.e.: Emotional empathy; O.e.: Overall empathy; A.s.: Anxiety about death of self; A.s.y.: Anxiety about dying of self; A.o.: Anxiety about death of others; A.o.y.: Anxiety about dying of others.

Pearson's correlation factor was used. Weak, but statistically significant correlation was obtained among fantasy, empathetic concern, personal distress, emotional and overall empathy subscales as well as correlation among all four death anxiety subscales (Table 5). Therefore, it can be maintained that medical students who feel greater death anxiety also experience greater empathetic concern, personal distress, emotional and overall empathy, and are able to better empathize with others employing fantasy.

To determine gender peculiarities of correlation between death anxiety and empathy Central Limit Theorem was also used and Pearson's correlation factor was applied. It was established that in the male sample weak correlation existed among empathetic concern, emotional and overall empathy, and all four subscales of anxiety about death (Table 6). Also, in the male sample, correlation between subscale of fantasy and anxiety about dying of self and dying of others as well as correlation between subscale of personal distress and anxiety about death of others were established (Table 6).

Meanwhile, in the female sample very weak correlations were observed – it was established

Table 6. **Correlation matrix of subscales of Interpersonal Reactivity Index Scale and Revised Collet-Lester Fear of Death and Dying Scale, male sample**

| | P. | F. | E.c. | P.d. | C.e. | E.e. | O.e. | A.s. | A.s.y. | A.o. | A.o.y. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **P.** | 1 | | | | | | | | | | |
| **F.** | ***.285**** | 1 | | | | | | | | | |
| **E.c.** | .197 | ***.292**** | 1 | | | | | | | | |
| **P.d.** | –.226 | .053 | .07 | 1 | | | | | | | |
| **C.e.** | ***.768**** | ***.833**** | ***.309**** | –.095 | 1 | | | | | | |
| **E.e.** | –.048 | .219 | ***.665**** | ***.792**** | .119 | 1 | | | | | |
| **O.e.** | ***.531**** | ***.74**** | ***.627**** | ***.409**** | ***.801**** | ***.69**** | 1 | | | | |
| **A.s.** | –.048 | .204 | ***.532**** | .206 | .109 | ***.48**** | ***.369**** | 1 | | | |
| **A.s.y.** | .053 | ***.321**** | ***.279**** | .258 | .246 | ***.364**** | ***.399**** | .553 | 1 | | |
| **A.o.** | –.013 | .206 | ***.3**** | .253 | .13 | ***.373**** | ***.32**** | ***.744**** | ***.745**** | 1 | |
| **A.o.y.** | –.049 | ***.404**** | ***.306**** | ***.361**** | .242 | ***.458**** | ***.453**** | ***.707**** | .433 | ***.832**** | 1 |

**Notes.** *$p \leq .05$, **$p \leq .001$; applied Pearson's correlation factor.

Table 7. **Correlation matrix of subscales of Interpersonal Reactivity Index Scale and Revised Collet-Lester Fear of Death and Dying Scale, female sample**

| | P. | F. | E.c. | P.d. | C.e. | E.e. | O.e. | A.s. | A.s.y. | A.o. | A.o.y. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **P.** | 1 | | | | | | | | | | |
| **F.** | ***.246**** | 1 | | | | | | | | | |
| **E.c.** | ***.394**** | ***.271**** | 1 | | | | | | | | |
| **P.d.** | ***–.211**** | .114 | .142 | 1 | | | | | | | |
| **C.e.** | ***.729**** | ***.843**** | ***.41**** | –.037 | 1 | | | | | | |
| **E.e.** | .061 | ***.238**** | ***.666**** | ***.833**** | ***.202**** | 1 | | | | | |
| **O.e.** | ***.551**** | ***.734**** | ***.675**** | ***.4556**** | ***.824**** | ***.721**** | 1 | | | | |
| **A.s.** | .009 | .121 | .043 | ***.186**** | .09 | ***.164**** | ***.159**** | 1 | | | |
| **A.s.y.** | .003 | .133 | ***.154**** | .136 | .095 | ***.188**** | ***.176**** | ***.544**** | 1 | | |
| **A.o.** | –.054 | .092 | .128 | ***.179**** | .034 | ***.206**** | .144 | ***.369**** | ***.467**** | 1 | |
| **A.o.y.** | –.047 | .062 | –.011 | .133 | .017 | .094 | .067 | ***.33**** | ***.484**** | ***.559**** | 1 |

**Notes.** *$p \leq .05$, **$p \leq .001$; applied Pearson's correlation factor.

that subscale of personal distress correlated with subscales of anxiety about death of self and death of others, while empathetic concern correlated with anxiety about dying of self (Table 7). It has also been established that subscales of anxiety about death of self and death of others in the female sample correlate with the overall empathy, while emotional empathy correlates with the said subscale and the subscale of dying of self (Table 7).

## DISCUSSION

The study has revealed that those medical students who experience greater empathetic concern and personal distress have higher scores of emotional and overall empathy as well as have better ability to empathize with others by employing fantasy experience greater anxiety about death of self, dying of self, the death of others, and dying of others.

Analysis of gender peculiarities of correlation between empathy and death anxiety has shown that a weak correlation among empathetic concern, emotional and overall empathy, and all four death anxiety subscales exists in the male sample. Correlation among subscale of fantasy and subscale of anxiety about dying of self, dying of others, and personal distress, as well as anxiety about death of others has been established in the male sample. On the other hand, the observed correlation in the female sample was very weak – it has been established that personal distress scale correlates with subscales of anxiety about death of self and death of others, while empathetic concern correlates with anxiety about dying of self. It has also been established that, in the female sample, subscales of anxiety about death of self and death of others correlate with the overall empathy, while emotional empathy correlates with the said anxiety about dying subscales and the subscale of anxiety about dying of self.

In scientific literature it is noted that death anxiety and empathy are negatively correlated. It is maintained that individuals that are distinguished with lower level of death anxiety are more empathic than those who have higher level of death anxiety (Claxton-Oldfield & Banzen, 2010; Garbay et al., 2014; Polat et al., 2012). Some results of the present study contradict to this correlation – it has been established that death anxiety does not correlate either with the ability to empathize with others by employing perspective, or with cognitive empathy. Therefore, it may be assumed that cognitive empathy and its aspects are more related to intellectual abilities of an individual than to such emotional factors as death anxiety.

These results contradict to the findings of other investigators which indicated that death anxiety and empathy were positively correlated (Kastenbaum, 2003; Servaty et al., 1996; Valmaitė, 2006). Results obtained in the present study support such conclusions. It has been established that medical students who experience greater anxiety about death of self, dying of self, death of others, and dying of others are distinguished by higher levels of personal distress, empathetic concern, fantasy, emotional and overall empathy. We could not find explanation of this tendency in the scientific literature, but it may be assumed that an individual who experiences death anxiety is susceptible to react emphatically to others in such way establishing his/her own being. Such individual feels important when helping others, and this, possibly, helps strengthening the sense of meaningfulness of life.

The research revealed that correlation between death anxiety and empathy is gender related. In the literature, it is maintained that the said correlation is stronger in the female sample (Kastenbaum, 2006; Polat et al., 2012). In the study of Velea and others (2012) opposite results were obtained that showed correlation between death anxiety and empathy in the male sample. Results of the present study conform to those obtained by Velea and others. It has been established that correlation among empathetic concern, emotional and overall empathy, and death anxiety exists in the male sample, whereas the obtained correlation in the female sample was weak. The obtained result makes females emotionality questionable and allows assumption that, despite public expectations that restrict emotional expression of men (Neimeyer, 2009), when confronted with death anxiety men are capable of responding emotionally and empathically to others.

The present small scale pilot study has both scientific and practical value. Both analyzed constructs – anxiety about death and empathy – are significant in medical professionals' work, therefore, knowledge of indexes that reveal the said constructs, their correlation, and expression by gender allows creating special empathy development and death anxiety suppression programs and applying them in the course of studies of medical students.

The present study is distinguished by several limitations. First of all, the sample was selected using the convenient method and students of

medical program of only one university of the country were surveyed. Second, it is difficult to compare the results of the study with data of foreign authors as different death anxiety and empathy questionnaires are used in studies. Third, comparison with the work of foreign authors is limited by time and cultural differences.

On the other hand, the study will be expanded in the future in the sense of quantity and geography of subjects. It also would be valuable to perform comparative analysis of scores and correlation of death anxiety and empathy of medical students and those who are not related to healthcare. Thus it would be possible to determine whether the established regularities are also reflected among other members of society or the said regularities are characteristic only of the sample of medical students. Furthermore, to find out peculiarities of correlation between death anxiety and empathy, it would be meaningful to perform multi-dimensional analysis in future studies. Based on such strategy it would be possible to determine side effects that possibly have impact on correlations between death anxiety and empathy.

## CONCLUSIONS

Medical students who experience greater anxiety about death of self, dying of self, death of others, and dying of others suffer from greater personal distress and empathetic concern, are distinguished by higher scores of emotional and overall empathy, and are capable of empathizing with others employing fantasy. No statistically significant correlation was found among subscales of perspective and cognitive empathy, and anxiety about death of self, dying of self, death of others, and dying of others.

Among males, statistically weak correlation among subscales of empathetic concern, emotional and overall empathy, and anxiety about death of self, dying of self, death of others, and dying of others was determined. Correlation between subscale of fantasy and anxiety about death of self, dying of self, dying of others, and between subscale of personal distress and anxiety about death of others has been established in the male sample.

Statistically significant very weak correlation among subscales of personal distress and anxiety about death of self, and death of others as well as between subscales of empathetic concern and anxiety about dying of self was determined in the female sample. In the female sample, correlation among subscales of overall empathy and anxiety about death as well as anxiety about death of others has been established, while emotional empathy correlates with the said death anxiety subscales and the subscale of dying of self.

**Conflict of interests.** The research was not funded by any organization or company.

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# EFFICIENCY OF BREATHING EXERCISES USED IN PHYSICAL THERAPY FOR 6–12-YEAR-OLD ASTHMATIC CHILDREN'S RESPIRATORY FUNCTION

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## ABSTRACT

*Background.* The aim of the study was to assess the efficiency of breathing exercises for 6–12- year-old asthmatic children's respiratory function.

*Methods.* The study involved 15 children, 9 boys (60%) and 6 girls (40%). The average age of all subjects was 9.07 ± 1.94 years. Boys' average age was 8.89 ± 1.90 years, and that of the girls – 8.33 ± 2.16 years. All subjects participated in physical therapy were breathing exercises were applied for four weeks, 30–45 minutes per day. Moreover, before and after treatment with breathing exercises they had Stange and Henci tests (samples of breathing); breathing muscle strength test with pneumotonometer and abdominal muscle endurance test.

*Results.* After four weeks of physical therapy, the mean respiratory arrest inhalation statistically significantly increased by 11.16%, ($p < .05$). Exhaled breath with hold was 19.17% of the average change, but this change was not statistically significant ($p > .05$); inspiration pressure changed by 27.30% on average ($p < .05$); static abdominal muscle endurance significantly increased from 26.33 to 36.13%; right side muscle static endurance significantly increased by 31.78% and left side static muscle endurance changed by 19.43%.

*Conclusion.* Breathing exercises applied for four weeks for children aged 6–12 years, suffering from bronchial asthma, are useful for increasing respiratory arrest aspiration, inspiration and expiratory pressure, and the abdomen, trunk muscle endurance, but they do not result in any changes in respiratory arrest exhaled.

**Keywords:** breathing exercises, physical therapy, bronchial asthma, respiratory function.

## INTRODUCTION

Bronchial asthma (BA) is one of the most common dysfunctions of the respiratory system. BA is a common chronic inflammatory disease that affects 235 million people around the world, which is the cause of frequent hospitalization (Ang et al. 2016). Moreover, on average, a quarter of the 40 million Americans suffering from asthma are children till 18 years old. Despite high numbers of patients, 4.1 million suffered from an asthma attack or episode (*American Lung Association*, 2011; *Centers for Disease Control and Prevention*, 2014). Children mortality related to asthma is associated with the inability to timely detection of the disease and preventive, lack of preventive measures (National centre for health statistics, 2014).

According to the latest World Health Organization (2014), data bronchial asthma is common worldwide disease, only in Europe 8–10% of population are suffering from asthma. Asthma is an inflammatory disorder with airway hyper responsiveness leading to recurrent episodes of wheezing, breathlessness, chest tightness and coughing, especially during the night and the early morning

Blažienė, Dubakienė, and Ėmužytė (2001), Bojarskis, Dubakienė, Ėmužytė, Kudzytė, and Valiulis (2002), Kudzytė, Griška, and Bojarskas (2008), and Valiulis, Bojarskas, and Ėmužytė (2005) note that approach to bronchial asthma classification, diagnosis, formulation, treatment and prevention were formed long time ago.

However, the current science considers asthma as a disease and offers treatment guidelines (Abramson, Puy, & Weiner 2011; Barnes, 2010; Morris, 2010).

Studies show that pulmonary condition of asthmatic children engaged in continuous physical activity is much better because when exercising the lungs get more oxygen and the air is more easily inhaled and exhaled (Ahnert et al., 2010; Basso et al., 2010; Keraitė-Bliūdžiuvienė, 2005; Repšienė, 2006; Stankutė, 2011)

Physical therapy treatment plan for bronchial asthma should include activities that increase the function of breathing, strengthen breathing muscles and increase common physical fitness (Sipavičianė & Škikas, 2012).

## METHODS

To examine the function of respiratory system we used samples and tests for the respiratory system: Stange *(sample)* test, Henci *(sample)* test, the maximum inspiration (PImax) and maximum expiratory (PEmax) pressure. Also we used abdominal muscle endurance and side back muscle endurance tests.

**Stange test**. This test is applied to evaluate the children's respiratory capacity (respiratory functional status). During the test, two or three times children were asked to breathe deeply the air through the nose and not to breathe as long as possible. After the first test, a 2–3-minute break was taken and then children were asked to do the same. Time was measured in seconds by a stopwatch.

**Henci test** also aims to assess the functional status of the respiratory system. Before the test children were asked to try to breathe deeply in and out, repeat that for 2–3 times and hold their breath. Time was measured in seconds by a stopwatch.

**Pneumotonometer** was used to evaluate respiratory muscle strength changes before and after breathing exercises. Respiratory muscle strength was measured with pneumotonometer by measuring the maximum inspiration (PImax) and maximum expiratory (PEmax) pressure. Duering the test the patient is asked to exhale maximally with lips pressed against the mouthpiece of the device and try to breathe hard, and with the maximum inhalation to try to exhale hard. The data were taken for analysis only when the patient inspired or breathed for at least 1-2 seconds (Enright & Hyatt, 1987).

**Abdominal muscle endurance test**. In order to assess the effects of physical therapy, children suffering from bronchial asthma were tested for the respiratory function. Before the test, children were asked to sit down with a 90-degree angle between the torso and thigh, and the thigh and calf.

**The side back muscle endurance test**. Before the test children were asked to lie down on one side, the upper front leg and the lower elongated (step phase) of the upper arm hand resting on the opposite shoulder and the lower arm bent at right angles. The request was to lift the body off the floor and the hold this position for as long as possible. The assessment was performed for both sides (left and right) muscle strength. Time was measured in seconds by a stopwatch (Strand et al., 2014).

**Statistical analysis** was performed using SPSS 21.0 for Windows and Microsoft Office Excel 2010 computer programs. Quantitative variables were the arithmetic mean and standard deviation. The changes were assessed by calculating the percentage difference. Values at $p < .05$ were considered as statistically significant.

## RESULTS

Prior to physical therapy for children suffering from bronchial asthma, respiratory arrest inhalation (Stange test) was average – 29.13 ± 9.84 s, and respiratory arrest Exhaled (Henci test) value was 11.84 ± 6.16 s. After four weeks of physical therapy respiratory arrest inhalation average statistically significantly increased by 11.16% and it was 32.38 ± 12.19 s ($p < .05$). Exhaled breath hold changed by 19.17% and it was 14.11 ± 5.02 s, but this change was not statistically significant ($p > .05$) (Figure 1).

**Inspiration and expiratory pressure and maximum expiratory airflow velocity changes before and after physical therapy**. The analysis of changes of expiratory and aspiratory pressures showed that after four weeks of physical therapy both inspiration and expiratory pressure values were statistically significantly higher than before physical therapy ($p < .05$). Before expiratory pressure physiotherapy the average was 59.53 ± 38.15 $cmH_2O$, and after physical therapy exhalation pressure average increased by 26.99% and reached 75.60 ± 34.96 $cmH_2O$. The research starting point of inspiration pressure average was 63.73 ± 21.20 $cmH_2O$, and after physical therapy inspiration pressure changed by 27.30% and was 81.13 ± 15.87 $cmH_2O$ (Figure 2).

**Abdominal and side torso muscle isometric endurance change before and after physical therapy**. Prior to physical therapy children's

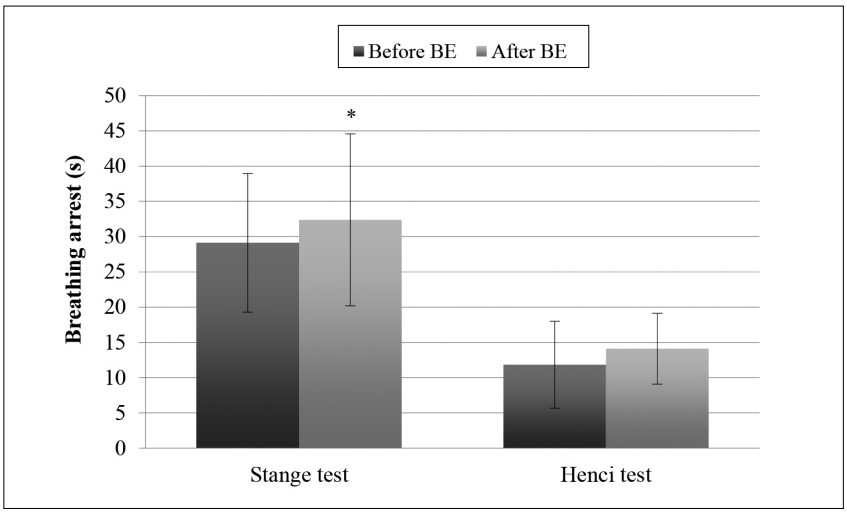


Figure 1. **Respiratory arrest inhale and exhale changes before and after breathing exercises**

**Note.** *$p$ < .05 compared with the result before breathing exercises.

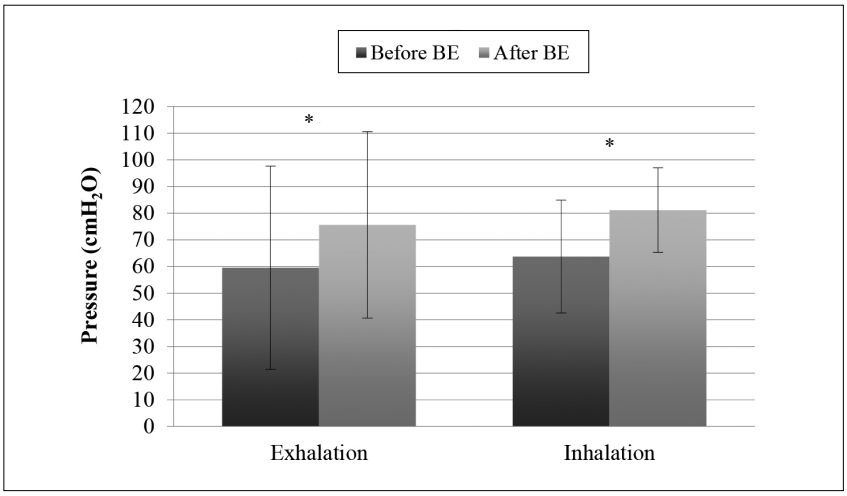


Figure 2. **Expiration and inspiration pressure change before and after physical therapy**

**Note.** *$p$ < .05 compared with the result of physical therapy.

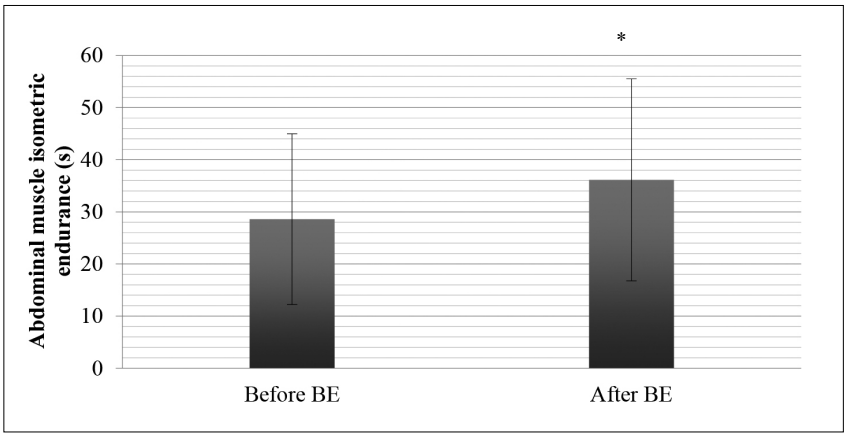


Figure 3. **Abdominal muscle endurance change before and after physical therapy**

**Note.** *$p$ < .05 compared with the result of physical therapy.

suffering from bronchial asthma static abdominal muscle endurance average was 28.60 ± 16.37 seconds and after physical therapy static abdominal muscle endurance significantly increased by 26.33% to 36.13 ± 19.38 s ($p$ < .05) (Figure 3).

The analysis of the lateral trunk muscle endurance change showed that after four weeks of physical therapy endurance averages were statistically significantly higher than those before physical therapy ($p$ < .05). Before physiotherapy, right side abdominal muscle endurance average was 39.68 ± 21.21 s and after physical therapy this side muscle static endurance significantly increased by 31.78% and was 52.29 ± 27.01 s. The study in the initial point of the left-hand side of the torso muscle endurance average was 49.97 ± 22.05 s and after physical therapy this side static muscle endurance changed by 19.43% and was 59.68 ± 27.89 s (Figure 4).

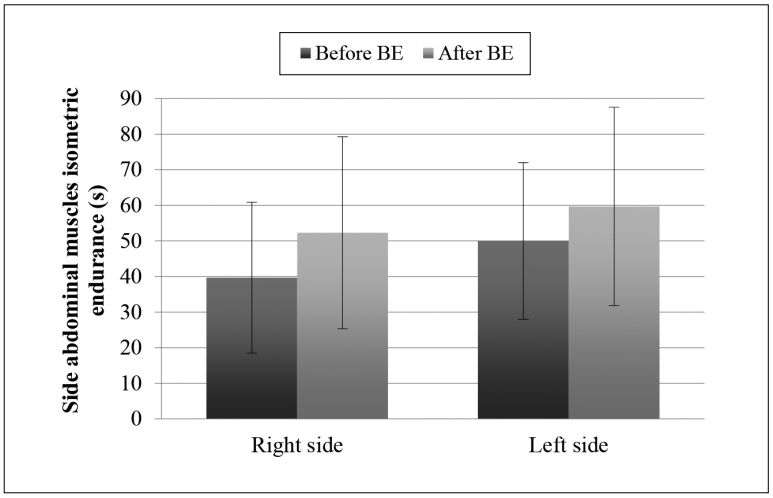


Figure 4. **The side abdominal muscle endurance change before and after physical therapy**

**Note.** *$p < .05$ compared with the result of physical therapy.

## DISCUSSION

The aim of the present study was to investigate whether breathing exercises could play the main role in the treatment of patients with asthma. Our study dealt with the variability of breathing techniques. This study shows that breathing exercises can have beneficial effects in asthmatics. The main findings are that physiotherapy may improve not only the respiratory function, but also endurance of abdominal muscles.

In recent years, there were several significant physiotherapy achievements in the treatment of asthma in children (Ahnert et al., 2010; Keraitė-Bliūdžiuvienė, 2005; Repšienė, 2006; Stankutė, 2011), which proved that physical therapy effect was indeed positive and could significantly mitigate or in some cases, eventually even eliminate the symptoms. For example, research where 60 children received comprehensive rehabilitation (physical therapy, massage, halotherapy, physiotherapy) shows that forced expiratory volume in one second (FEV1), forced vital capacity indicators (FVC), forced expiratory ratio (FEV1 / FVC) and peak expiratory flow rate (PEF) after rehabilitation treatment statistically significant ($p < .05$) improved as in this study, breathing exercises where helpful for changes in respiratory function.

Stange and Henci sample rehabilitation indicators treatment before and after the analysis showed that after rehabilitation, both the first and second group significantly ($p < .05$) improved, but this improvement was more marked in individual physical therapy group. Results of this study show that Stange and Henci sample changes were not dependent on individual therapy. We can just see statistically significant changes in Stange sample in all groups.

None of the studies mentioned worsening of asthma symptoms following physical training.

## CONCLUSIONS

Breathing exercises applied for four weeks for 6–12-year-old children suffering from bronchial asthma are useful as they increase respiratory arrest aspiration, inspiration and expiratory pressure, and the abdomen, trunk muscle endurance, but do not show any changes in respiratory arrest exhaled.

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# FEATURES OF SPORTS PERFORMANCE RELATED INJURIES OF ELITE TRACK AND FIELD ATHLETES IN LITHUANIA

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## ABSTRACT

*Background.* Sports injuries have a huge impact on performance of athletes in competitions. A lot of athletes do not obtain full recovery after injuries, which leads to trauma recurrence or higher severity injuries. Being aware of dominating anatomical regions and frequencies of occurrence of these traumas could help to prevent it and to protect athletes' health.

*Methods.* In 2013 Lithuanian professional athletes were asked to fill in questionnaires developed by using standardized methodology validated by the IOC and implemented by the IAAF during international track and field competitions. Data were collected, processed and analysed. Results were obtained using statistical methods, significance level of $p \leq .05$ was considered statistically significant.

*Results.* We investigated 33 athletes- sprinters and throwers (javelin and discus throwers, shot putters). They had 57 cases of traumatic injuries in one year period (2012–2013). Results of the study showed that injuries of lower extremity statistically significantly dominated comparing with upper extremity and head/trunk in both fields of sport. Injuries by anatomical region were: lower extremity – 67%, upper extremity – 12%, head and trunk – 21%. Most of all were injured: hamstrings 23%, inguinal 10.5%, lumbar 13% area. Comparing traumas between throwers and sprinters groups lower extremity injuries statistically significantly dominated in sprinters group, while upper extremity had been injured only in the throwers' group. Analysing severity of the injuries we noticed that moderate and mild injuries were dominating. Mild and moderate severity injuries appeared leading to a higher risk of re-injury than high severity traumas. Recurrence of the same injury was noticed only in the group of sprinters – 57.9% of sprinters repeatedly suffered mostly from hamstring and inguinal traumas.

*Conclusions.* According to the results of this study, sports medicine physicians could predict potential localization and recurrence of injuries and collaborating with coaches and athletes prepare opportune training programs to avoid harm.

**Keywords:** sports injuries, recurring injuries, trauma, track and field athletics, sports medicine

## INTRODUCTION

Track and field (athletics) is a popular sport worldwide (Jacobsson et al., 2012). In today's society, sport is being widely accepted as integral part of keeping fit and retaining healthy lifestyle (D'Souza, 1994). Sports injuries have an important impact on sport and daily life (Edouard, Depiesse, Hertert, Branco, & Alonso, 2013; Junge et al., 2009). To be able to plan safe sport (Alonso et al., 2009; Heiderscheit, Sherry, Silder, Chumanov, Thelen, 2010; Proske, Morgan, Brockett, & Percival, 2004) and to choose the best treatment and rehabilitation for athletes in track and field, injury patterns need to be registered (Hoskins& Pollard, 2005; Lempainen, Sarimo, Mattila, Heikkilä, & Oravaet, 2007; Owoeye, Odebiyi, Odunaiya, Ogunkunle, 2010). Additionally, there is sparse of research on injury rates, prevalence, type and severity affecting athletes of track and field (Huxley, O'Connor, Healey, 2013). So it is reasonable to analyse the most injured body parts/

localizations, recurrence of the same injury (Opar, Williams, & Shield, 2012), chronic pain/unhealed, trauma/unhealed injury, severity degree, differences between sprinters and throwers. Many authors strive to examine severity of injuries (Rekus et al., 2013) and use diverse range of methodologies for its graduation (Malliaropoulos, Isinkaye, Tsitas, & Maffulli, 2011). In this study we investigated Lithuanian elite sprinters and throwers (javelin and discus throwers, shot putters) trained in 2013. The objectives of this study was to analyse which body parts were mostly injured, to assess incidence of the severity of traumas and their connection with primary localization and to evaluate frequency of recurrences as well. These findings may be beneficial and give possibility to adjust training programs for track and field athletics.

## METHODS

The objects of this study were Lithuanian elite track and field athletes in 2013. The questionnaire was given to sprinters and throwers (javelin and discus throwers, shot putters) in their training and competitive places. The study involved 33 athletes: 63.6% men ($n$ = 21) and 36.4% women ($n$ = 12), who potentially suffered from injuries over one year period (2012–2013). Their age ranged from 18 to 32 (mean of age was 21.64 ± 0.58) years. Median sports experience was 7.52 ± 0.59 years. Average of trainings sessions per week were 5.88 ± 0.33. Mean of one training session length was 108.18 ± 2.90 minutes. All 33 athletes participated in Lithuania's Track and Field championship in 2013. Ten athletes were included in the Olympic lists. We examined 14 throwers (javelin and discus throwers, shot putters) and 19 sprinters (100 m, 200 m, 400 m, 4×100 m, 4×400 m, hurdles). There were 57 traumatic injury cases overall. The testing methodology was the same like in the other our study (Rekus et al., 2013), only minor changes and new questions about chronic pain/ trauma/unhealed injury were added.

**Instruments.** All 33 athletes were given a questionnaire which was made by standardized methodology (Daily Report on Injuries and Illnesses, codes and classifications) validated by the International Olympic Committee (IOC) and implemented by the International Association Of Athletics Federations(IAAF) during international track and field competitions, during the period of the Daegu 2011 IAAF World Championships (27 August to 4 September). The Questionnaire was applied during trainings and competitions registering injuries of track and field athletics all year round in 2013. In our questionnaire there were 13 questions: 1. Sex; 2. Age; 3. Date of birth; 4. Number of training years in track and field; 5. Average time of training sessions per week; 6. Average length of training session; 7. Event; 8. Are you competing in Lithuanian track and field championship?; 9. Are you included in the Olympic lists?; 10. Number of injuries in 2013; 11. 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, b. 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; 12. Write/ grade your every injury severity by 5 degrees showed below: I. very mild injury (no missed training sessions); II. Mild injury (1 to 7 training days missed); III. Moderate injury (about 2 weeks training missed); IV. Severe injury (from 2 weeks up to 3 months training missed); V. Very severe injury (training stopped for 6 months and more); 13. Do you have chronic pain/ trauma/unhealed injury show anatomical region? Our questionnaire did not ask what kind of trauma it was and what its causes were as not all athletes who suffered very mild injuries had turned for medical care. That is why a questionnaire had been given not to physicians but to athletes themselves. We did not add questions about damaged structures and type of injury because not all athletes could remember the clinical diagnosis and approach terminology of medicine. We used the silhouette of the figure of the human body upon which an athlete pointed out the injured body parts (area of injury) and noted the time of impaired health, how many times they could not work out. By the number of missed training and competition days we made classification of the injury severity degree. We investigated how many and what kind of injuries the athlete had suffered as well as a recurrence of the same injury in 2013. As javelin, shot putters and discus throwers' training principles and some technical moments had much in common with each other, thus we combined them into one group called the "Throwers". Same was done with different sprint types: 100 m, 200 m, 400 m, 4×100 m, 4×400 m and hurdles, and we named them the "Sprinters". Similar events categories were done in David D'Souza study

(D'Souza, 1994). Due to this, we expected to have more accurate results.

Data analysis was performed using Statistical Package for Social sciences (SPSS) version 20. Data are reported as mean ± standard error. Frequency between classified body parts was analysed by related samples Cochran's Q Test. Comparing groups of athletes with injuries and without injuries we used one-sample Binomial test. Injury cases between two different groups of events were compared by independent-samples Mann–Whitney *U* test. Statistical significance was set at $p \leq .05$.

## RESULTS

During the chosen period of study we examined 33 athletes: 14 throwers and 19 sprinters. Only 2 athletes (both in the throwers group) had no injuries. Statistically significantly more athletes experienced traumas ($p < .05$). In the group of throwers 12 athletes had 18 injury cases, while two of them had no trauma. In the group of sprinters 19 athletes had 39 injuries. Overall 31 athletes experienced 57 injuries. There was no significant difference between incidences of injuries sustained by two groups – sprinters and throwers.

**Localization of primary injury.** There were 57 injury cases overall: head and trunk – 12 (21%): neck – 1 (2%), upper back – 2 (3%), lumbar – 8 (13%), gluteal – 1 (2%); upper extremity –7 (12%): wrist – 1 (2%), elbow – 1 (2%) shoulder – 4 (7%), fingers – 1 (2%); lower extremity – 38 (67%): ankle – 4 (7%), Achilles – 3 (5%), calf anterior – 2 (3%), calf posterior – 1 (2%), popliteal region – 2 (3%), knee – 5 (8%), inguinal – 6 (10.5%), quadriceps – 3 (5%), hamstrings – 12 (23%) (Table, Figure 1).

In both fields of sport the lower extremity injuries statistically significantly dominated comparing with upper extremity and head and trunk ($p < .05$).

In the group of throwers there was no significant difference between lower extremity, upper extremity and head and trunk experienced injuries. The most injured parts of lower extremity were knee – 16.6%, hamstrings – 11% and ankle – 11%. In upper extremity traumas shoulder area was dominating – 22% (Figure 2).

In the group of sprinters lower extremity injuries ($p < .05$) were dominating comparing with others – upper extremity and head and trunk, injuries. Most damaged parts of lower extremity were hamstrings – 26%, groins – 16% and quadriceps – 8%. In localization of head and trunk, 18% of noted injuries were in lumbar area (Figure 3). Interestingly, sprinters have no injuries in the region of upper extremity.

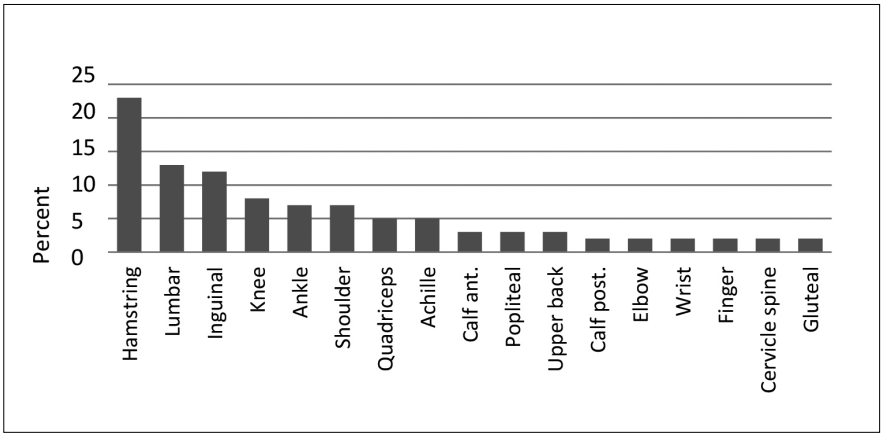
Comparing lower extremity injuries in throwers' and sprinters' groups statistically

Table. **Frequency of participants' injuries by body region**

| | **Head and trunk injuries (*n* = 12)** | **Upper extremity injuries (*n* = 7)** | **Lower extremity injuries (*n* = 38)** | **Total (*N* = 57)** |
|---|---|---|---|---|
| Sprinters | 9 *(23%*)* | 0 *(0%*)* | 30 *(77%*)* | 39 (68%) |
| Throwers | 3 *(17%*)* | 7 *(39%*)* | 8 *(44%*)* | 18 (32%) |

**Note.** *Percent of these traumas in particular athlete group.

Figure. 1. **All injuries (%)**



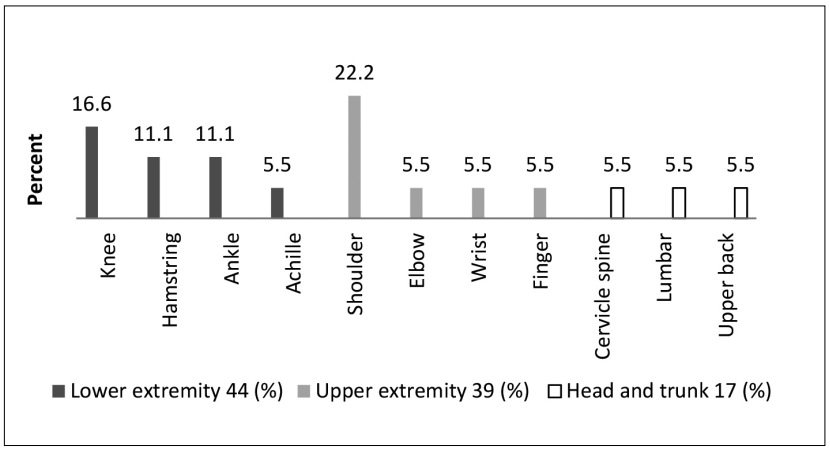



Figure 2. **Injury places by body region and localization (total injuries of throwers)**

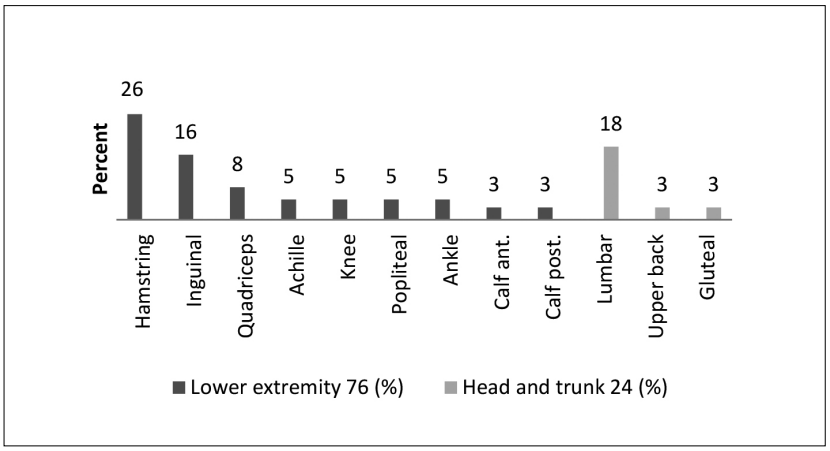



Figure 3. **Injury places by body region and localization (total injuries of sprinters)**

**Note.** Ant. – anterior, post. – posterior.

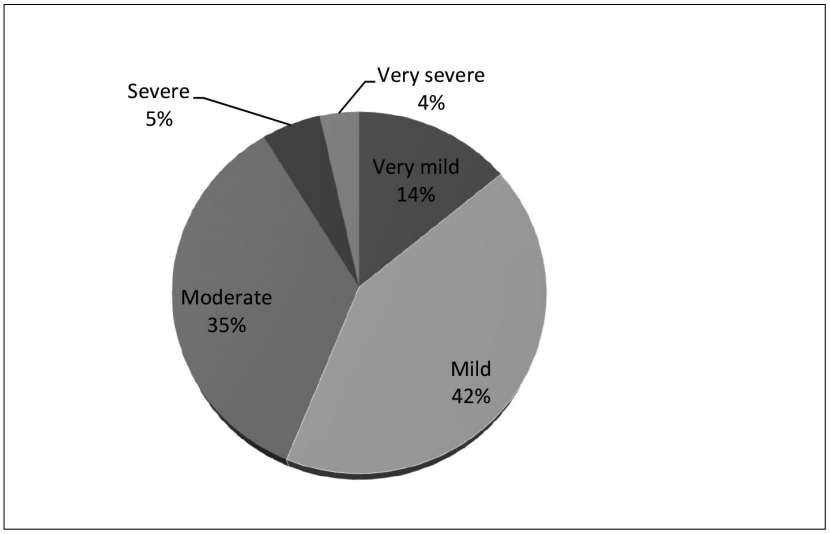



Figure 4. **Distribution of injuries by degree of severity (N = 57)**

significantly ($p < .05$) lower extremity injuries were dominating in sprinters group compared to throwers. Upper extremity had been injured only in throwers group.

**Severity of injuries.** Comparing the severity of the injuries, we established that moderate and mild injuries were dominating. Among 57 traumas, 42% ($n = 24$) were mild, 35% ($n = 20$) were moderate, 14% ($n = 8$) very mild, 5% ($n = 3$) severe and 4% ($n = 2$) very severe (Figure 4).

By severity three most common injuries by localization distributed as follows:

1. Injuries of hamstrings: 67% mild, 25% moderate, 8% were very mild, while no severe and very severe injuries appeared;

2. Traumas of lumbar localization were only mild (88%) and moderate (12%);
3. In inguinal area were 67% moderate, 16.5% mild and 16.5% severe traumas.

**Recurrence of the same injury.** Comparing repetition of injuries between group of throwers and sprinters there were established statistically reliable difference ($p < .05$): in the group of throwers there was no recurrence of the same during the study period, while in the group of sprinters 11 athletes had recurrence. It affirms that 57.9 % of sprinters over one year period repeatedly suffered from injuries, which distributed as follows:

1. Injury of hamstrings relapsed for 3 sprinters, 2 of them had it more than once;
2. Inguinal/groin injuries relapsed for 3 athletes, 2 of them had it more than once as well;
3. Two athletes had recurrence of lumbar injuries, 1 of them had it 3 times;
4. Several athletes had recurrence of quadriceps, inguinal and Achilles injuries.

Additionally, during the survey 8 sprinters and 1 thrower noted that they continued training with unhealed injuries.

## DISCUSSION

Although our group has previously published a similar study, the scientific literature on injury risk in track and field athletes is still scarce. The injury surveillance system proved again to be accepted by the team physicians all over the world including homeland. However, further efforts should be implemented in the future to improve data completeness and quality. To address the potential for prevention, the information on injury mechanism must be considered in a model that also considers internal and external risk factors that can modify injury risk. Other important thing is that sports physicians could correctly assess these results - they will be able to predict potential risk of injuries and they will be ready to provide the necessary assistance. However, knowing about most injured body parts and localizations, recurrences of same injury, distribution of severity degrees may also be very beneficial to predict and prevent athletes of traumas.

The International Olympic Committee recently recommended health evaluations to be routine in all elite sports (Ljungqvist, Jenoure, & Engebretsen, 2009). Athletes in this study were categorized by fields of sport in two groups: throwers (discus, javelin, shot put) and sprinters (100–400 m, including hurdles) (Jacobsson et al., 2012). Seasonal variations in competition and practice schedules can affect measures of injury prevalence in track and field. Here, data collection was conducted during a period of year. One of the limitations of this study was the minor number of cases for such analysis, but still the results obtained during the study allow distinguishing the tendencies. A precise description on the inciting event is a key component to understand the causes of any particular injury type in a given sport (Bahr & Krosshaug, 2005). After comparing gained data it is getting clearer that Lithuanian elite track and field athletes have similar difficulties as other elite track and field athletes from different countries. No difference between events categories was verified statistically (Opar et al., 2012).

Researchers (Beijsterveldt et al., 2013) who used similar questionnaire by investigating athletes of The European Youth Olympic Festival found that the knee (12.1%), ankle (11.1%) and thigh (10.6%) were the three most commonly injured body parts. Analysing sprinters and throwers specifically, we established that lower limb was the most common site of injury. Mostly injured body localization was lower extremity in a lot of studies (Graff & Birken, 2009; Jacobsson et al., 2012; Pastre, Filho, & Monteiro, 2004; Watson & DiMartino, 1987; Zemper, 2005). Hamstring injuries were the most commonly recorded injuries of lower extremity (Alonso et al., 2010; Alonso et al., 2012; Hoskins & Pollard, 2005; Junge et al., 2009; Opar et al., 2012; Verrall, Slavotinek, Barnes, & Fon, 2003). Sprinters in other research are mentioned as in the high risk of lower extremity, particularly hamstrings (Alonso et al., 2009; Alonso et al., 2010; Alonso et al., 2012; Van Gent et al., 2007;) and inguinal region traumas (Hiti, Stevens, Jamati, Garza, & Matheson, 2011). Eccentric strength training of hamstrings muscles should be a part of and should be recommended as a key component in traumas prevention programs. Recent evidence suggests that the protocols of eccentric training have the ability to reduce hamstring injuries (Malliaropoulos, 2013).

Studies with throwers mostly recorded injuries of the lower extremity were the knee. A study of Swedish elite track and field athletes (Jacobsson et al., 2012) showed the highest injury prevalence was the knee and lower leg. Owoeye and researchers (Owoeye, Odunaiya, Akinbo, & Odebiyi, 2009) concluded that exercise therapy was the most

frequently used treatment in the lower limbs traumas. This should be considered as the lower extremity is mostly injured body part in all fields of athletes.

Most common injury from upper extremity was shoulder and it was noticed only in throwers' group. In precision we should to exclude and to analyse different throwing events damaged structures and its character (Illyes & Kiss, 2005) comparing with throwing techniques. It could be assumed that a throw is the action we make when throwing a pebble into the sea, but in fact, the sequence of events and biomechanics of this are completely different from that straight arm throw of javelin throwing, the centrifugally induced velocity of hammer throwing, the explosive push of putting the shot and the spinning pull of the discus throw (Copeland, 1993). Although, in our study, injuries of upper extremity were not common, and we may predict that if they appeared, they were treated well and long enough, so there was no recurrence of traumas of this localization.

All track and field athletics coaches and other supervising specialists know that these two fields completely differ in the sense of physical preparation and competing. In throwing biomechanics synchronously work all body muscles starting-up from leg, rotational rising to pelvis and all explosively power going to shoulder and hand. For this reason the focus is on lumbar region strengthen during the training. It would be logical to consider that heavy weight-training exercises may lead to many injuries (Aggrawal, Kaur, Kumar, & Mathuret, 1979), but the tendency of trunk and back injuries was not strong. In our study of head and trunk injuries, there was no significant difference between groups of sprinters and throwers.

Malliaropoulos with their research team noted that low-grade injuries lead to a higher risk of re-injury than high-grade traumas (Malliaropoulos et al., 2011). We found that 8 sprinters and 1 thrower had chronic / unhealed injuries (mostly severe and very severe) during period of study, while it is known that acute or chronic injury of any anatomical region can easily lead to repetitive trauma(McSweeney, Naraghi, Salonen, Theodoropoulos, & White, 2012). Additional factors leading to chronicity can come from the first injury us such through modifications in the muscle tissue and possible adaptive changes in biomechanics and motor patterns of sporting movements (Croisier, 2004). In our study, recurrence of the same injury mostly were in hamstrings, inguinal or lumbar area, as other surveys, mentioned earlier, reveals as well.

## CONCLUSIONS

During the chosen period of the study most of athletes experienced traumas ($p < .05$): 31 versus 2 who were not injured. The lower extremity was the most injured part of body of all fields athletes ($p < .05$), though we did not notice any strong tendency that throwers injured the lower extremity or upper extremity or head and trunk more frequently. While in the group of sprinters, lower extremity injuries ($p < .05$), mostly hamstrings, dominated comparing them with head and trunk injuries. Besides, they did not suffer from traumas of the upper limbs at all.

Mild (42%) and moderate (35%) injuries were dominating and this type of injury severity led to a higher risk of re-injury than higher severity traumas. Injuries of hamstrings and lumbar area were mostly mild severity (67 and 88% of them), while injuries of inguinal area were usually moderate (67%).

Recurrence of the same injury was noticed only in the group of sprinters: 57.9% sprinters repeatedly suffered from injuries, commonly from repetitive hamstrings and inguinal traumas.

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# EFFECTIVENESS OF PHYSICAL THERAPY COMBINED WITH ELECTRO STIMULATION FOR PATIENTS WITH LUMBAR PART DISC HERNIATION

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## ABSTRACT

*Background.* The aim of the study was to evaluate the effectiveness of physiotherapy combined with electro stimulation, for patients with spinal disc herniation in lumbar part.

*Methods.* The study involved 38 people, 18 men and 20 women. The average age of all subjects was 29.84 ± 4.65 years. All subjects participated in the study for eight weeks, 30–45 minutes, three times a week. They were randomly divided in to three groups: two experimental and one control group. The first experimental group (12 people) participated in physical therapy combined with electro stimulation; the second experimental group (14 people) participated in physical therapy combined with placebo (fake) electro stimulation, and the third (control) group (12 people) participated in physical therapy treatments. All groups before and after the treatment performed trunk (flexor, extensor, lateral musculature) muscular endurance tests (McGill), analogue pain scale evaluation, and SF – 36 questionnaire.

*Results.* After eight weeks of physical therapy combined with electro stimulation average numbers of analogue pain scale results decreased statistically significantly by 2.17 ± 1.11 ($p < .05$), trunk extensors (33.00 ± 12.78), flexors (31.67 ± 9.15) and lateral left (20.25 ± 2.80) / right (19.50 ± 3.71) musculature differences were statistically significant ($p < .05$). Physical therapy and placebo (fake) electro stimulation group and physical therapy group did not show statistical significance for all the tests except for analogue pain scale test (1.29 ± 0.83 and 1.92 ± 1.08).

*Conclusion.* Physical therapy combined with electro stimulation applied for eight weeks for 25–39-year-old adults suffering from lumbar part disc herniation is an effective way to enhance trunk flexors, extensors, right/left lateral muscular endurance and reducing lumbar part back pain.

**Keywords:** muscles, electro stimulation, physiotherapy, placebo.

## INTRODUCTION

Lower back pain occurs for people all ages, for both genders and different ethnical groups (Ščiupokas, 2005). Approximately nine out of ten adults experience back pain at some stage in their life, and ten out of twenty working adults suffer from back pain each year (Parel, 2007). Relapses in pain (60%) and work absences (33%) are common, making lower back pain one of the most expensive conditions in societies. The total cost counted with the management of lower back pain in Australia is at 9.17 billion Australian dollars, with the cost of indirect care and productivity losses contributing 8.15 billion Australian dollars of this total figure (Amorim et al., 2016). Non-specific lumbar part pain occurs from soft tissue such as muscle, fascia and ligaments (Mense et al, 2010). It is considered that the causes of as much as 97% of back pain cases are mechanical, with regard to static and dynamic spinal dysfunction. Such pain associated with spinal (vertebral discs, joints, ligaments, muscles) degeneration processes, but only in rare cases (not more than 10%) of the mechanical origin of back pain can lead to more serious consequences (Ščiupokas, 2005).

Previous research has shown that patients with lower back pain who engage in moderate or high levels of physical activity have better chances in terms of pain, disability and quality of life than those who do not maintain regular levels of physical activity (Pinto et al., 2014). These patients are likely to have a new episode of lower back pain or to continue pain and that is why they seek additional health care (Enthoven, Skargren, & Oberg, 2004). Electrical muscle stimulation helps restore normal functioning of tissues and functional status of organs (Gorinienė, 2006). Also Electro stimulation can strengthen muscles and improve their function (Kuru, 2012). Electro stimulation device myha – bodytec was used.

Placebo enrolment is often believed to substantially improve desired results of the patient and the researcher (Hróbjartsson, 2010). Each physical therapy procedure is determined by specific context effect on the patient, physicians should pay attention to the context in order not to increase the placebo effect (Testa & Rossettini, 2016).

The aim of the study was to evaluate efficiency of physiotherapy combined with electro stimulation for patients with spinal disc herniation in lumbar part.

## METHODS

We used basic endurance tests to examine trunk muscles: Mcgill trunk flexor, trunk extensor and the lateral musculature tests.

**Trunk Flexor Test.** The flexor endurance test begins with the person in a sit-up position. Person's back is at resting angle and drops to 60 degrees from the floor. Knees and hips are flexed at 90 degree angle, arms are across on the chest with the hands placed on the opposite shoulder, and the feet are secured touching the floor. The test begins when a person is holding 60 degree angle from the ground and holds that position as long as possible, there is a triangle shaped box placed 10 cm from the back for self-confidence and failure. Failure is determined when any part of the person's back touches the triangle box (or gets lower more than 10 cm from the starting position).

The second test was **Trunk muscle extensor Test**. The back extensors are tested with the upper body levered out over the end of the test bench or a table and with the pelvis, knees, hips secure and fastened to the bench. Hands are held crossed on the chest and placed on the opposite shoulders. Failure occurs when the upper body drops below the horizontal position. Last one of the tests is **lateral right/left musculature test**. Lateral musculature is tested with the person lying on the full side – bridge position on left or right side separately. Legs are extended, and the top foot is placed in front of the lower foot. Subjects support themselves on one elbow and on their feet while lifting their hips off the floor to create a straight line from head to toe. Free arm is held straight near the hip. Failure occurs when the person losses the straight-head toe line and the hip gets lower the straight line (Nesser, 2008).

**The SF-36** is one of questionnaires used worldwide today. It contains of 36 questions that evaluates health across eight dimensions – physical functioning, vitality, social functioning, body pain, mental health, role limitation because of physical health, role limitation because of emotional problems and basic general health. Each question answer within a dimension is combined and generates a score from 0 to 100, where 100 means good health (Walters & Brazier, 2003).

**Electro stimulation (ES)** is effective for developing physical performance. ES offers a beneficial alternative to traditional strength training. Improving muscle strength and power by the use of ES, the settings of the device (impulse intensity, stimulation frequency, impulse width, pulse type, stimulation rate) have to be exact (Filipovic, Kleinöder, Dörmann, & Mester, 2012).

**Number of analogue pain scale (NAS).** The scale is divided in to 10 equal parts and determines which section patients have marked the scale. When the pain measured on a scale is1–4 points, it is weak pain, 5–6 moderate pain, 7–8 felt a strong pain, 9–10 points unbearable (very strong) pain (Petrikonis, 2004).

**Statistical analysis.** The statistical analysis was conducted using SSPS (Statistical Package for Social Science) 17.0 software. Obtained variables were used for assessing the descriptive statistical methods (mean ± standart deviation). Continuous variable normality assumption was verified using the Kolmogorov–Smirnov test. Two independent groups were compared to quantitative values apply to Student ($t$) criteria, if the variable distribution satisfied the distribution normality assumption. If some variables not satisfied with the distribution of normality conditions, nonparametric Mann–Whitney $U$ method was applied. If quantitative dependent variables satisfied normality condition, we used Student's paired test, it not – nonparametric Wilcoxon test at $p < .05$.

# RESULTS

The average score difference between all the groups (before and after the study) using numbers analogue pain scale (NAS) was significant ($p < .05$). For the first group, the average score was 2.17 ± 1.11, for the second group the score was 1.29 ± 0.83, and for the third group average score was 1.92 ± 1.08 (Figure 1).

Trunk extensor test differences in results between the first (33 ± 12.78) and the second (19. 57 ± 9.96) groups showed statistical significance ($p < .05$), the first and the third (14.83 ± 12.39) group difference was statistically significant as well, but differences between the second and the third groups did not show any statistical significance (Figure 2).

Trunk extensor test results showed that statistically significant differences were between the first (31.67 ± 9.15) and the second (17.5 ± 10.7), the first and the third (19.3 ± 8.15) groups (Figure 3).

Groups 1 (20.25 ± 2.8) and 2 (11.93 ± 3.79), 1 and 3 (11.92 ± 4.21) showed statistically significant differences ($p < .05$), but results in the second and the third group did not show statistically significant difference (Figure 4).

Differences in the trunk lateral right musculature test result for the first (19.5 ± 3.71) and the second (13.5 ± 4.03), the first and the third (12.91 ± 2.34) groups showed statistical significance ($p < .05$), but those of the second and the third groups did not show significance (Figure 5).

Figure 1. **Differences in NAS average points between groups 1 and 2 ($p < .05$), 2 and 3 ($p < .05$)**

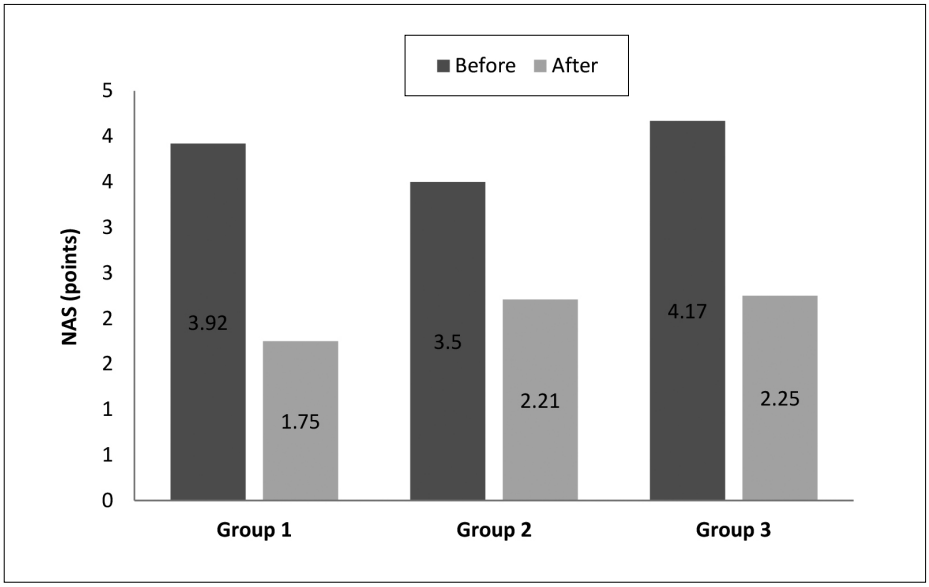
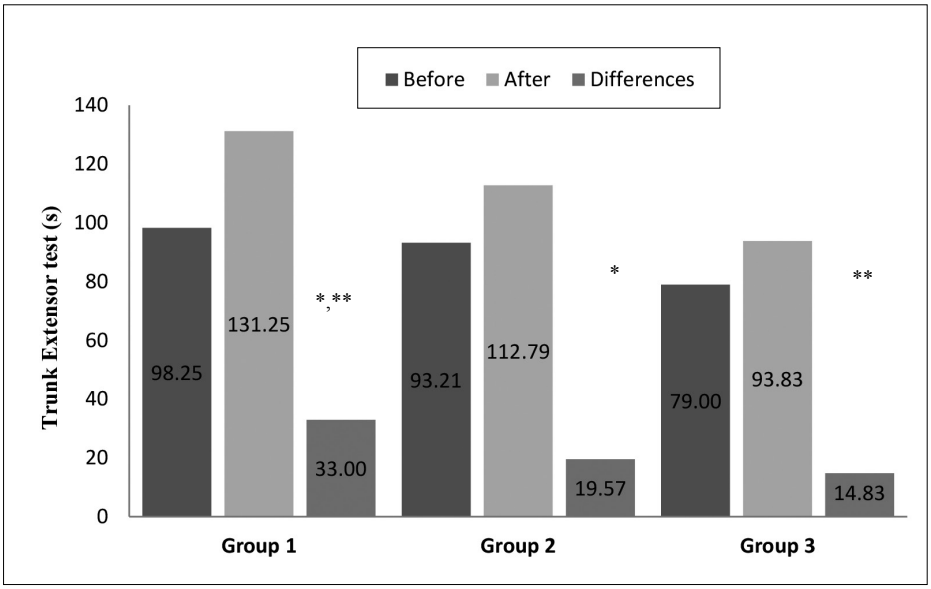



Figure 2. **McGill trunk extensor test. Differences between group 1 and 2 ($p < .05$), 1 and 3 ($p < .05$)**




**Note:** *$p < .05$, **$p < .05$.

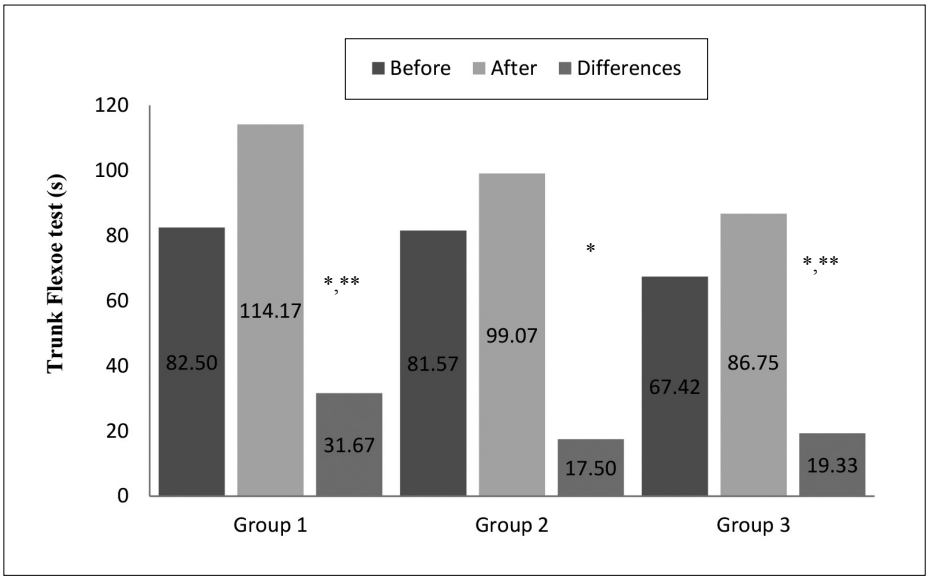



Figure 3. **McGill trunk flexor test. Average differences between groups before and after the trial ($p < .05$), groups 1 and 2 ($p < .05$), groups 1 and 3 ($p < .05$)**

**Note:** *$p < .05$, **$p < .05$.

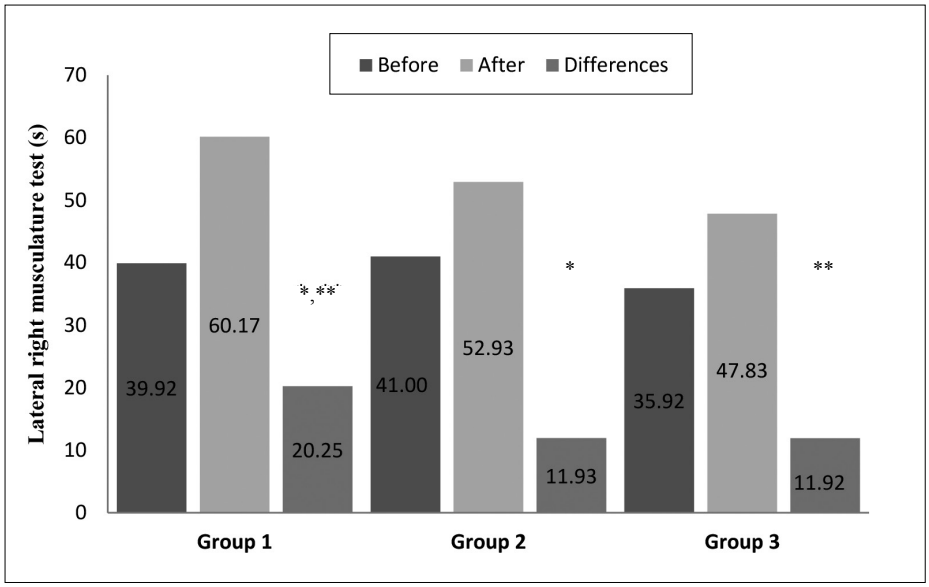



Figure 4. **McGill trunk lateral right musculature test. Average differences between groups before and after the trial ($p < .05$), groups 1 and 2 ($p < .05$), 1 and 3 ($p < .05$)**

**Note:** *$p < .05$, **$p < .05$.

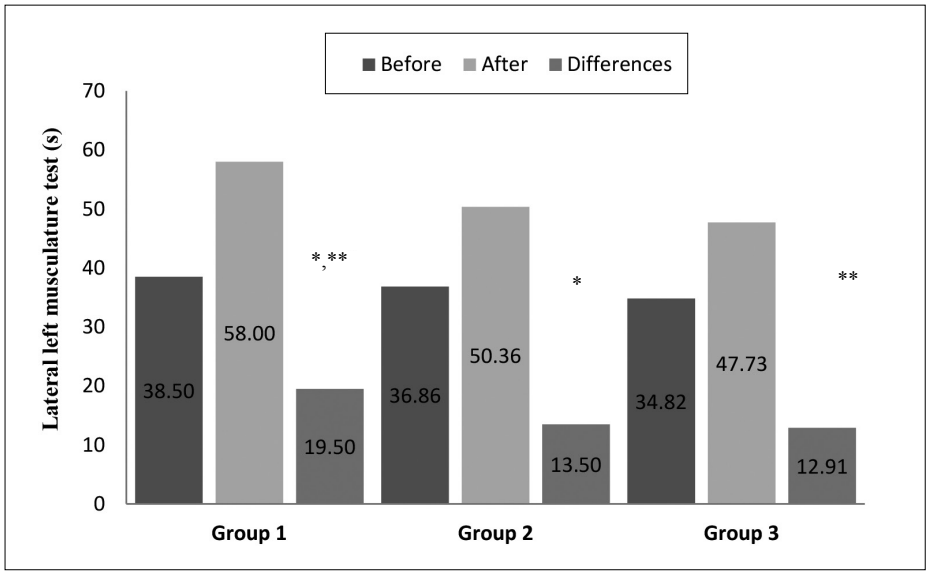



Figure 5. **McGill trunk lateral left musculature test. Average difference between groups before and after the trial ($p < .05$), groups 1 and 2 ($p < .05$), 1 and 3 ($p < .05$)**

**Note.** *$p < .05$, **$p < .05$.

## DISCUSSION

The aim of this study was to evaluate effectiveness of physiotherapy combined with electro stimulation for patients with spinal disc herniation in lumbar part. It was found that electro stimulation combined with physical therapy achieved statistically significant results ($p < .05$) than after physical therapy.

Wirtz, Zinner, Doermann, & Kleinoeder (2016) presented a study aiming to investigate the effects of a multiple set squat exercise training intervention with superimposed electro stimulation on strength and power, sprint and jump performance. All groups showed improvements in leg press strength and power, countermovement and squat and sprint performance ($p < .05$). Strength endurance occurred after six weeks of training; however our study showed statistical significant endurance results in all groups after nine weeks of exercise programme.

Babault et al. (2007) presented a study which investigated the influence of a 12-week electro stimulation training program performed by rugby players. Twenty-five rugby players participated in the study. After 12 weeks of ES training, muscle endurance enhanced statistically significantly. Those findings indicated that 12 week of electro stimulation training program have significant beneficial effect on muscle strength and power. Similar findings but in shorter time period were established by Brocherie (2005). The aim of the study was to examine the influence of short – term electro stimulation training program on knee extensor endurance, skating and vertical jump performance on ice hokey players. After three weeks of training the knee extensors, skating performance increased significantly. Our rezults were simillar to other studies findings (Brocherie, Babault, Cometti, Maffiuletti, & Chatard, 2005; Babault et al., 2007), the strength or endurance tested on subjects enhanced statistically significantly or did not have any changes, except for the study of Brocherie et al. (2005), where the vertical jump height decreased significantly and had the shortest study period. There are various studies carried out over various periods of time, but further studies are needed to set the least time possible to achieve the highest results in physical therapy used with ES.

## CONCLUSIONS

Physical therapy combined with electro stimulation is an effective way to enhance trunk muscular endurance and reduce lower back pain for patients with spinal disc herniation in lumbar part.

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# DIFFERENTIAL TRAINING TASKS TRIGGER THE DECREASE OF CONCATENATION BETWEEN CARDIOVASCULAR PARAMETERS

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## ABSTRACT

*Background.* A lot of studies have shown the Differential Training (DT) is more effective than the traditional training based on repetition at constant conditions. The aim of this study was to find the changes in dynamical concatenation between ECG parameters during the DT task.

*Methods.* Participants (13 healthy adult males) performed two balance tests standing on LIBRA balance board. Continuous ECG registration during both balance tests and during the rest was 3 minutes. The changeable parametric interactions and its dynamics during exercise tasks while monitoring ECG parameters and its data sequences analysis based on mathematical method based on matrix theory were applied, the concatenation between ECG parameters were analysed.

*Results.* Results obtained during the study showed that there were no drastic differences between ECG parameters while performing both balance tests. The concatenation between analysed ECG parameters increased or there was no significant change. The decrease of concatenation was observed during the second task while the participants performed the squats standing on the balance board. This type of change in concatenation was found during the analysis of all ECG parameters, i.e. between duration of RR intervals and QRS, between JT and RR intervals and between QRS and JT intervals.

*Conclusion.* DT tasks trigger the decrease of concatenation between cardiovascular parameters that allows discussing about the hypothesis that decrease of concatenation between systemic regulatory commands and cardiac metabolic changes could be one of possible chain activating and enhancing the efficiency of long-term adaptation at conditions of DT.

**Keywords:** cardiovascular system, concatenation, Differential Training.

## INTRODUCTION

The discussion on schedule of the training session is an important research question. How to make motor learning and training more efficient and effective is important for sports practices as well. The application of variable practice has achieved acceptance as being beneficial for motor learning processes. Numerous studies have demonstrated enhanced motor learning performance in variable practice over repetitive learning schedules (Beckmann, 2013). The new methodology of so called "Differential Learning" (DL) or "Differential Training" (DT) was introduced (Schöllhorn, 1999, 2000) and this approach has been applied in the context of motor learning and extensively investigated by Schöllhorn and collaborates (Frank, Michelbrink , Beckmann, & Schöllhorn, 2008; Schöllhorn, Beckmann, Janssen, & Drepper, 2010). It was shown that DT was more effective than traditional training (TT). DT scheduled on movement variations are from a

traditional point of view considered as movement errors and accordingly have to be avoided in common motor learning schedules (Schöllhorn, 1999; Henz & Schöllhorn, 2016). The effectiveness of DT was shown for track and field (Beckmann & Gotzes, 2009; Beckmann & Schöllhorn, 2006), handball (Wagner & Müller, 2008), basketball (Lattwein, Henz, & Schöllhorn, 2014), volleyball (Römer, Schöllhorn, Jaitner, & Preiss, 2009), ice-skating (Savelsbergh, Kamper, Rabius, De Koning, & Schöllhorn, 2010), hockey (Beckmann, Winkel, & Schöllhorn, 2010). Most intriguingly, DT not only leads to increased acquisition rates but also to increased learning rates (Beckmann & Schöllhorn, 2006; Savelsbergh et al., 2010).

Internal body changes during exercising are a trigger for long-term adaptation (Saltin, & Rowell, 1980; Boström et al., 2013; Alleman et al., 2015). A number of physiological changes can be described as activation of mechanisms responsible for maintaining of homeostasis. Thus, these changes are an important because this is a trigger for activation of long-term adaptation processes taking place in the body during the recovery process (Boström, Graham, & Georgiadi, 2013).

Cardiovascular system is a vital body system and plays an important role in long-term adaptation to workloads. There are relatively small cardiovascular changes at onset of low intensity exercising and thus could be a good situation to vary by exercising tasks and compare dynamical concatenation between cardiovascular parameters. A lot of studies have shown that the Differential Training (DT) is more effective than the traditional training based on repetition at constant conditions. However, the underlying mechanisms are not fully understood. We hypothesised that the fine tuning between various body fractal levels is an important for sports performance and the disruption or the temporally loss of these interaction could be a trigger for long term adaptation. The aim of this study was to determine the changes in dynamical concatenation between ECG parameters during the DT task.

## METHODS

Thirteen healthy adult male volunteers took part in this study. After adaptation to the laboratory environmental all participants performed two balance tests by standing on LIBRA balance board. The first balance task was without additional disturbances and during the second balance task the participant was asked to perform squats, i.e. in this task, while each next squat had to be performed at constantly changing conditions, which means that this situation was more close to the methodology of DT.

The continuous 12-lead ECG registration was done before and after each balance task. Continuous ECG registration during both balance tests and during the rest was 3 minutes. In this study the changeable parametric interactions and its dynamics during exercise tasks ECG parameters (*RR intervals; JT intervals and duration QRS complex*) monitoring and its data sequences analysis based on mathematical method based upon matrix theory were applied. According to the model of integral evaluation of body functioning during exercising the concatenation between the two chosen ECG parameters were analysed. Two synchronous signals (ECG parameters) were taken at discrete time intervals and after normalization (to interval [0; 1]) by the difference between maximal and minimal physiological values. The data was normalized using the formula

$$x_{new\ value} = \frac{x_{old\ value} - x_{\min}}{x_{\max} - x_{\min}},$$

where $x_{\min}$ and $x_{\max}$ are minimal and maximal physiological values of parameter.

These signals are co-integrated into the second order matrix. From the initial parameters of the matrix (difference dfr $A_n = x_n - y_n$ and co-diagonal product cdp $A_n = ab(x_{n-1} - y_{n-1})(x_{n+1} - y_{n+1})$, in both cases $x_n$ and $y_n$ are real numbers and they represent the recorded parameters) follow characteristic which has more comprehensive sense, i.e. discriminant (Dsk):

$$\text{Dsk } A_n = (\text{dfr } A_n)^2 + 4 \text{ cdp } A_n$$

Large Dsk values indicate low inter-parametric concatenation, whereas small Dsk values (close to zero) correspond to high interaction between the analysed parameters.

**Statistical analysis.** Kolmogorov-Smirnov test was used to determine whether data had an underlying normal distribution and the requirement for homogeneity variance of compared samples that was verified with Levene's test. The difference was regarded as statistically significant if $p < .05$. The values are reported as arithmetical mean ± standard error of the mean (SEM).

## RESULTS

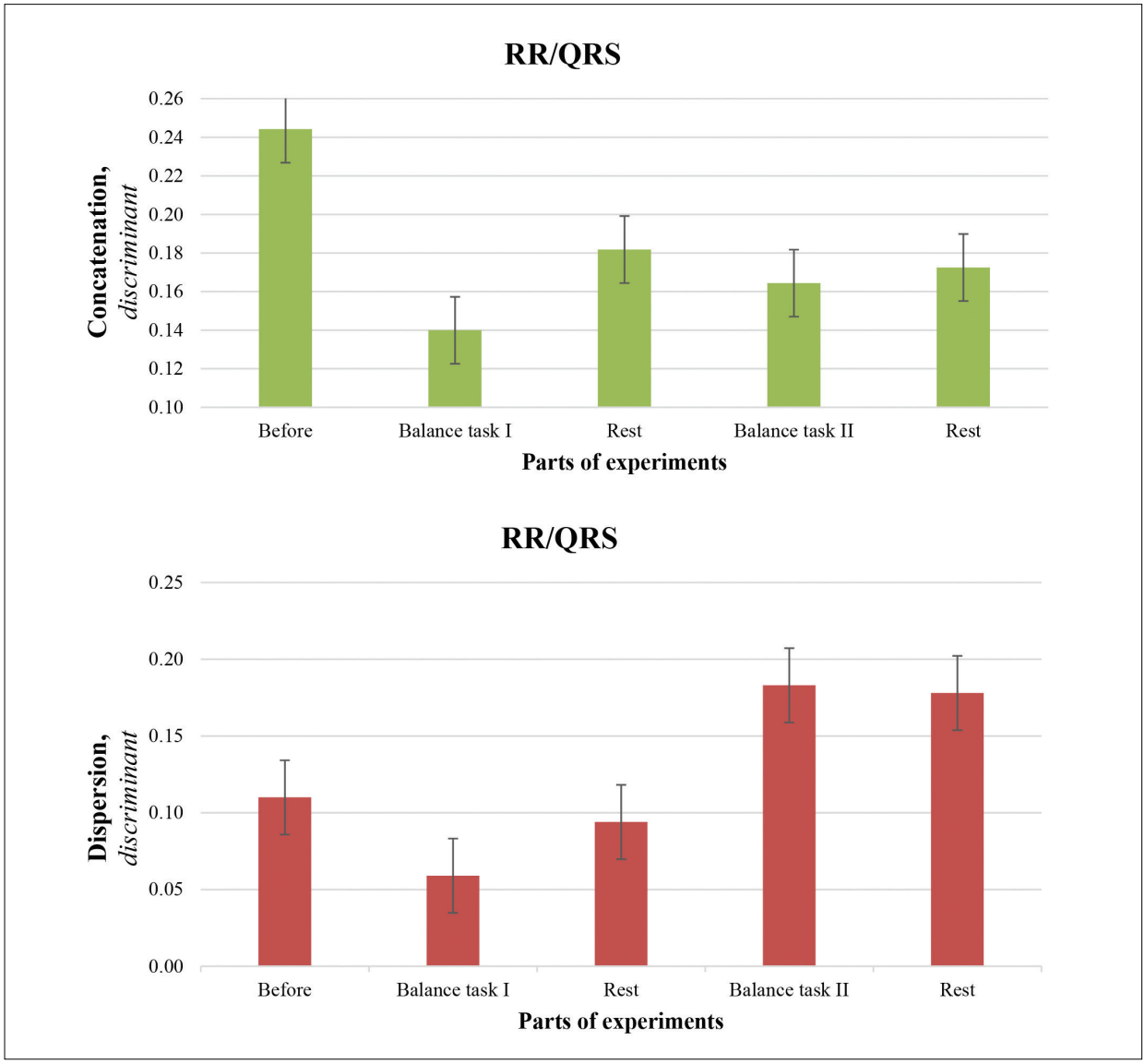
The results of this study were analysed on the basis of the statement that the complexity of a dynamic system decreases with the loss of parametric independence (Alleman, Stewart, Tsang, & Brown, 2015). Research (Costa, Peng, & Goldberger, 2008) shows that the increase of concatenation between cardiovascular indices begins at the onset of exercise. This type of changes can be observed during some stages of workload but reaching some functional state

Table. **ECG parameters registered during various parts of experiment**

| Index | Before | First balance task | Rest | Second balance task | Rest |
|---|---|---|---|---|---|
| HR *b/min* | 77.8 ± **4.0** | 89.3 ± 4.2 | 81.5 ± 4.2 | 90.7 ± 3.5 | 83.7 ± 4.4 |
| JT *ms* | 249.5 ± 7.7 | 235.7 ± 7.9 | 245.3 ± 8.2 | 234.6 ± 6.7 | 238.6 ± 7.9 |
| QRS *ms* | 84.4 ± 1.7 | 85.7 ± 2.1 | 85.6 ± 1.6 | 87.8 ± 2.0 | 85.3 ± 1.4 |

**Note.** Averaged data of 3 minutes during each part of experiment.

Figure 1. **Concatenation between ECG parameters RR intervals & duration of QRS**




**Note.** According the model of integral evaluation (Vainoras, 2002) RR – represents systemic regulatory response; QRS represents organ level regulatory response.

(*fatigue*) the increase of concatenation has changed in an opposite direction, i.e. the decrease or loss of these concatenations leads to inability to continue exercising.

Results obtained during the study showed that there was no drastic difference between the values of registered ECG parameters while performing both balance tests by standing on LIBRA balance board. The values of RR intervals were 0.93 ± 0.04 s – before exercising; 0.85 ± 0.03 s – during the first and 0.69 ± 0.02 s – during the second exercise tasks. In the Table these data presented as HR values during various part of experiment. The results obtained during this study showed that even low intensity of exercising at constantly changing conditions triggers some changes between cardiovascular parameters.

Figures 1–3 present the data obtained during data sequences analysis based on mathematical method based on matrix theory. The increase of concatenation between systemic and organ level commands while exercising presented in Figure 1 ($D_{RR/QRS}$ was 0.24 ± 0.01 – before exercising and $D_{RR/QRS}$ was 0.14 ± 0.01 and 0.16 ± 0.01 – during the first and second balance tasks). There were no significant changes in concatenation between parameters representing peripheral (organ) regulatory commands and metabolic changes (the initial values of $D_{QRS/JT}$ was 0.28 ± 0.01; during the first balance task 0.27 ± 0.01 and 0.25 ± 0.01 – during the second task), these data presented in Figure 2. The concatenation between systemic regulatory commands and metabolic changes significantly ($p < .05$) decreased, these data presented in Figure 3. We should point that the increase of complication of the motor task lead to more expressed decrease of this concatenation, i.e. $D_{RR/JT}$ – 0. 13 ± 0.05 while performing the first balance task and $D_{RR/JT}$ was 0. 16 ± 0.06 while performing the second balance task, i.e. the squats were performed at constantly changing conditions.

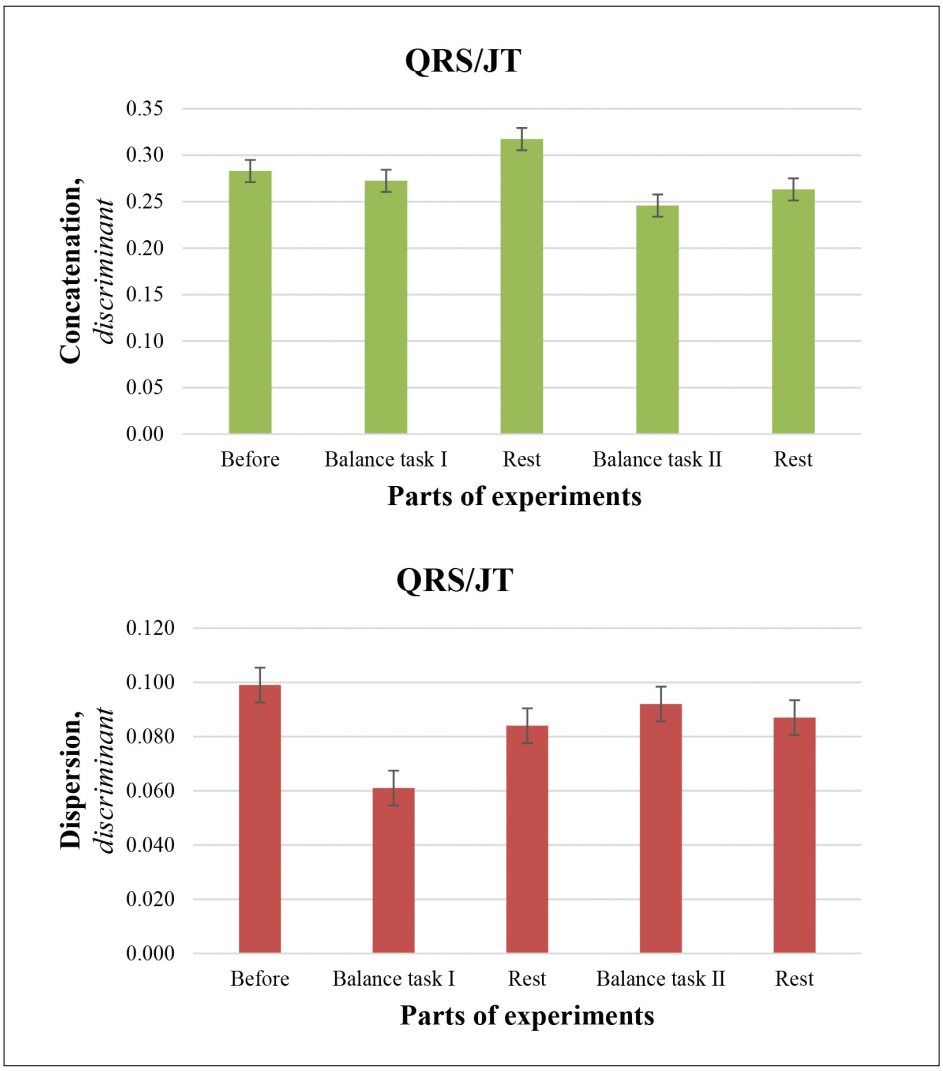
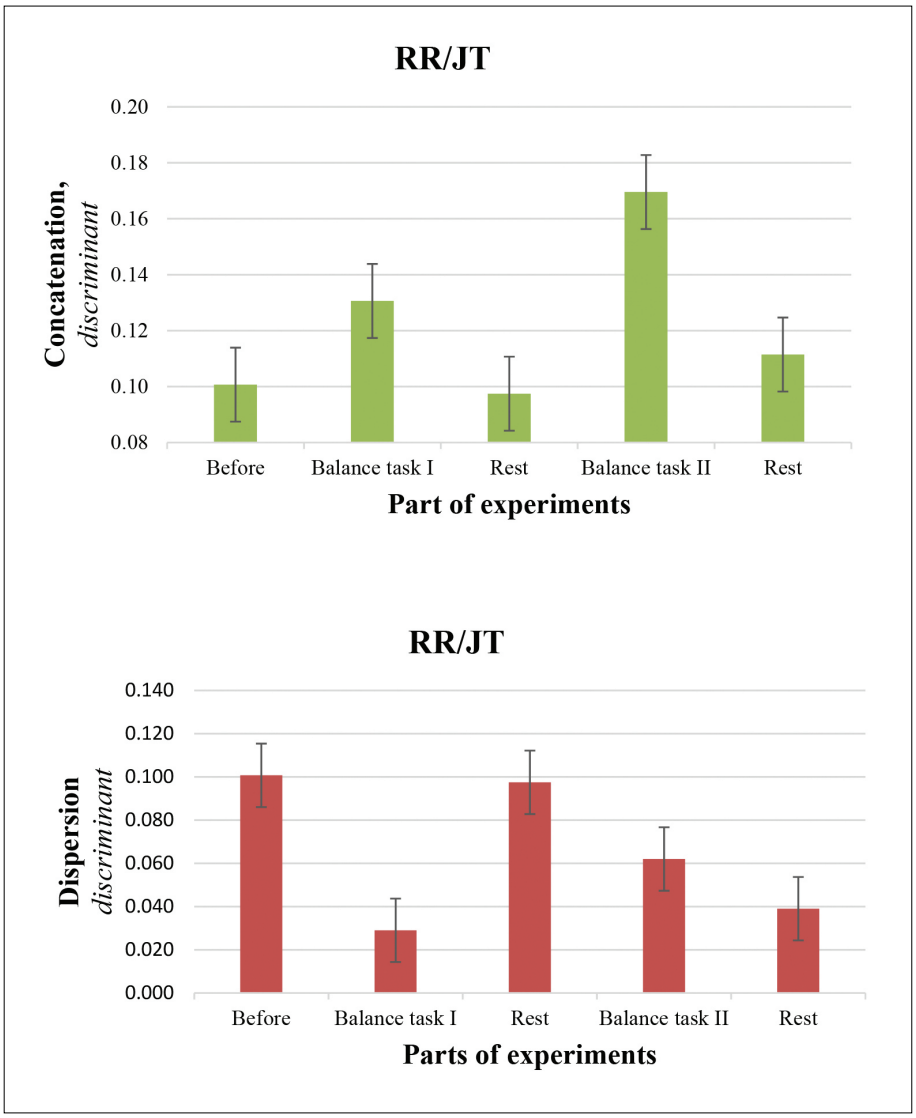



Figure 2. **Concatenation between ECG parameters QRS duration & JT interval**

**Note.** According the model of integral evaluation (Vainoras, 2002) QRS – organ level regulatory response; JT represents cardiac metabolic response.

Figure 3. **Concatenation between ECG parameters RR & JT intervals**




**Note.** According the model of integral evaluation (Vainoras, 2002) RR – represents systemic regulatory response; JT represents cardiac metabolic response.

## DISCUSSION

The task to keep balance while standing on balance board can be described as movement a variation that is closely to DT tasks. The second task, i.e. to perform the squats during the balance test while each next squat should be performed at constantly changing conditions, what means this situation was more complicated, more unexpected and both balance tasks laid in line with the requirements of the DT methodology.

Results obtained during the study showed that there were no drastic differences between the values of registered ECG parameters while performing both balance tests by standing on LIBRA balance board. The significant difference in the type of change of concatenation between registered ECG indices was distinguished. The concatenation between analysed ECG parameters increased or there was no significant change while performing the balance task by standing on LIBRA balance board only. The decrease of concatenation was observed during the second task while the participants performed the squats standing on the balance board. This type of change in concatenation was found during the analysis of all ECG parameters, i.e. between duration of RR intervals and QRS; between JT and RR intervals and between QRS and JT intervals.

A dynamical concatenation shows the interactions of components and changes of their interconnections (Bikulčienė, Navickas, Vainoras, Poderys, & Ruseckas, 2009; Poderys et al., 2015). According the model of integral evaluation

(Vainoras, 2002) dynamical concatenation $D_{RR/QRS}$ describes intersystemic concatenation between two fractal levels, i.e. the link between responses of systemic and organ levels; $D_{RR/JT}$ describes relationship between regulatory and supplying systems (metabolic response) and $D_{JT/QRS}$ describes relationship between organ level regulatory response and cardiac metabolic response (Vainoras, 2002; Telatavičienė, 2014).

Internal body changes occurred during exercising is a trigger for long-term adaptation. Mobilization of cardiovascular system during exercise tasks is warranted that the body meets the demands of exercising muscles. Aside from matching changes in ECG exercise also induces preconditioning whereby the body is more resistant even long after the exercise has ceased. So the physiological changes occurred during exercising are important trigger activating the long-term adaptation processes taking place in the body during the recovery process. All physiological systems undergo specific adaptations that increase the body's efficiency and capacity. The magnitude of these changes depends largely not only on the intensity and duration of the training sessions but on the content, i.e. on the type of motor tasks, as well.

A lot of evidence showing that DT is more effective than TT may be is that in repetitive training the training processes are stimulated less than in DL (Henz & Schöllhorn, 2016). One line of argumentation might be that due to repetitive movement performance habituation processes of the cognitive and motor system are to be postulated (Henz & Schöllhorn, 2016). However, the underlying mechanisms are not fully understood, and there is currently much focus on detailing such pathways (Boström et al., 2013).

In contrast, in repetition based motor learning movements are performed with a large number of repetitions without voluntary variations until a predefined ideal state of movement is reached. The system dynamic approach states that living systems show fluctuations continuously and an increase of fluctuations before a phase transition has the purpose to find a new and more effective mode. Within the DT approach, fluctuations during the motor learning process are a fundamental basis for improvement (Henz & Schöllhorn, 2016).

## CONCLUSION

Differential training tasks trigger the decrease of concatenation between cardiovascular parameters, that allows to discuss about the hypothesis that decrease of concatenation between systemic regulatory commands and cardiac metabolic changes could be one of possible chain activating and enhancing the efficiency of long-term adaptation at conditions of differential training.

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

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