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DYNAMICS OF BODY COMPOSITION AND BODY IMAGE OF SEDENTARY WORKING WOMEN WHO ATTEND ZUMBA OR FUNCTIONAL TRAINING PROGRAMS: PILOT STUDY

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ABSTRACT

Background. The aim of the study was to evaluate dynamics of body composition and body image in women who perform sedentary work and are attending Zumba or functional training programs.

Methods. There were 31 women taking part in this study. They attended Zumba ($n = 16$) or functional training ($n = 15$) programs. All participants were asked to fill in Body Image Scale and Body Shape Questionnaire. Participants' body composition was evaluated by measuring skinfold thickness with a calliper. All measurements were made twice: before and after eight weeks.

Results. No statistically significant changes of body composition were found in Zumba and in functional training groups. The results showed that women became more satisfied with their bodies after the functional training program.

Conclusion. Body composition did not change significantly after eight weeks of Zumba or functional training, however the reduction of body dissatisfaction was observed after the functional training program.

Keywords: body dissatisfaction, fat mass, fat free mass.

INTRODUCTION

Recent research has shown that office workers spend between 66–82% of their work hours sedentarily (Bergman, Boraxbekk, Wennberg, Sorlin, & Olsson, 2015). Low energy expenditure due to lack of activities during sedentary work is a main reason for the increase in overweight and obesity (Church et al., 2011).

Overweight and obesity have become a major and growing nutritional problem in today's modern world (Ribeiro-Silva et al., 2017). According to the World Health Organization (WHO), nearly 40% eighteen-year-olds and older population in the world were overweight and 13% adults were obese. The mortality rate from obesity is higher than from famine in the world. Obesity is associated with an increased risk of type 2 diabetes, hypertension, hyperlipidemia, sleep apnea, osteoarthritis and other conditions (Williams, Mesidor, Winters, Dubbert, & Wyatt, 2015). Over the past decade, various therapeutic ways have been sought to help solve this problem (Abdelaal, le Roux, & Docherty, 2017).

Concerns about the appearance of the body are relevant not only in adolescence, but also in all stages of woman's age. It is not a consequence of modern culture, this was a relevant issue throughout history and the perception of the individual's beauty has changed to this day. Since the 1960s the slender body of a woman and the muscular body of a man have started being ideal (Garrusi & Baneshi, 2017). Today, the aspiration of many women is not only a slender body, but an athletic body, which is even more challenging for women.

Prevailing healthy lifestyle cult also influences the attitude of one's own body in these days. The body image defines the physical perception of the body and the emotional response to it. Body image is a complex somatic and mental dimension. In Western countries, the extremely lean body's ideology increases the body dissatisfaction, the use of drastic weight loss means and eating disorders (Sakalauskaitė & Tutkuvienė, 2009). Disordered eating and body shame may be detected among athletes, exercisers and sedentary women despite the physical activity level. Research has shown that there were no significant differences in disordered eating, body dissatisfaction, self-esteem and fluid manipulation – related behaviour among athletes, exercisers and sedentary female students (Jankauskiene & Pajaujiene, 2012). Jankauskiene, Pajaujienė, and Mickūnienė (2010) have found that in order to meet social expectations, the risk of eating disorder increases regardless of the body mass index. Another research has shown that physical activity experience is related with higher body shape satisfaction (Jankauskiene, Kardelis, & Pajaujiene, 2005). Women look for different ways to improve their appearance to meet their appearance standards (Garrusi & Baneshi, 2017).

One of the most popular aerobic physical activities is Zumba training (Luettgen, Foster, Doberstein, Mikat, & Porcari, 2012). Modern Zumba workout choreography includes Salsa, Merengo, hip-hop, Samba, Mambo dance moves, aerobic steps, squats, split squats and other exercises. Latin music rhythm sounds during the Zumba sessions.

Functional workout is not a new concept. Functional training is designed to enhance day-to-day activities, recreational activities and/or sports activities. The object of this training is the neuromuscular system, where movements are trained (muscle groups and nervous system), not only muscles (Beckham & Harper, 2010). Functional workouts are effective in improving muscle strength, balance, mobility, and the quality of daily movements. Functional training affects the muscles in coordinated, multi-axial movements and involves multiple joints, dynamic tasks, consistent level of support surface to improve function. It is said that functional training is a purposeful training method because the function itself is already a goal. The principle of functional training is the specificity of the workout – a specific movement is trained to maximize its performance. In other words, the desired goal is better if workout is closer to it. In order to improve day-to-day performance, the exercise program should include similar movements and patterns of performance as in daily activities (Liu, Shiroy, Jones, & Clark, 2014).

The aim of the study was to evaluate dynamics of body composition and body image in women who perform sedentary work and attend Zumba or functional training programs.

METHODS

Participants. There were 31 sedentary women taking part in this study who attended functional (n = 15) or Zumba training (n = 16) programs. The inclusion criteria of participants were: young age (up to 44 years), sedentary work, attendance of functional or Zumba training, but not any other physical activities. Mean age of women in functional training group was 34.7 (22–44) years, in Zumba group – 36.4 (26–44) years. The participants of the study attended functional training sessions or Zumba training sessions which were held two times per week, for eight weeks. The duration of one session was 60 min. All measurements were made twice: before and after eight weeks. All participants were informed about the aim of the study, research procedures, requirements and benefits. Ethics approval No. BEC-1R(M)-92 was granted from the Ethical Committee of Lithuanian University of Health Sciences.

Assessment of body composition. Body composition was evaluated by measuring skinfold thickness with a calliper at four body sites – triceps, abdominal, supraspinale and thigh (Jackson, Pollock, & Ward, 1980). These skinfold measurements were used for percent body fat, absolute fat mass, fat free mass and fat free mass index calculation. The body weight of participants was measured using electronic scales with measurement accuracy of 100 g.

Assessment of body image. Figure rating scale was used for body image assessment (Pruis, & Janowsky, 2010) The permission to use this scale was obtained from the scale authors. Figure rating scale comprises a series of nine male or female figure drawings of increasing body size. In this figure rating scale, the participants of the research were asked to select from 9 female body figures of increasing size (labelled 1–9) that best resembled their current body size and desired body size. In this way subjective self-evaluation of the participants, the real and desired body image, were observed. By subtracting the ideal number of body image from the real body image, we got an ideal body image gap from the real. A greater difference indicates greater dissatisfaction with participant's body.

Also Cooper, Taylor, Cooper, and Fairburn's (1987) Body Shape Questionnaire (BSQ) was used to evaluate the signs of dissatisfaction with body image. We used a shortened form of the questionnaire consisting of 16 questions. The Lithuanian version of the body shape questionnaire was received from the author and the authors of the Body shape questionnaire gave the permission to use this questionnaire. The purpose of the questionnaire is to determine the fear of the subjects to gain weight, self-evaluation dependence on the appearance of the body, the desire to lose weight and dissatisfaction with their own body. Reliability of the shortened questionnaire (Cronbach α) was .87.

Statistical analysis. Data analysis was performed using "SPSS 21.0 for Windows" and "Microsoft Office Excel 2013". Nonparametric tests were used to compare samples: the Wilcoxon criteria were used to compare two dependent samples and the Man–Witney–Wiloxon criteria were used for comparing two independent samples. The data are presented as a median (the minimum value - the maximum value, the average). Statistical significance was set at $p < .05$.

RESULTS

Changes in body composition parameters. There was no difference between the two groups before attending Zumba and functional training programs in body weight ($U = 106$, $p = .6$), percent body fat ($U = 98$, $p = .4$), absolute fat mass ($U = 86$, $p = .18$), fat free mass ($U = 115$, $p = .86$) or fat free mass index ($U = 99$, $p = .42$). After Zumba and functional training programs we did not observe statistically significant changes of body composition parameters, only the tendency of the body weight, percent body fat and absolute body fat decrease were estimated (Table 1).

Table. **Changes in body composition parameters after Zumba and Functional training programs**

Training programs	Before	After	Criteria value; *p* value
Body weight (kg)			
Zumba	67.35 (55.4–87.2, 68.31)	67 (55.9–86, 67.9)	$Z = -1.78$, $p = .07$
Functional training	66.7 (52.8–80, 66.36)	66.3 (52.9–79.5, 66.2)	$Z = -1.51$, $p = .13$
Body mass index			
Zumba	24.14 (21.75–31.21, 25.39)	24.12 (21.6–31.09; 25.24)	$Z = -1.76$, $p = .08$
Functional training	23.49 (19.63–29.38, 24.06)	23.7 (19.66–29.2; 24)	$Z = -1.5$, $p = .13$
Percent body fat (%)			
Zumba	26.97 (21.95–39.28, 28.91)	27.25 (21.15–39, 27.71)	$Z = -1.47$, $p = .14$
Functional training	26.92 (15.78–34.19, 26.42)	27.1 (16.59–33.52, 26.25)	$Z = -1.71$, $p = .08$
Absolute fat mass (kg)			
Zumba	16.69 (14.1–33.37, 20.16)	16.5 (14.32–32.51, 19.87)	$Z = -1.81$, $p = .07$
Functional training	18.28 (8.8–27.35, 17.82)	18.56 (9.27–26.65, 17.65)	$Z = -1.72$, $p = .08$
Fat free mass (kg)			
Zumba	48.96 (40.52–53.82, 48.15)	48.86 (40.58–53.48, 48.04)	$Z = -0.25$, $p = .79$
Functional training	48.98 (39.91–53.64, 48.54)	49.13 (39.99–53.48, 48.55)	$Z = -0.47$, $p = .63$
Fat free mass index (%)			
Zumba	17.77 (16.72–19.33, 17.89)	17.84 (16.83–18.96, 17.88)	$Z = -0.31$, $p = .75$
Functional training	17.65 (14.84–20.69, 17.56)	17.61 (14.87–20.65, 17.56)	$Z = -0.47$, $p = .64$

Changes in the body image. During the first examination, the real body image did not differ between the groups (U = 116, p = .89). During the first examination, the real body image of the Zumba training group was 4 (3–6, 4.5) points, and after the training program – 4 (3–5, 4.06) points. After the Zumba training program, the real body image scores did not differ statistically significantly, however, there was a tendency of score decrease (Z = –1.81, p = .07). During the first examination of functional training group, the real body image was 5 (2–6, 4.27) points, and after the training program – 4 (2–5, 3.8) points. The scores of the real body image in the functional training group decreased statistically significantly (Z = –2.33; p = .02) (Figure 1).

Before applying training programs, the ideal body image did not differ between two groups (U = 120; p = 1). The ideal body image of the Zumba training group was 3 (2–4, 3.19) points, and after the training program – 3 (2–4, 3) points. After Zumba training program, the ideal body image did not change significantly (Z = –1.34, p = .18). The ideal body scores in the functional training group were 3 (3–5, 3.2) points, and after the training program – 3 (2–4; 3) points. The ideal body scores also did not change statistically significantly is this group (Z = –1, p = .31).

The difference between the ideal body image and the real body image did not differ between two groups (U = 84.5, p = .16). Before applying Zumba training, the difference between the ideal body image of the participants from the real body image was 3 (2–4; 2.81) points, and after the exercise training – 2.5 (2–4, 2.63) points. The difference between the ideal body image and the real body image was not statistically significantly different in the Zumba training group, but the tendency of decrease the ideal body image difference from the real body image was observed (Z = –1.73, p = .08). The difference between the ideal body image and the real body image during the first examination in the functional training group was 2 (1–3, 2.33) points and in the second examination – 2(1–3, 2.27) points. The difference between the ideal body image and the real body image did not change statistically significantly in functional training group (Z = –0.57, p = .56).

Before functional and Zumba training, the total body shape questionnaire score did not differ between two groups (U = 116.5, p = .89).

The total score for the body shape questionnaire was 35.5 (22–66, 39.62) points in the Zumba training group at the beginning of the study, while during second examination total score was 36 (20–55, 37.12) points. There were no statistically significant changes of body self-dissatisfaction after Zumba training program, only the tendency of total score decrease was observed (Z = –1.47, p = .14). Of all the 16 questions statistically significant

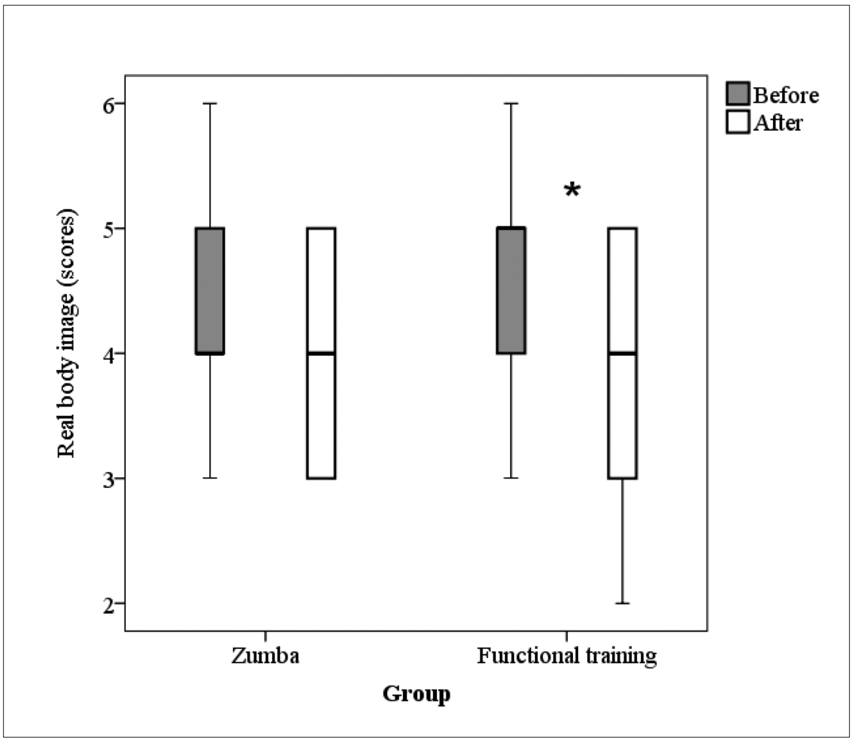
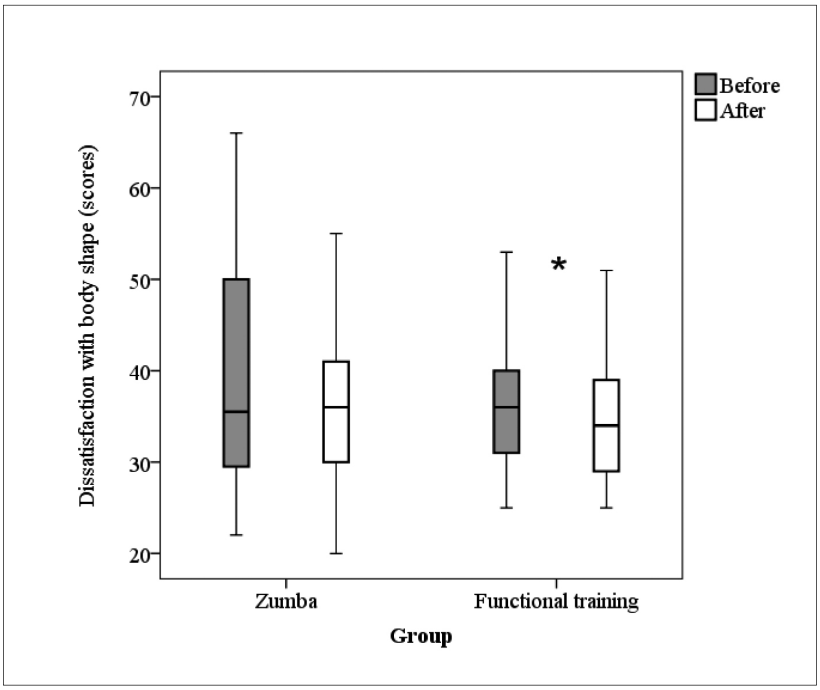


Figure 1. **Changes in real body image after Zumba and functional training programs**

Note. *p < .05.

Figure 2. **Changes in dissatisfaction with body shape after Zumba and functional training programs**



Note. * $p < .05$.

changes were observed in 14th question "Have you felt that it is not fair that other women are thinner than you?" ($Z = –2.53$, $p = .01$) and 15th question "Have you worried about your flesh being dimply?" ($Z = –2.41$, $p = .02$).

The total score of the body shape questionnaire during first examination in the functional training group was 36 (25–53, 37.06) points and in the second study – 34 (25–51, 35.13) points. The dissatisfaction with their body statistically significantly reduced after the functional training program ($Z = – 2.36$, $p = .02$) (Figure 2).

Of all the 16 questions, there was a statistically significant decrease in the 3rd question "Have you worried about your flesh being not firm enough?" scores ($Z = –2.16$, $p = .03$) and the 6th question "Has being with thin women made you feel self-conscious about your shape?" scores in functional training group ($Z = –2$, $p = .04$).

DISCUSSION

Analysing the data of our study we found the body weight, percent body fat and absolute body fat decrease tendency in Zumba and functional training groups. Active body mass and active body mass index changes were not found. Ljubojević, Jakovljević, and Popržen (2014) found that eight weeks of Zumba training three times a week statistically significantly reduced body weight, percent body mass and increased lean body mass measurements of young women. Comparing this study to ours, the results may differ because of different training rate. Haghjoo, Zar, and Hoseini's (2016) study showed that eight weeks, three times a week Zumba training reduces women's body mass index, percent fat mass, absolute fat mass and reduces waist – hip ratio, but statistically significant results of fat free mass were not found. We also found no changes in fat free mass measurements, but other results differ from those of Haghjoo et al.s' (2016) investigation findings because of different training rate. Therefore, based on the research we have been discussing, we conclude that after two months of attending Zumba training, body composition changes can be detected by training at least three times a week. Analogous research that studies the effect of functional training on the body composition of women who perform sedentary work cannot be found, but we will discuss studies that compare the effects of aerobic and strength training on body composition measurements since functional training was used in our study, most exercises consisted of strength exercises. Willis et al. (2012) studied aerobics, aerobic-strength and strength training on the body composition of participants who perform sedentary work. Aerobic training and aerobics-strength training were found to be superior to strength training to reduce body weight and percent fat mass, and strength and aerobic-strength exercises are more effective in increasing fat free mass of participants. It has been shown that in order to prevent weight gain or to reduce the fat mass, a moderate intensity physical activity of 150–250 minutes should be performed per week, and in order to achieve a clinically meaningful reduction in body weight, moderate intensity physical activity should be performed at 225–420 minutes per week. Performing 150–250 minutes per week of moderate physical activity, clinically relevant changes in the body composition are achieved with nutritional correction (Donnelly et al., 2009). In our research, the participants trained for 120 minutes per week. Based on the studies discussed, we can state that the exposure time we applied was too short or that the frequency of exercise was too rare to achieve statistically significant changes in the body composition. We found statistically significant improvements in the real body image in the functional training group, as well as a significant reduction in body self-dissatisfaction in the functional training group and a decrease tendency of owns body dissatisfaction and a statistically significant reduction in separate question scores in the Zumba group. Other body image changes were not detected. According to scientific literature, physical exercises have a positive effect on general well-being, psychological state, improve mood, quality of life, increase self-esteem and reduce depressive symptoms (Tylka, & Homan 2015). Although we did not evaluate these changes in our research, we believe that a possible mood or self-efficacy improvement had an impact on the body image results.

Vocks, Hechler, Rohrig, and Legenbauer (2009) found that women who attended physical activity classes felt leaner than they really were. In our study it also occurred: women who trained in the functional training group, considered themselves to be leaner after classes. Women who participated in our study attended the Zumba and functional training groups, i.e. they met and communicated with each other. Communication allows to express emotions and reduce stress and anxiety (Adilogullari, 2014), so we believe that socialization could also have an impact on an improved attitude in their body. The self-body evaluation depends on the motivation for attending workouts. It has been observed that frequent high intensity trainings increase the risk of eating disorders, and women who are attending physical activities with the aim of loss and burning calories are more dissatisfied with their body than those whose purpose of attending workouts is to improve general well-being, not related to slimming (LePage & Crowther, 2010; Homana & Tylka, 2014). It is believed, that persons who are not satisfied with their body, experience negative emotions after physical activities more often, i.e. physical activity leads to a more critical evaluation of their body, and those who are positively evaluating their body, experience even better emotions after physical activity (Homana & Tylka, 2014).

CONCLUSION

Body composition did not change significantly after eight weeks of Zumba or functional training, however the reduction of body dissatisfaction was found after the functional training program.

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TRANSTHORACIC ECHOCARDIOGRAPHY AND DEPENDENCE OF ELECTROCARDIOGRAPHIC INDICATORS ON PHYSICAL ACTIVITY TYPE IN LITHUANIAN ATHLETES

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ABSTRACT

Background. Since athletes have a higher risk to experience cardiovascular system complications, this gives us an important reason for further investigation. Early detection of pathological hypertrophy of the left ventricle may exclude athletes from sports activities and prevent complications and possible death.

Methods. In our study, 75 patients underwent transthoracic echocardiography (TTE). The values of left ventricle were measured: left ventricle end-diastolic diameter (LVEDD), interventricular septum thickness in diastole (IVSTd), LV posterior wall thickness in diastole (LVPWTd), LV mass (LVM), LV mass index (LVMI), LV end-diastolic diameter index (LVEDDI). Standard 12-lead ECG was recorded at 25 mm/s and with standard calibration of 10 mm/mV from a patient in a supine position.

Results. When we compared results of LVH according to ECG and TTE, ECG showed higher count of athletes with marginal changes and less LVH compared to TTE in female endurance and male athletes. Moreover, moderate positive correlation between LV mass and R wave size (V5) (r = .617) was found in female endurance athletes. Furthermore, high positive correlation between LVEDD and QRS interval length (r = .911) was found in female strength athletes. Also, moderate negative correlation (r = –.603) between heart electrical axis and R wave size (V5) was found in male endurance athletes.

Conclusions. Knowledge of the ECG changes associated with the type and intensity of exercise, race, age and gender can lower the traditionally high number of false positives, thus reducing unnecessary investigations. In our study, ECG showed higher count of athletes with marginal changes and less LVH compared to TTE in women endurance, men strength and endurance groups.

Keywords: heart ventricles, electrocardiography, hypertrophy.

INTRODUCTION

Sudden death is a tragic event in any occasion. Sudden death during sports is an extremely rare event, but the impact is greater, because athletes are regarded as the healthiest group in society. ECG can reveal changes associated with cardiac disease. Puig, Freitas, Costa, and de Freitas (1994) have concluded that ECG changes in athletes usually reflect structural adaptation to regular physical training. On the other hand, abnormalities on a young athlete's ECG can also be an expression of an underlying disease that may carry a risk of sudden cardiac death (SCD) during sports. Lack of knowledge of the 'normal' ECG changes in athletes may lead to false-positive results and often limits participation in sports to athletes whose ECG patterns are within the normal pattern.

Current European Society of Cardiology (ESC) guidelines (Uberoi et al., 2011) include an ECG, besides physical examination, as a pre-screening test for athletes. The American Heart Association (AHA) and the ESC have both published recommendations (Corrado et al., 2010) for the interpretation of the ECG in athletes. These guidelines presents a summary of the most frequent ECG changes considered 'normal' in athletes and creates discussion regarding the advantages and disadvantages of ECG screening in this population.

Athlete's heart is currently defined (Leite, Freitas, Campelo, & Maciel, 2016) as a non-pathological condition as a result of structural and morphological adaptation to intensive exercise. The cardiovascular adaptation to exercise differs according to physical activity type: endurance (dynamic/aerobic) and strength training (isometric/anaerobic). Some sports, such as cycling and rowing, combine both types of cardiovascular changes. Venckunas, Stasiulis, and Raugale (2006) suggest that endurance sports lead to volume overload and increased diameter of the heart chambers, while strength sports can cause overload by pressure and are related to the thickening of the left ventricle wall. Early detection of pathological hypertrophy of the left ventricle may exclude athletes from sports activities and prevent complications and death. At present echocardiography can analyse (D'Andrea et al., 2006) the structural and functional changes in the myocardium of athlete's hearth and distinguish the physiological and pathological hypertrophy.

While studies are so controversial and similar studies have not been carried out in Lithuania, it is relevant to find more information about transthoracic echocardiography and electrocardiographic indicators' dependence on physical activity type in Lithuanian athletes.

METHODS

The study was carried out at the Kaunas Sports Medicine Centre within 2 years. The Bioethics Centre's Approval was received at LSMU (No. BEC – MF – 474) in order to publish the article. Patients were selected based on the following criteria: age (from 18 to 40 years), athletes, who were engaged in strength or endurance sports at least 4 h/week for 1 year. Patients arrived at a periodic medical examination at Kaunas County Medical Centre where they underwent two-dimensional transthoracic echocardiography (TTE). Their systolic and diastolic blood pressure, height, weight and history of exercise intensity were noted. Hasdemir et al. (2011) suggested that arterial blood pressure should be measured in the subject's sitting position by auscultation of Korotkoff sounds (first and fifth Korotkoff tone phase) with a stethoscope and using a cuff before performing (TTE). Also, none of our subjects had physical activity on the day of the study. Standard 12-lead electrocardiogram (ECG) was recorded from a patient in a supine position on the same day of examination (before TTE).

As Yim (2013) suggested, we chose to perform a two-dimensional transthoracic echocardiography because it is non-invasive investigation and does not involve radiation. We used ultrasound system CX50 with transducer – S5-1 in this investigation. A two dimensional Doppler technique was used as well. We used these dimensions to measure the left ventricular: left ventricle end-diastolic diameter in diastole (LVEDD, mm), interventricular septum thickness in diastole (IVSTd, mm), LV posterior wall thickness in diastole (LVPWTd, mm). Lang et al. (2015) recommend to measure these indicators at end of the diastole (before the mitral valve closing or in the heart cycle with the largest diameter or volume of the ventricle). Due to the statistically significant difference between the subjects' height and weight in the groups of athletes, it was decided to evaluate the relative indices with the area of the body surfaces. Relative body surface area was calculated according to the formula:

$$LVM = 0.8 \text{ x } (1.04\ ((LVEDD + LVPWTd + IVSTd)^3 - LVEDD^3)) + 0.6 \text{ g},$$

where LVM – left ventricular myocardial mass; LVEDD – left ventricle end-diastolic diameter; IVSTd – interventricular septum thickness in diastole; LVPWTd – LV posterior wall thickness in diastole, based on the latest recommendations of the American Society of Echocardiography (2015), and the European Cardiovascular Association (Lang et al., 2015). According to these parameters, the following values were calculated: LV mass (LVM, g), LVMI (LV mass index, g/m^2), LV end-diastolic diameter index (LVEDDI, mm/m^2). The left ventricular myocardial mass index (LVMI) was calculated dividing the mass of the left ventricular by the body surface area. The left ventricular diastolic diameter index (LVEDDI) was calculated dividing the diastolic size of the left ventricle by the body surface area.

Statistical analysis was performed using SPSS version 16.0 (IBM, Armonk, NY, USA) software package. Qualitative variables were described based on their frequency rate (%). The quantitative values are given as the arithmetic mean ± standard deviation (x ± *SD*). Qualitative variables' homogeneous distribution was evaluated by chi-square (χ^2) test (χ^2 or Fisher's exact test – in case of small expected values). The normality of distribution of quantitative variables was tested by Kolmogorov-Smirnov test. For comparison of quantitative variables Mann–Whitney–Wilcoxon (for non-normal distributions), Student's *T*-test (for normally distributed values) were used. The correlation coefficient (*r*) of Spearman, Pearson, and Cramér's V was calculated for the relation between variables. The relation when the correlation coefficient $r < .3$ was considered as weak, when $.3 \leq r \leq .7$ was considered as moderate and when $r > .7$ was considered as strong. Differences at $p < .05$ were considered as statistically significant.

RESULTS

This study involved 75 participants (age 23.39 ± 5.86) in total. Individuals were categorized by gender and physical activity type (strength and endurance athletes): 20 women were endurance sports representatives, while strength sports group involved 5 subjects; 25 men were endurance sports volunteers, when 25 subjects were categorized as strength sports athletes. General characteristics of the athletes are presented in Table 1.

When we compared results of LVH according to ECG and TTE, ECG showed higher count of athletes with marginal changes and less LVH compared to TTE (Figures 1, 2) in women endurance, men strength and endurance groups.

In our study, moderate positive correlation between LVEDDI and QRS interval length ($r = .486$) and between IVSTd and R wave size (V5) ($r = .453$) was found in female endurance athletes. Moreover, moderate positive correlation between LV mass and R wave size (V5) ($r = .617$) was

Table 1. **Athletes' characteristics by gender**

Subjects' groups	**Women endurance athletes (*n* = 20)**	**Women strength athletes (*n* = 5)**	**Men endurance athletes (*n* = 25)**	**Men strength athletes (*n* = 25)**
Age (years)	24.14 ± 6.16	20.38 ± 2.45	22.35 ± 5.35	24.44 ± 6.46
Height (cm)	175.30 ± 7.94	162.80 ± 7.5	186.08 ± 8.77	183.44 ± 8.69
Weight (kg)	69.80 ± 11.52	60.00 ± 8.31	81.04 ± 9.87	85.16 ± 16.73
Body surface area (m^2)	1.83 ± 0.18	1.63 ± 0.13	2.03 ± 0.15	2.03 ± 0.22
Years of training (years)	13.25 ± 7.09	6.60 ± 3.29	12.20 ± 6.86	10.84 ± 5.76
Hours of training (hours/week)	9.40 ± 4.28	6.80 ± 2.08	11.20 ± 6.06	8.42 ± 2.68
Systolic blood pressure (mmHg)	115.20 ± 9.81	114.40 ± 11.61	123.76 ± 12.43	126.24 ± 9.55
Diastolic blood pressure (mmHg)	70.20 ± 10.80	64.80 ± 8.67	73.92 ± 13.39	76.80 ± 6.89
Resting heart rate (t/min)	67.50 ± 10.64	70.80 ± 12.30	70.52 ± 9.62	66.96 ± 7.88

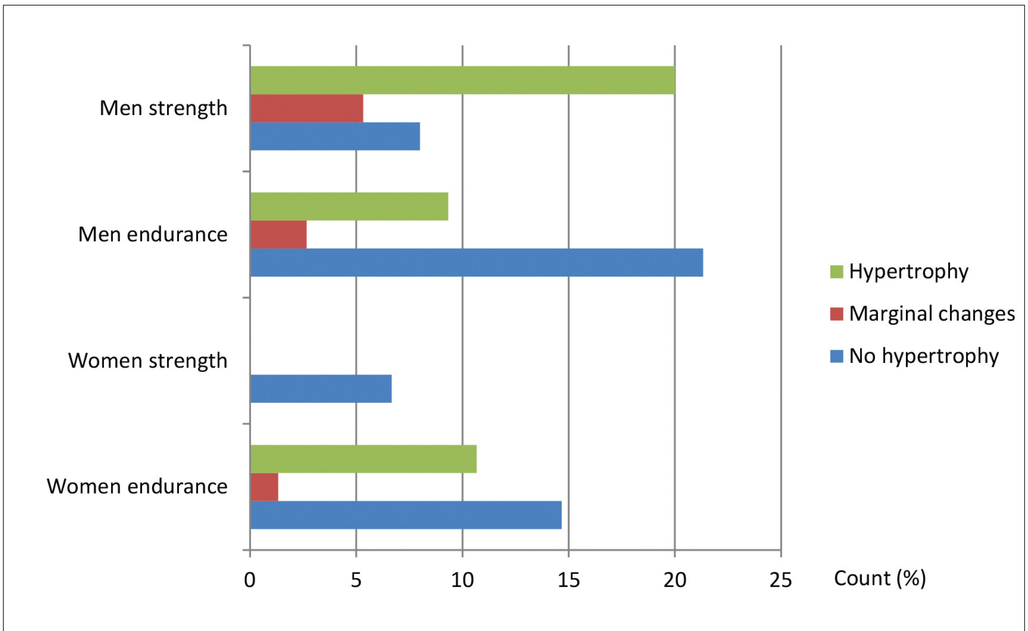

Figure 1. **LVH according to transthoracic echocardiography**

Figure 2. **LVH according to ECG**

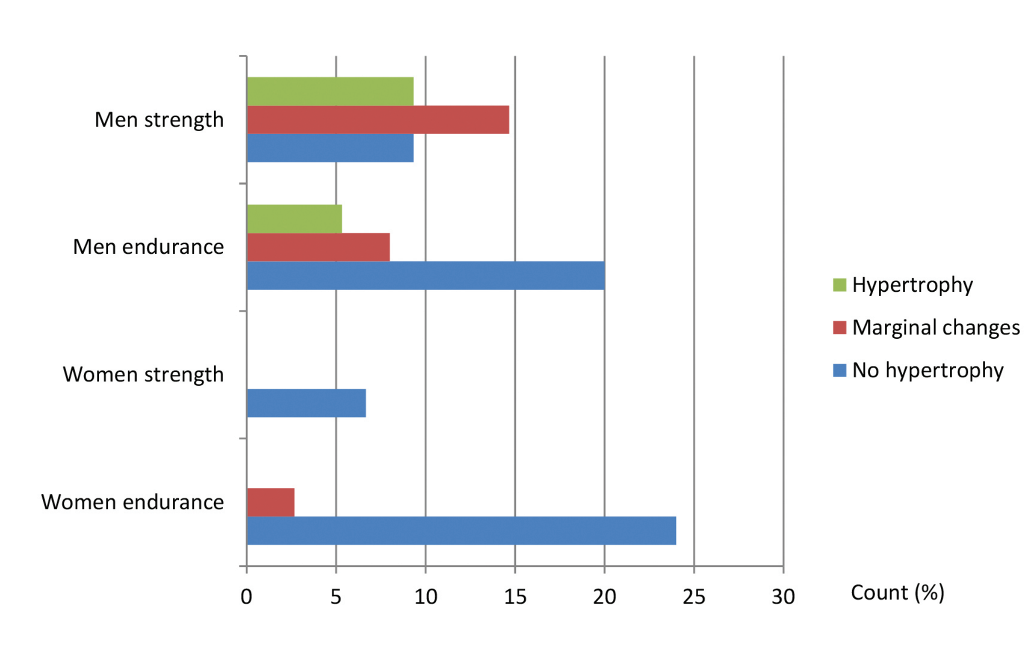

Table 2. **LVH ECG an TTE parameters according to gender and physical activity type**

Subjects' groups	Women endurance athletes	Women strength athletes	Men endurance athletes	Men strength athletes
LVEDD (mm)	46.57 ± 3.56	41.30 ± 3.35	51.02 ± 3.19	50.92 ± 4.83
LVEDDI (mm/m^2)	25.59 ± 2.55	25.50 ± 2.97	25.24 ± 1.95	25.09 ± 2.31
LVM (g)	149.11 ± 29.56	96.22 ± 21.25	197.25 ± 28.20	215.42 ± 49.06
LVMI (g/m^2)	81.07 ± 12.70	58.94 ± 11.64	99.06 ± 18.88	105.08 ± 18.40
IVSTd (mm)	9.24 ± 1.14	7.72 ± 1.07	10.28 ± 0.86	10.95 ± 1.25
LVPWTd (mm)	9.45 ± 1.10	7.68 ± 0.84	10.29 ± 0.82	10.98 ± 1.10
QRS (ms)	89.45 ± 10.78	81.60 ± 7.93	95.68 ± 10.69	91.68 ± 9.29
Sokolov–Lyon criteria (mm)	24.60 ± 5.30	24.60 ± 6.47	29.80 ± 10.79	32.40 ± 10.29
Axis (°)	60.80 ± 35.51	68.00 ± 16.60	75.00 ± 28.51	62.08 ± 19.16

found in female endurance athletes. Also, high positive correlation between LVEDD and QRS interval length (r = .911) was found in female strength athletes. Furthermore, moderate negative correlation between heart electrical axis and R wave size (V5) was found (r = –.603) was found in male endurance athletes. Also, moderate negative correlation between S wave size (V6) (r = –.469) and LVEDDI was found in male strength athletes. General TTE and ECG characteristics of athletes are presented in Table 2.

DISCUSSION

Dumanoir, Haykowsky, Syrotuik, Taylor, and Bell (2007); Gates, Tanakaa, Graves and Seals (2003) found that the impact of physical training on cardiac structure and function depended on the type, intensity and duration of training, as well as previous physical fitness, genetics and gender. Investigation on the physiological limits of left ventricular hypertrophy in elite junior athletes (Sharma et al., 2002) demonstrated that the left ventricular posterior wall thickness in the group of athletes was significantly increased compared to the untrained subjects. Pluim, Zwinderman, Van der Laarse, Van der Around and Wall (2000) studied the hearts of 1451 athletes and concluded that the absolute average thickness of the posterior wall of the left ventricle and the interventricular septum in the control group was significantly lower than that in the strength, endurance, or concurrent training groups. Also, Mahdiabadi, Gaeini, Kazemi and Mahdiabadi (2013) found that the thickness of the left ventricle, the interventricular septum and the posterior wall was the greatest in the strength group. According to the latest recommendations (2015), American Society for Echocardiography and the European Cardiovascular Association (Lang et al., 2015) provided standards based on body surface area. The present study highlights the poor accuracy of the five tested ECG criteria in correctly identifying LVH based on the results of the gold standard echocardiogram method in a population of athletes. The Perugia, Cornell and Romhilt- Estes ECG criteria presented high negative predictive values, which could be helpful for excluding the presence of LVH in athletes. (Samesima et al. (2017) found that the Perugia and Cornell criteria were more effective for excluding LVH in athletes involved in sport modalities with a predominance of the dynamic component.

The greatest disadvantage of pre-participation screening of young athletes' ECGs for abnormalities that may disclose a cardiac disease is the high number of false positives. Corrado et al. (2010) found that unawareness of the changes regarded as normal on young athletes' ECGs could lead to these being classified as abnormal in up to 50% of athletes. Knowledge of the ECG changes associated with the type and intensity of exercise, race, age and gender can lower the high number of false positives, and reduce unnecessary investigations.

CONCLUSIONS

A large number of young athletes demonstrate ECG changes due to physical adaptation and only a very small number actually have changes that are considered abnormal and need further investigation. Knowledge of the ECG changes associated with the type and intensity of exercise, race, age and gender can lower the traditionally high number of false positives, thus reducing unnecessary investigations. Our study found that ECG showed higher count of athletes with marginal changes and less LVH compared to TTE in women endurance, men strength and endurance groups

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Conflict of interest declaration. The authors have no conflict of interest to declare.

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PROBLEMATIC ALCOHOL USE IN TEAM AND INDIVIDUAL EXERCISE SETTINGS

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ABSTRACT

Background. The scholastic literature suggests that alcohol use may be a problem in team sports, but data on the general or average exercisers are lacking. This inquiry examined the *prevalence* of use and the *level* of problematic use of alcohol in a highly heterogeneous group of team and individual exercisers.

Methods. Two-hundred exercising male (n = 79) and female (n = 121) participants (M age = 26.79 ± SD = 7.88 years) answered demographic questions and completed the Alcohol Use Disorder Identification Test (AUDIT).

Results. The rate of alcohol drinkers did not differ between the groups, but males exercising in team settings reported higher levels of alcohol drinking problems than individual exercisers in general. The findings were similar for older (aged 25 years and over) adults too, as shown by a separate analysis of the latter group. The frequency and volume of exercise were unrelated to problematic alcohol use. Cases of high level of alcohol use problems were twice as many in team than in individual exercisers.

Conclusions. The prevalence of alcohol use in team and individual exercisers is similar, but problematic alcohol use is greater in the former group. Increased alcohol use problems in team exercisers seem to be limited to men and it occurs in older adults too. Men drink more than women, but the behaviour may have a general social, rather than a sport-specific, context.

Keywords: dependence, drinking, physical activity, social, substance use.

INTRODUCTION

In their literature review of youngsters under 25 years of age, Lisha and Sussman (2010) observed that 22 studies out of the 34 examined found that sport participants reported higher levels of drinking than non-participants. A systematic review of longitudinal studies also showed that in 15 out of the 19 reviewed studies alcohol use was positively associated with sports participation in adolescents and young adults (Kwan, Bobko, Faulkner, Donnelly, & Cairney, 2014). A study with young men, aged 16 to 34 years who took part in non-elite sports, showed that excessive drinking was more likely with teammates than with other social groups (Black, Lawson, & Fleishman, 1999). One longitudinal study revealed that participation in team sports was related to increased alcohol use problems in the late adolescence and early adulthood (T. Wichstrøm & L. Wichstrøm, 2009). Finally, studying a sample of high school athletes, Kulesza Grossbard, Kilmer, Copeland, and Larimer (2014) found that team-sport participation was associated with greater alcohol related problems than participation in individual sports. The scholastic literature provides convincing evidence that youngsters involved in team sports might be more susceptible to drinking problems than their counterparts involved in individual sports.

There are some unresolved questions, however, concerning the link between team and individual forms of exercises and alcohol use and misuse. One is whether the results obtained in studies with athletes can be extrapolated to the average exercisers. Further, since most studies were with young athletes in specific sports, could these finding be applied to a heterogeneous, or the general exercising population who perform a very wide spectrum of activities with different frequencies and intensities? As the difference in alcohol related problems between team and individual sport participants is not consistent across sports (Sønderlund et al., 2014), one point that begs for clarification is whether the unique social context of a very specific sport, or simply the general social environment is what makes people more vulnerable to alcohol misuse. Research shows that outside the domain of sports and exercise, socialization and selection are both determinants of heavy drinking (Becker & Curry, 2013). Therefore, it is plausible that team physical activity, whether it is exercise for fun or competitive sport, is a stage that provides opportunities for both selection and socialisation, in which case certain personal motivational factors gravitate people towards team or individual sports; then the link between taking part in sports and alcohol use problems may need to be re-evaluated.

In this inquiry we looked at a sample of randomly generated heterogeneous exercisers, participating in over 25 different sports, representing both genders, with a wide age range (62 years), wide frequency-range of weekly workouts (16 times), and wide range of total weekly hours of exercise (69 hours). This sample composition is different from the specific athletes and very young samples studied to date. Based on the non-sport link between alcohol use and socialization (Becker & Curry, 2013), we hypothesized that alcohol use problems might surface in team exercisers, *in general*, or regardless of the level of involvement, weekly frequency or intensity of exercise, simply because of the social context in team physical activities. To test our hypothesis, we compared a randomly generated sample of very heterogeneous (on purpose) team and individual exercisers on the basis: (i) of the *prevalence of alcohol use* and (ii) based on the *level of problematic alcohol use.* It was our aim to answer the question whether participation in physical activities, *in general*, could be associated with different drinking patterns in team and individual exercisers.

METHODS

Participants. The current research was conducted with ethical approval of the Research Ethics Committee of the Faculty of Education and Psychology at Eötvös Loránd University in Budapest, Hungary. Participants were recruited for another study testing the co-occurrence of substance and exercise addiction (Szabo, Griffiths, Aarhus Høglid, & Demetrovics, 2018). They were randomly selected from a pool of 691 people who completed the survey on condition that they participate in individual or team exercises. The selection was based on a *priori* sample size calculation using the G*Power (v. 3) software (Faul, Erdfelder, Buchner, & Lang, 2009). This test indicated that the minimum required sample size was 172 (as based on: $f = .25$, $\alpha = .05$, and $1–\beta = .90$). This number was increased to 200 in order to work with equal sample sizes (100 individual and 100 team-exercisers). The random sample was generated with the *select random cases* feature of the SPSS software, which resulted in 79 men and 121 women who were included in the final sample. Participants' mean (M) age was 26.79 ± SD = 7.88 years, they exercised 4.45 ± SD = 2.21 times per week for an average of 2.06 ± SD = 6.28 hours per workout. Most of the current sample were Scandinavians (77.2%), while the rest were from other European countries (22.5%).

Materials. Apart from the demographic questions, participants performed the 10-item Alcohol Use Disorders Identification Test (AUDIT; Babor, Higgins-Biddle, Saunders, & Monteiro, 2001) to assess problematic drinking among those who answered "yes" (n = 162/200) to alcohol consumption within the past year. Cut-off scores are: 0–7 reflecting low risk, 8–15 reflecting medium risk, or hazardous drinking, and a score of 16 or above reflects a high risk, or a high level of alcohol use problems. In the current inquiry, the internal consistency of the scale was acceptable (n = 200; $\alpha = .75$).

Procedure and statistical analyses. The randomly generated data of 200 team and individual exercise participants were subjected to statistical analysis using the SPSS software. There were two specific questions addressed in this work: 1) Is there a greater *prevalence* of alcohol use among team than individual exercisers? and 2) Is *problematic alcohol use* (as based on the AUDIT scores) greater in team than in individual exercisers? This work was based on a between-participants design calling for an independent *t*-test if the assumptions for a parametric test are met. Thus, first we adopted the Kolmogorov-Smirnov and Shapiro-Wilk tests to verify the assumption of normality. Since the latter was not met, we used the Mann-Whitney *U*-test, which is a non-parametric alternative to independent *t*-test. For examining the frequency of alcohol users in team and individual sports, we used the chi-square test. Finally, Spearman's rho (ρ) correlations were used to determine the relationship between AUDIT scores and the weekly frequency and the weekly volume (hours) of exercise. The level of statistical significance was set to .05 for all tests.

RESULTS

The first question was examined with a Chi-square, which yielded no statistically significant difference between the prevalence of alcohol use in team (88/100) versus the individual (87/100) exercisers.

Regarding the second question, since the Kolmogorov-Smirnov and Shapiro-Wilk tests showed that the assumption of normality was violated in the data ($p < .001$), a Mann-Whitney *U* test was used to determine if problematic alcohol use was greater among team than individual exercisers. This test revealed that team exercisers (*Mdn* = 7, *M* rank = 96.82) differed statistically significantly from individual exercisers (*Mdn* = 6, *M* rank = 79.08) in their total AUDIT scores ($U = –2.307$, $p = .02$). Based on these scores, participants were categorized as having low (< 8), medium (8–15), and high levels (> 15) of alcohol use problem (Babor et al., 2001). There were twice as many (6/82 (7.3%), 5/1 men/women ratio) versus 3/80 (3.8%) 1/2 men/women ratio) high level alcohol use problems among team exercisers than individual exercisers, and two-thirds (4/6) of the team exercisers reached the cut-off score of 20 (all men), which calls for the clinical evaluation of alcohol dependence (Babor et al., 2001). None of the AUDIT scores reached 20 or more among individual exercisers (Figure). Spearman's rho (ρ) correlations indicated that the AUDIT scores were unrelated to the weekly frequency or weekly volume (hours) of exercise, but they were negatively related to the age of the participants ($\rho = –20$, $p = .01$).

In the subsequent analyses, we compared the AUDIT scores of men ($n = 61$; mean rank = 95.50) with those of women ($n = 101$; mean rank = 73.04), which were statistically significantly different (Mann-Whitney $U = –2.966$, $p = .003$) and led us to re-run the initial analyses for team versus individual exercisers, separately for males and females. These tests appeared to be statistically significant only for men ($U = –2.204$, $p = .028$), revealing that males involved in team exercises ($n = 35$; *M* rank = 35.30) scored higher on the AUDIT than those practicing individual forms of exercises ($n = 26$; *M* rank = 25.21). Finally, due to the statistically significant correlation between the AUDIT scores and age, as well as because earlier studies primarily examined adolescents or young adults, we re-ran the test for those aged 25 and over ($n = 67$), which again resulted in a statistically significant ($U = –2.317$, $p = .021$) difference between team ($n = 32$; *M* rank = 39.73) and individual exercisers ($n = 35$; *M* rank = 28.76), showing that the former had higher AUDIT scores than the latter.

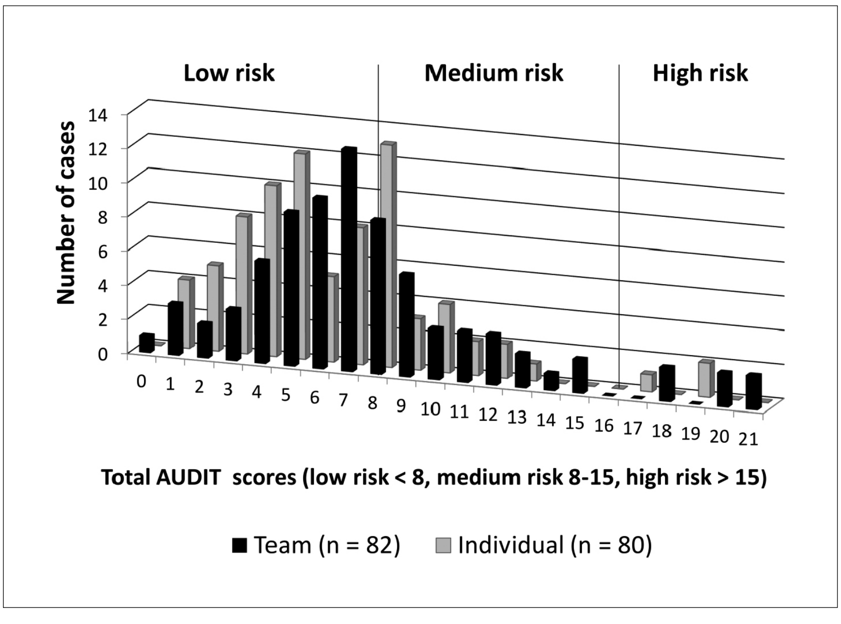

Figure. **Distribution of the scores obtained on the Alcohol Use Disorders Identification Test (AUDIT) from team and individual exercisers**

Note. A Mann–Whitney *U* test indicated that the two groups differed statistically significantly ($p = .021$) from each other; the former had a greater mean rank (89.86) than the latter (72.93).

DISCUSSION

The results of this work show that while the prevalence of alcohol use does not differ between team and individual exercisers, the *severity* of alcohol use-related problems appears to be greater in the former than the latter group. Indeed, the frequency of the clinical attention requiring cases was twice as high among team exercisers in contrast to individual exercisers. These findings are consistent with the results obtained with high school athletes (Kulesza et al., 2014), and expend those by showing that the differences between team and individual exercisers in alcohol use-related problems persist in the older adult stage as well. The results also agree with another earlier study, examining university students who participated in high-school athletics, in which statistically significant gender differences were disclosed between young men and women (Peretti-Watel, Beck, & Legleye, 2002), and again, expend those findings to the adult exercisers. We could not compare our findings with studies directly investigating prevalence and level of problematic alcohol use in a group of heterogeneous physically active team and individual exercisers because we could not locate such studies.

Why did we not study a specific target group, such as people in a particular sport with constant exercise practice routines? There are several answers to this question. The first is that at the exploratory level, we need to assess whether the phenomena exists at all. While there were a few reports suggesting that sport participation (Kwan et al., 2014; Lisha & Sussman, 2010) was linked to increased alcohol use problem, these reviews were conducted on research results obtained on adolescents and young adults. Further, direct or indirect studies of alcohol related problems in team and individual sports provide results that are restricted to adolescents and/or young adults (Kuleza et al., 2014; Peretti-Watel et al., 2002; Wichstrøm & Wichstrøm, 2009). While science most often needs to be reductionist to answer specific questions, there are a few exemptions when looking at the global picture might determine if it is worth posing specific questions. Indeed, our results suggest that in a highly heterogeneous sample of exercisers, as based on the very wide ranges of exercise frequency and volume, which were unrelated to the AUDIT scores, we could detect differences in alcohol related problems between team and individual exercisers. Given that the results appear to be restricted to men, and that they could be replicated in the sub-sample of older (than studied to date) adults, we might assume that the results are due to a *general tendency* of males drinking more in regularly attended social settings, relatively independently of sport and exercise behaviour. This plausible hypothesis is not farfetched at all considering a recent comprehensive review showing that men use alcohol in social settings to regulate their uptight emotions (Sayette, 2017). After drinking in a social group, men become more talkative and smile with greater ease, which let the author conclude that alcohol as a social 'reward' of easing-up and feeling good is a driving force behind heavy drinking socializing men. Therefore, stigmatizing sports or physical activity settings, simply because social encounters are regular and enduring over time, might be erroneous. However, it is possible that in some coherent teams the frequency of the social interactions and reasons to celebrate or moan (win or loss outcomes) may generate additional incentives for drinking.

The present exploratory findings show that independent of exercise parameters, in men only, there are greater alcohol use related problems if they exercise in team settings, and that the overall findings are consistent in older adults too. The results raise several new questions, while providing incentive for further research. The first is whether in regularly meeting teams or groups in a non-exercises or sport context similar findings would emerge. If yes, that would reinforce our conjecture and Sayette's theory that problematic alcohol use in social settings by men is a general, rather than an exercise or sport specific phenomenon. The second question then is, how comparable are the results obtained with heterogeneous exercisers, like the ones studied here, with those obtained with a cohesive sports team; any differences would require a look at the history, current frequency, emotional content, and level of interactions as the possible mediators of such differences.

Limitations. The current study is not without limitations. The first is that albeit the sample was randomly selected for the current inquiry, they came from a large dataset obtained from self-selected participants that poses an obvious, universal, and often irresolvable dilemma in most research, especially sensitive research with humans. Another limitation is that for determining prevalence we simply looked at use/no-use of alcohol within the past year in trying to identify drinkers and non-drinkers. Estimation of the units of alcohol could provide a clearer picture even though that may be subject to memory distortion and subjective bias. The sample size could also be criticized. However, this was not meant to be an epidemiological study and the needed sample size was calculated using *a priori*; if these results were statistically significant with a presumably small sample, and on the bases of the low power non-parametric tests, one could only expect more robust findings in research with higher sample sizes. Further, the very heterogeneous nature (no delimitation for exercise volume and type, social background, etc.) of the current sample could be prone to criticism too. However, we were examining a general issue for which the heterogeneity served the purpose. Further studies may wish to address the new questions which emerged from the results of the current work in a specific manner.

CONCLUSIONS

The prevalence of alcohol use in team and individual exercises is similar. Team exercise participation is related to heightened alcohol use problems. Increased alcohol use problems in team exercises may only occur in men. Increased alcohol use problems in team exercises occur in adults as well. In general, men show more significant alcohol use problems than women.

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Ethical clearance. Ethical permission for the study was obtained from the Research Ethics Committee of the Faculty of Education and Psychology at ELTE Eötvös Loránd University.

Conflict of interest. The authors have no conflict of interest to declare.

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EFFECT OF VISUAL AND AUDITORY FEEDBACK EXERCISES ON SHOULDER FUNCTION IN ROTATOR CUFF TENDONITIS PATIENTS

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ABSTRACT

Background. There is a lot of information in literature about rotator cuff strengthening, stretching, and postural correction exercises, which are recommended as a complex for tendonitis rehabilitation (Dong et al., 2015). There is lack of information about visual and auditory feedback exercises for shoulder functions in rotator cuff tendonitis.

Methods. The purpose of the study was to evaluate the effect of visual (VF) and auditory (AF) feedback exercises for shoulder functions in rotator cuff tendonitis patients. Thirty patients of Šiauliai rehabilitation centre were included in this study. Diagnostic tests, shoulder proprioception, posture, muscle strength (Lovett), functional muscle strength (Kendall), quality of life evaluations were performed before and after the study to evaluate the effect of VF and AF exercises.

Results. VF exercise group had a greater increase ($p < .05$) in shoulder flexion abduction, internal and external rotation range of motion, proprioception, muscle strength results, also increased physical functioning, and decreased role-physical and bodily pain in the quality of life evaluation. AF exercise group demonstrated a greater increase ($p < .05$) in shoulder flexion abduction range of motion and muscle strength, bodily pain decreased in the quality of life evaluation.

Conclusions. After comparing the results we concluded that shoulder extension, abduction, internal and external rotation range of motion and proprioception, muscle strength and the quality of life increased ($p < .05$) more in VF exercise group than in AF group. All in all, visual feedback exercises had greater effect onr shoulder functions and the quality of life compared to auditory feedback group. We would recommend including this type of exercises in rotator cuff tendonitis rehabilitation program.

Keywords: auditory feedback, visual feedback, quality of life, rotator cuff tendonitis.

INTRODUCTION

Rotator cuff tendonitis is one of the most common pathologies diagnosed in shoulder region, which causes shoulder pain (Kolk, Yang, Tamminga, & Van Der Hoeven, 2013). According to etiological studies, tears of rotator cuff occur for 25% of people older than 60 years old, and 20% of people older than 20 years old. Almost every person who has shoulder pain sooner or later seeks medical care (Hermans et al., 2013).

Active stabilizers of shoulder consist of rotator cuff muscles which surround humeral head (Dong et al., 2015). Tendonitis of these muscles occurs because of intrinsic and extrinsic factors. Intrinsic factors are degenerative processes in tendons, which cause biomechanical, metabolic, and functional changes. Extrinsic factors are anatomically incorrect forms of acromion, kinematic changes between humerus and scapula bones, incorrect posture, incorrect force couples in shoulder and upper back, tight pectoral muscles, decreased mobility in posterior shoulder capsule (Mackenzie, Herrington, Horlsey, & Cools, 2015).

Optimal proprioceptive information, which is essential for normal movement performance and correction, is about 150 ms (Salles et al., 2015). Visual feedback exercises described in literature about shoulder joint were only performed for posture correction where shoulder was affected indirectly (Weon et al., 2010). This type of treatment had good outcomes evaluating serratus anterior and upper trapezius muscle strength, also the authors described increased scapula – hummers rhythm.

Auditory feedback has the same effect as visual feedback, but in this case the therapist has to tell the patient what he/she needs to correct while performing a movement (Vogt, Pirrò, Kobenz, Höldrich, & Eckel, 2010).

The problem of this study is: while there is a lot of information about rotator cuff strengthening, stretching, and posture correction exercises (Dong et al., 2015), there is lack of information about the effect of visual and auditory feedback exercises for rotator cuff tendonitis and shoulder functions.

The aim of a study was to evaluate the effect of visual and auditory feedback exercises for shoulder functions in rotator cuff tendonitis patients.

We hypothesised that visual feedback exercises would have a greater impact on shoulder functions than auditory feedback exercises because visual feedback makes it possible to correct errors faster.

METHODS

Participants. There were 30 subjects (17 men (mean age 41.47 ± 15) and 13 women (mean age 46 ± 8.5)) in this study, who were patients in Šiauliai Rehabilitation Centre. All participants had rotator cuff tendonitis diagnosed and treated conservatively. Inclusion criteria were: diagnosis confirmed by the doctor, pain lasting more than a month. Subjects were not included into this study if they had surgeries in the painful shoulder in the past or had any systemic diseases. Participants were randomly assigned into two groups: exercises with visual feedback (VF) (8 men, mean age 42.13 ± 10.88 years, and 7 women, mean age 45.86 ± 9.99 years) and exercises with auditory feedback (AF) (9 men, mean age 40.89 ± 18.6 years and 6 women, mean age 46.17 ± 7.33 years). All subjects gave written consent for participation in the study and could get all information about changes in their condition during the study. Permission of Regional Ethics Committee was received on 2017 05 15, No. 17/12.

Examination. All subjects were examined two times: before and after the study. Examination began by performing special diagnostic rotator cuff tendonitis tests: painful arc, Neer's, Hawkins-Kennedy, Rent sign, Bear hug, empty/full can tests. Then posture examination was performed using Hoeger Posture Assessment Scale.

Range of motion and proprioception evaluation. Shoulder range of motion of flexion, extension, abduction, internal, external rotations were assessed using a goniometer (Hislop, Avers, & Brown, 2013). Proprioception was examined immediately after the range of motion measurements, for all subjects blindfold was applied and the joint position sense testing began (Dover, Kaminski, Meister, Powers, & Horodyski, 2003). Joint position sense testing first required the calculation of the target angle based on our range of motion measurements. We calculated the target angle by subtracting 10% of the total range of motion (external rotation + internal rotation or flexion + extension) from the specific range of motion being tested. We used a percentage of the total range of motion so that each subject would experience the same relative target angle. A sample calculation for external and internal rotation target angles is as follows: external rotation range of motion = 100°, internal rotation range of motion = 80°; thus, the total range of motion = external + internal rotation = 180°. To determine the target angle for external rotation, we take 10% of 180° = 18°; therefore, 100° – 18° = 82° will be the target angle for external rotation for this subject. Likewise, for internal rotation, 80° – 18° = 62°; thus, 62° would be the target angle for internal rotation for this subject. Target angles for all four movements were calculated. These target angles were then used for the subject to aim for during the repositioning required for the joint position sense testing. Specifically, we moved the subject's limb to the target angle and held it in place for 3 seconds. The subject was then told to relax and actively return the arm to the neutral starting position. During the internal/external rotation testing, the neutral position was achieved when the forearm was perpendicular to the table (0° of shoulder rotation). During the flexion/extension testing, the neutral position was achieved when the subject's arm was relaxed at her side. Each subject was then instructed to actively return their arm to the target angle and to inform the investigator when they felt they had reproduced the original target angle. The arm was held motionless while the angle measurement was recorded. The repositioning was repeated three times for each of the four movements.

Error scores from the three repositioning trials of each movement were calculated as the difference between the repositioning trial angle and the target angle. The absolute value of this difference was averaged over the three trials and used in the statistical analysis.

Muscle strength evaluation. Manual muscle testing was performed using Lovett scale (Hislop et al., 2013). Also, functional muscle strength testing was performed using Kendall, McCreary, Provance, Rodgers, and Romani's (2005) recommendations. Quality of life evaluation was performed using Short Form 36 (SF-36) questionnaire.

Experiment. The experiment took place in Šiauliai Rehabilitation Centre Physiotherapy Room. The study lasted from 2017 11 09 till 2018 03 19. All subjects were randomly assigned to two groups: the first group (n = 15) performed exercises with visual feedback in front of the mirror, and the second group (n = 15) – using auditory feedback exercises, with the therapist commenting the performance of exercises and telling how to correct mistakes. Exercises were intended to strengthen rotator cuff muscles, to increase shoulder range of motion, better scapular control. All exercises were performed using elastic resistance, free weights, and additional measures, such as balls and sticks. Physiotherapy procedures lasted for 3 weeks, 5 times per week, 30 minutes per procedure. All participants received outpatient treatment, which consisted of physical therapy, physiotherapy and massage procedures which were assigned by a rehabilitologist according to each individual case.

Statistical analysis. Mathematical statistics were performed using SPSS 25 software. When all data were collected, we calculated if all values had normal distribution level. All data were distributed normally. Statistical significance was calculated using T test, statistical significance was considered when $p < .05$. Also we calculated arithmetic averages, standard deviations, percentage expression of results.

RESULTS

After comparing the results we found that in VF group, decrease in special test results was found in painful arc (n = 5), Rent sign (n = 6), Bear hug (n = 6) tests (Table 1).

In AF group, decrease in special test results was found in painful arc (n = 6) and Bear hug (n = 7) tests. Results of posture in both groups showed no changes. Comparison of the range of motion results show (Figure 1) that in both VF and AF groups statistically significant ($p < .05$) increase was found in shoulder flexion, abduction, external and internal rotations. Greater increase was found in VF group: flexion increased by 22.1% (from 104.53 ± 44.88° to 142.6 ± 35.21°), abduction – by 22.58% (from 86.47 ± 40.57° to 120.6 ± 38.24°), external rotation – by 40.39% (from 31.2 ± 25.03° to 52.47 ± 21.4°), and internal rotation – by 45.57% (from 37.93 ± 32.52° to 64.4 ± 21°) more than AF group.

Proprioception results show that shoulder flexion position sense statistically significantly ($p < .05$) increased in VF group. Increase was greater by 28.91% (from 85.6 ± 46.01° to 120.27 ± 3 5.22°) in VF group than in AF group (Figure 2). Position sense of shoulder extension also statistically significantly ($p < .05$) increased in VF group. Increase was greater by 31.6% (from 23.93 ± 13° to 35.73 ± 13.48°) in VF group than in AF group. Position sense of shoulder external rotation statistically significantly ($p < .05$) increased also in VF group. Increase was greater by 44.49% (from 25.4 ± 20.55° to 40.13 ± 17.9°) in VF group than in AF group. Position sense of shoulder internal rotation statistically significantly

Table 1. **Positive outcomes of tendonitis special tests**

Test	VF group		AF group	
	Before	After	Before	After
Painful arc	n = 13	n = 8	n = 14	n = 8
Hawkins-Kennedy	n = 14	n = 11	n = 13	n = 10
Rent sign	n = 14	n = 8	n = 14	n = 13
Bear hug	n = 15	n = 9	n = 15	n = 7
Full can test	n = 14	n = 11	n = 14	n = 11
Empty can test	n = 14	n = 11	n = 14	n = 11

Note. Numbers show how many patients had positive diagnostic test outcome in that group. For example, 8 means that out of 15 patients, 8 had positive test outcome. We evaluated the decrease of these outcomes after the study. The greater the decrease, the better the effect of the therapy.

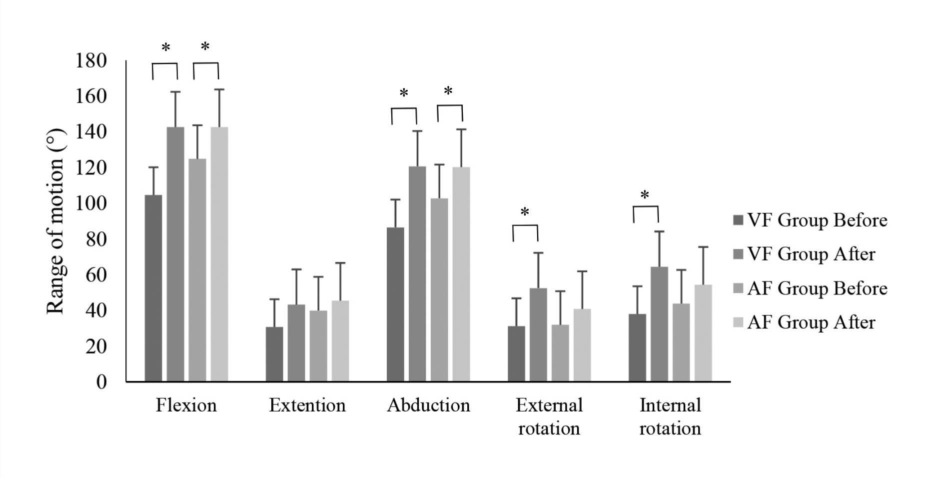


Figure 1. **Difference in shoulder range of motion during the study**

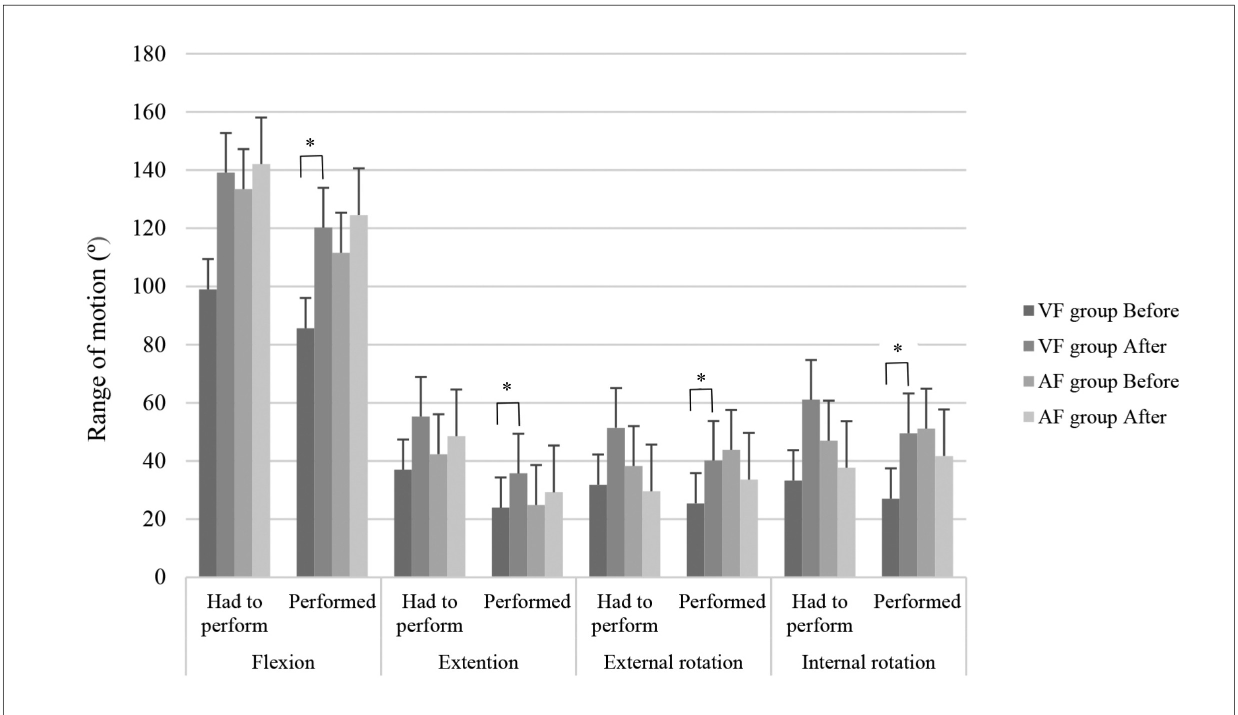
Note. All results in this figure are averages of every group subjects results, *$p < .05$, statistically significant difference between pre-experimental and post-experimental results.

($p < .05$) increased also in VF group. Increase was greater by 73% (from 33.27 ± 31.22° to 61.1 ± 21.3°) in VF group than in AF group.

Results of manual muscle testing show (Figure 3) statistically significant ($p < .05$) increase of muscle strength in shoulder flexion, abduction, as well as external and internal rotation in VF group. In AF, statistically significant ($p < .05$) increase was found in shoulder flexion and abduction movements. Also, comparison of results between groups show that shoulder flexion strength increased by 21.96% (from 3.15 ± 0.35 to 4.2 ± 0.56; $p < .05$) more in VF than AF group, shoulder abduction strength increased by 18.93% (from 3.08 ± 0.26 to 3.93 ± 0.8; $p < .05$) more in VF group, shoulder external rotation strength increased by 45.9% (from 2.31 ± 1.26 to 3.6 ± 0.74; $p < .05$) more in VF group and internal rotation strength increased by 60.9% (from 2.23 ± 1.25 to 3.87 ± 0.52; $p < .05$) more in VF group than in AF group.

Functional muscle strength testing results (Table 2) show that in VF group muscle strength increased statistically significantly ($p < .05$) in middle trapezius by 17.8%, deltoid – 15.6%, seratus

Figure 2. **Shoulder position sense in different movements**



Note. The diagram shows the results of the required movement and the actual movement the subjects did. The lesser error – better proprioception, *$p < .05$, difference between pre-experimental and post-experimental results.

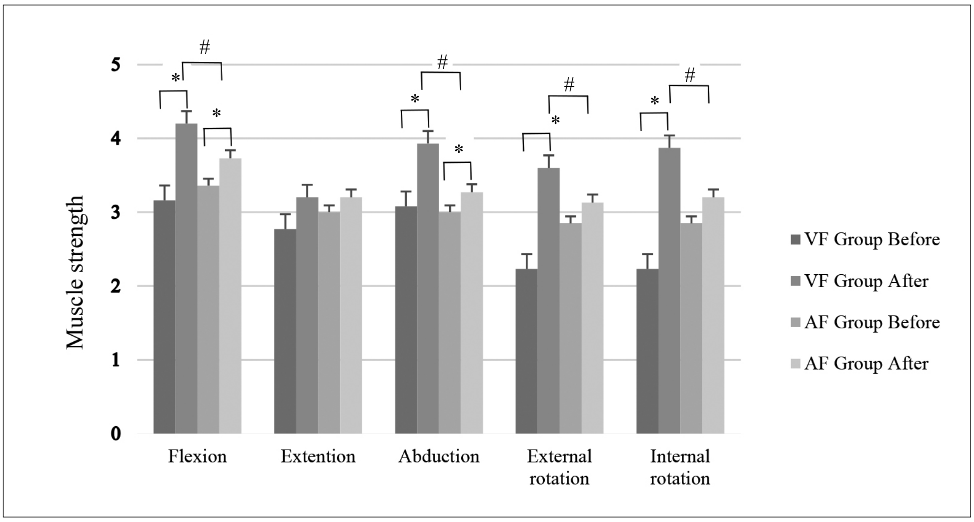


Figure 3. **Shoulder manual muscle strength testing results, measured in Lovett scale**

Note. All values are averages of every group subjects. Results are measured on 1–5 Lovett scale. *$p < .05$, difference between pre-experimental and post-experimental results; #$p < .05$, difference between VF and AF group results.

Table 2. **Results of functional muscle strength evaluation before and after the study**

Functional muscle strength	Before		After	
	VF group	AF group	VF group	AF group
Upper trapezius muscle	3 ± 0.6	2.8 ± 0.4	3.3 ± 0.7	3.1 ± 0.6
Middle trapezius muscle	3 ± 0.7	2.8 ± 0.5	3.5 ± 0.6*	3.2 ± 0.4*
Lower trapezius muscle	2,9 ± 0.5	2.8 ± 0.4	3 ± 0.5	2.9 ± 0.4
Deltoid muscle	3 ± 0.53	2.8 ± 0.4	3.5 ± 0.6*	3.1 ± 0.3*
Pectoralis major muscle (clavicular part)	2.6 ± 0.5	2.7 ± 0.6	2.7 ± 0.5	2.8 ± 0.3
Pectoralis major muscle (sternal part)	2.7 ± 0.4	2.7 ± 0.4	2.8 ± 0.4	2.9 ± 0.2
Serratus anterior muscle	2.7 ± 0.6	2.7 ± 0.4	3.1 ± 0.4*	3
Rhomboid muscle	2.5 ± 0.5	2.4 ± 0.5	2.7 ± 0.4	2.7 ± 0.4
Levator scapulae muscle	2.6 ± 0.5	2.6 ± 0.5	2.8 ± 0.4	2.8 ± 0.4
Latisimus dorsi muscle	2.9 ± 0.5	2.8 ± 0.4	3.4 ± 0.6*	3.1 ± 0.2*

Note. *$p < .05$, statistically significant difference between pre-experimental and post-experimental results. All figures in table are averages of all group subject results.

Table 3. **Quality of life evaluation in each SF-36 questionnaire subscale**

SF-36 subscales	Before		After	
	VF group	AF group	VF group	AF group
Physical functioning	56.3 ± 26.2	67.3 ± 24.9	79.3 ± 23.4*; #	68.3 ± 22.5
Role functioning/physical	23.3 ± 34.7	16.6 ± 22.5	43.3 ± 42.7*	20 ± 27.1
Bodily pain	62.2 ± 23.3	63.7 ± 18.5	39.2 ± 25.1*; #	48.1 ± 14.9*
General health	62.7 ± 10.5	51.7 ± 8	61.6 ± 20.6	55.7 ± 13.1
Vitality	53 ± 10.1	43.6 ± 9.5	55.6 ± 11.7	46 ± 9.5
Social functioning	45.9 ± 19.2	48.1 ± 13.1	54.1 ± 11	51.1 ± 15.6
Role functioning/emotional	46.7 ± 51.6	31.1 ± 36.7	71.1 ± 37.5	57.8 ± 42.7
Mental health	54.9 ± 8.5	53.9 ± 8	45.6 ± 22.5 #	58.4 ± 8

Note. *$p < .05$, statistically significant difference between pre-experimental and post-experimental results. All figures in table are averages of all group subject results. #$p < .05$, difference between VF and AF group results.

anterior – 15% and latisimus dorsi muscles – 20.93%. In AF group, statistically significant ($p < .05$) muscle strength increase was found in middle trapezius – 11.63%, deltoid – 11.6%, and latisimus dorsi muscles – 9.52%.

Quality of life changes were found in both groups (Table 3). Bodily pain section of statistically significantly ($p < .05$) decreased in both VF and AF groups. Also physical functioning increased, role functioning/physical decreased, and these changes also were statistically significant ($p < .05$) between groups. Also statistically significant ($p < .05$) difference was found in the mental health section of the questionnaire.

DISCUSSION

We found that exercises with visual feedback had a greater impact on shoulder functions: range of motion, proprioception, muscle strength, quality of life than exercises with auditory feedback in rotator cuff tendonitis patients. These exercises with visual feedback helped to increase more external and internal rotation range of motion and proprioception than in flexion and extension movements. The greatest difference was found in internal rotation movement, proprioception, and the external rotation movement.

Wilk, Hooks, and Macrina (2013) carried out a study about posterior shoulder capsule stretching to improve range of motion. Stretching was performed while scapula was stabilized, and stretching movement was internal and external rotation. Results after the study show that after stretching exercises, both rotation range of motion and mobility of posterior capsule statistically significantly increased.

Positive effect of visual feedback therapy is well known in treating phantomic pain using mirror, also in stroke patients (Thieme, Mehrholz, Pohl, Bahrens, & Dohle, 2013). In our study pain decreased and shoulder function was better in VF exercise group. This happened because subjects could control themselves when they saw what they did in the mirror. This improved shoulder proprioception and helped to achieve better shoulder function. In their study, Foell, Bekrater, Bodmann, Diers, and Flor (2014) found that mirror therapy helped to reduce pain by 27% for participants. Our study results also show decrease of pain in the quality of life questionnaire in both auditory and visual feedback exercise groups.

Nodehi-Moghadam, Nasrin, Kharazmi, and Eskandari (2013) evaluated shoulder muscle strength, range of motion proprioception changes for athletes who performed throwing movements in their sport. Proprioception was measured with a goniometer when subjects had to perform movements and the difference was recorded. After the study, the results show that throwing movement performing athletes demonstrated statistically significantly greater external rotation movement. However, evaluating isometric muscle strength, they found that internal rotation force was greater than external rotation. Proprioception was better in the dominant hand. Our study results partly coincide because proprioception greater improved in VF group, but internal rotation movement proprioception was better than external rotation movement.

Boorman et al. (2014) evaluated the quality of life and prognosis after rotator cuff tear treated conservatively. All participants completed three month rehabilitation programme and after that were examined by an orthopaedic surgeon. Treatment was considered successful if both patient and surgeon agreed that surgery was no longer necessary because the quality of life and function increased. After that the study results showed that 75% of participants no longer needed surgery because the quality of life and shoulder function increased. Littlewood, Malliaris, Mawson, May, and Walters (2014) used SF-36 questionnaire to assess the quality of life. In this study participants were taught home exercises for rotator cuff tendonitis. After the study the authors concluded that all questionnaire subscale results increased, but better results were in the experimental group where exercises were performed at home. The greatest increase was found in role functioning/physical, bodily pain and role functioning/emotional subscales. Comparing with our results, we also found a great increase in role functioning/physical and bodily pain subscales. Also statistically significant difference was found in physical functioning subscale.

Roddy et al. (2014) described posture exercises to reduce pain for rotator cuff tendonitis patients. Our study found that posture after the study did not change, but scapulae stabilization and rotator cuff exercises had a positive effect on diagnostic tests outcome results: three test outcome results statistically significantly decreased in both groups. This could have happened because after exercises scapular control increased, rotator cuff muscle coordination and pressure in sub-acromial space decreased.

CONCLUSIONS

After comparing the results we concluded that shoulder extension, abduction, internal and external rotation range of motion and proprioception, muscle strength and the quality of life increased ($p < .05$) more in VF exercise group than in AF group.

All in all, visual feedback exercises had a greater effect on shoulder functions and the quality of life compared to auditory feedback group. We would recommend including this type of exercises in rotator cuff tendonitis rehabilitation programme.

As there were no additional studies performed on this topic, we would recommend repeating this study with greater numbers of subjects and increasing the duration of the experiment to get more accurate results.

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RELATIONSHIP BETWEEN THE QUALITY OF LIFE AND PHYSICAL ACTIVITY IN PATIENTS WITH DEPRESSION DISORDER

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ABSTRACT

Background. Positive effect of physical activity on mental health has been proven by scientific research, whereas the quality of life scale is an important instrument for the assessment of the overall functioning of people with mental disorders. The aim of the study was to determine the relationship between the quality of life and physical activity in patients with depressive disorder.

Methods. The survey involved randomly selected subjects (n = 38) with depression aged 20–75. The subjects were assessed using quality of life SF-36 and physical activity questionnaires.

Results. The survey results showed that patients with mental disorders evaluated their physical health much better than mental health ($p < .01$). General health perception and social functioning improve with increasing energy and vitality. Subjects who were more physically active at home rated their general physical activity better in quality of life questionnaire.

Conclusions. Higher physical activity at work has a positive influence on vitality and general health perception.

Keywords: quality of life, physical activity, mental health.

INTRODUCTION

Paradigms in the assessment of human health have been changing for decades. Human health is currently defined as a state of complete physical, mental and social well-being, rather than the mere absence of disease or illness (WHO, 2015). Nowadays patients' evaluation of their health condition is becoming more and more important and depends not only on clinician's report of the illness (Bullinger & Quitmann, 2014). One of the elements of this perspective of health is quality of life. During last decades improving the quality of life (QoL) has been increasingly acknowledged as an important health index of individuals, social groups and even the entire society; and has garnered greater attention in both clinical practice and research (Reklaitiene, Karpaviciute, & Pozeriene, 2010; Revicki, Kleinman, & Cella, 2014).

Health as QoL component has become an important physical and social factor that was included into Human Development Index (Chaaban, Irani, & Khoury, 2016; Crafts, 1997; Niels, 2004). However, there has been a shift in mental health service policy from an emphasis on treatment focused on reducing symptoms, based on a narrow notion of pathology and illness, to a more holistic approach which takes into consideration well-being, recovery, social functioning, and QoL (Hogan, 2003). A policy that more people attending mental health services will recover and have a good quality of life necessitates that appropriate outcome measures are in place (Connell, O'Cathain, & Brazier, 2014).

Studies that evaluate QoL in persons with mental disorders are rather recent (Katschnig, 2006; Revicki et al., 2014). QoL has become the main instrument of measuring the success of treatment of mental disorders. Patients with serious mental disorders have a much lower QoL compared to the general population (Xiang, Chiu, & Ungvari, 2010). QoL is presented as direct outcome of mental illness, i.e. better QoL can improve the level of mental functions (Jakovljević, 2006).

Recently intensive research into the influence of physical activity on mental health has been conducted, however positive influence of physical activity on physical health was found long time ago (Goodwin, 2003; Harvey, Hotopf, Overland, & Mykletun, 2010; Wiles, Haase, Gallacher, Lawlor, & Lewis, 2007). Systemic analyses of subjects and interventions have revealed a relationship between physical activity and depression: physical activity reduces the possibility to experience symptoms of depression or even to suffer from depression (Brown, Ford, Burton, Marshall, & Dobson, 2005; Herring, O'Connor, & Dishman, 2010; Saxena, Van Ommeren, Tang, & Armstrong, 2005). Unfortunately, many depressed and anxious individuals either receive inadequate treatment or none whatsoever, and the capacity for treatment falls short of the need. Substantial mental health gains may be achieved by improving a habit of regular exercise, and the potentials of exercise may be integrated with cognitive-behavioural theory in daily practice (Martisen, 2008). It should be noted that a few researchers have investigated the hypothesis of reciprocal relationship between physical activity and symptoms of depression and anxiety, i.e. that symptoms of depression and anxiety can influence physical activity (Roshanaei Moghaddam, Katon, & Russo, 2009).

Mason and Holt (2012) presented the main findings from their review of studies that explored the experiences of physical activity among mental health service users: an opportunity for social interaction and social support; a sense of meaning, purpose, and achievement; feeling safe; improved symptoms; and identity. Similar findings were obtained by Crone and Guy (2008), who pointed out the health gains from exercise, such as getting control over one's life, having facilities for social life, and improving well-being. The evaluation of experiences among forensic mental health patients participating in an exercise program illustrated the importance of exercise: managing anxiety and stress; providing meaning and structure to the day; forming new relationships; learning new skills; and creating partnerships in care (Wynaden, Barr, Omari, & Fulton, 2012). Thus, **the aim of our study** was to determine the relationship between the QoL and physical activity in patients with mental health disorders. The hypothesis of the study was as follows: the quality of life of patients with depression disorder directly depends on physical activity: higher physical activity leads to better quality of life.

METHODS

Participants. In order to be eligible to participate in this study several inclusion criteria were applied: (1) having mental health disorders, as defined for this study, is a condition that causes a person difficulty in performing activities in important areas of life, where the difficulties are a consequence of mental disorder; (2) able to complete the questionnaire i.e. no substantial learning disability or dementia and no severe disability such as blindness or extreme frailty precluding the ability to answer independently.

Participants were recruited from Kėdainiai Mental Health Centre and expressed interest in the study. We selected 54 participants who were diagnosed with depressive disorder and 38 randomly were selected and agreed to participate in the study after familiarization with the research protocol. All participants (n = 38) were interviewed by the health researcher with a background in medical sciences. The age of the participants ranged from 20 to 75, (mean = 54.1 ± 18.3); 68.4% (n = 26) of the subjects were females, 31.6% (n = 12) were males. The majority of participants, i.e. 55.3% (n = 21) were single (unmarried, divorced, widowed). A bigger part of the subjects, i.e. 52.6% (n = 20) were unemployed. Most of them were city dwellers – 81.6% (n = 31).

Data collection. The QoL of patients with depression disorder was investigated by using a Short Form Health Survey (SF-36). The survey is a brief and easily administered measure of health-related QoL and consists of 36 multiple-choice items assessing 8 domains: physical functioning, role limitations due to physical and emotional problems, social functioning, mental health (emotional well-being), vitality/energy; bodily pain, and general health. Scores for each domain range from 0 to 100. Higher scores represent better health perceptions. Summary of physical health component (physical functioning, role limitations due to physical problems, bodily pain and general health perception) and mental component (vitality, social functioning, role limitations due to emotional problems and mental health) were computed too. The survey SF-36 was adapted to Lithuanian population and reliability and validity study has been conducted (Rugienė, Dadonienė,

& Venalis, 2005). In this study, the Cronbach's alpha coefficient for SF-36 was .78 (good). Also Cronbach's alpha coefficient was calculated for the eight subscales (from .67 to .94).

Physical activity was assessed by modified Baecke habitual physical activity questionnaire (BHPAQ) (Baecke, Burema, & Frıters, 1982). This questionnaire is a self-administered questionnaire that was used to objectively assess habitual physical activity of individuals. The questionnaire examines: (1) *Work activities* (physical activity level based on occupation, frequency of sitting, standing, walking, lifting, sweating, etc. at work); (2) *Sports activity* (activity level based on frequency of sweating while engaging in sport, leisure time sporting activity, duration of sporting activity, etc.); (3) *Leisure activity* (activity level based on duration of watching television, walking, cycling, etc. during leisure activities). All items result in a separate score that incorporates activity duration, frequency, and an intensity code based on energy costs. Summing the household score, sport score, and leisure time activity score results in a continuous overall produces the activity score. The questionnaire was administered as a face to face interview by an experienced research assistant.

Kaunas regional biomedical research ethics committee (BE-2-18) approved the study. Participants were informed orally and in writing about the aim of the study, that participation was voluntary and confidential. Informed consent was obtained from all participants. All participants were adults and capable to give written consent, but also written informed consent from next of kin of the patients was obtained.

Statistical analysis. Data analyses were performed using SPSS 16.0 (Statistical Package for Social Sciences for Windows). Baseline characteristics were expressed as real numbers (per cent) and mean ± *SD*. Data of QoL domains were compared using dependent *t*-test. The associations between QoL domains and physical activity were tested by Spearmen's correlation. Statistical significance was assessed at the levels of $p < .05$.

RESULTS

Physical activity at home is rather high among the subjects with depression: 76.9% of the subjects most often or always do light housework, such as dusting, dishwashing and the like. Only slightly fewer respondents (71.8%) most often or always do difficult housework, such as cleaning the floor or window cleaning, taking away garbage and the like; 35.9% of the subjects cook hot meals more than 5 times a week, and only 5.1% of the subjects never cook hot meals at home. The same percentage of subjects never or less than once a week go shopping; 46.2% of the subjects go shopping by car. Even one-fifth of the subjects (20.5%) never climb the stairs.

Daily physical activities assessment results show that quite a big part of the subjects – 69.2% – climb stairs instead of taking a lift in order to exercise and even 84.6% of the subjects walk short distances instead of going by bus or in a car. However, fewer respondents park their cars further from the destination point and walk the remaining distance or go for a walk during lunch break after dinner or get off the bus earlier in order to walk the remaining distance.

The survey results revealed low *regular physical activity* among the subjects. Brisk walking or running at least 2 km a week was slightly more popular among the respondents with mental disorders (38.5%); cycling being in the second place. Even 23.1% of respondents indicated that during the last 3 months they cycled at least 20 km per week. Less than 10% of the respondents were engaged in other physical activities (sports games, such as table tennis, tennis, basketball, football, swimming).

The subjects involved in the survey evaluated the quality of life below average (44.6 ± 15.7). The analysis of health related section of quality of life questionnaire revealed that mentally ill respondents gave the highest scores in physical activity domain (68.2 ± 29.6), and the lowest scores in social functioning domain (35.1 ± 24.8) ($p < .001$). Presumably, mental disorders of respondents have a negative effect on their emotional conditions, vitality, social functioning in the society and, therefore, low QoL. The respondents rated their mental health significantly lower, i.e. there was a statistically significant difference between physical and mental health component averages ($p < .001$).

Males with depression rated QoL in health related domains slightly better than females (Table 1). The biggest differences between males and females are seen in the following QoL domains: emotional health (47.33 ± 19.4 and 40.8 ± 19.3), vitality (44.6 ± 23.6 and 33.2 ± 20.9), physical activity (77.1 ± 25.8 and 64.2 ± 30.7), although these differences are statistically insignificant.

The analysis of the influence of family status on QoL in patients with mental disorders showed that

Table 1. **Scores of SF-36 questionnaire components in terms of sex and family status**

Mean score			Sex				Family status					
	Mean score		Male		Female		Single		Divorced		Married	
***SF-36 questionnaire components*:**	***mean***	*SD*	***mean***	*SD*	***mean***	*SD*	***mean***	*SD*	***mean***	*SD*	***mean***	*SD*
General mental health component	**31.60**	*12.51*	**35.1**	*15.3*	**30.1**	*11.0*	**24.4***	*8.1*	**37.4**	*16.9*	**32.9***	*11.7*
General physical health component	**41.31**	*10.53*	**44.6**	*39.8*	**39.8**	*11.3*	**44.2**	*6.3*	**39.4**	*6.1*	**41**	*14.2*
Emotional health	**42.83**	*19.31*	**47.33**	*19.4*	**40.8**	*19.3*	**34.9**	*19.5*	**43.5**	*18.9*	**46.1**	*20.2*
Role limitations due to emotional problems	**35.34**	*35.04*	**38.9**	*34.3*	**33.8**	*35.8*	**18.2***	*27.3*	**45.9***	*39.6*	**41.9***	*36.3*
Social functioning	**35.05***	*24.84*	**35.4**	*28.1*	**34.9**	*23.8*	**22.7***	*19.2*	**34.4**	*17.4*	**42.9***	*29.5*
Vitality and energy	**36.69**	*22.10*	**44.6**	*23.6*	**33.2**	*20.9*	**30.5**	*24.2*	**37.5**	*18.7*	**41**	*23.1*
General health perception	**44.41**	*17.61*	**48.8**	*21.1*	**42.4**	*20.9*	**42.6**	*20.4*	**48.4**	*20.1*	**43.9**	*17.0*
Bodily pain	**47.92**	*28.42*	**51.8**	*32.9*	**46.2**	*26.6*	**46.4**	*27.9*	**27.8***	*13.7*	**59.6***	*31.2*
Role limitations due to physical problems	**46.11**	*33.73*	**45.8**	*35.1*	**46.4**	*33.8*	**43.2**	*35.5*	**50**	*35.3*	**44.1**	*36.0*
Physical functioning	**68.19***	*29.61*	**77.1**	*25.8*	**64.2**	*30.8*	70.5	*30.8*	**64.3**	*21.1*	**72.6**	*31.6*

Note. *statistically significant difference of indicators, $p < .05$.

subjects who lived not alone (with the family) gave significantly higher scores in social functioning scale (42.9 ± 29.5) and general health perception scale (32.9 ± 11.8) compared to the scores of those living alone: social functioning (22.7 ± 19.2) and general mental health (24.4 ± 8.1) ($p < .05$) (Table 1). The survey revealed that single patients with mental disorders experienced many more role limitations due to emotional health (18.2 ± 27.3) than married (41.9 ± 36.3) or divorced (45.9 ± 39.6) patients ($p < .05$). Divorced respondents with mental disorders experienced more pain (27.7 ± 13.7) than married subjects (59.60 ± 31.2) ($p < .05$).

The analysis of the survey data showed the existing relationship of QoL domains (components) (Table 2). Strong statistically significant relations were established between the following QoL domains: vitality and general health perception ($r = .750$, $p < .01$) and social functioning ($r = .709$, $p < .01$).

Average statistically significant relations: better general mental health perception was influenced by better emotional health ($r = .679$, $p < .01$), fewer role restrictions due to emotional health ($r = .655$, $p < .01$), better social functioning ($r = .697$, $p < .01$), higher vitality ($r = .598$, $p < .01$). Physical activity has a positive effect on the general physical health component ($r = .617$, $p < .01$), better emotional health has a positive effect on social functioning ($r = .633$, $p < .01$), vitality ($r = .691$, $p < .01$) and general health perception ($r = .564$, $p < .01$).

The analysis of QoL and physical activity relations showed statistically significant relationship between physical activity at work and health perception "now". The less time the respondents spend at work sitting, the better they perceive their general health ($r = .421$, $p < .01$). Although the respondents indicated high physical activity at home and at work, statistically significant correlations were observed only

Table 2. **Relationship between the quality of life domains**

Spearmen's correlation coefficient	GMHC	GPHC	EK	RLEH	SF	V	GHP	P	RLPH
GPHC	–0.236								
EH	0.679**	0.055							
RLEH	0.655**	–0.116	0.375*						
SF	0.697**	–0.013	0.633**	0.331*					
V	0.598**	–0.148	0.691**	0.252	0.709**				
GHP	0.435**	–0.141	0.564**	0.194	0.435**	0.750**			
P	0.062	0.310	0.311	–0.073	0.355*	0.336*	0.258		
RLPH	0.172	0.306	0.320*	0.482**	0.160	0.074	0.066	0.010	
PA	–0.159	0.617**	0.245	0.031	0.131	0.167	0.145	0.237	0.069

Notes. GMHC – General mental health component; GPHC – General physical health component; EH – Emotional health; RLEH–Role limitations due to emotional health; SF – Social functioning; V – Vitality; GHP – general health perception; P – pain; RLPH – Role limitations due to physical health; PA – physical activity. $^{**}p < .01$; $^{*}p < .05$.

Table 3. **Relationship between QOL domains and physical activity**

Spearmen's correlation coefficient	Physical activity (QoL)	Vitality	Pain	General health perception
Physical activity at home	0.332*	0.227*	0.400*	0.249
Daily physical activity	0.112	0.254	0.077	0.249
Physical activity at work	0.160	0.443**	0.144	0.424**

Notes. $^{**}p < .01$; $^{*}p < .05$.

between physical activity at home (doing simple housework) and general physical activity in quality of life questionnaire. The higher physical activity at home, the higher was the rating of general physical activity in quality of life questionnaire ($r = .332$, $p < .05$) (Table 3). Higher physical activity has a positive effect on vitality of the subjects ($r = .443$, $p < .01$) and general health perception ($r = .424$, $p < .01$).

DISCUSSION

QoL can be related to many factors and circumstances: occupation, education, income and financial status, family life, social functioning, stress, health, quality of leisure time, self-perception, meeting individual needs and other (Katschnig, 2006; Reklaitiene et al., 2010). Several researchers pointed out that QoL in patients with mental disorders also depended on the severity of the disease, the main symptoms and the intensity of their expression (Fleury, Grenier, & Bamvita, 2015). The research showed that males with mental disorders rated QoL in health related domains slightly better than females. Previous studies, however (Lahelma, Martikainen, Rahkonen, & Silventoinen, 1999; Loge & Kaasa, 1998) reported that males had rated QoL lower than females.

In summary of QoL data in terms of family status the study showed that patients with mental disorders who were married and lived in a family gave higher scores in almost all scales of QoL questionnaire compared to other subjects. Presumably, family status has a significant influence on QoL and this presumption corresponds to the findings reported by other researchers (Revicki et al., 2014; Szende & Nemeth, 2003; Vaez, Ekberg, & Laflamme, 2004). Our study revealed that physical activity of patients with mental disorders was rather high. The respondents were sufficiently physically active at work too; however few of them were engaged in regular physical activity. Although the majority of the subjects indicated that they climbed stairs instead of taking the lift and walked short distances, only a small part respondents parked the car further from the destination point and walked the remaining distance, went for a walk or exercised (played sports games, run, swim) in their free time. Similar results were obtained in other studies that assessed sport and recreational physical activity (Crone & Gui, 2008). In the quality of life questionnaire the subjects gave the highest scores to the physical activity component. Having analysed these results we may presume that patients with mental disorders identify general physical activity with physical activity at home (doing the housework). Presumably, subjects with mental disorders have insufficient information about the possibilities of recreational physical activity and its importance. The analysis of physical activity at work data shows that patients with mental disorders more often have physically difficult and low-paid jobs.

Our results complement those of prior studies of physical activity and health related quality of life. In the Women's Health Australia study, average scores for perceived general health, mental health, and vitality (measured with the Medical Outcomes Study Short Form-36 instrument) increased with increasing physical activity for women in each of three birth cohorts (18–23 years; 50–55 years; 70–75 years) (Brown, Mishra, Lee, & Bauman, 2000). In a randomized controlled trial of 215 older adults, patients randomized to receive home-based resistance exercise (three times per week for 35 minutes) experienced 15 to 18% lower physical and overall disability at six-month follow-up (Jette et al., 1999).

The survey data analysis leads to the presumption that physical activity at home and at work has a positive effect on vitality, which in turn improves emotional health, social functioning and general mental health component. The subjects who experience fewer role limitations due to physical health also experience fewer role limitations due to emotional health. The results of the study show that having better emotional health, social functioning, and vitality, patients with mental disorders perceive their general health better. Similar observations were given by other researchers too. Data of the latest epidemiologic studies show that physical activity may reduce the risk of depression or alleviate depression symptoms. Meta-analysis of population study revealed a positive effect of physical activity both on healthy people and people with health problems (Harvey et al., 2010).

In summary of QoL survey of patients with mental disorders we may state that QoL depends in part on physical activity. However, the survey also showed that the subjects subjectively believed they were physically active, although their physical activity was most often related only with physical activity at home or at work. Such belief reveals social exclusion of such persons. Regular physical activity should be recommended as a composite part of social rehabilitation programme for patients with mental disorders.

CONCLUSIONS

The survey data show that quality of life of patients with depression is average. Males with mental disorders evaluated their QoL slightly higher than females with mental disorders in all scales of quality of life questionnaire. Persons living with families rated their social functioning and general mental health much better than persons living alone. Patients with mental disorders who receive higher monthly income rated QoL better in physical activity. General health perception and vitality domains compared to persons with lower monthly income.

Strong statistically significant relationships between QoL domains show that general health perception and social functioning improve with higher vitality.

QoL of patients with depression partially depends on physical activity at home, activities of daily living and activities at work. Any kind of physical activity is an important part of personal behaviour that improves the quality of life.

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EFFECTS OF DIFFERENT HALF-TIME RE-WARM UP ON VERTICAL JUMP DURING SIMULATED BASKETBALL GAME

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ABSTRACT

Background. This study investigated the acute effects of different half–time re–warm ups on vertical jump height during simulated basketball games.

Methods. Ten college level males (age (mean ± standard deviation (*SD*)), 22.0 ± 5.0 years; weight, 86.0 ± 5.5 kg; height, 193 ± 1 cm.) were divided into two teams, who played three simulated basketball games with three different type half-time re-warm ups: aerobic; aerobic + post-activation potentiation exercises and aerobic + post-activation potentiation + stabilization exercises. Counter-movement jump was measured before and during the simulated basketball game at seven time points: before and after warm up, after the 1st, the 2nd quarters, after re-warm up and after the 3rd and the 4th quarters. Simulated basketball games were separated at least by 72 hours.

Results. The non-significant decrease in Counter-movement jump height during simulated basketball games was observed after executing all three different types of half-time re-warm ups. However, Counter-movement jump significantly ($p < .05$) decreased during simulated basketball game only in aerobic type half-time re-warm up game.

Conclusion. During simulated basketball game, the least decrease in Counter-movement jump height was observed after aerobic type re-warm up with post-activation potentiation exercises performed at half-time.

Keywords: basketball, half-time re-warm up, power, post activation potentiation.

INTRODUCTION

Basketball is intermittent team sport, where energy is being received from different energy systems (Jeffreys & Moody, 2016). Nowadays basketball is regarded as a physically dominant sport, where physical abilities play a huge role in the overall performance (Schelling & Torres-Ronda, 2013). High-intensity movements in basketball are directly related to the development of power and agility in movement skills (Castagna et al., 2007; Meckel, Casorla, & Eliakim, 2009). The ability to move quickly and jump as high as possible shows the players' capacity and other technical skills that are important in basketball, i.e. a quick breakthrough, quick advances from defense to attack, sharp jumps, fight for the ball and defense. There is a huge variety of movements, most of which are not only performed repeatedly, but at high intensity as well (Elo & Svilar, 2016). Strength and conditioning coaches, sport scientists are looking for a way to optimize the performances of basketball players during the game and for each half separately. Therefore, it is necessary to determine, which warm up would prove to be the most effective in terms of movement effectiveness and overall performance. Some authors recommend using alactic type exercises when performing a warm up, i.e. applying muscle post activation potentiation (PAP), others – alactic anaerobic / anaerobic lactic, i.e. between lactate and lactate accumulation threshold. Two warm ups were carried out during the simulated basketball game – the main warm up that is done before the game and half-time re-warm up. It is equally important to find the optimal warm up not only during the program, but also during the half-time re-warm up.

Warm up not only helps to reduce the risk of injuries but allows players to perform movements more effectively from the very beginning (Edholm, Krustrup & Randers, 2015). It can be caused by a big variety of biomechanical, physiological and biochemical processes, such as increased flexibility of musculotendinous unit, elevated blood flow to the muscles, increased metabolism, increased conduction of nerve impulse (Bishop, 2003). Even though two warm ups are being performed in the whole basketball game, there is very limited research carried out about half-time re-warm up and its effect on the second half. Taking as an example, football is more advanced in this matter. Mohr, Krustrup, and Bangsbo (2005) carried out a study and found that football players tended to play slower during the second half. The same authors have found that there is increased risk of injuries during the second half, compared to the first half. That being the case, dynamical re-warm up was more effective in terms of power outputs than passive re-warm up during the second half of football match (Edhol at al., 2015).

METHODS

Subjects. Ten college level males (mean ± *SD*; age, 22.0 ± 5.0 years; weight, 86.0 ± 5.5 kg; height, 193 ± 1 cm, training experience, 8.0 ± 2.9 years). Participants were free of injuries in the 6 months before the starting of the study. The experiment was performed during the preseason period, during which players trained 1–2 h per day and 5–6 days per week. Players did not undertake intensive exercise in the 48 h before each testing session. All players were notified about the aim of the study, research procedures, requirements and benefits.

Procedure. Each team had 5 players and every simulated game was played 5 on 5 – every player played 40 minutes. Simulated games were played following official basketball rules and each team had a basketball coach. The games were played at maximum effort, athletes were motivated verbally in order to make the simulated game more reliable and similar to the official match. Counter-movement jump was measured before the warm up, after the warm up, after the first quarter, after the second quarter, after the re-warm up and after the third and fourth quarters. After the first half of the game, tactical simulation was conducted and for 5–8 minutes, athletes listened to the coaches' tactical advice and rested passively. For the rest 7–10 minutes of the half-time, the players executed different types of re-warm up.

Simulated basketball game. The participants were then divided into two teams by the coach. The criteria for a team assignment were the basketball performance level and playing position. The two teams played a simulated game that consisted of four 10-minute quarters with a 15-minute break at half time and 8-minute breaks after the first and the third quarters. The players usually had a 2- minute break to rest after the first and the third quarters, but the subjects in the present study rested for 2 minutes during those breaks and then performed tests for 6 minutes. The game involved official umpires and took place on an indoor basketball court. Player substitutions were not allowed, and the players stayed in the game even when they had five fouls. This protocol of simulated basketball game was established previously (Pliauga et al., 2015).

Counter-movement jump (CMJ) with arm swing. This test was previously used in basketball to assess vertical jump performance (Boccolini, Brazzit, Bonfanti, & Alberti, 2013; Nikolaidis, Calleja–González, & Padulo, 2014). Participants performed vertical jump on a contact mat (Powertimer Testing System, New Test, Oulu, Finland) starting from an upright standing position with preliminary downward movement to a knee angle of approximately 90° with an arm swing. Three trials were performed with 20 s of rest between each trial. The best result was used for analysis. If the third trial result was the best, one additional trial was carried out (Pliauga et al., 2015). The height of the jumps was calculated by applying the following equation: H = 1.226 x Tf2 (m), where Tf = flight time (s) (Bosco, Viitasalo, Komi, & Luhtanen, 1982). The best result was used for further analysis. The ICC for this test was established previously (0.95; (Kamandulis et al., 2013).

Post activation potentiation (PAP). In order to cause post activation potentiation, participants performed accelerations (4 sets, duration of a repetition 4–7 s) and 5 jumps (60–70–80–90–95 percent). The jumps were performed according to a subjective feeling.

Table. **Different half-time re-warm ups schemes**

Characteristics	Aerobic	Aerobic + PAP	Aerobic + PAP + stabilization
Content	• Tactical instructions (7min); • Jogging; dribbling; shooting the ball (8 min) ((heart rate 130 – 140 bpm)	• Jogging; dribbling; shooting the ball; • Sprints; shuffles; 5 vertical jumps (60, 70, 80, 90, 95% of maximum effort).	• Jogging; dribbling; shooting the ball; • Sprints; shuffles; 5 vertical jumps (60, 70, 80, 90, 95% of maximum effort); Stabilization exercises: leg flexion/extension; supine bridge with leg raise.
Exercises typology	Continuous	Intermittent	Intermittent
Intensity	Low	Submax, max	Submax, max

Heart rate (HR) monitoring and recording. During the half-time re-warm up HR was constantly registered by pulse measuring instrument with memory Polar Team System 2 that registered HR values every five seconds.

Half-time re-warm up. The participants made three different half-time re-warm up: aerobic; aerobic + PAP exercises; aerobic + PAP exercises + stabilization exercises. All characteristics of the half-time re-warm ups were described and carried out in the indicated sequences (Table 1).

Mathematical statistics. The arithmetic mean, standard deviation and percentage change were calculated. The application of the Student's *t* test revealed a statistically significant difference. The level of alpha statistical significance was set at $p < .05$. The calculations were performed using Microsoft ® Excel program.

RESULTS

The height of counter-movement jumps before and after different half-time re-warm up is presented in Figure 1. There was a decrease in counter-movement jump after executing all three different type half-time re-warm up, thus, only aerobic type half-time re-warm up showed to decrease counter-movement jump significantly ($p < .05$). Nevertheless, vertical jump height decreased after performing aerobic type re-warm up with PAP and aerobic type half-time re-warm up with PAP and stabilization exercises, however in both types of aforementioned re-warm up no significant decreases were found ($p > .05$).

The height of counter-movement jumps before and after all simulated game quarters are presented in Figure 2. Results were measured before warm

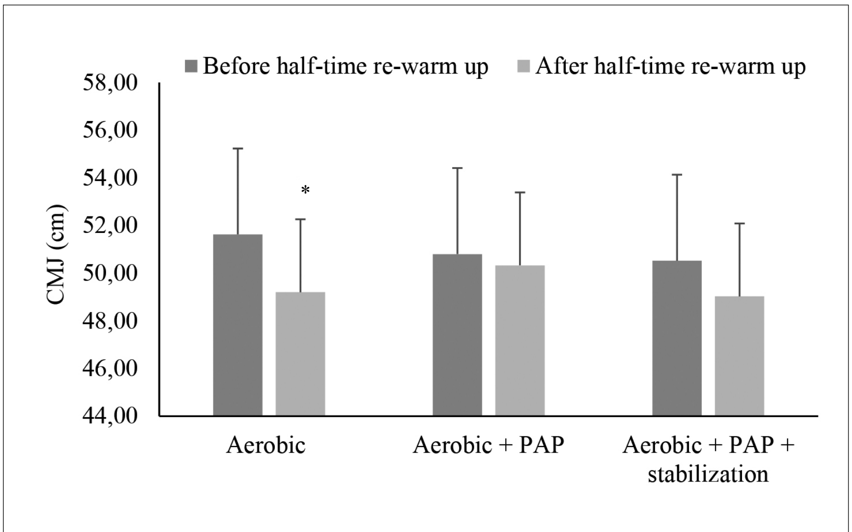
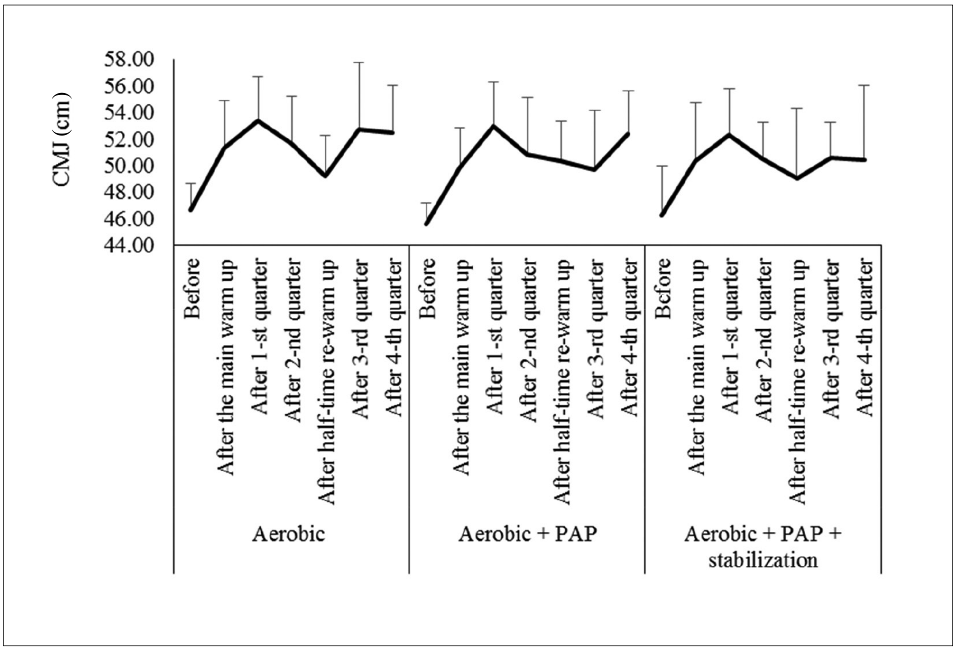


Figure 1. **Mean values of counter-movement jump before and after different half-time re-warm up (average ± *SD*)**

Note. * – significantly different between results before and after re-warp up.

Figure 2. **Mean values of vertical jump height during the simulated basketbll games after different half-time re-wam up (average ± *SD*)**



up, after warm up, after the 1st quarter, after the 2nd quarter, after three different types of half-time re-warm up, after the 3rd quarter and after the 4th quarter. Vertical jump height decreased the least after performing an aerobic type re-warm up with PAP.

DISCUSSION

This study investigated the acute effects of different half-time re-warm up on counter-movement jump during simulated basketball games. It was concluded that half-time re-warm up with aerobic and PAP exercises was the most effective because counter-movement jump performance was impaired the least comparing with other two re-warm up regimens.

There is limited research on power indicators after re-warm up in basketball. The topic of re-warm up has been emphasized significantly in football and scientists have shown a clear advantage of this strategy. Based on scientific literature, distance covered in the second half by football players decreases and the speed of running in the first 15 minutes of the second half is significantly slower compared with the first 15 minutes in the first half (Weston et al., 2011). The findings of our study showed similar results as indicated by Weston because independent of applied re-warm up regimens in every case there was reduction in athlete's power indicators after the second half compared with the beginning of the first half. Previous research also supports the idea of higher intensities being produced by the athletes in the first 5 minutes of the first half compared with the first 5 minutes of the second half (Mohr, Krustrup, & Bangsbo, 2003). The mechanisms underlying power reduction in the second half are not yet fully understood. However, scientists have drawn attention to a couple of hypothesis about tactical aspects of the game: fatigue, length of the half breaks, temperature (Mugglestone, Morris, Saunders, & Sunderland, 2013; Zois, Bishop, Fairweather, Ball, & Aughey, 2013). It is a common case that athletes perform warm up before every game, but it is less common for athletes to re-warm up during half time. Having that in mind, researchers noticed 2°C reduction of muscle temperature at the beginning of the second half in football (Mohr, Krustrup, Nybo, Nielsen, & Bangsbo, 2004). Other authors add that adequate rise of muscle temperature promotes potentiation of the nervous system (Gray, De Vito, Nimmo, Farina, & Ferguson, 2006) which indicates athlete's ability to perform high intensity movements faster and more efficiently (Mohr et al., 2004). The same researchers concluded that reduced muscle temperature in the lower extremities have strong correlation with reduction of maximal sprinting speed, unless muscle temperature during half time break is maintained, in that case athletes maximal sprinting speed remains unchanged. Furthermore, it is important to outline that, during the half-time break using low to moderate intensity re-warm up football players maintain the indicators of counter-movement jump and maximal sprint speed during the second half (Edholm et al., 2015).

Our study revealed that reduction of power before and after re-warm up fluctuated between 0.93–4.8% depending on re-warm up type. These results are familiar with othrer authors' work – Edholm et al. (2015) showed a reduction in counter-movement jump height by 7.6 and 3.1% after passive and low intensity re-warm up respectively. In our study, the indicators after aerobic re-warm up were lower compared with Edholm's results (4.8%), however it is important to emphasize that these two studies should not be compared equally because re-warm up in Edholm's research was conducted for the whole half break, contrary with our study, where the first 8 minutes of the half time break were used for simulated head coach's tactical suggestions, therefore re-warm up time was shorter.

Reffering to Lovell, Kirke, Siegler, McNaughton, and Greig (2007), power decreased by 6.2% after repeated 7-minute re-warm up with 70% of maximum heart rate. The previously mentioned study performed a similar re-warm up compared to our aerobic with PAP re-warm up, however we can only compare these studies theoretically.

Basketball players showed the best power results after aerobic with PAP re-warm up. There is a lot of research of PAP advantage and the authors agree that post-activation potentiation is a phenomenon which could increase muscle power (Wilson et al., 2013). Chiu and colleagues (2003) showed an increase in vertical jump height with arm swing and vertical jump height without arm swing after executing jumps of a platform results by 1–3% in experienced athletes while doing 5 sets of 1 repetition of squats with 90% 1RM (1 repetition maximum). Power indicators were the highest right after performing warm up and lowest after the 3rd quarter. Aerobic with PAP re-warm up can influence the results because of additional energy demand. The most effective way to use PAP phenomenon is to find balance between fatigue and potentiation (Tillin & Bishop, 2009). This balance depends on many factors, such as players training experience (Kilduff et al., 2007), recovery breaks between exercises (Kilduff et al., 2008), intensity and type of exercise (Sale, 2002).

Stabilization is defined as the ability to maintain body balance when the movement changes from dynamic to static (Wikstrom, Tillman, Smith, & Borsa, 2005). Dynamic stabilization helps athletes to maintain stable body position in specific movements (Bressel, Yonker, Kras, & Heath, 2007; Kovacs et al., 2008). Stabilization impact on jumping with one leg was investigated only in one study which concluded that dynamic stabilization and jumping with one leg had significant correlation (Lockie, Schultz, Luczo, Callaghan, & Jeffriess, 2013). Not enough studies have researched the impact of stabilization exercises on vertical jump height.

CONCLUSIONS

During simulated basketball game the least decrease in counter-movement jump height was observed after aerobic type re-warm up with post-activation potentiation exercises performed at half time. Also, it has to be mentioned that aerobic type re-warm up has maintained greater counter-movement results after the 3rd and the 4th quarters. Thus, it is recommended that aerobic type re-warm up and basketball-specific exercises should be performed at half time in order to achieve PAP and an increase in muscle temperature. Nevertheless, more research has to be carried out to gain better understanding of the effect of different re-warm up.

Conflict of interests. The authors declare no conflict of interests regarding the publication of this manuscript.

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EFFECT OF PILATES METHOD ON 6–10-YEAR-OLD DANCESPORT DANCERS' PHYSIOLOGICAL RESPONSES

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ABSTRACT

Background. Dancesport dancers were investigated aiming at improving their physical qualities, posture, balance, flexibility and endurance. Undoubtedly, the Pilates method is one of the best ways for exercising one's core muscles and flexibility. However, there is a lack of data in the academic literature concerning the influence of Pilates exercises on dancers' fitness levels depending on different age groups and ranking. Based on this, the aim of our study was to evaluate the 16-week Pilates exercise effects on 6–10-year-old Dancesport dancers' physiological responses.

Methods. The static deep trunk muscle endurance was tested with pressure measuring device "Stabilizer", flexibility was assessed using "Sit and Reach" test, static balance – "Flamingo" test and dynamic balance – "Star" excursion test. Research participants were Dancesport dancers ($n = 38$) who had been practising Pilates (13 girls and 7 boys) and attending a usual dance program (11 girls and 7 boys).

Results. After 16 weeks, dancers who had been practicing Pilates method significantly improved static and dynamic deep trunk muscle endurance in all positions, static and dynamic balance and flexibility. The dancers that practiced a usual dance program significantly improved static deep muscle endurance only in the prone position, dynamic in the supine position, but their dynamic balance, static balance and flexibility did not change significantly.

Conclusion. Better improvement in 6–10-year-old Dancesport dancers of deep trunk muscle endurance, balance and flexibility was found after 16 weeks of Pilates exercises compared to dancers who practised a usual dance program.

Keywords: Pilates method, Dancesport dancers, deep muscular endurance, balance, flexibility.

INTRODUCTION

There are long lasting debates in modern scientific discourse whether dance should be regarded a sport or an art. Homer considered dance a pleasure, Socrates construed dances as a form of healthy physical exercises, Shamans used to heal applying dances. Aborigines had dance rituals to cause rain; Irokese solved conflicts with the help of dance. Today dance is a unique combination of both: art and sport which cannot be treated equally.

Today sport is not only a pleasure or excitement, sports are means of developing self-identity or "real identity". It can be achieved with the help of yoga, Tai chi, other techniques of relaxation, body fitness and other activities creating happiness through disciplining the body (Grupe, 1994). In this context, dance undoubtedly corresponds to the definition of sport as a part of cultural life.

Dancesport is an aesthetic sport where the body shape of the dancer is related to the choreography and the competition results depend on the beauty of the performance (Liiv, 2014). Dancesport dancers perform synchronous, dynamic movements of different intensity within the couple. Core stabilization, balance, muscle strength, flexibility and endurance are the key factors for a good dance performance (Watson et al., 2017). There are studies which have demonstrated that extended core stabilization training program will improve specific measures of dance performance (Watson et al., 2017). Therefore, strengthening and stretching exercises should be incorporated into dance technique classes in order to achieve the main goal (Ahearn, 2006). Previous studies proved that Pilates was an effective tool for improving posture, body flexibility and increasing muscular strength and balance (Ahearn, 2006; Di Lorenzo, 2011; Zaičenkovienė, 2016).

Endurance of trunk muscles and lumbar core stability are necessary for maintaining spinal stability (Javadian, Akbari, Talebi, Taghipour-Darzi, & Janmohammadi, 2015). That is particularly important in Dancesport as a strong stabilizer of spine muscles which improves body balance and deep muscular endurance. However, there is lack of data in scientific literature about the effects of Pilates exercises on Dancesport dancers' physiological responses, prevention of injuries and sport results (Bernardo & Nagle, 2006).

The number of dancers suffering from low back pain, scoliosis, spondydolosis, etc. is constantly increasing (Fraser, 2017). For that reason, it is important and useful to learn how different correctly performed exercises can affect dancers' physical condition and help to achieve the desired results. Pilates exercises help people to feel the joy of life without pain, to develop harmony of body, mind and spirit (Mętel, Milert, & Szczygieł, 2012).

Numerous published studies have demonstrated the increased balance instability, spinal curvatures, muscle misbalances, and low back injuries in dancers (Koutedakis & Jamurtas, 2004; Kruusamäe et al., 2015; Watson et al., 2017). This study aim was to establish whether Pilates exercises have an impact on static and dynamic balance, flexibility and the change of static and dynamic deep muscle endurance.

METHODS

Participants. The study was conducted in Kaunas, the Dancesport club "Dance 4 Fun". The subjects were 38 dancers randomly assigned to the experimental group (EG) and the control group (CG). The EG included 20 young dancers (13 girls and 7 boys, age: 8.6 ± 1.3 years old, experience of dance training: 2.1 ± 0.7 years) and the CG – 18 dancers (11 girls and 7 boys; age: 8.1 ± 1.5 years old, experience of dance training: 2.2 ± 0.8 years). Duration of the study was 16 weeks. EG subjects had two sessions per week which lasted 30 min. They had supervised Pilates sessions on a mat and 60 min usual dance practice; CG subjects had two sessions per week: 60 min usual dance practice. A week before the study experimental and control groups passed static and dynamic deep trunk muscle endurance tests, static and dynamic balance tests and flexibility test (pre- testing). The same tests were applied after the study (post-testing).

Mathematical statistical analysis. The arithmetic mean (x) and the average standard deviation (*SD*) were determined for comparison. Differences between different groups were estimated using one-factor dispersion analysis (ANOVA). The following reliability levels were used for statistical calculations: $p > .05$ – insignificant; $p < .05$ – significant. All calculations were performed using *MS Excel* program.

Static and dynamic deep trunk muscle endurance tests were performed with the help of a stabilizer which allowed detecting and monitoring trunk muscle endurance. The data were measured in seconds. Static deep trunk muscle endurance test results in prone position were measured when the pressure cell was placed under the abdomen, in supine position the pressure cell was placed under the lumbar spine and inflated to the baseline of 70 mmHg. The subjects were asked to breathe normally, to draw abdominal wall up without moving pelvis and spine, and he pressure had to decrease by 6–10 mmHg. Dynamic deep trunk muscle endurance test results in prone and supine positions were measured the same as static but with lifting the hip of the supporting surface. The pressure had to remain constant.

Flamingo static balance test. The subjects were asked to stand on the wooden beam (50 cm long, 4 cm high, 3 cm wide) on the tested leg and bend the free leg at the knee, and the foot of this leg was held close to the buttocks with both hands on the iliac crests, standing like a Flamingo. The subjects were instructed to maintain this position as long as they could. Stopwatch was used to note each time the person lost balance either by falling off the beam or letting the foot being held go of or hands removed of the body. The number of falls was counted in 1 minute of balancing. The test was terminated if a person reached the ground with the free leg more than 15 times during the first 30 seconds.

The star excursion dynamic balance test was performed in posteromedial, posterolateral and anteromedial directions. Three sticky tapes, each one 150 cm long, were stuck on to the floor intersecting in the middle, and with the lines placed at 45° angles. While performing the test, the subjects were asked to keep their hand on the pelvis, to stand on one leg on the intersection of the lines and to move the indicator along the line with the toes of another leg. The test was performed barefoot. Each subject was allowed 3 trials in each direction and on each leg. A trial was classified as invalid if the participant did not return to the starting position, stepped on the top of the reach indicator for support, failed to keep balance on one leg and the reaching foot failed to remain at the indicator. The best result was recorded.

Sit and reach flexibility test was performed with a 35 cm length, 45 cm width and 32 cm height box. The lid of the box was 55 cm length and 45 cm width, 15 cm outgoing the side plane for subject's foot support. In the middle of the upper plane, there was a measurement scale from 0 to 50 cm. The subjects sat on the floor with the legs stretched out in front of them with the knees straight and the feet flat against the front end of the test box. Then they lent forward at the hips, keeping their knees straight and slid their hands up the ruler. The test was repeated twice and the best result was recorded.

RESULTS

Static deep trunk muscle endurance results in a prone position. Comparing pre-post test results of the experimental group, the difference was statistically significant ($p < .001$). Pre-test result of static deep trunk muscle endurance in a prone position was 0.44 ± 0.71 s, whereas post-test result of static deep trunk muscle endurance increased to 15.48 ± 0.63 s. The change of indicators of the control group was found to be statistically significant ($p = .002$). Pre-test result was 9.83 ± 0.77 s, post-test result reached 12.74 ± 0.53 s. Significant changes were found comparing static deep trunk muscle endurance result in a prone position of both groups: EG and CG (Figure 1).

Static deep trunk muscle endurance results in a supine position. Comparing pre-post test results of the experimental group, the difference was statistically significant ($p = .0012$). Pre-test result of static deep trunk muscle endurance in a supine position was 16.81 ± 1.37 s, while post-test result of static deep trunk muscle endurance increased to 23.25 ± 1.44 s, the difference was statistically significant ($p = .0012$).

The change of indicators of the control group was found to be statistically insignificant ($p = .36$). Pre-test result was 16.86 ± 1.32 s, post-test result reached 17.56 ± 4.25 s. Comparing the results of static deep trunk muscle endurance in a supine position of both groups (CG and EG), it appeared that the results of EG were statistically significant higher than those of CG (Figure 2).

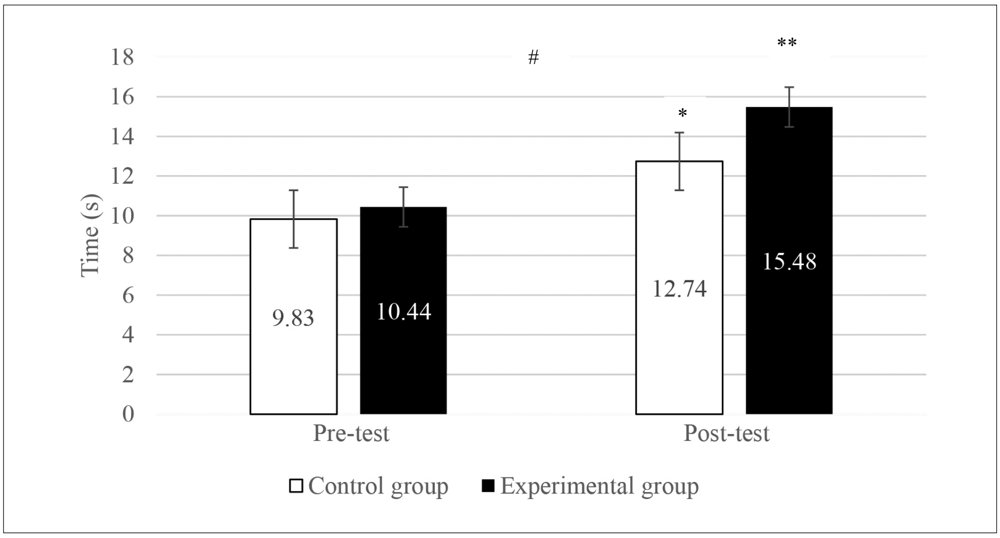
Dynamic deep trunk muscle endurance results in a prone position. The results of the experimental group in a prone position changed statistically significant ($p < .001$). Pre-test result of the experimental group was 8.79 ± 1.20 s, post-test result increased to 13.17 ± 1.46 s Pre-test result of the control group was 8.68 ± 0.87 s, post – 9.83 ± 0.77 s and did not change significantly ($p = .146$). Comparing the results of dynamic deep trunk muscle endurance in a prone position of both groups (CG and EG), it appeared that the results of EG were statistically significantly higher than those of CG (Figure 3).

Dynamic deep trunk muscle endurance results in a supine position. Pre-test result of the experimental group was 9.38 ± 0.50 s, post-test result increased to 14.61 ± 0.68 s. The change of experimental group in a supine position was statistically significant ($p < .001$). Pre-test result of the control group was 8.81 ± 0.65 s, post-test result increased to 10.04 ± 0.70 s The change of the control group in a supine position was statistically significant ($p = .01$). Significant changes were found comparing dynamic deep trunk muscle endurance results in supine position of both groups: EG and CG (Figure 4).

Static balance results (Flamingo test). Comparing pre-post test results of the experimental group, the difference was statistically significant ($p < .001$). Before the study, the average number of falls in EG reached 18.55 ± 2.52 times per min., whereas after the study, the average number of falls decreased to 13.05 ± 2.18 times per min. The change of indicators of the control group was found to be statistically insignificant ($p = .131$). Before the study, the average number of falls of CG reached 15.35 ± 1.87 times per min., after the study, the average number of falls decreased to 14.94 ± 1.65 times per min. No significant changes were found comparing the results of static balance of both groups (CG and EG), it appeared that more statistically significant results were in EG than in CG (Figure 5).

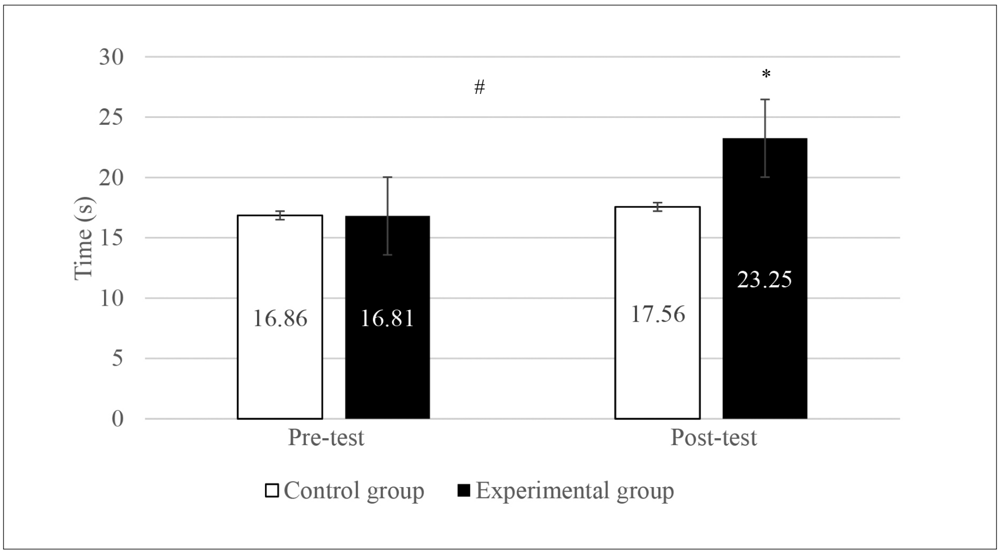
Dynamic balance results (the star excursion balance test). Left anterior reach results. Comparing pre-post test results of the experimental group, the difference were statistically significant

Figure 1. **Static deep trunk muscle test results of experimental and control groups in a prone position**



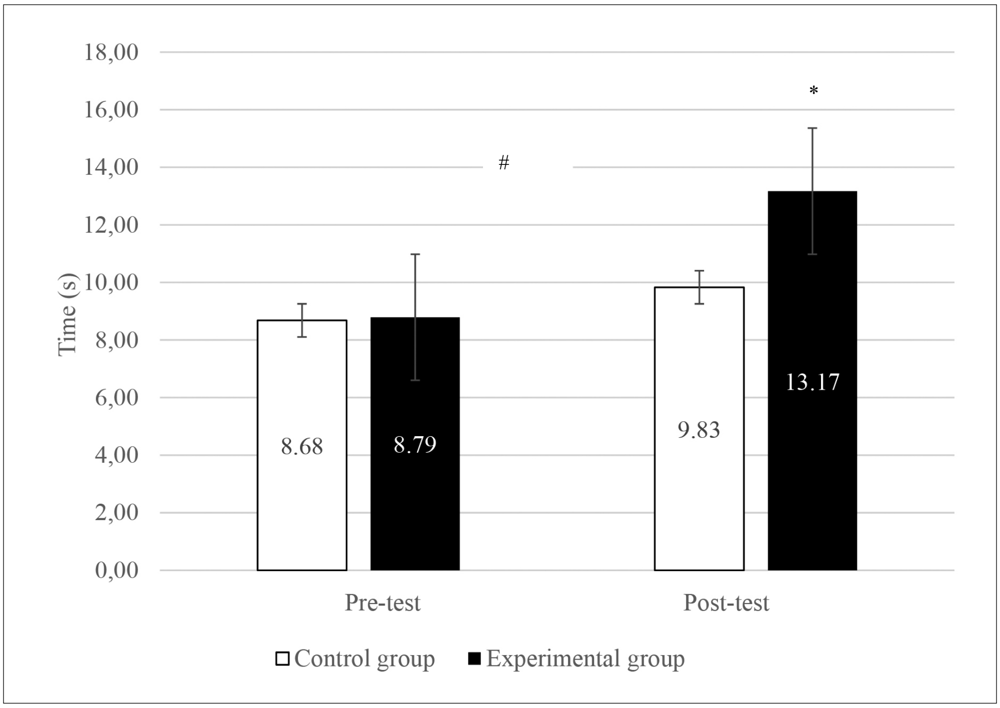
Notes. *$p < .05$ comparing pre-post test results of CG; **$p < .05$ comparing pre-post test results of EG; #$p < .05$ comparing post test results of both groups.

Figure 2. **Static deep trunk muscle test results of experimental and control groups in a supine position**



Notes.*$p < .05$ comparing pre-post test results of EG; #$p < .05$ comparing post test results of both groups.

Figure 3. **Dynamic deep trunk muscle test results in a prone position of experimental and control groups**



Notes. *$p < .05$ comparing pre-post test results of EG; #$p < .05$ comparing post test results of both groups.

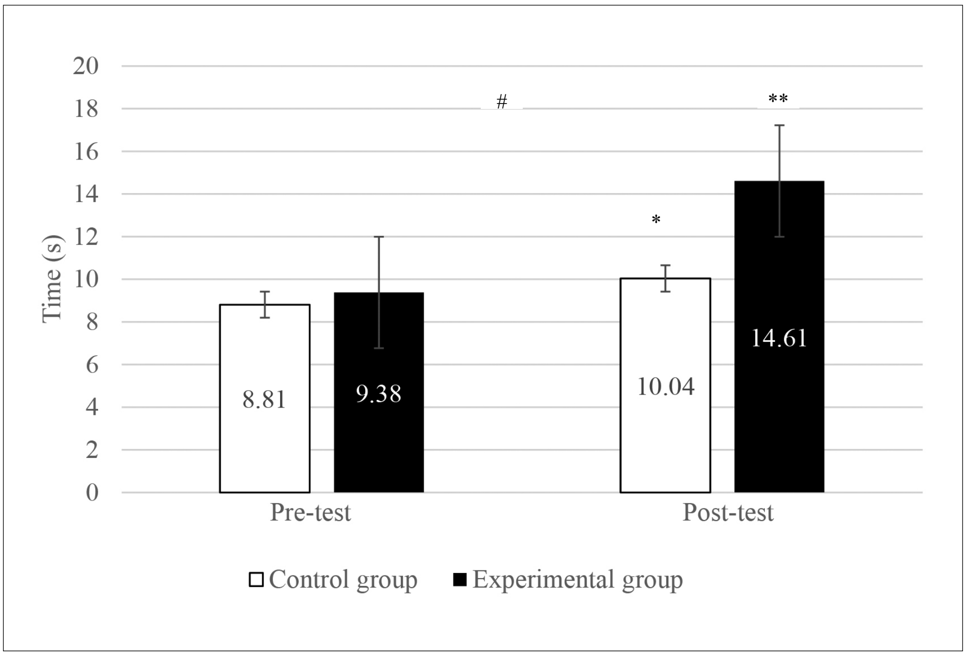


Figure 4. **Dynamic deep trunk muscle test results of experimental and control groups in a supine position**

Notes. *p < .05 comparing pre-post test results of CG; **p < .05 comparing pre-post test results of EG; #p < .05 comparing post test results of both groups.

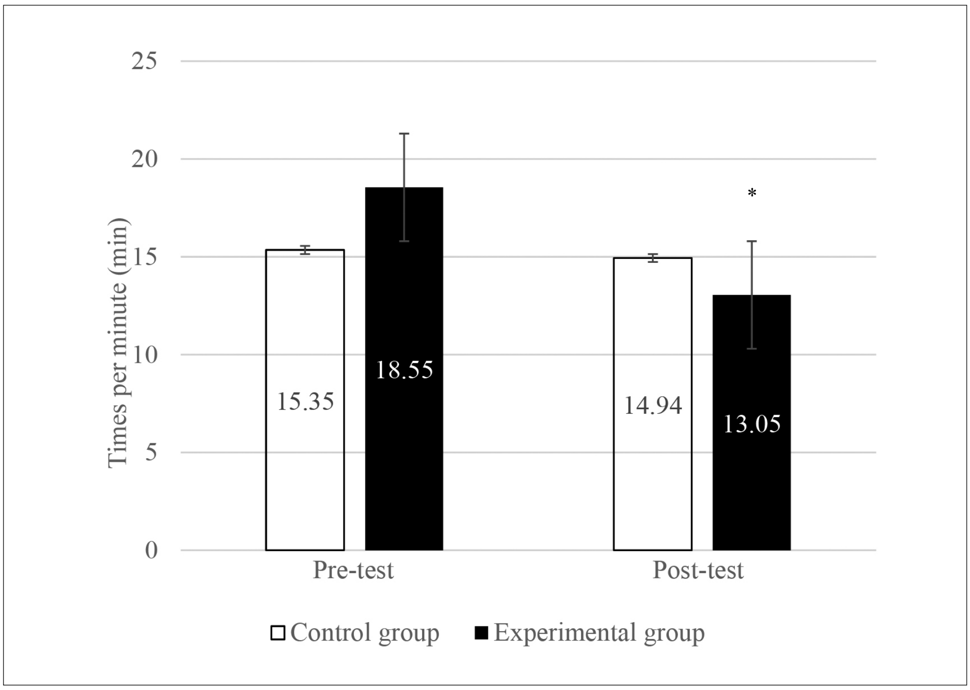


Figure 5. **Static balance (Flamingo test) results of experimental and control groups**

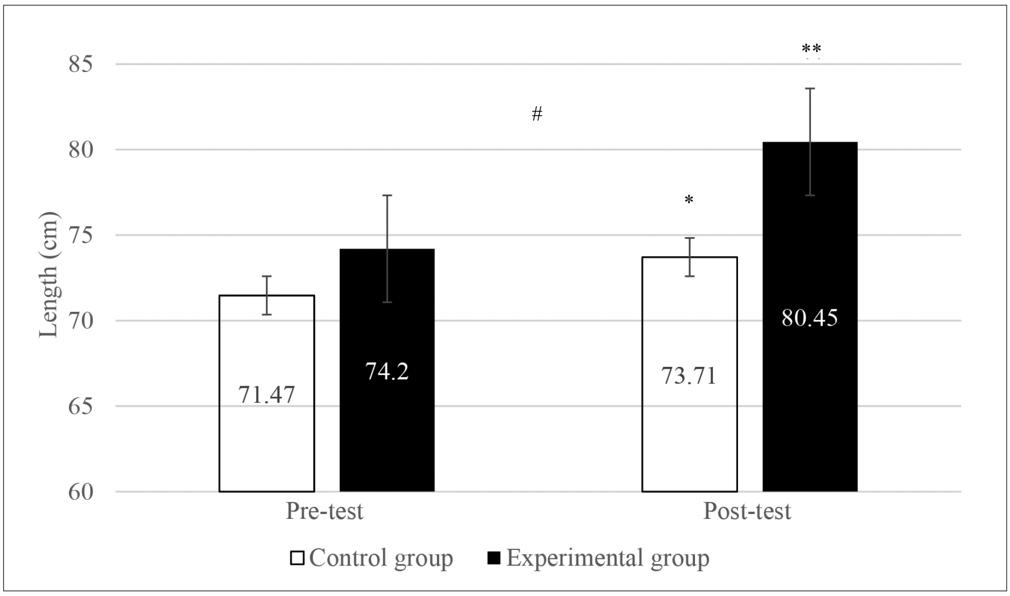
Note. *p < .05 comparing pre-post test results of EG.

(p < .001). Pre-test result of EG reached 74.20 ± 2.67 cm, whereas post-test result increased to 80.45 ± 2.46 cm. Comparing pre-post test results of the control group, the difference was statistically significant (p < .001). Pre-test result of CG reached 71.47 ± 2.33 cm, whereas post-test result increased to 73.71 ± 2.33 cm. Significant changes were found comparing dynamic balance (left anterior reach) results of both groups, EG and CG (Figure 6).

Right anterior reach results. Comparing pre-post test results of the experimental group, the difference appeared to be statistically significant (p < .001). Pre-test result of EG reached 75.60 ± 2.53 cm, whereas post-test result increased to 81.90 ± 2.61 cm. Comparing pre-post test results of the control group, the difference was statistically significant (p < .001). Pre-test result of CG reached 75.11 ± 2.65 cm, whereas post-test result increased to 77.17 ± 2.65 cm. There was no significant change comparing dynamic balance (right anterior reach) results of both groups: EG and CG (Figure 7).

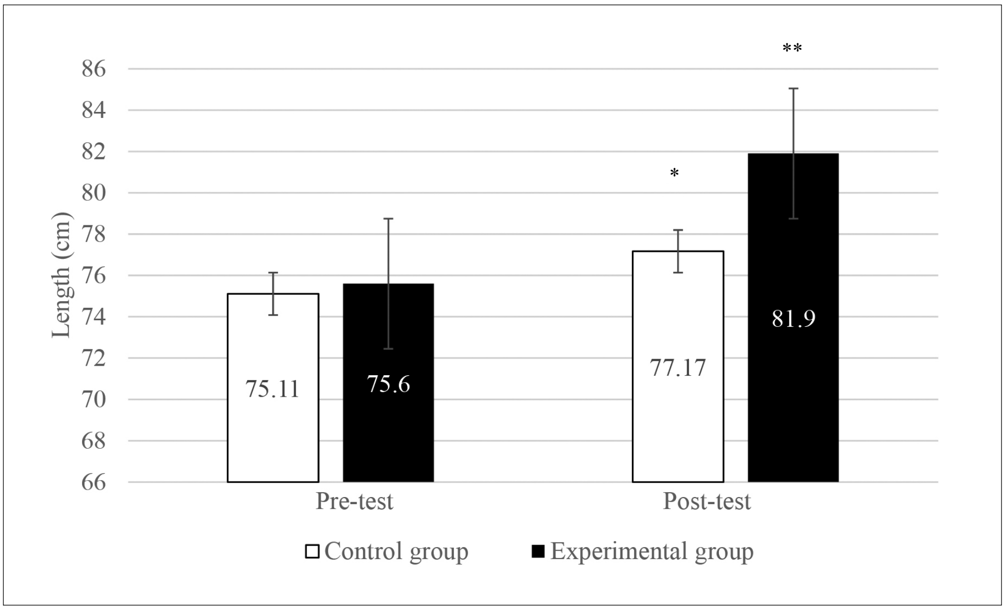
Right posterolateral and right posteromedial reach results. Pre-test right posterolateral reach result of EG reached 80.40 ± 2.95 cm, post-test

Figure 6. **Dynamic balance left anterior reach results of experimental and control groups**



Notes. *$p < .05$ comparing pre-post test results of CG; **$p < .05$ comparing pre-ost test results of EG; #$p < .05$ comparing post test results of both groups.

Figure 7. **Dynamic balance right anterior reach results of experimental and control groups**



Notes. *$p < .05$ comparing pre-post test results of CG; **$p < .05$ comparing pre-post test results of EG.

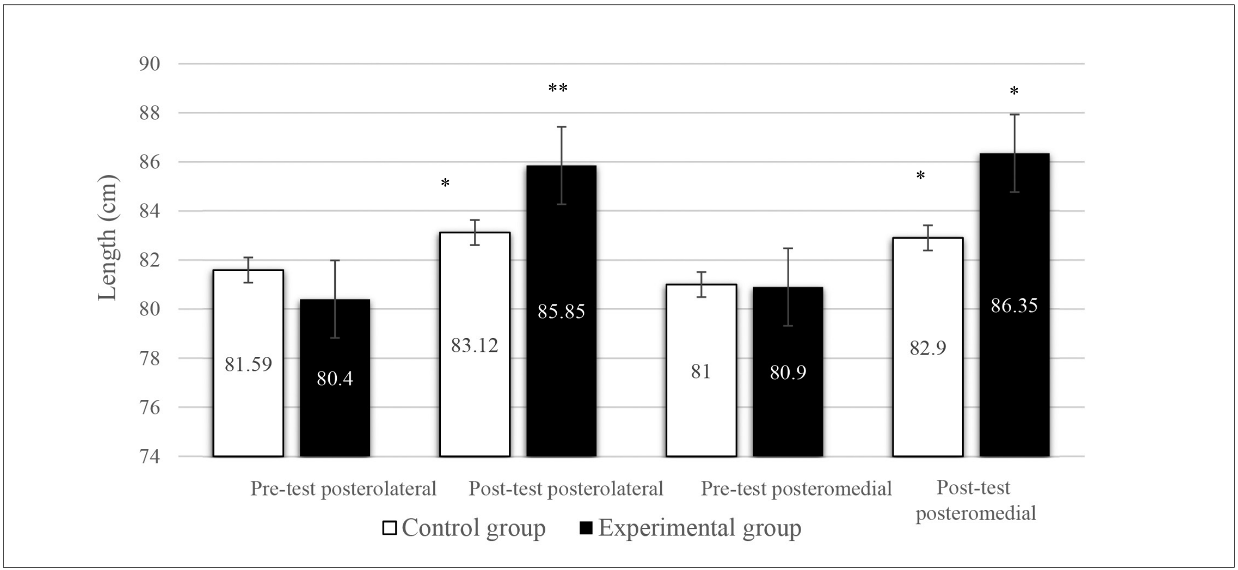
result increased to 85.85 ± 3.05 cm. Pre-test right posteromedial reach result of EG reached 80.90 ± 2.70 cm, post-test result increased to 86.35 ± 2.74 cm. The change of indicators of the experimental group was found to be statistically significant ($p < .001$). Pre-test right posterolateral reach result of CG reached 81.59 ± 3.03 cm, post-test result increased to 83.12 ± 2.95 cm.

Pre-test right posteromedial reach result of CG reached 81.00 ± 2.64 cm, post-test result increased to 82.94 ± 2.79 cm. The change of indicators of the control group was found to be statistically significant ($p < .001$). There was no significant change comparing dynamic balance (right posterolateral and right posteromedial reach) results of both groups: EG and CG (Figure 8).

Left posteromedial and left posterolateral reach results. Pre-test left posteromedial reach result of EG reached 77.85 ± 2.23 cm, post-test result increased to 83.50 ± 2.33 cm. Pre-test left posterolateral reach result of EG reached 79.65 ± 2.70 cm, post-test result increased to 85.35 ± 2.87 cm. The change of indicators of the experimental group was found to be statistically significant ($p < .001$). Pre-test left posteromedial reach result of CG reached 78.25 ± 2.34 cm, post-test result increased to 79.65 ± 2.26 cm.

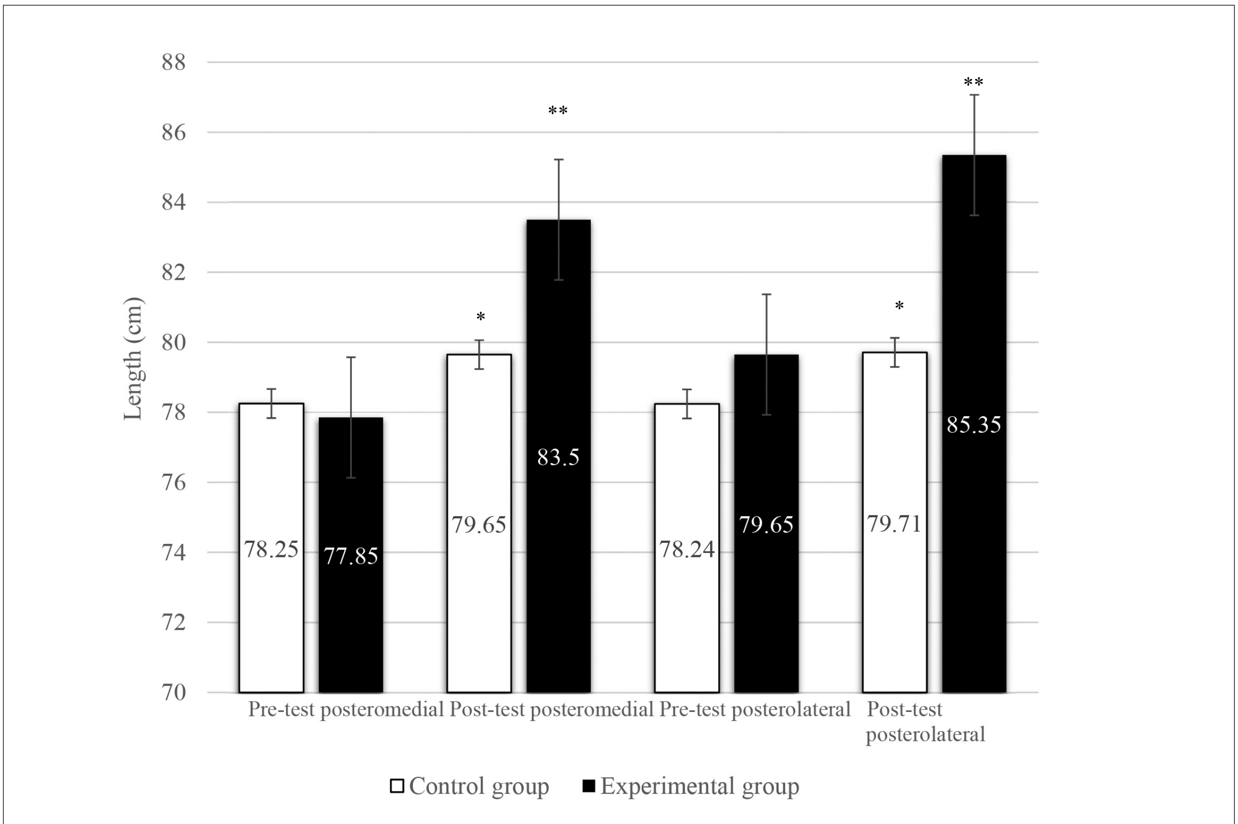
Pre-test left posterolateral reach result of CG reached 78.24 ± 2.50 cm, post-test result increased to 79.71 ± 2.55 cm. The change of indicators of the control group was found to be statistically significant (p < .001). There was no significant change comparing dynamic balance (left posterolateral and left posteromedial reach) results of both groups: EG and CG (Figure 9).

Figure 8. **Dynamic balance right posterolateral and right posteromedial reach results of experimental and control groups**



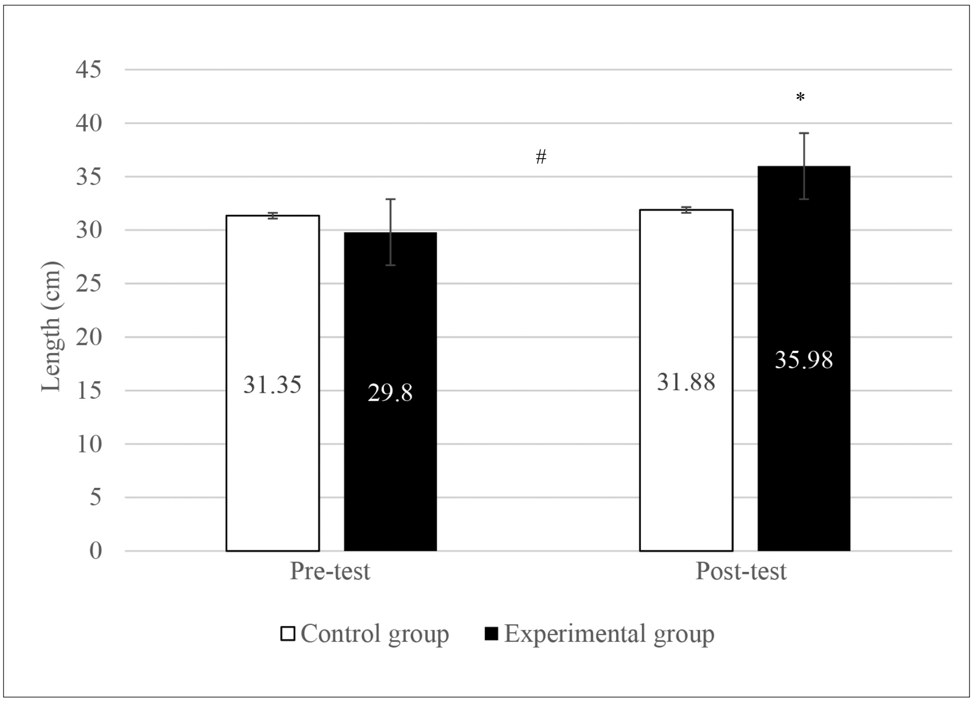
Notes. *p < .05 comparing pre-post test results of CG; **p < .05 comparing pre-post test results of EG.

Figure 9. **Dynamic balance left posterolateral and left posteromedial reach results of experimental and control groups**



Notes. *p < .05 comparing pre-post test results of CG; **p < .05 comparing pre-post test results of EG.

Figure 10. **Flexibility test results of experimental and control groups**



Notes. *p < .05 comparing pre-post test results of EG; #p < .05 comparing post test results of both groups.

Flexibility results. Comparing pre-post test results of the experimental group, the difference was found to be statistically significant ($p < .001$). Pre-test flexibility result of the experimental group was 29.8 ± 1.13 cm, while post-test results of EG increased to 35.9 ± 0.96 cm. The change of indicators of the control group was found to be statistically insignificant ($p = .142$). Pre-test flexibility result of the control group was 31.35 ± 1.10 cm, post-test results of CG increased insignificantly to 31.88 ± 1.18 cm. Comparing the results of flexibility of both groups (CG and EG), it appeared that more results of EG were statistically significant higher than those of CG (Figure 10).

DISCUSSION

The main aim of this study was to investigate the effect of Pilates exercises on 6–10-year-old Dancesport dancers' physiological responses. The results showed that after 16 weeks of the study 6–10-year-old Dancesport dancers who had been practicing Pilates method (EG), significantly improved static and dynamic deep trunk muscle endurance in a prone and a supine position. The dancers that used to practice usual dance program (CG), significantly improved static deep muscle endurance in a prone position, but there was no significant change in a supine position. Dynamic deep trunk muscle endurance in a prone position did not change significantly in the group that used to practice usual dance program (CG), but in supine position, it showed significant improvements. Sekendiz, Altun, Korkusuz and Akin (2007) used Pilates method intervention and increased abdominal and lower back strength, abdominal muscular endurance, and posterior trunk flexibility in his subjects. Another investigation established that Pilates improved body composition, flexibility (low back, hamstrings, and upper body), and muscular endurance (abdominal and lower back) (Rodgers & Gibson, 2009).

Moreover, after 16 weeks of the study, the static and dynamic balance of 6–10-year-old Dancesport dancers changed significantly, however, the group, that used to practice usual dance program, improved dynamic balance only. Besides, after 16 weeks of the study, the flexibility of 6–10 year old Dancesport dancers improved significantly, but the group, that used to practice usual dance program, did not changed flexibility significantly. A study showed that muscular strength was significantly higher after Pilates training, besides subjets had significantly greater flexibility increases in some dance technical skills (Amorim, Sousa, Rodrigues dos Santos, 2011). The effect of regular Pilates exercises on flexibility was proved by Segal, Hein and Basford (2004). We can recommend Pilates exercises for young Dancesport dancers as means for physiological characteristics improvement.

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INSTRUCTIONS FOR CONTRIBUTORS

1. Aims and scope

The BJSHS journal publishes research articles in the following areas: Social Sciences (Physical Education, Sports Coaching, Sports Pedagogy, Sports Psychology, Sports Sociology, Research Methods in Sports, Sports Management, Recreation and Tourism), Biomedical and Health Sciences (Coaching Science, Sports Physiology, Motor Control and Learning, Sports Biochemistry, Sports Medicine, Physiotherapy and Occupational Therapy, Physical Activity and Health, Sports Biomechanics, Adapted Physical Activity) and Humanities (Sports History, Sports Philosophy, Sports Law, Sports Terminology). The issues contain editorials, reviews of recent advances, original scientific articles, case studies.

Peer-Review Statement

All papers undergo the regular review process by at least two members of the Editorial Board or by expert reviewers selected by the Editorial Board.

The author (reviewer) has the option of the blind review. In this case the author should indicate this in their letter of submission to the Editor-in-Chief. This letter is sent along with the article (review).

2. Online Submission of manuscripts

The manuscript with an accompanying covering letter proving that the article submitted is original and not previously published should be submitted via online Manuscript Submission System following the link: www.manuscriptmanager.com/bjshs/.

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  Title Page File:
  Include the title of the article; the authors' names and surnames and their institutional affiliations (indicating the city and the country); mailing address, telephone and fax number, and e-mail address for the corresponding author.

  Article File:
  The main text of the article, beginning from the title of the article and Abstract till References (including tables and figures) should be in this file. Do not include your names and affiliations in this file.
- Step 4: Enter covering letter to the Editor and response to reviewers if resubmitting.
- Step 5: Check submission details and send.

3. Preparation of manuscripts (Article File)

The manuscript must be written in English. The guideline for the preparation of manuscripts is the *Publication Manual of the American Psychological Association (6th edition).*

The title page should contain the title of the article; the authors' names and surnames and their institutional affiliations (indicating the city and the country); mailing address, telephone and fax number, and e-mail address for the corresponding author.

Page 2 should include the **abstract** (250 words) revealing the scientific problem and providing the major data of the research. It must be structured into the following sections: Background. Methods. Results. Conclusion. Keywords (from 3 to 5 informative words and/or phrases).

The full text of the manuscript should begin on page 3. It should be structured as follows:

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

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

Results. The findings of the study should be presented concisely, consistently and logically, not repeating the chosen methods. The statistical significance and statistical power of the finding should be denoted.

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

Conclusions. The conclusions provided should be formulated clearly and logically avoiding excessive verbiage. The most important requirement for the research conclusions is their originality in the world. It is advisable to indicate the further perspectives of the research.

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).

References. Only published materials (with the exception of dissertations) and sources referred to in the text of the article should be included in the list of references. References should be consistent with the *Publication Manual of the American Psychological Association (6th edition).*

Manuscripts must be typed in 1.5 space and in 12 pt. font with 3 cm margin on the left and 1.5 cm on the right, 2.5 cm margins at the top and the bottom of the page. Pages should be numbered in the bottom right-hand corner beginning with the title page numbered as page 1. Line numbering should be switched on.

All abbreviations should be explained in parentheses what they stand for on their first occurrence in the text. Non-standard special abbreviations and symbols need only to be defined at first mention. The results of all measurements and symbols for all physical units should be those of the System International (SI) Units. In the text of the article all numbers up to ten are to be written in words and all numbers starting from eleven on – in Arabic figures.

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Author, A. (year). Title of chapter. In E. Editor (Ed.), *Title of book* (pp. xx–xx). Location: Publisher.

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