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COMPARISON OF STANDING LONG JUMP TECHNIQUE PERFORMED BY SUBJECTS FROM DIFFERENT AGE GROUPS

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ABSTRACT

Background. The aim of this study was to determine kinematic parameters relevant for the proficient performance of standing long jump (SLJ) test in boys and adolescents.

Methods. The investigation was conducted on 120 participants divided into five experimental groups of 20 boys and adolescents aged 4–18 and one control group composed of 20 students from the second year of Faculty of Kinesiology whose performance was considered as a model of proficient execution of analysed test. The set of variables was composed of 15 kinematic parameters. For determining the influence of selected kinematic parameters on proficiency of standing long jump test, the Stepwise Regression Analyses was used.

Results. The results showed the existence of specific relationship between selected kinematic parameters that significantly affected the execution of standing long jump test in each age group.

Conclusion. It can be concluded that, according to analysed kinematic parameters, technique of standing long jump significantly differ from early age to maturity.

Keywords: explosive strength, motor assessment tools, motor development, jumps, technique.

INTRODUCTION

Standing long jump is a standard test for the assessment of lower limb explosive strength, which is one of the determinants of success in all activities that require a demonstration of the maximum muscle force in the shorter period of time (Newton & Kreamer, 1994).

This test is very often used in education, sport and recreation for measuring children, students, athletes, and adults in order to assess the levels of individual motor abilities, as well as for a more objective evaluation of the teaching and training process (Pišot & Planinšec, 2010; Popeska, Georgiev, & Mitevski, 2009; Vitasalo, 1988).

The objective of the standing long jump is that the body of a subject is projected horizontally from one place to another, as far as possible from the take-off line. The subject starts from a static position and generates a large horizontal and vertical velocity passing through half squat position followed by coordinated arm swing and both feet take-off. The take-off is characterised by a large body inclination (take-off angle). In the flight phase comes the blocking action of the arms with legs moving forward preparing for landing on both feet. The respondent usually lands with emphasized forward bent and extended legs, with feet away in front of the hips. For successful jump, the respondent must keep a balance after landing avoiding falling backward (Seyfarth, Friedrich, Wank & Blickhan, 1999; Wakai & Linthorne, 2005).

The success in the standing long jump is determined by the total length of the jump (d_t), which is the horizontal distance from the take-off line to the landing line measured by the nearest point of contact on the landing (back of the heels). It can be said that the overall performance of a jump depends on the sum of three components: the length at take-off (d_1), flight distance (d_2) and

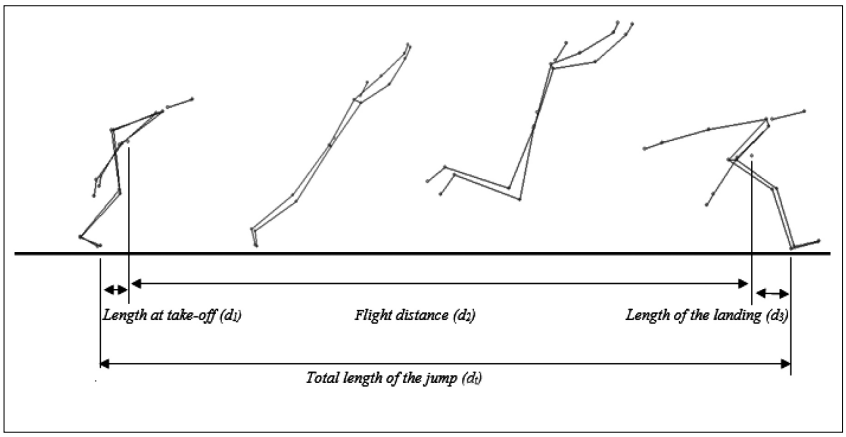

Figure. **Standing long jump performed by students from the Faculty of Kinesiology**

the length of the landing (d_3) (Wakai & Linthorne, 2005) (Figure).

Only in case when all the aforementioned requirements and standards of the standing long jump performance are satisfied it can be said that the test measures the explosive strength of the lower extremities. However, given the fact that horizontal jump of the human body requires optimum coordination and muscle strength (Malina, 2004), numerous studies have concluded that standing long jump is a complex motor task (Blackburn & Morrissey, 1998; Domire & Challis, 2010; Fukashiro et al., 2005; Nagano, Komura & Fukashiro, 2007; Wakai & Linthorne, 2005).

Mackała, Stodolka, Siemienski, and Čoh (2012) investigated the effects of several variables on the preparatory and take-off phases of the standing long jump, including individual lower extremity joint angles, take-off angle, centre of mass trajectory and segmental peak velocities. Based on the obtained results they concluded that there was statistically significant difference between the standing long jump from different starting positions of knee angle and trunk bend. Szerdiova, Simsik, and Dolna (2012) analysed the impact of upper extremity angular momentum and alterations in kinematics (centre of mass trajectory, horizontal and vertical velocities at take-off, take-off angle) on the length of standing long jumps with and without arm swing. Based on the results the authors concluded that there were statistically significant differences in jumps from different initial positions. Therefore, it can be assumed that motor coordination and technical performance have a great influence on the final outcome of the standing long jump, rather than the explosive strength of the individual (Lorger, M. Hraski, & Ž. Hraski, 2012).

Following that, standing long jump can be considered as a complex movement that requires a high level of coordination skills in order to achieve maximum performance of the jump. The aim of this study was to determine kinematic parameters relevant for the proficient performance of standing long jump (SLJ) test in boys and adolescents. In accordance with the defined research aim, we hypothesized that there would be a significant influence of certain kinematic parameters on the proficiency of standing long jump test performance in boys and adolescents aged 4–18 years.

METHODS

Participants. The investigation was conducted on 120 participants divided into five experimental groups of 20 boys and adolescents aged 4–18 from the city of Zagreb, and the control group composed of 20 students from the second year of the Faculty of Kinesiology, University of Zagreb, whose performance was considered as a model of proficient execution of analysed test (Table 1).

Table 1. **Participants included in this study**

Variable/ Group	4–6 years	7–9 years	10–12 years	13–15 years	16–18 years	Students
Height (cm)	115.15	134.99	150.35	170.31	180.02	182.99
Weight (kg)	21.25	34.15	42.98	64.06	73.02	82.43

Variables. The set of variables was composed of 15 kinematic parameters that are important for defining the model, relevant for the proficient performance of the standing long jump (Ashby & Delp, 2006; Ashbby & Heegaard, 2002; Fukashiro et al., 2005; Horita, Kitamura & Kohno, 1991; Wakai & Linthorne, 2005; W. Wu, J. Wu, Lin,

Table 2. **Kinematic parameters determining the standing long jump**

Variable	Mark	Unit
Shoulder angle at the beginning of the preparatory phase	SABPP	°
Shoulder angle at the lowest point of the centre of gravity	SALCG	°
Hip angle at the lowest point of the centre of gravity	HALCG	°
Knee angle at the lowest point of the centre of gravity	KALCG	°
Elbow angle at take-off	EATO	°
Shoulder angle at take-off	SATO	°
Hip angle at take-off	HATO	°
Knee angle at take-off	KATO	°
Take-off angle	TOA	°
Elbow angle at the highest point of the centre of gravity	EAHCG	°
Shoulder angle at the highest point of the centre of gravity	SAHCG	°
Landing angle	LA	°
Vertical velocity at take-off	VVTO	cm/s
Horizontal velocity at take-off	HVTO	cm/s
Jump length	JL	cm

& Wang, 2003; Zhouyi, Yoshimasa, Yun, & Kazuhiko, 2010) (Table 2). All variables are described and analysed through four basic phases of the jump (1. Preparatory phase, 2. Phase at take-off, 3. Flight phase, and 4. Landing phase), describing the geometry of the body, velocity of segments and the centre of gravity, as well as the temporal and spatial parameters of the jump.

Measurement protocol. The study was conducted in kindergartens, schools and colleges in the city of Zagreb. All subjects voluntarily participated in the study.

Collection of video data was made using two digital video cameras operating at the rate of 60 frames per second. All subjects were in the sports footwear and clothing. The test was performed on standing long jump track with marked start line and a measuring scale in centimetres. Respondents had three test trials followed by the three executions of the standing long jump test. The longest jump of each respondent was subjected to further analysis. The collected videos were processed by regular Ariel Performance Analysis System procedure.

Data processing. The influence of specific kinematic parameters on the proficiency of standing long jump performance was examined by Stepwise Multiple Regression Analysis, using Forward and Backward Stepwise models (method of gradual extension of the model and the method of gradual reduction of the model).

RESULTS

Based on the results, obtained by Stepwise Multiple Regression Analysis, it is evident that for a group of students of the Faculty of Kinesiology, whose performance was considered as a model of proficient execution of analysed test, a statistically significant influence of certain kinematic parameters on the proficiency of standing long jump (Tables 3 and 4) exists.

Results obtained by gradual extension of the model of kinematic parameters showed that the length of the jump was significantly affected by horizontal velocity at take-off, as well as by the variables that defined the arms swing – elbow angle at take-off, shoulder angle at the highest point of the centre of gravity during the flight and shoulder angle at the beginning of the preparatory phase.

Results of Stepwise Multiple Regression Analysis, obtained by a gradual reduction of the model of kinematic parameters, gave a more detailed description of a model of standing long jump performance.

Namely, on the base of obtained results (Table 4) it can be suggested that the tested standing long jump, together with the parameter of horizontal velocity at take-off and elbow angle at take-off, is also determined by the angle of take-off.

Tables 5 and 6 show the results of Stepwise Multiple Regression Analysis obtained by gradual extension of the model of kinematic parameters and the method of gradual reduction of the kinematic parameters for a group of boys aged 4 to 6 years. From the tagged p-values that are significant at the level $p \leq .05$, it can be identified that there is also a statistically significant influence of certain kinematic parameters on the length of the standing long jump. However, unlike the students of the Faculty of Kinesiology, for a group of boys aged

Regression model	*F* – value (10.9) = 41.914		
Variable	**Standardised Beta regression coproficient**	***t*-value**	***p*-level**
HVTO	1.55	2.33	***.05**
EATO	0.41	3.77	***.00**
VVTO	–0.91	–0.98	.35
HALCG	0.08	1.30	.22
SAHCG	–0.30	–3.90	***.00**
SABPP	0.21	3.03	***.01**
LA	0.21	1.99	0.8
SALCG	0.20	2.32	***0.5**
EAHCG	–0.16	–1.58	.15
TOA	1.24	1.17	.27

Table 3. **Forward Stepwise Multiple Regression Analysis – method of gradual extension of the model for a group of students of the Faculty of Kinesiology**

Note. *$p \leq .05$.

Regression model	*F* – value (3.16) = 34.087		
Variable	**Standardised Beta regression coproficient**	***t*-value**	***p*-level**
EATO	0.39	3.80	***.00**
TOA	0.39	3.64	***.00**
HVTO	0.80	6.79	***.00**

Table 4. **Backward Stepwise Multiple Regression Analysis – method of gradual reduction of the model for a group of students of the Faculty of Kinesiology**

Note. *$p \leq .05$.

Regression model	*F* – value (1.18) = 44.126		
Variable	**Standardised Beta regression coproficient**	***t*-value**	***p*-level**
HVTO	0.96	8.26	***.00**
LA	0.22	1.97	.07
VVTO	0.25	2.24	***.04**
EATO	–0.20	–1.84	.09

Table 5. **Forward Stepwise Multiple Regression Analysis - method of gradual extension of the model for a group of boys aged 4 to 6 years**

Note. *$p \leq .05$.

Regression model	*F* – value (4.15) = 20.597		
Variable	**Standardised Beta regression coproficient**	***t*-value**	***p*-level**
HVTO	0.84	6.64	***.00**

Table 6. **Backward Stepwise Multiple Regression Analysis - method of gradual reduction of the model for a group of boys aged 4 to 6 years**

Note. *$p \leq .05$.

4–6 years the length of the jump depended on the horizontal velocity at take-off and the vertical velocity at take-off.

Results of Stepwise Multiple Regression Analysis, obtained by gradual extension of the model of kinematic parameters and the method of gradual reduction of the kinematic parameters for a group of boys aged 7 to 9 years are shown in Tables 7 and 8. Referring to these results we can claim that in boys aged 7–9 years there is also a statistically significant influence of certain kinematic parameters on the proficiency of the standing long jump, i.e. the length of the jump depends on horizontal velocity at take-off and vertical velocity at take-off, as well as, opposed to the group 4- to 6-year-olds, on hip angle at the lowest point of the centre of gravity during the preparatory phase, shoulder angle at take-off and take-off angle.

Table 7. **Forward Stepwise Multiple Regression Analysis – method of gradual extension of the model for a group of boys aged 7 to 9 years**

Regression model	***F* – value (3.16) = 44.771**		
Variable	**Standardised Beta regression coproficient**	***t*-value**	***p*-level**
HVTO	0.80	9.61	***.00**
SATO	0.19	1.52	.15
VVTO	0.23	3.01	***.01**
HALCG	–0.20	–2.63	***.02**
SAHCG	0.23	1.91	.08
KALCG	0.13	1.79	.10
LA	0.12	1.33	.21

Note. *$p \leq .05$.

Table 8. **Backward Stepwise Multiple Regression Analysis– method of gradual reduction of the model for a group of boys aged 7 to 9 years**

Regression model	***F* – value (7.12) = 30.797**		
Variable	**Standardised Beta regression coproficient**	***t*-value**	***p*-level**
SATO	0.33	3.79	***.00**
TOA	0.35	3.36	***.00**
HVTO	0.95	8.69	***.00**

Note. *$p \leq .05$.

As with the previous groups of subjects, a statistically significant influence of selected kinematic parameters on the proficiency of standing long jump performance is noticeable in the group of boys aged 10 to 12 years (Tables 9 and 10). Based on the results of the Stepwise Multiple Regression Analysis, it is evident that the length of the jump also depends on the vertical velocity at take-off, but opposite to the group of 4- to 6- and 7- to 9-year-olds. There are additional parameters that more precisely define the geometry of the body before take-off, at the very moment at take-off and during the flight phase, knee angle at the lowest point of the centre of gravity during the preparatory phase, hip angle at take-off, take-off angle and shoulder angle at the highest point of the centre of gravity during the flight phase. Furthermore, opposite to the group of subjects aged 4 to 6 and 7 to 9 years, in a boys aged 10 to 12 years, a statistically significant influence on the length of the jump has an angle of landing.

Table 9. **Forward Stepwise Multiple Regression Analysis – method of gradual extension of the model for a group of boys aged 10 to 12 years**

Regression model	***F* – value (2.17) = 36.761**		
Variable	**Standardised Beta regression coproficient**	***t*-value**	***p*-level**
HVTO	–0.23	–0.27	.80
VVTO	2.76	1.70	.13
LA	0.30	2.57	***.03**
HATO	–0.36	–2.56	***.03**
SAHCG	–0.21	–2.25	***.05**
KALCG	–0.39	–2.97	***.02**
HALCG	0.33	2.24	.06
TOA	–3.15	–1.54	.16
KATO	0.35	2.26	.05
SABPP	–0.15	–1.35	.22
SALCG	0.13	1.16	.28

Note. *$p \leq .05$.

Regression model	*F* – value (11.8) = 14.845		
Variable	**Standardised Beta regression coproficient**	***t*-value**	***p*-level**
TOA	–2.13	–8.50	***.00**
VVTO	2.06	8.19	***.00**

Table 10. **Backward Stepwise Multiple Regression Analysis – method of gradual reduction of the model for a group of boys aged 10 to 12 years**

Note. *$p \leq .05$.

Based on the results obtained by Stepwise Multiple Regression Analysis by the method of gradual extension of the models and methods of gradual reduction of kinematic parameters for a group of subjects aged 13 to 15 years, it is evident that there is also a statistically significant influence of certain variables on the performance of standing long jump (Table 11 and 12). As a difference to the results of a group of subjects from 4 to 6, 7 to 9 and 10 to 12 years, in a group of 13- to 15-year-olds, parameter vertical velocity at take-off is omitted, and variables of horizontal velocity at take-off and hip angle at take-off are dominant.

From the results shown in Tables 13 and 14 it can be seen that, as with the previously analysed groups of subjects, for adolescents (aged 16–18 years), the proficiency of the standing long jump is statistically significantly determined by such variables as the horizontal velocity at take-off, hip angle at take-off, take-off angle and vertical velocity of take-off.

Namely, once again it has been found that a variables of CG velocity during the take-off and variables involved in defining the geometry of the body at the moment at take-off, are dominant.

Regression model	*F* – value (1.18) = 36.291		
Variable	**Standardised Beta regression coproficient**	***t*-value**	***p*-level**
HVTO	1.96	2.93	***.01**
TOA	2.30	1.75	.10
EATO	0.20	1.82	.09
HATO	0.26	2.25	***.04**
VVTO	–1.72	–1.51	.15

Table 11. **Forward Stepwise Multiple Regression Analysis – method of gradual extension of the model for a group of boys aged 13 to 15 years**

Note. *$p \leq .05$.

Regression model	*F* – value (5.14) = 16.454		
Variable	**Standardised Beta regression coproficient**	***t*-value**	***p*-level**
HVTO	0.82	6.02	***.00**

Table 12. **Backward Stepwise Multiple Regression Analysis – method of gradual reduction of the model for a group of boys aged 13 to 15 years**

Note. *$p \leq .05$.

Regression model	*F* – value (2.17) = 10.220		
Variable	**Standardised Beta regression coproficient**	***t*-value**	***p*-level**
HVTO	1.21	5.79	***.00**
EATO	0.14	0.73	.48
SABPP	–0.32	–1.98	.07
HATO	–0.49	–2.66	***.02**
EAHCG	0.38	1.88	.08
LA	0.26	1.44	.17

Table 13. **Forward Stepwise Multiple Regression Analysis – method of gradual extension of the model for a group of adolescents aged 16 to 18 years**

Note: *$p \leq .05$.

Table 14. **Backward Stepwise Multiple Regression Analysis – method of gradual reduction of the model for a group of adolescents aged 16 to 18 years**

Regression model	*F* – value (6.13) = 9.437		
Variable	**Standardised Beta regression coproficient**	***t*-value**	***p*-level**
TOA	–1.21	–4.15	***.00**
VVTO	1.30	4.45	***.00**

Note: *$p \leq .05$.

However, a statistically significant influence of parameters that define highly important arm swing in the preparatory phase, registered in the analysis of the jump performed by students of the Faculty of Kinesiology, is still missing (shoulder angle at the beginning of the preparatory phase, shoulder angle at the lowest point of the centre of gravity and shoulder angle at the highest point of the centre of gravity).

DISCUSSION

In accordance with the objective of this study, the results of Forward and Backward Multiple Regression Analysis for a group of students of the Faculty of Kinesiology showed that the length of a standing long jump was statistically significantly influenced by horizontal velocity at take-off, the take-off angle and the variables that define arm swing (shoulder angle at the beginning of the preparatory phase, shoulder angle at the lowest point of the centre of gravity, elbow angle at take-off and shoulder angle at the highest point of the centre of gravity). Obtained results confirmed the conclusions of previous studies of Ashby and Delp (2006), Ashby and Heegaard (2002), Lees, Vanrenterghem, and Clercq (2000), and Wakai and Linthorne (2005) who found that the proficiency of the standing long jump depended on three components: horizontal velocity at take-off, take-off angle and arm swing during a jump.

Contrary to the results obtained on the group of students of the Faculty of Kinesiology, results obtained on boys aged 4-6 years showed that the length of the jump depended only on the parameters of horizontal and vertical velocity at take-off.

For the respondents of this group, the length of the jump was not significantly affected by variables that define the geometry of the body during a jump. It can be suggested that in children of preschool age, expected stereotype of motion characterised by leg work coordinated with symmetrical arm swing, is still not sufficiently developed.

Similar results come from research of Wilson and Brown (1993). On the basis of the obtained differences in kinematic parameters of the take-off and landing phases in children aged 4–7 years, they concluded that with improvement of the geometry of the body, in the observed phases, the subjects achieved better results. Harrison and Keane (2007) found that the group of respondents between the ages of 5 to 6 years who practiced different types of jumps during period six weeks (2 x 30 min) significantly improved their performance and stereotype of standing long jump motion, while in a group of subjects of the same age who exercised only vertical jump there were no statistically significant changes. Labiadh, Ramanantsoa and Golomer (2010) examined the coordination of body segments in 3- to 7-year-olds during the performance of the standing long jump, based on jump imitation performed by adults. From the results of the video analysis they found that the experimental groups achieved a large number of coordination modes of jump and large variations in duration of the jump, which means that at that age the technical performance of the standing long jump has not yet become stable. Lv (2012) found the exact quantitative changes of motor skills in children from 3 to 6 years of age during performance of the standing long jump, concluding that the geometry of the jump significantly changed with age.

Furthermore, in this study it has been found that the length of the jump for 4- to 6-year-old boys is significantly affected not only with horizontal but also with vertical velocity at take-off. On the basis of these results it can be argued that in children of that age the direction of the jump is not yet defined and sufficiently controlled. This is supported by previous studies by Davies and Jones (1993), Fukashiro et al. (2005), and Robertson and Fleming (1987), who concluded that there were several important factors influencing the direction of the jump and differentiating horizontal from vertical jump. These factors were the geometry of

the body at take-off phase defined by the hip angle at take-off and trunk inclination (take-off angle). Roy, Youm and Roberts (1973) have also analysed the components of vertical and horizontal jump in subjects aged 7–16 years. They concluded that the parameters defining the direction of the jump were partly constant after 10 years, and finally constant after 13 years of life.

Kinematic parameters that are relevant for the performance of the standing long jump in boys aged 7–9 years indicate that children after proceeding from kindergarten to school pass through certain changes in performance technique of standing long jump. Although, one of the parameters defining the CG trajectory of the jump (vertical velocity at take-off) has not yet become stable, certain parameters that define the geometry of the body before and at take-off phase appeared as it was the case with the students who represented the model of the jump. In particular, it is evident that for 7- to 9-year-olds: besides horizontal velocity at take-off, the parameters hip angle at the lowest point of the centre of gravity and the shoulder angle at take-off and take-off angle play an important role in forming the trajectory of the jump.

Similar results were obtained in research of Phillips, Clark and Petersen (1985). The authors found that the angle of shoulders significantly increased with age. Also, statistically significant differences were obtained in variable inclination of the body and horizontal displacement of the centre of gravity. Based on the obtained results they concluded that from 3 to 9 years of age the final length of the jump was significantly affected by the moving the centre of gravity forward from the take-off line, which decreases take-off angle. Also, Zheng, Chiu, Hsieh and Liao (2007) found a statistically significant positive correlation between the parameters of jump length and take-off angle, landing angle as well as with the inclination of the trunk in landing in students from the 1st to the 3rd grade, while on the basis of a comparison of the standing long jump of 6- to 11-year-olds and young athletes Zhouye, Yoshimasa, Yun and Kazuhiko (2010) concluded that a coordinated arm swing was very important during the standing long jump performance and that in children of primary school age the proper functioning of the arms, hip and knee joints in the preparatory phase before take-off was still not developed.

In this study, the results of the analysis of boys aged 10 to 12 years suggests that the length of the jump still significantly depends on the parameter vertical velocity at take-off, whicht shows that parameters which define the trajectory of the jump are still not constant. Opposite to the groups of 4- to 6- and 7- to 9-year-olds, parameters that in more detail define the geometry of the body prior, at take-off and in flight phase of standing long jump, appear (knee angle at the lowest point of the centre of gravity, hip angle at take-off, take-off angle and shoulder angle at the highest point of the centre of gravity). However, statistically significant influence of variables that define arm swing in the preparatory phase of the jump was not registered, as it was the case with students of the Faculty of Kinesiology. Roy et al. (1973) have also found that for boys from 7 to 13 years, while performing standing long jump, not only horizontal shift, but also vertical shift of the centre of gravity during the take-off plays a significant role during the take-off.

Furthermore, differing to previous groups of subjects, in boys aged 10 to 12 years, a parameter landing angle has statistically significant influence on the length of the standing long jump. Following this, it can be concluded that in that age group geometry of the body, during the flight and at the moment of landing, is becoming more similar to the model obtained from the students of the Faculty of Kinesiology. According to the collected data, it is evident that respondents who achieve lower landing angle by stretching arms and lower legs forward, together with forward bent, have accomplished better final results of the standing long jump, as it was confirmed by Decker, Torry, Wyland, Strett and Steadman (2003) and Wakai and Linthorne (2005).

Contrary to the results of groups of subjects from 4 to 6, 7 to 9 and 10 to 12 years, in 13- to 15-year-olds a statistically significant influence of parameter vertical velocity at take-off on the length of the jump was not registered, and the length of the jump is primarily predetermined by hip angle and horizontal velocity at take-off. Roy et al. (1973) also found that in boys after the age of 13 a significant role during performing standing long jump was played by the horizontal displacement of the centre of gravity.

Compared to previously analysed groups biomechanical characteristics of standing long jump performed by respondents aged 13 to 15, were most

similar to those obtained on the students of Faculty of Kinesiology. This leads to the conclusion that in that age a stabilization of kinematic parameters that determine the trajectory of the jump occurs.

Based on the results obtained for the group of adolescents (age 16 to 18) it can be noted that, although previous research confirmed the presence of maturation and stabilization of movement structures of standing long jump (Roy et al., 1973, Wang, Lin, Huang & Yang 2002; Zhouye et al., 2010), this study showed that adolescents still had certain technical problems with the standing long jump performance. Namely, there was still no statistically significant influence of parameters that define the important arm swing in the preparatory phase as well as the blocking action of arms in flight phase of the jump. This has also been confirmed by group of authors who concluded that standing long jump was a complex motor skill playing a fundamental role on the final result of the standing long jump and the coordination of its segments (Ashby & Delp, 2007; Chow, Koh, Davids, Button & Rein, 2014; Lee & Cheng, 2008; Nagano et al., 2007; Wakai & Linthorne, 2005; Weimar, Martin & Wall, 2011).

Therefore, the obtained results in this study support the hypothesis that there would be a significant influence of certain kinematic parameters on the proficiency of standing long jump test performance in boys and adolescents aged 4–18 years at the 95.0% confidence level.

CONCLUSION

Standing long jump test is a complex movement in which the jumper, in order to achieve the longest length of the jump, must execute a combination of very demanding coordinated actions. The aim of this study was to determine kinematic parameters relevant to the proficient performance of standing long jump test in boys and adolescents aged 4 to 18 years.

On the basis of the obtained results it can be concluded that the performance of standing long jump test is determined by specific kinematic parameters different for each of the age groups analysed in this study, including students from the Faculty of Kinesiology whose execution of the standing long jump was treated as a model. This confirmed the hypothesis that there would be a significant influence of certain kinematic parameters on the proficiency of standing long jump test performance in boys and adolescents aged 4–18 years.

Results of this study showed that the length of the standing long jump performed by students depended on horizontal velocity at take-off, take-off angle and the parameters that determine the arm swing during the jump (shoulder angle at the beginning of the preparatory phase, shoulder angle at the lowest point of the centre of gravity, elbow angle at take-off and shoulder angle at the highest point of the centre of gravity), while in other analysed different age groups it was observed that these parameters were changing significantly with age.

In pre-school children (4–6 year olds) standing long jump is determined only by the horizontal velocity at take-off. In their performance of this task almost all of the components that lead to the successful performance of the jump are missing (arm swing, take-off angle, as well as the parameters that determine the trajectory of the jump). Furthermore, in early school age (7–12 year olds), the important element that affects the length of the standing long jump also is parameter take-off angle, while at the age of 13–18 years, parameter hip angle at take-off is also statistically significant.

It is interesting that in all of the analysed age groups the parameters that determine the arm swing during the jump were not statistically significant.

Since the standing long jump is a standard test for the assessment of lower limb explosive strength, according to the results obtained by this research, which proved that in different age groups different techniques of performance of this task exist, it is reasonable to ask a question whether the test standing long jump has the same object of measurement in respondents of different age, especially for younger subjects.

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EFFICIENCY OF ORTHOPAEDIC BRACE WITH LASER ON KNEE JOINT FUNCTION, PAIN AND SWELLING

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ABSTRACT

Background. The effectiveness of outpatient mobile laser intervention on specific treatment goals has not been fully explored. Thus, the aim of the study was to examine the effect of orthopaedic knee brace with laser on knee joint function, pain and swelling.

Methods. Volunteers were divided into two experimental groups: chronic pain (n = 20, knee pain > 6 months) and acute pain (n = 20, knee pain < 1 week), and one control (n = 20, placebo) group. Subjects in all groups were immobilized in a knee brace for 4 weeks. In addition, the experimental groups underwent low-intensity laser therapy, whereas control group underwent pseudo-laser therapy, every second day for 10 min. The sequences of the tests were as follows: (a) clinical assessments and evaluation of knee extension and flexion amplitude, swelling, Lysholm subjective assessment questionnaire, VAS pain scale, (b) evaluation of balance using Kistler platform, (c) muscle peak torque and isometric torque variability assessment using isokinetic dynamometry. All tests were performed twice - before and after intervention.

Results. Knee brace with laser is effective treatment for the reduction of pain, swelling, and recovering of daily functions (p < .05). Operation of the complex device is particularly effective in treating knee pain in the acute period (p < .05).

Conclusions. Knee brace with laser therapy in the rehabilitation period ensures faster healing of patients compared to wearing only knee brace, particularly in acute pain, while muscle strength and proprioception remains depressed.

Keywords: mobile laser therapy, range of motion, swelling, muscle strength, proprioception.

INTRODUCTION

Knee joint have been most commonly injured joint in athletes (Bollen, 2000). In most cases the most vulnerable are anterior cruciate and lateral ligaments, meniscus, and knee cartilage. Injuries cause pain, swelling, decreased muscle strength and range of motion (ROM), which leads to chronic alterations such as arthropathy or chondropathy. Rehabilitation treatment is applied to cure the inflammatory processes and fully restore knee function.

Table. **Subjects' data**

	All subjects (*N* = 60)	**Control group (*n* = 20)**	**Experimental chronic pain group (*n* = 20)**	**Experimental acute pain group (*n* = 20)**
Age, years (mean and (*SD*))	35.3 (13.8)	40.6 (18.0)	22.9 (10.9)	31.3 (10.7)
Men Women	38 22	15 5	11 9	12 8
Injured left leg Injured right leg	26 34	10 10	10 10	6 14

One of the most effective rehabilitation methods is laser therapy. Therapeutic effect of stationary (uninstalled in orthopaedic devices) low-frequency laser on the acceleration of healing of tissues has been substantially examined (Hegedus, Viharos, Gervain, & Gálfi, 2009; Peter et al., 2011; Walsh, Baxter, & Allen, 2000). The effect of low-intensity laser radiation is anti-inflammatory, anaesthetic, regenerative and promoting regional blood circulation and microcirculation (Bjordal, Couppé, Chow, Tunér, & Ljunggren, 2003). Laser therapy stimulates the production of collagen, activates the metabolism, changes the DNA synthesis and improves the functions of damaged nerve (van Middelkoop et al., 2011; Rola, Doroszko, & Derkacz, 2014).

At present, little is known about mobile devices with laser radiation aiming at effective improvement of muscle functions. Mobile laser may reduce treatment costs since the use of fixed installations necessitates the patient to attend the clinic for the procedures. The latter is a waste of time for both the patient and the clinic staff. Mobile devices enable the procedures to be performed at home or in any location convenient for the patient. However, the use of a mobile device requires some skills and knowledge from the patient and therefore it remains unclear whether the treatment effect is comparable to the one demonstrated previously with stationary ones (Bjordal at al., 2008; van Middelkoop et al., 2011). Consequently, the aim of the study was to examine whether the mobile orthopaedic knee brace with laser is effective for knee joint function improvement, swelling, and acute or chronic pain reduction.

METHODS

Subjects. The study included 60 subjects with a doctor appointed knee brace with laser effects by the indications. The subjects' data can be viewed in the Table. In the case of chronic pain, the experimental group ($n = 20$) included subjects who met the following criteria: knee pathology with arthropathy, systemic connective tissue diseases, soft tissue diseases, osteopathy, chondropathy, sore knee for at least 6 months. In the case of acute pain, the experimental group (EA; $n = 20$) included subjects who met the following criteria: experienced knee injuries, knee surgery after traumatic injuries (knee ligament tear, meniscus tear intraarticular fractures, patella injuries, etc.). Subjects in control groups met the criteria of chronic ($n = 10$) and acute pain ($n = 10$).

Each subject read and signed a written informed consent form consistent with the principles outlined in the Declaration of Helsinki. Kaunas Regional Bioethics Committee approved this study.

Experimental protocol. During the study, the subjects underwent the combined treatment using immobilization (knee brace) and laser therapy. The stages of the testing were as follows: (a) clinical assessments and evaluation of active knee joint ROM, swelling, Lysholm subjective assessment questionnaire, VAS pain scale, (b) evaluation of balance using Kistler platform, (c) muscle peak torque and isometric torque variability assessment using isokinetic dynamometry. All tests were performed twice: before and after wearing the knee brace with laser device for four weeks, while applied laser therapy at home was used every second day for 10 min. Control group subjects had laser imitation instead of real laser in the knee brace. Before each test trial, subjects received standardized verbal instructions and completed from two to three familiarization trials using submaximal efforts.

Knee brace with laser. The construction consists of commercial visible or infrared laser diodes installed in the knee brace bodies and connected to a power source by flexible wires (Figure 1). The device uses 808 nm infrared laser

diodes and the visible area 650 nm wavelength diodes. Laser type and operating mode is selected according to the nature of the pathology. According to the nature of pain, three types of braces with four embedded laser diodes are used. The electric circuit of the device is powered by a 3.7V Li-ion battery. Diode operating voltage is up to 2.2 volts. According to the doctor's recommendations, laser diodes are fitted at the specified locations on the knee brace hinge. Power supply is a separate small block which is also fixed to the brace.

Figure 1. **Knee brace with laser**

Maximal voluntary isometric and concentric torque. The maximal voluntary isometric contraction peak torque (MVIC) of the knee extensor and flexor muscles of the involved leg (uninvolved MVIC in subjects in acute pain group) was measured using an isokinetic dynamometer (System 3; Biodex Medical Systems, Shirley, New York). The subjects sat in an upright position on the Biodex Dynamometer Accessory Chair and were secured using thigh, pelvic and torso straps to minimize extraneous body movements. Gravity correction was done using the torque exerted on the dynamometer resistance adapter when the knee was in a relaxed state. Calibration of the Biodex dynamometer was performed according to the manufacturer's service manual prior to each testing session. Each subject was required to fold their arms across his chest and was given verbal encouragement and visual feedback from the Biodex computer monitor to facilitate maximal-effort contractions.

Maximal isometric and concentric strength of the quadriceps and hamstring muscles were investigated using 1-minute rest periods between series of measurements. Isometric trials were completed at a knee angle of 70° (0°: knee fully extended). Subjects completed two 3–5-second maximal isometric knee extensions while they were asked to produce their maximal force as fast as possible. For the concentric isokinetic trials, ROM was 80°, from 100° to 20° knee flexion, and vice versa. Concentric tests were performed at two angular velocities: 60°/second and 180°/second. Subjects were asked to complete the full ROM during three consecutive extension-flexion trials.

Isometric torque variability test. Isometric torque variability was established during a 20-s submaximal isometric contraction. Target torque with chronic pain group participants was equal to 20% of MVIC involved legs, subjects with acute pain group – 10% of uninvolved legs. Subjects were asked to perform the tasks as accurately as possible with visual feedback, i.e. the subjects were able to see the torque signal. Knee extension and flexion torques of the damaged leg during 3–20 s isometric contractions were analysed, and the coefficient of variation (CV) was calculated as an indicator of motor output variability (Skurvydas et al., 2011). Knee extension and flexion variability was tested at 70° knee joint angles. The rest interval between measurements was 45 s. Previously published methodology (Skurvydas et al., 2011) was used in the study.

Subjective knee function evaluation. Lysholm questionnaire was used to evaluate the subjective functional state of the knee joint. Subjects subjectively assess their ability to carry out daily activities determined by the condition of the knee joint (Tegner & Lysholm, 1985).

Pain. Assessment of pain was carried out on a visual analogue scale (VAS) scores where research participants subjectively evaluated perceived pain (from 0 to 10; 0 – almost no pain, 10 – unbearable pain) (Miyama & Nosaka, 2007).

Inflammatory process assessment. In order to evaluate knee swelling and oedema as well as their pre-post dynamics, the circumference (girth) of the knee in three standardized points was measured with a tape measure: over the joint, at the patella, and below the knee.

Range of motion. Active knee joint ROM (flexion and extension) was measured using a universal goniometer. The subjects was positioned supine, with the hip and knee in the neutral position. The femur was stabilized to prevent rotation with a hand.

Balance. The balance of the subjects was assessed by the method of static posturography.

Kistler force plate (Switzerland, Slimline System 9286) and computer equipment registering signals were used for this purpose. This measurement system is meant to explore human biomechanical parameters and used in research institutions. Balance is measured when the subject stood on the force plate for 60 s. The position of the subject on the platform was as follows: eyes open, looking straight ahead; feet put together, arms down at the sides, palms inwards. The duration of registering the posturogram was 60 s, sampling rate – 100 Hz. We registered the changes in velocity of the centre of pressure (COP) displacement in the lateral and anterior-posterior directions. The registration of the posturogram was started when the subjects took the correct posture on the force plate. Two trials were performed; the best result of the second trial was used for assessment. The frequency of the registered signal was 50 Hz.

Statistical analysis. The different outcome measures were verified for normal distribution using the Kolmogorov-Smirnov test. Descriptive data are presented as the mean ± *SD*. The level of significance was set at $p < .05$. Paired Student's *t* tests were used to test differences in outcome measures between the separate values. Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS software version 11.0 Cary, NC, USA).

RESULTS

Peak torque values of muscle of knee extension and flexion. There were no statistically significant differences between pre and post intervention of knee extension ($p > .05$; Figure 2a) and flexion ($p > .05$; Figure 2b) in MVIC in both control and experimental groups. However, concentric knee extension and flexion torque performed at angular velocities of 60°/second post intervention increased in EC group ($p < .05$), whereas torque performed at angular velocities 180°/second changed insignificantly ($p > .05$). In control group, concentric knee extension and flexion torques in both velocities remained unchanged ($p > .05$).

Intraindividual variability in knee extension and flexion torque at submaximal level. The results showed that neither control nor EC or EA subjects experienced a significant effect ($p > .05$)

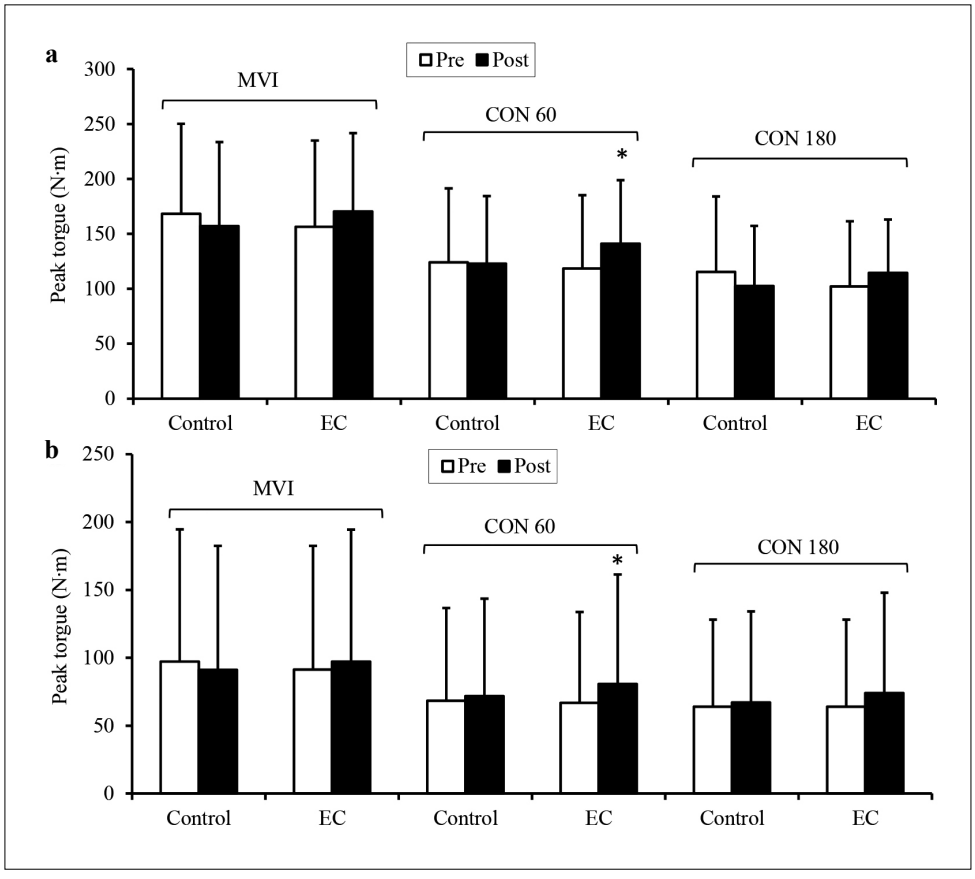

Figure 2. **Mean values (coefficient of variation (CV)) of maximal isometric (MVIC) and concentric, performed at angular velocities 60°/s (CON 60) and 180°/s (CON 180), peak torques for the knee joint in control and experimental chronic pain (EC) groups pre and post wear of brace. (a) knee extension; (b) knee flexion**

Note. *$p < .05$ comparing to pre intervention value.

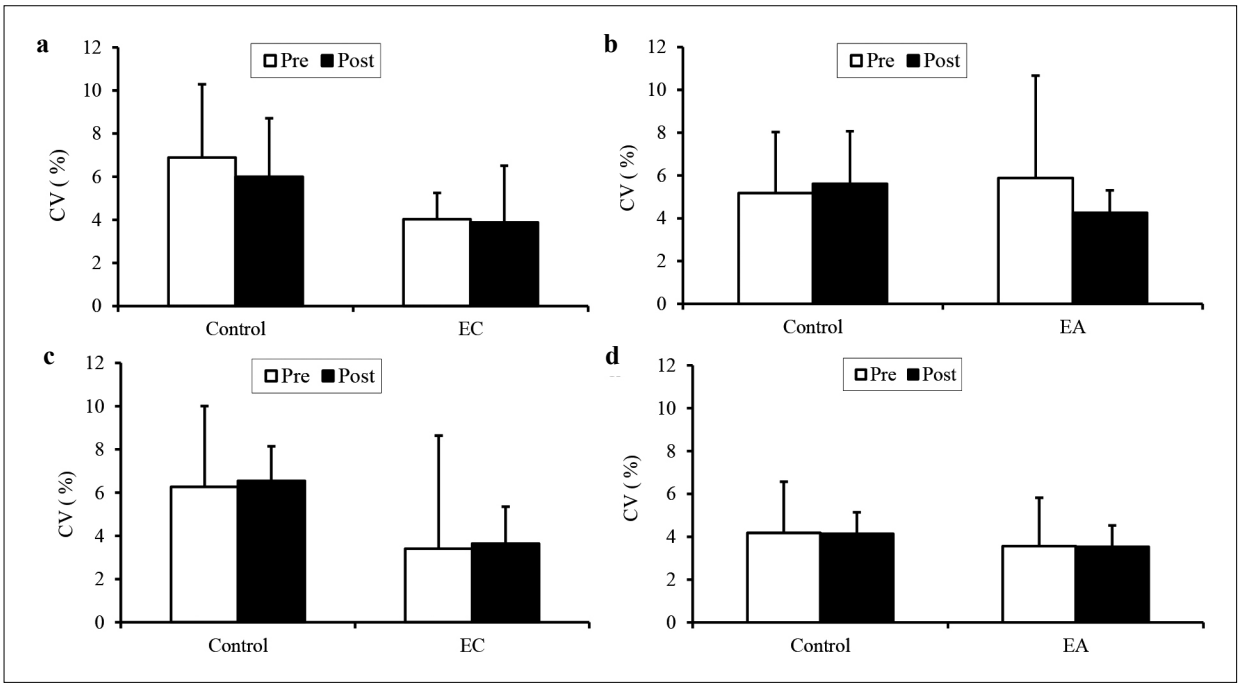

Figure 3. **Mean values (coefficient of variation (CV)) of submaximal isometric torque variability in control, Experimental Chronic pain (EC) and Experimental Acute pain (EA) groups pre and post brace wear. (a and b) knee extension; (c and d) knee flexion**

on knee extension and flexion torque variability (CV) after wearing a knee brace (Figure 3).

Knee function. Before wearing the Knee Brace Lysholm average mean scores in EA subjects were significantly lower than those in the control and EC groups of subjects, while control and EC did not differ significantly (Figure 4; $p > .05$). Post Knee Brace wear score significantly increased in all groups ($p < .05$). The highest increase ($p < .05$) was in EA group (43.4 points compared with control (9.6 points) and EC (19.4 points) subjects. Post Knee Brace wear average mean scores in experimental EC and EA group subjects were significantly higher than those in the control group subjects ($p < .05$).

Pain. The initial values of pain among all groups (control, EC and EA) differed significantly (Figure 5; $p < .05$). After the **Knee Brace** wear pain assessment scores significantly decreased in all groups ($p < .05$) and did not differ among themselves. Decrease (pre-post **Knee Brace** wear) was higher in the EA group compared to that in the control group and the EC ($p < .05$). EA and EC group mean change scores did not differ significantly.

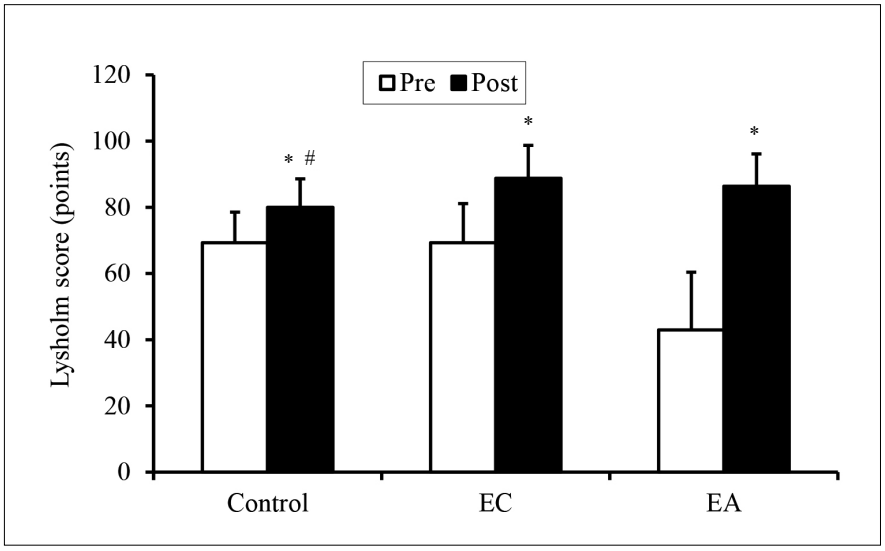

Figure 4. **Mean values (coefficient of variation (CV)) of Lysholm Knee score in Control, Experimental Chronic pain (EC) and Experimental Acute pain (EA) groups pre and post knee brace wear**

Note. *$p < .05$ comparing to pre intervention value, #$p < .05$ control compared to EC and EA groups.

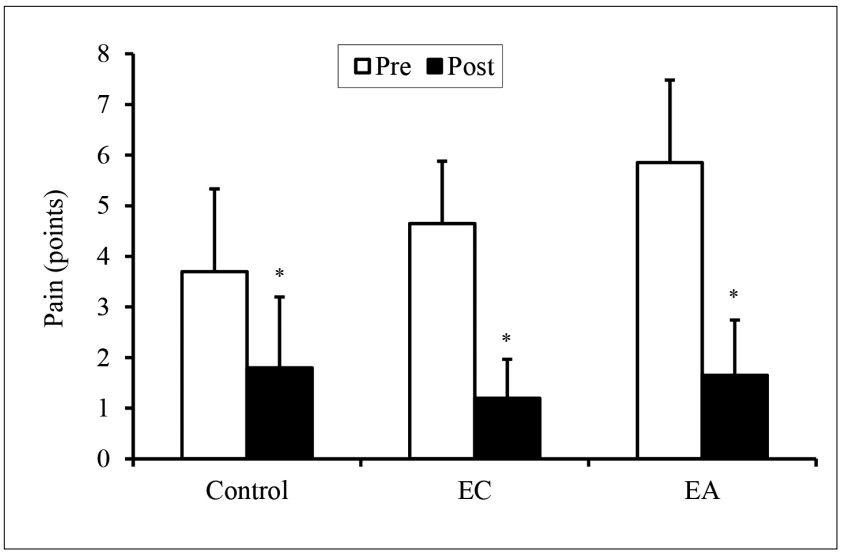

Figure 5. **Mean values (coefficient of variation (CV)) of Visual Analogue Pain Scale (VAS) score of Control, Experimental Chronic pain (EC) and Experimental Acute pain (EA) groups pre and post knee brace wear**

Note. *$p < .05$ comparing to pre intervention value.

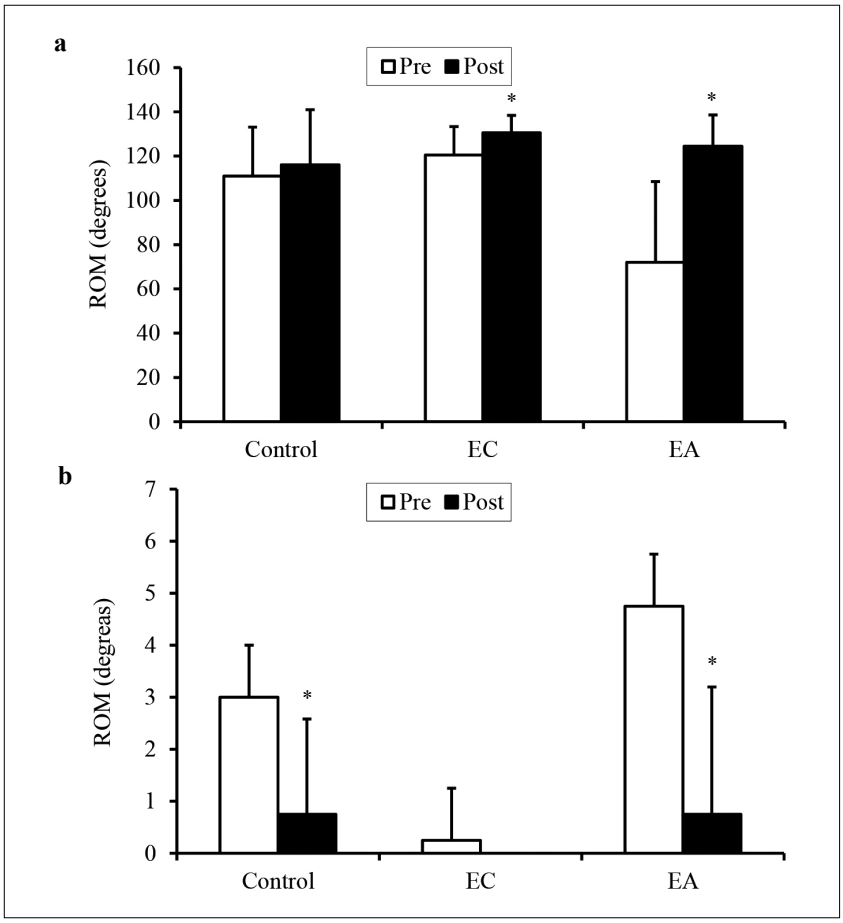

Figure 6. **Mean values (coefficient of variation (CV)) of the range of motion (ROM), (a) flexion; (b) extension of Control, Experimental Chronic pain (EC) and Experimental Acute pain (EA) groups pre and post knee brace wear**

Note. *$p < .05$ comparing to pre intervention value.

Range of motion. The initial values of knee extension in all groups (control, EC and EA) differed significantly (Figure 6; $p < .05$). The lowest value was in EC group, the highest value - in EA group. After wearing knee brace in control and EA groups, knee extension significantly increased ($p < .05$). The highest pre-post increase was in EA subjects. Similar, the highest results increase were found for knee flexion in EA group ($p < .05$) with no changes in control group ($p > .05$).

Swelling. Knee joint average circumference post wearing the knee brace of control and EC group of subjects did not change, whereas EA group subjects' average volume of knee joint statistically significantly decreased in all measurements ($p < .05$; Figure 7).

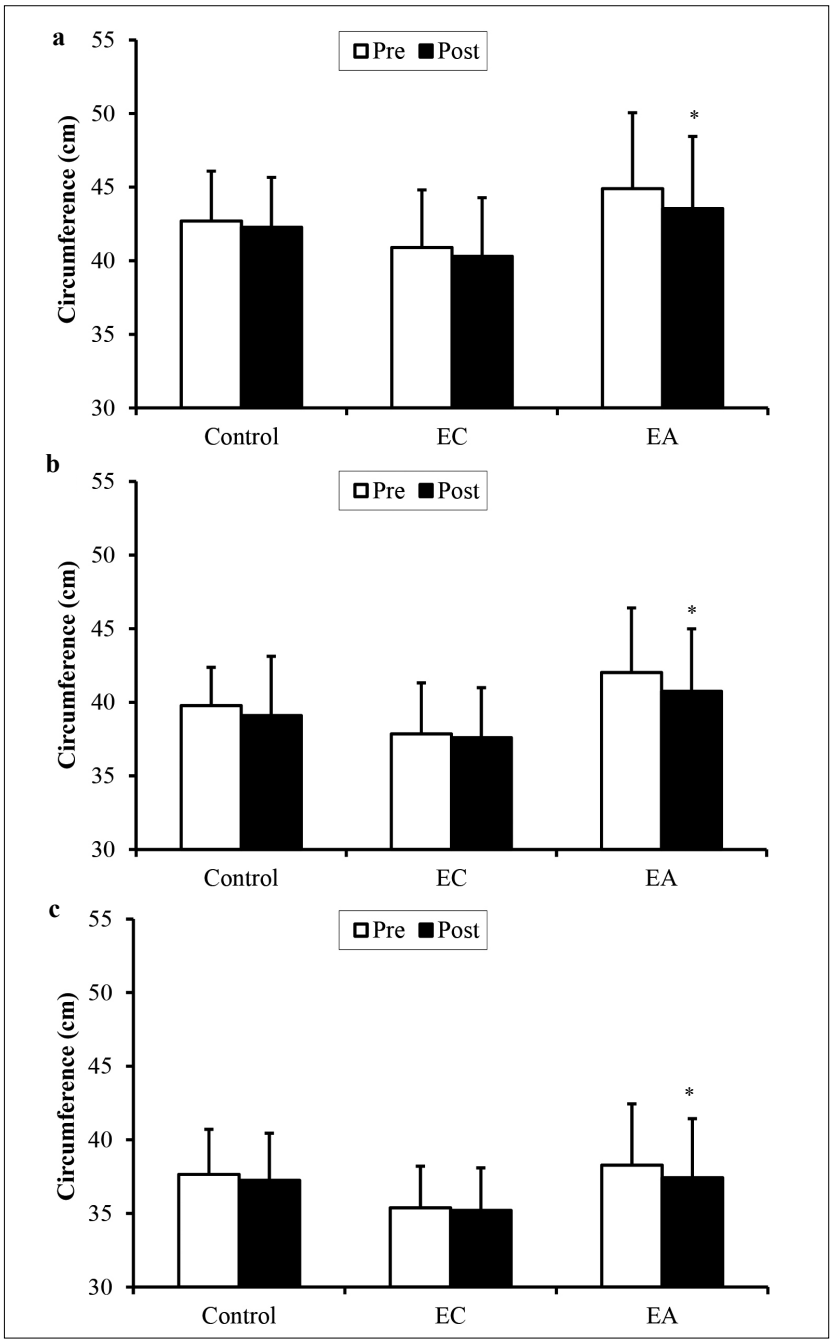

Figure 7. **Mean values (coefficient of variation (CV)) of knee joint circumference (a) over the joint, (b) at the patella, (c) below the flange joint of Control, Experimental Chronic pain (EC) and Experimental Acute pain (EA) groups pre and post knee brace wear**

Note. **p* < .05 comparing to pre intervention value.

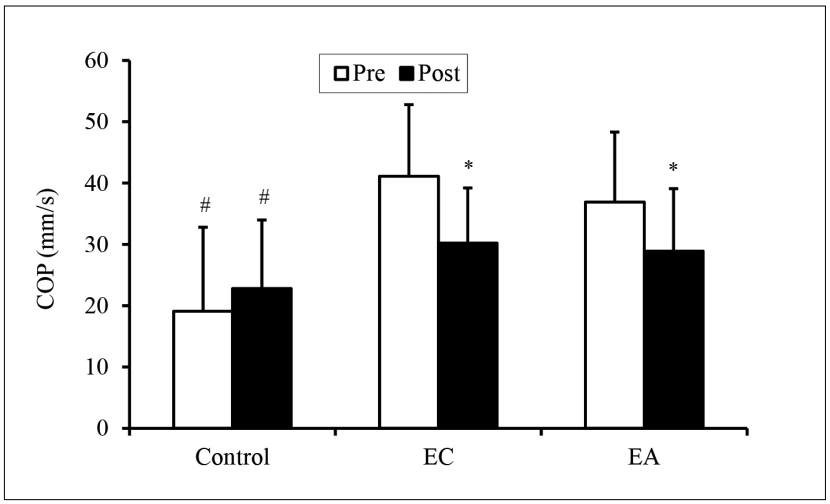

Figure 8. **Mean values (coefficient of variation (CV)) of changes in the velocity of the centre of pressure (COP) of Control, Experimental Chronic pain (EC) and Experimental Acute pain (EA) groups pre and post knee brace wear**

Note. **p* < .05 comparing to pre intervention value, #*p* <.05 compared with EC and EA groups.

Balance. The results showed that subjects in EC and EA groups showed significantly lower changes in velocity of centre of pressure after intervention ($p < 0.05$, Figure 8). No changes in balance were recorded for control group ($p > .05$).

DISCUSSION

Research results showed that low-intensity laser effect with the application of the immobilization is effective for the reduction of pain, relief of inflammatory processes, and rebuilding of patients' daily routine functions. The mobile innovative device is particularly effective in treating knee pain in the acute period.

Technical characteristics of our laser did not differ from lasers used in hospitals. The analysis shows that the diodes most commonly used in clinical practice are 808 nm LEDs with the greatest depth of penetration into the tissues, and the radiation power of up to several hundred milliwatts (Bjordal et al., 2008; van Middelkoop et al., 2011). In our case, infrared laser diodes of the same power incorporated in the brace, have reduced the patient's pain (especially in the acute condition), swelling in the calf and increased the range of flexion and extension of the knee. In addition, subjects subjectively better assessed their skills in everyday activities as measured by the Lysholm scale. Finally, clinical indicators improved more in the experimental group (especially in acute pain) than in the placebo group suggesting that the patient recovers faster using a portable (mobile) laser in the immobilization period. Our data are in accordance with other studies where positive effect of laser application were shown on humans and animals (Hegedus et al., 2009; Pallotta et al., 2012; Shen at al., 2009; Sushko, Lymans'kyi Iu, & Huliar, 2007; Walsh et al., 2000). It is believed that the positive effect of complex treatment can be observed primarily due to the efficiency of laser improving microcirculation of the damaged tissue and promoting collagen synthesis (Hegedus et al., 2009; Rola et al., 2012).

Since balance control involves a multi-joint system (ankle, knee, hip, etc.), any joint dysfunction may reduce the stability of balance (Turcot, Sagawa, Hoffmeyer, Suvà, & Armand, 2015). Effect of laser therapy on postural stability has been very little studied. However, it has been established that the application of laser therapy statistically significantly reduced knee pain in patients suffering from osteoarthritis (Nakamura at al., 2014). The findings of our study confirmed the positive effects of rehabilitation with laser in the treatment of chronic and acute knee pain. Pain reduction improved performance in knee function thus improving balance stability of patients.

Despite the positive clinical results, knee extensor and flexor muscle contraction strength and proprioception indicator – muscle contraction strength variability during the period – changed slightly (except for isokinetic torque at 60°/ second speed). High variance of values of strength and proprioception test results showing the heterogeneity of the sample should be noted as well. The reason for the apparent discrepancy in muscle torque and clinical test results might reflect different intervention effects on very different mechanisms responsible for soreness, swelling, balance, strength and proprioception. Results support the notion that immobilization with brace and laser therapy cannot replace muscle strengthening program, especially in chronic conditions. It is likely that immobilization itself may prevent decrease in muscle force variability at low intensities because lack of movement does not stimulate muscle proprioception (Duchateau & Enoka, 2008).

Probably the most important finding in present study was that in general the positive effect of interventions was evident applying the intervention at home rather than in a stationary clinic. In this case, treatment costs are reduced for research participants and rehabilitators spend less time. Yet in clinic, laser therapy is used only by qualified personnel because the procedure requires specific knowledge about the diversity of exposed points (painful area, active points, etc.). Research results showed that after patients have been trained to use a low-frequency laser in outpatient (home) conditions, good results can be achieved. In pain patients have a high motivation to learn to use a brace with laser and use the interventions according to the given instructions regularly. We have observed that patients had difficulty applying the laser therapy at home because the laser beam coverage was low, and this made it hard trying to hit exactly the painful areas. Further improving the knee brace it would be appropriate to increase the laser impact zone thus decreasing the influence of patient's low qualification factor (error probability) for the final result.

In conclusion, knee brace with laser therapy in the rehabilitation period ensures faster healing of

patients, particularly in acute pain, while muscle strength and proprioception remains depressed. Further studies are necessary to search for optimal laser parameters to make it simpler to use at home with laser impact area expansion being attractive candidate for such purposes.

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RELATIONSHIP BETWEEN MUSCLE STRENGTH OF DOMINANT AND NON-DOMINANT ANKLE AND DYNAMIC BALANCE IN FOOTBALL PLAYERS

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ABSTRACT

Background. Developing lower extremity muscles in a proportional shape plays an important role of balanced body movement. It is believed that special development of muscles which provide multidirectional movements of ankle will contribute to the increase of balance ability, and this may significantly support the improvement of technical skill performance in football. The *aim* of the research was to examine the ability to keep dynamic balance and ankle joint muscle strength in football players, and to prove the relation between the ankle joint muscle strength level and the dynamic balance ability of each foot.

Methods. The participants were amateur footballers (n = 17, football experience 10 ± 1.4years, weekly training 12 ± 1.3 h). "WFQ-R poll" questionnaire was used to determine the participants' dominant and non-dominant limb, the dynamic balance was assessed using "Tecnobody Pro-Kin Type B 252" (Italy) device and ankle joint muscle strength was measured using an isokinetic dynamometer "Cybex Norm" (USA).

Results. Significant differences ($p < .05$) were found between limbs for ankle plantar flexors, in non-dominant limb plantar flexors were stronger. Dynamic balance ability for dominant foot was better in comparison with non-dominant foot. The correlation was found between ankle plantar flexors, evertors, invertors and between dorsal and plantar flexors for both limbs.

Conclusions. Strength improvement of muscles affects the movement of the ankle dynamic balance positively, but for the development of static and dynamic balance, proprioceptive balance training is as effective as strength training.

Keywords: lower limbs, peak torque, balance, asymmetry.

INTRODUCTION

Football is a highly coordinated sports branch in which some endurance factors using aerobic and anaerobic efforts like speed, strength, agility, balance, coordination, muscular and cardiovascular endurances commonly effect on performance (Akgün, 1996). In football, such characteristic features as frequency of tackles, sudden direction changes, jumping, leaping, ball control and technical abilities, highly depend on the level of neuromuscular coordination (proprioception). The level of neuromuscular coordination ability is in close relationship with dynamic balance (Csanadi, 1973).

In football, developing lower extremity muscles proportionally plays an important role for balanced body movements. It is believed that a special development of muscles which provide multidirectional movements of ankle will contribute to the improvement of balance ability, and this may significantly support the improvement of technical skills. Technical skills improve while using them in a balanced way in body's moving asymmetry.

Balance and stability are important parts of many movement applications to sustain a posture (Carr & Shepherd, 1998), they are considered to be an important aspect of sport performance (Bressel, Yonker, Kras & Heath, 2007; Hrysomallis, McLaughlin & Goodman, 2006) as well as ankle joint injury risk prevention (Lin, Liu, Hsieh & Lee, 2009; McGuine, Greene, Best, & Leverson, 2000; Troop, Ekstrand & Gillquist, 1984). This feature can be accepted as an important factor affecting success in football. In most match situations, the lower limbs assume an important role – to provide necessary body stability during kicking, dribbles, repetitive decelerations and accelerations, rapid changing of moving direction, jumps and other manoeuvres, which are typical for football discipline (Pau et al., 2015; Teixeira, de Oliveira, Romano & Correa, 2011). Lower extremity stabilization muscles have an important role in balancing. It can be said that strengthening these muscles affects the development of balance (Malliou, Gioftsidou, Pafis, Beneka & Godolias, 2003).

There are different ways to evaluate muscular strength, balance and stabilizations of joints. The most useful method in sport practice to determine muscle strength and the asymmetry level between dominant/non-dominant limb and agonist/antagonist muscles is testing with an isokinetic dynamometer (Olyaei et al., 2006). An isokinetic device makes it possible to objectively assess lower extremity muscular strength, which is extremely important for some specific movements like sprint, jumping, rapid movement direction changing, ball passing and kicking (Malliou et al., 2003).

In football the dominant foot is mostly used for activities like ball control, passing and kicking, while non-dominant limb provides balance and support functions. Greve, Alonso, Carolina and Camanho (2007), McCurdy and Langford (2006) compared foot balance index of dominant and non-dominant foot in their studies and they could not find any statistically significant difference.

Malliou, Gioftsidou, Pafis, Beneka, and Godolias (2004) observed that there was a development in proprioception in a positive way and it had a blocking effect on lower extremity injury according to data derived from tool procedures which were applied on young and healthy football players and used at the end of specific balance training. In a study comparing balance parameters between two groups of footballers and not footballers, Sucan, Yilmaz, Can, and Süer (2005) determined that all the balance parameters were different for the benefit of "playing footballers" and this situation was stated as physiologic system where balance could be controlled better in playing football players. Radford (2006), however, identified that there was no difference between the parameters of professional and academicals football players.

Numerous studies have focused on the static balance testing in football players; however Pau et al. (2015) suggest that dynamic balance evaluation is more important in football because test conditions are more similar to those encountered in matches or training sessions. The main finding of the studies about the relationship between static and dynamic balance abilities in young and professional elite football players is that there are no significant correlation between those two (Hrysomallis et al., 2006; Pau et al., 2015). Static balance results do not reflect dynamic balance abilities, in football these two are not related.

Findings of Hsieh, Yang and Hsieh (2008) showed that ankle muscular strength played an important role on providing dynamic balance and they emphasized that strength training for lower extremity was important to increase dynamic balance. Mattacola and Loyd (1997) proved that strength training in plantar flexor, dorsal flexor, inversion and eversion muscle groups three times a week for 6-weeks as well as training proprioception balance improved dynamic balance. Kligytė, Ekman and Medeiros (2003) determined that weakness in lower extremity muscular strength had a negative effect on dynamic balance; however dynamic balance problems could not be resolved only increasing lower extremity muscular strength. Hamrin et al. (1982) reported that there was a weak correlation between lower extremity muscular strength and balance after disability. The *aim* of the research was to examine the ability to keep dynamic balance and ankle joint muscle strength in football players, and to prove the relation between the ankle joint muscle strength level and the dynamic balance ability of each foot.

METHODS

Participants. Amateur football players (n = 17, age 22.3 ± 5.1 years, body mass 72.47 ± 9.71 kg, height 178.47 ± 7.5 cm, football experience 10 ± 1.4 years), who regularly exercised (12 ± 1.3 h/week), played on the field in Izmir and never had any disability of ankle joint before, participated in

the study. All participants were divided into groups of 3-5 individuals per each group for each test day.

Procedures. Before dynamic balance and muscle strength tests, participants completed "Waterloo Footedness Questionnaire - Revised" (WFQ-R) to determine their dominant and non-dominant lower limb. The participants warmed up by cycling on a bike ergometer with 55-65 r/min speed for 5 min and after that they did static and dynamic stretching exercises for low extremity and body core muscles for about 5 min.

Dynamic balance testing was performed using Tecnobody Pro-Kin Type B 252 Device (Italy); dominant and non-dominant limb Total Stability Index (tsi) from Equilibrium/Disequilibrium management test protocol was applied for future data proceeding. Participants were asked to stand barefoot on one leg with eyes wide opened, their arms were crossed over the chest and the knee of the contralateral limb was flexed and held at about 90° without contacting the support limb. They tried to stay as still as possible for 30 s. During the test participants were instructed to stand as motionless as possible, they were able to follow foot position and "0" point (which stated the best balance level) from a monitor in front of them. One familiarization trial per each lower limb was allowed before testing. During testing, silence was kept in the laboratory, participants joined dynamic balance test one by one. After 5 min rest football players who completed dynamic balance test (one trial per limb) went to ankle joint muscle strength testing.

During ankle joint muscle strength measurements (peak torque), one leg was placed in Cybex Norm (USA) isokinetic dynamometer in the following testing positions: knee joint flexion 80–110°, ankle joint testing angle fixation in eversion 20°, inversion 30°, plantar flexion 15° and dorsal flexion 10°. Aiming at familiarization with testing exercise, participants had a trial with 3 repetitions, and then they had a 10 s break. The testing protocol included 5 repetitions for each limb in concentric isokinetic mode at 120°s^{-1} angular speed. Peak torques of ankle joint muscles (inversion, eversion, plantar and dorsal flexion muscles) were presented in foot-pounds (ft· lb).

All measurements were carried out in 10 days, and one hour per each participant on average was spent, 20 h in total.

Data analysis. Indications of 4 direction strength related to ankles in the dominant and non-dominant limbs were compared. The relationship between dominant and non-dominant limb's strength values and dynamic balance abilities was determined. SPSS statistical package (SPSS Inc., Chicago, IL, USA) for Windows 11.0 version was used for data analysis. Taking account of average values, frequency analyses, descriptive statistics, nonparametric paired groups test and correlation tests were used. Significance level $p < .05$ was accepted as statistically significant.

RESULTS

According to WFQ-R questionnaire results, 14 football players had right leg dominance and only 3 players – left leg dominance. Descriptive statistics and differences between the players' limbs, torque values of lower limb ankle joint muscles plantar/dorsal flexors and invertors/evertors peak are presented in Table 1.

Significant differences were found between limbs for ankle plantar flexors ($p < .05$); in non-dominant limb plantar flexors were stronger. There were no statistically significant differences between dominant and non-dominant ankle dorsal flexors, invertors and evertors muscles - the average values in both limbs were rather similar.

Dominant and non-dominant limb Total Stability Index values are presented in Table 2. Significant differences were observed between

Table 1. **Dominant (D) and non-dominant (N-D) ankle joint muscle strength values (ft·lb)**

Values	Plantar flexors		Dorsal flexors		Invertors		Evertors	
	D	N-D	D	N-D	D	N-D	D	N-D
Average	54.5	64.8	35.41	33.17	19.23	19.35	15.94	15.23
SD	23.83	34.87	12.73	11.39	5.05	6.54	4	3.9
Min	26	28	15	17	12	12	11	10
Max	107	152	56	61	29	37	22	22
p	.02*		.41		.85		.14	

Note. *$p < .05$, Wilcoxon Signed Ranks Test.

average values which state dynamic balance abilities of dominant and non-dominant foot ($p < .05$). According to the obtained data, dynamic balance for dominant foot was better in comparison with non-dominant foot.

Table 2. **Total Stability Index values in the dynamic balance test**

Limbs	Average	SD	Min	Max	p
Dominant	2.21°	0.55	1.27°	3.21°	
Non-dominant	2.57°	0.8	1.43°	4.44°	.05*

Note. *$p < .05$, Wilcoxon Signed Ranks Test

Relationships between average values of dominant and non-dominant limbs' dynamic balance and ankle muscle strength values can be seen in Tables 3 and 4. There were no statistically significant relationships between average values of dominant and non-dominant limbs' dynamic balance and ankle muscle strength peak torque values (inversion, eversion, plantar flexion and dorsal flexion).

The correlation was found between ankle plantar flexors, evertors and invertors as well as between dorsal and plantar flexors for both limbs.

Spearman's Correlation	1	2	3	4	5
Dynamic Balance (D)	1				
Dominant Inversion	.33	1			
Dominant Eversion	.20	.84**	1		
Dominant Plantar Flexion	.25	.52*	.38	1	
Dominant Dorsal Flexion	.21	.48*	.30	.67**	1

Table 3. **Correlation between dominant ankle joint muscle strength and dynamic ability average parameters**

Note. *$p < .05$; **$p < .01$, nonparametric correlation.

Spearman's Correlation	1	2	3	4	5
Dynamic Balance (N-D)	1				
Non-dominant Inversion	.76	1			
Non-dominant Eversion	–.10	.63**	1		
Non-dominant Plantar Flexion	–.21	.73**	.30	1	
Non-dominant Dorsal Flexion	.07	.33	.17	.63**	1

Table 4. **Correlation between non-dominant ankle joint muscle strength and dynamic ability average parameters**

Note. *$p < .05$; **$p < .01$, nonparametric correlation.

DISCUSSION

The purpose of the present study was to examine the relationship between the dynamic balance ability and ankle joint muscle strength of the dominant and non-dominant limbs in football players. The main results of the study show lack of correlation between dynamic balance and ankle joint muscle peak torque, and significant correlation between ankle plantar flexors, evertors and invertors as well as between dorsal and plantar flexors for both limbs in amateur football players.

Numerous studies have focused on the relationship between balance and lower extremity muscles strength. In contrast with our study, Pant, Sukumar, Sharma, Pandey and Goel, (2006) stated that there was an important relationship between ankle dorsal flexion (r = .443) strength and body balance. In the same study, it was found that there was a lower relationship (r = .203) between eversion strength and balance, while there was a weak relationship (r = .159) between inversion strength and balance. Cote, Brunet, Gansneder and Shultz (2005) reported that postural control and dynamic balance were needed for daily life activities and sport activities for the optimum performance. Hrysomallis (2008) observed postural balance indicators of 28 elite Australian footballers before and in the break of season, and the main finding was that footballers who had regular balance training were better in single leg balance test. According to this author, the usual football training does not improve balance ability. The results of our study showed that in footballers, dynamic balance of the dominant limb was statistically better than the one in non-dominant limbs ($p < .05$). In contrast, Aydin, Yildiz, Yildiz, Ateşalp, and Kalyon (2002) found no significant

difference between dominant and non-dominant lower extremity balance in gymnasts. These conclusions could reflect a sport specific training effect on balance and ankle joint muscle strength development, it could be suggested that in sport gymnastics there are more symmetric physical loads for both extremities which exclude balance and muscle strength asymmetry development. In line with a previous study (Aydin et al., 2002), Greve at al. (2007), McCurdy and Langford (2006) compared dominant, non-dominant limb balance indexes and could not find statistically significant differences between lower extremities.

Holm et al. (2004) observed a significant improvement in dynamic balance after neuromuscular preventive training program introduced to healthy female handball players and the improvement in dynamic balance was maintained one year after the start of training.

Bernier, Perrin, and Rijke (1997) observed ankle inversion and eversion torque strength and body balance and as a result, they found that ankle strength was statistically not effective on body balance. They also observed dominant and non-dominant ankle inversion and eversion eccentric peak torques and they stated that non-dominant foot strength was significantly stronger than the dominant foot ($p < .05$).

Mattacola and Loyd (1997) proved that due to ankle plantar and dorsal flexor, inversion and eversion muscle group strengthening, training three times per week for 6 weeks, dynamic balance improves. Kligyte et al. (2003) determined that weakness of lower extremity muscular strength might have an effect on dynamic balance; however dynamic balance problems could not be solved only with the increase of low extremity muscular strength.

Bozan, Koçyiğit, Cankurtaran, Gülbahar, and Peker (2010) found that in addition to strengthening exercises in postmenopausal and osteoporosis patients, balance and coordination exercises produced better results of dynamic balance functions. According to Altay (2001), the athletic skill of balance is an important factor to distinguish between good and poor athlete's performance and balance provides a positive effect on the physical development of motor skills. Troop et al. (1984) emphasized that weak balance in football players could be a risk factor for ankle disability.

It is clear that dynamic balance and lower ankle joint muscle strength play an important role in low extremity injury prevention and football players' specific motor abilities, such as agility. Agility is the ability to change the body's position efficiently, and requires the integration of balance, coordination, speed, reflexes, strength, and endurance (Brown, Ferrigno & Santana 2000). There is no doubt that dynamic balance is an important factor for agility (Altay, 2001) and also an important component for coordinative abilities (Chelladurai, 1976; Chelladurai, Yuhasz, & Sipura 1997; Lemmink, Elferink-Gemser, & Visscher 2004). It is believed that dynamic balance can positively affect agility and agility training can also develop dynamic balance.

The results of the study proved that in amateur footballers dynamic balance ability of the dominant limb was statistically better than balance abilities of non-dominant limb. Besides, although it was not statistically significant, dorsal flexion strength values of the dominant foot were slightly better than dorsal flexion strength values of the non-dominant foot, and there was no statistically significant relationship between dominant and non-dominant limbs' balance and average strength values of the ankle (inversion, eversion, plantar flexion and dorsal flexion). On the other hand, it was determined that there an insignificant and negative relationship between balance ability and eversion and plantar flexion strength of non-dominant foot. Some findings of existing research support these conclusions.

As a result, we can say that strengthening muscles which play a role in the movements of the ankle may also positively affect dynamic balance. Proprioceptive balance training can also be effective on static and dynamic balance development as much as strength training. Hrysomallis (2008) observed that in a postural balance indication with only one leg of footballers before season and in the break of season, footballers who had balance training were better than those who did not. According tham, normal football training did not develop balance ability. Troop et al. (1984) emphasized that weak balance could be defined as a risk factor for disability of ankle. Results obtained in our study revealed that depending on strength and dynamic balance development with both dominant and non-dominant ankle strength training, dynamic balance training can affect agility which is considered as important biomotor ability for team sports like football, and decreasing possibility of ankle disability risks. Besides some coordinative skills like balance, agility, rhythm reaction, determining

direction in space-place, kinesthetic perception should be taken in consideration.

CONCLUSION

Strength improvement of muscles affects the movement of the ankle dynamic balance positively, but for the development of static and dynamic balance, proprioceptive balance training is as effective as strength training.

Teaching basic technical skills and developing coordination skills, forming movement symmetry is very important for sports carrier equally using dominant and non-dominant extremities.

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THE INFLUENCE OF THE FIRST GOAL ON THE FINAL RESULT OF THE FOOTBALL MATCH

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ABSTRACT

Background. Among many technical and tactical aspects of the behaviour of players, the goals are the most studied. The goal is the key to success for teams and its analysis in all matches of a major football tournament that allows multiple assessments.

Methods. The aim of this study was to analyze the influence of the first goal on the final result of the football match, identifying the team that scored the first goal and the final result obtained by this team: winning, drawing or losing, and subsequently, to relate the obtained results to physical, technical, tactical and psychological performance. We analyzed all the matches of the last 5 editions of the 6 major football tournaments (national teams) in the world: FIFA World Cup, UEFA Euro, CONMEBOL America Cup, AFC Asian Cup, CAF Africa Cup of Nations, and FIFA Confederations Cup (n = 996). The data were obtained from the database on the websites of the official federations, through overviews of the official matches. Quantitative data were collected in relation to the time that the goals were scored in the course of the matches. The statistical analysis of the results was conducted using the non parametric chi-square test.

Results. According to the results, the team that scored the first goal in these last tournaments presented a high probability of winning (the average of 71.17% in the 6 tournaments).

Conclusion. Thus, the high probability of victory in favour of the team that scores the first goal in the match of football is linked to the physical, technical, tactical and mainly the psychological aspects.

Keywords: psychological goal, tactical aspects, evolutionary trends, football tournaments.

INTRODUCTION

In competitive sports, and more specifically in football, the level of performance is determined by a number of dexterities and abilities that are significantly inter-correlated: technique (coordination abilities, kinetic skilfulness), tactics (cognitive and planning abilities), psychological factors (motivation, desires, willingness) and finally, fitness (Weineck, 1997). The union of these skills and capabilities has the pursuit of victory as the main objective, through a good defensive performance, avoiding goals marking by the opposing team, and good offensive performance, by goals marking (Leite, 2013a).

In football matches the goal is the pinnacle of the game, it determines the procedures that lead to the goal, and therefore the imbalance on the scoreboard supposed to find some of the keys of the game, as it allows identifying the most effective forms of attack, and, conversely, providing insight to better defensive organization. Both aspects are an important base for tactical training of the teams (Mombaerts, 2000). The evaluating goal scoring patterns in football matches may contribute to determining the factors that enable effective competition performance (Armatas, Yiannakos, Papadopoulou, & Skoufas, 2009a). It is the aim of every coach to prepare players such that they can score goals to win matches and tournaments (Njororai, 2014).

Among the many technical and tactical aspects of players behaviour, the goals are the most studied. The goal is the key of success for the teams (Cachay & Thiel, 2000 as cited in Michailidis, Michailidis & Primpa, 2013) and therefore its analysis in all matches in a big football tournament (e.g. World Cup, European championship, World Cup, etc.) allows for multiple assessments. These results are used by the coaches with the view of producing more effective training sessions in their teams. Additional analyses of consecutive tournaments and comparison of the results can indicate trends in football evolution over time (Lottermann, 2000; Theis, 2000 as cited in Michailidis et al., 2013).

The need for constant record and evaluation of football characteristics is prevalent since it presents continuous evolvement and change as far as the mode of the game is concerned. Additionally, the information collected from researchers through these studies, and transferred to coaches and players, is very important for the design of training, the choice of appropriate tactics and its application in the game (Yiannakos & Armatas, 2006).

Coaches and sports scientists in general strive to learn the scoring patterns and the basic situations that prevail during matches so as to improve players' scoring skills. One of the key aspects of scoring that the coach and players should pay attention to is the distribution of goals throughout the match (Njororai, 2007). Therefore, being aware of how the goals occur allows coaches to prepare their guided training in competitive environment (Dias & Santana, 2006; Fukuda & Santana, 2012), creating a favourable environment for the development of players and teams (Alves & Bueno, 2012).

The present study aims to expand the knowledge level of the internal dynamics involving the football, as well as variables that possibly explain the phenomena that occur in the practice of this sport modality. It is attempting to inquire performance indicators, technical and tactical perspectives that unbalance the match in our favour (Huges, 2004). In this sense, the aim of this study was to analyze the influence of the first goal on the final result of the football match identifying the team that scored the first goal of the match and the final result obtained by this team: win, draw or defeat; thus, identifying what is the probability of a team that scores the first goal of the match to be victorious and subsequently, to relate the obtained results to physical, technical, tactical and psychological performance.

METHODS

Sample. We analyzed all the matches played in the last 5 editions of the major football tournaments (national teams) in the world: FIFA World Cup 2014, 2010, 2006, 2002 and 1998 (n = 320); UEFA Euro 2012, 2008, 2004, 2000 and 1996 (n = 155); CONMEBOL America Cup 2011, 2007, 2004, 2001 and 1999 (n=130); AFC Asian Cup 2015, 2011, 2007, 2004 and 2000 (n = 154); CAF Africa Cup of Nations 2015, 2013, 2012, 2010 and 2008 (n = 157); FIFA Confederations Cup 2013, 2009, 2005, 2003 and 2001 (n = 80); totalling 996 matches in these 6 tournaments.

The data were obtained from the database on the websites of the official federations: Union of European Football Association – UEFA (www.uefa.com); Confederación Sudamericana de Fútbol – CONMEBOL (www.conmebol.com); The Asian Football Confederation – AFC (www.the-afc.com); Confédération Africaine de Football – CAF (www.cafonline.com); *Fédération Internationale de Football Association* – FIFA (www.fifa.com); through official overviews of the games. We collected quantitative data which are related to the times the goals were scored in the course of the matches. Castellano, Casamichana, and Lago (2012) established the reliability of the FIFA match statistics by randomly coding five matches and compared it with the FIFA website data. The resulting values using Cohen's Kappa (K) were between .93 and .97. This establishes a high reliability index for the FIFA and other federations' website data.

Procedure. For the study, we used the following variable - the relationship between scoring the first goal of the game and the final result obtained by the same team, using the variables: Victory, Draw and Defeat. For this variable, as it is described in studies developed by Leite and Barreira (2014), Barreira, Garganta, Guimarães, Machado, and Anguera (2014) and Machado, Barreira, and Garganta, (2014), only the goals scored during regular time of the game, 90 minutes, were considered.

Data analysis. All data were analyzed using the statistical package for PC SPSS 20.0. (Lead Tecnologies Inc, USA). Non parametric chi-square (χ^2) analysis was used to determine the statistically significant differences and the level of significance was set at $p < .05$.

RESULTS

The data in Table 1 show the results obtained in the matches of the last 5 editions of the FIFA World Cup. In World Cup 2014, in 74.08% of the matches (40 matches), the team that scored the first goal won the match. In World Cup 2010, the team that scored the first goal was victorious in 78.57% of the matches (44 matches). In World Cup 2006, in 73.68% (42 matches), the team that scored the first goal won the match. In World Cups 2002 and 1998, the team that scored the first goal was victorious in 63.94% (39 matches) and 65% (39 matches) of the matches, respectively.

The data in Table 2 show the results obtained in the matches of the last 5 editions of the UEFA Euro. In Euro 2012, in 75.86% of the matches (22 matches), the team that scored the first goal won the match. In Euro 2008, the team that scored the first goal was victorious in 72.42% of the matches (21 matches). In Euro 2004, in 53.85% (14 matches), the team that scored the first goal won the match. In Euro 2000 and 1996, the team that scored the first goal was victorious in 75% (21 matches) and 73.08% (19 matches) of the matches, respectively.

The data in Table 3 show the results obtained in the matches of the last 5 editions of the CONMEBOL America Cup. In America Cup 2011, in 66.67% of the matches (14 matches), the team that scored the first goal won the match. In America Cup 2007, the team that scored the first goal was victorious in 70.83% of the matches (17 matches). In America Cup 2004, in 61.54% (16 matches), the team that scored the first goal won the match. In America Cups 2001 and 1999, the team that scored the first goal was victorious in 80% (20 matches) and 72% (18 matches) of the matches, respectively.

The data in Table 4 show the results obtained in the matches of the last 5 editions of the AFC Asian Cup. In Asian Cup 2015, in 78.13% of the

Aspect (excluding 0x0 draws)	FIFA World Cup 2014	FIFA World Cup 2010	FIFA World Cup 2006	FIFA World Cup 2002	FIFA World Cup 1998	Average
Win	74.08	78.57	73.68	63.94	65	71.06*
Draw	11.11	16.07	14.04	22.95	25	17.83
Defeat	14.81	5.36	12.28	13.11	10	11.11

Table 1. **The influence of the first goal on the final result of the match in FIFA World Cups (%)**

Note. * – statistically significant difference between draw and loss ($p < .05$).

Aspect (excluding 0x0 draws)	UEFA Euro 2012	UEFA Euro 2008	UEFA Euro 2004	UEFA Euro 2000	UEFA Euro 1996	Average
Win	75.86	72.42	53.85	75	73.08	70.04*
Draw	17.24	13.79	23.07	14.29	26.92	19.06
Defeat	6.9	13.79	23.07	10.71	–	10.90

Table 2. **The influence of the first goal on the final result of the match in UEFA Euro (%)**

Note. * – statistically significant difference between draw and loss ($p < .05$).

Aspect (excluding 0x0 draws)	CONMEBOL America Cup 2011	CONMEBOL America Cup 2007	CONMEBOL America Cup 2004	CONMEBOL America Cup 2001	CONMEBOL America Cup 1999	Average
Win	66.67	70.83	61.54	80	72	70.21*
Draw	28.57	12.5	26.92	12	16	19.20
Defeat	4.76	16.67	11.54	8	12	10.59

Table 3. **The influence of the first goal on the final result of the match in CONMEBOL America Cups (%)**

Note. * – statistically significant difference between draw and loss ($p < .05$).

Aspect (excluding 0x0 draws)	AFC Asian Cup 2015	AFC Asian Cup 2011	AFC Asian Cup 2007	AFC Asian Cup 2004	AFC Asian Cup 2000	Average
Win	78.13	75	60.71	68.96	60.87	68.73*
Draw	9.37	14.29	25	24.14	34.78	21.52
Defeat	12.5	10.71	14.29	6.9	4.35	9.75

Table 4. **The influence of the first goal on the final result of the match in AFC Asian Cups (%)**

Note. * – statistically significant difference between draw and loss ($p < .05$).

Table 5. **The influence of the first goal on the final result of the match in CAF Africa Cups (%)**

Aspect (excluding 0x0 draws)	CAF Africa Cup 2015	CAF Africa Cup 2013	CAF Africa Cup 2012	CAF Africa Cup 2010	CAF Africa Cup 2008	Average
Win	40.74	57.14	80.65	68	73.33	63.97*
Draw	40.74	39.29	12.90	16	20	25.79
Defeat	18.52	3.57	6.45	16	6.67	10.24

Note. * – statistically significant difference between draw and loss ($p < .05$).

Table 6. **The influence of the first goal on the final result of the match in FIFA Confederations Cups (%)**

Aspect (excluding 0x0 draws)	FIFA Confe. Cup 2013	FIFA Confe. Cup 2009	FIFA Confe. Cup 2005	FIFA Confe. Cup 2003	FIFA Confe. Cup 2001	Average
Win	86.66	78.57	66.67	78.57	100	83.04*
Draw	6.67	7.14	26.67	7.14	–	8.48
Defeat	6.67	14.29	6.66	14.29	–	8.48

Note. * – statistically significant difference between draw and loss ($p < .05$).

Table 7. **Average probability between the indicators and analyzed tournaments (%)**

Aspect	FIFA World Cups	UEFA Euro	CONMEBOL America Cups	AFC Asian Cups	CAF Africa Cups	FIFA Confe. Cups	Average
Win	71.06	70.04	70.21	68.73	63.97	83.04	71.17*
Draw	17.83	19.06	19.20	21.52	25.79	8.48	18.65
Defeat	11.11	10.90	10.59	9.75	10.24	8.48	10.18

Note. * – statistical significant difference between draw and loss ($p < .05$).

matches (25 matches), the team that scored the first goal won the match. In Asian Cup 2011, the team that scored the first goal was victorious in 75% of the matches (21 matches). In Asian Cup 2007, in 60.71% (17 matches), the team that scored the first goal won the match. In Asian Cups 2004 and 2000, the team that scored the first goal was victorious in 68.96% (20 matches) and 60.87% (14 matches) of the matches, respectively.

The data in Table 5 show the results obtained in the matches of the last 5 editions of the CAF Africa Cup of Nations. In Africa Cup 2015, in 40.74% of the matches (11 matches), the team that scored the first goal won the match. In Africa Cup 2013, the team that scored the first goal was victorious in 57.14% of the matches (16 matches). In Africa Cup 2012, in 80.65% (25 matches), the team that scored the first goal won the match. In Africa Cups 2010 and 2008, the team that scored the first goal was victorious in 68% (17 matches) and 73.33% (22 matches) of the matches, respectively.

The data in Table 6 show the results obtained in the matches of the last 5 editions of the FIFA Confederations Cup. In Confederations Cup 2013, in 86.66% of the matches (13 matches), the team that scored the first goal won the match. In Confederations Cup 2009, the team that scored the first goal was victorious in 78.57% of the matches (11 matches). In Confederations Cup 2005, in 66.67% (10 matches), the team that scored the first goal won the match. In Confederations Cups 2003 and 2001, the team that scored the first goal was victorious in 78.57% (11 matches) and 100% (14 matches) of the matches, respectively.

Table 7 shows the average results for each analyzed tournament. According to results, the team that scores the first goal of the match features a probability of 71.17% to get the victory, 18.65% probability to draw the match, and 10.18% being defeated.

DISCUSSION

According to the data of tables 1–7, the team that scores the first goal in a football match presents a high probability of achieving victory (average of 71.17%). This probability is increasing, often in tournaments held in recent years. According to Leite (2013 b), this phenomenon can be explained because modern football has changed over the last few years. Among these changes are tactical evolution and modern fitness.

According to Castillo-Rodríguez et al. (2007), football is evolving in order to outline the matches tactically, observing little variations in matches and few goals, which makes us see the importance of being the team to score the first goal, since in a high probability the team will be winning. The tactical football evolution has been such that it is observed as the team goes ahead on the scoreboard in a few occasions draw and even less is defeated by the opposing team. As Bloomfield, Polman and O´Donoghue (2005) suggest, the start goal is influential in determining the match result.

In the literature of football, there are some studies investigating the influence of the first goal on the final result of the football match (Armatas & Yiannakos, 2010; Leite, 2013b). Saltas and Ladis (1992 as cited in Armatas, Yiannakos, Zaggelidis, Papadopoulou & Fragkos, 2009b) examined all the matches of the Greek championship 1990–1991 and found that the team that scored the first goal of the game came out victorious in 70.3% of all matches. Armatas et al. (2009a) studied the influence of the first goal for the final result of the game in 240 matches in the Greek Super League 2006–2007 and found that in 71.43% the team that scored the first goal of the game won.

Armatas et al. (2009b) also studied the influence of the first goal on the final outcome of the Greek Super League games from 2007–2008, of the 240 matches played in the competition, the team that scored the first goal of the match came out victorious in 74.2%. Sampedro and Pietro (2012) checked the effect of scoring the first goal for the final result of the match in the Spanish league in the seasons 2005-06 to 2009-10. In total 1.759 matches were analyzed and it was found that on average the team that scored the first goal was victorious in 79.32%.

According to Armatas and Yiannakos (2010), maybe the participation of very weak teams in World Cup, but also the deterioration of physical condition of most teams (tournament conducted after all major leagues) resulted in a decreased reaction when a team was conceded a goal. Probably the participation of weaker teams, mainly related to the technical aspect (but also considering the tactical and physical aspects), is certainly one of the possible causes. The deterioration of the physical condition, by itself, does not seem to explain it, since all the teams participating (e.g. in the World Cup and Euro Cup), participate in tournaments at the end of their leagues and have similar schedules.

As football is a tactical and strategic sport, the contextual variable of the partial outcome of the match seems to have an influence on the game and the player, as the teams alter the style of play based on the partial result of the match (Bloomfield et al., 2005; Taylor, Mellalieu, James & Shearer, 2008), probably after achieving a goal the coaches change their tactics and give more defensive orientation in their team (Michailidis et al., 2013), making it difficult that the result of the scoreboard change (Castillo-Rodríguez et al., 2007).

Although it does not happen always, usually, the team scores a goal (in the first case), has a natural tendency to retreat somewhat their redlines and defend more, e.g., playing longer amid zones field instead of attack or defence areas as it usually happens when the score is tied (Bloomfield et al., 2005). This forces the opposing team, which is at a disadvantage, having to try to reverse the score, implying that the team risking more to the attack (Castillo-Rodríguez et al., 2007). According to Leite (2013a), this fact has two characteristics:

- Exposes the team that is looking to reverse the score the more attacking the opposing team, and consequently suffer counterattack;
- Can also cause physical exhaustion be more pronounced in this team, which may favour a higher incidence of goals at the end of the match by the opposing team.

The goal also appears to be an inducer factor of high psychological burden on the players (Álvarez-Medina, Giménez-Salillas, Corona-Virón & Manonelles-Marqueta, 2002), being a strong predictor of the final result (Sampedro & Pietro, 2012). Roffé, De la Vega, Garcia-Mas and Llinás (2007) claim that every analysis that has been done on the "psychological goal" (also called psychological moment) has been able to find relevant relationships with psychological variables both individual or of a team. Gayton, Very & Hearns (1993) define the psychological moment as the benefit obtained when you have an initial success in a sporting context, which produces a psychological moment in the athlete that will lead to future success and that explains the yielded variations in the teams and in their players.

Theis (1992) reported that when a team scored the first goal, it demonstrated improvement in performance and increased self-confidence. Football coach should have his players prepared tactically and psychologically in order to be ready to face getting back in score. Thus, training should

include training matches with different numbers of players and time limit.

The mental aspect just seems to be the main factor associated with the influence of the first goal for the final result of the game, however, there are other factors (e.g. substitutions, expulsions, interval) that seem to influence the performance of the teams but with less relevance (Roffé et al., 2007), i.e. the team that can score the first goal of the game tends to improve their psychological aspect, maintaining or improving their performance, while the team that suffers the first goal also suffers a decrease in psychological aspect, tending to reduce its performance in competition (Leite & Barreira, 2014). According Roffé et al. (2007), the player can enter a "psychological crisis", during which their ability to meet the demands and needs of the competition can be substantially altered.

Bompa (2005) states that the higher the player's level is, the bigger the demand requirement will also be and therefore the stress during a game. According to Brandão (2000), from the psychological point of view, stress is related to the activation of cognitive, psychological or mental activity. The author found the stress factors in football players, saying that, in the modality, stress is a complex and multifunctional process that can negatively influence the performance of the athlete. Thus, having to try to return an adversely score, besides the physical exhaustion, it can certainly cause the player's psychological strain.

Currently, with the technical balance achieved by athletes and high performance football teams, the emotional aspects (psychological) have been considered as an important differential in the moments of great decisions (Acevedo & Pérez, 2013; Rubio, 1999; Rubio, 2002; S. Souza, L. Souza & Ferreira, 2011) and may be often the difference between victory and defeat in a competition. With the psychological work, the athlete may have a better adaptation to the rigorous work effort that requires belong to a high-performance team (Cárdenas & Cárdenas, 2012).

CONCLUSION

Comparing the results found in this study with the results of previous studies, scoring the first goal in a modern football match is a high probability of achieving victory. According to Garganta (1997), the final result of a player or team in sports games has a multifactorial character. Therefore, sports performance can be attributed to a high degree of specialization and development of the physical, technical, tactical and psychological parameters.

Thus, the high probability of victory in favour of the team that scores the first goal in the match of football is linked to these aspects, mainly the psychological parameter. In top-level football teams, the team that is well trained and able to maintain a good performance in all these aspects tends to be more likely to perform better in the match.

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ST-SEGMENT DEPRESSION IS AN IMPORTANT INDEX OF CARDIOVASCULAR FUNCTIONAL STATE DURING EXERCISING IN NON-ATHLETES' COHORT

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ABSTRACT

Research background. The hypothesis for this study was that functional ischemic episodes in cardiac muscle during intensive exercising are characteristic of non-athletes and research aim was to find out if individual functional fitness could be revealed by registering ST-segment depression during various type of exercising.

Methods. Non-athletes and well-trained runners were involved in the study. Three separate studies (*first* – increasing intensity of exercising; *second* – intensive exercise bout; *third* – continuous aerobic exercising) were performed. Twelve leads EGC were registered; heart rate (HR) and ST-segment depression were taken for analysis.

Results. Elite runners exhibited better functional fitness, i.e. were able to perform higher increase in workload, and lower HR values during the same intensity of exercising. The significant differences between cohorts were observed in the dynamics of ST-segment depression. There were no significant changes at onset of incremental exercising in both cohorts, but after reaching some intensity of exercising transient ischemic episodes were registered in the cohort of non-athletes (*the first study*). The same type of differences between cohorts was observed at onset of maximal vertical jumping (*the second study*) and even during the performance of continuous aerobic exercising (*the third study*).

Conclusions. Functional ischemic episodes in cardiac muscle during exercising is characteristic of non-athletes but not of well-trained athletes, and the ST-segment depression could be used as an important index of ECG in the formation of feedback about exercise dosage control during health promotion exercising.

Keywords: monitoring, heart rate, ST-segment depression.

INTRODUCTION

Modern lifestyle, passive office work and a fast-food culture has caused the increase of health issues such as overweight, stress, sleeping problems. Protective effects of exercising are well-known. Exercises are widely used as one of the most powerful non-pharmacological strategies that affect most cells and organs in the body (Shalaby, Saad, Akar, Reda, & Shalgham, 2012). The problem of individualization, i.e. exercise dosage control, is a talking point and this problem needs new solutions. To this day, the heart rate (HR) response measurement as a convenient non-invasive evaluation tool is widely used to monitor and analyze individual workouts (Dellal et al., 2012; Hetting, Monden, van Meeteren, & Daanen, 2014; Jeukendrup & VanDiemen, 1998). Various types of heart rate monitors have been used for over 30 years (Achten & Jeukendrup, 2003). On the other hand, fast development of new technologies allows registering and monitoring a lot of new physiological parameters during exercising and it is very important to know what parameters should be included and implemented in new monitoring systems enabling objective assessment of an individual's functional state and peculiarities of their changes during exercising. Registrations of electrocardiogram (ECG) are widely used for diagnostic or functional state assessments and

at present the abilities to register the ECG signal during exercising and transmit it by using a wireless technology became a reality. The hypothesis for this study was that functional ischemic episodes in cardiac muscle during intensive exercising is characteristic of non-athletes and the objective of this study was to establish if individual functional fitness could be revealed by registering ST-segment depression during various type of exercising.

METHODS

Three separate studies were performed as to find out peculiarities in the dynamics of HR and ST-segment depression during various types of exercising in non-athletes' and well-trained runners' cohorts. Healthy adult male non-athletes and well-trained runners took part in all these studies. These studies were approved by the Ethics Committee of the Lithuanian University of Health Sciences (No. BEC-SRFO (M)-87. 31-12-2012) and conducted in accordance with the principles outlined in the Declaration of Helsinki. All subjects provided their written informed consent before participation in the study.

A computerized system "Kaunas-load" was applied for 12 lead ECG recording and analysis while the averaged figures obtained during 10 s interval of all 12-leads of ECG were presented. The changes in RR interval or heart rate (HR) and ST-segment depression (*sum of negative values in 12 leads*) were taken for analysis.

The first study was designed to compare the dynamics of chosen cardiovascular indices in conditions of increasing intensity of exercising. Participants were non-athletes (n = 21*, age* 23.0 ± 1 years, body mass index 24.4 ± 1.3) and runners (n = 8, age 20. 9 ± 1.21, body mass index 22.3 ± 0.38) underwent a 50W increase in workload (bicycle ergometry) every 6 minutes and they exercised until inability to continue the task.

The second study was designed to establish the dynamics of indices while performing intensive exercise bout. Participants were non-athletes, i.e. volunteer male students who were not engaged in sports training (n = 11, age 20.9 ± 1.2 years, body mass index 22.3 ± 0.4) and runners (n = 8, age 20.9 ± 1.2, body mass index 22.3 ± 0.38) underwent a 30-second all-out repeated jumps test. The jumps were performed on a force platform. In order to prevent venous pooling, the subjects underwent 10 s squats after finishing the jumps and sat still during the next 3 minutes of the recovery.

The third study had to establish the peculiarities in the dynamics of indices while performing continuous aerobic exercising. Participants were non-athletes (n = 10, age 23.3 ± 0.9 years, body mass index 21.2 ± 0.5) and runners (n = 10, age 23.1 ± 1.3, body mass index 21.9 ± 0.4). After 5 min warm-up they had 24 min aerobic exercising (on a bicycle). The intensity of exercising at the beginning was chosen individually as the HR should be in the zone of 70–85% of $HR_{Reserve}$. This chosen mechanical intensity (external workload) was the same during the workout.

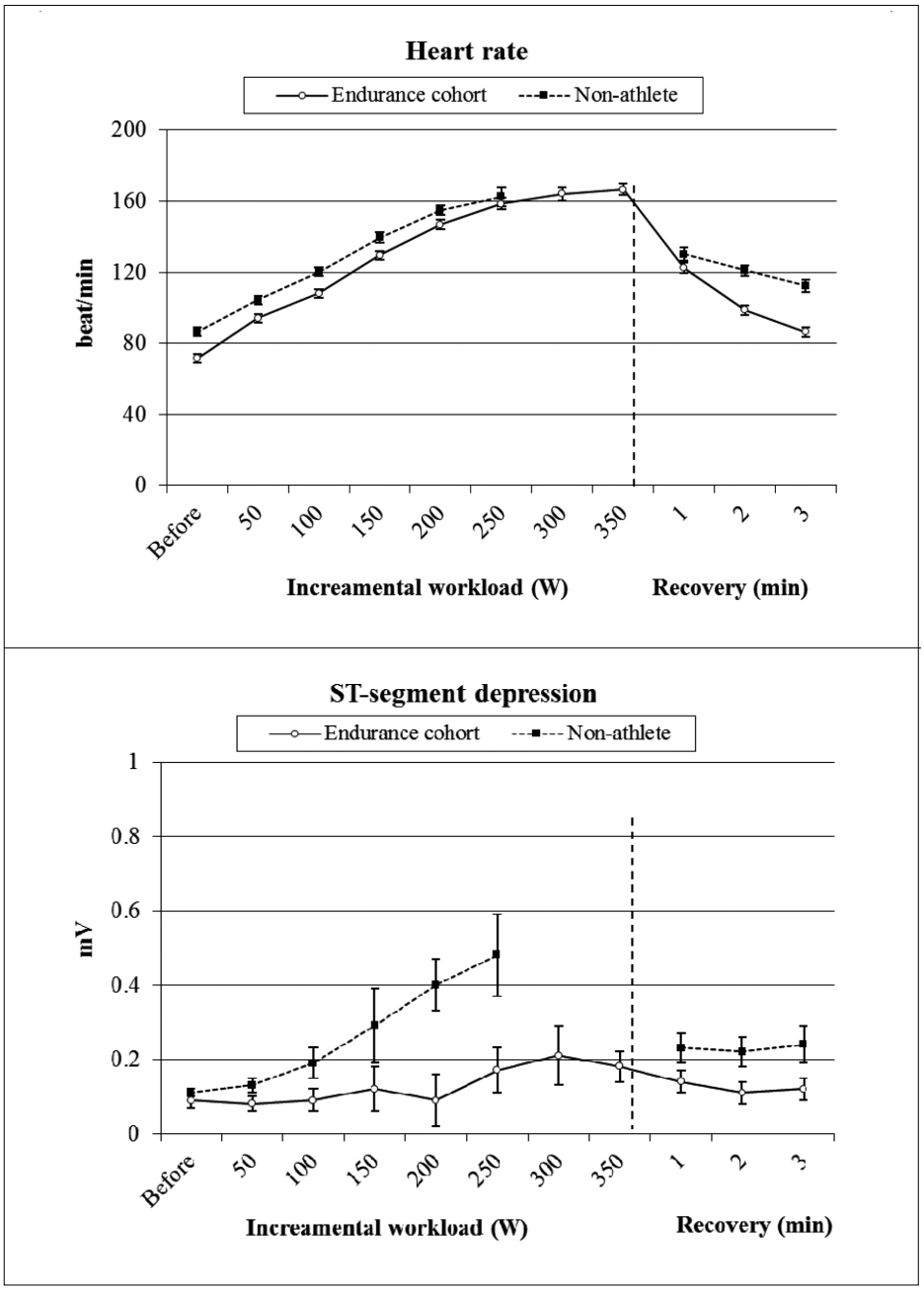
Statistics. The arithmetic mean (x) and standard deviation (s) were calculated. The significance of the differences between values was evaluated by computing t criterion; the pair's t-test was used. The difference was considered statistically significant when p was < .05 (95 CI).

RESULTS

The first study (increasing intensity of exercising). The results obtained during the first study showed a significant difference between groups in physical working capacity. Non-athletes were able to continue exercising up to 250 W, and runners continued exercising up to 350 W. The mobilization of cardiovascular function according to HR changes during the increasing workload is shown in Figure 1. A significant increase in HR was observed during the graded exercise test up to inability to continue the task, and this increase continued according to the increasing workload. The runners' HR was significantly (p < .01) lower at rest and during the entire test than that of non-athletes (before the load at rest it was 87.8 ± 2.7 in the group of non-athletes and 71.4 ± 2.5 in the runners' cohort; at the last minute of workload it was 174.3 ± 3.0 in the non-athletes' cohort and 166.7 ± 3.4 in the endurance cohort). The study showed that athletes demonstrated higher physical performance but maximal HR values were in both cohorts when the full fatigue phase was achieved, and these values did not differ significantly (p >.05). Faster HR recovery was observed in the group of runners.

Different type of dynamics of ST-segment depression in runners' and non-athletes' cohorts was discovered during incremental exercising. There was no significant change observed in runners' cohort while other type of dynamics was observed in non-athletes' cohort. There was no change in ST-segment depression at onset of

Figure 1. **Dynamics of HR and ST-segment depression during the incremental increase in workload and recovery**



exercising, but when the intensity of exercising increased the individual type of change was observed. The averaged data presented in Figure 1 showed an increase of ST-segment depression while the intensity of exercising was 100 W, and further increase with each step of increasing workload in the non-athletes' cohort. During the highest physical test loads in both groups, the difference between the cohorts was statistically significant, $p < .05$ (in non-athletes' cohort it was recorded at 250 W, ST-segment depression –0.48 ± 0.11mV; in runners' cohort – at 350 W – 0.18 ± 0.02 mV ST-segment depression).

The second study (intensive exercise bout). At onset of repeated maximal jumps, a steep change of cardiovascular indices occurred. Figure 2 presents the dynamics of registered ECG indices when performing a 30-s repeated jump test and during the recovery. The same type of changes in HR, i.e. steep increase, was observed in both cohorts. The HR at the end of jumping task was 168.4 ± 2.2 beats/min in runners' cohort and 174.5 ± 2.2 beats/min in non-athletes' cohort. Different dynamics of ST-segment depression during the intensive jumping task was observed. There was a small change found in runner's cohort, but the significant ($p < .05$) increase of ST-segment depression was observed in non-athletes' cohort (the sum of negative values in 12 leads was 0.85 ± 0.32 mV).

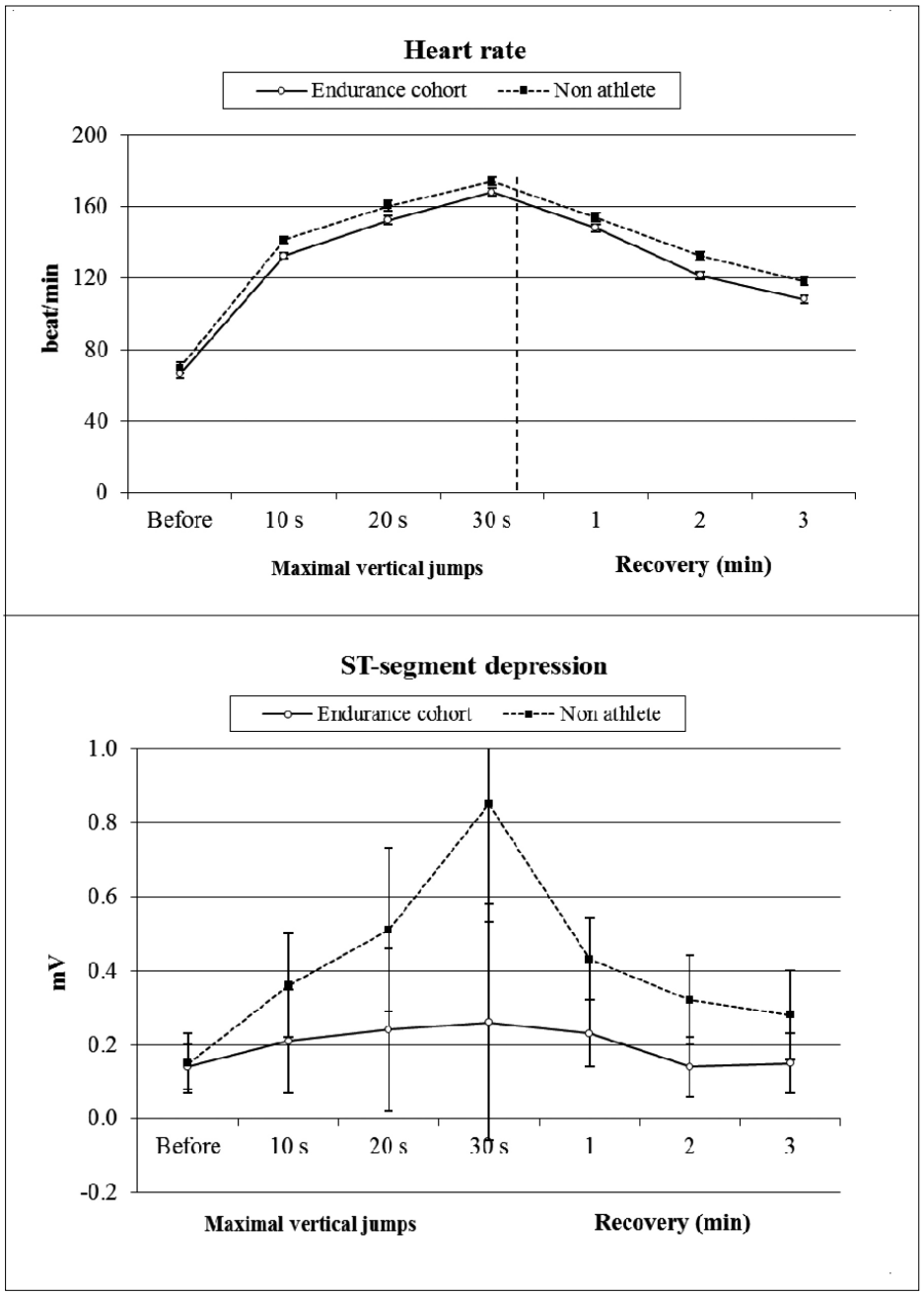


Figure 2. **Dynamics of HR (A) and ST-segment depression during the 30-s vertical jumps test and recovery**

The third study (continuous aerobic exercising). The results obtained during this study showed significant difference in functional fitness of participants and their ability to perform the external workload. The influence or regular training of runners became evident while comparing the intensity of exercising. The averaged values of relative power during exercising were 1.9 ± 0.1 W/kg of body weight in runners' cohort and 1.5 ± 0.1 W/kg of body weight in non-athletes' cohort ($p < .05$).

Figure 3 presents the dynamics of HR and ST-segment depression during continuous aerobic exercising. There were no significant differences between the groups in HR at onset of exercising, but the steepest increase of HR was observed in non-athletes' cohort.

Different types of dynamics of ST-segment depression were registered during continuous aerobic exercising. Figure 3 shows that there were no significant changes of ST-segment depression during exercising in runner's cohort ($p > .05$), and the significant increase of ST-segment depression was in non-athletes' cohort ($p < .05$). It should be noted that some individuals from non-athletes' cohort did not demonstrate significant changes, but averaged values of ST-segment depression (the sum of negative values in 12 leads) were 0.37 ± 0.07 mV at onset of exercising and slightly decreased at the end of exercising (0.32 ± 0.07 mV).

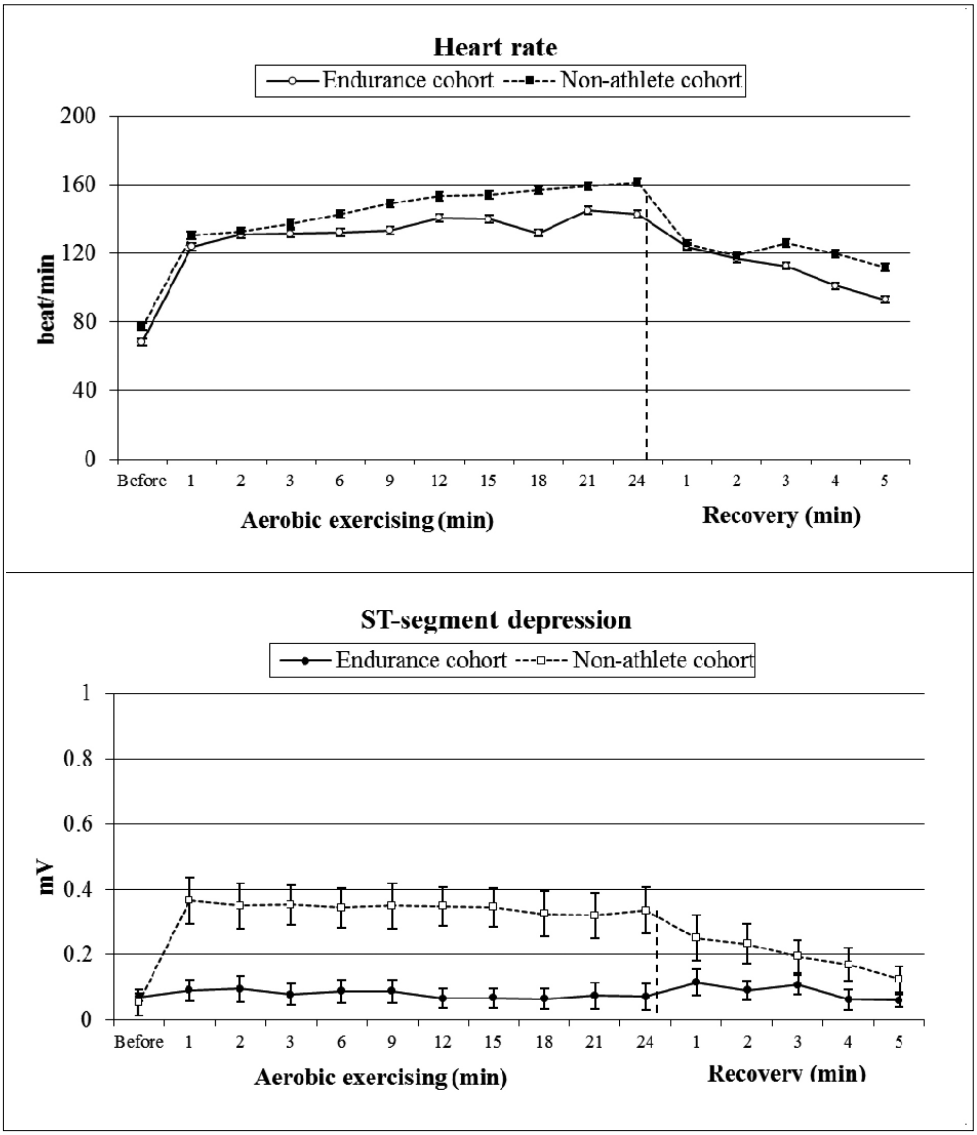


Figure 3. **Dynamics of HR and ST-segment depression during the continuous aerobic exercising and recovery**

DISCUSSION

Exercising positively affects body functions and individualization in this case is a key point for success. The fast development of new technologies allows registering and monitoring ECG signals during exercising and the question is what kind of indices can be added to monitoring HR as to provide valuable information. The analysis of cardiac response to various types of exercising could be helpful here.

There is no doubt that endurance athletes demonstrate higher performance abilities than non-athletes. This was shown by many researchers (Buliuolis, Trinkūnas, Snarskaitė, & Poderys, 2003; Cantrell, Schilling, Paquette, & Murlasits, 2014; Delp, 1998; Noakes, 2000; Noakes, Peltonen, & Rusko, 2001; Poderys, 2002) noting that the improvement is a result of changes in many body systems and mostly it occurs by adaptation of cardiovascular system. This observation was confirmed in our first study. The results showed that athletes differed from the healthy group with better cardiovascular reactions to incremental increase in workload. The comparison showed that elite runners exhibited better functional fitness; the increasing workload HR values were significantly lower in well-trained runners than in the cohort of non-athletes. The lower HR values at various steps of increasing workload indicate higher functional abilities that were obtained by training.

There were no ischemic episodes at onset of incremental exercising in both cohorts at onset of exercising, but after reaching some intensity transient ischemic episodes were registered in the cohort of non-athletes. The same type of differences between cohorts was observed at onset of jumping (*the second study*) and even during the

performance of continuous aerobic exercising (*the third study*). Prognostic importance of ischemic episodes detected by ST-segment monitoring has been shown in many investigations (Guldenring et al., 2012; Yazigi et al., 1998; Jernberg, Lindahl, & Wallentin, 1999; Taglieri et al., 2011).The transient increase in ST-segment depression during exercising indicates ischemic episodes in cardiac musculature that could be treated as heart function limiting failure during the load, which this is not a desirable physiological change.

The cardiovascular system is one of the constituent parts and a holistic system of the body (Pande et al., 2012, van Schuylenbergh, Eynde, & Hespel, 2004; Vainoras, 2002). By summarizing the results obtained during these studies it should be noted that the cardiovascular system with its functional adaptation to workloads is an important factor defining the peculiarities of their response to exercising. There were no serious functional ischemic episodes found in cardiac musculature during various types of exercising in well-trained athletes' cohorts, but it was common in non-athletes' cohorts. This is an important point for monitoring cardiovascular response during exercising. ST-segment depression could be a valuable marker testifying individual limits.

CONCLUSION

Functional ischemic episodes in cardiac muscle during exercising is a characteristic of non-athletes, but not of well-trained athletes, and the ST-segment depression could be used as important index of ECG in the formation of feedback about exercise dosage control during health promotion exercising.

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VALIDITY AND RELIABILITY OF THE LITHUANIAN VERSION OF PROSOCIAL TENDENCIES MEASURE – REVISED (PTMR)

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ABSTRACT

Background. The study was carried out with the aim to examine the construct validity and reliability of a Prosocial Tendencies Measure–Revised (PTM-R) (Carlo, Hausmann, Christiansen, & Randall, 2003).

Methods. The study process was done following four stages. In stage 1, 984 adolescents between ages of 13 to 16 years (*M* age = 14.9, *SD* = 0.97; 50.3% girls) completed a translated version of the scale. In this stage Exploratory Factor Analyses (EFA) was carried out in order to measure the structure of the PTM-R. In stage 2, 757 adolescents between ages of 13 to 16 years (*M* age = 14.24, *SD* = .81; 51.78% girls) completed the questionnaire and Confirmatory Factor Analyses (CFA) was made. In stage 3, validity of the PTM-R was investigated. In stage 4, reliability of the measure was tested by evaluating Cronbach's alpha values.

Results. Exploratory Factor analysis of the PTM-R revealed four-factor solutions. A six-factor solution as in original measure was not obtained. Confirmatory factor analysis confirms four-factor structure of PTM-R and supports the multidimensional definition of prosocial behaviour. Three types of prosocial behaviour as anonymity, altruism, and public prosocial behaviour was the same as in the original measure. Other three types of prosocial behaviour emerged as one factor and were entitled as help in emergency. Correlation analyses between prosocial behaviour and different types of aggression showed good level of discriminant validity.

Coefficient alpha was used to estimate of reliability based on the internal consistency among items. Alpha coefficients were .85 for help in emergency, .71 for anonymous prosocial behaviour, .68 for altruistic behaviour, and .59 for public prosocial behaviour.

Conclusions. In conclusion, the four-factor structure of PTM-R was obtained. Results showed that the adapted measure was valid and reliable for Lithuanian adolescents aged between 13 and 16. Contradiction to the original measure structure and future research directions are discussed.

Keywords: prosocial behaviour, prosocial behaviour measure, validity and reliability.

INTRODUCTION

In recent years, there has been an increase in social and psychological research on the various forms of youth aggression and their differential associations with social and psychological adjustment (Kamper & Ostrov, 2013), social cognitive factors (Bradshaw, Goldweber, & Garbarino, 2013) as well as other social and situational factors (Winstok, 2010). The problematic behaviour of adolescents in the school setting has been addressed with prominent interest by a number of scholars (Kokko, Tremblay, Lacourse, Nagin, & Vitaro, 2006; SelahShayovits, 2014). It is not thus accidental that parents, teachers and other members of the society commonly believe that children first of all strive to satisfy their individual needs. It consequently determines their egoistic and selfish actions (Carlo, 2006). On the other hand, the formal standards and rules adopted by the society not always ensure prosocial behaviour (Carlo, Knight, McGinley, Zamboanga,

& Jarvis, 2010). Not surprisingly, in addition to the most recent studies of aggression, prosocial behaviour has also been investigated with the ever increasing interest.

Even though the causes of prosocial behaviour, especially those of altruism, have been extensively researched (e.g. see Kurzban, BurtonChellew, & West, 2014), the number of such studies has increased during the recent years (Carlo et al., 2010; Hardy, Carlo, & Roesch, 2010; Kumru, Carlo, Mestre, & Samper, 2012). On the other hand, the interest in the prosocial behaviour of adolescents and other related qualities of a personality is of utmost importance when drafting efficient educational programs aimed at the prevention of antisocial and problematic risk-bearing behaviours or measuring moral behaviour relationship with pupils' involvement in different prosocial activities.

Prosocial behaviour is defined as any act that benefits another person or other persons (Aronson, Wilson, & Akert, 2005). Analyses of such behaviour in sports setting is important as sports by nature is a social context in which participant interacts with, related to, and influence each other (Kavussanu, 2008). Moreover, sport has a unique social and educational environment, where, unlike other life contexts, moral decisions have to be made within a very short period of time under psychological pressure (Naylor & Yeager, 2013). Not surprisingly researchers focus on prosocial and antisocial behaviour expression towards team-mates and opponents (Boardley & Kavussanu, 2010; Kavussanu & Boardley, 2009), association of different sport context with athletes' prosocial and antisocial behaviours (Rutten et al., 2011), achievement goal orientation relationship with athletes' behaviour (Boadley & Kavussanu, 2010), athletes' perceived motivational climate effects on prosocial and antisocial behaviours of hockey and netball players (Boardley & Kavussanu, 2009), athletes' perception of social identity association with their prosocial and antisocial behaviours (Bruner, Boardley, & Cote, 2014). On the other hand, these studies focused primarily on athletes' behaviour in sports settings. Recently, there has been only one study pubished analysing athletes' prosocial behaviour in different settings (Kavussanu, Boardley, Sagar, & Ring, 2013).

Recent studies have shown that prosocial behaviour is a broad and multidimensional construct (Carlo & Randall, 2002; Carlo et al., 2003; Carlo et al., 2010; Azimpour, Neasi, Shehni-Yailagh, & Arshadi, 2012). One of the instruments that measures different types of prosocial behaviour is Prosocial Tendencies Measure – Revised originally developed by Carlo, Hausmann, Christiansen, and Randall in 2003. This 21-item instrument measures six types of prosocial behaviour. Firstly this instrument was used with Lithuanian adolescents analysing links between pupils' participation in extracurricular activities and their prosocial behaviour *(*Šukys, 2010). Although the translation of the instrument was explained in this study, more information about its validity was not mentioned. Another study aimed at establishing relationship between 16-18-year-old students' participation in extracurricular activities and their prosocial behaviour as well as their value orientations (Baltakienė, 2013) applied the same instrument. In this study exploratory factor analyses revealed four factor structure but no additional analyses and explanation was made.

The need for new knowledge related to the evaluation of adolescents' prosocial behaviour in relation with their involvement in sport and physical education urges us to apply a valid research instrument to measure such behaviour. Based on the earlier studies that lack information about the validity of adapted Prosocial Tendencies Measure – Revised (PTM-R) the aim of this study was to validate adapted PTM-R with two independent samples.

METHODS

The first study (stage 1) was conducted to examine the structure of the measure using exploratory factor analysis (EFA) with one sample. In the second study (stage 2), factor structure was examined using Confirmatory factor analysis (CFA) with the second sample. In stage 3, discriminant validity was tested evaluating the measures against each other. We examined whether prosocial behaviours were related or unrelated to another construct (aggressive behaviour). Finally, in stage 4, reliability of the measure was tested by evaluating Cronbach's alpha values.

Participants. The first sample of participants included 984 adolescents between ages of 13 to 16 years (*M* age = 14.9, *SD* = 0.97; 50.3% girls). The participants were recruited from one district in the centre of Lithuania. The sample was drawn from schools representing the main schools, secondary schools and gymnasiums. In total, 16 schools and four different age groups (i.e. four classes) were

randomly selected and included into the study. The second sample of participants involved 757 adolescents between ages of 13 to 16 years (*M* age = 14.24, *SD* = 0.81; 51.78% girls). The participants were recruited from the same district of Lithuania.

Measures. Prosocial Tendencies Measure – Revised (PTMR) proposed by Carlo, Hausmann, Christiansen, and Randall (2003) was adapted to Lithuanian respondents using backtranslation procedure described by Hambleton, Merenda, and Spielberger (2005). Participants completed the translated version of the Prosocial Tendencies MeasureRevised (PTMR) to access how likely they were to engage in prosocial behaviours across a variety of situations. Participants rated the extent to which statements described them using a 5point Likerttype scale (from 1 = *does not describe me at all* through to 5 = *describes me greatly*). Original version of PTM-R assesses six types of prosocial behaviours: altruistic, public, emotional, dire, anonymous, and compliant.

Aiming at establishing validity participants of the second sample completed the Aggression Questionnaire (Buss & Perry, 1992). This is a 29-item instrument used to assess four components of aggressive behaviour: physical aggression, verbal aggression, anger, and hostility. The students had to assess each statement on a 5-point scale from 1 (*extremely uncharacteristic of me*) to 5 (*extremely characteristic of me*). This instrument earlier was validated with children (Dumčienė, Sipavičienė, Malinauskas, Klizas, & Ramanauskienė, 2010), and adults (Čėsnienė & Kašinska, 2011).

Procedure. Firstly the study was contacted with the school administration. After the permission was given from the appropriate administration bodies in schools, investigators arrived at the schools. Children with parental consent who also assented to participate were given questionnaire booklets during regular class hours within their normal classrooms. Questionnaires were administered by the investigator at the beginning of the class. Participants were informed about the purpose of the study, they were explained that all responses would be kept anonymous and confidential and used only for research purposes, that participation was voluntary, and that participants could withdraw at any time.

Data analysis. Descriptive statistics, Cronbach's alpha analyses on each of the subscales, correlational analyses and EFA were performed using IBM SPSS Statistics for Windows software (version 19.0). CFA analyses were performed using AMOS 18. CFA was performed to test factor structure retained from the EFA. A model with the four factor structure, based on EFA, was created and submitted for confirmation on the second sample. Chi-Squared test (values closer to zero indicate a better fit), root mean square error of approximation – RMSEA (a value of .06 or less is indicative of acceptable model fit) (Hu & Bentler, 1999), comparative fit index – CFI which value > .90 indicate good model fit, value > .95 – very good model fit (Arbuckle, 2006).

RESULTS

Exploratory factor analysis using the principal components method of extraction and varimax rotation was performed on all 21 items. Four factors with eigenvalues >1 emerged, explaining 50.73% of the total variance (Kaiser Meyer Oldkin = .88, Bartlett's test of sphericity yielded χ^2 = 6457.80, df = 210, p < .001). The first factor was defined by 10 items containing three types of prosocial behaviour (dire, compliant and emotional), and explained 25% of the variance. This factor was referred to as *Help in emergency*. The second factor (anonymous prosocial behaviour) was defined by four items and explained 14% of the variance. The third factor (altruism) was defined by four items and explained 10% of the variance, whereas the fourth factor (public prosocial behaviour) consisted of three items, and accounted for 8% of the variance.

As a six-factor solution was not obtained, the four-factor structure identified in EFA was examined using CFA in the second sample. The model had a good fit $\chi 2$= (164) = 569.039, p < .001, *CFI* = .907, *RMSEA* = .053 [.047- .058]. This confirms the four-factor structure of PTM-R and supports the multidimensional definition of prosocial behaviour (Table 1).

Next correlations among the four types of prosocial behaviour were examined (Table 2). As the table shows, correlations ranged from .32 to .39 indicating that all subscales related with one construct. Additionally validity was examined by computing the correlations between prosocial behaviours and aggression (Table 2). Help in emergency, anonymous and public prosocial behaviour correlation with the different types of aggression were small or not significant. Negative correlation was observed between altruistic behaviour and aggression types.

Table 1. **Factor loadings for exploratory factor analysis with varimax rotation and confirmatory factor analysis**

Scale	Study 1 EFA	Study 2 CFA
Help in emergency		
Item 5 (Dire)	.78	.65
Item 6 (Compliant)	.76	.64
Item 21 (Emotional)	.75	.63
Item 16 (Compliant)	.74	.59
Item 11 (Emotional)	.72	.46
Item 13 (Dire)	.67	.61
Item 19 (Emotional)	.67	.73
Item 8 (Dire)	.66	.60
Item 2 (Emotional)	.62	.61
Item 15 (Emotional)	.59	.72
Anonymous		
Item 14	.76	.77
Item 10	.73	.66
Item 17	.72	.62
Item 7	.61	.45
Altruism		
Item 18	.75	.72
Item 20	.68	.46
Item 9	.62	.52
Item 4	.42	.54
Public		
Item 3	.76	.62
Item 1	.74	.47
Item 12	.33	.59

Note. The type of prosocial behaviour which is reflected by an item in the original measure is given in parentheses.

Table 2. **Descriptive statistics, alpha coefficients, and subscale correlations (*n* = 757)**

Variable	1	2	3	4	5	6	7	8
1. Help in emergency								
2. Anonymous	.33**							
3. Public	.36**	.33**						
4. Altruistic	–.32**	–.34**	–.39**					
5. Physical Aggression	.03	.13*	.14**	–.28**				
6. Verbal Aggression	.20*	.15**	.13**	–.20**	.47**			
7. Anger	.13**	.09	.10*	–.15**	.58**	.56**		
8. Hostility	.17**	.19**	.16*	–.22**	.39**	.45**	.48**	
Mean	3.31	2.24	2.41	3.51	2.75	2.89	2.69	2.68
Standard deviation	0.80	0.90	0.83	0.87	0.77	0.79	0.75	0.69
Cronbach alpha	.85	.71	.59	.68	.73	.69	.72	.71

Note. **$p < .01$.

Coefficient alpha was used to estimate the reliability based on the internal consistency among items. Alpha coefficients were .85 for help in emergency, .71 for anonymous prosocial behaviour, .68 for altruistic behaviour, and .59 for public prosocial behaviour.

DISCUSSION

The study aimed to validate adapted Prosocial Tendencies Measure-R for Lithuanian adolescents aged between 13 and 16. For this reason, exploratory factor analysis and confirmatory factor analysis were done. Discriminant validity and reliability were measured. One of the main findings of this study was the validation of a four-factor model of prosocial behaviour. Although such types of prosocial behaviour as *dire*, *emotional* and *compliant* constitute a single form of prosocial behaviour, yet this proves that prosocial behaviour is a multidimensional construct (Carlo & Randall, 2002; Carlo et al., 2010). When commenting upon the four-factor model, attention should be paid to several factors. In previous research, the scores of these three types of prosocial behaviour were the highest (except for *altruism*), and they correlated far more prominently (Carlo et al., 2003). Meanwhile, *public*, *anonymity* and *altruism* factors are singled as separate forms, and the results corroborate the data obtained by other researchers (Carlo & Randall, 2002; Carlo et al., 2010). The cultural factor should also be considered. Other studies suggest the existence of differences while comparing prosocial behaviour in adolescents of different cultures (Kumru et al., 2012) as the behaviour of adolescents is determined by their cultural values (Brittian et al., 2013).

The prosocial behaviour of adolescents is affected by the behaviour of their parents such as parent-child connectedness (Hana, Xin, & Randall, 2013) and parental monitoring, especially for such types of prosocial behaviour as emotional, dire and compliant (Carlo et al., 2010). Cultural differences in parenting practices have been proven to exist (Yagmurlu & Sanson, 2009). Even though the most up-to-date researches adapting the scale of prosocial behaviour in other cultures (in this particular case, in Iran) confirmed the existence of six types of prosocial behaviour (Azimpour et al., 2012); however, no data has been found on previous adaptations of this scale in Eastern or Central European countries.

Some authors suggest that the reliability level is acceptable at .80, and the value of .60 to .69 is minimally reliable (Cohen, Manion, & Morrison, 2009) although the value of reliability for one of the subscales was lower than minimum cut-off value. Nevertheless the reliability of the subscales is appropriate as in other studies it ranged from .59 to .86 in younger adolescents and from .75 to .86 in middle-aged adolescents (Carlo et al., 2003). In other studies with Lithuanian adolescents aged 16-18 years, alpha values ranged from .55 to .86 (Baltakiene, 2013). The low value of alpha may be justified if the number of items in the scale is relatively low (Schmitt, 1996). This may explain low alpha value for public prosocial behaviour as it was defined by three items.

CONCLUSION

In conclusion, the four factor structure of PTM-R was obtained. Results showed that the adapted measure was valid and reliable for Lithuanian adolescents aged between 13 and 16. This measure could be used while analysing peculiarities of adolescent prosocial behaviour and also behaviour relationship with their involvement in sports activities and other extracurricular activities. This measure also could be used by assessing effectiveness of the educational programmes for improvement of adolescents' moral behaviour specifically in sport settings or generally on school. By applying this instrument we recommend that researchers should carefully consider which type of prosocial behaviour is of the greatest interest in their studies. As different subscales reflect different types of prosocial behaviour we do not recommend calculating only the total value of measurement.

As this study was aimed at validation of adapted PTM-R to Lithuanians, further research is needed focusing on the reliability applying other methods of estimation, for example test-retest measure. Additionally, studies focusing on other types of validity measure are encouraged.

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LEARNING ENVIRONMENT IN PHYSICAL EDUCATION IN ŠAKIAI AND ŠAKIAI DISTRICT: COMPARATIVE ANALYSIS

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Abstract

Background. According to various research publications, physical education teachers work in the environment where the teaching process is often hindered by low physical education subject status, insufficient number and quality of lessons, lack of facilities and equipment for learning and the environment which is neither functional nor safe or hygienic. Concerned about pupils' physical activity decrease in secondary schools, Education and Sports Department of Šakiai District Municipality submitted a request to Physical Education study programme director of Lithuanian Sports University to carry out research revealing the existing situation about physical education and sports infrastructure in Šakiai district secondary schools. The aim of our study was to compare physical education environment in Šakiai and Šakiai district high schools, junior gymnasiums and lower secondary schools.

Methods. We used a questionnaire for the survey drafted in the international study by Sport Science and Physical Education Council (ICSSPE / IOC) (Hardman & Marshall, 2009) and other references. During the study, we interviewed 13 physical education teachers from 14 Šakiai city and Šakiai district schools (2 women and 11 men).

Results. The quality of learning tools in city schools was seen as excellent or good, while the quantity was also seen only as extensive or above average. Obtained results in the district schools varied, but most of them indicated that the quality (33%) and quantity (50%) was only adequate or sufficient. Physical education subject status in comparison with other subjects in half of the city schools was seen as the same and in the other half – as lower. In most schools in the district, it was seen as the same (92%). City schools did not lack hygienic equipment, but a significant number of district schools did not have changing rooms with lockers and hangers (33%) and showers (25%). In the district schools that had showers, they were not used in 56% of them.

Conclusions. Schools in the city are supplied with more and better teaching tools and equipment. Physical Education subject status in half of city schools is perceived as inferior to other subjects. Hygiene conditions in city schools are good compared to the district schools, where they are poor.

Keywords: physical education, learning equipment, learning environment, status, hygiene conditions.

INTRODUCTION

The aim of Physical Education, as stated in the new Eurydice Report on Physical Education and Sport in 30 European countries, including Lithuania, is to promote direct and lifelong physical, personal and social development and to develop a healthy lifestyle (European Commission/EACEA/Eurydice, 2013). Physical education teachers carry out a key role in realizing the objectives of the training program and applying sports science and pedagogical knowledge in practice (Kougioumtzis, Patriksson, & Strahlman, 2011).

Research shows that physical education teachers work in an environment where educational activities are constantly hindered by the low status of physical education classes (Christodoulou, 2010; Hardman, 2011), insufficient number and quality of facilities and lack of teaching tools and educational environment (Jankauskienė, 2008; Trinkūnienė & Kardelienė, 2013) which is neither functional, safe

nor hygienic (Dadelo, Tamošauskas, Kazlauskienė, Podlužnas, & Tarulis, 2011).

General Programs for Primary and Secondary Education (Pradinio ir pagrindinio ugdymo bendrosios programos, 2008) maintain that the environment where physical activity takes place must be functional, safe, and hygienic. Premises, facilities, equipment, supplies, etc. must be ergonomic, tidy, appropriately lit, ventilated, and harmless to health, as well as maintained at the optimum temperature and have showers. The learning environment must be organized in a way that students could excel personally.

The Resolution of the Seimas of the Republic of Lithuania of November 18 No. XII-1342 on Sport Policy (2014) proposes to increase the variety of sports for all children and youth so that they can participate in sports, exercise, live healthy lives; improve children's health care, provide proper hygienic conditions and sports infrastructure and finance students' participation in physical education classes; improve the image of physical education teacher; provide the country's secondary education schools with modern sports infrastructure, equipment and tools before 2020.

The educational problem analysis "What are the educational disparities between rural and urban schools?" (2011) reveals that not all the secondary schools of the country have all the necessary premises suitable for education. Fewer rural than urban schools have a sports hall, and city schools lack stadiums and courts, which are more common in rural schools. It is common in schools (especially in small towns or villages) that the learning tools of the educational environment are not fully functional, safe and hygienic or updated. In addition, teachers who face challenges in organizing creative lessons point out the lack of teaching tools to be the main reason (Karbočienė, Alūzas, & Norkus, 2005). Even though the environmental problems of physical education are analysed there are no research related to urban-rural differences of physical education in Lithuania in general.

Officials at the Department of Šakiai District Municipality are concerned about the decrease of pupils' physical activity in secondary schools and they submitted a request to the Physical Education study programme director of Lithuanian Sports University to carry out research revealing the existing situation of Šakiai district physical education and sports infrastructure in secondary schools.

The aim of the study was to compare physical education environment in high schools, secondary and main schools in Šakiai city and Šakiai district.

METHODS

The study participants, who were interviewed to identify physical education learning environment and situation in Šakiai city and Šakiai district high schools, secondary and main schools, were 13 physical education teachers from 14 Šakiai city and Šakiai district (2 women and 11 men, or 15.38 and 84.62%). One respondent worked in two schools. The mean age of physical education teachers was 49.5 years; the length of their pedagogical experience was 26.2 years. According to the acquired education, most of them (76.9%) were physical education teachers and the others were sports coaches. According to the acquired pedagogical qualification, the majority (69.23%) were senior teachers.

The questionnaire used in the survey was drafted using the materials of the international study by Sport Science and Physical Education Council (ICSSPE / IOC) (Hardman & Marshall 2009); Physical Education and Sports Report in the European schools (European Commission / EACEA / Eurydice, 2013); Lithuania's hygiene standards HN 21:2011 "School Engaged in General Education Programs: General Health Safety Requirements" (2011); the Schools Supply Standards (2001); and General Programs for Primary and Secondary Education (2008).

The questionnaire consisted of 39 questions divided into four groups: quality and quantity of teaching tools and equipment; physical education environment (physical education subject and teacher status in comparison with other subjects and teachers); hygiene of students' educational process; social and demographic data of physical education teachers.

The study took place in Šakiai and Šakiai district high schools, secondary and main schools in February–March, 2015, in the following stages: 1) the necessary data (type of school, address, telephone number) about Šakiai and Šakiai district schools (AIKOS, 2015) and the physical education teachers employed were gathered; 2) Senior Specialist of Šakiai District Education and Sports Department in charge of physical education sent questionnaires to four district teachers; 3) three questionnaires for physical education teachers were handed during the pupils' badminton competition

in Šakiai centre of youth creativity and sports; 4) six teachers were given the questionnaires at their schools agreeing the meeting time by phone in advance; 5) the questionnaires were collected within five working days. During the survey, teachers were introduced to the aim of study, it was emphasized that participation in the study was voluntary and that anyone could withdraw from the study before completing the questionnaire. The survey followed the ethical and legal principles of research. On average, it took 15 minutes to fill in the questionnaires.

The statistical data analysis was performed using MS Excel. We calculated the data distribution frequency in percentage and averages.

RESULTS

The quality and quantity of teaching tools and equipment. Research results showed that half of the physical education teachers in town rated teaching tools and equipment as of excellent quality and the other half – as good quality (see Figure 1). Meanwhile, the majority (one third) of physical education teachers in district schools indicated that teaching tools and equipment in their schools were of adequate quality, and a quarter – good and below average. Neither city nor district schools rated the quality of physical education teaching tools and equipment as inadequate.

A similar situation was found about the quantity of teaching tools and equipment (see Figure 2). Half of physical education teachers rated teaching tools and equipment as extensive in quantity and the other half as above average. However, only 17% of district school teachers rated the quantity as extensive and above average. Most of them (50%) indicated that the quantity was only sufficient.

According to the Schools' Supply Standards (2001) and Lithuanian Hygiene Standards HN 21:2011 (2011), schools must have a gym (see Table 1). It was found that they were all in city schools,

Figure 1. **Assessment of the quality of teaching tools and equipment**

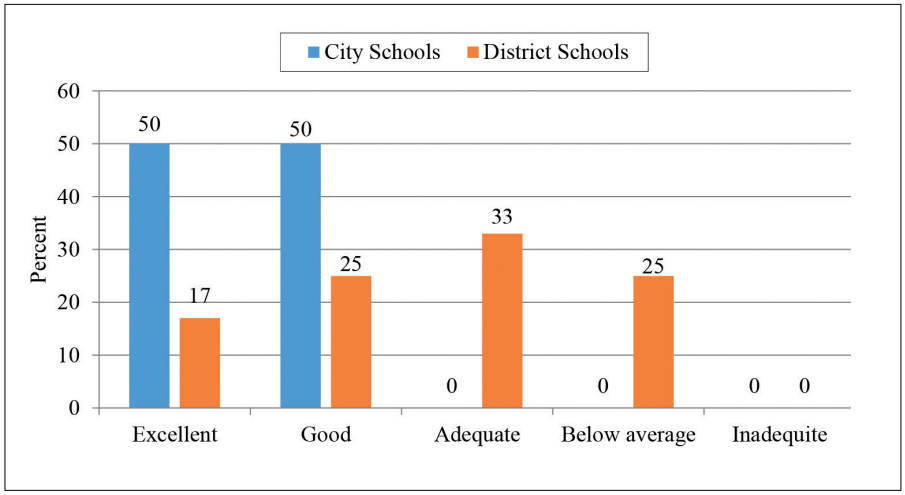
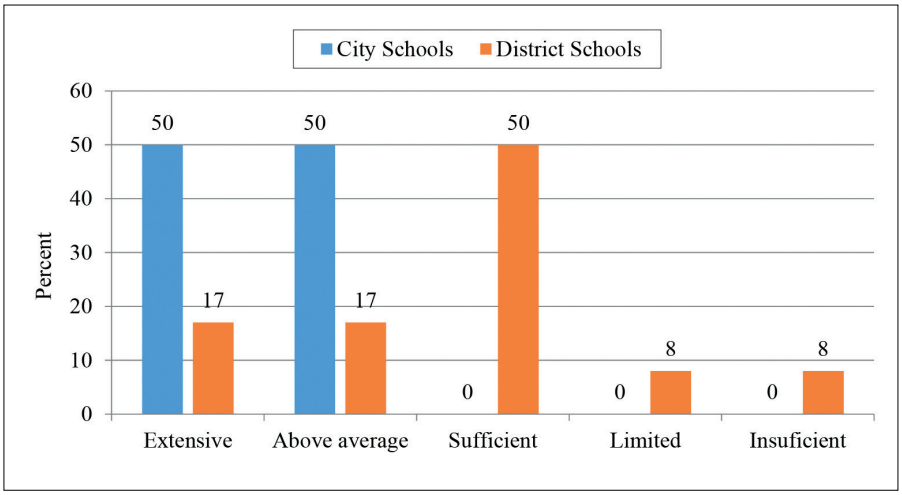


Figure 2. **Assessment of the quantity of teaching tools and equipment**



Sport facilities and their features	City Schools (%)		District Schools (%)	
	Yes	No	Yes	No
Do you have a gym?	100	0	92	8
Do you have a separate exit from the gym outdoors?	50	50	58	42
Do you have a pool?*	0	100	0	100
Do you have a stadium?	100	0	75	25
Do you have a football pitch?	100	0	75	25
Does the football pitch have running tracks around it?	100	0	58	42
Do physical education teachers have a separate office?	100	0	42	58

Table 1. **Sports facilities and their features**

Note. * – it is recommended to have one according to Schools' Supply Standards (2001).

but 8% of district schools did not have gyms. Much worse was the situation with gyms' separate exits outdoors. Half of the schools in the city (50%) and in the district (42%) did not have it. Not a single school in the city or district had a pool, but it is not necessary to have one. All schools in the city had a stadium with a football pitch surrounded by running tracks and a separate office for physical education teachers. Meanwhile, in the district only three-quarters of schools had a stadium with a football pitch and only 58% of them had running tracks around it. The study showed that as many as 58% district schools did not have a separate office for physical education teachers and often they had to use the equipment room as an office.

It was found that all the schools in town had gyms that met the standard size (The Schools' Supply Standards, 2001), and in the district only one school did. The remaining schools had substandard gyms. Football pitch area in schools with at least 1000 students should seek 3000 m^2, but such schools existed neither in the city nor in the district (Lithuania's hygiene standards HN 21:2005 "Secondary School: General health safety requirements", 2005).

According to the Schools' Supply Standards (2001), Physical Education teaching tools and equipment, which are required in schools, are divided into seven categories: track and field athletics, gymnastics, sports games, skiing, learning tools, informational tools and media. The results showed that the majority of schools in the city had track and field athletics tools, but not the district schools. Gymnastics equipment was in an analogous situation as almost all city schools had the necessary teaching tools, but the situation was worse in the district. Only a quarter of schools had resistance bands, balance beams, lifting weights, universal simulators, jump ropes, climbing ropes, pull up bars, a third of them – parallels bars, and a fifth – clubs.

The School's Supply Standards (2001) do not have specific requirements for schools to have non-traditional physical activity equipment, but a general and expanded physical education course includes non-traditional physical activity corresponding to the age of the pupils. Safe non-traditional, non-olympic sports: dancesport, aerobics, skateboarding, roller-skating, darts, bowling, weight lifting, yoga, martial arts, frisbee and others. However, the study showed that the schools did not have abundant means for these activities. It was found that almost all city and district schools had checkers, but only a quarter had pins. Neither the city nor the district school had skateboarding or roller-skating. Half of the schools in the city had an audio player.

Physical Education environment. It was found that half of the physical education teachers in the city schools pointed out that the subject status of physical education at school was the same and lower than other subjects (see Figure 3). Meanwhile, almost all (92%) district school teachers noted that the subject status of physical education was the same as of other subjects.

Similar results were obtained for physical education teacher status (see Figure 4). It was found that most of town and district school physical education teachers indicated that their status was the same as of other subject teachers.

During the study the teachers pointed out the most important problems related to physical education which they faced in their schools. In the city schools, most of them were related to physical education process hygiene. They mentioned that pupils did not have enough time to have a shower

Figure 3. **Physical education subject status compared to that of other subjects**

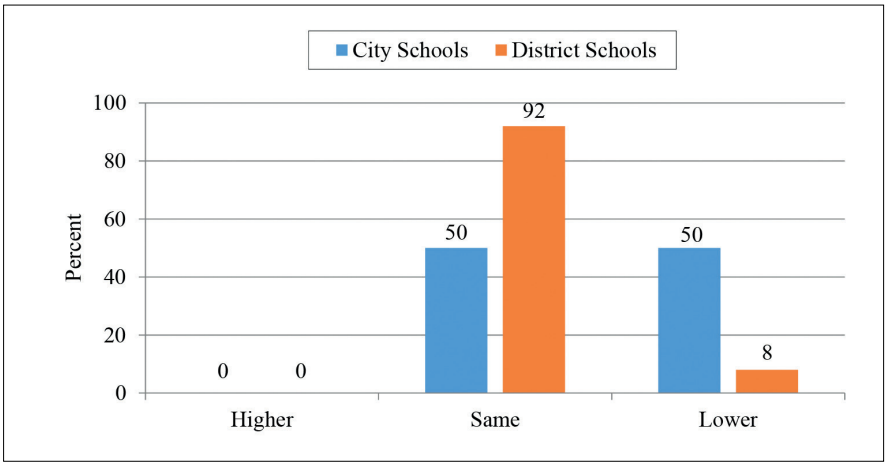


Figure 4. **Physical education teacher status compared to that of teachers of other subjects**

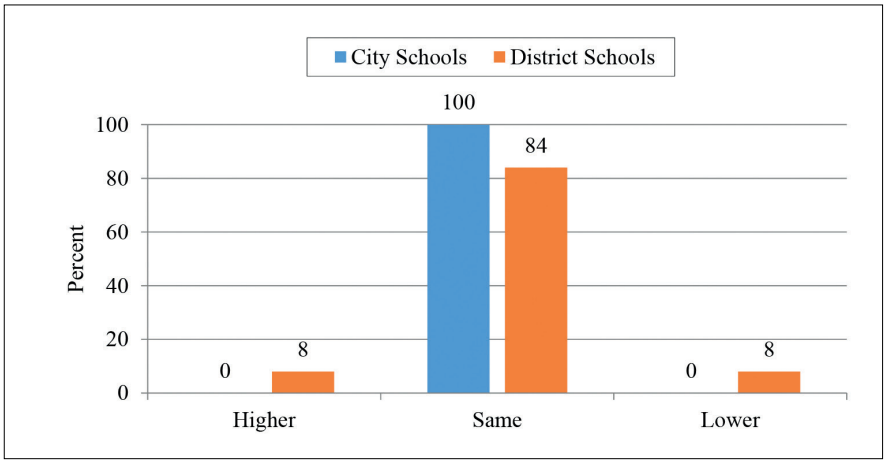


Table 2. **Hygiene conditions in physical education classes**

Hygiene conditions in physical education classes	City schools (%)		District schools (%)	
	Yes	No	Yes	No
Are there separate dressing rooms for boys and girls?	100	0	83	17
Are there toilets?	100	0	100	0
Are there showers?	100	0	75	25
If there are showers, is there hot water?	100	0	89	11
If there are showers, do pupils use them?	100	0	44	56
Do dressing rooms have lockers for clothes?	100	0	67	33
Does special equipment protect gyms' windows and radiators?	100	0	83	17

and that affected their general unwillingness to participate in the lesson. In the district schools, the answers were divided nearly equally – 55% teachers indicated that existing teaching tools and sports facilities were poor, outdated. The remaining 45% reported that pupils avoided physical education classes (did not participate or participated passively).

Pupils' education process hygiene. The results show (Table 2) that one of the reasons why the pupils avoided participating in physical education classes was unsatisfactory hygiene conditions. In the city schools, the situation was excellent, but the district schools had some problems: 17% schools did not have separate changing rooms for boys and girls; 25% of schools did not have showers and 11%

of schools that had showers did not have hot water. Even though 75% of district schools had showers accessible to students, they were used only in 44% of schools.

DISCUSSION

The study was conducted in order to learn and to compare the current situation of teaching tools in Šakiai city and Šakiai district high schools, secondary and main schools. In Physical Education and Sport at School in Europe Eurydice Report (2013), physical education strategy and objectives in European countries, including Lithuania, have been analysed to make physical education classes more diverse. Considering the study results we can see that in the city teachers rate the quality of teaching tools and equipment as excellent or good. However, the situation in the district schools is absolutely different. According to one-third of teachers (33%), the quality of the equipment and teaching tools is only adequate. Only 42% of them rate it as good or excellent. Similar situation is seen by comparing the results of the Worldwide Survey of School Physical Education (2013) and Al-Mohannadi and Capel (2007), suggesting that in the world the quality teaching tools and equipment is rated as adequate by 33% of schools (25% say that it is below average and 14% – inadequate). Assessment in Europe is quite similar – 38% of schools rate it as adequate (20% – below average and 6% – inadequate).

Most schools worldwide (37%) rate the quantity of teaching tools as limited and insufficient (24%), limited but sufficient (21%), above average (12%) and extensive (6%). The situation in Europe is not good either because the majority split between adequate or limited (33% of each). Šakiai city teachers rate the quantity as excellent or good. Meanwhile, most of the teachers of district schools (50%) rate the quantity as only sufficient. Other significant group of them (34%) rates it as extensive or above the average. In summary, one could say that the quality and quantity of training tools and equipment in district schools is not very good and is significantly different from the situation in Šakiai city schools.

In 2013, Lithuanian School Students Union received many complaints about the quality physical education lessons and hygiene standards, and therefore they became concerned about those problems and exercising conditions for pupils in Lithuanian secondary schools. In order to assess the overall situation in Lithuanian schools, the School Students Union conducted a survey that was given to 5–12-grade Lithuanian pupils to present their views about the quality of physical education classes. 2110 pupils from various regions of Lithuania participated in the survey. It showed that only 48% of pupils participated in physical education classes willingly. About half of the respondents indicated that the inventory of physical education was adequate or below average. In addition, about one-third of pupils assessed their school gyms. Our study shows that the district schools experience a shortage of gyms. A quarter of Šakiai district schools do not have stadiums with a football pitch and running tracks around needed for track and field athletics, which are necessary for General Programmes for Primary and Secondary Education (2008) from the fifth grade. Nevertheless, generally not all district schools have any football pitch or gym. Among the district schools with gyms, only 55% of them meet the standards (Schools Supply Standards, 2001). Worldwide Survey of School Physical Education (2013) showed that the majority (30% of the world schools) rated the quantity of their sports facilities as sufficient (6% above average, 20% extensive, 27% limited and 17% inadequate). In Europe, most schools (38% of them) also rated the quantity of sports facilities as sufficient (9% extensive, 27% above average, 18% limited and 8% insufficient). Judging by the study results, we can see that the majority of the district school sports facilities were in poor condition and that is one of the reasons that influence pupils' reluctance to participate in physical education.

In the Schools' Supply Standards (2001) state what physical education requires the schools to have means for track and field athletics, gymnastics, sports games, skiing. The study has shown that in the city schools almost all the equipment is available (with a few exceptions), but in the district schools they are not available in one third of schools, and in some cases – half of the schools. As to track and field athletics equipment, schools often lack the relay baton and pole vault; gymnastics lack lifting weights, resistance bands, universal simulators, jump ropes, gymnastics pins, sticks, climbing ropes, balance beam and parallel bars; sports games lack badminton rackets and balls, badminton poles with net, board games, volleyball poles with the net. While skiing equipment should

also be in every school, it is missing nearly in all Šakiai city or district schools (only 8% of district schools have it).

According to Christodoulou (2010) and Jenkinson and Benson (2010) we know that the subject status in Europe is rated as lower than that of other subjects in 46% of schools (Worldwide Survey of School Physical Education, 2013). Our study shows that in half of the schools (50%) the subject is rated just as important as other subjects, but in the other half – as less important. That is similar to the situation in the whole Europe. However, in Šakiai district schools, this problem is insignificant since only in 8% of schools physical education classes have a lower status. Due to this problem, lessons are cancelled for unplanned circumstances.

According to Trinkūnienė and Kardelienė (2013), Physical Education teacher status is seen as lower compared to that of math or Lithuanian language teachers. The same tendency can be seen in Worldwide Survey of School Physical Education (2013). Globally, 18% of teachers experience a lower status, while in Europe, 9% of teachers experience it. Our study shows that this problem is not common among our respondents. Šakiai city physical education teachers have the same status as the teachers of other subjects and in the district schools, only 8% of teachers meet the lower status problem (8% of them have even a higher status).

In the aforementioned Lithuanian Schools Students Union survey (2013), pupils point out three reasons that cause their reluctance to participate in the lessons: after lessons there is no place to have a shower or showers are in a very poor condition, dressing rooms and halls are cold in winters, gyms are dirty and messy.

In our study, the biggest problems indicated by teachers (100% city schools and 55% district schools) are related to physical education teaching tools and hygiene conditions (pupils do not use the showers, avoid classes, avoid using showers, schools lack showers). Although, the city schools do not lack hygiene facilities (despite the fact that pupils do not want to use the showers, which leads to avoiding classes), district schools face various problems: there are no separate changing rooms for boys and girls (in 17% of schools), no racks and lockers for clothes (in 33% of schools), gyms' windows and radiators are not protected by special equipment (in 17% of schools). A study (Dadelo, Tamošauskas, Kazlauskienė, Podlužnas, & Tarulis, 2011) investigated the attitude of first-year VGTU students to physical education lessons at their senior high school. Respondents stated that in Lithuanian schools physical education lessons conducted to 9–12th grade pupils often did not conform with the basic principles of pedagogy, hygiene, and physiology. In Lithuanian Schools Students Union survey (2013), pupils rate changing rooms mostly as a good or at least adequate and the gyms as very good, good or average. However, almost 50% of respondents from all over Lithuania rated showers/washrooms as very poor. In our study, most schools had showers (82.6%), but in 64.6% of them, pupils simply did not use them. Pupils point out these reasons: showers are locked (inaccessible); there is not enough time; teachers do not allow using them; there is no light; no hot water; no blinds (lack of privacy); not enough showers; they seem unhygienic. Among the aforementioned reasons, even five of them are related to the hygiene conditions.

CONCLUSIONS

1. After identifying and comparing teaching tools and equipment in Šakiai city and Šakiai district high schools, secondary and main schools, the situation revealed that city schools were better equipped with both – tools and equipment. Moreover, the quality of available tools and equipment was better. District schools generally lacked some of the necessary teaching tools and equipment.

2. After identifying and comparing the physical education subject status to that of other subjects in Šakiai and Šakiai district high schools, secondary and main schools, it turned out that it is the same in almost all district schools and in half of city schools it is lower. It was found that in four fifths of all city and district schools physical education teacher status was the same as that of other subjects.

3. After identifying and comparing the educational process hygiene situation in Šakiai and Šakiai district high schools, secondary and main schools, it was revealed that it was good in all city schools while in the district schools it was poorer. Teachers pointed out that the biggest problem in the district schools was that pupils did not use the showers.

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LIFESTYLE PECULIARITIES OF YOGA PRACTITIONERS AND NON-PRACTITIONERS

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ABSTRACT

Background. In the modern world, people are short of time for physical and spiritual education, which may lead to major health problems. Due to passive lifestyle, many of them have a poor body composition, impaired circulation and reduced flexibility, which may contribute to physical disorders and susceptibility to chronic diseases (Chen, Tseng, Ting, & Huang, 2007). Hypothesis: lifestyle of yoga practitioners is healthier and health evaluation is better compared to those of non- practitioners. The aims of the research were to asses and compare the features of lifestyle and health evaluation of yoga practitioners and non-practitioners.

Methods. The study included middle-aged participants (from 35 to 55 years). A total of 193 people were evaluated, 86 of them were practising yoga. Among these participants, 63 were women, 23 – men. The other 107 did not practise yoga, 58 of them were women, 43 – men.

The questionnaire of the lifestyle of Lithuanian adults was used (Grabauskas, Klumbienė, & Petkevičienė, 2011).

Results. The analysis of the results confirmed the hypothesis proposed at the beginning of the work. Yoga practitioners' nutrition, physical activity, addictions and evaluation of their health was better than those of non-practitioners.

Conclusion. Yoga practitioners have healthier lifestyle habits, they consume less animal fat, eat more fruits, cereals and cereal-based products. In addition, they are more physically active than non- practitioners, both men and women often exercise alone or in group practice sessions and without yoga they have more kinds of physical activity. A lower prevalence of addictions was observed among them; none of them smoked and they had a lower intake of alcohol beverages compared to yoga non-practitioners. Yoga practitioners are healthier and have a better value of their health and the quality of life.

Keywords: yoga, lifestyle, health assessment.

INTRODUCTION

According to the data of the American Sports and Fitness Association, 90% of people experience physical, mental or psychological problems on a continuing basis worldwide, and 26% of population are subjected to stress and strain that are associated with mental and physiological fatigue (Lamb, 2006*)*.

Therefore, it is relevant to search for measures that encourage people to take interest in healthy lifestyle and be physically active. Worldwide, there are many health promotion tools that are of doubtful value and short-lived. However, the guidelines that have undoubted benefits for health have existed over the centuries and have remained unchanged. These guidelines comprise physical activity, healthy diet and peace of mind – all these three constituents are ensured by yoga practise (Saper, Eisenberg, Davis, Culpepper, & Phillips, 2004).

With an increase in the amount of experienced stress, yoga is becoming a cultural phenomenon

and it is the worldwide trend of health promotion. Studies have shown that 9% of all population tried yoga as alternative treatment, and it is growingly becoming popular (Lamb, 2006). The main goal of yoga is to improve general wellbeing. It is aimed not at curing diseases; it teaches people to change their lifestyle and mind. Yoga practise improves, maintains and restores health. It is also valued as stress reduction and considered to be a "cure" against aging. Thus, yoga is regarded as a perspective or assisting treatment for emotional and physiological problems (Emerson, Sharma, Chaudhry, & Turner, 2009). The aim of the research was to assess and compare the yoga practitioners and non-practitioners lifestyle features and health evaluation.

METHODS

The study included middle-aged participants (from 35 to 55 years). A total of 193 people were evaluated, 86 of them were practising yoga. Among these participants, 63 were women, 23 – men. The other 107 did not practise yoga; among them 58 were women, 43 – men.

A questionnaire-based interview included questions about diet, physical activity, harmful habits, and health assessment. The aim of the questions was to determine and compare the peculiarities of lifestyle of yoga practitioners and non-practitioners as well as subjective health assessment. The questionnaire of the lifestyle of Lithuanian adults (Grabauskas et al., 2011) was employed in the study.

The obtained data were analysed using the IBM SPSS Statistics 22.0 package. The significance level was set at $p < .05$, the statistical interdependence was evaluated by chi-square (χ^2) criteria.

RESULTS

A comparison of breakfast intake in yoga practitioners and non-practitioners showed statistical significance. Breakfast consumption was pointed out by 87% of yoga practitioners, while skipping breakfast was reported by 65.3% of non-practitioners. Yoga practitioners slightly more frequently had dinner, and non-practitioners – supper (Figure 1).

A pattern of food intake in women did not show statistical difference. Women yoga practitioners had breakfast (76.2%) slightly more frequently compared to 67.2% of non-practitioners who reported having breakfast (Figure 2).

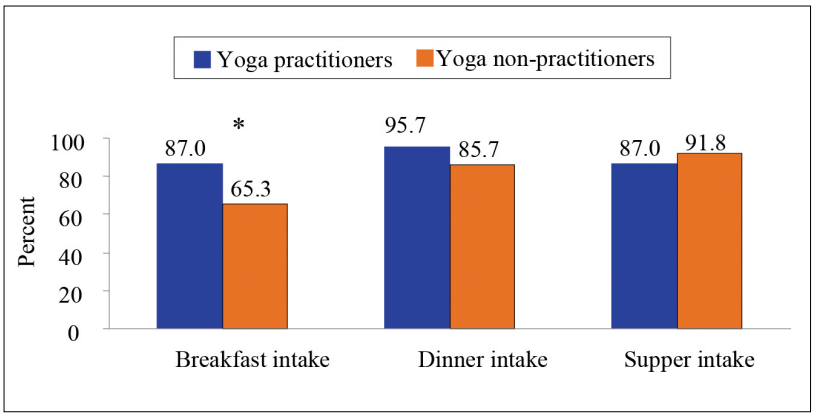


Figure 1. **Pattern of food intake in men yoga practitioners and non-practitioners**

Note. $x^2 = 4$, $df = 1$, $^*p < .05$.

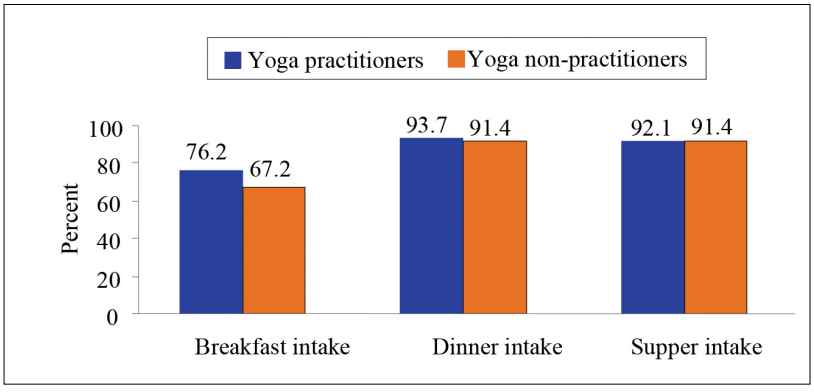


Figure 2. **Pattern of food intake in women yoga practitioners and non-practitioners**

Note. $x^2 = 1$, $df = 1$, $p > .05$.

The regular meal patterns were reported by 60.5% of yoga practitioners while only 25.2% of non-practitioners could provide the positive answer. Occasional regular meal pattern was pointed out by 47.7% of non-practitioners and 29.1% of yoga practitioners ($p < .05$).

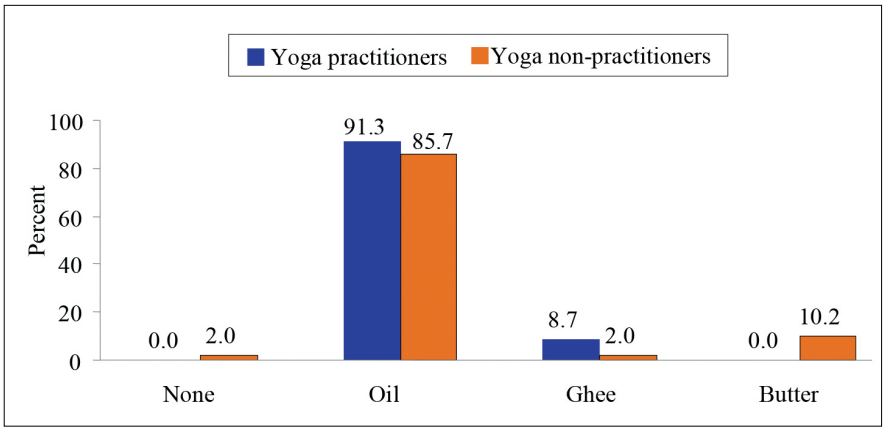
Type of fat consumed by men did not show statistical difference. Vegetable oil was chosen by 91.3% of yoga practitioners and 85.7% of non-practitioners. Ghee was consumed more frequently by yoga practitioners compared to non-practitioners who had butter (10.2%) (Figure 3).

The results showed that 94.8% of women yoga non-practitioners and 58.7 of yoga non-practitioners marked vegetable oil as the most frequent type of oil consumed. Ghee was selected more frequently by yoga practitioners (25.4) versus non-practitioners (14.3%) (Figure 4).

The analysis of pattern of fruit intake considering yoga practice revealed that the majority (44.2%) of yoga practitioners consumed fruits for 6–7 days and 38.4% – 3–5 days weekly. The pattern of fruit intake in the group of non-practitioners was as follows: 30.8% had fruits for 1–2 days, 29.5% – for 3–7 days. Gender difference showed no statistical significance (Figure 5).

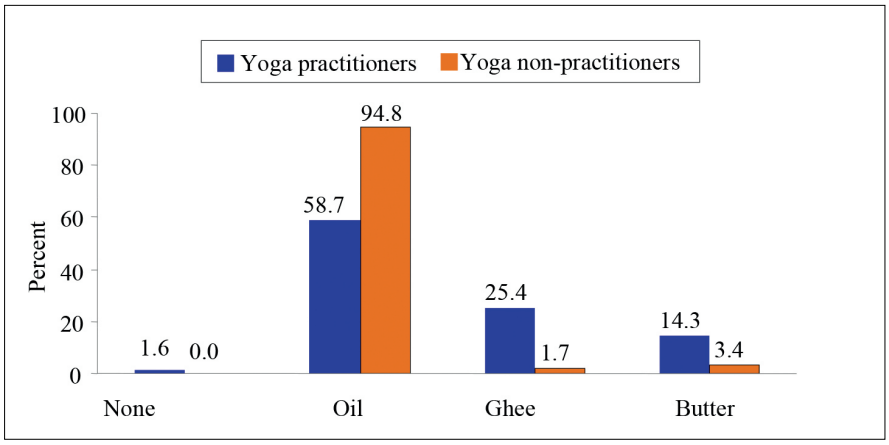
Men yoga practitioners more frequently consumed cereals or grains compared to

Figure 3. **Pattern of fat intake in men yoga practitioners and non-practitioners according to the type of fat**



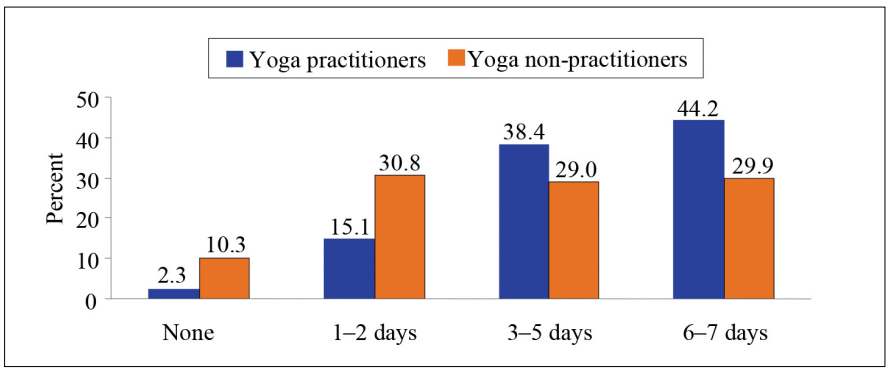
Note. $x^2 = 5$, $df = 3$, $p > .05$.

Figure 4. **Pattern of fat intake in women yoga practitioners and non-practitioners according to type of fat**



Note. $x^2 = 22$, $df = 3$, $p < .05$.

Figure 5. **Pattern of fruit intake in women yoga practitioners and non-practitioners**



Note. $x^2 = 13$, $df = 3$, $p < .05$.

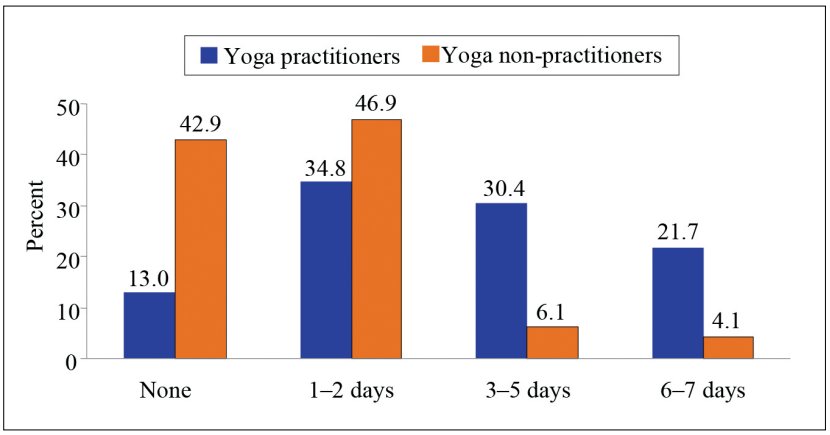


Figure 6. **Pattern of cereals or grain consumption in men yoga practitioners and non-practitioners**

Note. $x^2 = 16$, $df = 3$, $p < .05$.

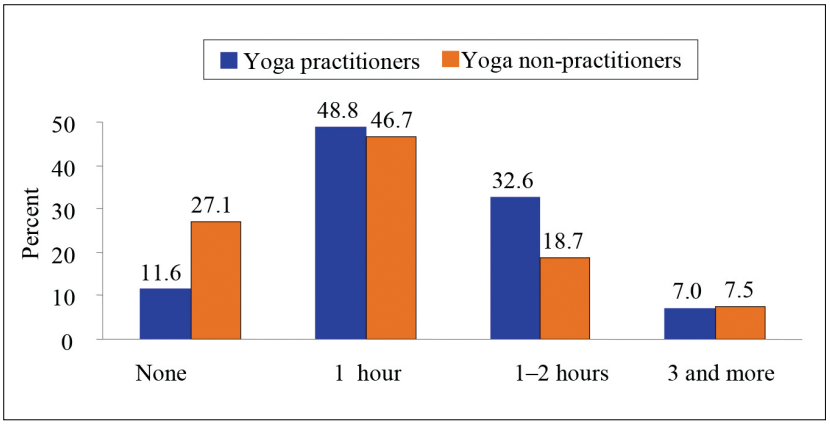


Figure 7. **Pattern of time devoted to physical activity in groups of yoga practitioners and non-practitioners**

Note. $x^2 = 9$, $df = 3$, $p < .05$.

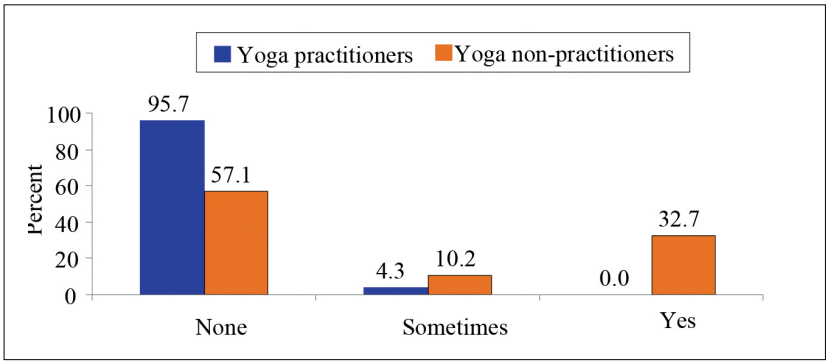


Figure 8. **Pattern of smoking in the group of men yoga practitioners and non-practitioners**

Note. $x^2 = 12$, $df = 2$, $p < .05$.

non-practitioners. Cereal consumption in the group of yoga practitioners had the following pattern: 34.8% had cereals 1–2 days weekly, 30.4% – 3–5 days, and 21.7% – 6–7 days; in the group of non-practitioners – 46.9% had cereals 1–2 days weekly, and 42.9% reported not having cereals at all (Figure 6).

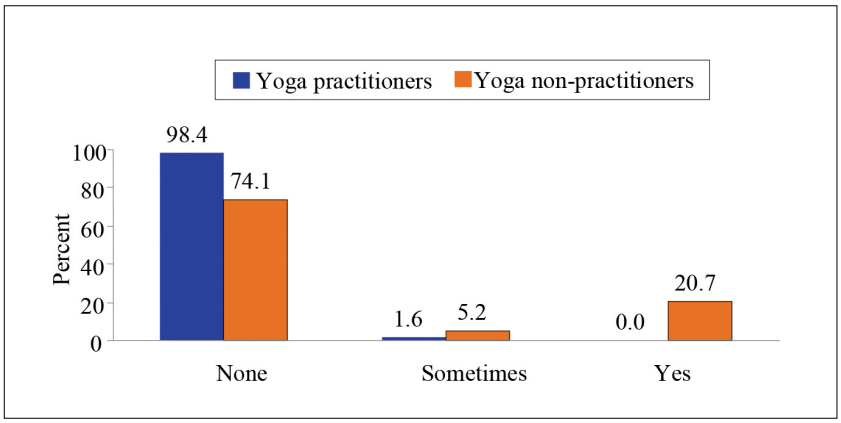
The analysis of time devoted to physical activity revealed that 48.8% of yoga practitioners and 46.7% of non-practitioners had an hour of physical activity. Yoga practitioners (32.65) had 1–2 hours per day, 11.6% – did not have at all. Only 18.7% of non-practitioners had 1–2 hours, and 27.1% of respondents reported not devoting time to physical activity at all. Gender differences showed no statistical significance (Figure 7).

The research determined that the majority of men in the group of yoga practitioners did not smoke, while among non-practitioners, 57.1% were non-smokers, and 32.7% reported smoking on regular basis (Figure 8).

Non-smoking was reported by 98.4% of yoga practitioners and 74.1% of non-practitioners; 20.7% of non-practitioners smoked regularly (Figure 9).

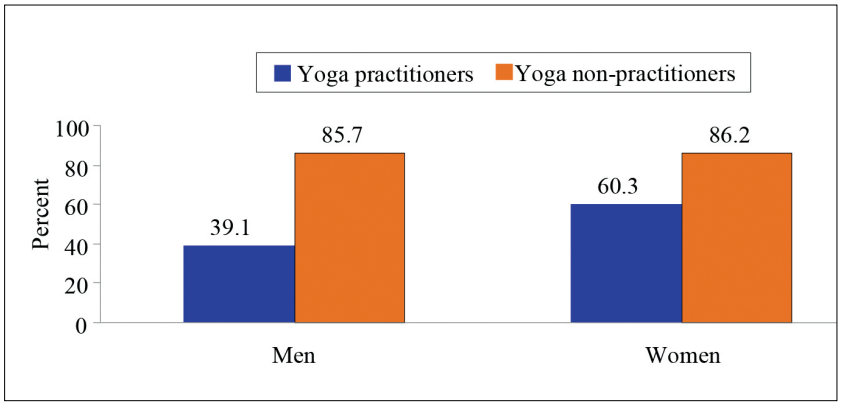
The majority of yoga non-practitioners including 86.2% of women and 85.7% of men consumed

Figure 9. **Pattern of smoking in the group of women yoga practitioners and non-practitioners**



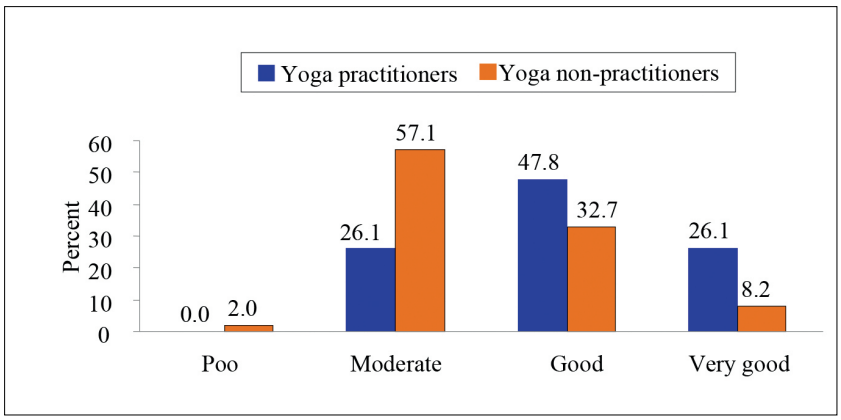
Note. $x^2 = 16$, $df = 2$, $p < .05$.

Figure 10. **Pattern of alcohol consumption in yoga practitioners and non-practitioners**



Note. $x^2 = 23$, $df = 1$, $p < .05$.

Figure 11. **Pattern of subjective self-rated health in men yoga practitioners and non-practitioners**



Note. $x^2 = 8$, $df = 3$, $p < .05$.

alcohol beverages. Yoga practitioners reported having significantly lower alcohol intake: women – 60.3% and men – 39.1% (Figure 10).

The analysis of the responds about general health showed that the majority of self-reporting yoga practitioners (47.8%) evaluated their health as good; moderate and very good was reported by 26.1% of the studied. Moderate health was self-reported by yoga non-practitioners (57.1%), good – by 32.7%, and very good – by 8.2% of respondents (Figure 11).

The majority of self-reporting women evaluated their health as good – 71.4% of yoga practitioners and 51.7% of non-practitioners. Moderate health was self-reported by 36.2% of non-practitioners and 7.9% of yoga practitioners; very good – by 20.6% of yoga practitioners and 6.9% of non-practitioners (Figure 12).

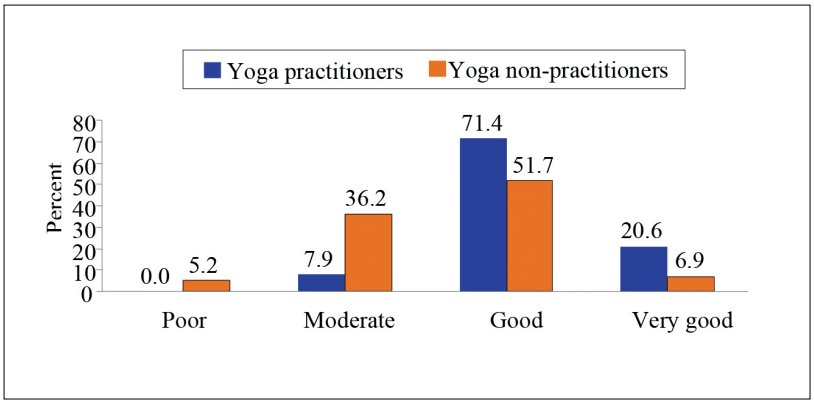


Figure 12. **Pattern of subjective self-rated health in women yoga practitioners and non-practitioners**

Note. $x^2 = 20$, $df = 3$, $p < .05$.

DISCUSSION

In his study on regular eating pattern, Norkus found out that only half of Lithuanian people had regular food intake: three times per day (42% of women, 57% of men) (Norkus, 2012). According to our data, regular eating pattern did not correspond with Norkus' study results; yoga practitioners (93%) and non-practitioners (84.1%) had meal intake 3–5 times per day. The data of the research show that yoga practitioners as well as non-practitioners have meal intakes three times per day; however, they have breakfast and dinner on regular basis.

A study on people's dieting patterns found that fatty foods, particularly animal products, were predominant in the ration of both genders. Carbohydrate consumption was very low, and only 20% of people used fruit and vegetables (Barzda, Bartkevičiūtė, Abaravičius, Stukas, & Šatkutė, 2009). Therefore, the consumption of products high in energetic value, amounts of fats and sugar is becoming more frequent, while intake of cereal grains, fruits and vegetables is dramatically reducing (Grabauskas, 2012). In our research the similar trend is found only among yoga non-practitioners. The excessive amount of meat consumption is in men – 44.9% have meat 3–5 days. A low intake of fruits is observed – 30.8% of the respondents had them only 1–2 days per week as well as a very low amount of grains per week; most of the subjects do not use grains or have them 1–2 days per week. However, among yoga practitioners these rates significantly differ – mostly men use meat 1–2 days (52.2%), and 34.8% do not consume meat at all; women mostly do not consume meat (49.2%) or have a meat intake 1–2 days per week (41.3%). Mostly vegetables were consumed 3–5 days, and fruit – 6–7 days per week. Cereal grains were consumed 1–7 days per week.

Our results show that yoga practise affects people's attitudes about the regularity of eating, proper nutrition that involves low amounts of animal products, high intake of fruits, vegetables and cereal grains.

According to the guidelines of the World Health Organization, an adult should be physically active at least for 30 min per day (WHO, 2007). In our research, the data of the respondents are in concordance with the guidelines, but yoga practitioners devote more time for exercising.

According to Grabauskas' (2012) study, almost 51.6% of Lithuanians never exercise, and during their leisure time they are physically passive. The results of our study confirm these data: 53% of men and 48.3% of women never exercise. Among yoga practitioners, 17.3% of men and 14.2% of women are physically inactive.

We also have found that yoga practitioners also preferred other kinds of activities, such as walking (66.3%), exercising (36%), swimming (11.6%), or cycling (17.4%).

The similar data were received in Penman's study, according to which yoga practitioners were physically more active because they devoted more time for walking, swimming and cycling (Penman, Cohen, Stevens, & Jackson, 2012).

Therefore, yoga practitioners are more physically active, and yoga by itself encourages people's physical activity.

We also have found that 32.7% of men and 20.7% of women yoga non-practitioners regularly smoked. These data are almost in concordance with

other research results; according to Astrauskienė at al., 40% of men and 20 % of women smoked on regular basis (Astrauskienė, Gasperas, & Jasaitis, 2009).

Penman found that people who started yoga practice ceased smoking (80%) and using alcohol beverages (23%) (Penman, Cohen, Stevens, & Jackson, 2012). The results of our research show that 69.6% of men and 30.2% of women used to smoke regularly. Thus, yoga practice may encourage people to cease smoking.

In Astrauskiene at al.'s (2009) study about alcohol intake, gender difference showed no statistical significance. Alcohol consumption was reported by 69% of men and 56% of women. According to our research, gender difference showed no statistical significance among yoga non-practitioners: 85.7% of men and 86.2% of women consumed alcohol beverages. However, yoga practitioners, particularly, men, reported lower amounts of alcohol intake (39.1% of men and 60.3% of women, respectively).

According to the study on the Lithuanian adults' lifestyle in 2010, good self-rated health was reported by 52% of women and 53% of men (Grabauskas et al., 2011). Considering gender, our research data correspond to the data in Grabauskas et al.'s study only in female group (51.7%), however, only 32.7% of men self-reported health as good. The data of yoga practitioners show that not only their health is better, but also they self-reported having good health (47.8% of men and 71.4% of women). The same data were obtained when evaluating the quality of life. The frequency of yoga practice at home favourably predicted ($p < .001$): mindfulness, fruit and vegetable consumption, vegetarian status and vigour. Specifics components of yoga practice improve health behaviours or lifestyle-related health conditions (Ross et al., 2012).

According to the survey of the middle-aged Lithuanian people, 24% of them reported sufficient physical activity, and 76% think that they are not enough physically active (Maciulevičienė & Kardelis, 2006). These data correspond with our results only in the group of men yoga non-practitioners (26.5%) and women yoga practitioners (25.4%). The majority of men yoga practitioners (39.1%) think that they are sufficiently physically active.

According to Grabauskas at al., the rate of obesity is growing due to the predominance of sedentary lifestyle. In Lithuania, 19.7% of people are obese, and 55% are overweight (Grabauskas et al., 2011).

Our research shows that only the data of yoga non-practitioners are in concordance with Grabauskas at al.'s study (obesity in 14.3%, being overweight in 51% of the research participants). Weight is normal in the majority of women and yoga practitioners.

The analysis of the data confirms the hypothesis proposed at the beginning of the research.

CONCLUSION

Yoga practitioners have healthier lifestyle habits, they consume less animal fat, eat more fruits, cereal grains. Also, they are more physically active than non-practitioners. The lower prevalence of addictions is among yoga practitioners; none of them smoke and have a lower intake of alcohol beverages compared to yoga non-practitioners. Yoga practitioners are healthier and have a better value of their health and the quality of life.

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