

**IMPACT OF TRAINING IN SPORTS GAMES AND CYCLIC SPORTS  
EVENTS ON THE MUSCULAR AND CARDIOVASCULAR SYSTEM  
OF 11 – 14 YEAR-OLD BOYS**

Maturation processes determine an interaction of inherent (endogenous) and acquired (exogenous) factors [1]. Exogenous factors, i.e. physical activity, the nature of physical load and other physical load characteristics play a significant role in this interaction. An activity of CS is exceptionally important in the chain of adaptive mechanisms. Generalized epidemiological studies of other scientists highlight the positive effects of physical exercise on the working capacity and functional state of the muscular and cardiovascular system [6]. However, specificity of exercises selection is relevant to sports games (partially regulated physical load) or cyclical sports (strictly regulated physical load) and has a great impact on development of the muscular and CS features. Children choose a specific sport (event), and regular long-term attention of training sessions becomes a significant factor in prevalence of the nature of physical exercises [9]. This article examines long-term training effect of different sports on boys' muscles and the CS.

The aim is to determine sports games and cyclical sports impact on features of dynamics in functional parameters of the muscular and cardiovascular systems of 11-14-year-old boys.

The study involved 11-14-year-old boys, Lithuanian high school and sports school pupils (healthy, having no bad habits). In this study the contingent was made up of 257 boys of 11-14. All testees were divided into three groups: non-athletes (n = 85), cyclical sports athletes – runners (n = 89) and representatives of sports games – basketball, handball, football (n = 83). This study involved boys going in for a sport no less than 2 years.

The study was carried out in Kinesiology laboratory, Lithuanian Academy of Physical Education, in spring 2006 (April/May), at the same time of day. During two days before testing boys had not performed any exercises.

Local ethical committee approved this study protocol. The subject underwent a dosed exercise test, i.e. The Ruffier Test (30 squats per 45 seconds) and various exercise tests, i.e. a 30-seconds-duration vertical jump test [11]. A computerized ECG analysis system "Kaunas-load", developed at Kaunas Medical University Institute of Cardiology, was employed for 12 synchronous lead ECG recording and analysis. The changes in HR as a sum in 12 leads were analyzed.

Boys' muscular strength was measured by the hand dynamometer "Nicholas." With "Nicholas" hand power measurements device, the maximum force required for the isometric muscular contraction mode is obtained when the resistance caused by the research investigator appears. The characteristic of the dynamometer is a measure of strength between 0 and 199.9 kg, therefore it is possible to evaluate the major muscular strength. The device is placed between the investigator's and testee's arm. The investigator's pressure force through the dynamometer is aimed at the testee's upper limb. There were also measured calf extensors and flexors strength and forearm extensors and flexors strength.

In order to compare the data there were determined the arithmetic meaning ( $\bar{x}$ ), an average standard deviation (SD). Due to evaluation of significant differences of values there was used one-way analysis of variance – ANOVA (Student's test summary of several independent samples). There were used the following statistical significance levels: p <0.05 – a reliable, p <0.01 – a highly reliable, p <0.001 – a particularly credible conclusion.

Comparing the results of dynamometry in four age groups (11, 12, 13, and 14) measured in our selected groups of muscles on the right and left side calf extensors (Fig. 1) and flexors (Fig. 2) and also forearm extensors (Fig. 3) and flexors (Fig. 4), we found out that the best results were achieved by cyclical sports athletes. The weakest results were shown by non-athletes boys. Examination of the calf extensors strength showed that among 11-13-year-old boys the best results were shown by cyclical sports athletes, as well as the calf flexors strength – between 11 and 12-year-old boys. Measurements of forearm flexors strength of 11-14-year-olds and the best results were demonstrated in cyclical sports groups, as well as statistically significant difference compared with the results of non-athletes and sports games players groups. The same situation was observed in evaluation of forearm extensors strength of right side and left side of 11 and 13 year-olds.

Dynamometry assessments between the groups showed that the muscle strength of the cyclical sports athletes is greater than non-athletes and sports games players. Statistically significant differences between boys were identified in all age groups in assessment of both right and left sides.

HR dynamics according to Ruffier and 30 seconds vertical jumping tests demonstrated by non-athletes boys, sports games players and cyclical sports athletes aged 11-14 is presented in Figure 5. At the age of 11, 12 and 14 there were not found statistically significant differences between athletes and non-athletes groups. Also HR results of 13-year-old non-athletes boys and cyclic sports athletes did not differ. However, analyzed data of both groups throughout the study exhibited statistically significant differences in comparison with the sports games players.

The body's reaction to physical exercises belonging to the group of external factors and affecting the body's growth and development features, has an impact on functional and morphological changes in the systems [5]. The most sensitive age to external influences is 11-14 years, therefore investigation of 11-14 year-old boys engaged in sports may reveal the complex interaction of inherent and acquired (endogenous and exogenous) factors.

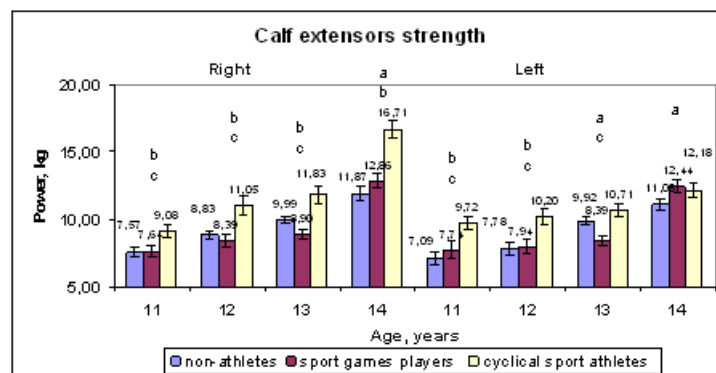


Fig. 1. Results of calf extensors strength of non-athletes, sports games players and cyclical sports athletes. Note. The difference between non-athletes and sports games players – a, cyclical sports athletes and non-athletes – b, sports games players and cyclical sports athletes – c - is statistically significant when p <0,05.

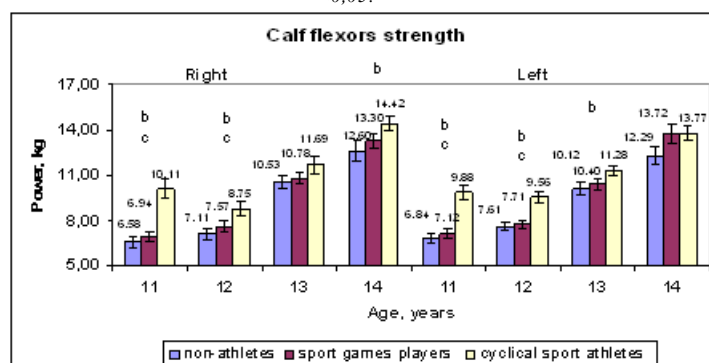


Fig. 2. Results of calf flexors strength of non-athletes, sports games players and cyclical sports athletes. Note. The difference between non-athletes and sports games players – a, cyclical sports athletes and non-athletes – b, sports games players and cyclical sports athletes – c – is statistically significant when  $p < 0,05$ .

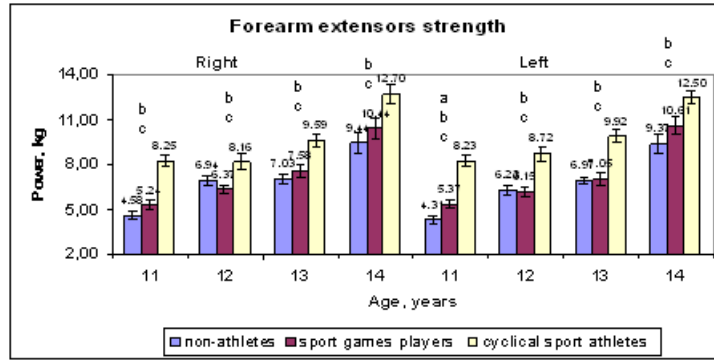


Fig. 3. Results of forearm extensors strength of non-athletes, sports games players and cyclical sports athletes. Note. The difference between non-athletes and sports games players – a, cyclical sports athletes and non-athletes – b, sports games players and cyclical sports athletes – c – is statistically significant when  $p < 0,05$ .

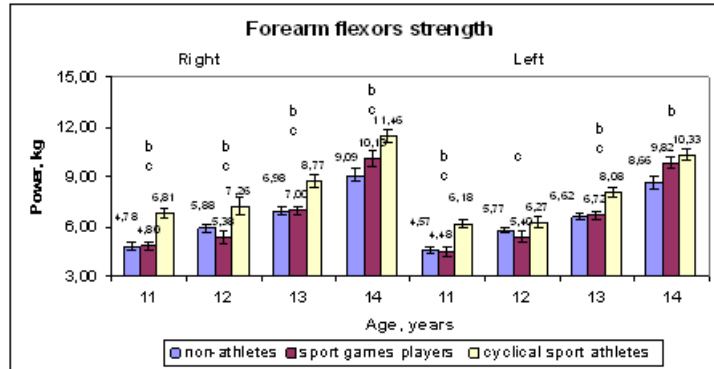


Fig. 4. Results of forearm flexors strength of non-athletes, sports games players and cyclical sports athletes. Note. The difference between non-athletes and sports games players – a, cyclical sports athletes and non-athletes – b, sports games players and cyclical sports athletes – c – is statistically significant when  $p < 0,05$ .

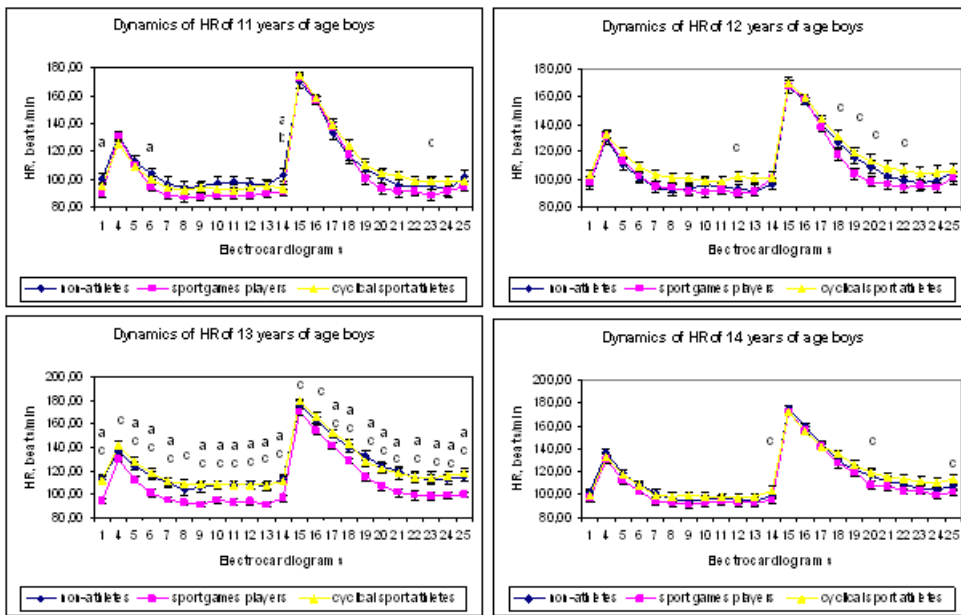


Fig. 5. HR dynamics of 11 to 14-year-old non-athletes, sports games players and cyclical sports athletes according to The Rouffier Test and 30 seconds vertical jumping test. Note. The difference between non-athletes and sports games players – a, cyclical sports athletes and non-athletes – b, sports games players and cyclical sports athletes – c – is statistically significant when  $p < 0,05$ . 1 ECG - before load; 4 to 14 ECG - recovery after Rouffier test; 15-25 ECG - recovery after 30 seconds vertical jumping test.

The current investigation is dedicated to studies and evaluation of sports games and cyclical sports impact on features of dynamics of body's functional state of 11-14-year-old boys. It is shown that physical load nature (partially regulated, specific for sports games activities and strictly regulated physical load, specific to cyclical sports training sessions) differently affects features of the CS in a growing and rapidly evolving body.

Comparison of the obtained data showed that the lowest HR values were in the 13-year-old sports games players group which significantly differed from non-athletes and cyclical sports athletes. Thus lower HR values show that boys attending sports games trainings exhibit slower heart rate – longer diastole (heart relaxation), faster mobilization of the CS at the onset of exercise. This confirms an opinion of some scientists [3] according to whom specific exercise used in sports games training sessions, and partially regulated nature of physical load have an impact on adaptation changes.

Although better results of the CS dynamics evaluation were specific to representatives of sports games, dynamometry assessments between the groups showed that muscle strength is more specific to cyclical sports athletes, but neither to non-athletes boys nor players. Statistically significant differences between boys were identified in all age groups, in assessment of right and left sides. Muscle capacity assessment data confirmed a number of other authors claiming that exercise affects the growth and development processes [7].

Considerable research has been performed in order to assess patterns of the growth and development [8], finding the most appropriate physical load [4]. Generalization of some scientists and results of this study suggests that interaction of external and internal factors determines features of muscular and CS functional capacity development and its expression during exercise of 11-14-year-old boys. Physical load of variable intensity specific to exercises of sports games training sessions is a significant external factor affecting accelerated change of cardiovascular functional parameters at the age of 13. However, endogenous factors, especially in 13-14 year-old groups, are strongly influenced by the CS, so that even non-athletes boys' CS functional parameters are improving rapidly, and according to these indices non-athletes children almost equal to peers engaged in sports. Precisely regulated physical load specific to cyclical sports is an external factor affecting boys' muscle strength parameters of 11-14 year-olds.

The obtained results can be explained by some scientists' conclusions [9], where physical loads of diverse directions, creating different external and internal stimuli relations, lead to different adaptation properties. Thus, because of regular physical loads the functional state of the CS is improved as a result of training sessions of sports games players, whereas the muscular system performance - of cyclical sports athletes.

Summing-up these results it is necessary to take into account the fact that athletes' physical maturity and functional preparedness indicators are the outcome of selection and adaptation dynamics [10]. Also, our study confirms other researchers' findings [2] stating that sports activities unquestionably have an impact on the

capacity of the cardiovascular system and skeletal muscles

Conclusions. 1. Sports games training sessions is a significant exogenous factor affecting functional parameters of accelerated changes in the cardiovascular system (CS) of 11-13 year-old age groups. Decisive influence of endogenous factors on child's growth and development significantly increases at the age of 13-14 due to changes of important cardiovascular system indices improvement and the fact that non-athletes children become almost equal to athletes contemporaries considering these parameters. 2. The improvement of muscle capacity indices depends on the nature of physical load: muscle strength indices more increased in cyclical sports group.

*Подано до редакції 26.04.10*

#### SUMMARY

The article investigates influence of sports games and cyclical sports types on features of dynamics in functional parameters of the muscular and cardiovascular systems of 11-14-year-old boys. Influence of endogenous factors on child's growth and development considerably increases at the age of 13-14 resulting in significant changes in improvement of the CS indices. The investigation reveals that non-athletes children are almost equal to peers engaged in sports due to all characteristics. The volume of muscle capacity indices depends on the nature of physical load: muscular strength indices are more increased in cyclical sports group.

**Keywords:** the cardiovascular system, muscles, sports games, cyclical sports.

*А. Емельяновас, И. Валантициене, И. Тилиндие*  
**ВОЗДЕЙСТВИЕ СПОРТИВНЫХ ИГР И ЦИКЛИЧЕСКИХ ВИДОВ СПОРТА НА МЫШЦЫ И СЕРДЕЧНОСОСУДИСТУЮ СИСТЕМУ МАЛЬЧИКОВ 11-14 ЛЕТ**

#### РЕЗЮМЕ

В статье рассматривается влияние спортивных игр и циклических видов спорта на свойства динамики функциональных параметров мышц и сердечно-сосудистой системы (СС) мальчиков в возрасте 11-14 лет. Определенное влияние эндогенных факторов на рост и развитие ребенка значительно увеличивается в возрасте 13-14 лет и влечет за собой улучшения в СС, а также было обнаружено, что дети, которые не занимаются спортом по всем характеристикам практически равны сверстникам, занимающихся спортом. Объем мышц зависит от физической силы: мышечная сила более увеличена в циклических видах спорта.

**Ключевые слова:** сердечнососудистая система, мышцы, спортивные игры, циклический вид спорта.

*А. Емельяновас, И. Валантициене, И. Тилиндие*  
**ВПЛИВ СПОРТИВНИХ ІГОР І ЦИКЛІЧНИХ ВИДІВ СПОРТУ НА М'ЯЗИ ТА СЕРЦЕВО-СУДИННУ СИСТЕМУ ХЛОПЧИКІВ 11-14 РОКІВ**

#### РЕЗЮМЕ

У статті розглядається вплив спортивних ігор та циклічних видів спорту на властивості динаміки функціональних параметрів м'язів та серцево-судинної системи хлопчиків 11-14 років. Певний вплив ендогенних факторів на зріст та розвиток дитини значно збільшується у віці 13-14 років і призводить до поліпшення роботи ССС, а також було виявлено, що діти які не займаються спортом за всіма характеристиками практично рівні своїм одноліткам, які займаються спортом. Об'єм м'язів залежить від фізичної сили: м'язова сила більш збільшена в циклічних видах спорту.

**Ключові слова:** серцево-судинна система, м'язи, спортивні ігри, циклічний вид спорту.