

Adaptive Capabilities Of Students When Using Trekrezan And Physical Exercises Of A Health-Improving Orientation

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Abstract

96 first-year students of the Astrakhan State University of Architecture and Civil Engineering and the Astrakhan State Technical University, boys aged 17-18 years old, took part in the study on a voluntary basis. In the first group (students were engaged in an experimental program of a health-improving nature), at the start of the study, significant differences were shown in lower results of right-hand dynamometry ($p<0.05$). In the second group (students were engaged in a standard program of physical education), the studied indicators significantly exceeded such indicators in the main group according to the Genche's test and the pulse

recovery time after exercise ($p<0.05$). A high percentage of boys of the first group with a weak pulse recovery reaction was found (42.9%), in the second group, a bad reaction was determined in 28.6% of boys. In the first group, when using a health-improving technique in physical education classes and after two courses of using trekrezan (in autumn and spring) at the end of the study, i.e. at the end of the academic year, a significant improvement was registered in the indicators of the speed of pulse recovery after physical exertion ($p<0.01$). In the first group changes towards growth are noted in these indicators: by 6.1% for the Stange's test and by 14.2% for the Genche's test. In the first group, the results significantly improved for most indicators of the studied characteristics ($p<0.01$; 0.05), with the exception of static endurance of the back and arm muscles. They haven't changed. The maximum positive changes in this group were recorded at 18.6% in the study of dynamic endurance, at 10.2% of working capacity, and at 15.0% of power endurance. The indicators in the Juhash test increased by 21.0%. The comparison of intergroup differences showed significant changes of the first group of boys in the indicators of the step test ($p<0.01$). Most of the boys of the first group at the beginning of the study had a lower level of some qualities and functions that determine the adaptive capabilities of the human body. At the end of the study, positive dynamics was noted for most indicators in the first and second groups. Health-improving methods in practical physical education classes and the use of trekrezan are an effective means of strengthening health, preventing acute respiratory infections and increasing the adaptive potential of the body.

Keywords: students; boys; adaptive capabilities; adaptive potential; trekrezan; health; physical education classes; wellness methods; tests.

Introduction. A significant disadvantage of the development of modern science and technology is inactivity, which is gradually becoming a pandemic. Inactivity is one of the main causes of metabolic disorders in the human body, diseases of the central nervous system, respiratory and cardiovascular systems, musculoskeletal system, the formation of chronic fatigue syndrome (2,p.2, 4,p. 2, 14,p. 2). With the intensification of physical and mental activity, energy expenditure increases, the amount of energy-forming substances sharply decreases, the body's resources are intensively consumed, etc., therefore, the role of physical education and sports (PE&S) plays a great importance. And the process of education and upbringing in universities plays an important role in the comprehensive physical development of young people, who will then work productively, clearly and firmly make important decisions, courageously endure failures and strive for success in any activity and under any circumstances (5, p.3, 6, p. 3, 7, p. 3,10, p. 3,14, p. 3,15, p. 3,16, p. 3,17, p. 3,).

Functional changes in the body that occur when exposed to physical training are determined by the nature, volume and intensity of the loads used. The most effective means of increasing the adaptive potential (AP) are physical exercises (PE) for various types of endurance, since the manifestations of this quality depend on the state of the cardiovascular system (CVS) and the respiratory organs of a person. But the desired results can be achieved only with systematic classes of PE&S, built on the knowledge of the laws of the development of adaptive capabilities of the body, ways to improve performance under muscle loads (2,p. 3, 5,p.3, 6,p. 3, 7,p. 3, 8,p. 3, 9,p. 3 10,p. 3, 18,p. 3, 21,p. 3, 23,p. 3, 26,p. 3, 27,p. 3). There are also chemical preparations with adaptogenic and immunogenic properties, which are available in the form of medicines or biologically active additives). These include, in particular, protatrans – these are salts of

biologically active acids of triethanolammonium, under the general formula X - N+H(CH₂CH₂OH)₃. The ancestor of this class of medicines is Trekresan – Tk) - the triethanolammonium salt of 2-methylphenoxyacetic acid, which has the above-listed effects (1, p. 3, 3, p.3,4, p. 3).

A clearly and precisely planned educational process according to the PE&S of a health-improving orientation and using the principle of continuity significantly increases the body's defenses and contributes to the formation and improvement of the AP of the body. The alternation of practical exercises of various types, varying the intensity of loads develops a stereotype of a sequential change of functional states, which gives an increase in AP (2, p. 3, 11, p.3,12, p. 3,13, p. 3,25, p. 3,22, p. 3). With the help of such lessons of PE&S many of the indicators of physical development and functional state of the organism can be changed directly (10,p. 3, 19,p. 3, 20,p. 3, 24,p. 3).

Thus, studies of evaluating the effectiveness of training sessions of PE&S aimed at improving of AP of the boys' organism and concurrent use of prophylactic course of trekrezan, is an urgent task and they significantly extend the range of wellness techniques of sports science.

Materials and methods. All in all, 96 male first-year students of the Astrakhan State University of Architecture and Civil Engineering (ASUACE) and Astrakhan State Technical University (ASTU) studying construction and technical specialties, aged 17-18 years old took part in the survey. At the start of the study, a written voluntary consent to participate in this study was received from all the students. The study was conducted in three stages. 2 groups of boys were formed: the first (49 people) with classes of a health-improving orientation and the second (47 people), engaged in the standard program of physical education in universities. The first group included boys according to the results of a self-assessment survey of their own health and those who suffer from acute respiratory infections from 4 or more times during the academic year. Also, to reduce the number of colds, i.e. the prevention of acute respiratory infections and increase immunity, the boys of the first group were offered on a voluntary basis 2 courses of trekrezan in the form of a biologically active additive (dietary supplement). The 1st course was conducted in early October and the 2nd course - at the end of February, i.e. during the periods of the most frequent acute respiratory infections. Dietary supplement trekrezan was prescribed at a dose of 200 mg, 2 times a day (morning and evening) for 10 days, 15-30 minutes before meals.

The entire annual physical load was divided into VII stages. Stages I-III are focused on the development of general endurance, IV-VII – special endurance. To form the overall endurance, we used a long, uniform running, determining its 3 working zones by heart rate: Stage I-heart rate 120-140 beats / min; II-140-160; III – 160-180 beats/min. Special endurance was developed by repeated running on segments of 80-1000 m. Each of the VII stages (except for the first one) included 8 training sessions (2 times a week) and 8 independent ones according to the individual task of the teacher-coach. During the running mode, auxiliary complexes of circular training were performed for the development of physical

qualities. Circular training includes the PE of directed action on certain muscle groups in accordance with the running training regime. Functional indicators were evaluated using tests that characterize the state of the CVS (the speed of pulse recovery after physical exertion) and the respiratory system (the Stange's test, the Genche's test). The Harvard-step test (general performance), the Juhash test (strength endurance), the dynamic endurance of the abdominal and back muscles and the static endurance of the back and arm muscles were determined. In statistical calculations we used: the arithmetic mean (X), the mean square deviation (δ), the correlation coefficient (r), the standard error of the arithmetic mean (Sx), the Student's criterion and the significant reliability of the differences was considered at 1-5% significance level.

Results and discussions.

Table 1 presents data characterizing the physical development of first-year students (boys) at the beginning of the study.

№	Studied indicators	Studied groups of students		P
		the first group, n=49	the second group, n=47	
		$X \pm m$		
1	Body weight (kg)	$68,3 \pm 1,4$	$67,7 \pm 0,9$	>0,05
2	Body Length (cm)	$178,0 \pm 1,4$	$177,6 \pm 1,6$	>0,05
3	Chest circumference (cm)	$89,1 \pm 0,9$	$88,5 \pm 0,8$	>0,05
4	Vital capacity of the lungs (ml)	$3608,1 \pm 134,2$	$3612,8 \pm 92,3$	>0,05
5	Dead weight (kg)	$127,4 \pm 8,1$	$115,1 \pm 4,2$	>0,05
6	Dynamometry (kg) right hand	$47,2 \pm 2,3$	$52,8 \pm 1,4$	<0,05
	left hand	$48,3 \pm 0,9$	$49,8 \pm 2,0$	>0,05

Table 1. Indicators of physical development of boys at the beginning of the academic year in the 1st year

The results of the functional readiness of boys in the 1st year are presented in Table 2.

№	Studied indicators	Studied groups of students		P
		the first group, n=49	the second group, n=47	
		$X \pm m$		
1	Genche's test, (s)	$40,3 \pm 3,3$	$48,9 \pm 2,4$	<0,05
2	Stange's test, (s)	$48,6 \pm 3,2$	$51,7 \pm 1,9$	>0,05
3	Speed of pulse recovery, s	$37,0 \pm 1,5$	$32,7 \pm 1,1$	<0,05

Table 2. Indicators of the functional state of boys in the 1st year at the beginning of the academic year.

Next, we evaluated various types of endurance as the most informative indicators of the state of CVS (Table 3).

№	Studied indicators	Studied groups of students			P	
		the first group, n=49	the second group, n=47	$X \pm m$		
1	Strength endurance (Juhash test)					
	Quantity of repetition	1st exercise	$37,5 \pm 1,3$	$45,1 \pm 1,6$	<0,01	
		2nd exercise	$25,3 \pm 1,0$	$29,7 \pm 1,3$	<0,05	
		3rd exercise	$47,2 \pm 1,5$	$48,3 \pm 1,3$	>0,05	
		4th exercise	$34,6 \pm 2,1$	$40,5 \pm 1,3$	<0,05	
		5th exercise	$17,1 \pm 2,7$	$24,6 \pm 1,1$	<0,05	
		6th exercise	$17,4 \pm 1,4$	$23,3 \pm 0,8$	<0,01	
	The sum of all repetitions (Σ)		$174,1 \pm 1,7$	$206,5 \pm 1,2$	<0,01	
2	Number of points scored (level)					
	Overall performance (step-test)					
	Heart rate dynamics (30 s)	Heart rate after 1 min	$74,1 \pm 0,8$	$72,2 \pm 0,9$	>0,05	
		Heart rate after 2 min	$69,0 \pm 1,1$	$67,5 \pm 0,9$	>0,05	
		Heart rate after 3 min	$66,4 \pm 1,3$	$65,6 \pm 1,0$	>0,05	
		Step test index	$73,7 \pm 1,1$	$75,1 \pm 0,9$	>0,05	
3	Dynamic endurance of the back and abdominal muscles					
	Lifting the corpus in 1 min		$27,3 \pm 0,9$	$30,8 \pm 1,3$	<0,05	
4	Static endurance of the arms, back and abdominal press muscles					
	Load retention of 10 kg (s)		$38,9 \pm 1,0$	$41,9 \pm 1,3$	>0,05	
	Holding the 90° angle in the hang (s)		$5,53 \pm 1,8$	$5,26 \pm 1,1$	>0,05	

Table 3. Indicators of various types of endurance of boys in the 1st year at the beginning of the study

To assess the effectiveness of the studied indicators, at the end of the study we conducted final testing, which took place in the first and second groups using the same diagnostic methods as at the beginning of the study (Table 4).

Studied indicators	Stages of the study	Studied groups of students		P
		the first group, n=49	the second group, n=47	
		$X \pm m$		
Genche's test (s)	Beginning	$40,3 \pm 3,3$	$48,9 \pm 2,4$	<0,05
	End	$45,9 \pm 2,0$	$46,7 \pm 1,8$	>0,05
	P	>0,05	>0,05	
Stange's test (s)	Beginning	$48,6 \pm 3,2$	$51,7 \pm 1,9$	>0,05
	End	$51,5 \pm 1,7$	$52,1 \pm 1,2$	>0,05
	P	>0,05	>0,05	
Speed of pulse recovery (s)	Beginning	$37,0 \pm 1,5$	$32,7 \pm 1,1$	<0,05
	End	$32,2 \pm 0,9$	$32,1 \pm 1,2$	>0,05
	P	>0,05	<0,01	

Table 4. Indicators of the functional state of boys in the 1st year at the end of the study

Strength endurance was determined using the Juhash test, consisting of 6 diverse PE (Figure 1).

At the next stage, the analysis of the level of formation of various types of endurance, as an integral adaptive indicator, was carried out. The data obtained are shown in Table 5.

№	Studied indicators	Stages of the study	Studied groups of students		P
			the first group, n=49	the second group, n=47	
			$X \pm m$		
1	Strength endurance (Juhash test)				
	The sum of all exercises	Beginning	$174,1 \pm 1,7$	$206,5 \pm 1,2$	<0,01
		End	$200,1 \pm 1,4$	$201,6 \pm 1,5$	>0,05
		P	<0,05	<0,01	
2	The amount of points scored (evaluation)	Beginning	939	1214	
		End	1196	1198	

2	Overall performance (step-test)				
	Step test index	Beginning	$73,7 \pm 1,1$	$75,1 \pm 0,9$	>0,05
		End	$81,1 \pm 0,8$	$76,2 \pm 0,8$	<0,01
		P	<0,01	>0,05	
3	Dynamic endurance of the back and abdominal muscles				
	Lifting the corpus in 1 min.	Beginning	$27,3 \pm 0,9$	$30,8 \pm 1,3$	<0,05
		End	$32,2 \pm 0,8$	$31,9 \pm 0,7$	>0,05
		P	<0,01	>0,05	
4	Static endurance of the arms, back and abdominal press muscles				
	Load retention of 10 kg (s)	Beginning	$38,9 \pm 1,0$	$41,9 \pm 1,3$	>0,05
		End	$40,6 \pm 0,6$	$41,5 \pm 0,7$	>0,05
		P	>0,05	>0,05	
	Holding the 90° angle in the hang (c)	Beginning	$5,53 \pm 1,8$	$5,26 \pm 1,1$	>0,05
		End	$5,99 \pm 0,9$	$5,78 \pm 1,2$	>0,05
		P	>0,05	>0,05	

Table 5. Indicators of the level of endurance development of boys in the 1st year at the end of the study.

In the end, we found out that most of the boys from the first group in the beginning of the study have lower levels of some features and qualities that define the AP of the body, namely:

- worst performance of the respiratory system (Genche's test with a breathholding) and CVS (speed of heart rate recovery after exercise), which are most important for the formation of AP of an organism, with statistical confidence ($p<0.05$). Poor fitness for physical activity is a characteristic of 42.9% of boys in this group.

- a lower initial level of formation of special conditioned qualities was noted. In strength endurance, the first group of boys is significantly inferior to the boys of the second group in all components and the total sum of all PE ($p<0.01$; 0.05). The worst results were determined with high confidence in the first group of boys in tests of dynamic endurance of the back muscles ($p<0.05$).

The obtained results of the study allow us to state a positive trend in most indicators in the first and second groups of boys. But the most significant positive changes in comparison with the initial data occurred in the first group under the influence of health-improving activities (+trekrezan), namely:

- a significant improvement in functional indicators was determined by the parameters of the speed of pulse recovery after physical exertion ($p<0.01$), which characterizes the fitness for long-term physical work. The improvement of indicators at this stage of the study is noted by 6.1% in the Stange's test and by 14.2% in the Genche's test;

- the maximum positive indicators were noted among the boys of the first group - by 15.0% in the study of power endurance ($p<0.01$), by 10.2% in the study of working capacity ($p<0.01$) and by 18.6% in the study of dynamic endurance;

- a significantly positive increase in the results of all professionally important qualities was determined ($p<0.01$). The final score in the Juhash test increased by 21.0%, which is equal to the average level of strength endurance compared to the low level registered at the beginning of the study.

- the incidence of acute respiratory infections among students of the first group decreased by 2 times during the academic year.

The method of improving the AP of boys with a weakened level of physical health through the development of complex endurance in the practical classes of the PE&S and 2 seasonal courses of trekrezan, is an effective means of preventing acute respiratory infections and functional readiness for further training of students at the university.

Conclusion. At the start of the studies, significant differences in physical development indicators between the first and the second groups were revealed only in lower right-hand dynamometry indicators ($p<0.05$) of boys of the first group, i.e., that these groups of boys are homogeneous in terms of physical development. Comparison of the obtained initial results of functional tests showed that the studied indicators in the second group of boys significantly exceed similar indicators in the first group in the Genche's test and the speed of pulse recovery after exercise ($p<0.05$). In the Stange's test, there were no significant differences between the groups ($p<0.05$). It is necessary to note a high percentage of boys of the first group who have a poor reaction to the speed of pulse recovery (42.9%), according to the assessment of this technique, while in the second group, a bad reaction was registered among 28.6% of boys. This suggests that most of the boys of the first group who are engaged in PE&S have some deviations in the functioning of the respiratory system and CVS, which are most important for the formation of the AP of the body. A particularly significant function, in our opinion, is the speed of pulse recovery, since it characterizes the fitness of the body to physical exertion, which is the key in the development of efficiency and endurance. The dynamics of heart rate indicators during the recovery period and the step test index of the first group exceed similar indicators of the second group of boys, but these differences are not statistically significant ($p>0.05$). The results of the step test index correspond to the average level of physical performance. The initial results obtained in the tests indicate a significant advantage of the boys of the second group in all the components of the test ($p<0.01$; 0.05), except for the third PE for pulling the leg aside in 1 min. ($p<0.05$). According to the sum of all PE, the boys of the second group also significantly exceed ($p<0.01$) the indicators of the boys from the first group at the beginning of the study. This was manifested in rapid fatigue and a decrease in the productivity of the performed PE, which indicates a low ability for long-term work of the boys in this group. Significantly lower values in the first group of boys were also determined by

tests evaluating the spatial differentiation of muscle effort ($p<0.05$), the dynamic endurance of the back muscles ($p<0.05$) and the accuracy of motor reactions ($p<0.05$). The study of the manifestations of static endurance of the back, arms and abdominal press muscles did not determine statistical differences between the first and the second groups ($p>0.05$). The final study of the functional indicators of the boys revealed ambiguous intra-group dynamics of the characteristics of the CVS and the respiratory system in 2 groups. So, in the first group of boys, a positive shift was noted for all the studied functions, especially in terms of the parameters of the speed of pulse recovery after physical exertion ($p<0.01$), which characterizes the fitness for long-term physical work. The increase in indicators in the first group of boys is noted by 6.1% in the Stange's test and by 14.2% in the Genche's test. In the second group of boys, there was also an improvement in functional indicators by 1.9% in the reaction of load tolerance and by 0.8% in the Stange's test, and in the Genche's test, a decrease in time of holding breath on exhalation was noted by 4.6% (changes are not significant, $p>0.05$). According to the level of functioning of the CVS and the respiratory system, the boys of the second group lost their reliable superiority, revealed at the beginning of the school year. In the second group of boys, there was a slight deterioration in the results of the strength endurance test ($p<0.05$), which was determined by a decrease in the number of points scored by the sum of all PE. According to the remaining tests, the second group showed a slight increase in the studied indicators, but statistically significant ($p>0.05$). In the first group of boys, the qualitative changes were more significant at the end of the study. Thus, the boys of this group significantly improved the results in many indicators of the studied characteristics ($p<0.01$; 0.05), with the exception of static endurance of the back and arms muscles. The best indicators in the first group were determined by 18.6% in the study of dynamic endurance, by 10.2% in the study of working capacity and by 15.0% in power endurance. In the Juhash test, there was a 21.0% increase in the total amount of points, which corresponds to the average level of strength endurance in comparison with the low level determined at the start of the study. A comparison of intergroup differences showed that significant changes were also detected in the first group of boys according to the step test ($p<0.01$). Also, the incidence of acute respiratory infections among students of the first group decreased by 2 times. According to the rest of the final indicators, the results in the first group exceed similar data in the second group, but it is statistically unreliable, despite the fact that at the start of the studies, the boys of the second group had a significant superiority in most of the studied endurance characteristics.

References.

1. Voronkov, M. G. Rasulov, M. M. (2007). Trekresan-the ancestor of a new class of adaptogens and immunomodulators // Chem. - pharm. Zh. - 2007, No. 1, pp. 3-9.

2. Kuznetsov I. A., Rasulov M. M., Kachanov I. V., ShaimakovaZh. B. (2020). Adaptive potential and the possibilities of its correction in the preparation of students of construction and technical universities for professional activity // Monograph-Astrakhan: Publisher R. V. Sorokin, 2020 — 132 p.
3. Kuznetsov I. A., Baryshok V. P., Storozhenko P. A., Rasulov M. M., Golovanov S. A., Kachanov I. V. (2020). A tool that modulates the bioenergetics of the mitochondria of liver cells of animal origin // Patent for invention RU No. 2744009 dated January 27, 2020 Was registered in the State Register of Inventions of the Russian Federation on March 01, 2021.
4. Kuznetsov I. A., Potievskaya V. I., Kachanov I. V., Antipkina L. V., NavruzovI.L. (2019). Physiological characteristics of students when using trekrezan in combination with physical exercises of a health-improving orientation / / Innovative development of regions: the potential of science and modern education [Electronic resource]: materials of the II National scientific and practical conference (February 7, 2019): electronic edition / under the general ed. by T. V. Zolina. - Electron. text data (12.9 Mb) – Astrakhan: Astrakhan State University of Architecture and Civil Engineering, 2019 – 1 opt. disc (CD-R). pp. 21-25.
5. Kuznetsov I. A., Antonova M. A., Strelnikov A.M., Antipkina L. V., Tkachenko V. V. (2020). Monitoring of physical development and physical fitness of students / / Materials of the III National Scientific and Practical Conference (February 7, 2020): electronic edition / under the general ed. by T. V. Zolina. - Electron. text data (11.1 Mb). - Astrakhan: Astrakhan State University of Architecture and Civil Engineering, 2020 – 1 opt. disk (CD-R). pp. 43-46
6. Ortabaev Z. S. (2018). Management of physical culture of students of non-physical training areas / / Baltic Humanitarian Journal. 2018. Vol. 7. No. 3 (24). pp. 277-280.
7. Aagaard P., Bojsen-Moller J., Lundbye-Jensen J. (2020). Perspectives for progress in the assessment of neuroplasticity with strength training. Exerc. Sport Sci. Rev., 48 (2020), pp. 151-162
8. Alcaraz-Ibanez M., Rodriguez-Perez M. (2018). Effects of resistance training on performance in previously trained endurance runners: a systematic review. J. Sports Sci., 36 (2018), pp. 613-629
9. BalshawT.G. , Massey G.J. , Maden-Wilkinson T.M. , Lanza M.B. , Folland J.P. (2019). Neural adaptations after 4 years vs 12 weeks of resistance training vs untrained. Scand. J. Med. Sci. Sports, 29 (2019), pp. 348-359.
10. Burov, A.E., Erohina, O.A., Fedorova, O.V. (2014). Retrospective analysis of the level of physical preparedness of the student population. In the world of discoveries. 2014. № 9.4 (57). P. 1370-1379.
11. BlagroveR.C. ,Howatson G. , Hayes P.R. (2018). Effects of strength training on the physiological determinants of middle- and long-distance running performance: a systematic review. Sports Med., 48 (2018), pp. 1117-1149.
12. Bologna M. ,Paparella G., Fasano A., Hallett M. (2020). Evolving concepts on bradykinesia. Brain, 143 (2020), pp. 727-750.

13. Brach J.S., VanSwearingen J.M. , Gil A., Nadkarni N.K. , Kriska A. , Cham R. , Perera S. (2020). Program to improve mobility in aging (PRIMA) study: methods and rationale of a task-oriented motor learning exercise program. *Contemp. Clin. Trials*, 89 (2020), Article 105912
14. CasoloA. , Farina D., Falla D. , Bazzucchi I., FelicF.i, Del Vecchio A. (2020). Strength training increases conduction velocity of high-threshold motor units. *Med. Sci. Sports Exerc.*, 52 (2020), pp. 955-967
15. Cherup N.P., Buskard N.L. , Strand K.L. , Roberson K.B. , Michiels E.R. , Kuhn J.E. , Lopez F.A. , Signorile J.F. (2019). Power vs strength training to improve muscular strength, power, balance and functional movement in individuals diagnosed with Parkinson's disease. *Exp. Gerontol.*, 128 (2019), Article 110740
16. CondelloG. ,Capranica L. , Migliaccio S. , Forte R. , Baldassarre A., C. Pesce (2019). Energy balance and active lifestyle: potential mediators of health and quality of life perception in aging. *Nutrients* (2019), p. 11
17. Davis L.A. ,Alenazy M.S. , Almuklass A.M. , Feeney D.F. , Vieira T., Botter A., Enoka R.M. (2020). Force control during submaximal isometric contractions is associated with walking performance in persons with multiple sclerosis. *J. Neurophysiol.*, 123 (2020), pp. 2191-2200
18. Vecchio A. Del, Negro F. , Holobar A., Casolo A. , Folland J.P. , Felici F. , Farina D. (2019). You are as fast as your motor neurons: speed of recruitment and maximal discharge of motor neurons determine the maximal rate of force development in humans. *J. Physiol.*, 597 (2019), pp. 2445-2456
19. Duchateau J., Stragier S. , Baudry S. , Carpantier A. (2020). Strength training: in search of optimal strategies to maximize neuromuscular performance. *Exerc. Sport Sci. Rev.*, 49 (2020), pp. 2-14
20. Haugen T. , Seiler S. , Sandbakk O. , Tonnessen E. (2020). The training and development of elite sprint performance: an integration of scientific and best practice literature. *Sports Med. Open*, 5 (2019), p. 44
21. Herold F., Torpel A., Schega L. , Muller N.G. (2019). Functional and/or structural brain changes in response to resistance exercises and resistance training lead to cognitive improvements - a systematic review. *Eur. Rev. Aging Phys. Act.*, 16 (2019), p. 10
22. KordM.i, Folland J.P. , Goodall S. , Menzies C., Patel T.S. , Evans M. , Thomas K. (2020). Cycling-specific isometric resistance training improves peak power output in elite sprint cyclists. *Scand. J. Med. Sci. Sports*, 30 (2020), pp. 1594-1604
23. LahoutiB. , Lockyer E.J. , Wiseman S. , Power K.E. , Button D.C. (2019).Short-interval intracortical inhibition of the biceps brachii in chronic-resistance versus non-resistance-trained individuals. *Exp. Brain Res.*, 237 (2019), pp. 3023-3032
24. LumD. , Barbosa T.M. (2019). Brief review: effects of isometric strength training on strength and dynamic performance. *Int. J. Sports Med.*, 40 (2019), pp. 363-375
25. Macadam P., Cronin J.B. , Feser E.H. (2019). Acute and longitudinal effects of weighted vest training on sprint-running performance: a systematic review. *Sports Biomech.* (2019), pp. 1-16

26. MancaA. ,Dvir Z. , Deriu F. (2019). Meta-analytic and scoping study on strength training in people with multiple sclerosis. *J. Strength Cond. Res.*, 33 (2019), pp. 874-889
27. Trevino, M.A., Herda, T.J. (2016). The effects of chronic exercise training status on motor unit activation and deactivation control strategies. *Journal of Sport Science*. – 2016. – Vol. 34. – Iss.3. – pp.199-208.

Figure 1. The ratio of the average indicators of boys in the 1st year in the Juhash test at the start of the

