Journal of Physical Education and Sport ® (JPES), 18(1), Art 37, pp. 276 - 281, 2018
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Comparative analysis of parameters of the physical condition of 17-19-years-old male youths with different motion activity level

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Published online: March 30, 2018
(Accepted for publication March 06, 2018
DOI:10.7752/jpes.2018.01037

Abstract
This article deals with the results of the Comparative analysis of the influence of different motion activity level on physical development, functional condition, physical efficiency and the development of principal movement features of 17-19-years-old male youths. According to the study objective, we determined the specifics of interaction of motion activity volume and parameters of the physical condition of 17-19-years-old male youths for the period of studies in the higher educational establishment. We confirmed that the movement regime in the volume of 6 hours of classes of physical and health-improving training per week has a positive effect on the functioning of the cardiovascular system, which functions more efficiently, on the central nervous system, in particular, helps to improve attention, memory and coordination of movements and to decrease the time of mental operations. The analysis of average results obtained during the study allowed us to ascertain that the male youths with the medium motion activity level have actual ($p<0.05$; $p<0.01$; $p<0.001$) advantages in the parameters of body mass index, right hand dynamometry, HR at rest, Roufier index, short-term memory volume, information transfer volume, information transfer speed, in the results of 100-metres race, arm bending in push-up, sit-up for 1 minute, standing long jump and at performing the Sharpened Romberg Test. It was confirmed that the movement regime serves as an obligatory condition of supporting the normal functioning of all the physical condition components.
Key words: the male youths, motion activity, students.

Introduction

The student community at the present stage is the most socially active and mobile group which determines the future of the country to a great extent. The efficiency of obtaining professional and intellectual knowledge in higher educational establishments depends on numerous conditions, including the functional condition of students' bodies, and their attitude towards the healthy lifestyle formation (Tomenko, 2017).

The principal feature of the modern stage of higher school development is its deep differentiation. This process is implemented with the use of numerous pedagogical systems and innovative technologies. The influence of innovative educational loads with a high level of psycho-emotional and intellectual stress, the educational process intensification, the increase of requirements to knowledge volume and quality, and, the most important, the movement regime violations, have a negative impact on students' physical condition (Kozina, 2017; Galan, 2017).

The issue of improving the physical condition parameters in conditions of increasing the students' workload is a rather topical task nowadays. Regular compulsory physical training classes in most Ukrainian educational institutions of non-sporting profile are conducted only during the first two academic years at the level of 2 and 4 hours per week, and for the students of higher years of study, the number of physical training classes is limited to individual or sectional classes. This leads to the reduction of adaptation reserves, the appearance of a situation of incoordination of mechanisms of regulation of vegetative functions, which are expressed in the students in the form of decrease of capabilities, increased fatigue (Bar-Or, 2009; Romanchyshyn, 2015). Motion activity reduction is considered as one of the main factors favoring the development of a number of diseases, such as hypertension, aterosclerosis, coronary heart disease and myocardial infarction, vegetative-vascular dystonia, obesity, postural disorder with bone and muscle apparatus damage; the cardiovascular system is the most vulnerable (Ivashchenko, 2008).

The study of the body physical condition at different levels of motion activity is of special interest for the scientists, since its components are efficient indicators that can help to determine the potential level of adaptation of the body vegetative functions under the influence of motion activity.

Scientists consider the maximal energy potential expressed by maximal oxygen consumption (MOC) as the basic physical condition parameter (Blagiy, 2006; Apanasenko, 2010).

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Materials and Methods

With the purpose to determine the parameters of the students' physical development, the following anthropometric measurements were taken, which reflected the level of formation of morphological features (body length (BL) and body mass (BM), body mass index (BMI), circumferential size of various body parts, skin and fat folds, hand dynamometry). Physiological research methods were applied to assess the condition of the male youths' cardiovascular system (heart rate at rest (HR_{rest}), systolic arterial pressure (AP_{syst}) and diastolic arterial pressure (AP_{diast}); respiratory system condition (lung capacity (LC); assessment of the central nervous system (CNS) functional condition, the Sharpened Romberg Test, short-term memory volume (STMV), information processing speed (IPS), information processing volume (IPV); physical capability (Roufier index). With the purpose to characterize physical preparation, we used motion tests (100-metres race, shuttle run 4×9 m, angled position from seated position, bending – arm bending in push-up, standing long jump, and sit-up for 1 minute.). The conduct of this test complex covers many aspects of physical preparation. The research work was conducted on the basis of Bila Tserkva National Agrarian University of Bila Tserkva city with the 17-19-years-old male youths. 362 male youths with different motion activity level took part in the study.

Results

The subjects of the study were 362 male youths at the age of 17-19-years with different motion activity levels, in particular, 177 male youths were engaged in athletic and recreational activities for 6 hours per week, and 185 male youths, 2 hours per week.

The results of studies of morphofunctional conditions in male youths with different motion activity levels are presented in Table 1. As a result of the study of the physical development of the male youths with different motion activity levels, we obtained the mean values of the anthropometric parameters which were distributed within the range of the age norms.

Table 1. Parameters of morphofunctional condition of 17-19-years-old male youths with different motion activity level (n=362)

Parameters	Male youths with the medium motion activity level (n=177)					Male youths with the low motion activity level (n=185)					p
	$\overline{x}$	S	Me	25 %	75 %	$\overline{x}$	S	Me	25 %	75 %	
Age, years	18.1	0.91	18.0	17.0	19.0	18.0	0.92	18.0	17.0	19.0	>0.01
BL, cm	178.3	4.99	178.5	175.0	182.5	177.0	8.10	178.0	173.0	184.0	>0.01
BM, kg	68.1	6.98	68.3	64.5	71.2	73.1	16.70	71.5	62.7	85.0	>0.01
BMI, $kg \cdot m^{-2}$	21.4	1.65	21.2	20.5	22.4	23.1	3.87	22.6	20.5	25.1	<0.05
Chest circumference, cm	92.0	5.03	92.3	89.0	94.5	91.9	11.09	93.0	84.0	97.0	>0.01
Shoulder circumference, cm	28.3	2.42	28.6	26.5	31.0	31.6	4.52	32.0	29.0	34.0	<0.001
Waist circumference, cm	75.4	4.23	76.0	73.0	78.0	78.9	14.20	76.0	70.0	84.0	>0.01
Pelvis circumference, cm	93.3	4.06	93.0	91.0	96.0	93.6	15.80	96.0	85.0	103.0	>0.01
Thigh circumference, cm	48.7	3.79	49.0	46.5	51.0	54.5	8.04	55.0	48.0	59.0	<0.001
Sum of 5 skin and fat folds, mm	44.8	15.34	39.6	36.0	60.0	56.5	38.27	39.0	24.0	86.0	>0.01
Right hand dynamometry, kg	46.8	7.73	46.0	42.0	50.0	41.5	9.87	40.8	36.0	45.0	<0.05
Left hand dynamometry, kg	40.1	7.64	40.0	34.0	42.0	37.5	9.35	38.5	32.0	42.0	>0.01
LC, l	4.2	0.61	4.0	3.7	4.7	4.1	0.89	4.4	3.4	4.1	>0.01
HR, bpm^{-1}	76.3	6.06	77.0	72.0	80.0	85.4	7.02	87.0	79.0	92.0	<0.001
AP syst., mm Hg	116.2	5.52	120.0	110.0	120.0	113.3	7.84	110.0	110.0	120.0	>0.01
AP diast., mm Hg	76.0	4.98	80.0	70.0	80.0	73.5	5.34	70.0	70.0	80.0	>0.01
Roufier index, years	9.8	2.95	9.5	8.0	11.2	11.1	3.56	11.2	8.0	13.6	<0.05

Analysis of individual BMI parameters of the male youths with the medium motion activity level shows that in 85.9 % male youths, BMI was within the range of 20-25 $kg \cdot m^2$ which corresponds to the norm, 11.3 % have body mass deficit and only 2,8 % have overweight. In the male youths with the low motion activity level,

individual BMI parameters were distributed in the following way: 19.5 % have body mass deficit; 31.3 % male youths are within the normal range; 46.5 % male youths have overweight and 2,7 % male youths have BMI within the range of 30-40 $kg \cdot m^2$ which corresponds to the 'fat' level. We established that in the male youths with the medium motion activity level, the average BMI result is statistically ($p<0.05$) lower.

While comparing average results of circumferential dimensions in the male youths with different motion activity level, we revealed statistically higher ($p<0.001$) shoulder and thigh circumference parameters in the male youths with the low motion activity level.

We studied the fat component of the male youths, measured five skin and fat folds: triceps, biceps, under the shoulder blade, under the longitudinal bone, internal gastrocnemius fold and their sum. While analyzing the average results of the of sum of five skin and fat folds, we revealed that in the male youths with the low motion activity level, the stated parameter is higher by 11.7 mm, and that high variability is observed in both groups of subjects.

Studying right and left hand dynamometry in the male youths with different motion activity level proves the statistically higher ($p<0.05$) the average result for the right hand in the male youths with the medium motion activity level.

We analyzed the respiratory system condition by the LC value and established that average results of the male youths with different motion activity level were almost in the same range and corresponded to the age norm.

With the purpose to characterize the cardiovascular system condition, we studied the following functional parameters: heart rate at rest (HR_{rest}), systolic and diastolic arterial pressure ($AP_{syst\ and}$ AP_{diast}). We established that average HR parameters in the conditions of relative rest have the considerable difference between the groups of subjects, in particular, we registered statistically ($p<0.001$) higher HR_{rest} in the male youths with the low motion activity level. In this group of subjects, no cases of bradycardia were registered but 85 persons (44.9 %) have high heart rate (from 82 to 120 bpm^{-1}), and others are within the range of norm (from 64 to 80 bpm^{-1}). The analysis of individual results of HR at rest in the male youths with the medium motion activity level shows that 153 persons (86.4 %) are within the range of age norm, and the rest 24 (13.6 %) have high HR (from 86 to 93 bpm^{-1}).

Signs of hypotonia (AP<110/70 mm Hg) are typical for 3.9 % male youths with the medium motion activity level, hypertension – for 2,8 %; in the male youths with the low motion activity level, signs of hypotonia are observed in 19.5 %, and signs of hypertension – in 10.8 % persons.

With the purpose to determine physical capability level in the male youths, we applied Roufier index which characterizes the cardiovascular system response to a dynamic load.

As seen from Table 1, average Roufier index results in the male youths with the medium motion activity level correspond to the medium physical capability level. The analysis of individual results shows that 2,8 % male youths have high physical capability level, 23.7 % – correspond to the 'good' level, 45.2 % – medium level, 26.5 % – satisfactory level and 2,3 % – low level. When analyzing individual Roufier index results in the male youths with the low motion activity level, we did not observe the high physical capability level, 7.0 % of subjects had 'good' level, 20.5 % male youths had medium level, the most male youths have satisfactory level of 45.4 % and 27.1 % persons have low physical capability level.

The human cognitive activity comprises basic structural and functional factors. Perception and sensor (primary) analysis of external information are performed at the level of sensorimotor receptors (psychomotor system). Perception with the attention actuation favors obtaining the respective information by the memory units in the brain and its memorization. The information obtained is compared to the available set of behavior variants involved from short-term or long-term memory sections, and have response variants or set of variants (solutions).

We studied cognitive functions of the male youths with the test for short-term memory volume (STMV), information processing volume (IPV), information processing speed (IPS). The average results are given in Table 2.

Analysis of the study of cognitive functions of the male youths with different motion activity level showed their high variability under the parameter characterizing the short-term memory volume from V=35.9 % to V=47.0 %.

Table 2. Parameters of cognitive functions of 17-19-years-old male youths with different motion activity level (n=362)

Parameters	Male youths with the medium motion activity level (n=177)					Male youths with the low motion activity level (n=185)					p
	$\overline{x}$	S	Me	25 %	75 %	$\overline{x}$	S	Me	25 %	75 %	
STMV, %	36.9	14.31	33.3	25.0	41.7	26.5	12.45	33.3	16.7	33.3	<0.01
IPV, bit	417.3	45.67	429.1	398.7	451.3	348.0	43.41	332.7	302.8	402.9	<0.01
IPS, $bit \cdot sec^{-1}$	14.6	1.32	14.4	13.8	15.4	16.5	1.16	16.7	15.9	17.8	<0.01

It should be noted that in the male youths with the medium motion activity level, the average STMV

result is actually higher ($p < 0.01$) than in the male youths with the low motion activity level.

We also detected that in the male youths with the medium motion activity level the average IPV and IPS result statistically higher ($p<0.01$) than in the male youths with the low motion activity level. This fact proves that the male youths from the first group have better perception abilities, and visual information processing speed.

With the purpose to study the physical preparation of the male youths, we used tests characterizing the following motion features: speed, agility, flexibility, strength, speed and power features and coordination of movements. The average results are given in Table 3.

Table 3. Parameters of physical preparation of 17-19-years-old male youths with different motion activity level (n=362)

Parameters	Male youths with the medium motion activity level (n=177)					Male youths with the low motion activity level (n=185)					p
	$\overline{x}$	S	Me	25 %	75 %	$\overline{x}$	S	Me	25 %	75 %	
100-metres race, sec	14.0	0.56	13.9	13.6	14.3	14.3	0.58	14.3	14.0	14.9	<0.05
Shuttle run 4x9 m, sec	9.7	0.65	9.4	9.2	10.2	9.8	0.30	9.8	9.7	10.1	>0.01
Arms bending nd unbending, times	35.4	11.45	38.5	31.0	44.0	27.1	10.99	27.0	19.0	30.0	<0.01
Angled position from seated position, cm	3.2	4.10	2.0	0.0	5.0	2.8	2.89	2.0	0.0	4.0	>0.01
Sit-up for 1 minute, times	44.5	3.47	44.9	41.8	46.3	38.0	8.57	38.0	32.0	43.0	<0.01
Standing long jump, cm	227.0	22.75	221.0	210.0	248.0	198.3	11.85	200.0	189.0	206.0	<0.01
The Romberg Test, sec	10.4	5.07	9.0	6.5	14.0	7.3	4.41	6.0	4.0	10.0	<0.05

While analyzing the results of the male youths with different motion activity level, we found out that in flexibility testing, the lowest parameters in both groups were obtained, and high variability of this parameter from V=103.2 % to V=128.1 % was observed which proves the group heterogeneity.

Comparing the average results, we found that the statistical difference is observed among the male youths with average and low motion activity level at 100-meters race ($p < 0.05$), arms bending and unbending ($p < 0.01$), angled position from seated position for 1 minute ($p < 0.01$), and standing long jump ($p < 0.01$).

In our study, we used the Sharpened Romberg Test to determine the development of coordination abilities. It is known from literary sources that coordination abilities represent the complex motion feature, genetically conditioned in the development, which allows controlling and regulating motion activity successfully. The analysis of average results of static coordination of the male youths with different motion activity level showed the statistically higher result ($p<0.05$) in the male youths with the medium motion activity level. It should be noted that the groups were heterogeneous in terms of the Sharpened Romberg Test, so, the variation coefficient was within the range from V=48.7 % to V=60.4 %.

Discussion

The level of the students' physical condition depends on numerous factors, that are mainly connected with the lifestyle and the motion activity level. Systemic curricular and extra-curricular physical training classes can ensure normal physical and spiritual development of the student's personality, an obligatory condition of forming priority orientations for health improvement and a motivational stimulus for regular independent physical exercises and sports.

In discussing the issue of the impact of various motion activity levels on the physical condition, attention should be paid to the fact that the traditional physical education system in Ukrainian higher education establishments do not favor the efficient solution of the issue of reducing the lack of motion activity, which is one of the causes of various deviations in students' health condition. The organized physical training classes provided by the curriculum satisfy only 25-30 % of the total daily requirement in motion activity for students. The students spend the significant part of their daytime in the classroom, and only physical training classes can fill the lack of movement partially. In general, it can be stated that such physical condition components as physical development, functional condition, physical preparation and efficiency at a low motion activity level have mostly negative parameters and experience no positive changes in the students during their studies at higher educational establishments.

The results of our studies confirm the data (Leskiv, 2013) that, as a result of low motion activity, body mass increases and, in combination with the violation of the mechanisms of the oxygen transport system, body

energy supply decreases, and fatigue increases. The volume of the students' motion activity impacts on the development of basic motion features (Dukh, 2012; Sergiyenko, 2014; Blagiy, 2015).

The inadequate level of everyday motion activity affects the functioning of numerous student's body systems, especially the cardiovascular and respiratory systems (Chertanovskyi, 2010; Chichkan, 2012; Glazkov, 2013; Ivanova, 2012), which leads to the entire body capacity decrease. We supplemented the information on the negative dynamics of the central nervous system parameters at low motion activity, in particular, attention is reduced, memory is weakened, coordination of movements is damaged, time of mental operations increases (Romanenko, 2005; Blagii, 2015; Nakonechnyi, 2017).

Conclusions

1. As a result of the conducted complex study of the physical condition of 17-19-years-old male youths with different motion activity level, we established that the average values of physical development were within the range of physiological norm. At this, we observed the statistically significant difference ($p<0.05$; $p<0.001$) in BMI, shoulder and thigh circumferential parameters. In the male youths with the medium motion activity level, average results of right hand dynamometry, HR at rest, Roufier index, STMV, IPV, IPS have actual ($p<0.05$; $p<0.001$) advantage before the male youths with the low motion activity level. Attention should be paid to the cardiovascular system which functions much more economically under the influence of systematic physical loads, and this ability is related only to the male youths with the medium motion activity level.
2. In the male youths with the medium motion activity level, the statistical difference ($p<0.05$; $p<0.01$) on 100-metres race, arm bending in push-up, sit-up for 1 minute, standing long jump and at performing the Sharpened Romberg Test is observed at performing motion tests. It should be noted that in the male youths with the low motion activity level, the physical preparation results testify to the low development level.

Conflict of interests

The authors declare that they have no conflict of interests.

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