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Original Article

Energy supply capacity when using different exercise modes for young 17–19-year-old men

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Abstract:

This work contains the scientific-practical task solution, which aims at the young men physical health level improvement by physical education during the higher educational institutions studies. Investigation of different physical load types effectiveness allowed to determine the effective physical training regime, which would contribute to physical health level improvement during young men studies in higher educational institutions. Running exercises were determined as the most effective health improvement means, as by running one can improve both aerobic and anaerobic (lactic) body performance. Besides, we found out running exercises productivity advantages in the mixed (aerobic-anaerobic) regime of energy supply comparing to trainings in the aerobic regime (lactic), which are the main factors characterizing men physical health. So in comparison with starting data the relative maximum oxygen consumption ratio during trainings in the mixed energy supply regime apparently increased by 20.9%, whereas in the aerobic regimen — by 13.6%. Such trainings effectiveness also demonstrated positive changes in the heart bioelectric activity indexes and some external respiration indexes. Moreover, trainings three times a week with minimum internal loading value not less than 44.6% of the maximum allowable value of energy supply contributed to the physical state level improvement.

Key words: physical health, level of physical state, aerobic productivity, anaerobic (lactic) performance, regimen of energy maintenance, means of Physical Education.

Introduction

The problem, which should be solved currently, is the improvement of young people physical health, which depends on the body aerobic capacities (Drachuk, 2006; Briskin, 2016; Bohuslavska, 2017).The cardiorespiratory system is the main limiting element of the aerobic capacity. Therefore, when studying physical activities health-improving impact on the human body, this element analysis becomes a priority. At the same time, the effectiveness of the cardiorespiratory system functioning is one of the main factors that determines the so-called physical state level (PSL), which together with the physical health is characterized by the human body aerobic capacity value, in particular, by the relative indicator of the maximal oxygen consumption ($VO_{2max\ rel.}$)Therefore, the physical health can be assesses by the physical state level (Furman, 2005, 2014; Hruzevych, 2017).

However, an essential role in the physical health formation is played not only by the human body aerobic, but also by the anaerobic capacities (Guo, 2008; Gorshova, 2009, 2017; Gruzevych, 2013).Taking into account this fact, it is necessary to improve both aerobic and anaerobic capacities of the body in order to improve the physical state and hence the physical health of people regardless of their age. Purposeful improvement of the aerobic and anaerobic capacity can be achieved by various physical training regimes (Kerr, 2008; Galan, 2017). However, the problem of correcting the human organism aerobic and anaerobic capacity by physical exercises cannot be considered solved. By now, the physical load regulation issue depending on the human organism functional preparedness to such loads remains disputable and not adequately investigated. Besides, further studies are required for the influence on aerobic and anaerobic (lactic) performance of different conditioning trainings, that is different energy supply modes (Kropta, 2004, 2017; Romanchyshyn, 2015; Salnykova, 2015).

According to literature references, the physical fitness level of 17-19 years boys is considerably lower than that of girls of the same age (Sulyma, 2017; Zhyrnov, 2017).Therefore, for men the problem of the physical health improving takes centre stage, especially when studying in higher educational institutions. This is conditioned by the increased requirements to the organism adaptation in new unusual psychophysiological and hygienic states of its functioning. This applies particularly to junior students of 17-19 years. The above mentioned facts allow us to separate this age group as a research subject. Only a physically healthy person can

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successfully adapt to unusual conditions. Various physical exercises can be used to improve our body adaptive capacities. In higher educational institutions, a standard physical training program is used to gain this goal. However, it does not solve the problem of young people physical health improvement, because, in our opinion, this program is not aimed at the aerobic performance improvement that predefines the body adaptive capacities (Kropta, 2004; Salnykova, 2014).

As a rule, the effectiveness of the physical activities influence on the young people body functional condition when studying in higher educational institutions is assessed by special tests, which are imperfect and, in our opinion, mostly characterize the motor performance qualitative parameters. Such tests cannot provide an objective assessment of the effectiveness of the physical exercises influence on the body functional state, in particular on the aerobic and anaerobic performance level. However, some researchers insist that the physical fitness of a person is conditioned not only by the body aerobic and anaerobic performance level, but also by the ability to exhibit qualitative parameters of the motor activities (Furman, 2005; Guo, 2008; Gorshova, 2009; Hruzevych, 2017), therefore there appears a task of studying the correlations between the body aerobic and anaerobic performance indicators characterizing the physical condition, on the one hand, and indicators of motor activities qualitative parameters, on the other hand. Studying such correlations would allow us to use some tests to supplement the information, obtained with the help of the physiological research methods.

Purpose. To determine peculiarities of the different physical trainings influence on aerobic and anaerobic (lactic) performance of 17–19 years boys for the development and application of new training programs that would contribute to the physical state improvement.

Materials and methods

The following research methods were used in this work: bicycle ergometry, electrocardiography, sphygmomanometry, spirometry, perimetry, tests for the evaluation of motor activities qualitative parameters.

To solve the tasks we examined 185 boys aged 17–19 years who entered the first year of the university, did not practice sports, were classified for health reasons to the main medical group and whose body weight did not exceed the normal value according to the Quetlet index. The physical training influence on the aerobic performance, which is decisive in the PSL formation, was evaluated by the PWC_{170} and $VO_{2\,max}$ indicators.

Initially, PWC_{170} indicator was determined by the bicycle ergometry method. For this purpose, the VE-02 bicycle ergometer was used. A person under study performed two 5-minute long exercises in a sitting position with a 3-minute pause between them. The cadence was controlled by a tachometer and was 60 rev. per min -1. The load was chosen in such a way that by the end of the 5th minute of the first exercise the heart rate was 100–120 bpm, and by the end of the second exercise it reached 140–160 bmp. The heart rate value was measured by the electrocardiography method using EK 1T - 03M and ECPSCHT - 4 electrocardiographs. In order to record the electrocardiogram in the state of the relative muscle rest, as well as during physical activities, the Nehb lead system was used with the L.A. Butchenko (1963) modifications. The heart rate calculation was performed by the formula: $ЧСС = \frac{60}{R-R}$, where R–R is the average duration of 6–7 heart beat cycles in seconds. The calculation of the first and second loads power was performed taking into account the body weight of a person under study: the first load was determined as 1 W (6 kgm·min-1) per 1 kg of the body weight, and the second one was determined as 2 W (12 kgm·min-1) per 1 kg of the body weight. In order to reduce the error of the PWC_{170} value, we stuck to the condition, when the difference between the heart rate during the first and second exercises should be not lower than 40 beats per min-1. If the difference between the first and second exercises heart rate was lower, then the person under study performed the third exercise after a three minutes pause at the rate of 2.5 W or 3 W per 1 kg of the body weight. In this case, the first and the third loads are taken into account. The calculation of the PWC_{170} absolute value was performed by the formula: $PWC_{170\ \text{abs.}} = N_1 + (N_2 - N_1)\cdot\frac{170 - f_1}{f_2 - f_1}$, where $PWC_{170\ \text{abs.}}$ is the physical activity power in W or kgm·min^{-1}, at which the heart rate reaches 170 beats·min^{-1}; N1 and N2 is the power of the first and second load respectively in W or kgm·min^{-1}; *f1* and *f2* is the heart rate at the end of the first and second load respectively in beats·min^{-1}.

The absolute value of the maximum oxygen consumption was determined according to the formula:

$VO_{2\ \text{max abs.}} = 1{,}7 \cdot PWC_{170\ \text{abs.}} + 1240$, where $VO_{2\ \text{max abs.}}$ was measured in ml·min^{-1} [V.L. Carpman et al., 1988].

After determining the $PWC_{170\ \text{abs.}}$ and $VO_{2\ \text{max abs.}}$ values we determined their relative values for 1kg of the body weight for the person under study. $PWC_{170\ \text{rel.}}$ value is measured in kgm·min^{-1}·kg^{-1}, and $VO_{2\ \text{max rel.}}$ is measured in ml·min^{-1}·kg^{-1}. By the $VO_{2\ \text{max rel.}}$ value we determined the PSL of the person under study, using the Ya.P. Pyarnat (1983) criteria.

The training influence on the anaerobic (lactic) performance was estimated based on the maximum external mechanical work amount indicators for 1 min (MEMWA).

When determining the MEMWA, the person under study first performed a standard exercise on a veloergometer with a capacity of 1350 kgm·min^{-1} for 1 minute with a cadence of 90 rev. min^{-1}. Then he had a rest for 1 minute, after which he performed the exercise again with the same capacity, but with the maximum possible cadence, that is with the maximum functional capabilities. During the work, the number of pedals revolutions (O) for 1 minute was calculated, which reflects the external volume of the work performed. Since this work is performed for 1 minute, it corresponds to the capacity (N), measured in kgm·min^{-1}, and is calculated by the formula: $N = C \cdot O$, where N is MEMWA; O is the maximum number of pedal revolutions during the second exercise; and C is a standardized indicator that characterizes pedal revolution resistance. For people with the body weight greater than 80 kg C value is 30 kgm·rev.$^{-1}$, and for people with the body weight less than 80 kg it is calculated by to the formula: $C = 30 - \frac{82{,}5 - \text{маса}\,(\text{кг})}{5}$ (kgm·rev.$^{-1}$).

Besides, the relative MEMWA was calculated for 1 kg of the body weight of a person under study, which was measured in kgm·min^{-1}·kg^{-1}.

We did not find any precise assessment criteria of the anaerobic (lactic) performance in the scientific literature. Therefore, we analyzed the relative MEMWA indicators of different people, comparing the obtained values for a person under study with the previous ones during the repeated examinations.

The arterial pressure measurement was performed in the relative muscular rest state with the help of the IADM-OP sphygmomanometer. The obtained value was compared with the blood pressure estimated due value for men, taking into account their age and weight [G.S. Byelcania et al., 2003]:

$BP_{syst.}$ = 109 + 0.5·age + 0.1·body weight (kg),

$AT_{diast.}$ = 74 + 0.1·age +0.15·body weight (kg).

The vital lung capacity was determined by the SPIRO-18V water spirometer in the in the upright position. Besides, the living ratio (BDI) was calculated by the formula: $\text{BDI} = \frac{\text{VLC}}{P}$, where VLC is the vital lung capacity in ml and P is the body weight in kg. The obtained results were compared to the average values for men, which is about 60 ml·kg^{-1} [V. I. Dubrovsky, 1998].

The Quetlet index was used to assess the body weight (Furman, 2005) : the squared ratio of the body weight in kilograms to the height in meters.The body weight was evaluated as follows: if the Quetlet index is less than 15, then it indicates an exhaustion; if it is between 15 and 20, it indicates the underweight body; if it is between 20 and 25, then the body weight is considered normal; if it is between 25 and 30, then it indicates the overweight body; and if it is more than 30, then it indicates the obesity.

Since sport games are an effective way to improve the visual analyzer functions in our work we investigated the peripheral visual field using the desk perimeter. For this purpose, in the natural illumination conditions we used white test objects sized 3/330. The research was conducted in 8 principal meridians. The resulting cumulative value was measured in degrees. The training influence on the motor activities qualitative parameters (physical qualities) was evaluated using motor proficiency tests, namely: endurance — as a result of 2500 m running, speed — as a result of 30 m running, agility — as a result of 4×9 m shuttle run, flexibility — as a result of the body forward inclination, hand muscle strength — as a result of the hand dynamometry, speed-strength capabilities — as a result of the double take-off standing long jump. The heart rate control during the exercises was performed by the portable heart rhythm detector PC-1, as well as by the palpatory method.

The internal loads volume was determined in kcal according to L. Brouha data on energy consumption by different heart rates [N.M. Amosov, Ya.A. Bendet, 1984] and expressed as a percentage of the maximum allowable energy consumption value (E_{max}).The latter value was calculated by the formula: $E_{max} = 0.23 \cdot VO_{2\ max\ abs.}$ (Furman, 2005).

Results

The ascertaining experiment, which determined the PWC_{170}, $VO_{2\ max}$, MEMWA and motor activities qualitative parameters, indicated the physical health insufficient level of young men aged 17–19 years. Thus, the PSL in all three age groups under study was evaluated as "average" and was near the "critical health level" (Fig. 1), which according to G.L. Apanasenko (1999) is characterized by the relative value of $VO_{2\ max}$ of 42.0 ml·min^{-1} ·kg^{-1}.

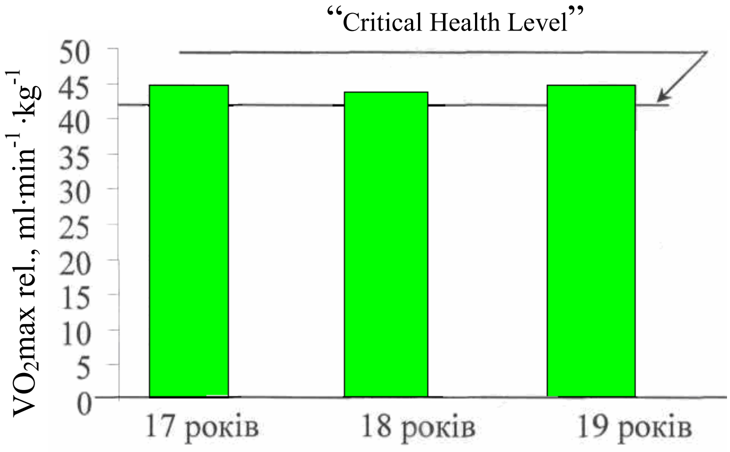

Fig. 1. Average relative indicator values of the maximum oxygen consumption by men aged 17–19 years

"Excellent" PSL, which according to O.A. Pirogova et al. (1988) data guarantees the disease clearance, was not found for any of people under study, and there are only about 15% of people with "good" PSL regardless of the age (Table 1).

There is also no significant difference between the average values of the organism anaerobic (lactic) performance in the studied age groups. Thus, for 17-year-old boys the relative MEMWA value was 30.86 ± 0.63 kgm·min^{-1}·kg^{-1} , for 18-year-old boys it was 31.34 ± 0.75 kgm·min^{-1}·kg^{-1} , and for 19-year-old boys it was 32.04 ± 0.90 kgm·min^{-1}·kg^{-1}.

Table 1. Level of young men physical state depending on the age, as a percentage of the total number of people under study

Age (years)	n	PSL,%				
		low	below the average	average	good	excelent
17	84	1.8	39.8	43.1	15.3	-
18	60	2.1	42.2	40.8	14.9	-
19	41	2.9	40.6	41.4	15.1	-

We did not notice high values of the studied indicators characterizing motor activities qualitative parameters. Among the first year students aged 17–19 years a particularly low level of agility, flexibility and speed-strength capabilities is observed, the average values of which were rated as "satisfactorily". The average values of endurance and speed were rated as "good", and muscular strength was within the average values for male students.

Consequently, the PSL by the relative $VO_{2\ max}$ value does not experience significant changes for male students aged 17–19 years and indicates a low level of their physical health. The significant difference absence of the PWC_{170}, $VO_{2\ max}$ and MEMWA values, as well as motor activities qualitative parameters of boys aged 17, 18 and 19 years allowed us to join them into one age group within this study of the effectiveness of different physical training modes influence on the body functional state.

Physical training modes were used during different classes, in particular classes according to the "Basic training program for higher educational institutions of Ukraine in physical education" (2000) in volleyball, weight machines strength exercises, running exercises in the energy supply aerobic-anaerobic mode and combined classes, where running in the energy supply aerobic mode and weight machines strength exercises are used. Regardless of the applied programs, the classes structure was as follows: warming-up, main part and final part. The program differences were conditioned by each class content and the training frequency. The training frequency was 2 and 3 times per week.

The examination was performed in stages: before the education-training cycle beginning, in 8, 16 weeks after the cycle beginning and after its completion (in 28 weeks). The output average values of the indicators under study for all the formed groups did not have any significant differences.

The research results show that during 28 weeks of the "Basic training program for higher educational institutions of Ukraine in physical education" there was no effective correction of the physical health level of male students. No significant changes of the indicators of physical performance, aerobic and anaerobic (lactic) performance, as well as motor activities qualitative parameters are registered.

Our research did not prove the body aerobic performance improvement under the influence of physical trainings 2 times a week, as it was mentioned in the corresponding scientific literature. None of our physical exercises modes of the mentioned frequency did improve the aerobic performance.

It is well known that the effectiveness of the physical training influence on the body functional state depends not only on the training frequency, but also on the balance between the load intensity and duration, that is on the physical activity internal volume.

According to the scientific research of Yu.M. Furman (2014), the threshold value of the internal load volume, which ensures the aerobic and anaerobic (lactic) performance improvement when practicing health-improving running exercises in the energy supply mixed mode, is about 43.8% E_{max} when having trainings at least three times a week.

According to our data, when practicing three-time a week volleyball classes with the energy consumption of 50.8% E_{max} at each training, as well as when using weight machines strength exercises with the internal load volume of 55.4% $E_{max,}$ there are no significant changes in the aerobic and anaerobic (lactic) performance of the body. But such trainings improve some motor activities qualitative parameters. It should be added that volleyball trainings contributed to the significant increase of the diastolic blood pressure by 10.0% ($p<0.05$) on the average, not exceeding the normal limits for boys aged 17–19 years, that is up to 77–79 mmHg, and peripheral visual field values, that is 3,6% ($p<0,01$) for the right eye and 3,9% ($p<0,001$) for the left eye. In our opinion, the diastolic pressure increase in the rest position is conditioned by the volleyball players activity specifics, which increases the central nervous system irritation. The latter contributes to the increasing sympathetic part of the nervous system autonomic division activity, which, in its turn, reflexively increases the peripheral blood vessels resistance. The peripheral visual field expansion during volleyball classes is a result of the increased demand to the visual analyzer during the game, which causes the peripheral retina segments excitability. The excitability mechanism is determined by the conditioning and humoral processes.

Running exercises turned to be an effective way of the young men aerobic performance improving, in particular, running three times a week in the mixed (aerobic-anaerobic) energy consumption mode with the internal load volume of 44.6% E_{max} , as well as aerobic running trainings (with the heart rate of 140–150 beat/min.$^{-1}$) in combination with weight machines strength exercises with the internal physical work volume of 58.7% $E_{max.}$ They caused the significant growth of both absolute and relative values of PWC_{170} and $VO_{2\ max}$. Moreover, the running energy consumption aerobic-anaerobic trainings were found more effective for the body aerobic performance improvement comparing to the combined trainings consisting of running and weight machines strength exercises. This caused more significant increase of the absolute and relative VO_{2max} values, as well as their significant increase for a shorter period of time from the training beginning (see Table 2, Table 3).

Table 2. Running exercises influence in the mixed energy consumption mode with a frequency of 3 times a week on the physical capability and aerobic performance (n = 19) indicators

Indicators	Average value, M ± m			
	Before training	In 8 weeks after the training beginning	In 16 weeks after the training beginning	In 28 weeks after the training beginning
PWC_{170}, kgm·min^{-1}	1089.39 ± 43.31	1245.54±52.05 *	1428.23±99.53 **	1373.35± 93.92 **
PWC_{170}, kgm·min^{-1}·kg^{-1}	15.40 ± 0.75	17.75±0.92 *	20.46 ±1.41 **	20.32 ±1.47 **
$VO_{2\ max}$, ml·min^{-1}	3091.96 ± 88.28	3357.41±100.93*	3667.99±96.08 ***	3574.69±102.78 ***
$VO_{2\ max}$, ml·min^{-1}·kg^{-1}	43.74 ± 1.80	47.84±0.97 *	52.55±1.47 *	52.88 ± 2.17 **

Notes:
The probability of the indicator dispersancy in reference to the initial data:
1. * p<0,05; 2. ** p<0.01; 3. *** p<0.001

Besides, we found advantages of the 3 times a week running trainings in the mixed energy consumption mode comparing them to trainings, where running loads were used only in the aerobic mode and in relation to the anaerobic (lactic) performance increase. With such trainings the absolute MEMWA value increased in 16 weeks after the classes beginning by 12.4% ($p<0.05$) on the average, and in 28 weeks — by 18.3% ($p<0.01$). The relative MEMWA value, in its turn, exceeded the initial level by 13.9% ($p<0.05$) in 16 weeks and by 23.8% ($p<0.01$) in 28 weeks.

The effectiveness of running exercises is proved by positive changes of the bioelectrical heart activity parameters in the rest condition. Thus, under the influence of running exercises in the aerobic energy consumption mode together with strength weight machines trainings in 28 weeks after such classes beginning the R - R interval duration increased by 7.4% ($p<0.05$) comparing to the initial value, and the Q-T interval increased by 4.2% ($p<0.05$).Besides, we registered the decrease of the P wave by 15.9% ($p<0.05$).

Table 3. The influence of trainings combining running exercises in the aerobic energy consumption mode and strength weight machines exercises with a frequency of 3 times a week on the physical capability and aerobic performance (n = 17) indicators

Indicators	Average value, M ± m			
	Before training	In 8 weeks after the training beginning	In 16 weeks after the training beginning	In 28 weeks after the training beginning
PWC_{170}, $kgm \cdot min^{-1}$	1043.07 ± 48.79	1163.92 ± 60.43	1332.53±72.15 **	1326.70±78.17**
PWC_{170}, $kgm \cdot min^{-1} \cdot kg^{-1}$	15.09 ± 0.43	16.58 ± 0.69	18.82±1.14 **	18.82±1.13 **
$VO_{2\,max}$, $ml \cdot min^{-1}$	3013.23 ± 59.57	3218.67 ± 85.78	3505.31±90.19***	3495.39±94.96***
$VO_{2\,max}$, $ml \cdot min^{-1} \cdot kg^{-1}$	43.63 ± 0.98	45.85 ± 1.17	49.51±1.31***	49.58±1.24 ***

Notes:
The probability of the indicator dispersancy in reference to the initial data:
1. * p<0,01; 2. *** p<0.001.

However, more significant ECG changes occurred under the influence of the aerobic-anaerobic energy consumption mode trainings (Table 4).Along with the intervals R–R and Q–T increase and wave P voltage decrease , indicating the myocardial function efficiency increase, the T wave increase was recorded. The latte increase indicates the myocardial metabolic processes improvement and its blood supply.Taking the above mentioned facts into account, we can state that running exercises in the mixed energy consumption mode, used for young people health improvement, are more effective for cumulative myocardial changes.

The effectiveness of running trainings, which increase the aerobic performance, also caused the VLC and living indices increase in 16 weeks after the classes beginning. In 28 weeks the VLC indicator reached even higher values and under the influence of the mixed energy consumption mode trainings exceeded the initial level by 23,1% (p<0,01), and under the influence of running exercises in the aerobic energy consumption mode in combination with weight machines exercises it exceeded the initial value by 10,1% (p<0,05).

According to scientific researches the body aerobic performance can also be increased within the physical education program implementation in higher educational institutions, but it is necessary to change its content and classes frequency. First of all, according to our data the classes should be conducted not twice a week, but three times a week for 60 minutes each. Secondly, the energy consumption of each class in athletics should be increased to approximately 76.5% of E_{max} by increasing the proposed exercises intensity, wider usage of interval training methods, as well as adding to the class main part aerobic (moderate intensity) running exercises with the external load of at least 2000 m. Using the corrected program of trainings for 12 weeks lead to the $VO_{2\,max\,rel.}$ value increase by 14.0% (p<0.01).

Table 4. The running exercises influence in the mixed energy consumption mode with a frequency of 3 times a week on the ECG (n = 19) indicators in the relative muscle rest state

Indicators	Average value, M ± m			
	Before training	In 8 weeks after the training beginning	In 16 weeks after the training beginning	In 28 weeks after the training beginning
P-Q, c	0.144 ± 0.004	0.149 ± 0.005	0.151 ± 0.005	0.150 ± 0.006
R-R, c	0.907 ± 0.023	0.949 ± 0.027	0.977 ± 0.031	0.998 ± 0.027 *
Q-T, c	0.345 ± 0.006	0.359 ± 0.006	0.361 ± 0.006	0.373 ± 0.008 **
Wave P voltage, mm	1.314 ± 0.06	1.279 ± 0.08	1.201 ± 0.09	1.138 ± 0.05 *
Wave R voltage, mm	30.7 ± 0.27	31.1 ± 0.34	30.8 ± 0.35	31.4 ± 0.37
Wave T voltage, mm	5.12 ± 0.31	5.89 ± 0.45	6.08 ± 0.37 *	6.62 ± 0.39 **

Notes: the probability of the indicator dispersancy in reference to the initial data: 1.* p<0.05; 2. ** p<0.01.

However, it should be noted that in this case there were no significant ECG parameters changes, except for the wave P voltage decrease by 16,4% (p<0,05) and R–R interval increase by 3,8% (p<0,05). This phenomenon of the $VO_{2\,max}$ value increase, not accompanied by the significant myocardium changes, according to V.P. Ponomareva (1982) and V.S. Mishchenko (1990) can be provided by the respiratory muscles efficiency increase, as proved by the significant VLC value increase by 12.2% (p<0.05) during the same training period, as well as the ability of the respiratory muscles to withstand fatigue when performing exercises.

Discussion

The study of the different physical activities influence on the aerobic and anaerobic (lactic) body performance parameters and qualitative motor activities parameters allowed us to determine effective physical trainings modes, which contribute to the body physical state improvement. Using these training regimes we solved the physical health improvement problem for young men aged 17–19 years, by increasing their body aerobic and anaerobic (lactic) performance through physical trainings. It is determined that the physical state level of male students aged 17–19 years does not change significantly, and by the relative value of the maximum oxygen consumption is considered as "average" and close to the "critical health level"; physical activities within the physical education program for higher educational institutions do not improve the body functional state.

It is proved that there is a strong positive relationship between the aerobic and anaerobic (lactic) performance ($r = 0.933$), where the exposure is the maximum external mechanical work amount during 1 minute, which allows us to use the relative indicator of the maximum external mechanical work amount during 1 minute to study the different physical activities influence on the body functional state.

The research of the relationship between the body aerobic and anaerobic (lactic) performance proved the existence of close correlations between them ($r = 0.933$; $p<0,001$).It should be noted that the in this case the exposure is the MEMWA value , and the resultant indicator is $VO_{2\ max}$.It means that it is possible to increase the aerobic performance level through trainings, which stimulates not only aerobic but also anaerobic (lactic) energy consumption processes. Such work contributes to the significant increase of the $VO_{2\ max\ rel.}$ (by 20.9%, $p<0,01$) and $MEMWA_{rel.}$ (by 23.8%, $p<0.01$).At the same time, the body aerobic performance increase when practicing trainings in the aerobic energy consumption mode is not accompanied by the anaerobic (lactic) performance increase. Running exercises in this mode contributed to the aerobic performance increase only ($VO_{2\ max\ rel.}$ value increased by 13.6%, $p < 0.001$), however the anaerobic (lactic) performance remained practically unchanged, as evidenced by the MEMWA absolute and relative values inalterability.

The positive influence on students physical health can be partially achieved by the motor activities qualitative parameters improvement. Our analysis of the relationships between the body aerobic and anaerobic (lactic) performance of young men aged 17-19 years with such motor activities qualitative parameters as endurance, speed, agility, flexibility, strength and speed-strength capabilities showed a strong correlation between the endurance (as a result of running 2500 m) and relative $VO_{2\ max}$ ($r = -0.822$; $p<0.001$) and MEMWA ($r = –0.813$; $p<0.001$) values. The relationship between the aerobic and anaerobic (lactic) performance with other motor activity qualitative parameters is absent or shows some weak dependence. The research results show the decisive influence on the physical state formation for the endurance development, the level of which, in its turn, depends on the efficiency of the body cardiorespiratory system functioning.

Trainings in different physical activities modes did not have significantly influence on the body weight of people under study. Thus, the research results emphasize the priority of the task of the young people health maintenance and strengthening during their studying in higher educational institutions. The success of this task solving to a great extent depends on the efficient use of different physical training modes. For this purpose, running exercises in the mixed energy consumption mode are the most effective, as they stimulate both aerobic and anaerobic (lactic) body performance, significantly improve physical capacity, endurance and VLC, causing positive changes of the heart bioelectric activity.

Based on the study of the body physical capability, aerobic and anaerobic (lactic) performance, as well as motor activity qualitative parameters of students, it was determined that the classes conducted according to the existing "Basic training program for higher educational institutions of Ukraine in physical education" are ineffective for increasing the physical health level of young men aged 17–19 years.

By studying different physical trainings influence on the body aerobic and anaerobic (lactic) performance we proposed physical education training programs, which improve the male students physical condition level. Besides, we've investigated the correlation between the aerobic and anaerobic (lactic) performance level, on the one hand, and the motor activities qualitative parameters, on the other hand, for men aged 17–19 years. It was determined that the relative indicators of maximum oxygen consumption and maximum external mechanical work amount during 1 minute are more reliable to characterize the efficiency of the physical education classes influence on the body functional state than motor activities qualitative parameters indicators, used in higher educational institutions for the somatic health controlling.

For the first time we substantiated the feasibility of using the relative indicator of the maximum external mechanical work amount during 1 min. to assess the efficiency of physical trainings influence on the physical health level.

Conclusions

Close negative correlations between the general endurance, which was determined by the time of running 2500 m, and aerobic ($r = -0.822$) and anaerobic (lactic) ($r = -0.813$) body performance, allowed us to consider the endurance level as one of the main physical state components. Connections between the aerobic and anaerobic (lactic) performance and other motor activities qualitative parameters are weak or absent.

It was determined that the aerobic and anaerobic (lactic) performance increase of young men depends on the physical activities frequency. When increasing the training frequency to 3 times a week and the intensity of each training from 53.3% to 76.5% of the maximum allowable energy consumption value by adding physical exercises, which stimulate the aerobic energy consumption processes, we see the significant increase of the body aerobic performance. With such trainings the absolute maximum oxygen consumption index increased by 12.4% and the relative index increased by 14.0%. It was determined that when using physical trainings, which cause the significant aerobic and anaerobic (lactic) performance increase, there occur some distinctive adaptive changes in the bioelectric heart activity. Physical exercises for improving the health do not affect the body weight of boys aged 17–19 years, if the weight does not exceed the norm before the trainings beginning.

Regardless of the frequency and loads of games and strength exercises, they have no significant influence on the aerobic and anaerobic (lactic) body performance, but improve some motor activity qualitative parameters. At the same time, games trainings, in contrast to other activities, contribute to the peripheral visual field improvement, and increase the diastolic blood pressure by 10% on the average in 28 weeks of regular exercises.

Competing Interests

The authors declare that they have no competing interests.

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