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IMPROVEMENT OF RESPIRATORY SYSTEM PERFORMANCE AMONG THE STUDENTS OF TRANSPORT COLLEGE BY MEANS OF RUNNING EXERCISES AND THE METHOD OF ENDOGENOUS HYPOXIC RESPIRATION

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Abstract

The influence of a 24-week program including running exercises and endogenous hypoxic respiration method on the parameters of external respiration was studied. After 8 and 16 weeks a spectrum of volume and speed parameters of external respiration improved. The changes in the above mentioned parameters are an indication of the better spare capacity of external respiration system and better functional capacity of respirational muscles. Positive changes in speed spirometry parameters characterize improved air passage through different sections of bronchi.

Key words: students, respiratory spirometry, running exercises, endogenous hypoxic respiration, transport college.

Станіслав Галандзовський, Вікторія Онищук. Покращення показників дихальної системи в студентів Транспортного коледжу за допомогою використання бігових навантажень і методики «ендогенно-гіпоксичного» дихання. Досліджено вплив 24-тижневої програми із використанням бігових навантажень та методики «ендогенно-гіпоксичного дихання» на показники зовнішнього дихання. Через вісім і 16 тижнів покращився спектр об'ємних та швидкісних показників зовнішнього дихання. Такі зміни характеризують підвищення резервних можливостей системи зовнішнього дихання, а також зростання функціональних можливостей дихальних м'язів. Позитивні зміни швидкісних показників спірографії засвідчують поліпшення проходження повітря на різних ділянках бронхів.

Ключові слова: студенти, дихальна спірографія, бігові навантаження, «ендогенно-гіпоксичне дихання», Транспортний коледж.

Станислав Галандзовський, Виктория Онищук. Улучшение показателей дыхательной системы у студентов Транспортного колледжа путем использования беговых нагрузок и методики «эндогенно-гипоксического» дыхания. Исследуется влияние 24-недельной программы с использованием беговых нагрузок и методики «эндогенно-гипоксического дыхания» на показатели внешнего дыхания. Через восемь и 16 недель улучшился спектр объемных и скоростных показателей внешнего дыхания. Такие изменения характеризуют повышение резервных возможностей системы внешнего дыхания, а также рост функциональных возможностей дыхательных мышц. Положительные изменения скоростных показателей спирографии свидетельствуют об улучшении прохождения воздуха разными участками бронхов.

Ключевые слова: студенты, дыхательная спирография, беговые нагрузки, «эндогенно-гипоксическое дыхание», Транспортный колледж.

Introduction. Considerate social and economic changes in society caused impact on the structure and process of physical education at technical colleges including the transport college. It's impossible to characterize social economic functions of students' physical education without considering future professional skills of students for their thorough performance of work duties. This to great extent concerns the whole system of physical eucation which mostly aims at integrated development of students as well as in–depth level of practical professional training[1; 2].

As it is known, usage of endogenous hypoxic respiration (EHR) together with physical activity encourages improvement of physical strength.

V. Y. Onishchuk states in her scientific works that application of EHR method with the help of the device Endohenik – 01 together with physical activity positively influences functional state of the students suffering from bronchial asthma [3; 4].

The results of scientific studies show that use of this model of hypoxia increases functional capacity of respiratory muscles and facilitates easier air passage through the bronchi of a small, medium and large size. Finally, such changes reduce energy consumption for respiratory muscle activity and also create favourable

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conditions for the better diffusion of gases through alveolar capillary barrier and, consequently, better conditions for the display of aerobic performance of the body appear. What is more, use of Endohenik – 01, as it was stated by some scientists [4, 5], contributes to the increase of red–blood–cell count, saturated with 2,3 – Bisphosphoglycerate which acts as the modulator of haemoglobin in the body. Connected with haemoglobin 2,3 – Bisphosphoglycerate increases oxyhemoglobin dissociation and decreases the risk of oxygen deficiency in the body.

Given all the above mentioned facts, the content of physical education of the students is determined by the requirements of their future profession, thus it has elements of practical professional physical training. Modern data confirm the relevance of specific physical training in the structure of physical education [6; 7]. However, the problem is not studied enough and requires further research.

Use of endogenous hypoxic respiration in the course of training increases functional readiness in terms of physical working capacity, aerobic and anaerobic productivity of the body and functions of the apparatus of external respiration.

The results of some studies show that a one-time use of EHR method causes positive changes in the functioning of the apparatus of external respiration, as reflected in better work of respiratory muscles and air passage through the bronchi of a small, medium and large size [3].

I. V. Hruzevich and Y. M. Furman state that the use of physical exercises together with EHR method in educational training process of teen-swimmers contributes to a high level of aerobic and anaerobic lactate working ability of the body [8].

N. V. Havrylova and Y. M. Furman prove, that the use of EHR method increases the effective influence of physical exercises on anaerobic lactate productivity and physical preparedness, as well as improves physical working ability, aerobic, anaerobic lactate productivity of the body and functional capacity of the apparatus of external respiration [9].

Taking into account the above mentioned facts, we can claim, that integrated use of running exercises and artificially created normobaric hypoxia and hypercapnia with the help of special respiratory devices may be one of the perspective available and effective technologies which are close to educational process in high school.

The **objective of the study** is investigation of the influence of running exercises in a combined regime of energy supply and EHR method on the performance of the students' respiratory system.

Tasks:

1) to define the volume and speed parameters of the respiratory system among the students of the transport college;

2) to evaluate the results of the influence of the programme of running exercises combined with EHR method on the volume and speed parameters of the respiratory system.

Material and Methods of the Study. The research took place in September 2015–April 2016 based on Vinnytsia state pedagogical university. It involved 44 male students. Study methods: theoretical analysis and synthesis of data of scientific methodical literature, methods of mathematical statistics.

In order to study the function of external respiration we applied the method of spirometry. In the course of testing we used an open type spirograf «Cardio Spiro». During the use of an open type Spirograph research participants inhale ambient air which is being exhaled comes to a gas meter that continuously defines the volume of air and oxygen uptake per unit time. Operation of the device started with its preparation in accordance to its manual [5; 3]. Testing was conducted in a position while seated. Before using the device the research participants breathed through a tube connected to the device for one minute with the aim of adaptation. In order to prevent air leak a clamp was placed on the participants' noses [5]. We defined respiratory rate (RR) and also registered volume parameters of external respiration: respiratory volume (RV), respiratory minute volume (RMV), inspiratory reserve volume (IRV), expiratory reserve volume (ERV), Vital capacity (VC), Inspiratory Vital Capacity (IVC), expiratory vital capacity (EVC), maximum lung ventilation (MLV). Volume parameters were recorded along with speed parameters: forced vital capacity (FVC), forced expiratory volume in 1 second (FEV_1), FEV_1/VC (Index Tiffeneau), peak expiratory flow (PEF), momentary expiratory flow through large bronchi (MEF_{25}), momentary expiratory flow through medium bronchi (MEF_{50}), momentary expiratory flow through small bronchi (MEF_{75}) , average expiratory flow through medium bronchi ($MEF_{25–75}$), average expiratory flow through medium bronchi ($MEF_{75–85}$).

The study was conducted in September 2015–April 2016 on the basis of Vinnytsia state pedagogical university and Vinnytsia transport college. It involved 44 male students. They were divided into 2 groups:

control group (CG) and main group (MG). Students of CG exercised in accordance with the «Training programme of physical education for high schools of 1st–2nd accreditation levels» [10]. Students of MG exercised in accordance with the designed program which included running exercises in the mixed regime of energy supply, and also EHR method with «Endohenik-01» [5].

Results of the Study. Discussion. Average volume and speed spirometry parameters of the students of CG and MG, recorded before exercising, didn't differ credibly ($p<0,05$).

After 24 weeks average volume and speed spirometry parameters of CG students aged 15–16 didn't increase credibly in the course of physical training (table 1).

After 24 weeks MG students who exercised in accordance with the integrated programme of running exercises in the mixed regime of energy supply, and EHR method improved their volume and speed spirometry parameters credibly.

Table 1

Influence of Running Exercises in the Mixed Regime of Energy Supply, and EHR Method on the Volume Parameters of External Respiration of Students Aged 15–16

Groups	Spirometry Parameters	Average Value, $\bar{x}\pm S$			
		Before	After 8 Weeks	After 16 Weeks	After 24 Weeks
CG	RR, times	17,59±0,57	17,68±0,63	15,77±1,03	16,27±0,63
MG		16,18±0,4	14,32±0,51*	13,59±0,63*	13,27±0,63*
CG	RV, l	0,64±0,04	0,63±0,04	0,64±0,04	0,64±0,04
MG		0,69±0,04	0,86±0,04*	0,88±0,04*	0,9±0,04*
CG	RMV, $l \cdot m^{-1}$	11,15±0,89	11,05±0,95	10,03±1,18	10,27±0,93
MG		10,96±0,73	12,1±0,69*	11,78±0,7*	11,71±0,71*
CG	IRV, l	2,18±0,22	2,17±0,22	2,19±0,22	2,26±0,22
MG		1,88±0,13	2,4±0,13*	2,5±0,13*	2,61±0,13*
CG	ERV, l	1,37±0,13	1,35±0,13	1,38±0,14	1,49±0,14
MG		1,48±0,15	2,11±0,15*	2,22±0,15*	2,32±0,15*
CG	VC, l	4,19±0,22	4,15±0,22	4,21±0,22	4,39±0,23
MG		4,05±0,25	5,38±0,24*	5,61±0,24*	5,83±0,24*
CG	IVC, l	2,82±0,2	2,8±0,2	2,83±0,2	2,9±0,2
MG		2,57±0,13	3,26±0,14*	3,39±0,14*	3,51±0,14*
CG	EVC, l	2,01±0,14	1,98±0,14	2,02±0,14	2,13±0,14
MG		2,17±0,16	2,97±0,16*	3,1±0,16*	3,22±0,15*
CG	MLV, $l \cdot m^{-1}$	117,05±8,34	116,21±8,22	116,28±8,21	116,36±8,21
MG		116,85±2,49	127,54±2,03*	128,78±2,01*	130,18±1,99*

Note. *Credible difference of value relative to the value registered at the beginning of the shaping experiment: * – $p<0,05$.*

As can be seen in the table 1, after 8 and 16 weeks a spectrum of volume parameters of external respiration improved. Such parameters as RR and RMV compared to the values which were registered before the shaping experiment credibly decreased (RR decreased by 12,99 and 19,06 %, and RMV – by 9,42 and 6,96 %), which demonstrates external respiratory function saving. Students also improved their IRV, ERV, VC, IVC, EVC. Average IRV increased by 21,67 and 24,80 %, ERV by 29,86 and 33,33 %, VC by 24,72 and 27,81 %, IVC by 21,17 and 24,19 %, EVC by 26,94 and 30,00 % ($p<0,05$). The changes in the above mentioned parameters are an indication of the better spare capacity of external respiration system. Members of this group also improved functional capacity of respiratory muscles, which is proved by the increase in MLV by 8,38 and 9,26 % ($p<0,05$). It's worth noting, running classes and EHR method encouraged a higher average value of RV (by 19,77 and 21,59 %).

Speed parameters of external respiration which characterize the ability of bronchi of different sizes to let air through during an exhale, give important information about the influence of running exercises in the mixed regime of energy supply on the functional capacity of respiration systems of the transport college students.

After 8 and 16 weeks students of the MG unlike CG improved their average values of the following parameters: FVC, FEV_1, PEF, MEF_{25}, MEF_{50}, MEF_{75}, $MEF_{25–75}$, $MEF_{75–85}$. The recorded changes in the speed spirometry parameters are an indication of better air passage in different bronchi sections. The average value of FVC, in particular, credibly increased related to primary data by 15,50% and 17,03%, FEV_1 – by 24,40 and 27,63 %, PEF – by 31,43 and 35,61 %, MEF_{25} – by 32,50 and 36,55 %, MEF_{50} – by 28,29 and 33,33 %, MEF_{75} – by 23,08 and 26,47 %, $MEF_{25–75}$ by– 26,04 and 28,64 %, $MEF_{75–85}$ – by 18,00 and 20,39 % ($p<0,05$). It's worth noting, after 16 weeks the value of FEV1/VC increased by 22,89 % (table 2).

Table 2

Influence of Running Exercises in the Mixed Regime of Energy Supply, and EHR Method on the Speed Parameters of External Respiration of Students Aged 15–16

Group	Spirometry Parameters	Average Value, $\bar{x}\pm S$			
		Before	After 8 Weeks	After 16 Weeks	After 24 Weeks
CG	FVC, l	2,98±0,23	2,97±0,23*	3,02±0,23*	3,07±0,23*
MG		2,29±0,1	2,71±0,09	2,76±0,09	2,83±0,09
CG	FEV_1/VC, l	71,29±5,75	71,8±5,86	71,95±5,78	70,22±5,66
MG		64,06±4,8	53,65±2,84	52,13±2,84*	51,12±2,67*
CG	FEV_1, l	2,19±0,25	2,18±0,25	2,24±0,25	2,32±0,25
MG		2,20±0,17	2,91±0,18*	3,04±0,18*	3,16±0,18*
CG	PEF, $l \cdot s^{-1}$	3,31±0,31	3,31±0,31	3,37±0,32	3,42±0,32
MG		2,64±0,27	3,85±0,29*	4,1±0,29*	4,33±0,29*
CG	MEF_{25}, $l \cdot s^{-1}$	3,12±0,3	3,11±0,3	3,15±0,31	3,19±0,31
MG		2,43±0,28	3,6±0,28*	3,83±0,28*	4,07±0,28*
CG	MEF_{50}, $l \cdot s^{-1}$	2,73±0,26	2,73±0,26	2,74±0,26	2,78±0,26
MG		1,80±0,17	2,51±0,17*	2,7±0,19*	2,83±0,19*
CG	MEF_{75}, $l \cdot s^{-1}$	1,57±0,18	1,56±0,18	1,57±0,18	1,64±0,18
MG		1,00±0,07	1,3±0,08*	1,36±0,08*	1,41±0,08*
CG	$MEF_{25–75}$, $l \cdot s^{-1}$	1,99±0,19	1,98±0,19	1,99±0,19	2,03±0,19
MG		1,42±0,11	1,92±0,11*	1,99±0,11*	2,06±0,11*
CG	$MEF_{75–85}$, $l \cdot s^{-1}$	1,32±0,12	1,31±0,12	1,31±0,12	1,32±0,12
MG		0,82±0,04	1,00±0,04*	1,03±0,04*	1,05±0,04*

Note. *Credible difference of value relative to the value registered at the beginning of the shaping experiment : * – $p<0,05$.*

Conclusions. The results of the conducted study indicate that introduction of running exercises in the mixed regime of energy supply into educational process encourages the improvement of volume parameters of respiratory system. Integrated use of EHR method and running exercises promotes better functioning of the apparatus of external respiration due to easier air passage through bronchi of a small, medium and large size, which is proved by the increased values of speed spirometry parameters.

Prospects for further research are to study the influence of running exercises in anaerobic regime of energy supply and EHR method on the parameters of work of cardiovascular system.

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