

Original Article

Combination of aerobic and anaerobic means in physical culture classes

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Abstract:

The aim of research is to support the usefulness of using combination of aerobic and anaerobic means in educational-training classes on physical culture. Material: the study involved 186 students of Belgorod National Research University and Belgorod University of Cooperation, Economics and Law (106 girls, 80 boys) aged 17-20. All test subjects belonged to the main training group. Two groups, namely experimental (EG) and control (CG), were formed. The students of the CG (n=85: 47 girls, 38 boys) were studied according to the curriculum approved by the Department of Physical Education. In the EG (n=101: 59 girls, 42 boys), the experimental method was included in the content of the existing curriculum. Pedagogical experiment was conducted due to the following: Heart rate during rest (st/min); The Ruffier test (st.units); Skibinski index (st.units); Robinson index (st.units). Evaluation of somatic health (points) of students was also conducted. Results: the conducted research has proved the advisability of using combination of aerobic and anaerobic means in educational-training classes on physical culture in order to improve the level of students' somatic health. Athletic gymnastics has proved to be an effective method for anaerobic training while health-improving swimming for aerobic one. The test results show that the classes based on a uniform alternation of health-improving swimming (in aerobic regime) and athletic gymnastics (in anaerobic regime), contribute to the improvement of functional and physical fitness, enhance physical development and rise the overall level of somatic health of students. Conclusion: The developed method allows us to present its content and orientation as an integral means of increasing the functional capabilities of the body.

Key Words: motor activity, athletic gymnastics, health-improving swimming, students.

Introduction.

In recent years Russian experts have observed a noticeable decrease of the standard of the student youth health (Drogomeretsky, Kondakov, & Gorelov, 2013; Gorelov, Obvintsev, & Kondakov, 2014; Kondakov, Voloshina, Kopeikina, & Balysheva, 2019; Nagovitsyn et al., 2019). According to the data for the years 2000-2019, up to 40% of all Russian students have been enrolled in special medical groups (SMG) due to the results of their medical examinations (Zhovan & Rumba, 2013). According to Zelenskyi and Zelenskyi (2018) only 13,3% of first- and second-year students and 16,7% of third-year studenti take physical exercises every day. Do not correspond to WHO on the level of physical activity: 55,6% of Spanish students (Acebes-Sanchez, Diez-Vega, & Rodriguez-Romo, 2019; Badicu et al., 2019); 31% of teenagers and 14% of young people in Nepal (Thapa, et al., 2019); 14,7% of boys and 8,9% of girls aged 8-19 years old in China, who is using mobile phones (Ye, Chen, Wang, & Li, 2018); 26-30% of males and 10-15% of females in Ukraine (Imas et al., 2018; Bodnar et al., 2019). Disorders of cardiovascular, respiratory, musculoskeletal systems, and vision (Kopeikina & Bogoeva, 2011; Bogoeva, Rumba, & Gorelov, 2011; Grachev & Gavrishova, 2013; Kolokoltsev & Ambartsumyan, 2020) are the most common ones detected among students. According to the results of numerous studies, these disorders occur during their study at last years of secondary school and in university. The main reasons for these disorders are the decrease in functional fitness due to the lack of motor activity, psycho-emotional overload, violations of work and rest routine (Gorelov, Kondakov, & Usatov, 2011; Kovaleva & Rumba 2012; Koryahin, Blavt, Gurtova, & Serbo, 2019; Gavrishova, Grachev, & Tret'yakov, 2020). At the same time, physical culture classes will undoubtedly have a positive effect on the functional fitness of students. Nowadays the issue of increasing the functional fitness of students is one of the main problems of physical education.

It is important to note that the comparison of the scientific data on the mechanisms of the effects of aerobic and anaerobic loads used for health-improving purposes makes it possible to assert the following:

✓ Aerobic training does not have any considerable effect on the buffer capacity of muscles, intramuscular concentration of high-energy substances, hypertrophy of muscle fibers and the ability to perform high-intensity physical work;

✓ Anaerobic training has little effect on aerobic capabilities and causes relatively small adaptive changes in the cardiovascular and oxygen transport systems of the body.

The professional literature data on the subject suggest that to achieve more profound adaptive changes in functional systems that are most susceptible to diseases. It is necessary to combine such means of physical culture that would stimulate the metabolic processes of aerobic and anaerobic character, since this corresponds to the biological laws of the body's functioning (Mazenzov, 2003).

On the basis of theoretical analysis and generalization of the professional literature data, we found that athletic gymnastics is one of the most accessible types of motor activities for use in physical culture classes in universities as this system of gymnastic exercises based on using weights and resistance promotes health improving, develops strength qualities and forms a physique. Athletic gymnastics is characterized mainly by anaerobic mechanisms of energy supply of muscle activity. The theoretical and experimental material accumulated so far in the framework of this problem shows that the most effective means of aerobic cyclic training is health-improving swimming.

In addition to this, experts note such advantages as the diversity of ways to dose the swimming load, and the positive effect of the water environment on the body (Kladkin, Protod'yakonova, Sentizova, & Platonova, 2018; Podrigalo et al., 2019; Milashechkin, Rusanov, & Valyugo, 2020). It should be noted that health-improving swimming is one of the most accessible and effective means of physical education for people of different ages and levels of fitness (Mehrabani et al., 2020; Milashechkin et al., 2020). At the same time, health-improving swimming in aerobic exercise regimen is widely used in physical education of students, as evidenced by the work of Karas (2006), Drogomeretsky, Tretyakov, Nesterenko, and Kondratenko (2018). The authors emphasize that in the process of health-improving swimming functional and physical fitness increase and the indicators characterizing muscle-skeletal and psycho-emotional state of students improve.

The aim of research is to support the usefulness of using combination of aerobic and anaerobic means in educational-training classes on physical culture.

Material and methods.

Participants.

The study involved 186 students of Belgorod National Research University and Belgorod University of Cooperation, Economics and Law (106 girls, 80 boys) aged 17-20. All test subjects belonged to the main training Department. Two groups, namely experimental (EG - n=101: 59 girls, 42 boys) and control (CG - n=85: 47 girls, 38 boys), were formed. The research related to human use has been complied with all the relevant national regulations, institutional policies and in accordance with the tenets of the Helsinki Declaration (WMA Declaration of Helsinki, 2016).

Procedure.

The students of the CG studied according to the curriculum approved by the Department of Physical Education [Kondakov, Kopeikina, Balysheva, Usatov, & Bocharova, 2016; Kadutskaya, Voloshina, Kondakov, & Irkhin, 2020). In the EG, the experimental method was included in the content of the existing curriculum. The essence of the experimental method of combining aerobic and anaerobic means in physical culture classes with students was even alternation of health-improving swimming (in aerobic regime) and athletic gymnastics (in anaerobic regime). During health-improving swimming classes students alternate between swimming the same distance by front crawl with a slight acceleration in heart rate up to 130-140 beats/min and by brass with heart rate of 100-110 beats/min; the total distance covered during the class gradually increases up to 700-900 meters. Basic exercises (weights up to 60-80% of repetition maximum) in athletic gymnastics are used for building muscle volume and developing absolute strength of the major muscle groups. Other auxiliary exercises (weights up to 30-50% of repetition maximum) are aimed at developing strength endurance and achieving muscle relief. Pedagogical experiment was conducted due to the following: Heart rate during rest (st/min); The Ruffier test (st.units); Skibinski index (st.units); Robinson index (st.units). Evaluation of somatic health (points) of students was also conducted.

Statistical analysis.

The statistical analysis of the obtained data was carried out using licensed Microsoft Excel. The indicators of the descriptive statistics (arithmetic mean, standard deviation, and average error) were determined. The reliability of the differences in values was evaluated by means of Student criterion. The difference was considered reliable at $p < 0.05$.

Results

The developed method of combining aerobic and anaerobic means for physical training of students contributed to the following:

- significant economization of the myocardial activity;

- optimization of diastolic blood pressure and vegetative indicators;
- increase of aerobic capabilities;
- rise of the level of energy potential of the body;
- increase of physical performance and that of the cardio-respiratory system;
- rise of strength, speed, and coordination.

As a result, the level of somatic health of the experimental group test subjects has significantly increased on average from 5 to 10 points for students of both sexes (table. 1).

Table 1. The significant changes that occurred based on the results of using the experimental method in class.

Index	Groups	Men		Women	
		Before the experiment	After the experiment	Before the experiment	After the experiment
Heart rate during rest (st/min)	CG	83.45±0.66	82.55±0.59	86.13±0.90	85.16±0.85
	EG*	84.00±2.56	68.73±3.74	90.67±3.38	75.33±1.45
The Ruffier test (st.units)	CG	10.98±0.29	11.67±0.30	13.41±0.21	13.17±0.22
	EG*	10.65±0.82	6.45±0.93	14.33±0.91	8.67±0.40
Skibinski index (st.units)	CG	30.97±0.66	33.09±0.60	17.94±1.32	18.48±2.29
	EG*	31.65±2.89	54.31±7.02	16.64±1.56	28.17±2.42
Robinson index (st.units)	CG	30.97±0.66	33.09±0.60	17.94±1.32	18.48±2.29
	EG*	31.65±2.89	54.31±7.02	16.64±1.56	28.17±2.42
Evaluation of somatic health (points)	CG	4.18±0.30	4.55±0.28	4.26±0.19	4.26±0.21
	EG*	5.27±0.90	9.91±0.96	4.89±0.48	9.89±1.05

* - significance level of differences at $p < 0.05$

The test results show that the classes based on a uniform alternation of health-improving swimming (in aerobic regime) and athletic gymnastics (in anaerobic regime), contribute to the improvement of functional and physical fitness, enhance physical development and rise the overall level of somatic health of students.

Discussion.

The conducted theoretical analysis and generalization of the professional literature data on the problem of improving the level of somatic health of students reveals a growing interest of scientists in this topic.

Currently many specialists in the field of physical culture, kinesiology, physiology and medicine all around the world are searching for solutions to such urgent problems as improving the level of somatic health, motor activity of students and developing ways of encouraging students' participation in physical culture and sports.

It should be noted that there exists a contradiction in the national theory and methodology of physical education of students between the physiologically determined expediency of combining aerobic and anaerobic means in physical culture classes (in order to improve the functional capabilities of the body and health) and the lack of scientifically based methods and technologies for conducting such classes. In view of the above, this contradiction predetermined the aim of our research: identification of effective means of aerobic and anaerobic training of health-improving orientation and optimal ways of their combination in physical education of students. A large number of specialists (Dobrescu, 2018; Chernenko, Honcharenko, & Marchenko, 2019; Khudolii, Ivashchenko, Iermakov, Nosko, & Marchenko, 2019; Eken, Özkol, & Varol, 2020) use exercises aimed at developing strength abilities in classes with senior schoolchildren and students as the main means. However, it is the effectiveness of the techniques aimed at developing strength qualities and correcting the physique that they tend to justify experimentally.

Among foreign authors, we can highlight the research of Oliver, Morton, Baldwin and Datta (2019), Garcia-Hermoso et al. (2019), Leuciuc (2018), that prove the positive effect of strength exercises not only on the indicators of strength training and increasing muscle mass, but also on improving the cardiovascular system, the quality of life and self-esteem of students (Smith et al., 2018). The data on the positive effect of athletic gymnastics on the functional reserves of the body have been found in the works of Kim (2003) and Gorbunov (2005), addressed to the students of special medical group. In addition, the scientific literature contains information about the positive effect of athletic gymnastics on the functional fitness of men (Karpov, 2010; Vavilov, 2011; Sleeper, Kenyon, Elliott, & Cheng, 2016) and women (Plaksina, 2008; Fields et al., 2018; Kharisov & Nenasheva, 2018) of mature age and schoolchildren (Kozina et al., 2016; Khudolii, Ivashchenko, Iermakov, & Rumba, 2016; Khudolii, 2019). In our opinion, the fact of the increase in the functional capabilities of those who practice it may be related to the specificity of the effect of anaerobic loads.

Also, in the scientific community, many studies on the impact of aerobic exercises used by students in class have been conducted. Thus, in the works of de Bruijn et al. (2019), Kyan, Takakura, and Miyagi (2019), Myshko (2018) the positive effect of such exercises on student performance has been proved. The research by the Chinese scientists Niu, Zhou and Ma (2018) showed the positive effect of aerobic exercise on the cardiovascular system and on the main indicators of physical health and development. The work of the

Taiwanese specialists (Chiu et al., 2017) demonstrated the improving effect on the body composition of obese students.

A large number of studies by various scientists was devoted to the study of health-improving swimming as an aerobic activity. It has been shown that swimming has a positive effect on the indicators of physical development, fitness, and reducing the level of anxiety of students enrolled into a special medical group for health reasons (Nosko, Arkhypov, Khudolii, Filatova, & Yevtushok, 2019), as well as on the academic performance of students (Al Dababseh et al., 2017), on enhancement of respiratory system functioning (Sheyko, 2015; Santibanez et al., 2017), mental health, motor coordination, and cognitive ability in children with attention deficit hyperactivity disorders (Sima & Potop, 2018).

Studies on the complex use of aerobic and strength-oriented exercises were found only in the work of Eather et al. (2019), that proved the high effectiveness of combinations of aerobic and strength blocks for improvement of the indicators of physical development, fitness, psycho-emotional state and overall student satisfaction. All this highlights the relevance of our work and proves the need to continue research in this area.

Conclusion.

The developed method of combining aerobic and anaerobic means in physical culture classes with university students has contributed to the economization of myocardial activity, optimization of diastolic blood pressure and vegetative indicators, increase of aerobic capabilities and the level of energy potential of the body, rise of physical performance and that of the cardio-respiratory system, increase of strength, speed and coordination.

When organizing classes with students, it is necessary to take into account the following factors that characterize the orientation of the training:

- Aerobic training does not have any considerable effect on the buffer capacity of muscles, intramuscular concentration of high-energy substances, hypertrophy of muscle fibers and the ability to perform high-intensity physical work;
- Anaerobic training has little effect on aerobic capabilities and causes relatively small adaptive changes in the cardiovascular and oxygen transport systems of the body.

It is also necessary to be guided by:

- physiologically determined expediency of combining aerobic and anaerobic means;
- search for other of effective means of aerobic and anaerobic training of health-improving orientation and optimal ways of their combination.

Conflict of interest.

The authors state that there is no conflict of interest.

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