Original Article

Using high-intensity interval training during swimming classes in higher educational institutions

LARISA VLADIMIROVNA BYANKINA¹, VLADIMIR VASILYEVICH BYANKIN¹, IRINA MIKHAILOVNA VOROTILKINA², MARIA MIKHAYLOVNA PROKOPYEVA³, LIUDMILA VLADIMIROVNA SOKORUTOVA³

¹Far Eastern State Academy of Physical Culture, Khabarovsk, RUSSIAN FEDERATION

²Sholom-Aleichem Priamursky State University, Birobidzhan, RUSSIAN FEDERATION

³Federal Autonomous Institution of Higher Professional Education “The North-Eastern Federal University named after M. K. Ammosov”, Yakutsk, RUSSIAN FEDERATION

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Abstract:

People's health and preservation and strengthening of their physical conditions has been a topical issue for quite a long time, as it can never be completely solved. Constantly changing of ecological, cultural, and social environment requires continuous adaptation to new conditions. In fact, this is what human life consists of, but health determines its quality to a large extent. Being a part of educational system, higher professional school is also encouraged to solve the problems of people's health improvement, mainly at specially organised physical education (PE) classes. Different sports represented in PE curricula in different higher educational institutions have a broad range of influence on students' health. However, they are first of all intended for the development of physical and functional capabilities of students. Existing contradiction between the amount of classes per week and recommended special physical activity for students should be solved by theoretical classes where teachers explain the significance of individual physical activity. Methodical skills for conducting individual training are acquired during practical classes. Different modes of exercise performance offered by the teacher have different influence on students' health. We have studied the levels of general physical fitness of students of both sexes and conducted an experiment using high-intensity interval training at swimming classes in groups of main department. The effectiveness of such classes demonstrated not only in improved swimming distance but also in the development of students' functional capabilities was justified.

Key words: physical education, professional school students, interval training.

Introduction

Educating a healthy person is one of the principal tasks of any educational institutions specialised in physical culture with its traditional methods, which chiefly influence people's physical condition (Matveev 2004; Milner 1991; Platonov 2004; Seluyanov 2001; Heinemann 2005). In contemporary world national health should be taken care of not only at the level of the state but also at the individual level. One of the objective measures of its development is physical state of a person including physical education and physical fitness (Dmitruk 2007; Kuper 1989; Kemper 1994). Their study has always provoked scientists' interest, and it has already been proved that it is influenced by various factors (Vilensky 2013; Physical development, physical fitness, and psychophysical state of certain groups of people of Russian Far East: a monography, 2014; Byankina, Mogilev, Vorotilkina, Galitsyn and Chiligin 2016). Physical state of the nation is changing under the influence of changing climate and geographic as well as socio-economic environment. Physical state directly depends on physical activity, whether it is organised in an educational institution or conducted individually.

Methodology

The presented research was conducted in several stages: at the first stage mass examination of young students' physical fitness was tested. At the second stage the method of high-intensity interval training at swimming classes was developed and tested and its effectiveness was checked.

We have studied 532 female and 358 male students (890 in total) from the universities of Russian Far East (by the example of Khabarovsk, Birobidzhan, and Yakutsk). Their physical fitness was examined through classical tests selected for the comparison: 100-m and 1000-m running, standing long-jump, push-ups for female students, chin-ups for male students.

To justify the use of high-intensity interval training method aimed at the development of stamina, we conducted an educational experiment in general physical education groups specialising in swimming. Two groups with 13 people in each took part in the experiment. The control group trained with gradual and limiting

effort escalation, which is usually used in training process. By the end of the experiment (the last 3 training classes) the activity had become less dynamic so that the combined effect transformed into sporting result when passing the final test. The experimental group trained according to high-intensity interval training method. The students swam the first 10-15 metres with maximum speed covering the rest of the distance (35-40 m) in restorative mode.

In both groups the training lasted 50 minutes. 18 classes were conducted in each group in total. Before the experiment, control 50-m swimming test and maximum oxygen consumption (MOC) test had been conducted. At the end of the experiment swimming for the same distance was tested and MOC was measured in order to be compared with the previous results.

At the beginning of the experiment the students of the control group swam 500 m at each of the first two classes. Training load gradually increased, and by the 15th class they swam from 1200 to 1500 m depending on their physical fitness. Starting from the 16th class the workload was gradually reduced, as it had been mentioned before, and at the last class the students swam 800-900 m. During the experiment the students had swum from 15 300 to 18 400 m in total. The average group result was 16 490 m.

In the experimental group the students swam 50-m distance during the classes according to the suggested programme – 10-15 m at the maximum speed and the rest of the distance in restorative mode. Depending on their physical fitness, they started from 7 to 12 50-m sections, and at the end of the experiment there were 16 to 28 sections. In total, the students had swum from 9050 to 18 300 m during 18 classes. The average group **result was 13 250 m.**

Results and discussion

The organisation of physical education in higher educational institutions is influenced by a number of factors which can be divided into two groups: the ones depending on students' individual characteristics and the ones related to capabilities of a certain educational institution. Motivated choice of a certain profession, established life stance, state of health and physical fitness, diverse activity and sport experience belong to the first group. Time budget, living conditions and a number of other specific aspects are also among individual characteristics. Thus, individual characteristics can be classified by physical, psychological, and social component the combination of which creates profusive variety of attitude to physical culture. The second group related to capabilities of a certain educational institution includes traditions of this educational institution in respect of physical culture and sport, material and technical resources, faculty potential. It is undoubtable that the process of education cannot be unified. Personal characteristics of teachers, their sportsmanship, focus on self-perfection have significant influence on students. Moreover, this influence can be either positive or negative. Can it be called influence if the result of the interaction between teacher and student is zero? We are inclined to consider such result negative, as there are certain goals to be achieved in the process of education. One cannot take into account all the above-mentioned factors in the organisation of physical education, at the level of higher educational institution on the whole and at the level of teachers or groups. For that reason, in addition to general methodology of classes and existing topical schedules with certain tasks and means for each class, each physical education teacher can either consider these specifics or not.

Effectiveness of educational process in physical education is tested by qualifying standards. Each higher educational institution can select the standards as well as rating scales from the offered ones. The obtained results of the above-mentioned tests were structured according to rating levels suggested by "Physical culture" curriculum of the higher educational institution where the research was conducted. We used the following gradation scale instead of point rating: "average", "low", "high" levels as well as "above the average" and "below the average" (tables 1, 2). "High" level corresponded to the excellent mark while "low" corresponded to the lowest grade.

Table 1. Distribution according to male students' physical fitness level

Levels tests	Low (%)	Below the average (%)	Average (%)	Above the average (%)	High (%)
100 m	0	10	65	15	10
1000 m	4	8	52	28	12
Chin-ups	0	4,2	63,1	27,1	5,6
Standing long-jump	0	1,4	61,6	22,3	14,7

Table 2. Distribution according to female students' physical fitness level

Levels tests	Low (%)	Below the average (%)	Average (%)	Above the average (%)	High (%)
100 m	16,7	31,2	43,6	4,9	3,6
1000 m	13,9	27,1	48,5	6	4,5
Push-ups	21,2	5,3	60,9	6,2	6,4
Standing long-jump	14,3	22,6	47,7	8,8	6,6

Analysing the level of speed development, it can be stated that 10% of male and 3,6% of female students have high physical fitness while 15% of male and 4,9% of female students showed results which were above the average. However, 65% of male and 43,6% of female students showed average results. The level of stamina development is similar to speed development: female students have more "low" and "below the average" results. As for strength tests (chin-ups for male students, push-ups for female students), the following level of physical fitness was detected: high for 5,6% of male and 6,4% of female students, above the average for 27,1% of male and 6,2% of female students, average for 63,1% of male and 60,9% of female students. Male students showed the best results for standing long-jumps: none of them showed the lowest level, and only 1,4 % had results below the average. Female students had the following level of physical fitness for this aspect: 6,6 % high results, 8,8% were above the average, and 47,7% were average. The highest results of analysed tests vary from 5,6 to 14,7% for male students and from 3,6 to 6,6% for female students. However, most of the examined students showed average and above the average results.

To make the process of physical education more effective, it is necessary to adapt the content of physical education classes to specifics of students' interest and motives (Vilensky 2013; Milner 1991; Grupe 1991; Jarvie Grant 2006). Teachers should pay special attention to the explanation of significance of physical exercises in order to improve physical fitness through providing students with new theoretical knowledge on potentiality of means and methods of physical education. In other words, students should learn to control their health with the help of different exercises.

Based on aerobic capabilities being the main criterion of physical health (Viru 1988; Kuper 1989; Milner 1991; Myakinchenko 2001; Byankina, Vorotilkina, Byankin, Bugaeva and Prokopyeva 2016), functional training is the one which should be paid most attention at physical education classes. The search for new methods of physical training contributes to the achievement of the posed tasks.

Without knowing the principal postulates of organising the training process, it is impossible to plan training activities. Many studies are dedicated to the development of physical qualities of both sportsmen and people engaged in physical culture (Verhoshansky 2007; Zatsiorsky 1966; Myakinchenko 2005; Platonov 2004). Defining training load in physical education is highly significant for planning physical training. Body burden is defined by the ratio of muscle work and preliminary body adaptation to muscle work (Sports medicine (Manual for doctors), 1984). Amount and intensity are the main characteristics of muscle work while their different combinations provide different effect.

Complying with the main principles of athletic training (continuous training process, unity of gradual and limited increase of training load, wave-like load dynamics) (Platonov 2004), we have considered the issue of influence of training load from the physiological point of view. General physical training group specialising in swimming was the most suitable for the experiment and solution of the posed tasks. The most important aspect of this sport is the development of stamina on which the results depend. The goal of stamina development is to increase the amount of mitochondria influencing MOC (Myakinchenko 2005). The more mitochondria there are, the higher MOC, an integrated index of the "amount of health", is (Viru 1988; Kuper 1989; Myakinchenko 2001; Seluyanov 2001).

The formation of training process aimed at stamina development was, first of all, based on the principles of consciousness and activity, availability and individualisation as well as on the above-mentioned principles of athletic training. The results of the experiment are presented in table 3.

It should be noted that in total the control group did 24,5% more swimming load over the course of the experiment than the experimental group: 16 490 m as opposed to 13 350 m. The average result growth was 3,19 seconds ($P < 0,05$) in the control group and 5,92 seconds ($P < 0,05$) in the experimental group. Average results increased by 16,4% while in the control group it was 8,4%. Despite reliable changes in the control group, the difference between average results of the control and experimental groups shows that the suggested methodology is effective.

Table 3. Physical and functional fitness results during the experiment in the groups

Test results	Experimental group (13 people)		Control group (13 people)		Growth differential EG-CG		t	P
	Before the experiment M1 ± m	After the experiment M2 ±m	Before the experiment M3 ±m	After the experiment M4 ±m	In units	%		
Swimming 50 m (sec)	41,97±1,32	36,05±0,56	41,32±1,3	38,13±0,59	2,08	5,77	2,56	<0,05
MOC (ml/min/kg)	44,5±0,6	51,5±0,8	45,2±1,3	48,2±0,7	3,3	6,8	3,11	<0,05

Functional indices, including MOC index, were also checked. As in the swimming test, there had been no reliable differences between the groups at the beginning of the experiment. Reliable increase of the results during the experiment can also be seen in the control and experimental groups, but the difference between final indices of the two groups is reliable and accounts for 6,8%.

The suggested methodology of physical load in the experimental group was based on physiological principles of stamina development – on the increase of the amount of mitochondria influencing MOC. The main criterion of people's health is their energy potential, that is, ability to consume energy from the environment, to accumulate it and mobilise in order to ensure one's physiological functions (Seluyanov 2001; Sports medicine (Manual for doctors), 1984). The more energy the body can accumulate, and the more effective its output is, the better the state of health is. As the amount of aerobic (including oxygen) energy production prevails in energy metabolism, the maximum value of aerobic possibilities of the body is the main criterion of physical health and vital capacity. According to physiology, the main index of body aerobic capabilities is the amount of consumer oxygen per unit of time. So, the higher MOC is, the better the state of health is. MOC reflects body aerobic capabilities (Kuper 1989). The number of mitochondria increases during short-term load when there is not enough time for muscles to "oxidise", and lactic acid transforms into CO₂ and H₂O during restorative swimming. In case of long-term work without any breaks (in the control group) lactic acid accumulates, and the body is "oxidised", which does not contribute to the increase of the number of mitochondria. As a result, stamina development using long-term medium-intensity work load is not really effective.

Conclusion

Summarising the conducted research, we can make the following main conclusions. Physical fitness of the examined students is rather high. About 90% of male and 60% of female students showed average and above the average results (average index for all tests). Male students showed the best results in the test checking their speed and strength abilities - standing long-jump. None of the results were low, and only 2% showed below the average level. Male students also had no low results in other tests. This can be explained by the fact that, on the one hand, the study was conducted in the main department (without students having certain medical conditions and belonging to a special health group). On the other hand, there were more female than male students in the experiment, and lower results appeared with the increased number of the examined students. Some of the female students showed low results in all tests – from 12 (stamina and speed-strength abilities) to 21% in the test checking strength. This can be explained by gender differences and ideas of female students of what the adequate state of health is. However, this assumption is to be additionally checked.

The educational experiment showed that the suggested method of training in the experimental group is effective. The results of tests for physical and functional fitness in the experimental group were reliably higher than in the control group which had been trained according to traditional system. This was proved by the results of mathematical and statistical processing of the research materials.

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