

дослідження домінуючих страхів у дітей з багатодітних і небагатодітних сімей показало, що діти з багатодітних сімей менш схильні до страхів, вони більш соціально адаптовані, комунікабельні та менш тривожні.

Ключові слова: дитячі страхи, види страхів, діти з багатодітних та небагатодітних сімей, корекційна програма, подолання страхів.

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CORRECTION OF PHYSICAL FITNESS OF SENIOR SCHOOL STUDENTS LIVING IN RADIATION ENVIRONMENT

The deterioration of environmental living conditions has actualized the problem of preserving and strengthening the health of people. The research aims to study the adaptation capabilities of motor activity of senior school students living under conditions of radioecological factors' influence depending on the level of their physical activity; as well as to study possibilities of their correction by means of health improving physical education. According to the research results, it has been found that increased motor activity does not always have a positive impact of physical fitness. Not only low but also the increased physical activity is not adequate for a senior school student's body. It promotes stress adaptation mechanisms and functional capabilities reduction. The carried out monitoring detected that only senior school students having average and above average levels of motor activity have got satisfactory degree of adaptation. When planning and arranging physical education lessons at school, one should take into account the current status of students and individual adaptation characteristics to physical exercises. It allows implementing health improving effect of the lessons as efficiently as possible. The use of health improving physical education means at the lessons of physical training for senior school students allowed forming a high level of adaptation capabilities and increasing non-specific body resistance. As a result, it helps to reduce the negative influence of adverse radiation ecological factors.

Keywords: *adaptation capabilities, senior school students, adverse radiation ecological conditions, health-improving physical culture.*

Introduction

More than 30 years have already passed from April 26, 1986, since the tragic day of the Chernobyl nuclear power plant accident, more than one generation of children have been raised, though despite this fact, the issue of unfavorable radiation situation is still relevant for a number of regions in Belarus, Ukraine, and Russia. This necessitates the search for effective means of preserving and strengthening the health of people living in such ecological conditions. And this is of the greatest importance for children and adolescents who determine the future of each nation.

It should be emphasized that not only radiation is an environmental factor that can worsen the level of people's health. Each region has its own socio-economic conditions, forming its own set of environmental factors that cause a decrease in people's adaptive capacity and increase in diseases incidence (Kaznacheev, et al., 1980; Blair, Brodneyn, 1999). In addition, for school-age children, studying is also a factor that provokes health deterioration. Constant "improvement" of the educational process, intensification of learning through the use of various innovative pedagogical technologies – all of these do not contribute to strengthening and improving the health of

the younger generation (Mikheienko, 2013; Polka, Kalinichenko, 2015, et. al.).

The conducted studies prove that physical exercises are one of the most comprehensible and effective means of increasing the adaptive capacity of various ages, strengthening health and increasing physical well-being (Artemenkov, 2015; Veselovskaya et al., 2018; Prusik et al., 2014; Rich, 1991; Wilmore, Costill, 2004). The issue of greater effectiveness of cyclic (aerobic and anaerobic) or acyclic (athletic, gymnastic, fitness) exercises, the degree of their physical and biological (physiological) effects has been discussed for years (Platonov, 2002; Smirnov, Dubrovsky, 2002; Wilmore, Costill 2004, Blaak, 2010; Samuelsson, 2008).

Aim and Tasks

The paper aims to examine adaptive capabilities of senior school students living in unfavorable radiation conditions, and the possibility of their improvement by means of recreational physical culture. At the same time, the following research tasks are set: to review this issue in the states with the greatest consequences of the Chernobyl accident (radioactive contamination); to examine the level of functional abilities of senior school students living in radiation conditions; to develop and test methods of correcting physical fitness of senior school students living in radiation conditions.

Research Methods

At the first stage of the study, we examined the dynamics of the adaptive capacity of the circulatory system (AC) in senior school students in Gomel. A total of 231 senior school students from Gomel took part in the study, who, according to the results of the data analysis, were divided into 4 groups, depending on the level of their motor activity. The first group, with the motor activity below the average level, included the students of the special medical group, who were engaged in special programs at school. The second group (with average motor activity) included schoolchildren of the main medical group engaged 3 times a week in physical education classes at school. The third group consisted of the students of the main medical group with motor activity above average, who, besides classes 3 times a week in physical education classes at school, attended various sports sections/clubs. The fourth group (with a high level of motor activity) included students of the main medical group engaged 3 times a week in physical culture lessons at school, as well as regularly attending sports sections taking part in competitions and having sports categories (first-class and second-class sportsmen).

In order to assess the adaptive capabilities of the respondents, we calculated the adaptation capacity according to the formula of R.M. Baevsky (Baevsky, Berseneva, 1987): $AC = 0.011 \times HR + 0.014 \times SBP + 0.008 \times ADD + 0.014 \times A + 0.009 \times BW - 0.009 \times H - 0.27$, where such parameters are used: HR – heart rate (bpm), SBP – systolic blood pressure (mmHg), DBP – diastolic blood pressure (mmHg), A – age (full years), BW – body weight (kg), P – height (cm).

According to the recommended scale for assessing physical fitness, adaptation is considered to be satisfactory at threshold values of AC of not more than 2.1 points; the tension of adaptation mechanisms is diagnosed with AC from 2.11 to 3.2 points; unsatisfactory adaptation is considered at 3.21-4.3 points; and with AC more than 4.31 points, the adaptation failure is noted. An analysis of the informative value and popular normative scales of this criterion was made by A.I. Bosenko and co-authors, and it was suggested that it was not sufficiently developed in the age and sex aspects (Bosenko et al., 2017).

The assessment of the adaptive capacity of the senior school students was carried out at the end of each academic term, four times a year.

The pedagogical experiment was carried out on the basis of secondary schools No. 51 and No. 11 in Gomel. 98 school students of 11 grades took part in it. They were divided into 2 groups: 1 group - control (26 boys and 24 girls) and experimental (22 boys and 26 girls). All students were assigned to the main medical group and did not have any abnormalities in their health status.

The experimental technique was based on the optimal combination of the basic (including compulsory theoretical knowledge and necessary motor skills) and variation (which presupposes the use of developed health aerobics complexes aimed not only at improving the level of physical fitness of senior school students, but and also the improvement of their functional state, the increase of their adaptive reserves) components in the structure of the lesson.

The variation component was based on the developed scheme for distributing the training material for classes in basic and step aerobics, using its new directions: funk aerobics (performing free dance movements in the “hip-hop” style), pump aerobics (power aerobics using hand weights and rubber expanders), tae-bo (aerobics with elements of oriental martial arts – wushu, taekwondo, kickboxing) and aeroboxing (aerobics using the elements of boxing and karate).

In order to assess the adaptive capabilities of the senior school students, in addition to the adaptive capacity of the circulatory system, we calculated the endurance coefficient (EC) and basal metabolism index (BM).

The effectiveness of the cardiovascular system functioning was examined by the value of the endurance factor, which was calculated according to the Kvas formula (Kaznacheev et al., 1980): $EF = \text{heart rate} \times 10 / (SBP - DBP)$, combines heart rate, SBP and DBP. Normally, $EF = 12 - 16$ relative units, its increase indicates a decrease in the activity of the cardiovascular system; its decrease shows its intensification; decrease of EF below 12 units indicates its significant fatigue.

To estimate the intensity of metabolism and energy in the body, we used the basal metabolism index, calculated according to the Reed formula (Smirnov, Dubrovsky, 2002): the percentage of deviation of $BM = 0.75 \times (HR + PP \times 0.74) - 72$, where HR is heart rate (bpm), PP – pulse pressure (mmHg) and 0.75; 0.74; 72 are constants.

When processing the data obtained, the methods of mathematical statistics were used (Glantz, 1998; Ivanov, 1990). The results obtained during the study were processed on a personal computer using the STATISTICA software package. We examined the arithmetic mean (\bar{X}) and the standard deviation (σ). The reliability of the dif-

ferences between the mean values was determined by Student's t-test. The reliability was considered to be significant at $P < 0.05$.

Research Results

The received results are presented in figure 1.

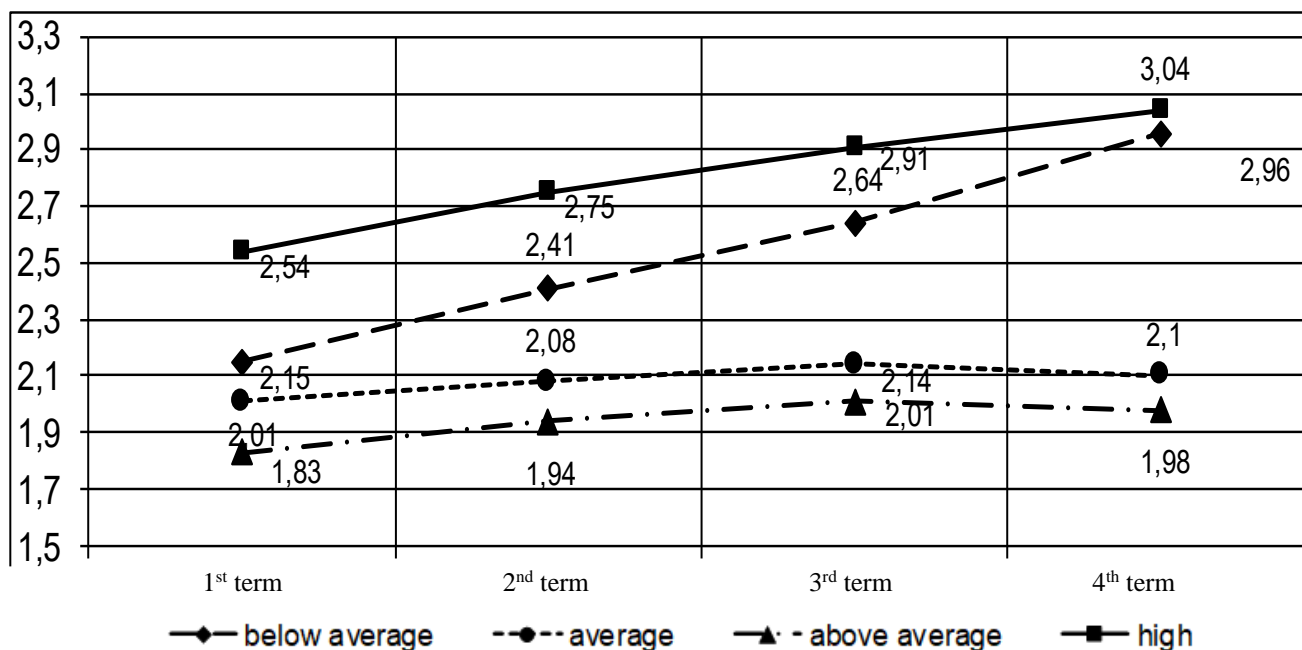


Fig. 1. Dynamics of Adaptation Capacity of the Respondents Living in Unfavorable Radiation Conditions, with Various Level of Physical Activity, Scores

The obtained data review made it possible to reveal a number of regularities. Thus, for the respondents belonging to the groups with an average and above average motor activity levels, the parameters of the adaptation capacity throughout the year fluctuate in a very small range (from 2.01 ± 0.19 points in the first academic term to 2.10 ± 0.20 points in the fourth term, and from 1.83 ± 0.18 points to 1.98 ± 0.18 points, respectively). At the same time, in the senior school students belonging to the group with a level of motor activity below the average, a stable tendency to an increase in the indicator was revealed throughout the school year (from 2.15 ± 0.13 points in the first term to 2.96 ± 0.10 points in the fourth term), the statistical significance of the differences was $t = 4.94, p < 0.001$.

Similar dynamics could be observed in the respondents with a high level of motor activity involved in sports (qualified sportsmen). The average group value of the indicator, even in the first term, being already high (2.54 ± 0.11 points), increased even further (up to 3.04 ± 0.14 points) by the end of the academic year, the statistical significance of the differences in this case is $t = 2.81, p < 0.01$. In our opinion, significant training loads in

combination with intense studying cause tension of adaptation mechanisms and do not contribute to its adequate formation. This fact is also noted in a number of other studies (Milyutin et al., 2012; Poborsky, 1997; Shaykhelislamova, et al., 2013).

Based on the obtained results, an experimental method for physical education of senior school students living in unfavorable radiation conditions was designed. The experimental technique was based on the optimal combination of the basic (including compulsory theoretical knowledge and necessary motor skills) and variation (which presupposes the use of developed health aerobics complexes aimed not only at improving the level of physical fitness of senior school students, but and also the improvement of their functional state, the increase of their adaptive reserves) components in the structure of the lesson.

The data analysis before and after its implementation helped to prove the efficiency of the suggested technique (Table 1).

Table 1.

Dynamics of Adaptation Capacity of Senior School Students Living in Unfavorable Radiation Conditions ($X \pm \sigma$)

№	Indices	Groups	Academic year			
			1st term	2 nd term	3 rd term	4 th term
Boys						
1	Circulation system adaptation capacity, points	CG	2.05±0.11	2.07±0.10	2.10±0.11	2.17±0.12
		EG	2.04±0.09	1.99±0.11	1.94±0.10	1.90±0.11
		Reliability of results (t / p)	0.25 / >0.05	1.89 / >0.05	3.80 / <0.01	5.87 / <0.01
2	Endurance coefficient, relative units	CG	18.37±1.25	18.54±1.34	18.42±1.47	18.60±1.58
		EG	18.60±1.54	17.55±1.48	16.34±1.53	15.45±1.67
		Reliability of results (t / p)	0.40 / >0.05	1.74 / >0.05	3.46 / <0.01	4.83 / <0.01
3	basal metabolism index, %	CG	11.12±2.14	11.31±2.17	11.57±2.34	11.82±2.47
		EG	11.86±2.19	9.27±2.41	6.12±2.39	3.42±2.59
		Reliability of results (t / p)	0.85 / >0.05	2.22 / <0.05	5.75 / <0.01	8.28 / <0.01
Girls						
1	Circulation system adaptation capacity, points	CG	2.18±0.10	2.20±0.09	2.22±0.10	2.21±0.12
		EG	2.21±0.13	2.10±0.11	2.03±0.13	1.95±0.14
		Reliability of results (t / p)	0.64 / >0.05	2.45 / <0.05	4.04 / <0.01	4.89 / <0.01
2	Endurance coefficient, relative units	CG	22.43±1.34	21.07±1.47	20.26±1.42	18.83±1.54
		EG	22.70±1.42	20.31±1.45	18.39±1.48	15.77±1.43
		Reliability of results (t / p)	0.47 / >0.05	1.26 / >0.05	3.15 / <0.01	5.01 / <0.01
3	basal metabolism index, %	CG	10.78±2.15	11.24±2.18	11.95±2.26	12.61±2.21
		EG	11.53±2.21	10.17±2.24	8.06±2.27	6.23±2.32
		Reliability of results (t / p)	0.84 / >0.05	1.18 / >0.05	3.86 / <0.01	6.88 / <0.01

Thus, according to the results of the adaptation capacity index, the boys of the control group experienced stable deterioration of reserve capacities and adaptation voltage throughout the school year (2.05 ± 0.11 , 2.07 ± 0.10 , 2.10 ± 0.11 and 2.17 ± 0.12 points in the 1st, 2nd, 3rd, and 4th terms, respectively).

At the same time, in the experimental group, this indicator was getting improved with each term from 2.04 ± 0.09 to 1.90 ± 0.11 , respectively. An analysis of the obtained data revealed that if in the 1st and 2nd quarters the parameters of the two groups did not have statistically significant differences, starting from the third quarter the reliability of the differences at $p < 0.001$ was noted.

In addition, the mean group result of the adaptation capacity of the boys in the control group (2.17 ± 0.12 points) found on the basis of the fourth term is estimated as the tension of the adaptation mechanisms (with a satisfactory adaptation threshold value of not more than 2.10 points).

A similar trend was also found in the girls. The indicator of the adaptive capacity in the senior students of the control group gets worsened with each term during the academic year, and physical exercises performed by the girls of the experimental group improved this indicator from 2.21 ± 0.13 points in the 1st term to 1.95 ± 0.14 points in the 4th term.

At the same time, the mean group values of the indicator of the adaptation capacity shifted from the tension

of the adaptation mechanisms (threshold values 2.11-3.20 points) to the state of satisfactory adaptation (the threshold value is not more than 2.10 points).

The reliability of the differences between the groups was as follows: in the 1st term, $t = 0.64$, $p > 0.05$; in the 2nd one - $t = 2.45$, $p < 0.05$; in the 3rd one - $t = 4.04$, $p < 0.001$ and in the 4th one - $t = 4.89$, $p < 0.001$.

The value of the endurance coefficient as an integral value that combines the heart rate, systolic and diastolic pressure, determines the effectiveness of the cardiovascular system. If the normal endurance coefficient is 16, then its increase indicates a weakening of the cardiovascular system, while a decrease – its strengthening.

According to the results of the pedagogical experiment, it was found that in the senior students of the control group the index of endurance coefficient during the academic year was almost at the same level (18.37 ± 1.25 - 18.60 ± 1.58 conventional units). During the year, the boys of the experimental group had positive dynamics from 18.60 ± 1.54 to 15.45 ± 1.67 conv. units, indicating an increase in the wellness of the cardiovascular system. Beginning with the third term, a significant difference was observed between the parameters of the control and experimental groups of the respondents ($t = 3.46$, $p < 0.01$ in the third term and $t = 4.83$, $p < 0.001$ in the fourth term).

In the girls of the control group, the index of endurance during the year tended to improve (22.43 ± 1.34 units in the first term - 18.83 ± 1.54 units in the fourth term, respectively), remaining at the level above the line. The training effect of physical education lessons at school was more pronounced in the girls of the experimental group, where this indicator during the year decreased from 22.70 ± 1.42 to 15.77 ± 1.43 conv. units. The reliability of differences between the groups during the school year was as follows: in the 1st term, $t = 0.47$, $p > 0.05$; in the 2nd term, $t = 1.26$, $p > 0.05$; in the 3rd one, $t = 3.15$, $p < 0.01$ and in the 4th one - $t = 5.01$, $p < 0.001$.

Since the values of the endurance coefficient (EC) are normally 12-16 conv. units, then the shift above the line indicates a decrease in the activity of the cardiovascular system, and below – its fatigue. Therefore, in the students of the control group, there is a weakening of the activity of the cardiovascular system, which cannot be corrected by the physical loads used during the school year.

The index of basal metabolism is one of the indicators of the intensity of metabolism and energy in the body and is expressed by the amount of energy necessary to maintain life in a state of complete physical and mental rest, on an empty stomach, in conditions of thermal comfort.

As our studies have shown, in the boys of the control group, the percentage of the deviation of basal metabolism during the school year tends to slightly increase with each term from $11.12 \pm 2.14\%$ to $11.82 \pm 2.47\%$, while in the experimental group, this indicator significantly decreased from $11.86 \pm 2.19\%$ in the 1st term to $3.42 \pm 2.59\%$ in the 4th term. The reliability of the difference between the groups was $t = 0.85$, $p > 0.05$; $t = 2.22$, $p < 0.05$; $t = 5.75$, $p < 0.001$ and $t = 8.28$, $p < 0.001$ in the 1st, 2nd, 3rd, and 4th terms, respectively.

In the girls of the control group, this indicator also tended to increase during the academic year ($10.78 \pm 2.15\%$ in the 1st term, $11.24 \pm 2.18\%$ in the 2nd term, $11.95 \pm 2.26\%$ in the 3rd term, and $12.61 \pm 2.21\%$ in the

4th term, respectively), while in the respondents of the experimental group the percentage of the deviation of the basal metabolism significantly decreased by the end of the school year. The indicator of reliability of differences between groups was in the 1st term $t = 0.84$, $p > 0.05$; in the 2nd one - $t = 1.18$, $p > 0.05$; in the 3rd one - $t = 3.86$, $p < 0.001$ and in the 4th one - $t = 6.88$, $p < 0.001$.

Since the calculation of the percentage deviation from the basic metabolism according to Reed's formula is based on the relationship between blood pressure, heart rate and body thermogenesis, lower basal metabolic rates in the experimental groups are indicative of the economization of the body functioning.

Conclusions

1. The dynamics of adaptive capabilities of senior school students during the school year is influenced by a complex of factors, among which the leading ones are living in unfavorable radiation conditions and the level of their motor activity.

2. Not only low but also high physical loads are unfavorable for the organism of school students, causing a decline in their reserve capacities and tension of the adaptation mechanisms. A satisfactory degree of adaptation at the end of the school year was noted in the respondents with an average and above average levels of motor activity, while the students with levels of motor activity below average and high by the end of the school year were characterized by tension of the adaptation mechanisms and the unsatisfactory level of adaptation.

The designed technique the physical education of senior school students living in unfavorable radiation conditions based on the use of fitness aerobics complexes in the variable part of the school lesson, purposefully affecting the functional systems of the organism, contributed to the positive dynamics of the development of adaptive processes, body resistance increase, and, as a result, the decrease of negative influence of adverse radiation factors.

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КОРЕКЦІЯ ФІЗИЧНОГО СТАНУ СТАРШОКЛАСНИКІВ, ЯКІ ПРОЖИВАЮТЬ В ЕКОРАДІАЦІЙНИХ УМОВАХ

Погіршення екологічних умов середовища проживання актуалізувало проблему збереження і зміцнення здоров'я людей. Найбільше значення це має для дітей і підлітків, які складають перспективне майбутнє кожної нації. Метою дослідження є вивчення адаптаційних можливостей в залежності від рівня рухової активності старшокласників, які проживають в умовах впливу несприятливих радіоекологічних чинників, а також можливості їх корекції з використанням засобів оздоровчої фізичної культури. Результати дослідження свідчать, що оздоровчий ефект підвищеної рухової активності не завжди є позитивним і залежить від багатьох факторів. Не тільки низькі, але і підвищені фізичні навантаження не є адекватними для організму старшокласників, сприяючи напруженню адаптаційних механізмів і зниженню функціональних можливостей. Проведений моніторинг виявив задовільну ступінь адаптації лише у старшокласників із середнім і вище середнього рівнями рухової активності. Разом з тим у школярів у групі з руховою активністю нижче середнього відзначається напруження механізмів адаптації, а в учнів старших класів з високою руховою активністю виявлено незадовільний рівень адаптації. Проведений педагогічний експеримент показав, що раціонально організовані заняття фізичними вправами у загальноосвітній школі є дієвим засобом підвищення адаптаційних можливостей організму учнів і профілактики захворювань. У той же час при плануванні та організації уроків з фізичної культури в школі слід ураховувати поточний стан школярів та індивідуальні особливості адаптації до фізичних навантажень, що дозволить максимально ефективно реалізовувати оздоровчий ефект занять. Використання оздоровчих засобів фізичної культури для учнів старших класів дозволило сформулювати високий рівень адаптаційних можливостей і підвищити неспецифічну резистентність організму, що, як наслідок, сприятиме зниженню негативного впливу несприятливих екорадіаційних факторів.

Ключові слова: адаптаційні можливості, учні старших класів, несприятливі екорадіаційні умови, оздоровча фізична культура.

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