ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

The Importance of Biological Age in The Control System of Training Process of Young Men in Powerlifting.

Vitaliy Nikolaevich Avsiyevich[1]*, Georgiy Andreevich Plakhuta[1], and Alexander Ivanovich Fyodorov[2].

[1]Kazakh Academy of Sports and Tourism Kazakhstan, 050022, Almaty, Baityrsynova Street, 105
[2]South Ural State University (national research university), Institute of Sport, Tourism and Service Russia, 454080, Chelyabinsk, prospect Lenin, 76

ABSTRACT

For the first time was developed a science-based methodology for managing the training process of young athletes in powerlifting considering the pace of biological development of the organism. The proposed new approach to the management of the training process and methodology of strength training in boys powerlifting taking into account age peculiarities of young athletes on the basis of: dynamics and interactions of morphofunctional indices and sports performance of boys involved in powerlifting given the pace of biological evolution.The theoretical significance of the work is related to the scientific substantiation of methods of management by training process of young men in powerlifting the essence of which is to revise the traditional ideas about the system of strength training based on age characteristics of the organism of young athletes depending on the pace of biological evolution. The rate of development of age-related physiological changes in the body is associated with the impact of trainingload in powerlifting and is influenced by the pace of biological development of boys.Application of the methods of management of the training process which are based on a scientifically based program of exercises and the author's method of training of young men that are involved in powerlifting will allow coaches to optimize the training process and prepare high-class athletes without compromising the health of young athletes.

Keywords: Biological age, powerlifting, management of the training process, young men, morpho-functional indicators.

Corresponding author

ISSN: 0975-8585

INTRODUCTION

Among the whole variety of factors of training activities that lead to deviations in the health of athletes, leading to the development of virtually all of the violations - is a factor of sports specialization, which determines the localization of pathological changes in the athlete's body and affects the clinical course and duration of a disease (injury). That should be taken into account in a developing of health protection measures direction in the course of many years of training athletes in the chosen sport [5].

The preservation of health, increasing of level of functionality, as well as raising the level of general physical training of young men should be a priority in the control system of training process in powerlifting, which will allow not only to prepare high-class athletes, but also will ensure their long stay in the sports activities.

The relevance of the research topic is due to the fact thatthe young men who are involved in powerlifting have theultimate load on themusculoskeletal system during the trainingprocess, whichis often accompanied by trauma. The effects of trauma accumulatingin the body are dangerousin the medium term witha significant deterioration in the healthof young athletes.

The functional status of young athletes depends not only on age-related changes, but also on the training load, therefore, the principal point in the management of sports training is the problem of determining an optimal amount of power loads, adequate physiological capacity of the body of a young athlete, in other words, the choice for a certain biological condition of athlete loads which gives the greatest training effect to achieve highly competitive results and at the time not making a harm to the health.

Till now, however, scientific and methodical training process in boys powerlifting is still under study and revision. Most coaches simply tolerate mechanical principles and methods of elite athletes training in order to build training process of young athletes.In this way are not evaluated the main physiological components of training of young athletes to the training and competition loads, functionalabilityof cardio-respiratory and musculoskeletal systems, those main systems of the body that are most susceptible to overtraining and, to a large extent respond to excessive load in powerlifting.

Determination of the biological age, in conjunction with indicators of a physical development can accurately determine the level of functionality of the main systems of a growing organism and to what extent - its health. Health problems in schoolchildren related to the acceleration or delay of a physical development usually have a functional nature. In pupils with an average physical development are rarely observed disorders of the cardiovascular system that should be considered as a result of the inadequacy of the proposed physical activity level of a physical development [2].

Information on the biologicaldevelopmentof the athletecan be used for:1) objective evaluation of data, testing, andlevel of sportsachievements;2) probabilistic simulation ofthe dynamics of changes insomaticparameters,body typeand correspondingphysiological parameters; 3)predicting futuregrowth trends, metrics andinfluencingtheir criteriaof sport success; 4)future planning and programming of the trainingprocess on the basis ofknowledge of the lawsof ontogenesisand peculiarities ofbiological development[6].

For each period of age development are characteristic theonly peculiar anthropometric data and biochemical processes, which necessarily affect its functionality, changes the chronological data of physiological processes, and accordingly the methodological approaches of the system of training process control should be changed. The effectiveness of these methodological approaches is associated with two fundamental characteristics: morphological and functional features of boys and the processes of biological development of the organism. In other words, the basis for management of the training process should be based on the functional characteristics and assessment of the biological development of the organism of young athletes at this age.

Among the young men who are involved in powerlifting, the training process is characterized with theultimate load on the musculoskeletal system during the training process, which is often accompanied by microtrauma. The effects of trauma accumulatingin the body are dangerousin the medium term witha significant deterioration in the healthof young athletes.

ISSN: 0975-8585

For the young men involved in powerlifting it is necessary to develop sparing methods of a training process control,involving the reduction of ultimate loads on the musculoskeletal system with age-appropriate and the pace of biological maturation of the organism of young athletes.

In the method of training of young men especially in the initial phase, when the athlete's body is not yet fully developed physiologically, it is unacceptable to focus on specialization. The training process should be organized in such a way that the ratio of a general physical training (GPT) and a special physical training (SPT) was in the equal proportions and allowed to develop strength training without compromising the physiological development of the organism.

THE PURPOSE OF THE WORK

To develop and test experimentally the effectiveness of methods of management of a training process of young men involved in powerlifting, taking into the consideration the pace of biological maturation of the organism to optimize the training of young sportsmen.

METHODS

For scientific and experimental substantiation of the effectiveness of the developed technique of management of a training process of young men involved in powerlifting with considering of age characteristics and a rate of biological maturation of the organism, was held the primary (forming) part of the experiment, which was attended by the control group (CG) and experimental group (EG). The subjects in the EG and the CG had the common experience of a variety of powerlifting from 10 to 12 months. CG consisted of 21 people, the EG consisted of 27 people. The groups were formed in a full compliance with the procedures of randomization for mandatory standardization of terms and statistical parameters measurements of the studied parameters. The composition of groups did not change throughout the experiment.

Before beginning the experiment all the subjects (CG and EG) had passed a qualified medical examination, and as a result there were not found any contraindications for the practice of powerlifting among the young men.

The training lessons in the EG and the CG were held in the sports complex (a gym with a weightlifting platform, athletics arena, gymnasium). The measurements were carried out using the same tool at the same time.

Subjects in the CG were trained by the conventional method, and had a total volume of the training load - 330 hours per year (80 hours – GPT, 250 hours – SPT), there was not any separating of boys according to the biological age within the group [3].

In the EG was applied a unique developed technique [1], and was also taken into account the requirements and recommendations of some leading world`s scientists [8-12]. Load distribution according to the types of biological development is presented in tables 1-3.

Table 1 - Load distribution according to the types of biological development in competitive exercises

Competitive exercises	Load distribution according to the types of biological development of the total number of competitive exercises (%)		
	accelerants	mediants	retardants
Squat	40	30	25
Benchpress	30	35	50
Deadlifts	30	35	25

ISSN: 0975-8585

Table 2 – Distribution of physical loads in accordance with the types of biological development of boys.

The form of a physical load		Typeof biological development		
		accelerants	mediants	retardants
		Volume of a load (h)		
GPT 50%	The development of a common high-speed abilities	29	27	17
	The general development of speed-strength abilities	32	40	20
	The development of a common proper-strength abilities	35	29	40
	Development of generalendurance	24	20	14
	Development of coordinationskills	24	22	24
	The development of flexibility of musculoskeletal system	16	12	10
SPT 50%	Exercisesspeed-strengthcharacter	32	32	20
	Exercises to develop explosive power	32	32	20
	Exercises to develop proper strength abilities	30	32	25
	Exercisesspecialstrengthendurance	26	22	20
	Improvement of the technique of competitive exercises	24	22	25
	Stretching	16	10	15
Annual volume of training load (h)		320	300	250

Table 3 – Distribution of physical loads in accordance with the types of biological development of boys in the section of GPT

Exercise	Type of biological development		
	accelerants	mediants	retardants
The runto 60 m	3 times a week	2 times a week	1 time a week
A jump	1 time a week	2 times a week	1 time a week
Shuttlerun 4×9 m	2 times a week	1 time a week	1 time a week
Running on 1000 m	1 time a week	1 time every 2 weeks	-
Running on 500 m	1 time a week	1 time a week	1 time every 2 weeks
Pulling up on high bar	At each training session, 3 sets at maximum reps	At each training session, 2 sets at maximum reps	Every other training session, 3 sets at maximum reps
Bending extension of hands in the emphasis	At each training session, 3 sets at maximum reps	At each training session, 2 sets at maximum reps	Every other training session, 2 sets at maximum reps
The rise of the legsina hanging position	At each training session, 5 sets at maximum reps	At each training session, 4 sets at maximum reps	At each training session, 3 sets at maximum reps

Training for the development of GPT in the developed technique is not identified in a separate training session and is implemented during the main lesson time, which is aimed at the development of strength abilities.The methodology includes general developmental exercises and exercises from athletics.

In the study we used the following methods:

Determination of the biological age was carried out in terms of a somatoscopeby method of Timakova T. S. (table 4) [7].

Table 4 – Scheme of estimation of the biological age of the athletes during the period of pubertal development

Phase	Score	Characterization of biologicalage
Prepubertal	1	Minor changes to the appearance of the genitals because of the increased subcutaneous fat
	2	Change of the color and the increasingof testicles of the scrotum, penis size, and the areola, their weak swelling, the appearance of individual hairs in the pubic area and the pace of growth processes

	3	The first change of the voice, swelling of the nipple, a noticeable growth of the penis in the length, the appearance of straight hair around the penis, acceleration of body growth in length
Actually-pubertal	4	Pigmentation of the nipple, curly pubic hair, development of cartilage, minor hair in the armpit, a further change of voice, the peak of the growth processes is passed
	5	The appearance of individual hairs in the corners of the upper lip. Pilosis of the pubis in the form of a triangle, the transition of the hairline to the hip, and protrusion of the thyroid cartilage, increased body hair growth in the armpit, the first wet dreams
	6	A weak hair on the cheeks, the rare curly hair in the armpit, hair on the lower limbs, pigmentation of the scrotum, growth of bone and muscle mass
Postpubertal	7	The appearance of multiple hair on the chin, need of a shaving (1-2 times per month), multiple curling hair in armpit, hair on the line of the abdomen, secondary swelling of the nipple
	8	Cessation of body growth in length, development of Adam's Apple, increased pigmentation of the anterior wall of the armpit and the nipple, the appearance of hair on the chest and around the nipple, frequent shaving of the hair on the beard (1-2 times per week)
	9	The sight of an adult man

The complex of methods of medical-pedagogical testing and a control was applied on the basis of the index of the functional condition of athlete (IFCA) which normally is from 3.9 to 7.1 (which indicates an adequate portability load). If IFCA will be higher by 7.1, it suggests a poor level of preparedness of the athlete, or of the excessive loads, overloads, increased excitability of the autonomic nervous system, which means that the load must be reduced during the training and should bepaidattention to the technical and physical components of the athlete.If IFCAis below 3.9, it indicates to the athlete physical illness, or serious impairment of the autonomic nervous system, which should lead to the cessation of training and an additional examination of the athlete [4].

Table 5 presentsthe range of IFCA which corresponds tothe functionalnormsof a healthy person:

Table 5 - Bounds of indexIFCA, corresponding to the functional norms of a healthy person(in points).

№	The name of the sample	The lower bound (in points)	The upper limit (in points)	The total index(in points)
1	Orthostatic test	0,8	1,2	0,8-1,2
2	Clinostatic test	0,4	1,2	0,4-1,2
3	Oculo-cardiactest	0,5	1,2	0,5-1,2
4	Dalsky`s test	1,2	1,5	1,2-1,5
5	The systoliccomponentof blood pressure	1,0	2,0	1,0-2,0
S (amount of points)	IFCA	3,9	7,1	3,9-7,1

The definition of the relationship (correlation) between the power indices of young men according to the sum of three exercises and the basic morphological and functional parameters were determined according to the formula:

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}, \qquad (1)$$

where:
r – the correlation coefficient;
x – the value of one variable;
y – anothervariable;
n - the number of subjects in the group.

If the value r is in the range from 0 to 0.3 the degree of correlation is weak, from 0.3 to 0.7 – is medium, from 0.7 to 1.0 - is high.

THE RESULTS AND DISCUSSION

Even at the initial stage of the training process the accounting data on the functional state of various physiological systems of the organism of boys depending on the rate of biological development allows to determine the adequacy and a potential impact and a further correction of training loads during strength training in powerlifting.

At different rates of biological development, young men specializing in powerlifting are determined by different anthropometric data and medical biological indicators of physiological body systems, by the power and speed-power indicators, different levels of general and special endurance, and by flexibility and coordination abilities.This should be considered in the training process and in the selection of particular types of strength exercises, defining the volume and intensity of physical activity in the general physical and special training. The management of the training process and the practical implementation of the training plans are recommended to carry on with considering of the established facts of the relationship dynamics of morphological and functional (physiological) indicators of young athletes involved in powerlifting with the pace of biological evolution. This factor should also be taken into account during the selection of athletes.

In determining the rate of biological evolution in the beginning of the experiment among the subjects of the EG and the CG the results are presented in table 6: among the 48 people - 14.5% of boys were identified as accelerants, 68.8% as the mediants and 16.7% as retardants. The overall ratio of the detected acceleration and of retardation in the groups is close to the mathematical values.

Table 6 - The level of biological maturation of young men involved in powerlifting in the CG and the EG (n=48)

Number of subjects (n)	Biological age (points)	Classification of biological evolution
7	3-4	acceleration
33	5-6	norm
8	7-8	retardation

In determining the correlation (relationship between the strength in the three competitive exercises and morpho-functional indicators of boys) was revealed the following (table 7):

1. Strength indicators in the sum of those exercises have a close positive relationship with indicators of chest excursion, systolic blood volume, a special physical working capacity and indices of special power of endurance, both in the CG and in the EG. In the EG was noted the close positive relationship between physical performance and lung capacity. In the CG was noted a close positive relationship between physical performance and chest circumference as well as a maximum lung ventilation.
2. Strength indicators in the amount of three exercises in the CG and the EG have an average correlation with indicators of body mass, maximum oxygen consumption, cardiac output, indicators of strain gauges (on the strength of the shoulder extensors and the hip flexors). The average correlation in CG was characteristic for such indicators as the vital capacity (VC), in the experimental group – for chest circumference (CC) and the maximum ventilation of lungs (MVL).
3. Weak relationship in the CG and the EG was noted between the strength indicators and indicators of a general physical capacity(PWC_{170} test).
4. Was not revealed any positive relationship between growth, body mass index, heart rate and power figures for the sum of three exercises.

Table 7 - Determination of the correlation between the power indices of young menby the sum of three exercises and the basic morpho-functional characteristics of the CG and the EG

Indicators	CG(r)	EG(r)	P
Height (cm)	-0,2	-0,25	<0,05
Bodyweight (kg)	0,39	0,30	<0,05
The bodymassindex	-0,12	-0,10	<0,05

Vitalcapacity (l)	0,69	0,70	<0,05
Chestcircumference (cm)	0,71	0,67	<0,05
Excursion of the chest (cm)	0,72	0,70	<0,05
Maximumventilation (l/min)	0,70	0,66	<0,05
Heartrate, (beats/min)	-0,20	-0,27	<0,05
Systolic volume of blood (ml)	0,73	0,71	<0,05
Minute volume of blood (l)	0,60	0,51	<0,05
Maximum oxygen consumption (ml/min/kg)	0,52	0,59	<0,05
Indicators of overall physical performance (test PWC_{170})	0,23	0,28	<0,05
Indicators of special physical working capacity	0, 85	0,88	<0,05
Indicators of straingauges	0,47	0,50	<0,05
Indicators of special strength endurance.	0,86	0,89	<0,05

The obtained data indicate that it is necessary to take into account the biological age of young athletes in the organization of management of training process in powerlifting. Athletes in different rates of biological maturation have different levels of morphological and functional indicators of the organism.

The results of the obtained experiment showed the following data presented in table 8:

In the beginning of the experiment performance in competitive exercises in subjects from the EG and the CG there were no statistically differences.

Before the beginning of the experiment the average value in the squat with barbell on shoulders (exercise, which characterize the strength development of the leg muscles) in the EG was equal to 130.1 kg and in the CG - 130,5 kg, ie the results are almost identical. At the end of the experiment the increase in the average values of EG reached the level of 158.0 kg (27.9 kg - 21,4%), in the CG - of 138,1 kg (7.6 kg and 5.8%). In average the strength values in the squat with a barbell on the shoulders in the EG increased by 27.9 kg for the period of the experiment, which is a good indicator in many kind of sports, while in the CG, growth was only 7.6 kg. The difference between the CG and the EG in the squat with barbell on shoulders averaged to 20.3 kg ($P<0.05$).

Before the beginning of the experiment the mean value in a bench press in the EG was equal to 80.1 kg and in CG - 80,5 kg, ie the results were almost identical. Intermediate test revealed an increase in the average values in the EG to 90.5 kg (10.4 kg – 8%) in the CG to 85.1 kg (4.6 kg with 3.5%).At the end of the experiment the increase in the average values of the EG reached the level of 103.0 kg (22.9 kg – 17,6%), in the CG - of 88.1 kg (7.6 kg and 5.8%). Differences werestatistically significant ($P<0.01$). In average the strength values in the bench press in the EG have increased by 22.9 kg for the period of the experiment, while in the CG the growth was only 7.6 kg. The difference between the CG and the EG in the bench press in average was 15.3 kg - 11.8%.

In the deadlift the result in the EG at the beginning of the experiment was equal to 130.8 kg, in the CG kg -131,1. By the end of the experiment the increase in the average values of EG reached the level of 160,7 kg (29.9 kg 22,9%), in the CG - of 139.2 kg (8.1 kg at 6.2%). The result in the EG was higher than in the CG 21.7 kg. Differences were statistically significant ($P<0.05$).

As it can be seen from table 8, the results of the athletes of the EG in the amount of triathlon have grown from 341,0 kg at the beginning of the pedagogical experiment to 421,7 kg at the end of the experiment. In athletes of the CG the results in the amount of triathlon have grown from 342,1 kg to 365,4 kg. Growth of a result in the EG exceeded the growth of the result in the CG by 56.3 kg (15.4 per cent). The differences between the groups in the increase of results in all the control exercises and the triathlon were statistically significant ($P< 0.05$).

ISSN: 0975-8585

Table 8 - Indicators of the competitive level of athletes CG (n=21) and the EG (n=27) during the pedagogical experiment

The control exercise (kg) / accuracy	Groups	Before the experiment		After the experiment	
		$\bar{X}$	S	$\bar{X}$	S
Squat (kg)	CG	130,5	8,5	138,1	8,1
	EG	130,1	8,3	158,0	8,0
Benchpress (kg)	CG	80,5	5,4	88,1	5,7
	EG	80,1	5,5	103,0	5,1
Deadlifts (kg)	CG	131,1	8,6	139,2	8,5
	EG	130,8	8,8	160,7	8,4
The sum of the triathlon (kg)	CG	342,1	22,5	365,4	22,3
	EG	341,0	22,6	421,7	21,5
P	<0,05				

Indicators of medical–pedagogical testing in the CG and EG before and after the experiment we mapped in a quantitative form in table 9 and 10, and in a graphical form in figure 1.

Table 9 - Indicators of medical-pedagogical testing of athletes of the CG and the EG at the beginning of the experiment

№	Test	n	Groups	$\bar{X}$	S	P
1	Orthostatic test	21	CG	1,37	0,03	< 0,05
		27	EG	1,36	0,04	
2	Clinostatic test	21	CG	1,30	0,03	
		27	EG	1,27	0,05	
3	Oculo-cardiactest	21	CG	0,80	0,03	
		27	EG	0,84	0,05	
4	Dalsky`s test	21	CG	1,14	0,07	
		27	EG	1,15	0,08	
5	Arterial pressure	21	CG	3,0	0,08	
		27	EG	2,94	0,13	
6	IFCA	21	CG	7,62	0,12	
		27	EG	7,53	0,16	

Table 10 - Indicators of medical-pedagogical testing of athletes of the CG and the EG after the experiment

№	Test	n	Groups	$\bar{X}$	S	P
1	Orthostatic test	21	CG	1,42	0,03	< 0,05
		27	EG	0,98	0,02	
2	Clinostatic test	21	CG	1,38	0,03	
		27	EG	0,87	0,04	
3	Oculo-cardiactest	21	CG	0,82	0,03	
		27	EG	0,78	0,05	
4	Dalsky`s test	21	CG	1,14	0,07	
		27	EG	1,29	0,05	
5	Arterial pressure	21	CG	3,0	0,08	
		27	EG	1,57	0,11	
6	IFCA	21	CG	7,76	0,12	
		27	EG	5,46	0,17	

ISSN: 0975-8585

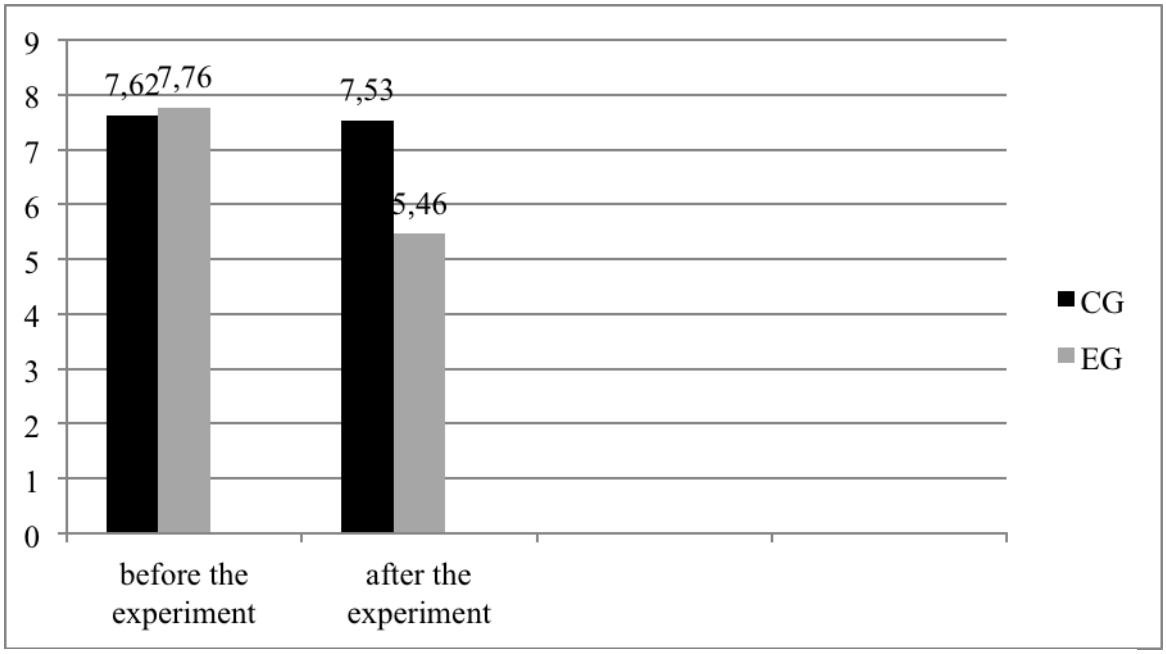

Figure 1 - Differences of IFCAin the CG and the EG

During the experiment it was revealed that the powerlifters in the CG (which athletes trained without taking into account the rate of biological age) didn't have the necessary adaptive changes of an organism in response to intense power loads, and because of their impact the IFCA was outside the range of normal (normal, IFCA = 3.9 to 7.1 points), corresponding to physiological data of the athlete with a normal level of health. The decline in functional status of athletes in CG was statistically significant ($P<0.05$).

Dynamics of changes of aggregate data of IFCA in the EG (up to 5.46 points), indicating a fairly high positive efficiency effects on functional data of organism of young athletes by the developed technique aimed for the development of strength abilities considering to the biological development.

At different rates of biological development, young men specializing in powerlifting are determined by different anthropometric data and medical biological indicators of the physiological systems of the body, actually-power and speed-power indicators, different levels of general and special endurance, flexibility and coordination abilities. That should be considered in the training process and the selection of particular types of strength exercises, defining the volume and intensity of physical activity in general physical and special training.The management of the training process and the practical implementation of the training plans are recommended to be consistent with the established facts of the relationship dynamics of morphological and functional (physiological) indicators of young athletes involved in powerlifting with the pace of biological evolution. This factor should also be taken into account during the selection of athletes.

The rate of development of age-related physiological changes in the body is associated with the impact of training load in powerlifting and is influenced by the pace of biological development of boys.

CONCLUSIONS

After using and testing our developed methodology we can conclude that the athletes of EG, who adopted it, showed a significantly higher result in a comparison to the CG. The result of the triathlon in the experimental group was higher than in the control group on 56.3 kg (15,4%), with a reliable significance level ($P<0.05$).

The developed method was implemented in the process of training of the Kazakhstan Federation of powerlifting, the effectiveness of this method was confirmed by the results at the World Championships, the WPC 2015 in Portugal, Litvinov K. (1 place for the sum of three exercises - of 342.5 kg in the weight category up

to 52,0 kg, age group 13-15 years) and Masoy A. (1 place for the sum of three exercises – of 350.0 kg in the weight category up to 67.5 kg, age group 16-17 years). These athletes were trained according to the developed methodology.

High efficiency of the developed methodical system of development of strength abilities in boys confirms the hypothesis of our study. The value of biological age considering in the control system of training process in powerlifting is confirmed by the substantial increase in the level of strength abilities of boys and results in competitive exercises.The obtained results of this study can be used in strength training of boys of different variants of biological development in powerlifting, weightlifting and other power sports, as a basis for training high-class athletes.

A developed techniqueincludes specific training parameters in all three competitive powerlifting exercises for each rate of biological age is more effective compared to traditional methods of training of young athletes and significantly reduces the risk of injury to the musculoskeletal system.

REFERENCES

[1] Avsiyevich, V. N. The management of the training process of young men involved in powerlifting, on the basis of biological age: study guide / V. N. Avsiyevich. — Kazan: Publishing house "Book", 2016. — p.100

[2] Akhaladze N. G. Biological age in the quantitative assessment of the effectiveness of health activity // Biological age: theses of reports. — Perm, 2000. — P. 6-7.

[3] Bychkov A. N. The program for youth sports schools, specialized children-youth schools of Olympic reserve and schools of the highest sports skill // Powerlifting: training manual. - M., 2005. - P. 323-366

[4] Dalsky, D. D., Zverev V. D.,Naumenko, E. V., Nesmeyanov A. A., Orlov V. A. Taymazov V. A., Fudin N. A., Khadartzev A. A. Physiological powerlifting: Monograph / edited by V. A. Taymazov's, AA Hadarcev – Tula: Tulsky poligrafist, 2013.– P.120.

[5] Koryagin, V. M. Athlete Health: theoretical preconditions of formation of health saving direction in the process of long-term preparation // Theory and methods of physical culture. - 2014. - No. 4. – P. 24-32.

[6] TimakovaT. S.Once more aboutbiological age// Bulletin ofsports science. – 2008. - No. 4.– P.55-60

[7] TimakovaT. S. Training of young swimmersin the aspectsof ontogenesis(textbook).– M.: "Similiya", 2006. – P.132.

[8] Baker D., Mitchell J., Boyle D., Currell S., Wilson G., Bird S.P., O'Connor D. , Jones J.Resistance training for children and youth: a position stand from the Australian Strength and Conditioning Association // ASCA. – 2007 // http:www.strengthandconditioning.org.

[9] Lloyd R.S., Faigenbaum A.D., Stone M.H., Oliver J.L., Jeffreys I., Moody J., Brewer C., Pierce K.UKSCA Position Statement: Youth Resistance Training. – 2012, summer. - Issue 26. - P. 26-39.

[10] Faigenbaum A.D., Kraemer W.J., Cameron J. R. Blimkie C.J.R., Jeffreys I., Micheli L.J., Nitka M., Rowland T.W. Youth Resistance Training: Updated Position Statement Paper From the National Strength and Conditioning Association (NSCA) // Journal of Strength and Conditioning Research. - 2009. - №23,supplement 5. - P. 60-79.

[11] Faigenbaum A.D., Myer G.D. Resistance training among young athletes: Safety, efficacy and injury prevention effects // British Journal of Sports Medicine. – 2010. - № 44. - P. 56-63.

[12] Faigenbaum A.D., Milliken L., Moulton L., Westcott W.L. Early muscular fitness adaptations in children in response to two different resistance training regimens // Pediatric Exercise Science. - 2005. - №17. - P. 237-248.