

Dynamics of the Functional State of Students in the Process of Powerlifting in Higher Education

 Valeriy Zhamardiy¹,  Olena Shkola²,  Olena Otravenko³,  Olena Momot⁴,  Mariia Andrieieva⁵,  Olena Andrieieva⁶,  Vasyl Mudryk⁷,  Viktor Slusarev⁸,  Halyna Broslavska⁹ and  Galina Putiatina¹⁰

¹Ph.D. in Pedagogics, Associate Professor of the Department of Physical Education and Health, Physical Therapy, Ergotherapy with Sports Medicine and Physical Rehabilitation, Ukrainian Medical Stomatological Academy, Poltava, Ukraine.

²Ph.D. in Pedagogics, Associate Professor, Head of the Department of Physical Education, Municipal Establishment «Kharkiv Humanitarian Pedagogical Academy» of Kharkiv Regional Council, Kharkiv, Ukraine.

³Ph.D. in Pedagogics, Associate Professor, Associate Professor of the Department of Theory and Methodology of Physical Education, Luhansk Taras Shevchenko National University, Starobilsk, Ukraine.

⁴Doctor of Pedagogical Sciences, Associate Professor of the Department of Theoretical and Methodological Fundamentals of Teaching Sports Disciplines, Poltava V. G. Korolenko National Pedagogical University, Poltava, Ukraine.

⁵Ph.D. in Pedagogics, Professor of the Department of Social Work, Municipal Establishment «Kharkiv Humanitarian Pedagogical Academy» of Kharkiv Regional Council, Kharkiv, Ukraine.

⁶Associate Professor of the Department of Clinical Pharmacology and Clinical Pharmacy, National University of Pharmacy, Kharkiv, Ukraine.

⁷Ph.D. in Pedagogics, Professor, Professor of the Department of Theory and Methods of Physical Education, Municipal Establishment «Kharkiv Humanitarian Pedagogical Academy» of Kharkiv Regional Council, Kharkiv, Ukraine.

⁸Ph.D. in Biological Sciences, Associate Professor, Associate Professor of Theory and Methods of Physical Education, Municipal Establishment «Kharkiv Humanitarian Pedagogical Academy» of Kharkiv Regional Council, Kharkiv, Ukraine.

⁹PhD in Pedagogics, Senior Lecturer at the Department of Mathematics and Physics, Municipal Establishment «Kharkiv Humanitarian Pedagogical Academy» of Kharkiv Regional Council, Kharkiv, Ukraine.

¹⁰PhD in Physical Education and Sport, Associate Professor, Vice-Rector for Scientific and Pedagogical Work, Kharkiv State Academy of Physical Culture, Kharkiv, Ukraine.

Abstract

The article defines the dynamics of the functional state of students after implementation of methods of special skills and abilities formation during powerlifting classes. It was found that one of the most important tasks of physical education in higher education is the creation of the most favorable, optimal conditions for the harmonious and spiritual development of each student, preservation of student's health, development of necessary theoretical knowledge, formation of special skills and abilities, maintenance and development of functional capabilities of the organism. We have studied that the formation of a responsible attitude of students to their health is associated with many aspects of the educational process. We have identified that one of the main ways is to cultivate positive, sustainable and effective cognitive interests and students' understanding of the importance of a healthy lifestyle provided in powerlifting classes.

Keywords: methods, powerlifting, students, physical fitness, physical education.

1. Introduction

Today, society needs from future specialists in physical education not only strong theoretical knowledge, but also practical skills and special abilities, a high level of psychophysical training and professional ability to work, increased physical reserve and functional capabilities of the body, the desire to achieve the goal, harmonious and spiritual development. They are necessary for timely adaptation to rapidly changing conditions of the working and external environment. Based on the requirements of legal documents relating to the training of future professionals, the educational process of physical education should be aimed at improving health, improvement of motor skills, as well as increase in the level of physical fitness of student youth.

Physical education and physical activity in daily activities are carried out on the basis of individual characteristics and needs of each student. The formation of beliefs in the need to involve students in regular physical education and mass sports is of paramount importance. The content and scope of relevant classes is



determined by the curriculum, scientifically sound guidelines, taking into account the nature of physical activity in professional activities and education. Powerlifting is one of the top priority types of physical activity within the framework of physical education classes. Powerlifting classes promote good health, increase efficiency, display and develop students' strength skills. The arsenal of tools and many years of accumulated experience of coaches and outstanding athletes in powerlifting are not used in the educational process of physical education.

2. Materials and Methods

The aim of the study is to determine the dynamics of students' body functional state after the introduction of methods of forming special skills and abilities in the process of powerlifting.

General scientific and special research methods were used to achieve the set goal and solve the problems, interconnected and consistently applied throughout the study: *theoretical (for the formation of theoretical and methodological foundations of the study)*: analysis and generalization of philosophical, sociological, psychological, pedagogical, valeological literature; study of educational programs; regulatory and legislative documents; methodical recommendations and textbooks on psychological and pedagogical disciplines; study of the experience of physical education departments in the development of powerlifting in higher education institutions; *empirical (to determine the general health of students)*: methods of collecting information (questionnaires, surveys, pedagogical testing and observation of students' educational and training activities), analysis of learning outcomes, interviews, methods of expert assessments, self-assessment, generalization of independent characteristics; *experimental (for the analysis of the basic ways of research of complex indicators)*: ascertaining, formative, control stages of pedagogical experiment using the Diary of physical self-improvement in powerlifting, visual aids; *statistical (to assess the statistical significance of differences in the status and dynamics of changes in health indices)*: descriptive statistics, determination of statistical significance of differences between groups by the Student's method and correlation analysis by the Pearson method.

The pedagogical experiment was carried out on the basis of Poltava National Pedagogical University named after V. G. Korolenko, which was attended by twelve study groups of students (a total of 294 people, including 161 - boys and 133 - girls) from historical, natural, psychological-pedagogical, physical-mathematical and philological faculties. All students were divided into control and experimental groups by the method of even distribution of groups. According to the schedule, physical education classes in all groups were held once or twice a week in the morning. Students of control groups were engaged in the curriculum for higher education institutions [12]. Students of experimental groups were engaged in the developed author's technique of formation of special abilities and skills in powerlifting. Training sessions, as part of compulsory and independent classes, were held three times a week in powerlifting and two classes, which included running and swimming. The duration of training sessions in groups was 90 minutes. The effectiveness of the proposed method was evaluated by the results of control tests. At the beginning of the school year (September), physical training tests were conducted and the level of special physical training in powerlifting in control and experimental groups was assessed. Control tests were conducted at the end of the school year (May-June). Students who dropped out of the experimental and control groups during their studies were not included in the statistical processing and were not replaced by others.

3. Results and Discussion

One of the most important aspects of management of long-term training in powerlifting is the system of complex control, which allows the coach-teacher to assess the level of physical and functional readiness of students, the correctness of the chosen direction of training, the dynamics of training and timely adjustments to the training process [1; 5; 6; 8; 10; 11; 20].

The methodological basis of comprehensive control consists from following: the correct choice of tests and their compliance with statistical reliability criteria, objectivity and informativeness; determining the optimal amount of indicators to assess the functional status and level of preparedness of students, its sufficiency, standardization of conditions and sources of information; compliance of control methods with testing tasks [12; 15; 16; 17; 18; 19; 21].

Important in the educational process of physical education is the accounting system, which characterizes its effectiveness. Accounting makes it possible to monitor the state of health, level of preparation of students, physical development, the dynamics of their sports results. Analysis of accounting



for quantitative and qualitative indicators allows the teacher not only to control the educational process of physical education, but also to actively intervene in it, adjust and improve it [2; 3; 4; 7; 9; 13; 14].

Training and extracurricular powerlifting classes with students of experimental groups E1, E2, E3 also contributed to the improvement of functional indicators (А что это за группы не понятно. In boys of the experimental group E1 there was a decrease in heart rate (HR) by 5,82 beats per minute (beats/min), and in the control group K1 by 3.38 beats/min, systolic blood pressure (sBP) decreased by 2.61 mm Hg, and in the control group K1 by 2.1 mm Hg, diastolic blood pressure (dBP) decreased by 2.66 mm Hg, and in the control group K1 by 1.99 mm Hg, hand muscle strength increased by 4.2 kg and 3.1 kg, respectively. Vital lung capacity (VLC) in boys of experimental group E1 improved by 189.9 ml, and in control group K1 by 132.78 ml, respectively. The changes in functional parameters of boys from the experimental E1 and control K1 groups were statistically significant at $p < 0.01-0.05$ (Tab. 1).

Table 1. Dynamics of the functional state of the body of boys with a high level of physical fitness during the period of pedagogical experiment (E1 - n=13; K1 - n=11)

Parameters	Group	Before the experiment	After the experiment	Changes for the year	Statistical significance	
		$\bar{X} \pm Sx$	$\bar{X} \pm Sx$	$\Delta \bar{X}$	t	P
HR, beats/min	E1	73.32±1.34	67.5±1.12	-5.82	1.98	<0.05
	K1	73.68±1.25	70.3±1.1	-3.38	1.63	>0.05
sBP, mm Hg	E1	127.3±1.2	124.69±1.35	-2.61	2.25	<0.05
	K1	128.2±0.78	126.1±0.93	-2.1	1.13	>0.05
dBP, mm Hg	E1	78.56±1.1	75.9±0.83	-2.66	2.31	<0.05
	K1	79.32±0.95	77.33±0.76	-1.99	1.10	>0.05
VLC, ml	E1	3795.4±82	3985.3±87	189.9	2.23	<0.05
	K1	3768.42±75	3901.2±70	132.78	1.69	>0.05
Hand muscle strength, kg	E1	41.5±0.5	45.7±0.6	4.2	2.84	<0.01
	K1	39.8±0.7	42.9±0.4	3.1	1.86	>0.05

Introduction of methods of formation of special abilities and skills of students in the educational process of physical education during powerlifting classes contributed to the improvement of functional indicators of the main body systems of girls in the experimental E1 and control K1 groups, which was statistically significant at $p < 0.01-0.05$. The similar data given in Table 2.

Table 2. Dynamics of the functional state of the body of girls with a high level of physical fitness during the period of pedagogical experiment (E1 - n=7; K1 - n=8)

Parameters	Group	Before the experiment	After the experiment	Changes for the year	Statistical significance	
		$\bar{X} \pm Sx$	$\bar{X} \pm Sx$	$\Delta \bar{X}$	t	P
HR, beats/min	E1	73.87±1.3	70.1±1.1	-3.77	2.18	<0.05
	K1	73.11±1.45	70.93±0.9	-2.18	1.79	>0.05
sBP, mm Hg	E1	124.7±1.34	122.12±1.2	-2.58	2.29	<0.05
	K1	125.2±1.5	123.9±1.1	-1.3	1.64	>0.05
dBP, mm Hg	E1	76.15±1.4	74.2±1.15	-1.95	2.43	<0.05
	K1	76.87±1.2	75.6±0.85	-1.27	1.72	>0.05
VLC, ml	E1	2675±68	2797±47.6	122.0	2.19	<0.05
	K1	2603±75.3	2694.1±52.4	91.1	1.67	>0.05
Hand muscle strength, kg	E1	36.1±0.6	38.43±0.72	2.33	2.36	<0.01
	K1	35.87±0.7	37.33±0.8	1.46	1.60	>0.05

In girls of the experimental group E1 there was a decrease in heart rate by 3.77 beats/min, and in the control group K1 by 2.18 beats/min, sBP decreased by 2.58 mm Hg, and in the control group K1 by 1.3 mm Hg, dBP lowered by 1.95 mm Hg, and in the control group K1 by 1.27 mm Hg, hand muscle strength increased by 2.33 kg and 1.46 kg, respectively. VLC in girls of the experimental group E1 improved by 122 ml, and in the control K1 by 91.1 ml, respectively.

Let us consider the dynamics of functional indicators in students of experimental E2 and control K2 groups. Heart rate in boys from the experimental group E2 decreased by 4.75 beats/min, from the control group K2 by 2.6 beats/min, sBP decreased by 3.0 mm Hg, and in the control group K2 by 2.2 mm Hg, dBP lowered by 2.7 mm Hg in group E2, and in the control group K2 by 2.0 mm Hg, VLC in boys from the experimental group E2 increased by 196.2 ml, and from the control group K2 by 133.1 ml, the strength of the muscles of the hand in the boys of the experimental group E2 increased by 4.3 kg, and the control group K2 by 3.2 kg, respectively, which was statistically significant at $p < 0.01-0.05$ (Tab. 3).

Table 3. Dynamics of the functional state of the body of boys with an average level of physical fitness during the period of pedagogical experiment (E2 - $n=25$; K2 - $n=27$)

Parameters	Group	Before the experiment	After the experiment	Changes for the year	Statistical significance	
		$\bar{X} \pm S_x$	$\bar{X} \pm S_x$	$\Delta \bar{X}$	t	P
HR, beats/min	E2	74.87±1.64	70.12±1.1	-4.75	2.47	<0.05
	K2	75.2±1.42	72.6±1.21	-2.6	1.81	>0.05
sBP, mm Hg	E2	123.7±0.58	120.7±0.3	-3.0	2.20	<0.05
	K2	124.2±0.63	122.0±0.53	-2.2	1.78	>0.05
dBP, mm Hg	E2	75.4±0.45	72.7±0.51	-2.7	2.39	<0.05
	K2	76.21±0.7	74.21±0.62	-2.0	1.99	>0.05
VLC, ml	E2	3711±58	3907.2±61	196.2	2.27	<0.05
	K2	3698±63	3831.1±49	133.1	1.87	>0.05
Hand muscle strength, kg	E2	37.2±0.88	41.5±0.75	4.3	2.43	<0.01
	K2	35.9±1.2	39.1±0.93	3.2	2.07	>0.05

Improvements in functional performance in girls of the experimental E2 and control K2 groups reflect significant changes in improving their functional readiness. Functional heart rate in girls of the experimental group E2 decreased by 3.32 beats/min, control group K2 by 2.25 beats/min, sBP decreased by 2.4 mm Hg, control group K2 by 1.4 mm Hg, dBP dropped by 1.7 mm Hg, control group K2 by 1.3 mm Hg, VLC of girls from the experimental group E2 increased by 132.4 ml, and in the control group K2 by 98.3 ml, the strength of the muscles of the hand in girls of the experimental group E2 increased by 2.65 kg, and in the control group K2 by 1.67 kg, respectively, which was statistically significant at $p < 0.01-0.05$ (Tab. 4).

The dynamics of improvement of functional parameters of students from experimental E3 and control K3 groups with low level of health and physical fitness showed that the boys from the experimental group E3 had a decrease in heart rate by 4.23 beats/min, and in the control group K3 by 2.08 beats/min, sBP decreased by 1.63 mm Hg, and in the control group K3 by 1.13 mm Hg, dBP lowered by 1.8 mm Hg, and in the control group K3 by 1.23 mm Hg, hand muscle strength increased by 3.1 kg and 2.8 kg, respectively. There was a statistically significant ($p < 0.05$) increase in the functional index of VLC in boys of the experimental group E3, in contrast to the control group K3. The VLC value in the boys of the experimental group E3 was 109 ml and the control group K3 79 ml, respectively (Tab. 5).

Table 4. Dynamics of the functional state of the body of girls with an average level of physical fitness during the period of pedagogical experiment (E2 – n=19; K2 – n=14)

Parameters	Group	Before the experiment	After the experiment	Changes for the year	Statistical significance	
		$\bar{X} \pm Sx$	$\bar{X} \pm Sx$	$\Delta \bar{X}$	t	P
HR, beats/min	E2	75.56±1.5	72.24±1.3	-3.32	2.33	<0.05
	K2	75.12±1.7	72.87±1.6	-2.25	1.76	>0.05
sBP, mm Hg	E2	123.1±0.91	120.7±1.2	-2.4	2.21	<0.05
	K2	123.4±0.85	122.0±0.76	-1.4	1.73	>0.05
dBP, mm Hg	E2	71.1±0.6	69.4±0.3	-1.7	2.19	<0.05
	K2	72.5±0.47	71.2±0.56	-1.3	1.82	>0.05
VLC, ml	E2	2511±36	2643.4±32	132.4	2.26	<0.05
	K2	2505±40	2603.3±33	98.3	1.73	>0.05
Hand muscle strength, kg	E2	24.2±0.84	26.85±0.6	2.65	2.29	<0.01
	K2	23.93±0.68	25.6±0.53	1.67	1.71	>0.05

The girls in the experimental group E3 had a decrease in heart rate by 2.52 beats/min, and in the control group K3 by 1.22 beats/min, sBP decreased by 1.5 mm Hg, and in the control group K3 by 0.96 mm Hg, dBP decreased by 1.2 mm Hg, and in the control group K3 by 0.94 mm Hg, hand muscle strength increased by 1.9 kg and 1.2 kg, respectively. There was a statistically significant ($p<0,05$) increase in the functional index of VLC in girls of the experimental group E3 (Tab. 6).

Taking into account anthropometric and functional indicators of students, the dynamics of indices of physical development of boys and girls of experimental E1, E2, E3 and control K1, K2, K3 groups was determined. Before the pedagogical experiment, the boys of the experimental group E1 mass-growth index (MGI) was 378.3 g/cm, and in the control group K1 it was 382.38 g/cm, and at the end of pedagogical experiment it was 375.49 g/cm in the boys of the experimental group E1 and 380.54 g/cm of the control group K1 (Tab. 7).

Table 5. Dynamics of the functional state of the body of boys with a low level of physical fitness during the period of pedagogical experiment (E3 – n=41; K3 – n=44)

Parameters	Group	Before the experiment	After the experiment	Changes for the year	Statistical significance	
		$\bar{X} \pm Sx$	$\bar{X} \pm Sx$	$\Delta \bar{X}$	t	P
HR, beats/min	E3	76.34±1.63	72.11±0.94	-4.23	2.52	<0.05
	K3	76.78±1.43	74.7±0.65	-2.08	2.01	>0.05
sBP, mm Hg	E3	120.23±0.8	118.6±0.75	-1.63	2.19	<0.05
	K3	119.87±1.3	118.74±0.8	-1.13	1.54	>0.05
dBP, mm Hg	E3	71.5±1.3	69.7±1.04	-1.8	2.33	<0.05
	K3	72.1±1.21	70.87±0.85	-1.23	1.69	>0.05
VLC, ml	E3	3369±39.5	3478±43.2	109	2.25	<0.05
	K3	3343±40.3	3422±37.3	79	1.82	>0.05
Hand muscle strength, kg	E3	31.7±0.72	34.8±0.5	3.1	2.21	<0.01
	K3	30.3±0.68	33.1±0.6	2.8	1.84	>0.05

Table 6. Dynamics of the functional state of the body of girls with a low level of physical fitness during the period of pedagogical experiment (E3 – n=48; K3 – n=37)

Parameters	Group	Before the experiment	After the experiment	Changes for the year	Statistical significance	
		$\bar{X} \pm Sx$	$\bar{X} \pm Sx$	$\Delta \bar{X}$	t	P
HR, beats/min	E3	79.12±1.12	76.6±0.85	-2.52	2.27	<0.05
	K3	78.57±1.33	77.35±0.93	-1.22	1.67	>0.05
sBP, mm Hg	E3	121.3±0.74	119.8±0.52	-1.5	2.18	<0.05
	K3	121.87±0.85	120.91±0.7	-0.96	1.54	>0.05
dBP, mm Hg	E3	68.5±0.7	67.3±0.54	-1.2	2.16	<0.05
	K3	67.9±0.85	66.96±0.9	-0.94	1.68	>0.05
VLC, ml	E3	2343±36.8	2443±29.4	100	2.21	<0.05
	K3	2310±40.2	2373±34.5	63	1.49	>0.05
Hand muscle strength, kg	E3	19.9±0.6	21.8±0.3	1.9	2.25	<0.01
	K3	18.2±0.6	19.4±0.4	1.2	1.63	>0.05

The results of the experimental study allow us to state a significant improvement in somatic health, general and special physical fitness of students of experimental E1, E2, E3 and control K1, K2, K3 groups according to the results of the control tests.

One of the most important tasks of physical education in higher education is to create the most favorable, optimal conditions for the harmonious and spiritual development of each student, maintaining his health, developing the necessary theoretical knowledge, formation of special skills and abilities, maintenance and development of functional capabilities of the organism. During the development of methods for the formation of special skills and abilities of students in the process of powerlifting, we focused on strengthening the physical health of students, in order to increase the level of physical and functional capabilities of the organism.

The vital index (VI) at the beginning of the experiment in the boys of the experimental group E1 was 64.01 ml/kg, the control group K1 62.33 ml/kg, and at the end of 67.5 ml / kg in the boys of the experimental group E1 and 63.86 ml / kg of the control group K1. The Robinson index at the beginning of the pedagogical experiment in the boys of the experimental group E1 was 74.03 conventional units (c.u.), while boys from the control group K1 had 76.36 c.u., and at the end of the Robinson index was 69.77 in the boys of the experimental group E1 and 73.71 c.u. in the boys of the control group K1 c.u.

Table 7. Dynamics of indices of physical development of boys with a high level of physical fitness for the period of pedagogical experiment (E1 – n=13; K1 – n=11)

Parameters	Group	Before the experiment	After the experiment	Changes for the year	Statistical significance	
		$\bar{X} \pm Sx$	$\bar{X} \pm Sx$	$\Delta \bar{X}$	t	P
MGI, g/cm	E1	378.3±0.55	375.49±0.53	-2.81	3.67	<0.05
	K1	382.38±0.38	380.54±0.48	-1.84	2.09	>0.05
VI, ml/kg	E1	64.01±1.98	67.5±0.76	3.49	3.89	<0.05
	K1	62.33±1.41	63.86±1.17	1.53	1.88	>0.05
The Robinson index, c.u.	E1	74.03±1.33	69.77±0.37	-4.26	3.37	<0.05
	K1	76.36±1.95	73.71±0.63	-2.65	2.00	>0.05
HRRT, min	E1	1.24±1.61	1.0±0.9	-0.24	2.65	<0.05
	K1	1.26±1.33	1.13±1.65	-0.13	1.98	>0.05
PI, %	E1	78.84±1.7	81.17±1.39	2.33	2.21	<0.05
	K1	76.22±1.25	78.0±1.84	1.78	1.66	>0.05

Heart rate recovery time (HRRT) after 20 squats during 30 s in boys of the experimental group E1 was 1.24 minutes, the control group K1 time was 1.26 minutes at the beginning of experiment, and at the end of experiment it was 1.0 min in the boys of the experimental group E1 and 1.13 min in the control group K1. The power index (PI) at the beginning of the experiment in the boys of the experimental group E1 was 78.84%, in the the control group K1 it was 76.22%, and at the end of the experiment it was 81.17% in the boys of the experimental group E1 and 78.0% in the boys of the control group K1, which was statistically significant at $p < 0.05$.

Before the pedagogical experiment, the girls from the experimental group E1 had mass-growth index of 367.7 g/cm, in the control group K1 index was 377.23 g/cm, and at the end of the experiment mass-growth index was 375.48 g/cm in girls from experimental group E1 and 365.08 g/cm in girls from control group K1. The vital index at the beginning of the experiment in the girls of the experimental group E1 was 55.37 ml/kg, the control group K1 had 53.23 ml/kg, and at the end of experiment it was 67.5 ml/kg in girls from experimental group E1 and 54.5 ml/kg in girls from control group K1. The Robinson index at the beginning of the pedagogical experiment in the girls from the experimental group E1 was 76.12 c.u., in control group K1 it was 78.48 c.u., and at the end of experiment it was 72.89 c.u. in girls from the experimental group E1 and 76.74 c.u. in control group K1 (Tab. 8).

Table 8. Dynamics of indices of physical development of girls with a high level of physical fitness for the period of pedagogical experiment (E1 - $n=7$; K1 - $n=8$)

Parameters	Group	Before the experiment	After the experiment	Changes for the year	Statistical significance	
		$\bar{X} \pm Sx$	$\bar{X} \pm Sx$	$\Delta \bar{X}$	t	P
MPI, g/cm	E1	367.7 \pm 1.21	370.32 \pm 0.67	-2.62	3.43	<0.05
	K1	377.23 \pm 0.45	375.48 \pm 1.21	-1.75	1.81	>0.05
VI, ml/kg	E1	55.37 \pm 1.7	57.44 \pm 1.43	2.07	3.04	<0.05
	K1	53.23 \pm 1.4	54.5 \pm 0.75	1.27	2.03	>0.05
The Robinson index, c.u.	E1	76.12 \pm 0.33	72.89 \pm 0.75	-3.23	2.65	<0.05
	K1	78.48 \pm 1.15	76.74 \pm 0.44	-1.74	1.83	>0.05
HRRT, min	E1	1.26 \pm 1.43	1.06 \pm 0.5	-0.20	2.54	<0.05
	K1	1.27 \pm 1.19	1.15 \pm 1.29	-0.12	1.76	>0.05
PI, %	E1	58.47 \pm 1.12	60.36 \pm 1.33	1.89	2.18	<0.05
	K1	57.2 \pm 0.93	58.66 \pm 1.11	1.46	1.73	>0.05

The HRRT after 20 squats, for 30 s of girls from experimental group E1 was 1.26 min, girls from control group K1 had HRRT 1.27 min, and at the end of the experiment it was 1.06 min in experimental group E1 and 1.15 min in control group K1. The PI at the beginning of the experiment in experimental group E1 was 58.47%, control group K1 had 57.2%, and at the end of experiment girls from experimental group E1 had 60.36% PI and 58.66% in control group K1, which was statistically significant at $p < 0.05$.

Before the pedagogical experiment boys from the experimental group E2 had mass-growth index of 425.39 g/cm, in the control group K2 index was 434.35 g/cm, and at the end of the experiment mass-growth index was 421.98 g/cm in boys from experimental group E2 and 432.42 g/cm in boys from control group K2. The vital index at the beginning of the experiment in the boys from the experimental group E2 was 57.7 ml/kg, in the control group K2 it was 57.46 ml/kg, and at the end of experiment it was 61.33 ml/kg in the boys from the experimental group E2 and 59.26 ml/kg in control group K2 (Tab. 9).

Table 9. Dynamics of indices of physical development of boys with an average level of physical fitness for the period of pedagogical experiment (E2 – n=25; K2 – n=27)

Parameters	Group	Before the experiment	After the experiment	Changes for the year	Statistical significance	
		$\bar{X} \pm Sx$	$\bar{X} \pm Sx$	$\Delta \bar{X}$	t	P
MPI, g/cm	E2	425.39±0.4	421.98±0.35	-3.41	3.93	<0.05
	E2	434.35±0.3	432.42±0.33	-1.93	2.14	>0.05
VI, ml/kg	E2	57.7±1.61	61.33±0.98	3.63	3.32	<0.05
	E2	57.46±1.44	59.26±1.36	1.8	1.78	>0.05
The Robinson index, c.u.	E2	88.37±1.84	83.4±1.2	-4.97	3.08	<0.05
	E2	90.07±1.35	87.28±1.54	-2.79	2.07	>0.05
HRRT, min	E2	1.45±1.23	1.09±0.87	-0.36	2.36	<0.05
	E2	1.5±0.67	1.36±1.12	-0.14	1.82	>0.05
PI, %	E2	68.4±1.93	71.76±1.15	3.36	2.07	<0.05
	E2	67.89±1.72	69.7±1.47	1.81	1.53	>0.05

The Robinson index at the beginning of the pedagogical experiment in the boys of the experimental group E2 was 88.37 c.u., control group K2 had index of 90.07 c.u., and at the end of the experiment it was 83.4 c.u. in the experimental group E2 and 87.28 c.u. in control group K2. Heart rate recovery time after 20 squats for 30 s in boys from experimental group E2 was 1.45 min, in control group K2 it was 1.5 min, and at the end of experiment it was 1.09 min in boys from experimental group E2 and 1.36 min in control group K2. The power index at the beginning of the experiment in boys from the experimental group E2 was 68.4%, in control group K2 it was 67.89%, and at the end of experiment it became 71.76% in the boys from the experimental group E2 and 69.7% in the control group K2, which was statistically significant at $p < 0.05$.

Before the pedagogical experiment, the girls from the experimental group E2 mass-growth index was 384.37 g/cm, in the control group K2 it was K2 387.87 g/cm, and at the end of the experiment it became 381.2 g/cm in the girls from the experimental group E2 and 386.09 g/cm in control group K2. The vital index at the beginning of the experiment in girls from experimental group E2 was 48.38 ml/kg and 46.02 ml/kg in the control group K2, and at the end of the experiment it became 51.0 ml/kg in girls from the experimental group E2 and 47.72 ml/kg in control group K2 (Tab. 10).

Table 10. Dynamics of indices of physical development of girls with an average level of physical fitness for the period of pedagogical experiment (E2 – n=19; K2 – n=14)

Parameters	Group	Before the experiment	After the experiment	Changes for the year	Statistical significance	
		$\bar{X} \pm Sx$	$\bar{X} \pm Sx$	$\Delta \bar{X}$	t	P
MGI, g/cm	E2	384.37±0.7	381.2±0.78	-3.17	2.94	<0.05
	E2	387.87±1.2	386.09±1.67	-1.78	1.75	>0.05
VI, ml/kg	E2	48.38±1.27	51.0±0.23	2.62	3.12	<0.05
	E2	46.02±0.23	47.72±1.17	1.7	1.81	>0.05
The Robinson index, c.u.	E2	90.57±1.77	86.34±1.65	-4.23	2.43	<0.05
	E2	92.75±0.65	90.8±1.54	-1.95	2.04	>0.05
HRRT, min	E2	1.48±0.76	1.19±0.63	-0.29	2.23	<0.05
	E2	1.49±0.72	1.37±1.38	-0.12	1.63	>0.05
PI, %	E2	53.13±0.43	55.33±1.17	2.2	2.27	<0.05
	E2	52.1±1.13	53.62±0.33	1.52	1.59	>0.05

The Robinson index at the beginning of the pedagogical experiment in the girls from the experimental group E2 was 90.57 c.u. and 92.75 c.u. in the control group K2, and at the end of the experiment it became 86.34 c.u. in the experimental group E2 and 90.8 c.u. in control group K2. The HRRT after 20 squats for 30 s in girls from experimental group E2 was 1.48 min and 1.49 min in the control group K2. At the end of the experiment it became 1.19 min in girls from experimental group E2 and 1.37 min in control group K2. The power index at the beginning of the experiment in girls from the experimental group E2 was 53.13% and 52.1% in the control group K2, and at the end of the experiment it became 55.33% in the experimental group E2 and 53.62% in the control group K2, which was statistically significant at $p < 0.05$.

Before the pedagogical experiment boys from the experimental group E3 had mass-growth index of 475.9 g/cm, the control group K3 had 480.54 g/cm, and at the end of the experiment it became 473.96 g/cm in the experimental group E3 and 479.42 g/cm in the control group K3. The vital index at the beginning of the experiment in boys from experimental group E3 was 54.57 ml/kg, boys from control group K3 had 52.12 ml/kg, and at the end of the experiment it became 56.13 ml/kg in experimental group E3 and 53.12 ml/kg in the control group K3 (Tab. 11).

Table 11. Dynamics of indices of physical development of boys with a low level of physical fitness for the period of pedagogical experiment (E3 - n=41; K3 - n=44)

Parameters	Group	Before the experiment	After the experiment	Changes for the year	Statistical significance	
		$\bar{X} \pm Sx$	$\bar{X} \pm Sx$	$\Delta \bar{X}$	t	P
MGI, g/cm	E3	475.9±0.75	473.96±0.77	-1.94	3.28	<0.05
	K3	480.54±0.58	479.42±0.35	-1.12	2.01	>0.05
VI, ml/kg	E3	54.57±1.21	56.13±0.53	1.56	2.67	<0.05
	K3	52.12±1.39	53.12±1.47	1.0	1.65	>0.05
The Robinson index, c.u.	E3	97.31±1.41	95.1±1.02	-2.21	2.84	<0.05
	K3	100.29±1.61	98.58±1.13	-1.71	1.94	>0.05
HRRT, min	E3	2.62±0.7	2.44±0.8	-0.18	2.49	<0.05
	K3	2.8±1.13	2.7±0.67	-0.10	1.82	>0.05
PI, %	E3	62.23±1.41	63.64±1.19	1.41	2.17	<0.05
	K3	61.89±1.13	62.86±1.5	0.97	1.65	>0.05

The Robinson index at the beginning of the pedagogical experiment in the boys from the experimental group E3 was 97.31 c.u. and 100.29 c.u. in the control group K3, and at the end of the experiment it became 95.1 c.u. in the experimental group E3 and 98.58 c.u. in the control group K3. The HRRT after 20 squats for 30 s in the boys from the experimental group E3 was 2.62 minutes, the boys from control group K3 recovered heart rate in 2.8 minutes, and at the end of the experiment it became 2.44 minutes in the experimental group E3 and 2.7 minutes in the control group K3. The power index at the beginning of the experiment in the boys from the experimental group E3 was 62.23% and 61.89% in the control group K3. At the end of the experiment it became 63.64% in the experimental group E3 and 62.86% in the control group K3, which was statistically significant at $p < 0.05$.

Before the pedagogical experiment the girls from the experimental group E3 had mass-growth index of 414.2 g/cm and it was 427.09 g/cm in the control group K3. At the end of the experiment it became 412.55 g/cm in the experimental group E3 and 425.98 g/cm in the control group K3. The vital index at the beginning of the experiment in girls from experimental group E3 was 43.18 ml/kg and 42.3 ml/kg in the control group K3. At the end of the experiment it became 44.63 ml/kg in the experimental group E3 and 43.23 ml/kg in the control group K3. The Robinson index at the beginning of the pedagogical experiment in the girls from the experimental group E3 was 100.3 c.u. and 102.52 c.u. in the control group K3. At the end of the experiment it became 99.34 c.u. in the experimental group E3 and 102.06 c.u. in the control group K3. The HRRT after 20 squats for 30 s in girls from experimental group E3 was 2.64 minutes and 2.67 minutes in the control group K3. After the experiment it became 2.5 minutes in the experimental group E3 and 2.6 minutes

in the control group K3. The power index at the beginning from the experiment in girls of experimental group E3 was 46.43% and 42.7% in the control group K3. At the end of the experiment it became 47.3% in the experimental group E3 and 43.35% in the control group K3, which was statistically significant at $p < 0.05$ (Tab. 12).

During the pedagogical experiment the index of harmonious morphological development was determined (HMDI) of boys and girls from experimental E1, E2, E3 and control K1, K2, K3 groups. It was found that 25% of boys have a normosthenoid body type, 55% have asthenoid and 20% have pycnoid body type. In girls, body type indicators were: normosthenoid - 20%, asthenoid - 15%, pycnoid - 65%. The data of the experimental study showed that most boys and girls have asthenoid and pycnoid body type.

Table 12. Dynamics of indices of physical development of girls with a low level of physical fitness for the period of pedagogical experiment (E3 - $n=48$; K3 - $n=37$)

Parameters	Group	Before the experiment	After the experiment	Changes for the year	Statistical significance	
		$\bar{X} \pm Sx$	$\bar{X} \pm Sx$	$\Delta \bar{X}$	t	P
MGI, g/cm	E3	414.2±1.54	412.55±1.34	-1.65	3.13	<0.05
	K3	427.09±1.13	425.98±1.75	-1.11	2.10	>0.05
VI, ml/kg	E3	43.18±1.24	44.63±1.63	1.45	2.46	<0.05
	K3	42.3±0.83	43.23±1.29	0.93	1.82	>0.05
The Robinson index, c.u.	E3	100.3±1.67	99.34±1.54	-0.96	2.61	<0.05
	K3	102.52±1.61	102.06±1.13	-0.46	1.92	>0.05
HRRT, min	E3	2.64±0.76	2.5±0.6	-0.14	2.33	<0.05
	K3	2.67±0.89	2.6±0.7	-0.07	1.76	>0.05
PI, %	E3	46.43±1.93	47.3±1.24	0.87	2.27	<0.05
	K3	42.7±0.83	43.35±1.74	0.65	1.79	>0.05

The use of powerlifting in the process of physical education allows students in a short period of time to improve health, general and special physical fitness, functional indicators. In general, exercises with weights have a positive effect on the formation of the physique, improve the efficiency of organs and systems of the body. Powerlifting has a number of advantages: it gives a noticeable effect of training for several months, allows you to have an isolated effect on underdeveloped muscle groups and easy to dose the load. Powerlifting also promotes good health, the formation of special skills, strengthens the musculoskeletal system, promotes general physical development. It also has a positive effect on the female body. Powerlifting classes help to improve the functionality of the entire female body, not just individual muscle groups, increase its resistance to various factors and improve health. The introduction of powerlifting in the process of physical education is justified as one of the ways to improve physical development and functional fitness of students.

Improving the effectiveness of physical education classes in higher education demands following: increasing the amount of time for physical education classes; conducting classes at the most convenient time for students; material and technical equipment of sports and gyms; use of the most popular types of physical culture and health-improving activities; development of author's curricula and methods for the formation of special skills and abilities of students in the process of physical education, which take into account indicators of health, physical development and physical fitness.

4. Conclusions

The analysis of the dynamics of physical development of students gives grounds to claim that the implementation in physical education process of developed methods of forming special skills and abilities of students contributed to the change for the better of all studied indicators. As a result of the study, experimental data were obtained, which expand the idea of the possibility of improving the physical development, physical fitness and health of student youth. Indicators of the level of physical development,

motor fitness and functional state of the body of students did not differ significantly from the results of similar studies by other scientists.

The results of the experimental study confirmed the effectiveness of the developed method of forming special skills and abilities of university students during powerlifting classes. Creating pedagogical conditions for improving the strength abilities of boys and girls contributed to the effective training of powerlifting with the use of physical exercises of strength orientation. The effectiveness of the method of forming special skills and abilities of students in the process of powerlifting classes will increase significantly if the powerlifting classes will take into account the physical capabilities of students and the motivational focus of these classes.

According to the specified components the planning of loadings and algorithm of carrying out of training sessions on powerlifting must be based on: type and nature of strength exercises, the volume and intensity of the load, the number of repetitions and the amount of load, frequency of training sessions and duration of strength work, rest intervals, number and sequence of strength exercises, etc. The built algorithm allows to optimize training difficulties, to differentiate training loading, methods and principles of development of power qualities and to provide use of optimum dynamics of increase of power loadings. Giving students the opportunity to freely choose the type of physical activity, taking into account their motives, needs and interests changes the attitude of students to physical education and their own health, resulting in intensified physical culture and health activities.

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