

Efficiency of Using a Physiological Portrait of a University Student in Physical Education

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ABSTRACT

The modern higher school has increased requirements not only for the training of highly qualified specialists with a certain amount of personal and professional qualities, good health and a sufficient level of physical fitness. However, the present students need the indicators of physical development, functional resources and right level of physical fitness. The purpose of the study was to justify the efficiency of using the "Physiological portrait of a university student" in physical education. To assess the basic indicators of health and fitness of students, a specially developed "Physiological portrait of a university student" (PhPUS) was used. It included indicators of physical development, functional capabilities of basic physiological systems and physical abilities of students. The practical significance of the study included comparing the parameters of PhPUS in the beginning and the end of the academic year. Another study on PhPUS blocks indicated improvement in the students' indices of physical development, functional indices of the main physiological systems and physical fitness. PhPUS for monitoring the physical health of students could help identifying the necessary measures to improve the process of physical education.

Keywords: *Student; health; monitoring; physiological portrait of a university student; Physical Education.*

INTRODUCTION

The health state of students, as socially important group of the modern society, is important to be emphasized besides indicators of social and economic and social development of any country (Kalinichev, 2017). In this regard, in modern society the great attention is paid to the role of a high school as a social institute which has to form not only the competent experts, but also the personality having physical, moral health and social activity (Altynova & Talantseva, 2018; Mikhailova, Sadretdinova & Fedoseeva, 2015).

Today the state of students' health causes special concern. According to an annual medical examination, more than 50% of the students (young men, and girls) who had enrolled in the first course had about 2-3 chronic diseases (Meevrmanova, Koygeldinova & Ibraev, 2017; Jantaeva & Akhmatova, 2016). More than 30% of young men could not be drafted into the army due to health reasons. Only 10-15% of graduates were considered as healthy (Gibadullin & Nyunyaev, 2015; Stewart-Brown, Evans & Patterson, 2000; Nunes, Williams & Sa, 2011). It has been said that the student youths are among the least socially protected groups of the population and hence more stringent requirements are necessary to improve their health conditions (Pang, 2018; Slawson, 2015) for better work capacity and productivity (Gotovtsev, Germanov & Romanova, 2012; Vaduganathan, 2015; Thome & Espelage, 2004; Hong & Wang, 2009).

The common diseases among young people in the course of training are diseases of digestive organs, the blood circulatory systems, violations of organs of vision (short-sightedness), nervous system and the musculoskeletal organs. Therefore, during training at the higher school health of students does not improve, but also in some cases worsens – the sickness rate of the students increases (Perova, Kurentsov & Golubev, 2014).

Unfortunately, many authors note that many students also realized the importance of health to achieve competitive advantage in the labour market (Kobylatskaya, Osipina & Shkatova, 2015). However, at the same time there were practically not sufficient measures undertaken to enhance

their health (Hind, Norman & Cooper, 2003; Sallis, McKenzie & Kolody, 1999). According to the experts (Bolotin, 2013), the state of health depends on four most significant factors with the following percentage ratios: health care (10-15%), heredity (15-20%), the environment (20-25%), and a way of life (50-55%). Bolotin (2013) found that there were: i) weak knowledge of health saving behavior, ii) insufficient level of development of students' abilities, skills on health-saving, iii) low level of individual physical fitness of students, iii) low level of physical activity and motivation of students to physical exercises, iv) passivity and imbalance of higher nervous activity, v) insufficient level of development of memory mental processes, attention, sensory and motor state of students; vi) insufficiency of individual experience of the organization of professional activity, study and self-discipline, and vii) low level of development of communicative qualities. Besides, Sakharova (2011) found that the state of students' health in many respects depends on the student's life-styles.

Rational physical training in a higher education institution is important for providing the necessary functional condition. In this regard, the situation connected with the steady growth of the sickness rate among students, especially during training demands careful study (Barybina, Kolomets & Komotskaya, 2014), analysis and effective actions (Kozina, Prusik & Prusik, 2015; Coakley, 2011).

For carrying out the monitoring of the health state, a number of researchers have specified about the use of "The passport of health" (Yatsun, Bespalov & Gorbunova, 2016). In higher education institution, there is no need of the analysis of parameters of this document since the students for definition of the group of health addresses the therapist, who, on the basis of the passport of health, defines this or that group and issues the corresponding conclusion. However, it is not always enough as the teachers for "Physical culture and sport" and "Physical culture and sport (elective discipline)" have to know the vulnerable systems and functional possibilities of the students. Hence, it is good to develop PhPUS for the educational processes. It can be an indicator of the physical health considering physical development, functionality and physical fitness of the students. On the basis of the results of the initial parameters measurement, the student can see for himself from outside, in comparison with his (her)

peers, and it will stimulate his desire to self-improve, to be engaged systematically in physical training and to adhere to bases of maintaining a healthy lifestyle. Besides, the teachers can make professional recommendations about the development of physical qualities.

The concept of physical health is characterized by the authors as a part of the general health of the person, that is, his/her physical condition in a broad sense of this word (Jantaeva & Akhmatova, 2016). Physical health as a physical state is defined by the level of morphological and functional properties of an organism at a concrete stage of its development.

The main purpose of this study is to prove efficiency of use 'Physiological portrait of a university student' (PhPUS) for the improvement of physical training in a higher education institution. The study was based on the hypothesis that the process of physical education will be more effective when using PhPUS.

METHODOLOGY

The research was conducted on the basis of the Federal State Budget Educational Institution of Higher Education, 'the Chuvash State Agricultural Academy', with involvement of 33 students of the 1st course (21 girls and 12 young men), carried for health reasons for classes in physical training to the main medical group. Age range of students varied from 17 to 19 years. The students confirmed voluntary participation by signing the informed written consents. For assessment of key indicators of health and fitness of the students, the specially developed PhPUS was used. It included indicators of physical development, functionality of the main physiological systems and physical abilities of the students (see Appendix).

For assessment of physical development of students, anthropometrical data were used. The body length was measured by means of the medical height meter (RM-1P), body weight – on medical floor scales (RP-150 of MG), the muscular force of hands – by means of dynamometer (DRP-90), force of muscles of a back – a back-bone dynamometer.

For monitoring of functionality of the main physiological systems of the students, measurements of the circumference of a thorax circle on inhalation (CTCinh, cm), on exhalation (CTCexh, cm) and at pause (CTCp, cm) were made by means of a centimetric tape. The thorax excursion was counted: $EXC = CTCinh - CTCexh$, cm. For determination of lifelong capacity of lungs (LCL, ml) the authors used lung-tester SP-01. By the standard technique tests of Shtange and Genchi, sec. were carried out.

Assessment of function of cardiovascular system was determined by frequency of hearty shrinkages rate (FHS, beats/min) and also by indicators of arterial blood pressure: systolic (SAP, mm m.c.), diastolic (DAP, mm m.c.) and pulse (PP of mm m.c.), (where m.c.= mercury column), which was defined as the difference of SAP-DAP. Level of physical fitness of students was defined by the following tests: run of 100 m (sec.); a long jump from the place, a push by two legs (cm); shuttle run 3 x 10 m (sec.); power exercises : bending, extension of hands in an emphasis lying (girls) and pulling up from a hang on a high crossbeam (young man); number of times; an inclination forward from a standing position with direct legs on a gymnastic bench, cm. Mathematical processing of materials was carried out by LS Kaminsky's method.

At the beginning of the academic year (September - October, 2017) collection of data for formation of PhPUS on the following blocks was carried out:

- indicators of physical development (growth: standing and sitting, cm; body weight, kg; thorax circle (inhalation, exhalation, pause, excursion, cm); force, kg);
- functional indicators of the FHS, SAP, DAP, PP cardio-respiratory system; LCL, tests of Shtange and Genchi; and
- level of physical fitness (testing of physical abilities with use of control standards).

At the end of the school year (May - June, 2018), using the same methods as at the beginning of the school year, the researchers re-tested the physical development indicators (i.e., body length: standing and sitting, cm; body weight, kg; thorax circle (inhalation, exhalation, pause, excursion, cm); muscle strength, kg); functional indicators of the FHS,

SAP, DAP, PP cardio-respiratory system; LCL, Shtage and Genchi tests; level of physical fitness (testing physical abilities using control standards).

RESULTS AND DISCUSSION

The results for the students' physical development, cardio-respiratory system and physical abilities are presented in Tables 1, 2 and 3.

The results in Table 1 show that the body length of the girls was 162.6 ± 0.95 cm, the young men – $177,3 \pm 1.76$ cm with a body weight of 54.1 ± 2.07 kg and 71.6 ± 2.13 kg, respectively. The circumference of the breast in female students was 85.9 ± 1.01 cm, the circumference of the chest in male students it was significantly higher and amounted to 95.2 ± 2.22 cm. A similar relationship was characteristic for the circumference of the breast (chest) on the exhale 81.1 ± 0.71 cm in girls and 82.4 ± 1.76 cm in boys. The excursion of the students' chest differed and was almost twice as high among male students. Low indices of the circumference of the breast of girls are explained by the weak development of the respiratory muscles. Hand dynamometry for girls' right hands was $21.1 \pm 0,65$ kg, for the left — 18.6 ± 0.53 kg, for young men, the figures are: 41.3 ± 1.85 kg and 38.9 ± 1.39 kg.

Table I: Indicators of Physical Development of the Examined Students at the Beginning of the Academic Year

Student	Indicators (M ± m)									
	Height, cm		Mass (kg)	Circumference of the thorax circle, cm				Strength, kg		
	Stand	Sit		Inh.	Exh.	Pause	Excursion	back-bone	right hand	left hand
Girls	162.6 ±0.95	84.6 ±0.59	54.1 ±2.07	85.9 ±1.01	81.1 ±0.71	82.7 ±1.01	4.9 ±0.36	54.0 ±2.04	21.1 ±0.65	18.6 ±0.53
Young Men	177.3 ±1.76	91.2 ±1.02	71.6 ±2.13	95.2 ±2.22	82.4 ±1.76	84.8 ±1.39	11.6 ±2.50	103.7 ±2.78	41.3 ±1.85	38.9 ±1.39

Comparison of the obtained anthropometrical data with standards of physical development of students suggested that at girls' growth, the weight and an excursion of a thorax were average, and all other indicators were regarded as below an average. Growth of young men was above average, thorax excursion and also back-bone force – average, other values – below standard sizes.

Therefore, at average height and above an average at the examined contingent, lower indicators of a circle of a thorax and muscular force were noted. At the same time, it should be noted that the excursion of a thorax was sufficient.

The functional parameters of the cardio-respiratory system (Table 2) show that the boys' heart rate was 83.7 ± 3.52 , girls (77.47 ± 3.85 bpm). However, the difference between these indicators was insignificant ($P > 0.05$). Blood pressure indices had similar dependence and were higher among the boys than among the girls, which are explained by physiological characteristics of the gender composition. LSL ranged from 3.5 ± 0.43 to 4.8 ± 0.18 ml.

Table 2: Functional Indicators of Cardio-Respiratory System of Students at the Beginning of the Academic Year

Student	Indicators (M ± m)						
	FHS, beats/min	AP mm m.c.			LCI, ml	Tests, sec.	
		SAP	DAP	PP		Shtange	Genchi
Girls	77.4 ±3.85	114.2 ±2.37	86.6 ±2.37	45.7 ±2.43	3.5 ±0.43	46.0 ±2.25	29.6 ±1.78
Young men	83.7 ±3.52	125.6 ±3.70	74.2 ±2.78	51.3 ±1.85	4.8 ±0.18	87.7 ±5.46	47.9 ±2.31

The results on assessment of functional indicators of cardio-respiratory system of students demonstrated that the girls' FHS and LSL were in limits of normal age amounts. The SAP and DAP have been lowered whereas the Test of Shtange was estimated on 'Well' and Genchi also 'Well'. As for the young men, the FHS, SAP and DAP were above age indicators. LSL met the age standards, Tests of Shtange and Genchi also were estimated 'Well'.

The indicators of physical fitness presented in the Table 3 demonstrated that:

- i) Girls
 - a) High-speed abilities corresponded to average (i.e., low level was defined at 4.76%, average at 90.48%, and high at 4.76%).
 - b) speed-strength abilities were at a low level (38.09% of students had an average value, low – 52.38%, and high – 9.53%);

- c) co-ordination abilities were regarded as average (9.53% had a low level, average – 90,47% of the students);
- d) strength abilities were regarded as low (low level revealed at 61.90%, average – 23.80%, high – 14.30%); and
- e) the indicator of flexibility was average (33.34% was low, 47,61% was average, and 19,05% was high).

ii) Young men:

- a) high-speed abilities were regarded as average (low indicators were revealed at 25.00% of students and average was 75.00%);
- b) speed-strength abilities were average (50.00% were regarded as average, 41.17% low and 8.83% high);
- c) co-ordination abilities were regarded as average (33.30% high level and 66.70% average);
- d) strength abilities were defined as low (16.60% high level, 16.60% average and 66.80% low); and
- e) the indicator of flexibility was average (16.60% high, 75.00% average, and 8.40% low).

Table 3: Indicators of Physical Abilities of Students for the Beginning of the Academic Year

Student	Indicators (M ± m)				
	Running 100 m, sec.	A long jump from the place, a push by two legs, cm	Extension of hands in an emphasis lying (girls) and pulling up from a hang on a high crossbeam (young man), reps.	Shuttle run 3 x 10 m, sec.	An inclination forward from a standing position with direct legs on a gymnastic bench, cm
Girls	17.4 ±0.13	163.5 ±2.22	6.6 ±0.59	9.1 ±0.08	10.1 ±1.41
Young men	14.1 ±0.09	221.3 ±4.77	6.6 ±1.19	7.8 ±0.12	8.1 ±1.17

It was found that physical abilities of the girls were low on speed-strength and muscle strength indicators while the young men were only on muscle strength indicators. The indicators of PhPUS in the first course of the Chuvash State Agricultural Academy suggested that that was insufficient levels of physical development, functional indicators of the main physiological systems and physical fitness of students.

After the research, the physiological portrait was discussed with each student who was allowed to involve in the process of improvement of those indicators of the allocated PhPUS blocks. The load was individualized, discussions with students on questions of preservation and promotion of health, maintenance of high performance, and others were carried out. There were also consultations related to students holding independent occupations, drawing up of individual sets of exercises, food, hygiene and others.

The research aimed to compare the PhPUS parameters obtained at the beginning and the end of the academic year. Data of PhPUS on the above-stated blocks for the end of the academic year are presented in Table 4, 5 and 6. The results in Table 4 show that at the end of the school year the body length of the girls have increased to 163.2 ± 0.89 cm, and the young men 178.7 ± 1.67 cm. The body mass did not change significantly, 54.2 ± 2.01 kg and 72.6 ± 1.57 kg respectively. The chest (breast) circumference and wrist dynamometry for their right and left hands also increased.

Table 4: Indicators of Physical Development of the Examined Students at the End of the Academic Year

Student	Indicators ($M \pm m$)									
	Height, cm		Mass, kg	Circumference of the thorax circle, cm				Power, kg		
	Stand	Sit		Inh.	Exh.	Pause	Excursion	Back bone	Right hand	Left hand
Girls	163.2 ± 0.89	85.1 ± 0.59	54.2 ± 2.01	86.1 ± 0.95	80.5 ± 0.71	81.9 ± 1.07	5.8 ± 0.47	56.6 ± 5.58	22.2 ± 0.59	19.6 ± 0.30
Young men	178.7 ± 1.67	91.6 ± 1.20	72.6 ± 1.57	97.6 ± 2.59	81.1 ± 1.85	86.6 ± 1.30	15.7 ± 1.39	108.0 ± 3.61	43.9 ± 1.76	39.7 ± 1.39

Comparing the indicators of physical development at the beginning and at the end of the academic year, it was noted that essential changes in anthropometrical parameters have not happened. The development of pectoral muscles was not satisfactory.

Analysis of the functional parameters of the cardio-respiratory system at the end of the academic year (Table 5) showed that the heart rate had no significant tendency to decrease; girls (76.1 ± 1.54 beats/min) and

young men (82.2 ± 3.52 beats/min). A similar trend was established for the indicators of the SAP, PP practically did not change; 45.7 ± 2.43 among female students, 51.3 ± 1.85 mm m.c. among male students. The LCL of boys was significantly higher than the girls and amounted to 5.4 ± 0.16 ml versus 3.7 ± 0.43 ml. Genchi's test also showed a significant difference in the performance of students with a predominance of boys.

Table 5: Functional Indicators of Cardio-respiratory System of Students at the End of the Academic Year

Student	Indicators (M ± m)						
	FHS, beats/min	AP mm m.c.			LCI, ml	Tests, sec.	
		SAP	DAP	PP		Shtange	Genchi
Girls	76.1 ±1.54	111.7 ±2.01	66.2 ±1.95	45.4 ±1.48	3.7 ±0.43	87.7 ±5.46	31.1 ±1.72
Young men	82.2 ±3.52	123.0± 2.78	70.7 ±2.31	52.3 ±1.85	5.4 ±0.16*	100.6 ±2.29	56.9 ±2.31*

Note: * – criterion of reliability in comparison with the beginning of the academic year.

The indicators of FHS, SAP, DAP and PP of students in comparison with the beginning of the academic year were lower and were in limits of norms of age groups that speaks about “economization” of cardiovascular system activity. LCL indicators in general met age standards of the students. Tests of respiratory system were estimated as ‘Perfect’.

The analysis of physical abilities indicators at the end of the academic year (Table 6) suggested that there was a general increase of the students’ physical fitness. At the beginning of the academic year, the physical abilities of the students were low in speed-strength (163.5 ± 2.22 cm) and strength indicators (6.6 ± 0.59 reps.), while in boys, only by strength (6.6 ± 1.19 reps.). Indicators of physical abilities of students at the end of the school year testified to their increase. For girls, the difference between the indicators at the beginning and end of the academic year was significant ($P < 0,05$) only in terms of strength (6.6 ± 0.59 to 9.3 ± 0.48 reps.) and coordination (9.1 ± 0.08 to 8.8 ± 0.06 sec.). For the young men, the difference between the indicators at the beginning and end of the academic year was insignificant ($P > 0,05$) and was in the range of speed from 14.1 ± 0.09 to 13.9 ± 0.05 seconds; speed-strength – 221.3 ± 4.77 to

226.3 ± 3.96; strength – 6.6 ± 1.19 to 8.2 ± 1,05 reps.; coordination – 7.8 ± 0.12 to 7.6 ± 0.10 sec. and flexibility – 8.1 ± 1.17 to 9.3 ± 1.15 cm.

Table 6: Indicators of Physical Abilities of Students at the End of the Academic Year

Student	Indicators (M ± m)				
	Running 100 m, sec.	A long jump from the place, a push by two legs, cm	Extension of hands in an emphasis lying (girls) and pulling up from a hang on a high crossbeam (young man), reps.	Shuttle run 3 x 10 m, sec.	An inclination forward from a standing position with direct legs on a gymnastic bench, cm
Girls	17.2 ± 0.13	168.1 ± 2.00	9.3 ± 0.48*	8.8 ± 0.06*	11.7 ± 1.31
Young men	13.9 ± 0.05	226.3 ± 3.96	8.2 ± 1.05	7.6 ± 0.10	9.3 ± 1.15

Note: * – criterion of reliability in comparison with the beginning of the academic year.

CONCLUSION

This research suggested that ‘Physiological portrait of a university student’ (PhPUS) can assess the indicators of physical development, functional capabilities of the basic physiological systems and physical abilities of students as well as compare them with standard indicators, corresponding to their age and sex. It is an effective means to improve the efficiency of the process of physical education. The research findings indicate that it is possible to make appropriate changes in a timely manner.

The research demonstrates the efficiency of use of PhPUS in the course of physical training of the participating students. It helps to increase the functionality, physical development and physical fitness. At the same time, their motivation for physical training and sport, both quality of training of students in general and each of them separately increases.

The ‘Physiological portrait of a university student’ (PhPUS) can be used in physical education of students in educational institutions. It is a measurement tool to assess physical development, functional capabilities and physical fitness of university students. It allows for the adjustment of

the process of mastering competences during the study of the disciplines such as 'Physical culture and sport' and 'Physical culture and sport (elective discipline)'. taking into account the individual characteristics of each student and make timely changes to the organizational and methodological support of these disciplines.

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APPENDIX

PHYSIOLOGICAL PORTRAIT OF A STUDENT OF THE UNIVERSITY
on the state of __ semester 201_/201_ of the academic year

Full name _____ Age _____

Indicators	Results	Analysis of the results
Body constitution type		
Posture		
Thyroid condition (in the presence of goiter, specify the degree)		
The indicators of physical development		
Height, cm		
Standing position		
Sitting position		
Weight, kg		
Chest circumference, cm		
Inhalation		
Exhalation		
Pause		
Excursion		
Strength, kg		
Backbone		
Right wrist		
Left wrist		
Functional parameters of cardio-respiratory system		
Heart rate (HR), beats per minute		
Blood pressure (BP), ml of mercury		
Systolic blood pressure (SBP)		
Diastolic blood pressure (DBP)		
Pulse pressure (PP)		
Vital capacity of lungs (VCL), ml		
Samples, sec.		
Stange's test		
Gencha		
Indicators of physical preparedness		
Run 100 m, sec		
Standing long jump, cm		
Pushup (girls) / Pull-up from the hanging position on the high crossbar (boys), number of times		
Shuttle run 3 x 10 m, sec		
Tilt forward from standing position with straight legs on the gymnastic bench, cm		

Conclusion _____
