
















Dynamics of the Students' Physical Fitness While Studying at Higher Educational Institutions

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Abstract

The article presents an analysis of the dynamics of the students' physical fitness while studying at Ukrainian higher educational institutions. The level of physical fitness was assessed by the results in exercises that characterize the development of basic physical qualities: speed qualities (100 m run), speed and power qualities (long standing jump), power qualities (pull-ups, push-ups, and sit-ups for males; flexed arm hang, push-ups, and sit-ups for females), endurance (3000 m run for males and 2000 m run for females), flexibility (bending forward from a sitting position), agility (4 x 9 m shuttle run). The study was conducted in Polissia National University in 2013-2019. 16 groups of the students from the faculties of economics, agronomy, ecology, technology, agricultural management, and agriculture mechanization took part in the study; in total, the research involved 369 students, including 195 males and 174 females. The research methods included the analysis and generalization of scientific, educational and methodical literature on physical education, the methods of conceptual and comparative, system and structural analysis, pedagogical observation, testing, the methods of statistical data processing. The study found that during the period of study at higher educational institutions, both male and female students had no significant improvement in

the results of most tests. Moreover, the students' results in the endurance, power, and flexibility exercises deteriorated. The analysis of the dynamics of the students' physical qualities development stated that the physical fitness level of the both male and female students of 1st-4th years was generally unsatisfactory. At the same time, the results of females were significantly lower than that one of male students throughout the whole studying period. This indicates a lack of efficiency of the current system of physical education at higher educational institutions of Ukraine. Among the reasons for the decrease in the physical fitness level of senior students are insufficient health and training orientation of physical education; insufficient material and technical base; low motor activity of students; the lack of students' interests, motives and needs for physical exercises, a low physical state level of school graduates, etc.

Keywords: physical education, physical fitness, physical qualities, students.

Introduction

The insufficient level of the students' physical fitness and no tendency to its increase among the students is caused by the low quality of physical education both at school and at higher educational institutions (HEI) of Ukraine, the intensification of bad habits among young students, the lack of interest and steady motivation for regular physical exercises and the implementation quality of the state programs for the development of physical culture and sports in Ukraine.

The information about the state of the students' physical fitness is important for the optimal definition and normalization of physical activity in physical education process at HEI. Physical fitness is to some extent an indicator of the students' physical activity, and an integral indicator of the body organs and systems functioning. A teacher is able to determine the level of functioning of certain body systems that can directly affect the students' state of physical fitness and health with the help of physical exercises and tests.

The physical fitness of the students of HEI have been the subject of research by many authors [1-4], the results of which show the students' physical fitness deterioration during four years of study at HEI. It was proved that the physical fitness level of students is influenced by many factors, some of which do not directly depend on the scientific and methodological support of the physical education process, professional level of teaching staff, material and technical support, sports facilities of HEI and the state of sports mass-participated health and fitness activities. All factors that affect the physical fitness level of students can be divided into two general groups: 1) those that a university applicant has or that influenced one's life before entering the university; 2) those that directly affect a student while studying at the university. The level of influence of these factors also depends on the individual characteristics of students, teachers and many other factors that may arise in the process of physical education [5, 6].

Regular physical exercises increase the volume of the heart muscle gradually, the network of blood vessels expands; change the blood composition (increase the number of erythrocytes, hemoglobin); increase the chest volume and the vital capacity of the lungs; improve the activity of the central nervous system, mental performance; increase the intensity and concentration of attention [7, 8]. Physical exercises provide favorable conditions for the optimal functioning of the whole body, not just the muscular system [9, 10]. Selecting special exercises, dosing them, depending on the physical condition, it is possible to purposefully affect the body, change its specific functions, restoring damaged systems. Gradually increased volume of physical activity provides general fitness of the body, which is the basis for improving the general physical condition and efficiency of students, which will have a positive influence on the efficiency of their professional activity [11].

2. Literature Review

Many scientists [12, 13, 14] note the low physical fitness level of students in most regions of Ukraine that corresponds to 1-3 points of the state system of physical fitness testing. As a result of testing, the scientists revealed the initial level of the physical fitness of first-year students, among who 18% had a low level (a poor grade); 49% - lower than the middle (an unsatisfactory grade); 20% - the middle (a satisfactory grade); 13% - above the middle (a good grade). No students with a high level of physical fitness were found.

The works of scientists [15] determined that more than 45% of HEI students did not meet the program requirements, namely, 17-20% did not meet the standards of endurance, power, and speed and power qualities; 12-15% - did not meet the standards of other types of exercises included in the state tests; 28-34% of third-year students and 20-25% of fourth-year students could not meet state test standards totally; according to the indicators of functional and physical fitness, the indicators of the vital capacity of the lungs,

the 3000 m run, pull-ups, and others were not homogeneous. The other scientists also paid attention to the low level of the students' physical fitness [16]. According to their data, endurance, speed and power qualities were developed the least. Speed and agility were developed slightly better. The students of one age group had different levels of physical fitness. In general, it was determined that 37% of young people had a low level of physical fitness, 48% – middle and 15% – high. According to scientists [17], the level of certain physical qualities development of the male students of agricultural universities corresponded to the middle level (3 points). The lowest results were recorded in the long standing jump and 3000 m run. The author considered that the level of the students' physical state in terms of health status was low. The research [18] shows that only 24.5% of the students had "good" physical fitness level, 61% – "satisfactory" and 14.5% – "unsatisfactory". At the same time, it was found [19] that the physical fitness level of 30% male students (excluding the standard for swimming) did not meet the requirements of state tests. 30% of students had a low level of physical fitness, 44 % – middle, 23% – above the middle, 3% – high. 67.6% of students with a low level of physical fitness were characterized by a low level of development of all basic physical qualities.

The study of the dynamics of physical development, physical fitness and health of students during the whole period of study at HEI showed that the growth rate of physical fitness indicators was slowed down after the second year, and significantly reduced in the third, fourth and fifth years of study [20]. The senior students who had stopped attending compulsory physical education classes and were not engaged in physical exercises and sports on their own had a clear decrease in physical performance and health deterioration [19].

The scientists [21] indicate that the dynamics of the physical qualities growth is different and depends on the initial level. The highest intensity of physical fitness growth is observed in students with a low level of fitness. As a result, by the end of the first year, the level of physical fitness of students is gradually equalized. The highest rates of physical fitness are observed in the second year, which is explained by the age period when the greatest positive changes in the forms and functions of the body of students occur. The other studies [22, 23] mention that there are no significant positive changes in the physical development and physical fitness of most students while studying at HEI. The authors explain this situation by the weak organization of work on physical education and the lack of individual approach to students in physical exercises.

Thus, according to literature sources [24-27], it is established that the main reasons for the low level of physical fitness and health of young students are the devaluation of the social prestige of a healthy lifestyle; underestimation of the social, health and educational role of physical education and mass-participated sports at HEI; a low level of the physical state of high school students and graduates who entered the university; the reduction of students' interest in the traditional form of physical education classes; the focus of the physical education process on students' compliance with control standards; the lack of individual approach in the process of physical education; unsatisfactory conditions of study at HEI, which are related to the lack of material and technical base and sports equipment, etc. All of the above determines the relevance of conducting research to find new efficient forms and means of intensifying the physical education process at HEI.

The aim of the study is to investigate the physical fitness dynamics of Ukrainian students during the period of study at higher educational institutions.

3. Method

The level of physical fitness was assessed by the results in exercises that characterize the development of basic physical qualities: speed qualities (100 m run), speed and power qualities (long standing jump), power qualities (pull-ups, push-ups, and sit-ups for males; flexed arm hang, push-ups, and sit-ups for females), endurance (3000 m run for males and 2000 m run for females), flexibility (bending forward from a sitting position), agility (4 x 9 m shuttle run).

The study was conducted in Polissia National University (PNU) in 2013-2019. 16 groups of the students from the faculties of economics, agronomy, ecology, technology, agricultural management, and agriculture mechanization took part in the study; in total, the research involved 369 people, including 195 males and 174 females. The study involved the students of the 1st-4th years of study. It was conducted according to the regulatory requirements listed in Table 1. The processing of the obtained results, their analysis, and formulation of conclusions was carried out at the Department of Physical Education of the

Polissia National University, Zhytomyr, Ukraine.

Table 1. Regulatory standards for physical fitness of students [28]

Physical qualities	Tests	Gender	Standards/ points				
			5	4	3	2	1
Speed	100 m run, s	male	13.2	13.9	14.4	14.9	15.5
		female	14.8	15.6	16.4	17.3	18.2
Endurance	3000 m run, min, s	male	12.00	13.05	14.30	15.40	16.30
	2000 m run, min, s	female	9.40	10.30	11.20	12.10	13.10
Speed and power	Long standing jump, cm	male	260	241	224	207	190
		female	210	196	184	172	160
Power	Pull-ups, reps	male	16	14	12	10	8
	Flexed arm hang, s	female	21	17	13	9	5
	Push-ups, reps	male	44	38	32	26	20
		female	24	19	16	11	7
	Sit-ups in 1 min, reps	male	53	47	40	34	28
		female	47	42	37	33	28
Agility	4 x 9 m shuttle run, s	male	8.8	9.2	9.7	10.2	10.7
		female	10.2	10.5	11.1	11.5	12.0
Flexibility	Bending forward from a sitting position, cm	male	19	16	13	10	7
		female	20	17	14	10	7

The following research methods were used to achieve the objectives: theoretical (the analysis and generalization of scientific and educational literature on physical education, the methods of conceptual and comparative, system and structural analysis), which made it possible to determine the state of physical fitness of students and the level of the individual physical qualities development, to systematize and generalize information about the object under study - the physical fitness level of students; empirical (pedagogical observation, testing) to diagnose the level of the physical qualities development of HEI students while studying at university; statistical data processing methods, which included the average statistical analysis of research results, were used for qualitative and quantitative processing of experimental data. During the examinations, the authenticity of the difference between the students' indicators at the beginning and at the end of the investigation was determined due to the Student's t-test. The significance for all statistical tests was set at $p < 0.05$.

4. Results and Discussion

It is known that the general physical fitness of students is determined by the level of physical qualities development. The physical fitness analysis of the students of the main educational department of PNU (Tables 2 and 3) stated that the physical fitness level of the students of the 1st-4th years was considered unsatisfactory. During the period of study at HEI, both male and female students did not significantly improve the results in most tests. Moreover, the students' results in the exercises for the development of endurance (3000 m run for males, 2000 m run for females), power (sit-ups for males, flexed arm hang for females), flexibility (bending forward from a sitting position for females) decreased during the study at HEI.

Table 2. The physical fitness dynamics of the students of PNU (males, n=195)

Tests	The year of study			
	1 st	2 nd	3 rd	4 th
3000 m run (min, s)	13.44.8 ± 1.15	13.33.9 ± 1.06	14.14.2 ± 0.54	14.05.3 ± 0.58
100 m run (s)	14.16 ± 0.69	14.10 ± 0.73	14.10 ± 0.62	14.12 ± 0.62
Long standing jump (cm)	220.48 ± 21.54	225.49 ± 13.87	225.30 ± 17.47	227.11 ± 17.39
Push-ups (reps)	36.17 ± 7.46	39.37 ± 7.26	38.23 ± 6.23	39.96 ± 5.36
Pull-ups (reps)	10.17 ± 4.89	11.49 ± 3.03	10.17 ± 3.52	11.02 ± 3.15
Sit-ups in 1 min (reps)	41.19 ± 7.26	42.10 ± 6.48	38.66 ± 10.49	40.91 ± 7.38
4 x 9 m shuttle run (s)	9.83 ± 0.58	9.59 ± 0.48	9.54 ± 0.50	9.40 ± 0.42
Bending forward from a sitting position (cm)	8.00 ± 6.80	10.92 ± 6.96	10.40 ± 6.32	10.49 ± 5.87

The analysis of the obtained data showed that the physical fitness level of male students was significantly better than that of females. The male students of the 1st year gained 1.5-6.0 points, 2nd year - 2.3-6.6 points, 3rd year - 2.0-5.3 points, 4th year - 2.1-5.6 points. The female students' results were slightly lower, namely, the female students of the 1st year of study gained 1.0-4.3 points, 2nd year - 1.5-4.5 points, 3rd year - 1.6-3.5 points, 4th year - 1.2-3.2 points. The comparison of the obtained results with the conclusions of many authors [2, 7, 10] showed that the students' physical fitness indicators did not differ significantly and were mainly unsatisfactory. Our data confirm that this state of physical qualities development is characteristic of the majority of Ukrainian HEI.

Table 3. The physical fitness dynamics of the students of PNU (females, n=174)

Tests	The year of study			
	1 st	2 nd	3 rd	4 th
2000 m run (min, s)	11.49.5 ± 1.13	11.38.6 ± 0.44	11.57.2 ± 0.48	12.08.5 ± 0.52
100 m run (s)	17.98 ± 1.11	17.44 ± 0.99	17.51 ± 1.44	17.74 ± 1.23
Long standing jump (cm)	163.60 ± 11.83	170.34 ± 13.18	169.11 ± 11.16	172.00 ± 11.34
Push-ups (reps)	12.26 ± 6.23	16.57 ± 5.60	13.00 ± 5.98	14.36 ± 6.08
Flexed arm hang, s	11.21 ± 8.31	13.14 ± 5.64	10.55 ± 6.67	10.41 ± 6.00
Sit-ups in 1 min (reps)	35.81 ± 7.61	38.66 ± 8.70	37.98 ± 7.18	38.36 ± 6.70
4 x 9 m shuttle run (s)	11.61 ± 0.57	10.90 ± 0.56	11.21 ± 0.54	11.06 ± 0.55
Bending forward from a sitting position (cm)	12.85 ± 6.08	14.89 ± 5.14	12.93 ± 6.50	12.61 ± 5.68

According to the scale of the test results assessment specified in the State tests of the physical fitness assessment, five levels of physical fitness are derived: high, above the middle, middle, below the middle, and low [28]. All levels are evaluated with appropriate grades - 5-1 points. We introduced an additional physical fitness level - "very low", which accounted for "0" grade, for the students who received less than 9 points for compliance with all the standards (this scale does not distinguish such grade). The study confirmed the need for such an assessment because 1.9-4.3% of male students had such a level of physical fitness, which accounted for less than 9 points for the implementation of eight standards (Table 4). These figures were even lower among female students - 4.5-10.6% (Table 5).

Table 4. The generalized indicators of the PNU male students' distribution by the physical fitness level

The year of study	Points / % of male students						Total point	Grade points
	"5"	"4"	"3"	"2"	"1"	"0"		
1 st	-	9.6	46.2	40.4	1.9	1.9	24.1	2.63
2 nd	2.1	22.4	49.0	26.5	-	-	27.4	3.00
3 rd	-	29.8	34.0	25.5	6.4	4.3	24.4	2.79
4 th	2.1	23.4	51.1	17.0	4.3	2.1	26.2	2.96
Average data	1.0	21.0	45.1	27.7	3.1	2.1	25.5	2.84

Table 5. The generalized indicators of the PNU female students' distribution by the physical fitness level

The year of study	Points / % of female students						Total point	Grade points
	"5"	"4"	"3"	"2"	"1"	"0"		
1 st	-	2.1	20.8	41.6	29.2	6.3	16.9	1.83
2 nd	-	4.5	50.1	38.6	2.3	4.5	21.9	2.48
3 rd	4.3	12.8	10.6	38.3	23.4	10.6	19.0	2.08
4 th	-	7.7	21.1	48.1	15.4	7.7	18.4	2.04
Average data	1.1	6.8	25.1	41.9	17.8	7.3	19.0	2.10

Among the male students of the 1st and 3rd years, there were no students with a high level of physical fitness identified. In the 2nd and 4th years of study, the number of such students accounted for 2.1%. During the period of study at HEI, the number of students with above the middle level of physical fitness tended to increase in the 2nd, 3rd, and 4th years of study. In the first year, their number accounted for 9.6% of the total number of respondents, and in the senior year, it increased two or three times. The number of students with the middle level of physical fitness was the highest in the 4th year (51.1%) and the lowest (34.0%) in the 3rd year. In the 1st year, it accounted for 46.2%, and in the 2nd year, the number of males with the specified level of physical fitness was slightly increased – 49.0%. In the first year of study, the number of males with below the middle level of physical fitness was 40.4% of the total number of respondents. In the 2nd year, their number decreased to 26.5%, in the 3rd – to 25.5%, and in the 4th – to 17%. The number of students with a poor and very poor level of physical fitness determined in the 1st year of study accounted for 3.8%, no students with such level were indicated in the 2nd year, and this number increased significantly to 10.7% in the 3rd year, and to 6.4% in the 4th year. Thus, it was defined that during the four years of study at HEI, the physical fitness level of males' had been increasing by the 2nd year, and then it was slowed down and became lower. In the 4th year, there was a slight increase. The highest physical fitness level of males was observed in the 2nd year, and the lowest – in the 1st.

There were no females with a high level of physical fitness during the period of study at HEI, except for the third year, where 4.3% of females with such levels were found. Only 2.1% of female students with a higher than the middle level of physical fitness were found in the 1st year, 4.5% in the 2nd year, 12.8% in the 3rd year, and 7.7% in the 4th year. There were 20.8% female students with the middle level of physical fitness in the 1st year, 50.1% in the 2nd year, 10.6% in the 3rd year, and 21.1% in the 4th year. It was determined that the number of females who had below the middle level of physical fitness accounted for 41.6% in the 1st year, 38.6% in the 2nd, 38.3% in the 3rd, 48.1% in the 4th. The first-year female students were revealed to have the highest rate of low and very low physical fitness level – 35.5%, the second-year female students had the best rate – 6.8%.

Analyzing the physical fitness dynamics of students, it can be noted that the quantitative composition of students attributed to a particular physical fitness level differs among the authors, and in general, it characterizes a very low state of physical fitness of Ukrainian students, especially females. The number of females with poor and very poor physical fitness level was 9.3 times higher than the number of males with the same physical fitness level in the 1st year. There was a tendency to an increase in the number of female students with this level of physical fitness in the 3rd and 4th years. The difference in the indicators by different authors may depend on the total sample of students, specialty, region, methods of training, the level of physical fitness of students before entering HEI, the testing period, etc.

The dynamics indicators of the students' physical fitness during the period of study at HEI can provide fairly clear criteria for assessing the state of the physical education process, the development level of physical qualities and motor skills, the adequacy of tools and techniques used in the educational process, sports and mass-participated health and fitness activities, etc. The low level of the students' physical fitness is accompanied by the lack of confidence in their actions, depression, adaptive discomfort, and the deterioration of recovery processes during physical and mental stress, satisfactory performance of the cardiovascular system, etc.

In order to determine the physical fitness dynamics of students during the period of study at HEI, we assessed the students' physical fitness level in each year of study. The dynamics of the students' physical fitness are presented in Tables 6 and 7.

Table 6. The difference in the physical fitness of the PNU students of the 1st-4th years (males)

The types of tests	The difference between the years of study					
	1 st – 2 nd	1 st – 3 rd	1 st – 4 th	2 nd – 3 rd	2 nd – 4 th	3 rd – 4 th
3000 m run (min, s)	+ 10.9	- 29.4	- 20.5	- 40.2	- 31.3	+ 8.9
100 m run (s)	+ 0.06	+ 0.06	+ 0.04	0.00	- 0.02	- 0.02
Long standing jump (cm)	+ 5.01	+ 4.82	+ 6.63	- 0.19	+ 1.62	+ 1.81
Push-ups (reps)	+ 3.20	+ 2.06	+ 3.79	- 1.14	+ 0.59	+ 1.73
Pull-ups (reps)	+ 1.32	0.00	+ 0.85	- 1.32	- 0.47	+ 0.85
Sit-ups in 1 min (reps)	+ 0.91	- 2.53	- 0.28	- 3.44	- 1.19	+ 2.25
4 x 9 m shuttle run (s)	+ 0.24	+ 0.29	+ 0.43	+ 0.05	+ 0.19	+ 0.14
Bending forward from a sitting position (cm)	+ 2.92	+ 2.40	+ 2.49	- 0.52	- 0.43	+ 0.09

Note. «+» – positive changes; «-» – negative changes

The results show that during the period of study at HEI, test results did not increase in terms of all physical qualities. Both male and female students of the second year were indicated to have the largest increase in results in almost all exercises. Starting from the 2nd year, the growth rate of males was slowed down and decreased concerning some indicators. There was a slight increase in the physical fitness level from the 3rd to the 4th year. On the contrary, there was a slowdown in the growth rate of the females' physical fitness after the 2nd till the 4th year. In the dynamics of four years of study, the total point of the male students' physical fitness was significantly unchanged and accounted for 24.1; 27.4; 24.4; 26.2 points respectively, with the average result for the educational institution – 25.5 points. The dynamics of the female students' physical fitness had significantly worse results, namely 16.9; 21.9; 19.0; 18.4 points, with the average result 19.0 points.

The research showed that the current methods of physical education do not provide an increase in the physical fitness of a large number of students to the level of curriculum and state tests requirements during the period of study at HEI, and the progressive form of organizing classes with a specific sports focus has not been widely used in the work of the departments of physical education.

Table 7. The difference in the physical fitness of the PNU students of the 1st-4th years (females)

The types of tests	The difference between the years of study					
	1 st – 2 nd	1 st – 3 rd	1 st – 4 th	2 nd – 3 rd	2 nd – 4 th	3 rd – 4 th
2000 m run (min, s)	+ 10.9	- 7.7	- 19.0	- 18.6	- 29.4	- 11.3
100 m run (s)	+ 0.54	+ 0.47	+ 0.24	- 0.07	- 0.30	- 0.23
Long standing jump (cm)	+ 6.74	+ 5.51	+ 8.40	- 1.23	+ 1.66	+ 2.89
Push-ups (reps)	+ 4.31	+ 0.74	+ 2.10	- 3.54	- 2.21	+ 1.36
Flexed arm hang, s	+ 1.93	- 0.66	- 0.80	- 2.59	- 2.73	- 0.14
Sit-ups in 1 min (reps)	+ 2.85	+ 2.17	+ 2.55	- 0.68	- 0.30	+ 0.38
4 x 9 m shuttle run (s)	+ 1.61	+ 0.40	+ 0.55	- 0.31	- 0.16	+ 0.15
Bending forward from a sitting position (cm)	+ 2.04	+ 0.08	- 0.24	- 1.96	- 2.28	- 0.32

Note. «+» – positive changes; «-» – negative changes

The studies also defined that the females' physical fitness results are significantly lower during the whole period of study. This indicates a lack of efficiency in the current system of physical education at HEI of Ukraine. Ensuring a positive level of the students' physical fitness during the period of study at HEI requires changes not only in the system of training classes' organization but in general in the system of physical culture and health activities. Among the reasons for the decrease in the physical fitness level of senior students, the following issues can also be identified: insufficient health-improving and training orientation of physical education; insufficient material and technical base of HEI; the low motor activity of students; the lack of students' interests, motives, and needs for physical exercises; insufficient development of the content of independent physical exercises, etc.

5. Conclusions

The improvement of the physical education process of students requires scientific substantiation of the most effective methodological approaches and technologies for organizing and conducting classes, fitness, and health activities, as well as encouraging students to personally choose the type of physical activity or sports improvement. One of the criteria for evaluating the efficiency of the physical education process of HEI students is the level of general physical fitness and the development of certain physical qualities, as well as their positive dynamics throughout the period of study. The experimental work on determining the efficiency of the system of physical education for students in Ukraine proves the low efficiency, functionality, and adaptability of the existing system of physical education at HEI of Ukraine.

It was determined that during the period of study at HEI, both male and female students had no significant improvement in the results in the majority of tests. Moreover, the students' results in the exercises for the development of endurance (3000 m run for males, 2000 m run for females), power (sit-ups for males, flexed arm hang for females), flexibility (bending forward from a sitting position for females) decreased during the study at HEI. The analysis of the dynamics of the students' physical qualities development stated that the physical fitness level of both male and female students of the 1st-4th years was generally unsatisfactory. At the same time, females' physical fitness results were significantly lower than that of the males' throughout the study period. This indicates a lack of efficiency of the current system of physical education at higher educational institutions of Ukraine.

The scientific approach to the process of physical education of students requires new technologies of physical education, namely person-centered physical education, which should consider the process of purposeful development of the value potential of physical culture and sports, values of physical self-improvement and a healthy lifestyle, the development of motor skills, individual fitness, and healthy lifestyle and social activity.

The prospects for further research are aimed at developing a new system of physical education for students in accordance with the European education system at HEI, at giving priority to a person-centered choice of the types of physical activity that will enhance the motivational and value-based attitude of students to physical education.

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