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## Physical Fitness Level of Students of Higher Educational Institutions from a Historical Perspective

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### Abstract

The article presents an analysis of the physical fitness level of the students of Ukrainian higher educational institutions during the last forty years. The physical fitness level of students was assessed by the results of exercises that characterize the development of basic physical qualities: speed (the 100 m run), power (pull-ups for males and push-ups for females), endurance (the 3000 m run for males and the 2000 m run for females), speed and power qualities (standing long jump). The study was conducted on the indicators of students (n=3964, including 1734 males and 2230 females) in 1982-2019. The research proved that the physical fitness level of parents was not better than that of their children – modern students: the results of the students of 2018-2019 in most of the exercises did not differ significantly from that of the students of the 80-90s of the last century ( $p>0.05$ ). The study defined that the low level of the students' physical fitness dates back to Soviet times. However, the worst level of the students' physical qualities development was found in 2018-2019; among the physical qualities of both males and female students, the worst development level was defined in the endurance and power exercises; females were determined to have a worse level than males which indicated the imperfection of the system of physical education in Ukraine, low motivation of students and unsatisfactory state of sporting and mass-participation health and fitness activities at higher educational institutions. The research determined that the system of physical education of the past is practically actual in Ukraine nowadays and it needs significant changes. This leads to the introduction of modern technologies of physical education and sports, the creation and modernization of

the material and technical base of higher educational institutions, the improvement of the system of physical education at school, conducting the research to improve teaching methods in physical education, intensifying the educational process of physical education taking into account the students' person-centered choice of motor activity and a complex of ecological, socio-economic, psychological and pedagogical, sanitary and hygienic factors.

**Keywords:** physical education, physical fitness, physical qualities, adolescent student.

## 1. Introduction

Physical education at higher educational institutions (HEI) of Ukraine is aimed at improving the functional capabilities of students, the development of their physical qualities (power, speed, endurance, flexibility, coordination) while improving special physical and technical readiness in motor activities, at activating volitional manifestations and the acquisition of professionally applied psychophysical skills and abilities, and in general, at the improvement of the students' health [1, 2]. The students' physical fitness level affects one's working performance, health status, and the general readiness of a specialist for professional activity in the future [3, 4].

One of the most important objectives of the system of physical education in Ukraine is to strengthen the health and physical fitness of students, to promote the acquisition of skills and abilities to use physical culture and sports in everyday life to maintain high efficiency and body recovery [5, 6]. The attitude of society to physical culture and sports at HEI requires the knowledge of health-improving aspects of the physical education process, which are based on morphofunctional capabilities, the initial level of physical fitness, the feature of the students' disease incidence, the specifics of future professional activities, etc. [7, 8, 9].

Recent researches [10, 11] suggest that the actual level of psychophysical readiness of the HEI graduates in Ukraine does not meet the modern requirements of life and professional work. This trend was confirmed by occupational diseases, injuries of the representatives of extreme and creative professions; the disorders in production technical processes related to the insufficient level of the physical and mental qualities performance of graduates [12, 13].

Physical fitness is an important characteristic of health and an integral indicator of the students' physical activity [14]. The students' physical fitness level depends on one's mastery of the means, forms, and types of physical education that are used during educational and independent physical exercises. Using appropriate physical exercises and regulating the intensity of their performance, one can purposefully influence the stimulation of all body systems, increase the level of their functioning, thereby ensuring a high level of the students' physical fitness of students [15].

A significant amount of research is aimed at improving the students' physical fitness, increasing the educational and humane orientation of physical education, developing interests and motives for physical exercises, refining program regulations for the educational process, forming a healthy lifestyle, enhancing physical activity, improving the assessment system of the students' physical fitness level, etc. [16, 17, 18, 19]. Despite such a wide range of research, the scientists are united in the fact that to improve the physical fitness of students, it is necessary to develop physical qualities on the basis of modern scientific advances comprehensively, systematically, and purposefully. The problem is that on the one hand, physical education should help ensure optimal adaptive responses of students' organism to the effects of activities and social living conditions, and on the other hand, physical education that does not take into account the total influence of general physical activity, social factors and training activity on the body, can not fully ensure the efficiency of physical education, high resistance of the body to adverse environmental conditions, sufficient performance and quality of life [20, 21].

The mentioned facts indicate that the physical education system at HEI and a methodology for organizing and carrying out classes need further improvement, development, and scientific substantiation of the ways of educational process intensification. This obliges the researchers and teachers of higher education to look for new forms and methods of conducting classes, necessitates to organize the educational process in the way that the minimum number of weekly classes is maximally efficient [22]. One of the directions of this work is to find ways to improve the physical fitness level of students in the process of physical education. Many years of experience and research [23, 24] suggest that the physical fitness of HEI students is laid in the early years, especially while at school. The content and level of activities in physical education classes, and

ultimately the physical fitness level will largely depend on the level of readiness and health of a HEI applicant [25].

The study of the dynamics of the students' physical fitness from a historical perspective will make it possible to assess the external influence factors and physical education means for further improvement of the physical education process at HEI of Ukraine.

## 2. Literature Review

The analysis of special literature [26, 27] shows that the existing methods of organizing physical education do not provide an increase in the physical fitness of a significant part of students during the period of study at HEI. Physical fitness is the student's readiness to perform the physical activities provided by the curriculum. It shows the level of the physical qualities development that has been achieved in the process of physical education. Physical fitness is the result of the students' physical activity, which is an integral indicator because almost all organs and systems of the body interact during the performance of physical exercises [1].

According to many scientists [28, 29], the indicators of the students' physical fitness dynamics while studying at HEI can provide quite clear criteria for assessing the state of the physical education process, the level of physical qualities and motor skills development, the adequacy of means and methodologies used in the education process, sporting and mass-participation health and fitness activities, etc. Investigating the students' physical fitness dynamics during the whole period of study at HEI, the scientists found that the growth rate of the physical fitness indicators was slowed down after the second year of study, and significantly reduced in the third, fourth and fifth years [30, 31]. The senior students, who had stopped attending compulsory physical education classes and did not engage in physical exercises and sports on their own, showed a decrease in physical performance and health deterioration [9, 20].

Some studies [32, 33], which are aimed at investigating the students' physical fitness dynamics for the first two years of study, can not give a complete picture of the dynamics of the students' physical fitness during study at HEI. The researches of many scientists [34, 35] indicate that the dynamics of the physical qualities growth rate are different and depend on the initial level. According to scientists, students with a low level of readiness have the greatest intensity of physical fitness growth. As a result, the level of physical fitness of students has been gradually equalized by the end of the first year. The highest rates of physical fitness are observed in the second year, owing to the age period which brings the greatest positive changes to the body and its functions. The other studies [11, 26, 31] indicate that there are no significant positive changes in the physical development and physical fitness of most students during the study at HEI. The authors explain this by the poor organization of the work on physical education and the lack of individual approach to students conducting physical exercises.

Analyzing the physical fitness dynamics of the students of different years of study according to the results of research [2, 5, 16, 36], it can be noted that the numerical composition of students, attributed to a particular level of physical fitness, differs among the authors, and in general, it characterizes a rather low physical fitness state of Ukrainian students, especially female. The number of female students with a poor and very poor level of physical fitness is several times higher than the number of males with a similar level of physical fitness in the first year of study [4, 9, 17]. There are big numbers of female students with the same level of physical fitness in the third and fourth years of study. The indicators difference of various authors depends on the total sample of students, specialty, region, methodology of training, the physical fitness level of students before entering a HEI, testing period, etc.

In general, the scientists [3, 6, 7, 21, 23] state the low physical fitness level of the students in most regions of Ukraine. According to scientists, power, endurance, and speed-power qualities are developed the worst. Flexibility and speed are developed at a slightly higher level. The students of one age group are characterized by dissimilar physical fitness level. Most students with a low level of physical fitness are characterized by asthenic body type, due to the fact that their body weight and chest volume are less than the normal. The insufficient level of the students' physical fitness and the lack of the trend towards its development during study at HEI are conditioned by the low quality of physical education both at school and at HEI, the intensification of bad habits among young students, the lack of interest and persistent motivation for regular physical exercises. The low physical fitness level of students comes with uncertainty

in their actions, depression, adaptive discomfort, the deterioration of recovery processes during physical and mental activity, satisfactory performance of the cardiovascular system, etc. [20, 29, 32].

**The aim of the study** is to investigate the physical fitness level of the students of Ukrainian higher educational institutions from a historical perspective.

### 3. Method

The physical fitness level of students was assessed by the results in the exercises that characterize the development of basic physical qualities: speed (the 100 m run), power (pull-ups for males and push-ups for females), endurance (the 3000 m run for males and the 2000 m run for females), speed and power qualities (standing long jump). The study was conducted in 1982-2019 on the indicators of students (n=3964, including 1734 males and 2230 females), who were studying at Zhytomyr Agricultural Institute (1982-1991), Zhytomyr Agroecological University (1992-1998), Zhytomyr National Agroecological University (1998-2019), National Polissia University (from 2019 to date). The study involved first-year students according to the regulatory requirements presented 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 National Polissia University (Zhytomyr, Ukraine).

**Table 1.** The established standards for the physical fitness of students [37]

Tests	Gender	The standards (grades)				
		5	4	3	2	1
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
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
Standing long jump, cm	male	260	241	224	207	190
	female	210	196	184	172	160
Pull-ups, reps	male	16	14	12	10	8
Push-ups, reps	female	24	19	16	11	7

The following research methods were used to achieve the aim of the study: theoretical (the analysis and generalization of scientific, educational and methodical literature on physical education, the methods of conceptual and comparative, system and structural analysis), which made it possible to determine the past and present state of the students' physical fitness and level of 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 physical qualities development of HEI students during the long historical period; statistical data processing methods, which included the statistically average analysis of the 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

The analysis of the results of both males and females in the 100 m run shows a clear pattern: the results of the female students in the 100 m run corresponded to the unsatisfactory grade during all the period, and the results of the male students – to the satisfactory grade (Table 2).

**Table 2.** The dynamics of the students' results (both male and female) in the 100 m run during the study period (1982-2019), Mean $\pm$ SD, s

The years of study	The number of students	The study participants	
		Male (n=1734)	Female (n=2230)
1982	n=67 males, 78 females	14.2 $\pm$ 0.11	17.6 $\pm$ 0.13
1986	n=82 males, 93 females	14.1 $\pm$ 0.10	17.5 $\pm$ 0.12
1990	n=88 males, 103 females	14.3 $\pm$ 0.09	17.8 $\pm$ 0.11



1994	n=97 males, 105 females	14.1±0.09	17.7±0.09
1998	n=112 males, 129 females	14.0±0.08	17.6±0.10
2002	n=184 males, 247 females	14.2±0.06	17.8±0.07
2006	n=258 males, 387 females	14.1±0.05	17.9±0.06
2010	n=294 males, 438 females	14.2±0.05	17.7±0.04
2014	n=217 males, 295 females	14.2±0.06	18.1±0.07
2018	n=187 males, 212 females	14.3±0.07	18.2±0.08
2019	n=148 males, 143 females	14.4±0.08	18.4±0.09
$p^{1982-2019}$		>0.05	<0.001

Legend: Mean – arithmetical average; SD – standard deviation;  $p^{1982-2019}$  – the significance of difference between the indicators of students at the beginning (1982) and at the end (2019) of the investigation according to the Student's t-test

In general, there was a tendency of insignificant alternation of the improvement and deterioration of results in the 100 m run of both males and females throughout the study period. It should be noted that the worst results of the students (both male and female) in the 100 m run were recorded in 2018-2019 when physical education was transferred to an optional and independent form of training in Ukraine. The difference between the indicators of the speed qualities development of male students in 1982 and 2019 accounted for 0.2 s and was not authentic ( $p>0.05$ ), the results of female students in the 100 m run were significantly decreased by 0.8 s ( $p<0.001$ ). The analysis of the results in the 100 m run showed that the introduction of a number of methodologies in the physical education process in the early 2000s, which should have significantly improved the students' results in physical education and encouraged them to develop basic physical qualities, did not lead to the development of speed.

The analysis of the male students' results in the 3000 m run showed that throughout the study period, the level of endurance development was assessed as satisfactory (Table 3). In the 90s the results began to deteriorate and reached 14.22.6 min, s in 1998. In subsequent years, the males' performance in the 3000 m run began to improve and reached the highest result 13.21.9 min, s in 2006. Since 2010 the results have started to deteriorate; the worst level of endurance development – 14.26.1 min, s was recorded in 2019, which confirmed the lack of the physical education system efficiency in Ukraine. It was found that during the study period, the results of male students in the 3000 m run deteriorated by 1.28.9 min, s, however, no significant difference between the indicators of 1982 and 2019 was found ( $p>0.05$ ). The average indicators in the 3000 m run also have some differences among various authors that may depend on the experimental sample of students, the testing period (at the beginning or at the end of the term), climatic conditions, region, HEI, etc.

**Table 3.** The dynamics of the students' results in the 3000 m run (males) and the 2000 m run (females) during the study period (1982-2019), Mean±SD, min, s

The years of study	The number of students	The study participants	
		Male (n=1734)	Female (n=2230)
1982	n=67 males, 78 females	13.37.2±1.84	12.24.2±1.93
1986	n=82 males, 93 females	13.41.7±1.96	12.13.3±1.98
1990	n=88 males, 103 females	14.09.5±1.07	11.57.8±1.76
1994	n=97 males, 105 females	14.12.7±1.13	11.49.8±1.68
1998	n=112 males, 129 females	14.22.6±1.31	11.58.8±1.73
2002	n=184 males, 247 females	13.57.8±0.97	12.07.6±1.56
2006	n=258 males, 387 females	13.21.9±0.88	11.42.3±1.17
2010	n=294 males, 438 females	13.32.3±0.84	11.57.8±0.93
2014	n=217 males, 295 females	13.33.6±1.16	12.07.4±1.89
2018	n=187 males, 212 females	14.18.4±1.12	12.27.9±1.94
2019	n=148 males, 143 females	14.26.1±1.29	12.51.4±1.96
$p^{1982-2019}$		>0.05	>0.05

Legend: Mean – arithmetical average; SD – standard deviation;  $p^{1982-2019}$  – the significance of difference between the indicators of students at the beginning (1982) and at the end (2019) of the investigation according to the Student's t-test

The analysis of the female students' results in the 2000 m run showed that the level of endurance development was assessed as unsatisfactory in 1982 and 1986, as well as in 2014-2019 and as satisfactory during all other years of the study. The results were improved in 2000 when the university had introduced a modular rating system for assessing the physical fitness level of students. The best result in the 2000 m run was recorded in 2006 (11.42.3 min, s), and the worst – in 2018 and 2019 (12.27.9 and 12.51.4 min, s). The difference between the female students' indicators of the 2000 m run in 1982 and 2019 accounted for 27.2 s and was unreliable ( $p>0.05$ ) (Table 3).

The study of the results in the standing long jump indicated that the results of male students were in the range of 218.1–229.1 cm during the whole study period (Table 4). In the period from 1982 to 2006, there was a slight improvement in the speed and power qualities of students. And there has been a steady decline in results since 2010 to date. In 2019, the lowest result in the standing long jump – 218.1 cm was recorded. At the same time, the level of speed and power qualities development of male students was assessed as satisfactory in 1990-2010, and as unsatisfactory in 1982, 1986, 2014-2019. During the study period, the performance of male students decreased by 5.5 cm, but the difference between the results of 1982 and 2019 was not authentic ( $p>0.05$ ). Throughout the study period, the results of female students in the standing long jump were in the range of 163.9–172.6 cm, which corresponded to unsatisfactory grade (Table 4). It was also found that during the study period, the results were changed slightly, but no significant difference was found ( $p>0.05$ ). The lowest level of the speed and power qualities development of female students was found in 2019 (163.9 cm). This indicates that the Ukrainian physical education system for students is degrading; all current recommendations of the Ministry of Education and Science of Ukraine are not able to stop the decline in the level of physical fitness of young students.

**Table 4.** The dynamics of the students' results in the standing long jump during the research period (1982-2019), Mean $\pm$ SD, cm

The years of study	The number of students	The study participants	
		Male (n=1734)	Female (n=2230)
1982	n=67 males, 78 females	223.6 $\pm$ 3.11	171.3 $\pm$ 2.86
1986	n=82 males, 93 females	223.6 $\pm$ 3.07	171.6 $\pm$ 2.93
1990	n=88 males, 103 females	224.8 $\pm$ 3.04	169.1 $\pm$ 2.74
1994	n=97 males, 105 females	225.2 $\pm$ 2.99	168.7 $\pm$ 2.34
1998	n=112 males, 129 females	226.5 $\pm$ 2.93	169.2 $\pm$ 2.29
2002	n=184 males, 247 females	228.7 $\pm$ 2.74	172.6 $\pm$ 2.05
2006	n=258 males, 387 females	229.1 $\pm$ 2.23	168.2 $\pm$ 1.97
2010	n=294 males, 438 females	224.2 $\pm$ 2.19	167.4 $\pm$ 1.85
2014	n=217 males, 295 females	221.8 $\pm$ 2.54	166.7 $\pm$ 2.12
2018	n=187 males, 212 females	219.4 $\pm$ 2.71	165.7 $\pm$ 2.28
2019	n=148 males, 143 females	218.1 $\pm$ 2.83	163.9 $\pm$ 2.55
p <sup>1982-2019</sup>		>0.05	>0.05

Legend: Mean – arithmetical average; SD – standard deviation; p<sup>1982-2019</sup> – the significance of the difference between the indicators of students at the beginning (1982) and at the end (2019) of the investigation according to the Student's t-test

The evaluation of the male students' results in pull-ups showed that throughout the study period, the level of power qualities development was assessed as unsatisfactory. The results in pull-ups were in the range of 7.5-10.3 reps, which was significantly lower than in the 100 m run and in the standing long jump (Table 5). The highest results in pull-ups were obtained in 2002-2010, when the university had introduced a modular rating system for assessing the physical fitness of students and additional minimum requirements for pull-ups for each year of study. The worst results in this exercise were recorded in 2019 (7.5 times). It was defined that during the study period, the level of the male students' power qualities tended to deteriorate, but an authentic difference between the indicators of 1982 and 2019 was not determined ( $p>0.05$ ).

The assessment of the female students' power qualities in push-ups showed that the level of the power qualities development of females was assessed as unsatisfactory at all stages of the study – the average results were in the range of 7.4-13.3 times (Table 5). The dynamics of the female students' results

improvement were observed in 2002-2010, and in subsequent years there is deterioration in the level of strength in female students. The worst results were determined in 2019. During the study period, the results of female students decreased by 0.9 times but did not change authentically ( $p>0.05$ ).

**Table 5.** The dynamics of the students' results in pull-ups (males) and push-ups (females) during the study period (1982-2019), Mean $\pm$ SD, reps

The years of study	The number of students	The study participants	
		Male (n=1734)	Female (n=2230)
1982	n=67 males, 78 females	8.4 $\pm$ 0.61	8.3 $\pm$ 0.46
1986	n=82 males, 93 females	8.1 $\pm$ 0.58	8.9 $\pm$ 0.44
1990	n=88 males, 103 females	7.7 $\pm$ 0.62	10.4 $\pm$ 0.42
1994	n=97 males, 105 females	7.9 $\pm$ 0.67	8.9 $\pm$ 0.39
1998	n=112 males, 129 females	8.4 $\pm$ 0.55	9.1 $\pm$ 0.40
2002	n=184 males, 247 females	10.3 $\pm$ 0.48	10.8 $\pm$ 0.32
2006	n=258 males, 387 females	8.5 $\pm$ 0.40	12.5 $\pm$ 0.29
2010	n=294 males, 438 females	10.1 $\pm$ 0.37	13.3 $\pm$ 0.27
2014	n=217 males, 295 females	9.1 $\pm$ 0.39	9.0 $\pm$ 0.31
2018	n=187 males, 212 females	8.1 $\pm$ 0.42	7.9 $\pm$ 0.36
2019	n=148 males, 143 females	7.5 $\pm$ 0.54	7.4 $\pm$ 0.39
$p^{1982-2019}$		$>0.05$	$>0.05$

Legend: Mean – arithmetical average; SD – standard deviation;  $p^{1982-2019}$  – the significance of the difference between the indicators of students at the beginning (1982) and at the end (2019) of the investigation according to the Student's t-test

Thus, the analysis of the results of the tests that were conducted in Soviet times and their comparison with modern results of similar tests suggests that the physical fitness level of parents was not better than that of modern students, who are their children. Therefore, it can be concluded that a low physical fitness level of students was laid in Soviet times. The Soviet system of physical education is actual in Ukraine nowadays; it needed significant changes, the introduction of modern technologies of physical education for students and the improvement of technical equipment of sports bases and their further construction in HEI of Ukraine. At the same time, the incompetence of the office of the Ministry of Education and Science of Ukraine, which was responsible for physical education, instead of reforming the quality of physical education, the introduction of modern fitness technologies, began to destroy the discipline of Physical Education. The departments of physical education were closed, the teaching staff was reduced, and physical education was conducted as an optional discipline once a week at many HEI. Only public resistance, the speeches of experts on television, and the press did not allow the complete destruction of physical education at HEI of Ukraine.

The introduction of new forms and technologies of physical education requires the creation of a fundamentally new infrastructure of the national system of physical education for students. The theoretical, methodological, and legal principles of designing this infrastructure and its further operation should be laid down in the national doctrine of the physical education of Ukrainian pupils and students. In terms of updating the capital funds of material and technical support of mass-participated physical education of students, it is necessary to ensure the design and construction of various standards options for educational and sports facilities and their operation throughout the day. The main requirement for such facilities should be their versatility, which provides the ability to solve problems, especially the problems of general physical training using training modes of motor activity. The most important elements of this structure should be training, control and diagnostic equipment, video equipment, computer support of the training process, universal possibilities of equipment transformations, configurations of training places, etc. Under certain conditions, this option can be supplemented by specially created opportunities for physical education classes in the field (in the woods, park, outdoor sports fields, etc.).

The new forms and technologies of the students' physical education are largely determined by the efficiency of methods, the availability of training facilities, the material and technical support, the initial level of physical fitness and health of students, and a set of environmental, socio-economic, psychological and pedagogical, and sanitary and hygienic factors.

## 5. Conclusions

The analysis of the students' physical fitness dynamics shows that students have had a satisfactory and unsatisfactory level of physical fitness for forty years. It was found that the low physical fitness level of students dates back to Soviet times. It was determined that the system of physical education of the past is practically actual in Ukraine nowadays and it needs significant changes. The worst level of physical qualities development of students was found in 2018-2019. Among the physical qualities of both male and female students, the worst level of development was found in the endurance (the 3000 m and 2000 m run) and power exercises (pull-ups and push-ups). At the same time, females were defined to have a worse level of all physical qualities than males.

The physical fitness analysis of the students of HEI for a long historical period showed imperfection of the system of physical education in Ukraine, a low level of the students' motivation and unsatisfactory condition of sports and mass-participated health and fitness activities at HEI. This leads to the introduction of the modern technologies of physical education and sports, the creation and modernization of the material and technical base of higher education institutions, the improvement of the system of physical education at school, conducting the research to improve teaching methods in physical education, intensifying the educational process of physical education taking into account the students' person-centered choice of motor activity and a complex of ecological, socio-economic, psychological and pedagogical, sanitary and hygienic factors.

The directions for future research are aimed at developing new forms of physical education for students, the introduction of fitness technologies, person-centered choice of physical activity by students, the improvement of the system of physical education for students, which will promote the formation of physical culture and health competencies of future professionals.

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