

## ORIGINAL ARTICLE

# DYNAMICS OF STUDENTS' FITNESS LEVEL WHILE DIFFERENTIATING PHYSICAL EDUCATION CLASSES IN ACCORDANCE WITH THEIR HEALTH AND NOSOLOGY OF DISEASES

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## ABSTRACT

**The aim:** Is to study the dynamics of students' physical fitness level while differentiating physical education classes in accordance with their somatic health and nosology of diseases.

**Materials and methods:** The paper presents the results of a study of the dynamics of the physical fitness indicators of students in the process of physical education. The study involved 660 students between the ages of 17 and 25. Testing of students' physical fitness was performed using the method of control measurements. Research methods included the theoretical analysis and generalization of scientific and methodical literature, pedagogical observations, testing, pedagogical experiment, and the methods of mathematical statistics.

**Results:** At the end of the experiment, the students of the experimental groups (both male and female) showed authentically ( $p < 0.05 - 0.001$ ) better indicators of the control tests than the students of the control groups.

**Conclusions:** It was established that the introduction of the original program of differentiating classes in accordance with the level of students' somatic health and nosology of diseases into the process of physical education has a positive effect on their physical fitness level. This will help to improve their learning and future professional activities.

**KEY WORDS:** students, differentiating physical education classes, health, physical fitness

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## INTRODUCTION

Physical fitness is an important indicator of the health and physical education of students, which ensures their readiness to perform the physical activities provided by the curriculum at higher education institutions (HEI) [1, 2, 3]. Physical fitness characterizes the level of physical qualities development, which was achieved in the process of physical education [4, 5, 6]. The physical fitness of students is related to the level of physical health. It can be argued that a student who has a high level of physical health also has a high level of physical fitness. Therefore, the results of motor tests of the students with a "safe" level of physical health are benchmarking for the development of motor skills of young people with lower levels of health. Physical fitness of students should be focused on improving health and only indirectly on the results of motor tests [7, 8]. The introduction of control tests significantly activates students, changes their attitude to the educational process [9, 10].

The issue of the differentiating physical education classes has been studied in the works of scientists [11, 12], however, given the current state of health and physical fitness of school and university students, it still remains relevant.

## THE AIM

The aim is to study the dynamics of students' physical fitness level while differentiating physical education classes in accordance with their somatic health and nosology of diseases.

## MATERIALS AND METHODS

The study was conducted at Polissia National University (PNU), Zhytomyr Ivan Franko State University (ZSU) (Ukraine) and Polesky State University (PSU) (Republic of Belarus). To analyze the state of students' physical fitness, we organized an initial experiment, which involved 388 students (142 students from PNU, 127 students from ZSU,

**Table I.** The physical fitness state of male students ( $\bar{X} \pm m$ )

Types of tests	The year of study			
	1st	2nd	3rd	4th
100 m run (s)	16.64±0.75	16.65±1.09	16.37±0.62	16.79±0.99
Standing long jumps (cm)	204.31±12.37	212.41±14.52	205.30±15.23	200.31±14.23
Push-ups (reps)	24.63±5.27	25.52±4.26	24.09±6.48	22.20±5.12
Pull-ups (reps)	11.50±1.64	11.49±3.03	09.23±3.46	09.70±3.15
Sit-ups in 1 min (reps)	25.41±3.86	25.77±1.80	24.58±3.49	24.48±3.18
Single-leg squats (reps)	6.44±0.58	6.87±0.49	6.54±0.23	6.87±0.42
Bending forward in a sitting position (cm)	12.54±1.69	11.52±3.03	09.21±5.43	10.30±3.09

**Table II.** The physical fitness state of female students ( $\bar{X} \pm m$ )

Types of tests	The year of study			
	1st	2nd	3rd	4th
100 m run (s)	18.31±0.87	18.55±0.79	18.77±0.72	18.75±0.98
Push-ups (on the knees) (reps)	21.34±1.52	20.81±1.98	20.09±2.28	19.56±2.92
Sit-ups in 1 min (reps)	23.73±6.12	28.07±2.93	24.66±3.11	23.78±4.96
Bending forward in a sitting position (cm)	10.88±3.07	11.61±1.92	11.21±2.17	10.12±2.10
Arch hold (reps)	19.29±1.29	18.46±1.47	17.98±1.83	17.21±2.83
Lunges (reps)	14.80±0.42	14.47±0.63	14.29±0.42	14.03±1.94

119 students from PSU): 175 male and 213 female students of the 1st-4th years of study (1st year n=88; 2nd year n=141; 3rd year n=93; 4th year n=66). To substantiate the authors' program of differentiating physical education classes, 2 experimental (n=139) and 2 control (n=133) groups of the students of the 1st-2nd year (male and female) were formed. The experimental group EGm included 60 male students, and the EGf group – 79 female students; the control group CGm – 52 male students, CGf – 81 female students. The students of experimental groups were engaged in the sectional form of physical education according to the original program, according to which the means of physical education and physical activity were differentiated depending on the level of physical health, disease nosology, doctor's indications, and the requirements of future professional activity. The students of control groups attended traditional physical education classes at HEI. The number of hours devoted to physical education per week in the experimental and control groups was the same and accounted for 4 hours.

The students' physical fitness level was assessed using control tests. The tests were applied to evaluate power qualities: 1) standing long jumps (males); 2) push-ups (males – lying on the floor, females – standing on the knees); 3) pull-ups on the crossbar (males); 4) sit-ups in 1 min; 5) single-leg squats (males); 6) the arch hold (females); 7) lunges (females). In order to assess the speed, a 100 m race with a sprint start was used. Flexibility was assessed by the exercise of bending forward in a sitting position. The following tests were used in the experimental groups to monitor the development of professionally significant motor skills: 1) the Cooper test (run-walk within 12 min-

utes) – to assess overall endurance; 2) the Flamingo Balance Test – to control coordination abilities.

The research methods included theoretical analysis and generalization of scientific and methodical literature, pedagogical observations, testing, pedagogical experiment, and the methods of mathematical statistics.

## RESULTS

The state of physical fitness of the students of the 1st – 4th years can be considered satisfactory in general (Tables I, II). The level of physical fitness of the female students of the 1st – 2nd years was better than that of male students. The students of the 3rd – 4th years were defined to have a tendency of changing results.

The satisfactory indicators of the students' physical fitness indicated not only the actual state of their physical fitness but also the shortcomings of the curriculum. The increase in the number of students with disabilities, the hard disease course, and the disease development for younger people were the reasons to lower the criteria for assessing some physical qualities. The control over the development of such important human qualities as general endurance and coordination skills was eliminated because the students were given an alternative choice of 4 test exercises in each semester out of 10 common and 8 variable control exercises. This implied that only the most effective type of control tests for each student was evaluated.

The analysis of the study results shows that a very low level of physical fitness was shown by 27.27 % of first-year students, 20.83 % of second-year students, 33.33 % of third-year students, and 25.00 % of fourth-year students.

**Table III.** The dynamics of the male students' physical fitness indicators after introducing the original program into the educational process ( $\bar{X} \pm m$ )

Tests	Groups	Initial data	Final data	Changes	Significance of differences	
					t	p
Cooper test – run-walk within 12 minutes (m)	EGm1	1278.46±59.16	1777.34±68.58	498.88	2.34	<0.05
	CGm1	1291.58±63.14	1512.07±66.72	220.49	1.68	>0.05
	EGm2	1421.31±67.78	2039.54±78.63	618.23	5.06	<0.001
	CGm2	1413.83±69.13	1799.25±72.34	385.42	2.19	<0.05
100 m run (s)	EGm1	17.91±1.11	16.21±0.97	1.70	2.89	<0.01
	CGm1	17.74±0.93	17.19±1.05	0.55	1.94	>0.05
	EGm2	16.93±1.08	15.46±1.13	1.47	2.47	<0.05
	CGm2	16.42±0.86	16.14±1.22	0.28	1.63	>0.05
Standing long jumps (cm)	EGm1	178.72±1.84	199.14±2.16	20.42	2.92	<0.01
	CGm1	181.40±1.67	187.43±1.77	6.03	1.83	>0.05
	EGm2	186.63±1.92	201.16±2.14	14.53	2.51	<0.05
	CGm2	187.85±1.87	189.64±1.65	1.79	1.49	>0.05
Pull-ups (reps)	EGm1	4.24±0.64	6.98±0.66	2.74	3.82	<0.001
	CGm1	4.71±0.57	4.92±0.54	0.21	1.64	>0.05
	EGm2	5.62±0.77	8.29±0.72	2.67	3.23	<0.01
	CGm2	5.80±0.82	5.95±0.76	0.15	1.57	>0.05
Sit-ups in 30 s (reps)	EGm1	11.36±0.95	21.63±1.67	10.27	4.23	<0.001
	CGm1	12.14±0.91	14.21±0.99	2.07	1.62	>0.05
	EGm2	13.62±0.85	23.87±1.48	10.25	4.17	<0.001
	CGm2	13.91±0.79	16.12±0.86	2.21	1.72	>0.05
Flamingo Balance Test (s)	EGm1	7.95±0.95	11.54±1.16	3.59	2.96	<0.01
	CGm1	8.15±0.66	8.59±0.84	0.44	1.85	>0.05
	EGm2	8.27±0.72	13.36±1.32	5.09	4.52	<0.001
	CGm2	8.33±0.63	9.41±0.81	1.08	1.83	>0.05
Bending forward standing on a bench (cm)	EGm1	11.14±0.43	13.77±0.87	2.63	2.56	<0.05
	CGm1	10.25±0.67	10.94±0.71	0.69	1.92	>0.05
	EGm2	10.02±0.56	14.52±0.86	4.50	3.24	<0.01
	CGm2	11.05±0.62	11.58±0.69	0.53	1.81	>0.05
Single-leg squats (reps)	EGm1	5.68±0.49	8.67±0.69	2.99	2.98	<0.01
	CGm1	5.45±0.56	5.94±0.60	0.49	1.79	>0.05
	EGm2	6.13±0.65	9.98±0.75	3.85	4.07	<0.001
	CGm2	5.24±0.51	6.29±0.58	1.05	1.96	>0.05

The students showed the best results during the exercise of standing long jumps. The largest number of female students who participated in the testing was observed among first- and second-year students depending on the type of tests, the smallest number – in all tests among fourth-year students. There was a noticeable tendency to decrease in the number of test participants from year to year for both males and females. Depending on the type of test, the percentage of the total number of students ranged from 18.69 % – 71.96 % (first year), 42.97 % – 74.38 % (second

year), 26.21 % – 40.00 % (third year), 20.00 % – 40.00 % (fourth year).

The analysis of the results of physical fitness shows that, first, fitness standards are not suitable for most students with disabilities, which necessitates a revision of the criteria for assessing physical fitness, taking into account individual capabilities, physical condition, and future professional requirements. Secondly, an urgent requirement today is the introduction of a differentiated approach when planning physical activity, taking into account the level of physical health of students.

**Table IV.** The dynamics of the female students' physical fitness indicators after introducing the original program into the educational process ( $X \pm m$ )

Tests	Groups	Initial data	Final data	Changes	Significance of differences	
					t	p
Cooper test – run-walk within 12 minutes (m)	EGf1	1128.42±56.14	1534.51±57.38	406.09	2.38	<0.05
	CGf1	1131.53±56.31	1366.49±58.37	234.96	1.64	>0.05
	EGf2	1250.28±57.86	1798.74±61.26	548.46	2.47	<0.05
	CGf2	1259.89±58.05	1484.63±59.23	224.74	1.53	>0.05
100 m run (s)	EGf1	20.53±0.83	18.96±0.68	1.57	2.31	<0.05
	CGf1	19.34±0.90	19.04±0.96	0.30	1.73	>0.05
	EGf2	19.07±0.89	18.72±0.86	0.35	1.79	>0.05
	CGf2	20.92±0.96	20.47±0.91	0.45	1.84	>0.05
Standing long jumps (cm)	EGf1	143.74±2.64	158.67±2.65	14.93	2.45	<0.05
	CGf1	148.91±2.14	149.32±2.53	0.41	1.34	>0.05
	EGf2	149.36±2.38	161.17±2.49	11.81	2.32	<0.05
	CGf2	152.29±2.71	153.65±2.68	1.36	1.89	>0.05
Push-ups on the knees (reps)	EGf1	21.34±1.45	26.67±1.58	5.33	2.65	<0.05
	CGf1	20.03±1.53	21.45±1.75	1.42	1.59	>0.05
	EGf2	22.64±1.67	27.93±1.84	5.29	2.48	<0.05
	CGf2	21.78±1.49	22.13±1.52	0.35	1.30	>0.05
Sit-ups in 30 s (reps)	EGf1	8.93±0.64	18.03±0.77	9.10	4.28	<0.001
	CGf1	9.44±0.78	11.21±0.69	1.77	1.87	>0.05
	EGf2	10.72±0.83	19.68±0.91	8.96	4.19	<0.001
	CGf2	11.60±0.72	13.24±0.82	1.64	1.72	>0.05
Flamingo Balance Test (s)	EGf1	7.95±0.95	12.65±0.86	4.70	2.87	<0.01
	CGf1	8.18±0.66	9.14±0.74	0.96	1.34	>0.05
	EGf2	7.80±0.72	13.53±0.93	5.73	2.98	<0.01
	CGf2	8.13±0.43	9.67±0.61	1.54	1.57	>0.05
Bending forward (cm)	EGf1	10.10±0.69	13.75±0.86	3.65	2.57	<0.05
	CGf1	10.50±0.73	10.89±0.74	0.39	1.24	>0.05
	EGf2	11.07 ± 0.79	14.36±0.97	3.29	2.43	<0.05
	CGf2	10.45 ± 0.81	11.25±0.67	0.80	1.46	>0.05
Arch hold (reps)	EGf1	14.23±0.93	18.83±1.23	4.60	2.67	<0.05
	CGf1	15.02±1.09	16.22±1.11	1.20	1.53	>0.05
	EGf2	16.13±1.03	21.43±1.27	5.30	2.96	<0.01
	CGf2	17.86±1.12	18.99±1.18	1.13	1.40	>0.05
Lunges (reps)	EGf1	12.34±0.94	16.43±1.04	4.09	2.52	<0.05
	CGf1	14.17±0.98	15.13±0.99	0.96	1.35	>0.05
	EGf2	13.56±0.87	18.74±1.17	5.18	2.93	<0.01
	CGf2	14.63±0.93	15.24±0.96	0.61	1.42	>0.05

In order to ensure the physical education efficiency of the students of HEI, we developed an original program of differentiating physical education classes for students, which takes into account their level of physical health and disease nosology.

There are means of physical education provided that meet the interests, needs, and individual capabilities of

students. In order to develop motor skills, we used physical exercises, which are basic in the curriculum: to develop general endurance – health walking and running, swimming, the elements of rhythmic gymnastics, dance, and step aerobics; to develop speed – running, swimming, sports games; to develop strength – exercises on gym-machines, with one's own weight, additional weights; to develop dex-

terity – moving games and the elements of sports games, shuttle running, and relay races; to develop flexibility – the elements of rhythmic gymnastics, aerobics, fitness, yoga.

The following tools were used in classes with students with disabilities: with the students of group A (with diseases of the musculoskeletal system): exercises of classical, dance and step aerobics, fitness, yoga, pilates, sports games; with the students of group B (with diseases of the cardiorespiratory system): healthy running, walking, general development exercises, the elements of classical aerobics, yoga, active games, the elements of respiratory gymnastics and autogenic training; with the students of group C (with diseases of the visual organs, kidneys, and other internal organs): healthy running, walking, general developmental exercises, moving games, dance aerobics, exercises on cardio gym-machines, fitness, yoga, stretching, breathing exercises.

The analysis of the students' physical fitness indicators, obtained in the process of formative pedagogical experiment, convincingly proved the high efficiency of the original program. In all eight tests on physical fitness, male students of the experimental groups significantly improved their performance (Table III).

There were significant changes in the results in the experimental groups. The most significant results were demonstrated by the EGm2 students in the Cooper test, sit-ups in 30 s, Flamingo Balance Test, single-leg squats ( $p < 0.001$ ); the EGm1 students – in pull-ups ( $p < 0.001$ ). The results of the experimental groups were also significantly improved in other tests ( $p < 0.05$ ;  $p < 0.01$ ). In the control groups, males improved the results in all tests, but the average indicators were significantly lower ( $p > 0.05$ ). It should be noted that in EG1, CG1, both in the groups of males and females, there was a decrease in the number of subjects at the end of the experiment. Females from the experimental groups also significantly improved performance in all fitness tests, except for the results of EGf2 in the 100 m run. The best results in both EGf1 and EGf2 were achieved in sit-ups in 30 s ( $p < 0.001$ ). The results in the Flamingo Balance Test also increased substantially ( $p < 0.01$ ). In the control groups, females improved the results in all tests, but the average values were lower than the level of reliability ( $p > 0.05$ ). In general, the performance of the female students of the control groups was significantly lower (Table IV).

This generally characterizes the increase in reserve capacity of the students' motor systems and reflects the efficiency of the presented original program and organizational approaches providing physical education.

## DISCUSSION

The analysis of the students' health in the process of physical education and the dynamics of their physical fitness indicators during different years of study, showed that the quantitative composition of students belonging to a particular level of physical fitness, differs between authors, and, in general, it characterizes the low state of the physical fitness of students in Ukraine, especially females [13, 14].

It was proved that the most common diseases among first-year students of HEI are the diseases of the cardiovascular, digestive, and musculoskeletal systems. Some researchers propose to differentiate students on the nosological principle of diseases or combining several diseases [8, 11]. However, even in a subgroup with the same diagnoses, there are students with different physical fitness levels and general physical performance, which leads to inconsistency of activities with the functional capabilities. At the same time, many students have not only one but two or more diseases, which also creates difficulties in attributing them to a certain nosological subgroup. In practice, there are also organizational problems in conducting classes on the nosological principle. There is an approach to the individualization of the students' physical training based on the types of the physique, constitutional identification, including a special medical group. The problem of choosing the principles of forming groups of students with disabilities is solved by the writing team. There are six main approaches to forming groups distinguished: on a nosological basis; taking into account the level of physical fitness; based on the functional abilities; according to the contraindications to physical activity; based on an individual differentiated approach; paying attention to the gender. At the same time, scientists agree with other experts and recognize the most acceptable principle of forming groups is based on nosology.

## CONCLUSIONS

1. The level of physical fitness of first-year students was assessed as "low" or "below the medium". A very low level of physical fitness was demonstrated by 27.27 % of the first-year male students, 20.83 % of the second-year male students, 33.33 % of the male third-year students, and 25.00 % of the male fourth-year students. Besides, 14.89 % of the first-year female students, 13.21 % of the second-year female students, 15.00 % of the third-year female students, 18.25 % of the fourth-year female students did not get to the assessment scale.
2. It was found that there was not significant difference between the indicators physical fitness and health of students of Ukraine and the Republic of Belarus ( $p > 0.05$ ), which indicates that Belarusian students have problems similar to Ukrainian students in the system of physical education in the HEI.
3. The introduction of the original program of differentiating physical education classes in the students' physical education process, taking into account their level of physical health, nosology of the disease, the doctor's instructions had a positive effect on the students' physical fitness level. The largest increase in the indicators of physical fitness of female students was recorded in the following control tests: sit-ups ( $p < 0.001$ ); Flamingo Balance Test ( $p < 0.01$ ); the arch hold ( $p < 0.01$ ); lunges ( $p < 0.01$ ). For the male students these were sit-ups ( $p < 0.001$ ); Flamingo Balance Test ( $p < 0.001$ ); single-leg squats ( $p < 0.001$ ); pull-ups ( $p < 0.001$ ); standing long jumps ( $p < 0.01$ ); the 100 m run ( $p < 0.01$ ); the Cooper test ( $p < 0.05$ ).

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**Conflict of interest:**

*The Authors declare no conflict of interest.*

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