

PHYSICAL STATE ASSESSMENT OF THE FIRST-YEAR FEMALE STUDENTS OF HIGHER EDUCATION INSTITUTIONS

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ABSTRACT

The aim: Is to determine informatively significant indicators of the physical state of the first-year students of higher education institutions.

Materials and methods: The study was conducted at Prydniprovsk State Academy of Civil Engineering and Architecture in 2019-2020. The study involved 100 first-year female students of the main department between the ages of 17 and 18. The state of health of female students, their motivational needs, and the level of their physical development, physical fitness, and functional state were studied.

Results: The study summarized knowledge and experience on the problem of selecting means for assessing the physical state of students, analyzed the motivational needs and health of female students, as well as identified informative indicators of the physical state of the female students by factor analysis.

Conclusions: The study indicates the need for an obligatory survey on the health of the first-year female students at the beginning of the academic year; the inclusion of the elements of modern fitness programs in the curriculum of the Physical Education discipline and the organization of sectional classes in accordance with the results of the survey if possible in order to increase students' motivation to attend classes and differentiate training in classes aimed at improving the physical state of female students.

KEY WORDS: physical state, health, physical fitness, students

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INTRODUCTION

A large number of scientific publications are devoted to the study of the physical state of students of higher education institutions (HEI) [1, 2, 3]. The results of most studies indicate a low level of physical state in general and its indicators (health, physical fitness, physical development, functional state) of most students of the HEI of Ukraine [4, 5]. According to the scientists [6, 7], the level of students' motivation for traditional physical education classes is estimated as low, accompanied by a low percentage of the attendance of classes in Physical Education. Moreover, in the process of studying at HEI, these indicators tend to deteriorate [8, 9]. At the same time, according to many scientists [10, 11], the worst level of these indicators was found in female students, in comparison with male students. All this leads to the search for the most informative indicators of the physical state of the first-year female students to take their needs into account in the process of physical education in order to strengthen their health,

improve physical and mental performance, and further professional activities of graduates.

The choice of optimal indicators for monitoring the physical state of a person has always attracted the attention of researchers [12, 13]. Besides, the choice of diagnostic tools for physical state differs significantly among scientists, based on the difference in the purpose of the survey, skills of researchers, material and technical support, special characteristics of the contingent, and other factors related to the survey. Since such studies allow not only determining the physical state of students but also assessing the effectiveness of training programs and tracking changes in physical state in the dynamics, the selection of indicators for such studies is very important. That is why the definition of informatively significant indicators of physical state, which can be used both during the express control and for a comprehensive assessment of the physical state of students in order to take their needs into account in the process of physical education at HEI is an urgent problem.

THE AIM

The aim of this study is to determine informatively significant indicators of the physical state of the first-year students of higher education institutions.

MATERIALS AND METHODS

The study was conducted at Prydniprovsk State Academy of Civil Engineering and Architecture in 2019-2020. The study involved 100 first-year female students of the main department of Civil Engineering and Architecture Faculties between the ages of 17 and 18 after medical examination and obtaining permission from a doctor. Research methods included the analysis and generalization of literature sources, surveys and questionnaires, testing, the methods of mathematical statistics.

In order to determine the state of health of the first-year female students, a survey was conducted. The students were asked to indicate their inherent diseases in writing in accordance with the nosology of diseases. In addition, the survey determined the type of physical activity that female students would like to engage in. The motivational needs of female students were determined using a questionnaire that took into account the gender characteristics of motivation. The level of physical development of female students was assessed by body mass index (BMI), Pignet index, and the index of proportionality (IP). To assess physical fitness, tests, and standards, which are used to assess the physical fitness of the population of Ukraine for this age group annually, were used: the 2000 m steady run; push-ups, or a long standing jump; the 100 m run; 4 x 9 m shuttle run; seated forward bend. After completing all the tests, the number of points obtained was determined. The assessment of the physical fitness level was carried out depending on the total number of points.

The indicators of the cardiorespiratory system, such as the heart rate (HR), systolic (SP) and diastolic pressure (DP), and respiratory rate (RR), were measured at rest using standard methods to assess the functional status of female students. The circulation efficiency ratio (CER) was calculated as the product of the HR and the difference between SP and DP. To determine the body's resistance to hypoxia, tests based on breath-holding were used: timed inspiratory and expiratory capacities, which are performed according to the standard methodology. The Ruffier test was used to assess performance. To determine the adaptive capacity of the circulatory system of female students, the adaptive potential (AP), which takes into account the indicators of the cardiovascular system, height, body weight, and age, was used. To assess the level of metabolic and energy processes in the myocardium, the Robinson index, which characterizes the state of the cardiovascular system regulation, was applied.

In order to analyze the sample, the arithmetic mean (X), standard error of the mean (m), standard deviation (S), and coefficient of variation (V) were determined for each variable. The factor analysis, which used 24 basic indicators of the physical fitness and morpho-functional state of female students, was conducted using a licensed SPSS package.

This study complies with the ethical standards of the Act of Ukraine "On Higher Education" No. 1556-VII dated 01.07.2014 and the Letter from the Ministry of Education and Science of Ukraine "On the Academic Plagiarism Prevention" No. 1/11-8681 dated 15.08.2018. Also, this study followed the regulations of the World Medical Association Declaration of Helsinki – ethical principles for medical research involving human subjects. Informed consent was received from all individuals who took part in this research.

RESULTS

According to a survey of the first-year students, it was found that 59 % of them did not have any chronic diseases, the other 41 % indicated such diseases as vegetative-vascular dystonia and minor circulatory disorders (21 %), minor visual disturbances (10 %), and musculoskeletal disorders (6 %). The diseases of the gastrointestinal tract, biliary tract, and kidneys were detected in 6 %, 5 %, and 4 % of the students respectively. The respiratory disorders and allergies were reported only by 2 % of the respondents (some respondents indicated several diseases during the study).

The results of the survey determining the type of physical activity, that the students would like to do in the Physical Education discipline, were distributed as follows:

- 57 % of the respondents chose different types of fitness training: 27 % preferred dance, 21 % – strength-building training and 9% would like to perform exercises that develop flexibility (yoga, stretching);
- 24 % of the respondents preferred active games (mostly badminton and volleyball);
- 12 % would like to take up swimming;
- 7 % preferred cyclic aerobic exercises related to athletics (mostly run).

According to the data obtained by questionnaires, the main motivational needs of the first-year female students for physical education were improving physical state (40 %) and getting credit (33 %); 13 % of the respondents indicated weight normalization and the improvement of appearance as the main reason for attending classes, and 8 % – an increase in the level of sportsmanship; good pastime was chosen as the main motive by only 6 % of the respondents.

The analysis of 24 indicators of the physical state of the first-year female students revealed that almost all anthropometric indicators of the respondents corresponded to the normative intervals (Table I). The physical fitness of the respondents, on the contrary, was worse than the normative intervals for the females of this age group on all indicators, except for the indicators of shuttle run and seated forward bend (according to which, the average indicators of the surveyed students were on the border of the normative interval). The functional state of the first-year female students on average corresponded to the norm, but these indicators had the greatest variability, which indicated the need to individualize the training load in the process of selecting and dosing the exercises and the need for feedback

Table I. The physical state indicators of the first-year female students (n=100)

Nº	Indicators	X	m	S	V	Normative intervals
The indices calculated on the basis of the anthropometric indicators, c. u.						
1	BMI	20.932	±0.29	2.852	13.62	18.5-24.99
2	Pignet index	24.02	±0.27	15.317	9.11	10-20
3	IP of the chest	0.507	±0.003	0.065	6.39	0.5-0.55
4	IP of the waist	0.402	±0.004	0.040	9.90	0.35-0.4
5	IP of the pelvis	0.582	±0.004	0.041	7.08	0.54-0.62
6	IP of the thigh	0.340	±0.003	0.030	8.76	0.32-0.36
7	IP of the shin	0.215	±0.002	0.017	7.92	0.21-0.23
8	IP of the shoulder	0.162	±0.003	0.026	16.24	0.16-0.18
The indicators that characterize physical fitness						
9	2000 m steady run, min	13.356	±0.16	1.594	11.93	≤11.5
10	100 m run, s	17.175	±0.11	1.073	6.25	≤16.3
11	4 x 9 m shuttle run, s	10.508	±0.05	0.521	4.96	≤11.3
12	Long standing jump, cm	168.65	±1.76	17.633	10.46	≥185
13	Seated forward jump, cm	16.02	±0.70	7.015	43.79	≥16
14	Push-ups, reps	13.55	±0.68	6.844	50.51	≥18
15	Physical fitness level*	11.58	±0.39	3.856	33.30	≥11
16	Physical fitness level**	11.98	±0.39	3.875	32.53	≥11
The indicators that characterize the functional state						
17	Heart rate at rest, bpm	78.61	±1.38	13.818	17.58	60-80
18	RR at rest in a min	16.9	±0.41	4.098	24.22	16-18
19	Timed inspiratory capacity, s	43.68	±1.37	13.709	31.39	40-50
20	Timed expiratory capacity, s	26.74	±1.11	11.092	41.48	25-30
21	Ruffier index, c. u.	12.725	±0.53	5.317	41.78	0-14
22	CER, c. u.	2896.88	±82.37	823.738	28.44	2400-2600
23	AP, c. u.	1.718	±0.03	0.301	17.50	<2.11
24	Robinson index, c. u.	85.076	±1.97	19.701	23.16	<111

Note: * – defined by the sum of points, taking into account the result in the long standing jump; ** – defined by the sum of points, taking into account the result in push-ups

during training. The large variability of the physical state indicators of the surveyed females indicated the need to divide them into subgroups during the development of physical qualities.

The results of the factor analysis of 24 main indicators of the physical state of female students are given in Table II. Among these indicators, 6 main factors were identified. The ratios covered 81 % of the total variance, which indicated the sufficient credibility of applying the λ -criterion.

The first factor is anthropometric, which included all anthropometric indicators that were closely related, combining 27.48 % of the total variance. At the same time, the leading factors in terms of factor load were the index of proportionality of the thigh (0.960), the body mass index (0.952), which reflected the relationship between the body weight and length, and the index of proportionality of the pelvis (0.946). The second place was taken by the index of proportionality of the shin and waist (0.880 and 0.868 respectively). The third place in

terms of factor load was taken by the Pignet index and the index of proportionality of the shoulder (-0.671 and 0.587). Thus, the factor analysis confirmed the close relationship between the anthropometric indicators of the surveyed females, emphasized their importance among other studied indicators and their separation from them. The high factor load of the indices of proportionality of the circumference of this factor is explained by their calculated ratio. The second factor – physical fitness (16.8 % of the total variance) combined all the indicators of physical fitness. The greatest factor load was observed in the indicators that characterized the overall level of physical fitness, taking into account the result in the long standing jump (0.963) and the result in push-ups (0.925), as well as the result in shuttle run (0.710). The obtained data confirmed the rationality of summing the points for individual test exercises to determine the level of physical condition. The third factor – functional indicators (15.98 % of the total variance) combined the primary indicators

Table II. The factor analysis of the physical state indicators of the first-year female students

Factors	F1	F2	F3	F4	F5	F6
The indices calculated on the basis of the anthropometric indicators						
BMI	0.9515	-0.1086	0.1090	0.0145	0.1033	-0.0743
Pignet index	-0.6706	0.0342	-0.1776	0.0642	-0.6576	0.1507
IP of the chest	0.2635	0.0392	0.1826	-0.1209	0.8432	-0.1485
IP of the waist	0.8682	-0.0195	0.1282	0.0686	0.1693	0.0417
IP of the pelvis	0.9457	-0.1002	0.0178	-0.0102	0.0194	-0.0937
IP of the thigh	0.9607	-0.0391	0.0142	-0.0109	0.0192	-0.1039
IP of the shin	0.8801	-0.1494	0.0114	-0.0974	-0.0242	-0.0354
IP of the shoulder	0.5867	-0.0940	0.0442	0.0731	0.0445	0.1369
The indicators that characterize physical fitness						
2000 m steady run	0.1267	-0.6097	0.0793	0.2648	-0.1142	0.1410
100 m run, m	0.1493	-0.6169	0.1567	-0.0652	-0.1565	-0.3956
4 x 9 m shuttle run, m	0.2337	-0.7105	0.1844	0.0226	-0.0539	0.0179
Long standing jump	-0.2338	0.5901	-0.0849	-0.1450	0.2186	0.3956
Seated forward jump	0.1194	0.6727	0.0633	0.0246	-0.4863	-0.2923
Push-ups	0.0085	0.0979	0.2564	-0.1297	-0.3231	0.7312
Physical fitness level*	-0.0211	0.9639	-0.0786	-0.0842	-0.0736	0.0413
Physical fitness level**	-0.0133	0.9258	-0.0048	-0.0872	-0.1826	0.1458
The indicators that characterize the functional state						
Heart rate at rest	0.0443	-0.1082	0.9723	-0.0384	0.0722	0.0966
RR at rest	0.0853	-0.0753	0.9757	0.0001	0.0237	-0.0105
Timed inspiratory capacity	0.0809	-0.1152	0.9757	-0.0198	0.0724	0.0816
Timed expiratory capacity	0.0981	-0.1095	0.9752	-0.0091	0.0500	0.0351
Ruffier index	-0.0027	-0.0892	-0.2410	0.6096	-0.1101	-0.3762
CER	-0.1287	-0.1639	0.0123	0.9109	-0.0029	0.0884
AP	0.2423	-0.0483	0.0245	0.9015	-0.0327	-0.0462
Robinson index	-0.0721	-0.0770	0.0290	0.9656	-0.0327	-0.0347
Variance proportion %	27.46	16.8	15.98	10.72	6.13	4.25

Note: * – defined by the sum of points, taking into account the result in the long standing jump; ** – defined by the sum of points, taking into account the result in push-ups

of the cardiorespiratory system at rest, which were closely related. The greatest total load was found in the indicators of HR at rest (0.976), timed inspiratory capacity (0.976), and timed expiratory capacity (0.975). Slightly lower rates were recorded in HR at rest (0.972). The fourth factor – the capabilities of the cardiovascular system combined 10.72 % of the total variance with the highest load on the Robinson index (0.966), CER (0.910), and AP (0.901). The Ruffier index, which was also included in this factor, on the other hand, had a relatively low factor load (0.609). The fifth factor – the proportionality index of the chest combined 6.12 % of the total variance. The proportionality index of the chest (0.843) had a higher factor load than the Pignet index (-0.657). The sixth factor – the strength of the upper extremities combined 4.25 % of the total variance. It included only one indicator that characterized the strength of the upper extremities and had the largest factor load.

DISCUSSION

The results of the questionnaire confirmed the scientists' research [14, 15] on the students' motivation for physical education classes, thus emphasizing the critical consequences of the cancellation of a compulsory credit in the discipline of Physical Education, as obtaining a final grade is one of the main motives.

It should be noted that not all of the diseases mentioned during the survey were confirmed by the medical records of the students surveyed, which indicates the family doctors, who issue medical notes permitting physical activity, lack this information. These data justify the need for binding additional diagnosing or at least for the survey of the students at the beginning of the academic year in order to identify chronic diseases and include them in their personal cards.

The results of the survey determining the desired type of physical activity substantiate the need to include the

elements of the relevant types of physical activity in the curriculum in the discipline of Physical Education, namely: fitness (aerobic and strength-building programs, as well as the programs aimed at the flexibility development), active games (volleyball and badminton), swimming and cross-country training.

The level of physical fitness, determined by the sum of scores obtained for 5 tests was low in only 36 % of the first-year female students surveyed. It may be connected with the fact that this survey included only the first-year female students who regularly attend classes and have a conscious attitude to the need to maintain their physical condition, but during the annual assessment of the population of Ukraine, all the female students under the age of 21 are examined. The low indicators of the physical fitness of the females surveyed substantiate the need to use the programs for the development of the speed and strength endurance and the strength of the upper extremities for the students with low levels of physical fitness in further work with this contingent. The results of this research confirm the findings of many scientists [16-21] and expand them.

CONCLUSIONS

The factor analysis of the physical state indicators of the first-year female students of HEI confirmed the possibility of reducing their total number during the express control to five: among anthropometric indicators, the body mass index was determined (factor load – 0.951); among the indicators of physical fitness – the level of physical fitness (0.963); among the indicators of the functional capabilities of the organism – timed inspiratory (0.975) and expiratory capacities (0.975); among the indices of the functional state – the Robinson index (0.965). The study indicates the need for a binding survey of the first-year female students on their health at the beginning of the academic year; the inclusion of the elements of modern fitness programs, volleyball, badminton, and other physical activities in the curriculum of the Physical Education discipline and, if possible, the organization of sectional classes in accordance with the results of the survey to increase students' motivation to attend classes and differentiate training during classes aimed at improving the physical condition of female students; taking into account the results of factor analysis determining informatively significant indicators of the physical state of female students in order to improve the process of physical education at higher education institutions.

The prospects for further research are to determine the effectiveness of introducing differentiated training in the development of appropriate physical qualities in order to improve the physical condition of the HEI students.

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The Authors declare no conflict of interest.

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