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Physical condition of first-level higher education students studying pedagogical specialties

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Abstract. A rapid decrease in the level of daily motor activity of student youth as a result of the transition to distance learning, which is characterised by a high amount of mental and psycho-emotional load, has led to an increase in morbidity and deterioration of the physical condition of students in general, which is an urgent problem. The purpose of the study was to determine the level of physical condition of first-level higher education graduates who are studying pedagogical specialties at Berdyansk State Pedagogical University. In the course of the experiment, a medical-biological research method was used, namely an anthropometric method for measuring body weight and length, body mass index, Erisman index, and chest circumference, to further determine the level of students' physical condition. In order to process the received data, the methods of mathematical statistics were used. It has been established that the anthropometric indicators of first-level higher education graduates studying pedagogical specialties at Berdyansk State Pedagogical University are within age norms. Some students are overweight. Indicators of the frequency of heart contractions in a state of relative rest are within age norms. In blood pressure indicators, there was a predominance of cases of hypertension in representatives of both sexes. The indicators of the functional state of the students' respiratory system, according to the Stange test, are within the physiological age norm. The level of physical condition of female students according to the method of O. Pirohova is defined as average; for boys, it is below average. The studies conducted proved that the majority of students have reduced indicators of their physical condition. The results obtained in practice can be taken into account by teachers during the organisation of physical education classes in distance learning conditions

Keywords: students; distance learning; functional state; the method of Pirohova; anthropometric indicators

Introduction

The assimilation of new knowledge mostly occurs by mastering various computer technologies, thanks to the development of artificial intelligence. The rapid implementation of the latest technologies was not left aside by institutions of higher education, for which, in the conditions of quarantine restrictions and during martial law, the issue of introducing distance education became especially urgent. However, the transition to distance learning led to a significant deterioration in the physical condition of students in higher education institutions in Ukraine.

C. Hodges *et al.* (2020) argue that the shift to online learning can provide the flexibility of teaching and learning anywhere and anytime, which is what happened in 2020. However, in their work, scientists L. Anikeyenko & N. Dhakal (2019) came to the conclusion that, despite the positive features of distance education, acquiring knowledge without visiting special educational institutions and without personal contact with a teacher has certain disadvantages. This is a decrease in the level of daily physical activity among students and their healthy lifestyle skills. In

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this regard, V. Bondarenko *et al.* (2022) emphasised that the physical condition of student youth is rapidly deteriorating. This leads to an increase in morbidity and a decrease in the level of physical activity. The requirements of modern higher education and, subsequently, the acquisition of certain professional skills require students to have a high level of indicators of physical condition and, in particular, physical fitness. In the process of physical education, many functional changes occur in the muscles, bones, cardiovascular system and other systems, which ensures adaptation of the body to further training loads in the future.

H. Boyko *et al.* (2022) emphasise that in the conditions of distance learning, the observance of recommended types of motor activity by students of higher education corresponds to the need for physical activity as an integral component of a healthy lifestyle, and only if they are aware of their attitude towards their own health as the highest value. In addition to long-term restrictions on physical activity and being constantly under the negative influence of information about new diseases, the tragic consequences of war also negatively affect the psycho-emotional state of students. The opinion of O. Mkrtichyan (2023) is valid because insufficient efforts are being made to solve the health problems of student youth, especially during the period of forced distance learning due to martial law. The scientist focuses on the expediency of higher education students acquiring the competence for self-diagnosis of the functional state.

An analysis of research by R. Slukhenska *et al.* (2020) on the issue of the health status of applicants proved that 90% of them show deviations in their health status, and approximately 50% have an unsatisfactory level of physical fitness. Diseases of the musculoskeletal system, organs of vision, cardiovascular system, etc. are the most common and progressive among them. L. Zhao *et al.* (2021) noted that, due to the extraordinary transition to online teaching and learning, teachers and students are forced to work with new systems and face increased workloads. Taking this into account, scientists draw a conclusion regarding the peculiarities of the organisation of distance learning, which requires teachers to develop new forms and methods of working with students. Therefore, it will be relevant to create a fundamentally new model of the process of physical education in the context of distance learning with the help of information technologies. Yu. Nenko & O. Ivashchenko (2023) note that the most common tools of the educational process management system are Moodle, Blackboard, Canvas, Edmodo, Google Classroom, and Microsoft Teams.

That is why the question of researching the existing level of physical condition and level of physical fitness of students is currently being updated. In the conditions of distance learning, taking into account these indicators is important because increasing the indicators of physical condition and the level of physical preparedness of students is a guarantee of effective development of personal and professional qualities in the future and an important task of physical education classes in a higher education institution. The system of physical education for graduates, which has developed in the state as of 2023, is inefficient, does not provide psychological and professional preparation for productive activities and the further lives of graduates, and needs constant improvement. The above determined the chosen goal of the study: to investigate the level of physical condition of the first-level higher education graduates on the example of students of pedagogical specialties at the Berdyansk State Pedagogical University.

Materials and Methods

A combination of empirical and theoretical methods was used for the purpose of practical implementation of the research goal. Research was conducted on the basis of Berdyansk State Pedagogical University (temporarily relocated to Zaporizhzhia, Ukraine). Before starting the study, the students were introduced to the research methodology and indicators reflecting the level of physical condition; a description of the testing methodology, their assessment criteria, and formulas were provided. The research was conducted in compliance with ethical standards, all survey participants were informed about what their data would be used for, about anonymity, and the risks that exist (Ethical expertise of scientific research, 2020). The experiment was conducted from September 2022 to August 2023. The indicators of the functional state of the cardiovascular and respiratory systems of students and anthropometric data were determined. For this, students were provided with electronic cards in September 2022, which describe the specifics of the measurements. After filling them out, the cards were sent to messengers or e-mail, with further processing of the results. Forty students ($N = 40$) of the first level of higher education, including 14 girls ($n = 14$) and 26 boys ($n = 26$), who are getting an education in specialty 014 "Secondary Education" (subject majors), took part in the research.

Anthropometric measurements were carried out in order to assess the level of physical development of first-level higher education graduates. Such indicators as body length and weight, body mass index, and chest circumference according to the Erisman index were studied. In order to assess the resistance of the students' bodies to mixed hypercapnia and hypoxia and to assess the general state of the body's oxygen supply systems during breath hold against the background of deep inhalation, the Stange test was used. The assessment of physical condition was carried out according to the method of O. Pirohova (Determination of the level..., n.d.). Mathematical statistics methods were used to process the obtained results. The arithmetic mean was calculated according to the formula:

$$\overline{X} = \frac{1}{n}\sum_{i-1}^{n} X_i = \frac{1}{n} = (X_1 + \cdots X_n), \quad (1)$$

where $\bar{X}$ is the arithmetic mean; n is a sample size; X_i is a sample variable. The standard deviation was calculated using the formula:

$$S = \sqrt{\frac{\sum_1^n (X_i - \bar{X})^2}{n}}, \quad (2)$$

where S is the standard deviation. The error of the arithmetic mean was calculated according to the formula:

$$m = \frac{S}{\sqrt{n}}, \quad (3)$$

where m is the error of the arithmetic mean. The coefficient of variation was calculated according to the formula:

$$V = \frac{S}{\bar{X}}, \quad (4)$$

where V is the sampling variation. X_{min} – the minimum sample rate, and X_{max} – the maximum sample rate, are the indicators given later in the paper. Among the theoretical methods used are the following. The analysis of scientific and methodical literature was used to study the relevance of the given problem, namely, the determination of the level of physical condition of higher education students during distance learning. Graphical methods were used in order to provide a general picture of the subject of research and, at the same time, a visual representation of its components, cause-and-effect relationships, and the power of the distribution of components in a given volume. To compare the level of physical condition and compliance of the obtained indicators with the age norms of physical development, the method of comparison was applied. When forming conclusions, the method of abstraction was applied.

Results

The morphological characteristics of the students were determined and analysed. It was found that in representatives of both sexes, the coefficient of variation (V) ranges from 2.09 to 4.81% in terms of body length and Erisman index; in girls, chest circumference indicators (V = 8.43%). The average variability of the sample was found in the indicators of body weight in boys (V = 16.20%), body mass index in representatives of both sexes (where V ranged from 10.79% to 15.66%), and chest circumference in boys (V = 14.48%). Significant variability in the sample was recorded in girls in body weight indicators (V = 21.68%). It was found that the selected population of students at the higher education institution is not homogeneous in terms of anthropometric indicators. The obtained results are shown in Table 1.

Table 1. Anthropometric indicators of students in the I-II courses of pedagogical specialties, N = 40

Indexes	Sex	$\bar{X}$	S	m	V, %	X_{min}	X_{max}
Body length, cm	girls (n = 14)	165.93	7.63	1.11	4.60	155	180
	boys (n = 26)	179.46	8.63	1.69	4.81	167	192
Body weight, kg	girls (n = 14)	58.07	12.59	2.04	21.68	45	85
	boys (n = 26)	79.5	12.88	2.53	16.20	56	105
Body mass index, kg×m^{-1}	girls (n = 14)	20.92	3.28	0.88	15.66	17.76	27.8
	boys (n = 26)	24.57	2.65	0.52	10.79	18.3	30.7
Erisman index, units	girls (n = 14)	−0.89	3.40	0.91	−3.82	−7.5	4.5
	boys (n = 26)	5.02	10.52	2.06	2.09	−13.5	27
Circumference of the chest, cm	girls (n = 14)	82.07	6.92	1.85	8.43	70	92
	boys (n = 26)	94.73	13.72	2.69	14.48	74	121

Source: created by the authors

It was found that the height and body weight indicators of higher education graduates are mostly within the age norms. Body length indicators in girls were 165.93 ± 7.63 cm, which corresponds to the average level of physical development. For boys, the measured indicators corresponded to a sufficient level of physical development, as they were 179.46 ± 8.63 cm. The body weight indicators of female students at the pedagogical university were 58.07 ± 12.59 kg, and for boys, 79.5 ± 12.88 kg. Despite the fact that the anthropometric indicators of the general group sample were generally within the age norms, cases of excess body weight were observed in some students. The obtained data on body length and weight made it possible to calculate the body mass index. It was established that the body mass index in girls was 20.92 ± 3.28 kg×m^{-1}, in boys it was 24.57 ± 2.65 kg×m^{-1}. This confirmed the previous conclusion that the majority of students have body mass indicators within the age norm.

Chest proportionality was assessed by calculating the Erisman index. The following average values have been established: for girls, −0.89 ± 3.40 units. This indicates that the majority of female students belong to the asthenic body type. In boys, the value of this index was equal to 5.02 ± 10.52 units, which indicates the predominance of representatives of the hypersthenic body type. Indicators of the functional state of the cardiovascular and respiratory systems of higher education graduates were used to characterise the state of the main life support systems of the body. The results are shown in Table 2.

Table 2. Indicators of the functional state of the cardiovascular and respiratory systems of students in the I-II courses of pedagogical specialties, N = 40

Indexes	Sex	$\bar{X}$	S	m	V, %	X_{min}	X_{max}
Heart rate, bpm^{-1}	girls (n = 14)	89.21	4.46	1.19	5.01	80	95
	boys (n = 26)	81.15	7.60	1.49	9.37	60	95
Systolic blood pressure, mm Hg	girls (n = 14)	133.64	6.64	1.77	4.97	120	146
	boys (n = 26)	128.27	7.26	1.42	5.66	110	145
Diastolic blood pressure, mm Hg	girls (n = 14)	91.14	7.44	1.99	8.16	78	105
	boys (n = 26)	85.31	5.50	1.08	6.44	70	95
Average arterial pressure, mm Hg	girls (n = 14)	105.36	6.96	1.86	0.07	92	119
	boys (n = 26)	99.65	5.02	0.98	0.05	87	110
Stange test, s	girls (n = 14)	31.21	4.15	1.11	13.31	27	40
	boys (n = 26)	45.46	9.03	1.77	19.85	30	62

Source: created by the authors

Analysing the obtained data, it should be noted that in representatives of both sexes, weak variability of the sample was found in all indicators of the functional state of the cardiovascular system (V ranges from 0.05 to 9.37%), which indicates a significant homogeneity of the sample in terms of these indicators. Average group indicators of the heart rate in a state of relative rest in girls were within 89.21 ± 4.46 bpm^{-1} and 81.15 ± 7.60 bpm^{-1} in boys. The obtained data corresponded to the age norm. The prevalence of arterial hypertension was observed in representatives of both sexes: blood pressure indicators in girls were 133.64/91.14 ± 6.64/7.44 mm Hg, in boys, 128.27/85.31 ± 7.26/5.50 mm Hg. The obtained data are consistent with the conclusions of other scientists, such as S. Hossain *et al.* (2020) and G. Perez & V. Delgado Martinez (2023), who link it to anxiety and stress. According to the Stange test, the average variability of the sample was revealed (V ranged from 13.31 to 19.85%). A detailed analysis of the results of this test established that 50% of the girls had an unsatisfactory functional state of the respiratory system; 43% of girls and 42% of boys had a satisfactory condition; and 7% of girls and 58% of boys are in good condition (Fig. 1). Thus, it was found that the functional indicators of the cardiovascular and respiratory systems in students in higher education institutions are mostly within the physiological age norm. The assessment of the level of physical condition was carried out according to the O. Pirohova method. The data are shown in Table 3 and Figure 2. It was established that, in terms of physical condition indicators, there was a significant variability of indicators in girls (V = 20.10%), and in boys it was average (V = 18.61%). This indicates the heterogeneity of the sample.

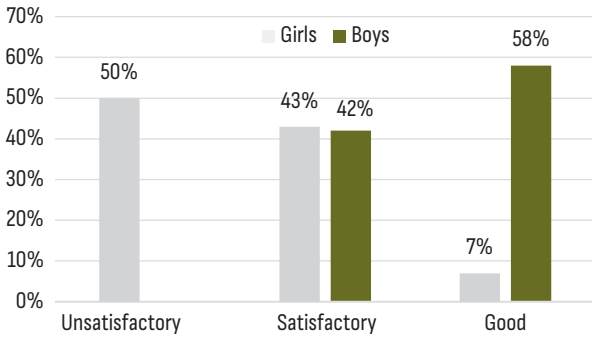

Figure 1. Assessment of the functional state of the respiratory system according to the Stange test, N = 40
Source: created by the authors

Table 3. Indicators of the physical condition of students in the I-II courses of pedagogical specialties according to the method of O. Pirohova, N = 40

Indexes	Sex	$\bar{X}$	S	m	V, %	X_{min}	X_{max}
Level of physical condition, units	girls (n = 14)	0.375	0.08	0.02	20.10	0.248	0.474
	boys (n = 26)	0.508	0.09	0.02	18.61	0.362	0.727

Source: created by the authors

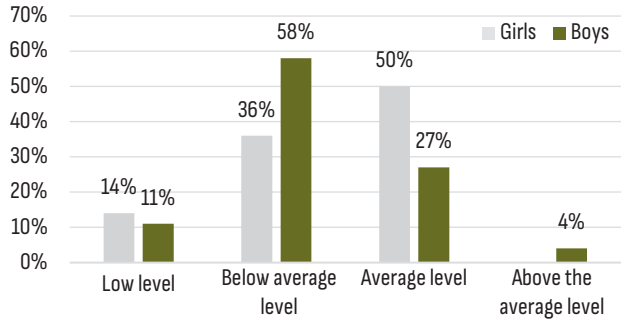

Figure 2. Assessment of the level of physical condition, N = 40
Source: created by the authors

A detailed analysis of the obtained data proved that the level of physical condition, according to the method of O. Pirohova, was defined as average in the vast majority of girls and below average in boys. 50% of female students and 27% of male students had an average level of physical condition; 36% of girls and 58% of boys had a level below average; 14% of girls and 11% of boys had a low level. A higher-than-average level of physical condition was found in 4% of students. The studies conducted proved that the majority of students have a low or below-average level of physical condition. The authors did not find a single student who had a high level of physical condition. It is advised to implement independent programmes with exercise components utilising remote technologies in order to raise the physical condition and daily motor activity.

Discussion

Analysing and contrasting the data gathered throughout the study process with that of other researchers is suitable. The obtained data confirm the results of previous studies by R. Mahruk *et al.* (2023), which revealed the predominance of those with higher education with only satisfactory skills in leading a healthy lifestyle, and I. Vovchenko *et al.* (2022), which established the presence of 50% of higher education graduates with average and above-average levels of physical condition. At the same time, the scientist established that a significant part of students (37.5%) is characterised by a low or below-average physical condition, while only a small percentage of students (12.5%) is characterised by a high level of physical fitness.

Considering that regular physical activity improves mental health, which is also confirmed by the results of A. Mahindru *et al.* (2023), the process of physical education at the university should be aimed at raising the level of physical condition of students and its further preservation for a long period of time. The presented data should motivate teachers to timely assess the physical condition of students and make the necessary corrections. The results of this study were confirmed in comparison with the opinion of O. Mozolev *et al.* (2020) that there is currently a deterioration in the indicators of the physical condition of students in higher education institutions. Specialists

such as O. Plyeshakova (2020) associate this with the high intensity of academic work during mental work at the computer and, as a result, a low level of motor activity. The obtained data are consistent with the conclusions of other scientists, I. Zenina *et al.* (2022), which proved that the number of students entering preparatory and special medical groups increased from 5.36% in the first year to 14.46% in the fourth year during their studies in higher educational institutions. Thus, almost 90% of this contingent have identified abnormalities in their state of health. This was significantly updated during the period of the mass introduction of computer technology. The most common symptoms of the deterioration of the physical condition of the acquirers are: headaches; blurred vision; memory impairment; increased fatigue; discomfort in the eyes (pain, dryness, lacrimation); increased irritability, and much more.

V. Zahorodniy & L. Yaroslavska (2021) confirm the opinion of the authors of this article that body length as an integral indicator of physical development in young men during the entire period of study does not change significantly and ranges from 178.64 ± 0.93 to 178.47 ± 0.89 cm. The body weight indicators of young men at the beginning of their studies at the university increase from 67.28 ± 1.43 kg to 69.31 ± 1.52 kg. In girls, body weight during the entire period of study decreases from 59.32 ± 3.44 kg in the first year to 55.93 ± 1.42 kg in the third year. The research of S. Kybalnyk & O. Ptashenchuk (2019) proved that the average indicator of the actual vital capacity of the lungs of the winners is 2.843 ± 0.77 l, in particular in girls – 2.581 ± 0.54 l, and in boys – 3.774 ± 0.73 l, which mostly corresponds to age norms.

The idea of a disappointing situation in the indicators of physical fitness related to the morpho-functional state of higher education students was further developed. The reasons for low physical fitness are genetics, condition, lifestyle, environmental conditions, as well as medical care, low motivation, a lack of an individual approach to the organisation of physical education classes, etc. Therefore, when doing physical exercises, as well as when testing students' motor readiness (current or final), it is necessary to take into account their individual physical condition. The results obtained by the authors confirm the conclusions of other scientists that the level of physical condition in most girls is defined as average and in boys as lower than average. This, in the authors' opinion, may indicate that the problem of poor physical condition among students can be caused by many factors, such as insufficient physical activity, irrational nutrition, the low-stress nature of modern life, environmental pollution, etc. The general deterioration of the physical condition is also caused by negative changes in the health of student youth, as noted by K.A. Almhdawi *et al.* (2021). These problems, according to M. Korchagin & Ye. Kurishko (2023), are aggravated by the influence of factors caused by the active phase of the war, which began in February 2022.

According to O. Palienko & O. Ivanenko (2022), the variety of functional deviations in physical condition, as well as differences in the initial level of students' motor abilities, require a differentiated approach both to the use of physical education tools and to regulatory requirements for evaluating the results of motor tests while taking into account the individual level of physical health of the applicants. The use of a scientifically based system for assessing the level of physical fitness of students based on objective quantitative characteristics of their state of health allows to personalise the process of physical education and increase its effectiveness. That is why it is necessary to significantly change the attitude of authorities and educational institutions regarding the formation of students' appropriate attitudes towards physical activity, leading a healthy lifestyle, preventing bad habits, and reducing hypodynamism as an important reserve for strengthening health. This is emphasised by P. Długosz *et al.* (2022), who indicate that there is a direct relationship between students' addiction to the Internet and their health problems. Taking into account the results of previous studies by Y. Matsukhova & O. Mykytchyk (2023), a survey of pedagogical students showed that most of them expressed a desire to engage in physical education using the latest fitness technologies.

Therefore, in order to increase the level of physical condition and the volume of daily motor activity, it is recommended to introduce independent classes with elements of fitness using remote technologies. Factors that directly affect the activity of students are the implementation of programmes of physical culture and health education, which provide stimulating elements for the motivation of systematic physical exercises, the use of innovative technologies, and consideration of the motivational priorities of students of higher education.

Conclusions

The article presented the results of research on the level of physical condition of students of pedagogical specialties in the conditions of distance learning. Having considered the available number of sources of scientific and scientific-methodical literature, it can be stated that there is a tendency to decrease the daily motor activity of students in the process of studying in institutions of higher education as a result of their physical condition. Girls' physical development is at an average level: body length 165.93 ± 7.63 cm; body mass index 20.92 ± 3.28 kg×m^{-1}; chest proportionality index –0.89 ± 3.40 units (the asthenic type prevails). The boys had a sufficient level of physical development: body length 179.46 ± 8.63 cm; body mass index 24.57 ± 2.65 kg×m^{-1}; chest proportionality index 5.02 ± 10.52 units, i.e., representatives of the hypersthenic type prevail. According to the results of the assessment of the functional state of the cardiovascular system, it was determined that among girls and boys, the heart rate indicators are within the age norms (89.21 ± 4.46 bpm^{-1} and 81.15 ± 7.60 bpm^{-1}). However, blood pressure indicators indicate the presence of hypertension: in girls, 133.64/91.14 ± 6.64/7.44 mm Hg; in boys, 128.27/85.31 ± 7.26/5.50 mm Hg.

The indicators of the Stange test indicate the predominance of an unsatisfactory level of the functional state of the respiratory system among 50% of girls. At the same time, 43% of female students and 42% of male students demonstrated a satisfactory condition; 7% of girls and 58% of boys had a good functional condition of the respiratory system. The level of physical condition according to the method of O. Pirohova among students of Berdyansk State Pedagogical University, among girls it

was at an average level, among boys it was at a level below average. There is a need to improve physical education programmes to improve the state of health and the level of physical fitness. In further research, there may be a scientific justification for the introduction of innovative forms of work for first-level higher education graduates studying pedagogical specialties with the aim of improving their physical condition.

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Conflict of Interest

None.

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Фізичний стан здобувачів першого рівня вищої освіти, які навчаються за педагогічними спеціальностями

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Анотація. Стрімке зниження рівня добової рухової активності студентської молоді внаслідок переходу на дистанційне навчання, яке характеризується високим обсягом розумового та психоемоційного навантаження, призвело до підвищення захворюваності та погіршення фізичного стану студентів загалом, що є актуальною проблемою. Метою дослідження було визначити рівень фізичного стану здобувачів першого рівня вищої освіти, які навчаються за педагогічними спеціальностями в Бердянському державному педагогічному університеті. Під час експерименту використано медико-біологічні методи дослідження, а саме антропометричний для вимірювання маси та довжини тіла, індексу маси тіла, індексу пропорційності Ерісмана, окружності грудної клітки для подальшого визначення рівня фізичного стану студентів. З метою обробки отриманих даних використано методи математичної статистики. Встановлено, що в здобувачів першого рівня вищої освіти, які навчаються за педагогічними спеціальностями у Бердянському державному педагогічному університеті, антропометричні показники знаходяться у межах вікових норм. У деяких студентів спостерігається наявність надлишкової маси тіла. Показники частоти серцевих скорочень у стані відносного спокою знаходяться у межах вікових норм. У показниках артеріального тиску в представників обох статей спостерігалося переважання випадків гіпертензії. Показники функціонального стану дихальної системи студентів за пробою Штанге знаходяться у межах фізіологічної вікової норми. У студенток рівень фізичного стану за методикою О. Пирогової визначається як середній, у хлопців – нижчий за середній. Проведені дослідження довели, що більшість студентів мають знижені показники рівня фізичного стану. Отримані результати на практиці можуть бути враховані викладачами під час організації занять із фізичного виховання в умовах дистанційного навчання

Ключові слова: студенти; дистанційне навчання; функціональний стан; методика Пирогової; антропометричні показники