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ANTHROPOMETRIC AND CARDIORESPIRATORY
INDICATORS FOR THE EVALUATION OF THE UKRAINIAN
YOUTH HEALTH

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Abstract

The development of precise criteria for the evaluation of youth's health and fitness level is an actual scientific problem. The express assessment technologies are of great interest nowadays due to their broad population coverage and optimum cost. The aim of the investigation was to evaluate the health status of the Ukrainian youth via the express evaluation method that helps to identify the state of cardiorespiratory system. Those involved in the randomized study were students (N=365, 163 male and 202 female) aged 18 to 22. Body mass index, lung vital capacity, vitality index, strength index, heart rate, systolic and diastolic blood pressures were studied by means of standard methods. The complex information received through different indexes was used for the generalized express assessment of health level. The results showed that 54.0 % of females and 15.3 % of males had an average level of health. No one from the experimental group showed the highest health level indices according to the standards. The low-level parameters were observed in 38.7 % of males and 19.3 % of females. The results obtained confirm the fact that student population has an average or below-average level of health. This indicates the occurrence of chronic contagious diseases, mainly those of cardiovascular and respiratory systems.

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Keywords: Health, cardiorespiratory system, youth, express method.



1. Introduction

Health is regarded as the human basic welfare component. It is related directly to life expectancy, access to education, labour market and the cost of medical care. It is not surprising that the issues of the young people's physical fitness, as well as the ways of its improvement, are of special interest. Moreover, the improving of physical condition of the younger generation is connected closely with the problems of longevity, disability prevention and effective recovery of the general population.

Deterioration of health of the youngest part of Ukrainian population arouses a particular concern. The level of physical fitness of at least 40% of Ukrainian youth has been low; cardiovascular and chronic respiratory diseases are common in different population groups and are the main causes of mortality (*Osnovni prychyny vysokoho rivnya smertnosti v Ukraini*, 2010, pp. 11-29). Progressive aggravation of health and wellness, the wide spread of chronic illnesses among young population are associated mainly with different negative behaviour patterns (unhealthy habits, prevalence of sedentary lifestyle, decrease of outdoor physical activity and excessive use of innovative technologies that have replaced live communication by existence in virtual reality) (Pavlova et al., 2015, p. 422).

The differences in the objective parameters of health or subjective perception data depend on age, gender, social circumstances, economic situation etc. (Prystupa & Pavlova, 2015, p. 37). Thus, better physical state is observed in males more frequently than in females (Haskell et al., 2007, p. 1082; Moreno & Cervelló, 2005, pp. 291-292). Also, in some countries, the difference between data can be particularly significant. Thereby 82% respondents from Ireland, 89% from Canada, 88% from the US, 81% from Switzerland and 76% from Norway evaluated their own health as good or very good (according to the results of Eurostat base). In low-income countries, particularly in Ukraine, only 54% residents assess their health status as good or excellent, while in middle-income countries, this figure makes up 70%.

2. Problem Statement

Developing clear criteria for the evaluation of youth's health and fitness level is a matter of topical interest. The results of the study were obtained using different research methods and involving population of various age groups (Yaremko et al., 2013, pp. 7-18). To evaluate the quantitative and qualitative characteristics of physical fitness, various methods were applied, like physical development indexes, a complex of morphological and functional indexes, morbidity rate per year, number of sick-list days, survey scales and indexes for subjective health determination. However, the express assessment technologies are of great importance nowadays due to their broad population coverage and optimum cost.

3. Research Questions

Hypothesis: determination of the cardiorespiratory state provides information for the evaluation of risk groups among the population.

4. Purpose of the Study

The purpose of the study was to describe the health level of the Ukrainian youth by applying the

express evaluation method that enables to assess the state of cardiorespiratory system.

5. Research Methods

Subjects. A total of 365 students (163 male and 202 female) aged 18-22 participated in the randomized study.

Methods. Anthropometric research methods were used to determine body length, weight and chest circumference. To determine body weight, professional medical scales were used; body length was measured by stadiometer, and chest circumference, by measuring tape. The index of physical development was calculated according to the results of body length and weight measurements (body mass index).

The lung vital capacity and vitality index was studied as a parameter characterising the capability of the respiratory system. It was measured by means of spirometry.

Muscle strength was evaluated with the carpal dynamometer. For the evaluation of wrist strength, the dynamometer was captured smoothly and with maximum effort. The result was recorded on a scale (in kilograms) and was used for calculating the strength index. It determines the compliance of muscle strength (the results of wrist dynamometry) with body weight (in kilograms). The norm parameters for males are 70-75%, and for females, 50-60%.

To investigate the functioning of cardiovascular system, the heart rate, the systolic and diastolic blood pressures were measured. Blood pressure was measured by standard methods. Three readings were taken at a 5-minute interval and then the mean was taken. All the readings were taken in sitting position and on the left arm.

For the assessment of health level, the Apanasenko's method was used (Yaremko et al., 2013, pp. 43-45). It generalises complex information received by means of different indexes that are calculated according to anthropometric data, muscle strength, heart rate and blood pressure (Table 01). Safe health levels begin from 14 points.

Statistical data processing was performed with SPSS Statistics.

Table 01. The express assessment of health by Apanasenko's method

The characteristics of indicators	The level of health				
	High	Above average	Average	Below average	Low
<i>Females</i>					
BMI	≥ 26.1 (-2)*	23.9–26.0 (-1)	18.1–23.8 (0)	17.0–18.6 (-1)	≤ 16.9 (-2)
Lung vitality capacity index / body weight (ml/kg)	> 56 (3)	51–56 (2)	46–50 (1)	41–45 (0)	< 40 (-1)
Muscle strength/ body weight (%)	≥ 61 (3)	56–60 (2)	51–55 (1)	41–50 (0)	≤ 40 (-1)
(Heart rate · Systolic blood pressure) /100	≤ 69 (5)	70–84 (3)	85–94 (0)	95–100 (-1)	≥ 111 (-2)
Recovery time after 20 squats for 30 sec. (min.)	≤ 59 (7)	1.00–1.29 (5)	1.30–1.59 (3)	2–3 (1)	≥ 3 (-2)
<i>Males</i>					
BMI	≥ 28 (-2)	25.1–28.0 (-1)	20.1–25.0 (0)	19.0–20.0 (-1)	≤ 18.9 (-2)

Lung vitality capacity index / body weight (ml/kg)	66 (3)	61–65 (2)	56–60 (1)	51–55 (0)	50 (–1)
Muscle strength/ body weight (%)	> 80 (3)	71–80 (2)	66–70 (1)	61–65 (0)	≤ 60 (–1)
(Heart rate · Systolic blood pressure) /100	≤ 69 (5)	70–84 (3)	85–94 (0)	95–100 (–1)	≥ 111 (–2)
Recovery time after 20 squats for 30 sec. (min.)	≤ 59 (7)	1.00–1.29 (5)	1.30–1.59 (3)	2–3 (1)	≥ 3 (–2)
<i>General assessment (points)</i>	<i>16–18</i>	<i>12–15</i>	<i>7–11</i>	<i>4–6</i>	<i>≤ 3</i>

Note: Data for the score evaluation are shown in brackets.

6. Findings

6.1. Anthropometric and physiological measurements

The results of anthropometric (body weight, body length, chest circumference) and physiological measurements (lung vitality capacity, muscle strength, heart rate, blood pressure) are shown in Table 02.

Table 02. Anthropometric data and cardiorespiratory indicators (M ± m)

Indices	Female	Male
Body weight, kg	55.3 ± 0,9	76.7 ± 3.5
Body length, cm	165.3 ± 0,8	180.2 ± 2.0
Chest circumference, cm	72.8 ± 0,6	91.7 ± 2.6
Vitality capacity, ml	2 353.6 ± 69.5	2 846.2 ± 219.7
Muscle strength, kg	30.4 ± 0.6	52.6 ± 1.9
Heart rate, bpm/min.	78.8 ± 1.5	78.6 ± 2.7
Systolic blood pressure, mm Hg	110.2 ± 1.4	120.9 ± 3.6
Diastolic blood pressure, mm Hg	68.9 ± 0.9	73.1 ± 2.7

The middle-level body mass index dominated in the examined group (Table 03). There was no significant difference between male and female population groups. The mean values were 75.2% for females and 76.7% for males. 17.8% of females had insufficient body weight. It was found that few females (3.0%) had critically low body mass index that corresponded to significant undernourishment. The increased body mass index was more typical for males. First-degree obesity and second-degree obesity had 15.3% and 8.0% of males, respectively.

Table 03. The distribution of persons (%) with different body weight in the population under study

Body mass index	Female	Male
Undernourishment	3.0	0.0
Insufficient body weight	17.8	0.0
Normal rates	75.2	76.7
First-degree obesity	4.0	15.3
Second-degree obesity	0.0	8.0

The generalised averages of wrist dynamometry were 52.6 kg and 30.4 kg for males and females, respectively. The wrist strength index (ratio of strength to body weight) was within normal rates for 73.6% of females and 61.5% of males.

6.2. The evaluation of cardiorespiratory system

To accomplish the complex evaluation of physical health, the state of respiratory system was characterised. Additional information concerning anatomical and physiological indices of the respiratory system was obtained by means of spirometry. The lung vitality capacity index was low. For males, it was 2 846 ml, and for females – 2 353 ml. The females' data were significantly lower than males'. These differences are physiologically determined. The average index for males was 21% higher than that for females.

Another parameter that reflects the system's functionality is the vitality index. Its average value for males was 50-65 ml/kg, and for females – 40-56 ml/kg. It was found that 58.3% of females and 84.6% of males had the indices lower than physiological norm, that is 48.6% of females and 76.9% of males had reduced indices. Half of the population under study exposed the indices almost at the lower limit of the normal rate.

In order to identify cardiovascular fitness, the level of heart rate, blood pressure and post-exercise recovery of heart rate were analysed. The heart rate was examined as an integral indicator of the cardiovascular system that reflects the level of tension of the functional oxygen transport system under physical stress. The normal resting heart rate was within 72-100 beats per minute for male students and 75-108 beats per minute for female students. The normal heart rate for this age group makes up 64-72 beats per minute. Such heart rate was observed only in 3.5% of females and 17.8% of males, while the majority of the individuals under study had tachycardia (Figure 01). The heart rate of 31.9% males and 9.9% females was higher than normal by 20%, whereas 23.3% of males and 16.3% of females had heart rate that was higher by 30% than normal index, and the means of 5.5% males and 49.0% females was higher than normal by almost 50%. Rather good results were obtained for the recovery time after 20 squats. For 83.53% of the population under study, this indicator was above average or high.

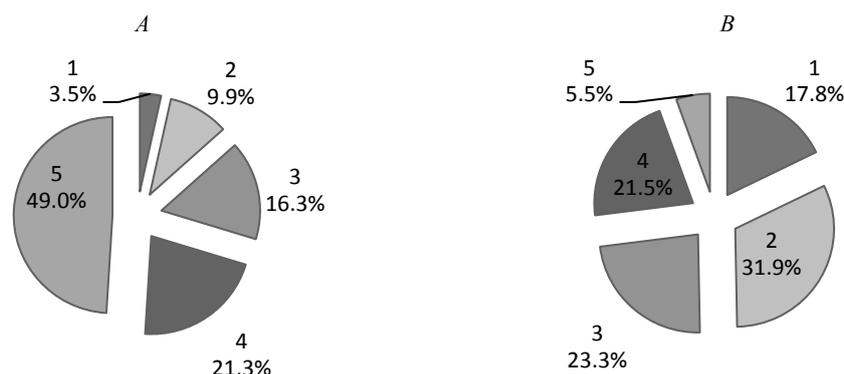


Figure 01. The level of heart rate of females (A) and males (B): 1 – heart rate indices were normal; 2 – indices exceeded the norm by 20%; 3 – indices exceeded the norm by 30%; 4 – indices exceeded the norm by more than 40%; 5 – indices exceeded the norm by more than 50%

Mean systolic blood pressure of the examined population was 110-120 mm Hg, and diastolic blood pressure – 68-73 mm Hg. The average of systolic and diastolic blood pressure was within the norm range for 87.7% and 66.3% of students, respectively (Figure 02), although some students had high blood pressure. 12.3% of males and females had somewhat higher (130-136 mm Hg) systolic blood pressure as

compared to normal indices. Increased diastolic pressure by 5% and 10% was observed in 19.5% and 7.7% of the population; 6.6% of the students had considerably increased blood pressure values (by more than 10%).

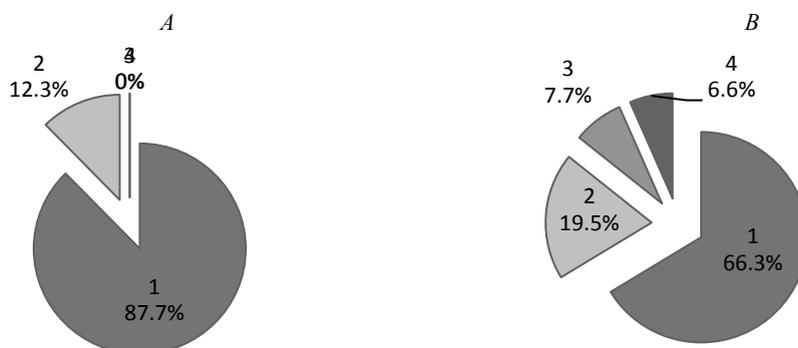


Figure 02. The characteristics of the students' systolic (A) and diastolic (B) blood pressure: 1 – normal blood pressure; 2 – blood pressure increased by 5%; 3 – blood pressure increased by 10%; 4 – blood pressure is increased by more than 10%

6.3. The general evaluation of health level

The vast majority of females (54.0%) possessed the average level of health (Table 04). These data were typical only for 15.3% of males. No one from the group under study had a high level of health indexes. Higher-than-average health indexes were observed only in 4.5% of females and 8.0% of males. The low-level parameters had 38.7% of males and 19.3% of females. A below-than-average level was found in 22.3% of females and 38.7% of males.

Table 04. The assessment of students' health level

Health level	Female, %	Male, %
High	0.0	0.0
Higher than average	4.5	8.0
Average	54.0	15.3
Lower than average	22.3	38.7
Low	19.3	38.7

According to the *Ukrainian annual report about health condition, sanitary and epidemiological situation*, the population of Ukraine has decreased by 679.4 thousand. This tendency is typical for many countries (Belarus, Bulgaria, Czech Republic, Greece, Estonia, Italy, Latvia, Lithuania, Moldova, Romania, Slovenia, etc.), but accelerated population decline has been observed only in Ukraine. Non-communicable diseases are the main causes of health deterioration in Ukraine nowadays (*Osnovni prychyny vysokoho rivnya smertnosti v Ukrayini*, 2010, pp. 11-15; Pavlova, 2016, pp. 32-33). More than 70% of mortality cases are caused by diseases of cardiovascular system, cancer, and chronic respiratory disease. Early screening and prevention of these chronic conditions are currently of paramount importance for the Ukrainian nation. The analysis of anthropometric characteristics and the functioning of cardiovascular and respiratory systems are essential for health status screening.

Every sixth child who is born in Ukraine has certain health problems (*Osnovni prychny vysokoho rivnya smertnosti v Ukrayini*, 2010, p. 11). During the school years, students lose at least a third of their health. Vision deteriorations, hearing problems, and diseases of digestive, urinary, nervous and endocrine systems are widely spread among children. Physicians have diagnosed chronic or acute diseases in 90% of Ukrainian students, more than half of them having a poor level of physical fitness. Every third respondent links his/her health problem with studying at school; in particular, 22% suffer from headaches and dizziness, 21% have neck pain, 23% are under chronic stress and anxiety for their own future, 18% suffer from back pain, 16% feel permanent fatigue (Bashavets, 2011, p. 8). Students with chronic diseases expose twice higher level of anxiety as compared to persons of the same age group who have no complaints about their health status (Pavlova, 2016, pp. 132-149). Every second female student connects his/her stressful condition with certain problems occurring during academic learning at university (bad scores, the necessity to work off skipped classes) or interpersonal relationships (conflicts with classmates, pedagogues, roommates, hostel warden, etc.).

Ukrainian students constitute a special social group that includes persons aged 17 to 22. This age period is accompanied by the active development of sensory-perceptual and psychomotor functions. Students possess higher level of performance and endurance, willingness and motivation for professional improvement as compared to other population groups. Due to significant psycho-emotional and mental stress associated with learning condition and the formation of new social contacts, they are permanently at an increased risk of developing health problems (Pavlova, 2016, p. 132). The proper physical development and functional status correlate with high quality of life in youth (Frost & McKelvie, 2005, p. 36; Monteiro-Peluso, 2005, p. 62; Pavlova, 2016, pp. 189-190; Pavlova et al., 2016, pp. 421-422; Posadzki et al., 2009, pp. 239-243). Therefore, the study of somatic health level is necessary for a comprehensive assessment of students' well-being.

In view of these problems, the search for means and methods to improve students' health is of significant importance. An effective mechanism of influence on the cardiorespiratory system can be considered the engagement of students in the physical training of health-enhancing orientation.

Among the issues that require further decision, it should be mentioned a differentiated approach to the distribution of students during training and the organization of physical training in leisure time, which, considering the students' interests, search for ways to increase the motivation for physical activity during leisure time.

These approaches require the use of available methods of monitoring health and well-being and the control of cardiovascular system. Also, the development of assessment scales to facilitate a differentiated approach to the physical education of students is of significant interest.

7. Conclusion

The Apanasenko's method that is based on the concept of physical health was used for the express evaluation of students' health level. The assessment of different indexes is performed in points that are calculated on the basis of body height, body mass, muscle strength, heart rate and blood pressure indices. A satisfactory level of health begins with the index of 14 points. The chronic forms of non-communicable diseases are not practically registered in this area. This method is of practical significance; the approach

could be used as a rapid method for health evaluation. It has been found that the young generation has an average or low health level. In addition, a significantly lower level of health was observed among males as compared to females.

The vast majority of young people have average or lower-than-average physical health. Individuals with normal body weight ratio dominated in the group under study. The vitality index of the students was below the norm, while the strength index was within normal limits. Despite the problem of high blood pressure and exceeded heart ratio, the heart rate after exercises and recovery time was within the norm.

Data obtained as a result of this scientific research testify to the fact that student population of Ukraine has average or below average health status. Low parameters that characterize cardiovascular and respiratory systems indicate the availability of chronic forms of non-communicable diseases common to Ukrainian population older than 22 years today.

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