Original Article

Specificity of the relationship between the volume of physical activity and the physical condition of 18-19-year-old girls

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Abstract:
         The article presents the results of the analysis of indicators of physical development, the functional state of the cardiovascular and respiratory systems, the level of physical performance and morbidity, the volume of physical activity and body composition of girls aged 18-19 years during the 2017-2018 academic year. Altogether 185 girls (n=185), whose average age was 18.8 years were involved in the research. The aim of the study was to identify the specificity of the relationship between the volume of physical activity and physical condition indicators of the girls aged 18-19 years during the study in a higher educational institution. When comparing the obtained average results characterizing the morpho-functional state of the girls aged 18-19 years with age norms, it was found that body length, body weight, girth body size and skin-fat folds are within the age range. Individual indicators of the volume of physical activity in girls indicate a significant predomination of the inactive lifestyle and low level of motor activity. Girls spend more time on sedentary, basic, and low level of physical activity, 546.6, 536.3, and 328.2 minutes, respectively.
We have found that most of inverse correlation relationships are observed between the volume of physical activity and indicators of the morpho-functional state: body weight (-0.452 at p <0.001), body mass index (-0.443 at p <0.001), shoulder girth (- 0.581 at p <0.001), thigh girth (-0.525 at p <0.001), waist girth (-0.480 at p <0.001), pelvic girth (-0.412 at p <0.001), chest girth (-0.294 at p <0, 01), systolic blood pressure (-0.353 at p <0.001), heart rate at rest (-0.543 at p <0.001), Ruffier index (-0.394 at p <0.001).
Key words: physical condition, volume of physical activity, girls.

Introduction

         Preserving the health of students is one of the priorities of any educational institution. The transformation of modern Ukrainian society, the change in the primary principles of life activity develop new social practices of contemporary students, adequate to the nature and content of the loads associated with the increasing complexity of social life, changing its rhythm. The interests and values attitudes of youth are currently associated mainly with technology, information technology, form an artificial habitat In recent decades, the problem of the state of health and physical development of pupils (Bolotin, 2014; Azhippo, 2015; Yarmak, 2017; Galan, 2017; Blagii, 2018) and students has become increasingly relevant, since students are one of the most representative groups of young people in the country (Aelterman, 2012). During the study at the university, students are at the stage of forming social and physiological maturity; they adapt well to factors of the social and natural environment and, at the same time, for a number of reasons they are subject to a high risk of physical disturbances (Paliichuk, 2018). The health of students is highly dependent on the specific living conditions and terms of stay in them. The influence of various factors on the formation of the developing body makes changes in the individual development and adaptation capabilities (Paliichuk, 2018). In the process of development, the contribution of these variables to the formation of a person's physical status changes (Galan, 2018). The need to control the physical condition is even more distinctly felt in those situations when the student youth, due to innovative educational workloads with a high level of psycho-emotional and intellectual load, decrease the level of physical activity (Yarmak, 2018). Analysis of modern scientific research shows that physical activity is an integral part of human behaviour, which should ensure the normal functioning of body systems and the preservation of health (Anikeev, 2010).

         The relevance of the research consists in identifying the specificity of the relationship between the volume of physical activity and physical indicators of the girls aged 18-19 years during their studies at a higher education institution since at this age biological development ends and morpho-functional parameters acquire

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optimal values (Balamutova, 2011; Sapognic, 2012; Cieślicka, 2012; Kruk, 2013). In this age range, the human body has the highest stability, economic feasibility and reactivity in response to the action of the stress factor of any modality.

Materials and Methods

Methods of research applied were as follows: analysis and synthesis of the specific scientific and methodical literature and documentary materials, educational research methods, anthropometric, physiological methods, methods for determining incidence rates, methods for assessing physical activity, methods of mathematical statistics.

Anthropometric studies of the girls were carried out with standard equipment according to generally accepted and unified methods. Indicators reflecting the level of formation of morphological characteristics (body length (BL) and body weight (BW), body mass index (BMI), chest girth, waist girth, pelvis girth, shoulder girth, thigh girth, and the sum of five skin and fat folds were determined. The composition of the body was studied using the polysegment analyzer of the Japanese company Tanita BC-545. The body composition was fractionated into fat, muscle and bone components. Physiological methods were used to assess the state of the cardiovascular system of girls, heart rate at rest (HR), systolic blood pressure (SBP) and diastolic (DBP) of the respiratory system, the vital capacity of the lungs (VC). The functional Ruffier's test was used to assess physical performance. Estimation of the daily motor activity of various nature was carried out applying the methods of Framingham research. Medical records analysis was conducted to determine the presence of disease among female students. The degree of body resistance of the girls to adverse environmental conditions was determined using the analysis of medical records and certificates of the past diseases.

The results were processed using the methods of mathematical statistics. The research work was carried out on the basis of the Bila Tserkva National Agrarian University with girls aged 18-19 years. Altogether 185 girls were involved in the research. Protocols of experimental studies were supported by the bioethics commission of the Bila Tserkva National Agrarian University. According to ethical standards, students were involved in the study voluntarily with the written consent to participate in all stages of the educational experiment, to further analyze and disclose their personal data when considering and reporting on the research results.

Results

During the 2017-2018 academic year, it was conducted the study of 185 girls, students of the second and the third years of the Agrobiotechnology Faculty, the Faculty of Economics and the Faculty of Veterinary Medicine of the Bila Tserkva National Agrarian University, the average age of the subjects was 18.8 years.

Adolescence is a specific, crucial stage in the individual development of the human organism. The age of 18-19 years is the period of the social development of personality. It is well known that at this stage the final biological development of an organism has not yet been completed, and knowledge of its peculiarities during this period allows us to develop methods of the targeted influence to achieve harmonious development of the organism and preserve its health (Prokofieva, 2006).

The results of the study of the physical development of girls are presented in Table 1 When analyzing the indicators of the physical development of the girls, we came to the conclusion that the average values of body length, body weight, girth size correspond to age norms. Analysis of individual BMI indicators in the girls allowed us to state, that 14.1 % (n = 26) of female students had body mass deficiency, 62.7 % of the girls (n = 116) had normal body weight, 17.3 % were overweight (n = 32) and 5.9 % of the girls (n = 11) had the class I obesity. There is a high variability of BW, BMI and five skin-fat folds and their amounts, the coefficients of variation range from V = 22.7 % to V = 62.6 %, which indicates the heterogeneity of the sample.

Bioimpedance analysis helps to control the state of the lipid, protein and water metabolism of the body and thus arouses interest among teachers, fitness trainers and doctors. Knowing the composition of the body, experts can assess the risk of developing metabolic syndrome, the degree of tissue hydration. Also, bioimpedance analysis can be one of the tools for evaluating the effectiveness of the proposed health programs for the correction of body weight.

The component composition of the human body undergoes changes throughout life. Any deviations from the age norm may indicate functional impairment and diseases.

Table 1. Indicators of physical development of the body of girls 18-19 years old (n = 185)

Indicators under study	$\bar{x}$	S	Me	25%	75%	Min.	Max.
Body length, cm	168.5	6.23	168.0	165.0	170.0	152.0	184.0
Body weight, kg	62.7	14.22	58.9	52.5	67.5	43.7	100.1
Body mass index, kg·m^2	22.6	5.31	21.4	19.3	24.8	15.3	34.1
Chest girth, cm	86.1	9.12	83.5	81.0	90.0	72.0	107.0
Shoulder girth, cm	26.9	3.12	26.0	24.0	30.0	21.0	35.0

Waist girth, cm	68.8	8.16	68.0	62.0	75.0	53.0	93.0
Pelvis girth, cm	95.0	7.09	94.0	89.0	100.0	81.0	118.0
Thigh girth, cm	52.8	6.30	52.0	49.0	57.0	31.0	69.0
The biceps skinfold, mm	12.2	7.88	12.0	7.0	18.0	3.0	35.0
The tricep skinfold, mm	20.1	8.43	19.0	12.0	26.0	8.0	37.0
The subscapula skinfold, mm	16.4	10.27	13.0	8.0	22.0	5.0	41.0
The suprailiac skinfold, mm	14.3	7.67	12.5	7.0	19.0	4.0	32.0
The medial(inside) calf fold, mm	19.6	8.89	20.0	11.0	24.0	5.0	46.0
The sum of five skin and fat folds, mm	82.2	38.31	75.5	54.0	109.0	30.0	173.0
Basal metabolic rate, kilocalorie	1412.2	130.71	1381.0	1338.0	1458.0	1254.0	1772.0
Body fat percentage, %	27.7	8.33	26.7	22.4	32.0	11.8	46.4
Visceral fat level, %	2.0	1.87	1.0	1.0	3.0	1.0	8.0
Bone mass, %	2.2	0.20	2.2	2.1	2.3	2.0	2.7
Muscle mass percentage, %	40.1	3.71	39.7	32.9	41.0	32.9	51.3
Right hand grip dynamometry, kg	30.5	3.77	30.0	29.0	33.0	20.0	41.0
Left hand grip dynamometry, kg	26.1	4.89	26.0	22.0	30.0	15.0	39.0

In the course of our study, we found that the average body fat percentage (BF), %, exceeds the age norm. Since the body fat percentage is the most variable component of the human body, the individual results for girls aged 18-19 years ranged from 11.8 % to 46.4 %. That is, among the girls studied, there was both an underweight of body fat (14.1 %) and overweight (23.2 %). In healthy people, individual indicators of visceral fat level are normally in the range of 1.0-4.0 %, the interval from 5.0-8.0 % is considered to be an acceptable level, 9.0 % or more indicates obesity. Obtained during the study, the average indicators of visceral fat in girls 18-19 years old are within the age norm. The individual age variations without a bone and muscle mass are sustainable and directly dependent on the genetic factors. The average bone mass in the girls is below the norm. Normally, the muscular mass in the girls ranges from 35.0 % to 41.0 %; 42.0 % of the muscular mass and more is typical for the girls engaged in physical training. The average indicators of the muscular factor in the studied girls are normal. With the use of the anthropometric and bioelectric parameters, it is possible to obtain an estimate of the basal metabolic rate, which characterizes human energy metabolism. When determining the individual indicators of the basal metabolism of the studied contingent, the specialists in the field of physical culture and sports have the opportunity to correct the diet and physical activity. In humans, the basal metabolic rate depends on gender, age, body length and body weight, body temperature, and other external and internal factors. The age norm for the girls aged 18-19 years is in the range of 1300-1700 kcal per day. The average result of the studied girls is within the age norm. It should also be noted that the basal metabolic rate depends on the level of development of the musculoskeletal tissue. The average results are presented in table 2.

Table 2. Indicators of the functional state of the cardiovascular and respiratory systems and the physical performance of girls 18-19 years old (n = 185)

Indicators under study	$\bar{x}$	S	Me	25%	75%	Min.	Max.
VC, l	3.4	0.43	3.4	3.2	3.8	2.1	4.5
HR_{rest}, beats /min^{-1}	89.4	12.54	87.0	79.0	98.0	68.0	118.0
SBP, mm Hg	113.5	7.21	111.0	111.0	121.0	100.0	135.0
DBP, mm Hg	73.5	7.11	71.0	70.5	82.0	60.0	90.0
Ruffier index, nominal units	9.6	3.11	9.0	8.5	10.2	6.1	17.0

In the overwhelming majority of the girls aged 18-19, individual VC results were within the age norm, and only in 9.7 % of the girls, the results were below the age norms.

The average HR at rest indicator is above the age norm, it is also disturbing that in 51.9 % of the girls aged 18-19 years, individual results range from 84 beats min-1 to 118 beats min-1, this fact may indicate psycho-emotional stress.

During our study, we found out that symptoms of hypotension are typical for 18.4 % of the girls (BP <110/70), and hypertension - for 20.5% of the girls under study.

The analysis of the individual results of the Ruffier index allowed us to state that the girls have no high level of physical performance, 17.3 % have a sufficient level, 32.9 % have an average level, 21.6 % have a satisfactory level and 9.2 % of the girls have an unsatisfactory level of physical performance.

To determine the daily volume of various physical activity in the girls, we used the methodology of the Framingham study. The volume of physical activity of students depends on many physiological, socioeconomic, domestic, psychological and other factors: age, gender, type of constitution, level of physical fitness, motivation

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to study, lifestyle, geographical and climatic conditions, the amount of free time and the way of its use, availability of sports facilities, etc (Zakharina, 2004).

Analysis of individual indicators of the volume of physical activity in the girls indicates a significant prevailing of the sedentary level of physical activity. As studies show, the female students spend most of the time on reading and working at a computer, aimed at expanding the reserves of thinking processes and intellectual activity. The largest number of minutes is spent by the girls on a sedentary, basic, and low level and is 546.6, 536.3, and 328.2 minutes, respectively. As a result of the study, we found out that the organized high-level physical activity in the girls does not exceed 28.9 minutes per day.

The scientists consider the decrease in physical activity as one of the main factors that contribute to the development of a number of diseases, in particular: hypertension, atherosclerosis, coronary heart disease and myocardial infarction, the vegetative-vascular dystonia, obesity, poor posture with damage to the bone and muscular system. The cardiovascular system is particularly vulnerable which is manifested by a deterioration of the functional state of the heart and a decrease in the efficiency of its work (Ivashchenko, 2008).

The next task of our study was to determine the presence of the disease among female students during the 2017-2018 academic year. According to the medical records, we obtained the following results. In the nosology of morbidity during the period of study, respiratory diseases occupy the first place, they were sick 80.5% (n = 149). The highest percentage of the girls , 65.8 % (n = 98) had acute respiratory diseases of the upper respiratory tract, 14.1 % had acute bronchitis (n = 21), 8.1 % had tracheids (n = 12), tonsillitis, laryngitis and pharyngitis in 12.1 % of girls (n = 18). The second place in the nosology of morbidity in the girls are taken by the disease of the musculoskeletal system, 8.6% of the girls (n = 16) were ill. The diseases of the genitourinary system 5.9% (n = 11) and surgical operations 4.3% (n = 8) are in the third and fourth place in the nosology of diseases. Altogether 2.1 % of the girls (n = 4) had neoplasms; 1.6 % of the students (n = 3) had diseases of the organs of eyes and skin.

Analyzing the girls' medical records, we found out that 32, 9 % of the girls got ill 2 times a year, and 11.4 % of the girls got sick more than 3 times a year. In the female students, there were 8.1 % of the girls who were ill for two classes of diseases and 3.2 % for the three classes of diseases. The average duration of the illness was 5-8 days. For the purposes of our scientific work, we investigated the specificity of the relationship between the volume of physical activity and physical condition indicators of the girls aged 18-19. The results are presented in Figure 1.
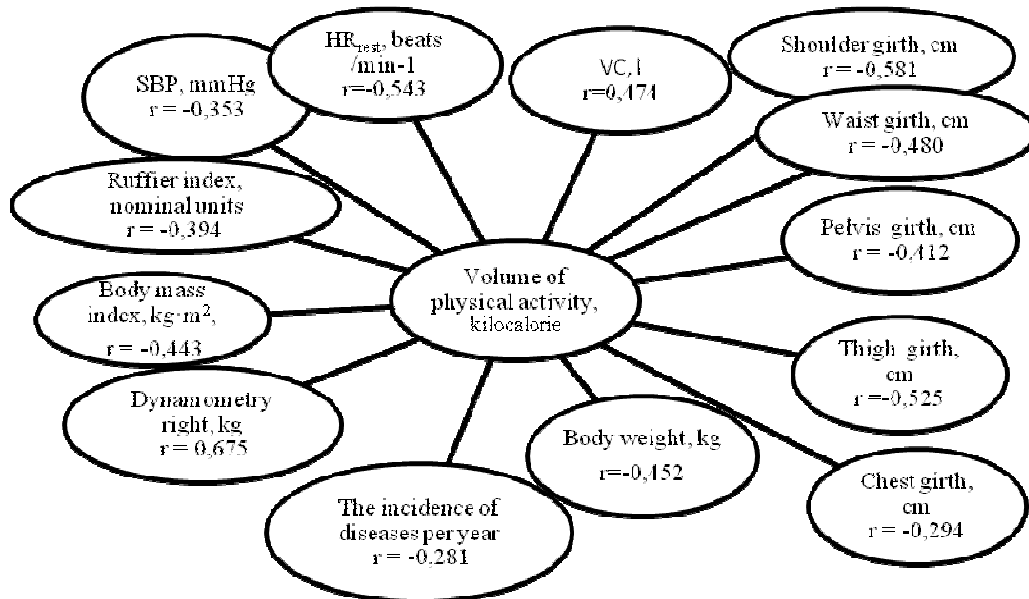

Fig.1. Correlation relationships between the volume of physicalactivity and the studied indicators of the physical condition.

Our study allowed us to state that most inverse correlation relationships are observed between the volume of physical activity and physical development indicators. In particular: BW (-0.452 with p <0.001), BMI (-0.443 with p <0.001), shoulder girth (-0.581 with p <0.001), thigh girth (-0.525 with p <0.001), waist girth (-0.480 at p <0.001), pelvis girth (-0.412 at p <0.001), chest girth (-0.294 at p <0.01). An inverse correlation relationship is observed with a SBP (-0.353 with p <0.001) and the number of diseases per year (-0.281 with p <0.001), Ruffier index (-0.394 with p <0.001), HR at rest (- 0.543 with p < 0,001). A direct relationship is observed between the volume of physical activity and dynamometry of the right hand (0.675 at p <0.001), and VC (0.474 at p <0.001).

Discussion

Today in Ukraine, the problem of preventing diseases and the health improvement of the population should be considered among the top priorities. From 65 % to 85 % of school-age children (Gorshova, 2017; Pityn, 2017; Galan, 2018) and student youth have various types of diseases (Galan, 2017). Recently, there has been a negative trend in the state of health of students in the period of study at a higher educational institution and their transition to graduation.

Analysis of researches indicates that only 9-10 % of young people have a level of health and physical condition near to normal, along with this fact, about 35-40 % of the young people have chronic diseases. Currently, the restrictions in the activity of the cardiorespiratory system and disorders of the musculoskeletal system are the most common disorders in the state of health of students. This problem is mostly due to a sedentary lifestyle and a low level of physical activity.

The results of our research confirm the data (Kondakov, 2008) about the negative trend towards the sedentary lifestyle of students, about the significant advantage of the seated level of physical activity (), about the fact that in recent years the percentage of students in the special education department (Korjagin, 2012). The results of our research confirm the data (Martirosov, 2006) that the analysis of the component composition of the body, in contrast to BMI, give more detailed information on the physical condition of the human body.

The results of our studies complement the data (Yarmak, 2018; Gu, 2018; Baidiuk, 2019) on the component body composition of this age group and the presence of correlation relationships between the cardiovascular system and the fat component.

Conclusions

Analysis of individual indicators of the volume of motor activity in girls indicates a significant advantage of the seated level of motor activity. In general, it can be stated that such components of the physical state as physical development, the functional state of the cardiovascular and respiratory systems, physical performance, and the incidence of illness with a low level of physical activity have mostly negative indicators and do not experience positive changes in students during training in high school. This fact is confirmed by a high inverse correlation of the volume of motor activity with BW, BMI, shoulder girth, thigh girth, waist girth, pelvis girth, chest girth, heart rate, BP, and correlation coefficients range from $r = -0.294$ to $r = -0.581$ with $p < 0.001$.

Competing Interests

The authors declare that they have no competing interests.

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