

ORIGINAL ARTICLE

GENDER AND SOMATOTYPOLOGICAL PECULIARITIES OF INDICATORS OF AEROBIC AND ANAEROBIC PRODUCTIVITY OF ENERGY SUPPLY OF THE BODY IN THE POST-PUBERTAL PERIOD OF ONTOGENESIS IN THE RESIDENTS OF THE ZAKARPATTIA REGION

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ABSTRACT
The aim: To establish gender differences in aerobic and anaerobic productivity in practically healthy residents of the Zakarpattia region in the post-pubertal period of ontogenesis, depending on the somatotypological characteristics of the organism.
Materials and methods: A comparative analysis of physical health status of 456 individuals, was carried out, whit was assessed by indicators of aerobic and anaerobic productivity of the body, depending on the somatotype, which was determined by the Heath-Carter method, and depending on the component body composition which was determined using the impedance method.
Results: The relative value $Vo_{2\,max}$ in females corresponds to "excellent", which guarantees a "safe health level" according to H.L. Apanasenko. At the same time, the level of aerobic productivity in males in terms of the relative value $Vo_{2\,max}$ is "average", which cannot guarantee a "safe health level". The anaerobic productivity of females is lower than in males in terms of the relative value of alactic power, lactic power, and the capacity of lactic energy supply processes by 55.6%, 54.7%, and 38.7%, respectively.
Conclusions: The level of aerobic productivity, regardless of the area of residence, in females is higher than in males according to Ya.P. Pyarnat's criteria. In males the increase in the fat component has a negative effect on the aerobic and anaerobic energy supply of the body. On the contrary, the growth of the muscle component of body mass helps to increase the aerobic and anaerobic capacity of the body.

KEY WORDS: physical health, somatotype, component composition

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INTRODUCTION
Physical health which is determined by the genotype and the phenotype formed on its basis [1-4], should be considered according to the sum of the reserve functional capacity of the organism [5] throughout life [6]. In view of this, health should be assessed not only qualitatively, but also quantitatively so as to provide an objective assessment [7, 8].

The quantitative assessment of health consists in measuring the energy potential of the human body, which is based on macroergic compounds ATP, CrP, GTP, and inorganic pyrophosphate. The greater the power and capacity of the energy potential realized by the body and the efficiency of energy expenditure, the higher the health status of the individual [4, 9]. The aerobic productivity of the body is considered an informative indicator of somatic health as anaerobic energy significantly prevails in the total amount of the energy potential of aerobic energy production [5, 10].

For the quantitative assessment of physical health status, the physiological indicator of such a functional system should be used, which would integrate the functions of most functional systems of the body. According to Yu.M. Furman [4, 5], the maximum oxygen consumption ($Vo_{2\,max}$) is the indicator of the aerobic functional energy supply system that meets these requirements. Its value is determined by the function of the cardiovascular, respiratory, blood systems and the oxygen utilization system in the muscles.

The interest in anthropometric and somatotypological studies has been growing considerably, since they allow to connect the structural features of the human body with the features of metabolism and body functions in normal and pathological conditions [11, 12]. Today, most researchers have come to the conclusion that somatotype should be at the center of the search for such features [13]. Nikitiuk [14] figuratively called the somatotype a "skewer", which can take on any amount of additional information in the form of functional biophysical indicators. Somatotype as a morphological expression of the constitution, is one of the integral characteristics of the human body [8, 13] which reflects the level and harmony of physical development [11, 12]. Today, the dependence of the functional capabilities

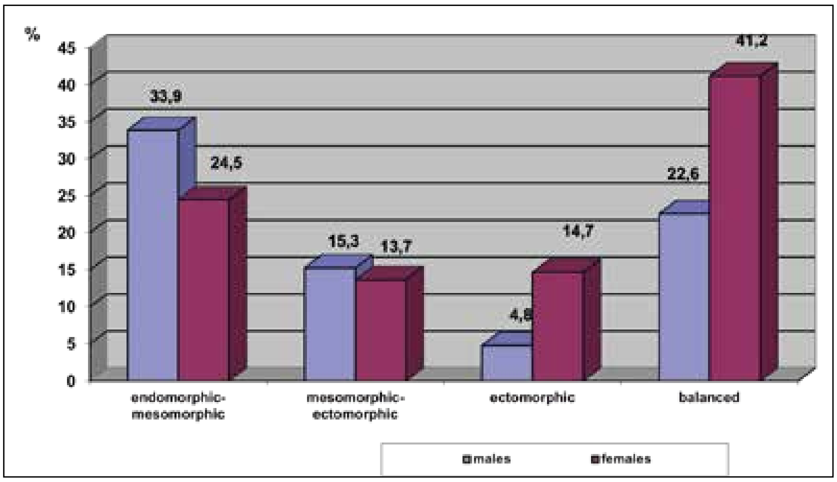

Fig. 1. Distribution of males and females from the mountainous districts of the Zakarpattia region by somatotypes

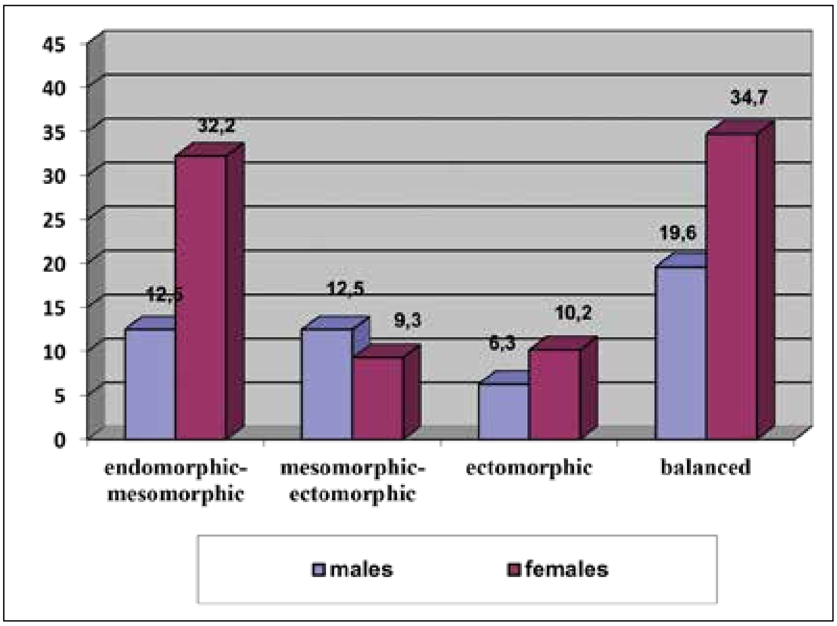

Fig. 2. Distribution of males and females from the lowland districts of the Zakarpattia region by somatotypes

of the body on the components of body composition is of particular interest [15]. Reorientation of anthropology from solely measuring the forms and proportions of the body to studying the dependence of body functions on them, makes the research of heredity and environmental variability at various stages of the organization and functioning of the human organism relevant.

THE AIM

The aim is to establish gender differences in aerobic and anaerobic productivity in practically healthy residents of the Zakarpattia region in the post-pubertal period of ontogenesis, depending on the somatotypological characteristics of the organism.

MATERIALS AND METHODS

Comparative analysis of physical health status of 456 adolescents in the post-puberty period of ontogenesis, aged from 16 to 21 years, was carried out. The number of the examined young males and females was 226 (49.6%) from the mountainous districts and 230 (50.4%) from the lowland districts of Zakarpattia region. Physical health status was assessed by indicators of the aerobic productivity of the body, namely, the maximum oxygen consumption was measured ($VO_{2\ max\ rel.}$) using the bicycle ergometry method. To evaluate the level of aerobic productivity, the Ya.P. Pyarnat's rating scale was used [4]. Indicators of anaerobic productivity of the body were studied by: measuring the power of anaerobic alactic energy supply processes by the Peak Power Output in 10 s (WAnT 10); the power of anaerobic lactic energy supply processes by the Peak Power Output in 30 s (WAnT30), using the Wingate anaerobic test described by Yu.M. Furman et al [4]. The anaerobic lactic productivity of the organism was measured by the Peak Power Output (PPO) in 1 min using A. Shogy and G. Cherebetin's method [4]. The somatotype was determined by the Heath-Carter method [16], which provides a three-component (fat, muscle and bone) anthropometric assessment. This method allows to quantitatively assess the advantage of: endomorphism, or relative obesity; me-

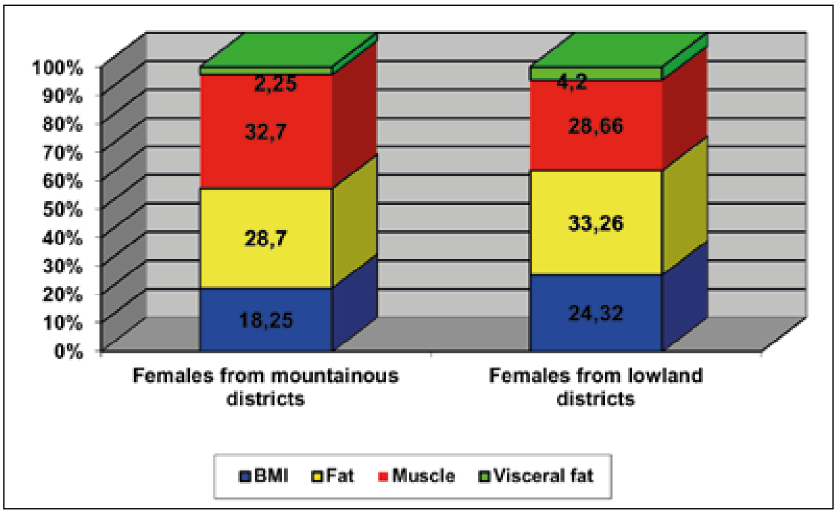

Fig. 3. Component body composition of female residents of the Zakarpattia region who have an excellent level of aerobic productivity according to $VO_{2\ max\ rel.}$ (n=220)

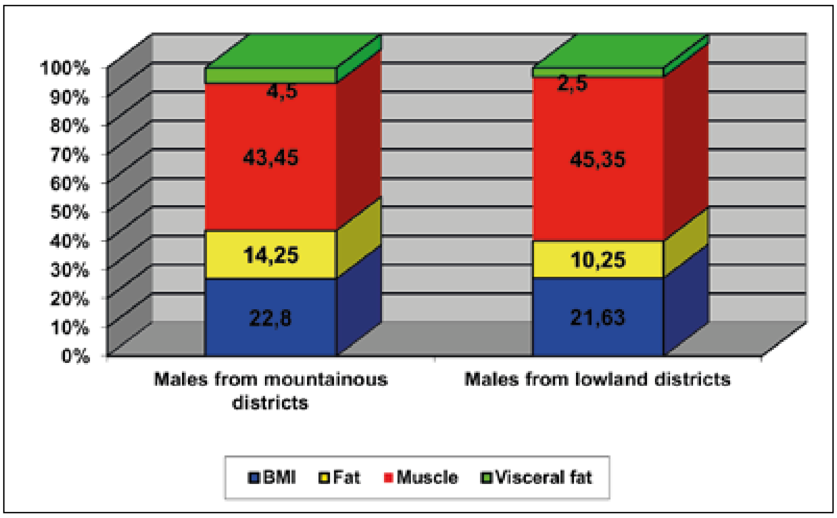

Fig. 4. Component body composition of young residents of the Zakarpattia region who have an average level of aerobic productivity according to $VO_{2\ max\ rel.}$ (n=236)

somorphism, or relative development of the skeletal and muscular system; ectomorphism, or relatively linear and slim body type. The component body mass composition was determined using the impedance method with the application of Omron BF511 Body Composition Monitor to estimate the percentage of fat mass (subcutaneous and visceral fat) and the percentage of skeletal muscle [15]. The statistical processing of the material was carried out in Excel 7.0 and SPSS version 10.0 using Student's t-test to find out the reliability of the difference between the average values.

RESULTS

There are differences in the numerical distribution of individuals in the post-pubertal period of ontogenesis with a prevalence of a certain component body mass composition and somatotype depending on the area of their residence either in lowland or mountainous districts of the Zakarpattia region. The gender factor also affects this distribution. Among females from lowland districts there is a greater number of individuals with a high percentage of fat component (38.1%) and a smaller number (6.8%) with a low fat percentage than among peers from mountainous districts (10.8% and 38.2%, respectively). In males from lowland and mountainous districts, no significant quantitative difference was observed between individuals in terms of the relative value of the fat content. No significant difference was found in the distribution of females from lowland and mountainous districts in terms of the relative value of the muscle content. At the same time, among females from mountainous districts there is a slightly higher number of individuals with high (by 3.6%) and very high (by 3%) percentage of the muscle component, compared to females from lowland districts.

Among males from lowland districts, a larger number of individuals with very high (by 38.7%) and high (by 8%) percentage of the muscle component was registered, compared to those living in mountainous districts. Among males from the mountainous districts, individuals with normal levels of this component prevailed as compared to peers from the lowland districts. The gender difference in the distribution of the youth of lowland and mountainous districts by somatotypes is characterized by the following: mesoectomorphic (9.3%) and endomesomorphic (6.3%) somatotypes represented the smallest number of individuals from lowland districts among females. Regardless of the gender, the largest number of individuals was represented

Table I. Average values of indicators of aerobic and anaerobic productivity of the organism (M±m) in post-puberty adolescents from lowland and mountainous districts of the Zakarpattia region, n= 456

Indicators	Aerobic productivity		Anaerobic productivity					
	Maximum oxygen consumption		power of alactic energy supply processes		power of lactic energy supply processes		capacity of lactic energy supply processes	
	$VO_{2\,max\ rel.}$ ml·min^{-1}·kg^{-1}		WAnT $_{10\ rel}$, kg-m·min^{-1}·kg^{-1}		WAnT $_{10\ rel}$, kg-m·min^{-1}·kg^{-1}		PPO $_{rel.}$, kg-m·min^{-1}·kg^{-1}	
Gender	lowland district	mountainous district	lowland district	mountainous district	lowland district	mountainous district	lowland district	mountainous district
Males (n=236)	42,7±0,65	40,3±1,23	57,02±1,32	63,5±1,39	52,1±1,64	61,1±2,01	29,81±1,01	27,96±0,94
Females (n=220)	42,9±0,58	41,7±0,46	41,2±0,32	40,8±0,64	39,4±1,16	39,5±1,08	23,4±0,3	21,5±0,8
P	> 0,05	> 0,05	< 0,01	< 0,01	< 0,01	< 0,01	< 0,05	< 0,05
M	1,03		1,57		1,55		1,39	

Note: P is the probability of a difference in the average values of the indicators of the body of young people within the same type of area (P<0.05); M is the multiplicity of changes in the average values of the indicators of the body of young people of different gender groups

Table II. The average values of indicators of aerobic productivity (M±m) in post-pubertal youth from the lowland and mountainous districts of the Zakarpattia region depending on the somatotype, n= 456

Indicators	Aerobic productivity			
	Maximum oxygen consumption			
	$VO_{2\,max\ rel.}$, ml·min^{-1}·kg^{-1}			
	Females (n=220)		Males (n=236)	
Somatotype	lowland district (n=118)	mountainous district (n=102)	lowland district (n=112)	mountainous district (n=124)
Endomorphs	38,2±1,63	41,4±2,3	-	-
Endomesomorphs	41,8±1,81	45,2±1,93	38,56±0,47*	39,1 ± 0,93*
Mesomorphs	-	-	44,63±1,3	42,2±1,61
Mesoectomorphs	40,8±1,64	38,1±2,11*	46,44±1,45	43,3±1,29
Ectomorphs	39,2±1,7	39,3±1,97*	44,7±1,02	45,8±1,48
Balanced	40,4±1,53	41,8±1,8	40,8±0,62*	41,6±2,13

* - the probability of a difference in indicators between different somatotypes within the same gender (p< 0.05)

by a balanced somatotype. The largest number of individuals with balanced (41.2%) and endomesomorphic (33.9%) somatotypes was registered among females from mountainous districts. At the same time, the largest number of individuals was represented by endomorphs (5.9%) among females, and by ectomorphs among males (Fig. 1 – 2).

Aerobic and anaerobic productivity of adolescents in the post-pubertal period of ontogenesis is determined by the area of residence, as well as the gender factor. The level of aerobic productivity, regardless of the area of residence, in females aged 16-20 is higher than in males aged 17-21, according to Ya.P. Pyarnat's criteria [4]. The relative value $VO_{2\,max}$ (42,9±0,58 ml·min^{-1}·kg^{-1}) in females corresponds to "excellent", which guarantees a "safe health level" according to H.L. Apanasenko [17]. At the same time, in males, the level of aerobic productivity in terms of the relative value $VO_{2\,max}$ (42,7±0,65 ml·min^{-1}·kg^{-1}) is "average", which cannot guarantee a "safe health level" according to H .L. Apanasenko. Anaerobic productivity in females is lower to that of males in terms of the relative value of alactic power, lactic power and capacity of lactic energy supply processes by 55.6%, 54.7%, and 38.7%, respectively, table I.

There are differences in physical health status in terms of the ability to demonstrate the aerobic capacity of the body in young males and females living in lowland and mountainous districts of the Zakarpattia region, depending on the ratio of fat and muscle components of the body (Fig. 3).

In females from lowland districts with normal fat content, normal and high muscle content, and a normal body mass index, the level of aerobic productivity is "excellent", according to Ya.P. Pyarnat's criteria, with the average value of the relative $VO_{2\,max}$ 40,3±1,11 ml·min^{-1}·kg^{-1}, 40,19±1,7 ml·min^{-1}·kg^{-1} and 39,8±1,73 ml·min^{-1}·kg^{-1}, respectively. The level of aerobic productivity in females from lowland districts with a high and low fat content is "good", with relative $VO_{2\,max}$ 35,02±1,58 ml·min^{-1}·kg^{-1} and 35,4±1,65 ml·min^{-1}·kg^{-1}, respectively. The "excellent" and "good" level of aerobic productivity in females from the lowland and

Table III. Average values of indicators of anaerobic productivity of the organism (M±m) in post-pubertal youth from lowland and mountainous districts of the Zakarpattia region depending on somatotype, n= 456

Indicators	Anaerobic productivity			
	power of alactic energy supply processes			
	WAnT $_{10\ rel.}$, kg-m·min^{-1}·kg^{-1}			
	Females (n=220)		Males (n=236)	
Somatotype	lowland district (n=118)	mountainous district (n=102)	lowland district (n=112)	mountainous district (n=124)
Endomorphs	37,1±0,65*	39,4±1,1	-	-
Endomesomorphs	40,25±1,23	42,3±1,36	50,3±1,18*	56,8±1,41*
Mesomorphs	-	-	63,1±1,15	67,5±1,62
Mesoectomorphs	38,5±0,81	37,8±0,84*	62,3±1,37	61,1±1,55*
Ectomorphs	37,4±0,76*	36,9±1,08*	54,8±1,17*	54,5±1,38*
Balanced	40,5±1,28	39,5±1,17	54,9±1,16*	56,6±1,47*

* - the probability of a difference in indicators between different somatotypes within the same gender ($p< 0.05$)

Table IV. Average values of indicators of anaerobic productivity of the organism (M±m) in post-pubertal youth from the lowland and mountainous districts of the Zakarpattia region, depending on the somatotype, n= 456

Indicators	Anaerobic productivity							
	the power of lactic energy supply processes				capacity of lactic energy supply processes			
	WAnT $_{30\ rel.}$, kg-m·min^{-1}·kg^{-1}				PPO$_{rel.}$, kg-m·min^{-1}·kg^{-1}			
	Females (n=220)		Males (n=236)		Females (n=220)		Males (n=236)	
Somatotype	lowland district (n=118)	mountainous district (n=102)	lowland district (n=112)	mountainous district (n=124)	lowland district (n=118)	mountainous district (n=102)	lowland district (n=112)	mountainous district (n=124)
Endomorphs	35,7±0,96*	38,3±0,91	-	-	22,9±0,73	23,4±0,7*	-	-
Endomesomorphs	39,0±1,03	40,83±1,04	50,1±1,48*	56,4±1,64*	20,9±0,59*	26,5±1,3	22,6±0,77*	26,7±0,8*
Mesomorphs	-	-	60,7±1,43	67,0±1,68	-	-	30,6±1,28	28,3±0,9
Mesoectomorphs	37,1±0,5*	35,6±0,78*	62,1±1,51	60,4±1,61*	23,9±0,9	25,2±0,98	33,6±1,43	29,0±1,01
Ectomorphs	35,4±0,72*	35,8±0,73*	53,1±1,36*	53,5±1,53*	24,7±1,08	25,2±0,87	27,3±0,81*	29,7±0,9
Balanced	39,33±0,89	37,7±0,84	55,2±1,47*	54,9±1,69*	22,7±0,68	21,6±0,61*	30,1±1,36	27,3±0,7*

* - the probability of a difference in indicators between different somatotypes within the same gender ($p< 0.05$)

mountainous districts of the Zakarpattia region guarantees a "safe health level". Females from mountainous districts with a high percentage of fat component have an "average" level of aerobic productivity, which does not provide a "safe health level" according to H.L. Apanasenko.

In males, regardless of the area of residence, an increase in the fat component has a negative effect on the body's aerobic energy supply. On the contrary, the growth of the muscle component of the body mass helps to increase the aerobic capacity of the body. Among all examined males, no individuals with "excellent" and "good" level of aerobic productivity of the body were found. Young males from lowland districts with a low fat content and very high muscle content have an "average" level of aerobic productivity, with relative $VO_{2\ max}$ 43,8±1,4 ml·min^{-1}·kg^{-1} and 42,9±1,02 ml·min^{-1}·kg^{-1}, respectively, which provides a "safe health level" according to H.L. Apanasenko. An "average" level of aerobic productivity was also found in males from mountainous districts with low fat content and high or very high muscle content, with relative $VO_{2\ max}$ 44,6±2,1 ml·min^{-1}·kg^{-1}, 42,4±2,0 ml·min^{-1}·kg^{-1} and 43,1±0,97 ml·min^{-1}·kg^{-1}, respectively, which exceeds the "safe health level". Males from lowland and mountainous districts with a high fat content with $VO_{2max\ rel.}$ 31,9±1,76 ml·min^{-1}·kg^{-1} and 33,7±0,93 ml·min^{-1}·kg^{-1}, respectively, have the lowest level of aerobic productivity that does not provide a "safe health level" according to H.L. Apanasenko, whereas males from lowland and mountainous districts with a very high content of muscle component have the highest level (Fig. 4).

Aerobic productivity of the youth of the Zakarpattia region in the post-pubertal period of ontogenesis is determined by somatotype. There are gender differences in this dependence; thus, in females whose somatotype is associated with a significant fat content, the level of aerobic productivity is "excellent". In contrast to females, males whose somatotype is characterized by an increased fat content, have reduced aerobic productivity. Aerobic productivity is higher in males whose somatotype is associated with a significant percentage of the muscular component. Regardless of the somatotype, females from lowland and mountainous districts have an "excellent" level of aerobic productivity, which guarantees a "safe health level" according to H.L. Apanasenko. In females, regardless of the area of residence, the highest values of the relative $VO_{2\,max}$ were recorded in endomesomorphs – 41,8±1,81 ml·min^{-1}·kg^{-1} in females from lowland districts, and 45,2±1,93 ml·min^{-1}·kg^{-1} in females from mountainous districts, respectively. Endomorph females from the lowland districts ($VO_{2max\ rel.}$ 38,2±1,63 ml·min^{-1}·kg^{-1}) and mesoectomorph females from the mountainous districts ($VO_{2max\ rel.}$ 38,1±2,11 ml·min^{-1}·kg^{-1}) have the lowest aerobic productivity indicators, table II.

Among males, regardless of the area of residence, mesomorphs, mesoectomorphs and ectomorphs showed the best aerobic abilities. The average value of the relative indicator of maximum oxygen consumption in young mesomorphs from lowland and mountainous districts is 44,63±1,3 ml·min^{-1}·kg^{-1} and 42,2±1,61 ml·min^{-1}·kg^{-1}, respectively, in mesoectomorphs 46,44±1,45 ml·min^{-1}·kg^{-1} and 43,3±1,29 ml·min^{-1}·kg^{-1}, respectively, in ectomorphs 44,7±1,02 ml·min^{-1}·kg^{-1} and 45,6±1,48 ml·min^{-1}·kg^{-1}, respectively. The level of aerobic productivity of males with such somatotypes corresponds to "average", and "safe health level" according to H.L. Apanasenko. The lowest aerobic productivity according to the $VO_{2max\ rel.}$ values was found in male endomesomorphs from lowland (38,56±0,47 ml·min^{-1}·kg^{-1}) and mountainous (39,1±0,93 ml·min^{-1}·kg^{-1}) districts, which corresponds to the level "below average" according to Ya.P. Pyarnat and the level of health "below safe" according to H.L. Apanasenko.

Anaerobic productivity of the organism in youth of the Zakarpattia region in the post-pubertal period of ontogenesis is also conditioned by gender and somatotype. There are gender differences in this dependence in females whose level of anaerobic productivity is lower than in males, regardless of the area of residence. Endomesomorph females, regardless of the area of residence, show a higher level of anaerobic productivity among other somatotypes, which is confirmed by the highest values of the relative power of alactic and lactic energy supply processes $WAnT_{10}$, $WAnT_{30}$ and PPO – 40,25±1,23 kg-m·min^{-1}·kg^{-1}, 39,0±1,03 kg-m·min^{-1}·kg^{-1} in females from lowland, and 42,3±1,36 kg-m·min^{-1}·kg^{-1}, 40,83±1,04 kg-m·min^{-1}·kg^{-1} i 26,5±1,3 kg-m·min^{-1}·kg^{-1} in females from mountainous districts, respectively. Endomorph females from the lowland districts ($WAnT_{10\ rel.}$ 37,1±0,65 kg-m·min^{-1}·kg^{-1}, $WAnT_{30\ rel.}$ 35,7±0,96 kg-m·min^{-1}·kg^{-1}) and ectomorph females from the mountainous districts ($WAnT_{10\ rel.}$ 36,9±1,08 kg-m·min^{-1}·kg^{-1}, $WAnT_{30\ rel.}$ 35,8±0,73 kg-m·min^{-1}·kg^{-1}) have the lowest anaerobic productivity, tables III – IV.

Performing physical exercises in an anaerobic mode requires energy stored in the muscles, therefore there are gender differences in this dependence in young males whose somatotype is associated with a significant percentage of the muscle component. Among males, regardless of the area of residence, the best anaerobic abilities were shown by mesomorphs and mesoectomorphs. The average value of the relative indicator of the power of alactic processes of energy supply $WAnT_{10}$ in young male mesomorphs from lowland and mountainous districts is 63,1±1,15 kg-m·min^{-1}·kg^{-1} and 67,5±1,62 kg-m·min^{-1}·kg^{-1}, respectively, in mesoectomorphs 62,3±1,37 kg-m·min^{-1}·kg^{-1} and 61,1±1,55 kg-m·min^{-1}·kg^{-1}, respectively. The average value of the relative indicator of the power of lactic processes of energy supply $WAnT_{30}$ in young male mesomorphs from lowland and mountainous districts is 60,7±1,43 kg-m·min^{-1}·kg^{-1} and 67,0±1,68 kg-m·min^{-1}·kg^{-1} , respectively, in mesoectomorphs 62,1±1,51 kg-m·min^{-1}·kg^{-1} and 60,4±1,61 kg-m·min^{-1}·kg^{-1}, respectively. The average value of the relative indicator of the capacity of lactic processes of energy supply PPO in young mesomorphs from lowland and mountainous districts is 30,6±1,28 kg-m·min^{-1}·kg^{-1} and 28,3±0,9 kg-m·min^{-1}·kg^{-1}, respectively, in mesoectomorphs 33,6±1,43 kg-m·min^{-1}·kg^{-1} and 29,0±1,01 kg-m·min^{-1}·kg^{-1}, respectively. The presence of the fat component in males is inefficient for the performance of work in the anaerobic energy mode, as evidenced by low relative indicators $WAnT_{10}$, $WAnT_{30}$, MK3P in endomesomorphs, compared to males of other somatotype groups. Thus, the lowest anaerobic productivity according to the indicator $WAnT_{10\ rel.}$, $WAnT_{30\ rel.\ i\ MK3P\ rel.}$ was recorded in young male endomesomorphs from lowland (50,3±1,18 kg-m·min^{-1}·kg^{-1}, 50,1±1,48 kg-m·min^{-1}·kg^{-1} and 22,6±0,77 kg-m·min^{-1}·kg^{-1}) and mountainous ($PPO_{rel.}$ 26,7±0,8 kg-m·min^{-1}·kg^{-1}) districts, tables III – IV.

DISCUSSION

The absolute value Vo_{2max} is directly dependent on body weight [1, 2, 6]. In males, this dependence is manifested to a greater extent than in females [11, 12]. Moreover, the dominant value belongs to the muscle component of body mass [3]. The fat component does not affect the absolute value $Vo_{2\,max}$ [2]. However, an increase in body weight due to the fat component negatively affects the relative Vo_{2max} value [2, 3, 9].

Aerobic productivity is determined by age and gender factors. There is contradictory information about the dynamics of age-related changes in absolute and relative Vo_{2max} value.

Some researchers indicate an increase in the absolute Vo_{2max} up to age 25, stabilization from age 25 to age 33, and a gradual decline after age 38 [5]. There is evidence that absolute Vo_{2max} value increases before full puberty [18]. The largest increase in this indicator is observed at 13-14 years of age in males (by 28%) and at 12-13 years of age in females. However, from the age of 16 in males and from 14 in females, the increase in $Vo_{2max\ abs.}$ is not observed [1]. Moreover, it is slightly lower in females than in males, and is 90.2% in males at 12-15 years of age, 82.5% at 16-20 years of age, and 82.1% at 21-24 years of age. [1, 7].

As for age-related changes in the relative Vo_{2max} value, some authors note its constancy, while others note its decrease. Concerning the age dynamics of $Vo_{2max\ rel.}$ Yu. Furman and S. Drachuk [4, 5] indicate its stability up to

17 years, whereas J. Astrand et al. [18] up to 35-40 years. W. Larry Kenney [8] claim that the relative value of Vo_{2max} practically does not change from 6 to 25 years and is on average 50 $ml \times min^{-1} \times kg^{-1}$. If we accept that Vo2 max is 100% at the age of 20-30, it will be 82.5% at 40-50 years of age, and 65% at 60-70 years of age according to V. Miroshnichenko [6]. A similar age-related decrease in the relative Vo_{2max} value is assumed according to Ya.P. Pyarnat's [4] and L. Astrand's [18] assessment criteria. Research results of O.O. Bekas [1] indicate a significant decrease in the Vo_{2max} value starting from the age of 16, both in males and females, whose body weight does not exceed the norm. Moreover, in the period from 16 to 20 years of age, there are no gender differences in the average $Vo_{2\ max\ rel.}$ value.

The data on the age-related dynamics of the body's anaerobic productivity are contradictory. There are data that indicate the growth of anaerobic alactic and lactic productivity up to 18 years and its stability up to 30 years. In persons younger than 18 and older than 30 years, anaerobic productivity decreases on average by 1-2% per year [19, 20]. A uniform age-related decrease in anaerobic productivity is indicated by Pałka MJ et al. [19]. According to their data, such a decrease reaches approximately 6% per decade. Moreover, the dynamics of the decrease does not depend on gender [13]. According to other authors, in adolescents aged 10-14, the value of anaerobic lactic productivity, which was determined by the relative indicator of external mechanical work in 30 seconds, does not differ from that of adults. At the same time, no significant gender difference of this indicator was found [19, 20]. However, the results of a research by S.A. Gaul et al. [10] demonstrate that the lactic and alactic productivity of children before the end of puberty is significantly lower than in adults.

The study of somatotypological characteristics has not only theoretical, but also practical significance, therefore it was studied by many researchers [2, 3, 6, 11, 12]. Thus, some studies highlight a strong correlation between dysplasia of connective tissue in patients with atopic dermatitis with the somatotype [23], as well as the dependence of the course of insulin-dependent diabetes upon anthropometric indicators and somatotype [22]. In addition, there are studies on somatotypological features of males with psoriasis [23], features of the course of schizophrenia [21]. There are also studies that characteristics features of the muscular system of boys and girls of different ages and somatotypes [9, 10]. Anthropometry is widely used to restore standards and indices for assessing the health of the younger generation [14, 15, 16]. Thus, it was widely used in the 18th century to assess the suitability of recruits for military service and it continues to be actively used to this day.

CONCLUSIONS

In females from lowland districts with normal fat content, normal and high muscle content, and a normal body mass index, the level of aerobic productivity is "excellent" according Ya.P. Pyarnat's criteria. Females from mountainous districts with high percentage of fat component have an "average" level of aerobic productivity, which does not provide a "safe health level" according to H.L. Apanasenko. Among all examined males, no individuals with "excellent" and "good" level of aerobic productivity of the body were found. In males, regardless of the area of residence, the increase in the fat component has a negative effect on the aerobic and anaerobic energy supply of the body. On the contrary, the growth of the muscle component of body mass helps to increase the aerobic and anaerobic capacity of the body.

The determined values of aerobic and anaerobic productivity of the body's energy supply in healthy young males and females make it possible to further develop an individual and population health forecast, to form groups of increased risk of pathology and to implement a program of medical and social rehabilitation.

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