ORIGINAL ARTICLE

PECULIARITIES OF PARAMETERS OF AEROBIC AND ANAEROBIC PRODUCTIVITY DEPENDING ON THE COMPONENTS OF BODY WEIGHT IN YOUNG MALES FROM THE MOUNTAINOUS DISTRICTS OF ZAKARPATTIA

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ABSTRACT

The aim: To establish differences in the aerobic and anaerobic capacity in young males with different components of body weight who live in the mountainous districts of Zakarpattia region.

Materials and methods: 124 young men aged 17-21 were examined to determine the aerobic and anaerobic capabilities of the body, taking into account the components of body weight.

Results: The level of aerobic productivity, which reflects physical health, depends on the component composition of the body. The highest level of aerobic capacity in terms of the $VO_{2\ max\ rel.}$ is found in young males who have normal body weight with a high and a very high relative content of skeletal muscle, a low relative content of fat, and a normal level of visceral fat. As a consequence, their physical health exceeds "safe health level", namely 42 $ml \cdot min^{-1} \cdot kg^{-1}$, and corresponds to "average" according to Ya.P. Piarnat's criteria.

Conclusions: A high relative fat content negatively affects the functional capabilities of the body of young males in both aerobic and anaerobic modes of energy supply. With the growth in the relative content of skeletal muscles, the increase of the aerobic capacity of the body, as well as the growth of the capacity of alactic and lactic energy supply processes is observed. None of the examined males had "good" or "excellent" parameters of aerobic processes.

KEY WORDS: body mass, fat, skeletal muscles, post-pubertal age

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INTRODUCTION

Physical health forms because of the body's ability to adapt to the external environment, while maintaining normal functional parameters of all physiological systems [1, 2]. Aerobic and anaerobic productivity of the body are integral indicators of physical health. Assessment of physical health by indicators of aerobic and anaerobic productivity makes it possible to characterize it both qualitatively and quantitatively [3-6]. Also, it should be pay attention the set of various morphological factors that determine the somatotype (in particular, the component composition of body weight), affect both functional capabilities of the organism and the susceptibility to certain diseases [7-9]. Therefore, determining the relationship between a person's ability to perform physical work in aerobic and anaerobic modes of energy supply of the body depending on the constitutional characteristics of body composition, is expedient as it allows to individualize the ways of prevention of certain diseases, and to choose effective treatment tactics that are relevant and socially significant [10-13].

THE AIM

The aim was to establish differences in the aerobic and anaerobic capacity in young males with different components of body weight who live in the mountainous districts of Zakarpattia region.

MATERIALS AND METHODS

The task was solved by using a variety of modern diagnostic methods to examine124 young males in the post-puberty period of ontogenesis, aged 17-21, residents of Zakarpattia. The power and capacity of aerobic (VO_{2max}), the power of anaerobic alactic ($WAnT_{10}$), anaerobic lactic ($WAnT_{30}$), and the capacity of anaerobic lactic processes (PPO) of the body's energy supply

were evaluated by bicycle ergometry test; the relative content of fat and skeletal muscles was determined by the bioimpedance method; methods of mathematical statistics using the programs Microsoft Office 2007, Microsoft Excel Stadia 6.1 / prof and Statistica, were used to determine Student's t-test to assess the reliability of the difference in indicators.

RESULTS

When studying the components of body weight in young males from mountainous districts, we identified three groups depending on the fat content and three groups depending on the muscle content. The number of males with a normal relative fat content (8.0 - 19.9%) was the largest – 101 individuals (81.5%). We did not observe any males with a high fat component (>24,9%). The number of males with normal and high relative content of skeletal muscles was the largest – 76 (61.3%) and 39 individuals (31.4%), respectively. There were no males with a low (< 33.3%) relative content of skeletal muscles among those studied (Table I).

The value of the absolute indicator $VO_{2\ max}$ in males with a high relative content of the fat component is higher than the value in males with a normal and low relative fat content ($p>0.05$). At the same time, the average $VO_{2\ max}$ value of males with high relative fat content is 1.32 times significantly lower than the average value in males with low and normal relative fat content ($p<0.05$), and does not reach "safe health level". The average value $VO_{2\ max\cdot rel.}$ exceeds "safe health level", i.e. 42 ml·min^{-1}·kg^{-1}, in young males from mountainous districts with a low relative fat content (44,6±2,1 ml·min^{-1}·kg$^{-1)}$, whereas the average $VO_{2\ max\cdot rel.}$ is 41,6±1,7 ml·min^{-1}·kg^{-1} and does not reach "safe health level" in young males with a normal relative fat content. $WAnT_{10\ rel.}$ was significantly higher in young males from mountainous districts with a low and normal relative content of the fat component compared to individuals with a high relative content of this component (by 31.4% and by 27.3%, correspondingly). Peculiarities of the power of anaerobic lactic processes in representatives of mountainous districts with different component composition of body weight were revealed when determining the $WAnT_{30\ rel.}$ indicator. The lowest average values of $WAnT_{30}$ were registered in males from mountainous districts with a high relative content of the fat component, which is 22.3% lower compared to young males with a low and 20.8% lower compared to young males with a normal relative content of this component (Table II).

As can be seen from Table II, the average values of the absolute capacity of anaerobic lactic energy supply processes of the body according to PPO are the highest in young males with a low and high relative content of the fat component, compared to males with a normal relative fat content ($p>0.05$). Young males from mountainous districts with a high relative content of this component have a significantly lower indicator $PPO_{rel.}$ by 26.4% compared to the indicator of young males with a low and by 10.1% compared to young males with a normal relative content of the fat component ($p<0.05$).

The values of the absolute $VO_{2\ max.}$ index in young males from mountainous districts with different relative content of skeletal muscles do not reliably differ from each other. The average value of $VO_{2\ max.rel.}$ in young males from mountainous districts with normal relative content of skeletal muscles is 38,9±1,1 ml·min^{-1}·kg^{-1}, which is significantly below "safe health level" and corresponds to "below average" level of aerobic productivity ($p<0.05$). In young males with high and very high relative content of skeletal muscles, the indicator $VO_{2\ max.rel\cdot}$ is significantly above the "safe health level", which corresponds to the "average" level of aerobic productivity and is 42,4±2,0 ml·min^{-1}·kg^{-1} and 43,1±0,97 ml·min^{-1}·kg^{-1}, respectively. The absolute value of WAnT10 in young makes from mountainous districts was probably higher

Table I. Distribution of males from the mountain districts of Zakarpattia by component composition of body weight, n=124

Relative fat content (%)							
< 8,0 (-) low		**8,0 – 19,9 (0) normal**		**19,9 – 24,9 (+) high**		**>24,9 (++) very high**	
number of persons	%	number of persons	%	number of persons	%	number of persons	%
7	5,6	101	81,5	16	12,9	-	-
Relative content of skeletal muscles (%)							
< 33,3 (-) low		**33,3 – 39,3 (0) normal**		**39,4 – 44,0 (+) high**		**> 44,0 (++) very high**	
number of persons	%	number of persons	%	number of persons	%	number of persons	%
-	-	76	61,3	39	31,4	9	7,3

Table II. Average values of indicators of aerobic and anaerobic productivity of the body (M±m) of males from the mountain districts of Zakarpattia, depending on the relative fat content, n=124

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	
Relative fat content (%)	$VO_{2\ max}$ ml·min^{-1}	$VO_{2max\ rel.}$ ml·min^{-1}·kg^{-1}	$WAnT_{10}$, kgm·min^{-1}	$WAnT_{10\ rel}$•, kgm·min^{-1}·kg^{-1}	$WAnT_{30.}$ kgm·min^{-1}	$WAnT_{30\ rel}$•, kgm·min^{-1}·kg^{-1}	PPO, kgm·min^{-1}	$PPO_{rel.}$, kgm·min^{-1}·kg^{-1}
< 8,0 (-) low (n=7)	3098,7± 79,6	44,6 ± 2,1	4683,7 ± 59,6	67,4 ± 2,2	4456 ± 84,3	64,1 ± 3,9	2173,6 ± 51,9	31,4 ± 1,8
8,0 – 19,9 normal (n= 101)	2996,6± 70,3	41,6 ± 1,7	4701,3 ± 76,2	65,3 ± 1,83	4526,0 ± 87,2	62,9 ± 3,8	1898,2 ± 49,8	25,7± 2,2*
19,9 –24,9 (+) high (n=16)	3164,8 ± 68,7	33,7 ± 0,93•*	4821,7 ± 78,6	51,3 ± 1,72•*	4682,1 ± 90,3	49,8 ± 2,7•*	2208,6 ± 60,4	23,1 ± 1,4•*

Note: the probability of a difference in mean values ($p<0.05$):
* - relatively low fat content;
• - relatively normal fat content;

Table III. Average values of indicators of aerobic and anaerobic body productivity (M±m) of males from the mountain districts of Zakarpattia depending on the relative content of skeletal muscles, n=124

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	
Relative skeletal muscle content (%)	$VO_{2\ max}$ ml·min^{-1}	$VO_{2\ max\ rel.}$ ml·min^{-1}·kg^{-1}	$WAnT_{10}$, kgm·min^{-1}	$WAnT_{10\ rel}$•, kgm·min^{-1}·kg^{-1}	$WAnT_{30.}$ kgm·min^{-1}	$WAnT_{30\ rel}$•, kgm·min^{-1}·kg^{-1}	PPO, kgm·min^{-1}	$PPO_{rel.}$, kgm·min^{-1}·kg^{-1}
33,3 – 39,3 (0) normal (n=76)	2896,5 ± 56,1	38,9 ± 1,1♦•	4658,4 ± 96,3	59,7 ± 2,9 ♦•	4438,9 ± 98,7	56,9 ± 3,6	1966,7 ± 54,2	25,5 ± 1,3
39,4 – 44,0 (+) high (n=39)	3086,4 ± 77,2	42,4 ± 2,0	4703,1 ± 88,2	63,4 ± 3,8	4503,2 ± 76,2	60,1 ± 3,8	2102,3 ± 46,3	27,8 ± 1,2
> 44,0 (++) very high (n=9)	3197,4 ± 59,3	43,1 ± 0,97	4869,8 ± 78,7	65,3 ± 3,2	4572,3 ± 90,6	60,9 ± 4,7	2123,4 ± 51,6	28,7 ± 2,1

Note: the probability of a difference in mean values ($p<0.05$):
* - relatively normal skeletal muscles content;
• - relatively high skeletal muscles content;
♦ - relatively very high skeletal muscles content.

in individuals with a very high relative content of the muscle component compared to individuals with a normal and high relative content of this component of the body. The relative value of $WAnT_{10}$ in young males from mountainous districts with a very high and high content of the muscle component reliably outweighs this indicator by 9.4% and 6.2%, respectively, compared to persons who had a normal relative muscle content. Different anaerobic productivity of young males from mountainous districts, depending on the component composition of the body, was also revealed when determining $WAnT_{30\ rel.}$ Thus, the lowest average values of the relative $WAnT_{30}$ indicator were recorded in young males from mountainous districts with a normal relative content of skeletal muscles compared to individuals with a high and very high relative content of the muscle component. At the same time, regardless of the relative content of the muscle component, indicators of the PPO i PPOrel. of the body's energy supply in absolute and relative values do not differ between themselves ($p>0.05$) (Table III).

Among the young males representing the mountainous districts of the Zakarpattia region, those with a low fat content, or high and very high muscle content had an "average" level of aerobic productivity in terms of the $VO_{2\ max}$•$_{rel.}$ This level of aerobic productivity provided them with a "safe health level" according to H.L. Apanasenko [18]. The level of aerobic performance was

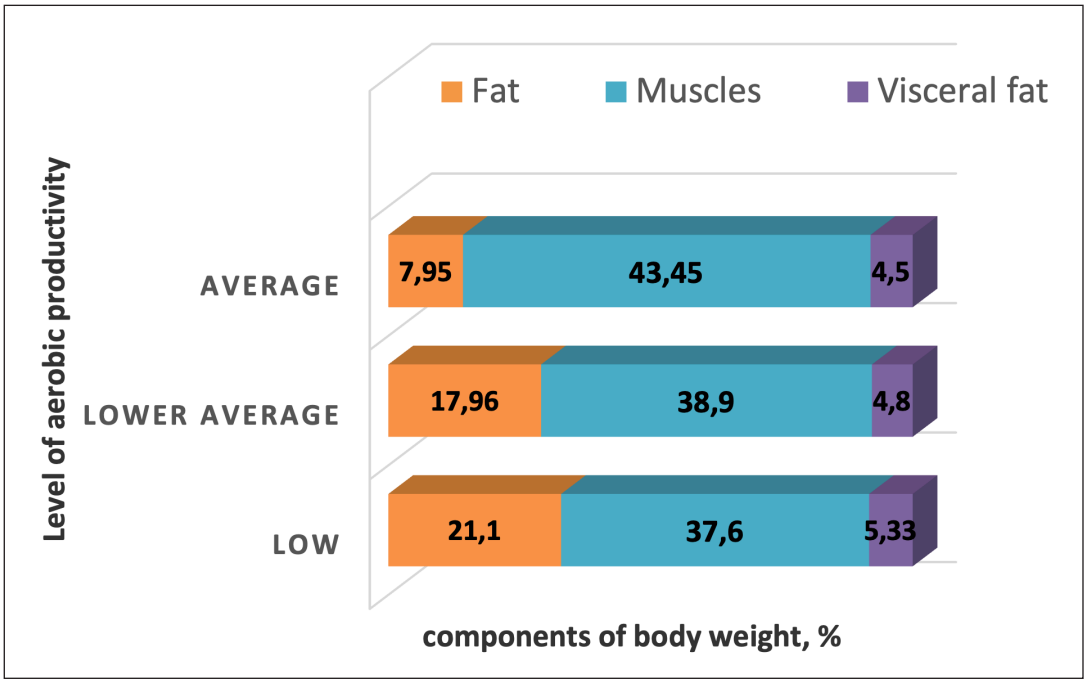

Fig. 1. Graphic representation of the dependence of the level of aerobic productivity of males from the mountain districts of Zakarpattia on the ratio of the component composition of body weight (n=124)

"below average" and "low" in young males with normal and high content of the fat component and with the normal content of the muscle component. Such levels of aerobic performance do not guarantee a "safe health level" according to H.L. Apanasenko, Fig. 1.

DISCUSSION

Studying the level of physical health in post-puberty individuals is extremely important as a young organism of an adult is almost completely formed, and it should prepare for a quality and longer life. Research of physiological indicators that form physical health makes it possible to correctly assess the physical health status in healthy population and allows for a more detailed assessment of the body's adaptive capabilities, as well as to provide a prognostic assessment of the probability of the occurrence of pathological abnormalities on the part of the cardiovascular system and decrease in tolerance to physical exertion.

Thus, Zhang M. and his co-authors in their research of the physical fitness of students at Chinese universities, draw attention to the potential hidden risk for the health of students who, have an excessive fat component with a normal body mass index. The authors also prove that the lower level of physical fitness of the students was partly due to the lower mass of skeletal muscles. That is, they confirm the negative influence of a high content of the fat and a low content of the skeletal muscles on the level of physical performance of young people in the post-pubertal period of ontogenesis [19].

Pigłowska M., investigating the relationship between body mass components, metabolic indicators and function of the endothelial among physically active healthy males, prove that the components of fat and muscle mass are important predictors of the metabolic profile. Maintaining regular high levels of physical activity and metabolic health throughout young and middle adulthood may have beneficial effects on body mass composition parameters and, as a result, may prevent age-related decline in lean body mass and endothelial dysfunction [20].

Our findings are confirmed by the studies of Anwar S. et al., who determined the correlation of the percentage of fat and muscle components of body mass with aerobic and anaerobic performance in 48 male student footballers. According to their findings, the relative content of body fat and skeletal muscle mass is correlated with indicators of aerobic and anaerobic capacity [21].

Researchers Yokota T. confirm the importance of the level of aerobic productivity in relation to the life expectancy of patients with metabolic syndrome. Low aerobic performance is a strong and independent predictor of all-cause mortality in male patients with metabolic syndrome. The use of means to improve the aerobic capacity of the body's energy supply processes and the energy metabolism of skeletal muscles in males with metabolic syndrome leads to a positive prognosis for this category of individuals [22].

Mucha D.K. evaluating the aerobic capacity of males and females depending on the type of posture, came to the conclusion that the research results should find wide practical applications in conducting a comprehensive assessment of body posture and physical per-

formance as a determinant of health preservation [23].

Studying the level of physical health of young males from the mountainous districts of the Zakarpattia region, we understand that the somatotype, component composition of the body, and the functional capabilities of the body are formed in this category of individuals in conditions of relative hypoxia. Szymczak R.K. et al. researching the effects of a long stay at a very high altitude (over 3500 m) on the physiology of male climbers, note that in conditions of hypoxia, the anaerobic productivity of the body decreases, the maximum respiratory volume increases, and the relative content of the fat component of the body weight decreases. At the same time, the lack of oxygen does not affect the level of maximum aerobic power, the indicators of maximum oxygen absorption, hemoglobin and hematocrit levels [24]. Therefore, the study of tests of aerobic and anaerobic capacity in healthy males and females post-puberty aged allows to develop individual and population medical forecasts, form groups of people with an increased risk of pathological processes, and implement medical and social rehabilitation programs.

CONCLUSIONS

A high relative fat content negatively affects the functional capabilities of the body of young males in both aerobic and anaerobic modes of energy supply. With the growth in the relative content of skeletal muscles, the increase of the aerobic capacity of the body, as well as the growth of the capacity of alactic and lactic energy supply processes is observed. None of the examined males had "good" or "excellent" parameters of aerobic processes.

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