

ANAEROBIC CAPACITY OF POSTPUBESCENT FEMALES FROM THE LOWLAND AREAS OF ZAKARPATTIA

Background. Human physical health depends on the body's ability to adjust (adapt) to the conditions of the external environment, while maintaining normal functional parameters of all physiological systems. The urgent mechanism of such adaptation is carried out by a humoral and reflex way, however, this process is personified by the somatotype of a person. Therefore, determining the component composition of the body and somatotype allows to individualize the ways to prevent certain diseases, to choose effective treatment tactics, as well as to predict the effectiveness of the treatment. The purpose of the study is to establish the ability of females of different somatotypes, who are residents of lowland areas of the Zakarpattia region, to adapt to physical work in the anaerobic mode of energy supply.

Methods. 118 healthy females aged 16 to 20, residents of lowland areas, participated in the study. To assess the ability to perform physical work on a cycle ergometer in anaerobic mode, we using the Wingate anaerobic test described by Yu.M. Furman et al. We also measured the capacity of anaerobic lactic processes according to the method of Shögy A., Cherebetin G. The somatotype was determined by the Heath-Carter method.

Results. The examined females, residents of lowland areas, were represented by 5 somatotypes: ectomorphic, endomorphic, endomesomorphic, mesoectomorphic, and balanced. The largest number of individuals were of balanced (34.7 %) and endomesomorphic (32.2 %) somatotype, the smallest of ectomorphic (10.2 %) and mesoectomorphic (9.3 %) somatotype. In individuals with an endomesomorphic somatotype, the average value $WAnT_{10\text{ rel.}}$ ($40.25 \pm 1.23 \text{ kgm} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$) significantly exceeds the average value of females only of the endomorphic ($37.1 \pm 0.65 \text{ kgm} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$) somatotype. At the same time, the average value of $WAnT_{10\text{ rel.}}$ in representatives of the balanced ($40.5 \pm 1.28 \text{ kgm} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$) somatotype significantly ($p < 0.05$) exceeds the value of females of the endomorphic somatotype by 9.2 % and those of the ectomorphic somatotype ($37.4 \pm 0.76 \text{ kgm} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$) by 8.2 %. It is worth noting that the lowest average values of $WAnT_{30\text{ rel.}}$ are observed in representatives of lowland areas of ectomorphic ($35.4 \pm 0.72 \text{ kgm} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$) and endomorphic ($35.7 \pm 0.96 \text{ kgm} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$) somatotypes, which do not differ from each other ($p > 0.05$). The highest average values of $WAnT_{30\text{ rel.}}$ in residents of the lowland areas were found in females of the endomesomorphic ($39.0 \pm 1.03 \text{ kgm} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$) and balanced ($39.33 \pm 0.89 \text{ kgm} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$) somatotypes, which are significantly higher (by 6 %) than the values of the representatives of the mesoectomorphic somatotype, and higher than the values of representatives of the ectomorphic and endomorphic somatotype (by 11 % and 10 %, respectively).

Conclusions. Anaerobic productivity of females from Transcarpathia is related to somatotypological features of the body. There are gender differences in the adaptation of young people to physical work of anaerobic orientation depending on the somatotype. Among girls living in lowland areas, endomesomorphs and individuals with a balanced somatotype exhibit the highest capacity of anaerobic alactate and lactate energy supply processes for muscle work, and ectomorphs have the lowest capacity.

Key words: anaerobic productivity, somatotype, physical health, females.

Background

Human physical health depends on the body's ability to adjust (adapt) to the conditions of the external environment, while maintaining normal functional parameters of all physiological systems (Larry Kenney, Wilmore, & Costill, 2021; Gorshova et al., 2017; Kovalenko et al., 2020). The urgent mechanism of such adaptation is carried out by a humoral and reflex way, however, this process is personified by the somatotype of a person (Stephanie, 2023; Fera et al., 2020; Karstoft, & Pedersen, 2016; Montero et al., 2018). Moreover, there are gender differences in such "personification", i.e., the levels of functional capacity of individual systems of male and female individuals with the same somatotype do not match (Miroshnichenko et al., 2019).

A number of scientists point out that a set of various morphological factors, on which the somatotype depends (in particular, the component composition of body mass), affect both the functional capacity of the body and the susceptibility to certain diseases (Furman et al., 2022). Therefore, determining the component composition of the body and somatotype allows to individualize the ways to prevent certain diseases, to choose effective treatment tactics, as well as to predict the effectiveness of the treatment (Ryan-Stewart, Faulkner, & Jobson, 2018).

Current scientific research in clinical medicine is impossible without clinical anthropology and its

methodology. Anthropometry that lies in the basis of anatomical constitution and parameters of physical development, is successfully used to identify the relationship with certain somatic diseases (Wu, & Ma, 2023; Miroshnichenko et al., 2020)

Assessment of anaerobic capacity of post-puberty female residents of the Zakarpattia region with different somatotypes will allow to obtain standards of physical health of females (Zera et al., 2022; Gaul, Docherty, & Cicchini, 2020).

The main objective: to establish the ability of females of different somatotypes, who are residents of lowland areas of the Zakarpattia region, to adapt to physical work in the anaerobic mode of energy supply.

Methods

118 healthy girls living in lowland areas of Transcarpathia, areas located at an altitude below 400 meters above sea level, took part in the study. The examined girls were aged from 16 to 20 years, which was 53.6 % of the total number of examined representatives from various districts of Zakarpattia. To assess the ability to perform physical work on a cycle ergometer in anaerobic mode, we determined the power of anaerobic lactic processes of energy supply of the body based on the maximum amount of work performed in 10 s ($WAnT_{10}$), as well as the power of anaerobic lactic processes of energy supply of the body based on the maximum amount of work

performed in 30 s (WAnT₃₀) using the Wingate anaerobic test described by Yu.M. Furman et al. (Furman, Miroshnichenko, & Drachuk, 2013). We also measured the capacity of anaerobic lactic processes according to the method of Shögy A., Cherebetin G., (Shögy, & Cherebetin, 1974) which characterized the maximum amount of external work in 1 min (PPO). When performing tests to assess physical performance, we took into account the physiological features of the female body, and during the ovulatory (13-14 day), premenstrual (26-28 day) and menstrual phase of the ovarian-menstrual cycle, such studies were not conducted (Larry Kenney, Wilmore, & Costill, 2021). The somatotype was determined by the

Heath-Carter method that provides a three-component (fat, muscle and bone component) anthropometric assessment (Carter, 2003).

Results

The examined females, residents of lowland areas, were represented by 5 somatotypes: ectomorphic, endomorphic, endomesomorphic, mesoectomorphic, and balanced. The percentage distribution of representatives of lowland areas by somatotype is shown in Fig. 1. The largest number of individuals were of balanced (34.7 %) and endomesomorphic (32.2 %) somatotype, the smallest of ectomorphic (10.2 %) and mesoectomorphic (9.3 %) somatotype.

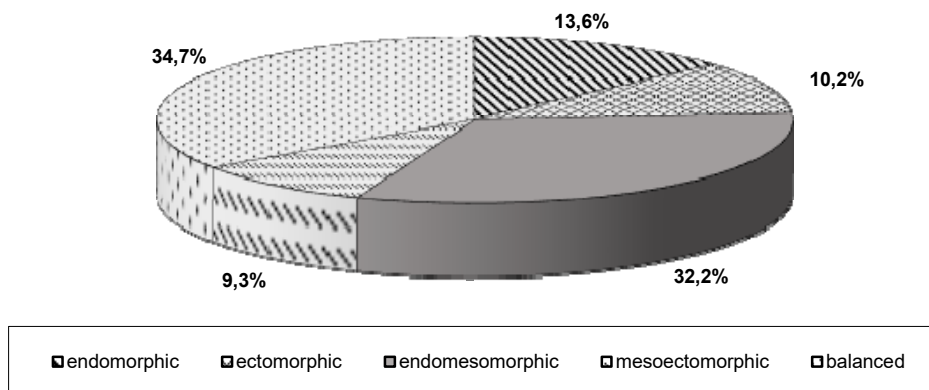


Fig. 1. Ratio of the number of lowland residents according to the somatotype, in %

The results of the study of the power of anaerobic alactic energy supply processes by the absolute value of WAnT_{10 abs.} in females from lowland areas revealed a significant prevalence of this indicator in representatives of the endomesomorphic somatotype, compared to individuals of other somatotypes. Thus, the value of the absolute indicator WAnT_{10 abs.} in the representatives of the endomesomorphic somatotype, on average, is $2658.1 \pm 76.75 \text{ kgm} \cdot \text{min}^{-1}$, which is 36.4 % higher than the value of the representatives of the mesoectomorphic somatotype, which is $1948.9 \pm 51.4 \text{ kgm} \cdot \text{min}^{-1}$ ($p < 0.05$), 10.4 % higher than the value of females of the endomorphic somatotype $2408.6 \pm 70.2 \text{ kgm} \cdot \text{min}^{-1}$, 15 % higher than the value of females of the balanced somatotype $2314.8 \pm 67.83 \text{ kgm} \cdot \text{min}^{-1}$ and exceeds by 48.2 % the average value of representatives of the ectomorphic somatotype, which is $1793.4 \pm 46.1 \text{ kgm} \cdot \text{min}^{-1}$ ($p < 0.01$). The study of the power of anaerobic lactic processes of energy supply of the body according to the relative value WAnT_{10 rel.} in the residents of lowland areas proved a significantly lower level of this indicator in females of ectomorphic and endomorphic somatotypes compared to the values of representatives of other somatotype groups. In individuals with an endomesomorphic somatotype, the average value WAnT_{10 rel.} ($40.25 \pm 1.23 \text{ kgm} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$) significantly exceeds the average value of females only of the endomorphic ($37.1 \pm 0.65 \text{ kgm} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$) somatotype. At the same time,

the average value of WAnT_{10 rel.} in representatives of the balanced ($40.5 \pm 1.28 \text{ kgm} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$) somatotype significantly ($p < 0.05$) exceeds the value of females of the endomorphic somatotype by 9.2 % and those of the ectomorphic somatotype ($37.4 \pm 0.76 \text{ kgm} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$) by 8.2 %. In representatives of endomesomorphic, mesoectomorphic and balanced somatotypes, the average values of WAnT_{10 rel.} have no significant difference ($p > 0.05$).

The analysis of the results of anaerobic productivity studies based on the absolute value of the indicator of the power of anaerobic lactic processes of energy supply (WAnT₃₀) in females from lowland areas showed that the average value of the absolute indicator WAnT₃₀ of representatives of the endomesomorphic somatotype is $2562.4 \pm 74.73 \text{ kgm} \cdot \text{min}^{-1}$, which is 13.3 % higher than in representatives of the balanced somatotype ($p < 0.05$), with the value of $2261.8 \pm 71.18 \text{ kgm} \cdot \text{min}^{-1}$; 36.6 % higher than in females of the mesoectomorphic somatotype ($p < 0.01$), whose average value is $1876.3 \pm 48.9 \text{ kgm} \cdot \text{min}^{-1}$; 50 % higher than the value of representatives of the ectomorphic somatotype ($p < 0.01$), which is $1708.6 \pm 40.6 \text{ kgm} \cdot \text{min}^{-1}$, and 10.6 % higher than the value of representatives of the endomorphic somatotype ($p < 0.01$), which is $2316.4 \pm 63.5 \text{ kgm} \cdot \text{min}^{-1}$.

The results of the study of physical performance based on indicators of the body's anaerobic productivity are shown in Table 1.

Table 1

Indicators of the anaerobic capacity of the body of females from the lowland areas of Zakarpattia depending on the somatotype (n=118)

Indexes	Average value, M±m				
	endomorphs (n=16)	endomesomorphs (n=38)	mesoectomorphs (n=11)	ectomorphs (n=12)	balanced somatotype (n=41)
WANT ₁₀ , kgm·min ⁻¹	• 2408,6±70,2	2658,1±76,75	•*∇ 1948,9±51,4	•*∇♦ 1793,4±46,1	•2314,8±67,83
WANT ₁₀ , kgm·min ⁻¹ ·kg ⁻¹	•∇ 37,1±0,65	40,25±1,23	38,5±0,81	∇37,4±0,76	40,5±1,28
WANT ₃₀ , kgm·min ⁻¹	• 2316,4±63,5	2562,4±74,73	•*∇ 1876,3±48,9	•*∇♦ 1708,6±40,6	• 2261,8±71,18
WANT ₃₀ , kgm·min ⁻¹ ·kg ⁻¹	•∇ 35,7±0,96	39,0±1,03	∇ 37,1±0,5	•∇ 35,4±0,72	39,33±0,89
PPO, kgm·min ⁻¹	1482,1±50,7	1364,7±40,6	•* 1218,7±36,4	•* 1183,8±26,4	* 1273,2±37,8
PPO, kgm·min ⁻¹ ·kg ⁻¹	22,9±0,73	*∇♦ 20,9±0,59	23,9±0,9	24,7±1,08	22,7±0,68

Note: the significance of a difference in average values (p<0.05):

* – relative to the endomorphic somatotype; • – relative to the endomorphic-mesomorphic somatotype; ♦ – relative to the mesomorphic-ectomorphic somatotype; – relative to the ectomorphic somatotype; ∇ – relative to the balanced somatotype.

The peculiarities of anaerobic productivity in residents of lowland areas of various somatotypes were also revealed when determining the relative power of anaerobic lactic energy supply processes of the body. It is worth noting that the lowest average values of WANT_{30 rel.} are observed in representatives of lowland areas of ectomorphic (35.4±0.72 kgm·min⁻¹·kg⁻¹) and endomorphic (35.7±0.96 kgm·min⁻¹·kg⁻¹) somatotypes, which do not differ from each other (p > 0.05). The highest average values of WANT_{30 rel.} in residents of the lowland areas were found in females of the endomesomorphic (39.0±1.03 kgm·min⁻¹·kg⁻¹) and balanced (39.33±0.89 kgm·min⁻¹·kg⁻¹) somatotypes, which are significantly higher (by 6 %) than the values of the representatives of the mesoectomorphic somatotype, and higher than the values of representatives of the ectomorphic and endomorphic somatotype (by 11 % and 10 %, respectively).

The results of the study of the capacity of anaerobic lactic processes of energy supply of the body in terms of the absolute value of PPO revealed a significant prevalence of this indicator in lowland females of the endomorphic somatotype, compared to representatives of other somatotypes. Thus, the value of the absolute PPO in the representatives of the endomorphic somatotype is 1482.1±50.7 kgm·min⁻¹, which on average is 21.7 % higher than the value of the representatives of the mesoectomorphic somatotype, which is 1218.7±36.4 kgm·min⁻¹, 16.4 % higher than the value of females of the balanced somatotype, which is 1273.2±37.8 kgm·min⁻¹, and 25.2 % higher than the value of females of the ectomorphic somatotype, which is 1183.8±26.4 kgm·min⁻¹ (p<0.05). The average values of PPO_{abs.} of representatives of endomorphic and endomesomorphic somatotypes do not differ significantly from each other.

The study of the capacity of anaerobic lactic processes of energy supply of the body according to the relative value of PPO proved a significantly lower level of this indicator in the lowland females of the endomesomorphic somatotype (20.9±0.59 kgm·min⁻¹·kg⁻¹) compared to the values of the representatives of other somatotype groups. In the representatives of the endomorphic somatotype, the average value of the PPO_{rel.} (22.9±0.73 kgm·min⁻¹·kg⁻¹) does not differ from the average value of PPO_{rel.} in representatives of the balanced somatotype (22.7±0.68 kgm·min⁻¹·kg⁻¹). At the same time, the average

value of individuals of ectomorphic somatotype (24.7±1.08 kgm·min⁻¹·kg⁻¹) is the highest and exceeds the value of females of endomorphic somatotype by 7.8 %, those of the balanced somatotype by 8.8 %, the mesoectomorphic somatotype (23.9±0.9 kgm·min⁻¹·kg⁻¹) by 3.3 % that do not differ among themselves (p > 0.05).

Discussion and conclusions

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. A uniform age-related decrease in anaerobic productivity (Palka, 1986). According to their data, such a decrease reaches approximately 6 % per decade. Moreover, the dynamics of the decrease does not depend on gender (Ryan-Stewart, 2018). 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. However, the results of a research by (Gaul, 2020) demonstrate that the lactic and alactic productivity of children before the end of puberty is significantly lower than in adults.

The level of anaerobic productivity of females from the lowland areas of Zakarpattia depends on the somatotype. The power of anaerobic alactic and lactic energy supply processes in females with endomesomorphic somatotype is higher than in other somatotypes. These indicators were the lowest in females with a predominance of ectomorphy.

The value of the relative indicator of the power of anaerobic alactic and lactic energy supply processes in the representatives of the endomesomorphic, mesoectomorphic and balanced somatotypes is higher than in the representatives of the endomorphic and ectomorphic somatotypes.

The results of the research indicate that the values of the absolute indicators of the maximum amount of external mechanical work per 1 min in females from lowland areas were significantly higher in the representatives of the endomorphic somatotype, the values of the absolute indicators in the representatives of the ectomorphic somatotype are the lowest, while the values of the relative indicators of PPO were the highest in females of the ectomorphic somatotype, and the lowest in females of the endomesomorphic somatotype.

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АНАЕРОБНІ МОЖЛИВОСТІ МІСЖАНОК ПОСТПУБЕРТАТНОГО ВІКУ НИЗИННИХ РАЙОНІВ ЗАКАРПАТТЯ

Вступ. Фізичне здоров'я людини залежить від здатності організму адаптуватися до умов зовнішнього середовища, зберігаючи нормальні функціональні параметри всіх фізіологічних систем. Актуальний механізм такої адаптації здійснюється гуморально-рефлекторним шляхом, однак цей процес уособлюється соматотипом людини. Отже, визначення компонентного складу організму та соматотипу дозволяє індивідуалізувати шляхи профілактики тих чи інших захворювань, обрати ефективну тактику лікування, а також прогнозувати ефективність лікування. Мета дослідження – встановити здатність представниць різних соматотипів, мешканок низинних районів Закарпатської області, адаптуватися до фізичної праці в анаеробному режимі енергозабезпечення.

Методи. У дослідженні взяли участь 118 здорових дівчат віком від 16 до 20 років, мешканок низинних районів. Для оцінки здатності виконувати фізичну роботу на велоергометрі в анаеробному режимі ми використали метод Вінгатського анаеробного тесту, описаного Ю.М. Фурман та співавторами. Також заздалося з методикою Shogy A., Cherebetin G. ми вимірювали зміст анаеробних лактатних процесів. Соматотип визначали за методом Хім-Картера.

Результати. Обстежені дівчата, мешканки низинних районів, були представлені 5 соматотипами: ектоморфним, ендоморфним, ендеоморфним, мезоектоморфним і збалансованим. Найбільша кількість осіб була збалансованою (34,7 %) та ендеоморфною (32,2 %) соматотипу, найменша – ектоморфною (10,2 %) та мезоектоморфною (9,3 %) соматотипу. У осіб ендеоморфного соматотипу середнє значення $ВАНТ_{10}$ відн. ($40,25 \pm 1,23 \text{ кгм} \cdot \text{хв}^{-1} \cdot \text{кг}^{-1}$) вірогідно перевищує середню величину дівчат лише ендоморфного ($37,1 \pm 0,65 \text{ кгм} \cdot \text{хв}^{-1} \cdot \text{кг}^{-1}$) соматотипу, тоді як середнє значення $ВАНТ_{10}$ відн. у представниць збалансованою ($40,5 \pm 1,28 \text{ кгм} \cdot \text{хв}^{-1} \cdot \text{кг}^{-1}$) соматотипу вірогідно ($p < 0,05$) перевищує значення дівчат ендоморфного соматотипу на 9,2 % та ектоморфного соматотипу ($37,4 \pm 0,76 \text{ кгм} \cdot \text{хв}^{-1} \cdot \text{кг}^{-1}$) на 8,2 %. Звертає на себе увагу те, що найнижчі середні значення $ВАНТ_{30}$ відн. спостерігаються у представниць низинних районів ектоморфного ($35,4 \pm 0,72 \text{ кгм} \cdot \text{хв}^{-1} \cdot \text{кг}^{-1}$) та ендоморфного ($35,7 \pm 0,96 \text{ кгм} \cdot \text{хв}^{-1} \cdot \text{кг}^{-1}$) соматотипів, які між собою не відрізняються ($p > 0,05$). Найвищі середні значення $ВАНТ_{30}$ відн. мають представниці низинних районів ендеоморфного $39,0 \pm 1,03 \text{ кгм} \cdot \text{хв}^{-1} \cdot \text{кг}^{-1}$ та збалансованою $39,33 \pm 0,89 \text{ кгм} \cdot \text{хв}^{-1} \cdot \text{кг}^{-1}$ соматотипів, які вірогідно на 6 % переважають значення представниць мезоектоморфного соматотипу, на 11 % переважають значення представниць ектоморфного та на 10 % ендоморфного соматотипу.

Висновки. Анаеробна продуктивність представниць Закарпатської області пов'язана із соматотипологічними особливостями організму. Існують гендерні відмінності в адаптації молодих людей до фізичної праці анаеробної спрямованості залежно від соматотипу. Серед дівчат, які проживають у низинній місцевості, найбільшу потужність анаеробних алактатних і лактатних процесів енергозабезпечення роботи м'язів демонструють ендеоморфи та особи зі збалансованим соматотипом, найменшу – ектоморфи.

Ключові слова: анаеробна продуктивність, соматотип, фізичне здоров'я, дівчата.

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