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CHARACTERISTICS OF EXTERNAL BREATHING IN YOUNG MEN OF THE INDIGENOUS ETHNIC GROUP OF YAKUTIA WITH DIFFERENT BODY TYPES

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The features of the functional organization of the external respiration system in students, young Yakuts, with different body types were studied. If in normosthenics the relationship of 13 studied parameters of the respiratory system was traced at the level of weak correlations, then in hypersthenics, on the contrary, rather strong correlations between the components of the respiratory act were revealed. The possibility of using the identified features of the organization of intrasystemic connections to predict the adaptive capabilities of students with different types of somatic constitution is considered. The lower, relative to normosthenics and hypersthenics, values of capacitance indicators and throughput of large bronchi in asthenics are compensated by a significant increase in the patency of respiratory bronchioles.

Keywords: indicators of external respiration; north; Yakut youths; body type; correlation relationships.

Introduction. The study of the adaptive capabilities of the body of student youth in Yakutia is of particular importance, since this population will form the main labor resource of one of the most remote, but strategically important regions of Russia. The functional reserves of the body are largely determined by the external respiration apparatus, which is the most important link in the oxygen transport system. In the North, dry cold air, acting directly on the mucous membrane of the airways, causes reflex bronchospasm, which leads to significant tension in the respiratory system [10]. A negative correlation has been established between the air temperature and the resistance of the bronchial tree: the lower the temperature of the air that cools the airways, the higher the degree of bronchospasm [13].

In assessing the state of human health and its adaptation to the environment, it is important to use the constitutional approach, which provides for the establishment of links and interdependence of the somatic and functional characteristics of the whole organism. The need to study the constitutional features of the individual is currently due to the increasing influence of anthropogenic and social environmental factors, which is reflected in the biological organization of modern man in the North [7, 9, 12, 16].

Purpose: To reveal the features of the functional organization of the external respiration system in young Yakuts with different body types.

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Materials and methods: The study involved young Yakuts, students of the North-Eastern Federal University (n=93), aged 18 to 21 years with different body types (asthenics, normosthenics, hypersthenics). Body length (BW, cm), body weight (BW, kg), chest circumference (WGC, cm) were measured, body mass index (BMI, kg/m2) was determined. Body type was assessed using the Pinier index [11]. Registration of 13 volumetric, velocity and volume-velocity indicators of external respiration [15] was carried out on the spirograph of the Valenta computer diagnostic system. All the main characteristics were automatically compared with the proper values, originally included in the software of the device and representing the data obtained for the inhabitants of the Central European part of Russia. The study was carried out taking into account the ethical standards of the Declaration of Helsinki. All subjects gave voluntary informed consent to participate in the research. Since the results of the study of respiratory system parameters did not obey the normal distribution law, the nonparametric Mann-Whitney method was used for statistical processing of the obtained data and the values were presented as a median (Me), first (Q1) and third (Q3) quartiles. Differences between groups were considered significant at $p < 0.05$. The assessment of the strength and nature of the relationship between the indicators of external respiration was carried out with the calculation of the Spearman pair rank correlation coefficients (r) taking into account statistically significant correlation coefficients at $p < 0.05$.

Results and discussion. The results of the study of the indicators of physical development of all the examined students (Table 1) are consistent with the previously obtained data [7], which established significantly lower values of anthropometric indicators in Yakut boys compared to Caucasian boys living in Yakutia. With almost the same body length, the values of MT, OGK and BMI in groups with different physiques differed significantly. The value of BMI in asthenics was at the lower level, and in hypersthenics - at the upper level of the norm (preobesity). The study of capacitive indicators of external respiration of VC, FVC and FEV1 revealed a decrease in their values relative to the due ones, and, to a greater extent, this affected FVC (Table 2). Data on low values of capacitive characteristics in young Yakuts are consistent with the results of a number of authors who examined young men who are representatives of indigenous ethnic groups living in regions with a sharply continental climate [5, 8, 14]. Significantly higher values of VC and FVC were observed by us in normosthenics and hypersthenics, who have a large chest circumference relative to asthenics. High VC values are indicated in male students, ethnic groups of territories with extreme natural and climatic conditions, with a hypersthenic body type [2, 4].]. Of the lung volumes that make up the VC, significant differences between the examined groups were found only in one indicator of the reserve breathing capacity (ROout), the value of which is higher in normosthenics compared to asthenics. Significant differences between the values of capacitive characteristics and lung volumes between the groups of normosthenics and hypersthenics were not found.

The study of the state of the air system revealed significantly higher patency of large bronchi in normosthenics and hypersthenics than in asthenics (Table 2). However, in bronchi of medium caliber (MOS50%), the throughput becomes the same in all groups. Further, in the small

Table 1

Indicators of physical development (M±m) of the examined students according to anthropometry data, depending on the body type (M ± m)

Indicator	Asthenic (1) n =27	Normosthenic (2) n = 47	Hypersthenic (3) n = 19	All n = 93
Body Length (cm)	174.3±1.13	173.3±0.88	172.0±1.58	173.2±0.56
Body weight (kg)	56.3±1.25*	63.8±0.92*	73.8±1.67*	64.2±0.95
Chest circumference (cm)	80.7±0.63*	87.6±0.62*	95.5±0.70*	87.3±0.84
Body mass index (kg/m^2)	18.48±0.27*	21.2±0.18*	24.9±0.30*	21.2±0.32

Note: * - significance of differences at - p < 0.001, 1-2; 2-3; 1-3.

respiratory bronchi (MOS75%), the patency increases relative to the proper values in all groups, but to the greatest extent in asthenics. The literature indicates an excess of the proper level of patency of small bronchi in the natives of the North-East of Russia [8], which may be due to increased production of surfactant in bronchioles and alveoli under the influence of low temperatures [6]. Surfactant, stabilizing the lumen of the bronchioles and alveoli at maximum exhalation, prevents the narrowing of the lumen of the small bronchi, which ensures a high airflow rate in them. The low airiness of the proximal bronchi in asthenics is compensated by a statistically more significant increase in the patency of small (MOS75%) bronchi than in normosthenics and hypersthenics. Additional opening of the respiratory bronchioles allows to increase the volume of functional dead space, the amount of residual warm air in the pulmonary tree necessary to warm the cold air coming from outside. A significant increase in the airiness of the respiratory bronchi allows increasing the intensity of gas exchange, which is important for maintaining oxygen homeostasis [10].

To study the features of the functional organization of the external respiration system in residents of regions with extreme climatic conditions, a correlation analysis of the relationships between the individual components of the respiratory act was used [3, 8]. In our studies, the results of the analysis of the values of the pairwise rank correlation coefficients between all 13 studied characteristics of the external respiration system: capacitive (VCvd, FVC, FEV1), lung volumes (TO, ROVd, ROVd), volume-velocity (POS, MOS25%, MOS50, MOS75) revealed differences in the number and strength of correlations in young men with different physiques (Table 3).

In normosthenic young men, oxygen homeostasis is ensured due to the plastic interrelation of the parameters of the external respiration system. In this group, intrasystem interaction was traced at the level of weak correlations; only one strong correlation was found at the level of 0.74-0.79 in the POS-MOS25 pair. It is possible that the relative autonomy of the functioning of the constituent components in the external respiration system in normosthenics allows it to have large reserve capabilities in satisfying the oxygen demand. In hypersthenics, the density of interaction of external respiration indicators was high due to a greater number of close relationships - the number of connections at the level of 0.71-0.9 was 9. In asthenics, the number of equally close connections was 4. Excessively high tension of intrasystemic connections in hypersthenics can lead to decrease in the adaptive capabilities of the respiratory system in the environmental and social

Table 2

The main parameters of the external respiration system in students with different body types (Me, Q1–Q3)

Parameters	Body Types			Reliability of differences, p
	Asthenic (1)	Normosthenic (2)	Hypersthenic (3)	
VLCins (L)	3.58 (3.23-4.1)	3.87 (3.41-4.31)	3.87 (2.96-4.4)	1-2 < 0.05
VLCins (% reference)	74 (66.2-81.5)	81.5 (75.5-90.5)	84 (59.5-93)	-
IRV (L)	2.22 (1.53-2.24)	1.67 (1.27-2.28)	1.72 (0.85-2.28)	-
ERV (L)	0.84 (0.6-1.21)	1.14 (0.85-1.34)	1.01 (0.88-1.26)	1-2 < 0.01
RV (L)	0.82 (0.67-0.96)	0.85 (0.71-0.97)	0.92 (0.79-1.03)	-
FVC (L)	3.18 (2.87-3.5)	3.47 (2.89-3.78)	3.44 (3.12-3.66)	1-2 < 0.05
FVC (% referens)	67 (62-72.7)	75.5 (69-84)	75 (71-81.5)	1-2 < 0.01 1-3 < 0.05
FEV1 (L)	3.03 (2.84-3.4)	3.06 (2.7-3.37)	3.17 (2.66-3.44)	-
FEV1 (% referens)	72 (67.5-82.2)	75 (69-84)	80.0 (70-85)	-
FEV1/FVC (%)	99.7 (95.2-100)	92.5 (84.9-99.2)	90.8 (86.8-94.1)	1-2 < 0.01 1-3 < 0.01
PEF (L/s)	6.76 (6.09-7.16)	7.07 (6.26-7.86)	7.33 (6.26-8.04)	1-2=0.072
PEF (% referens)	75 (68.2-81.7)	81 (75-89)	81 (69-92.5)	1-2 < 0.05
FEF25% (L/s)	6.14 (5.5-6.73)	6.24 (5.74-7.25)	6.21 (5.68-7.61)	1-2=0.057
FEF25% (% referens)	76 (70.2-84.5)	83 (76.5-91.5)	76 (71.5-99.5)	1-2< 0.01
FEF50% (L/s)	5.29 (4.72-5.93)	5.11 (4.14-5.55)	4.75 (4.09-5.46)	-
FEF50% (% referens)	98 (87.2-107.7)	93 (76.5-102.5)	90 (68.5-97.5)	1-3 < 0.05
FEF75% (L/s)	3.37 (3.11-3.74)	2.91 (2.37-3.81)	3.01 (2.44-3.44)	1-3 < 0.05
FEF75% (% referens)	129 (110-132.7)	114.5 (90.2-144.7)	106 (90.5-130)	1-3=0.057
TFVC (s)	1.05 (0.92-1.38)	1.33 (1.05-1.9)	1.53 (1.33-1.87)	1-2< 0.01 1-3< 0.01
TPEF (s)	0.31 (0.22-0.39)	0.26 (0.18-0.38)	0.22 (0.16-0.44)	-

Note. A dash indicates the absence of statistically significant differences between the compared groups.

conditions of the North. Our earlier studies of the morphological and functional characteristics of young Yakuts revealed a tendency to hypersthenization of the physique, against which the adaptive capabilities of the circulatory system decrease [9]. These results are consistent with the data of a study of young students in the city of Magadan, according to which a pronounced tension in the work of the cardiorespiratory system and a decrease in its functional reserves were found in hypersthenics relative to other somatotypes. [8]. By definition, P.K. Anokhin, the maintenance of vital constants of the internal environment of the body can be achieved both by reducing the strength of connections between the parameters of functional systems, and by strengthening the relationship [1]. The data obtained in this work indicate that the same reserve capabilities of the external respiration system in young men with normosthenic and hypersthenic types of somatic constitution are achieved by different ways of organizing the interaction of individual components of this system.

Conclusion. Despite the lower values of the main indicators of lung ventilation relative to the proper values developed for residents of the Central European part of Russia, we believe that our data are adequate to the level of physical development of the surveyed young men - representatives of the urbanized ethnic group of Yakutia, who have significantly lower anthropometric parameters relative to their peers - Caucasoids of the same region. In young men of normotonic and hypersthenic body types, the same, higher compared to asthenics, reserve possibilities of external respiration were established. However, the strategy for providing oxygen demand to the body of young Yakuts has specific features depending on their belonging to one or another type of somatic constitution. In young men with a normotonic physique, flexible connections between the components of external respiration were revealed, which, in our opinion, allows us to have large reserve capabilities in satisfying the oxygen demand. In young men with a hypersthenic type of constitution, a large number of strong correlations were found between the components of the respiratory act, which limits the plasticity of intrasystemic connections and can make the body less adaptive in the environmental and social conditions of the North. The low values of capacitance and throughput of large bronchi in asthenics, in comparison with normosthenics and hypersthenics, should not affect the homeostasis of blood gas composition, since young men of this somatotype showed a significant opening of respiratory bronchioles, which allows increasing the intensity of gas exchange in the lungs.

Table 3

Correlations between indicators of external respiration system

Correlation relationship	Asthenic	Normosthenic	Hypersthenic
VLCins - FVC	0.65***	0.49***	0.78**
VLCins – FEV1	0.5**	0.47***	0.86***
FVC - FEV1	0.85***	0.56***	0.74***
VLCins - RV	0.61***	0.38**	0.3
VLCins - IRV	0.49**	0.67***	0.84***
VLCins - ERV	0.45*	0.3*	0.35
FVC - RV	0.63***	0.28*	0.28
FVC - IRV	0.04	0.13	0.51*
FVC - ERV	0.4*	0.18	0.38
FEV1 - RV	0.55**	0.22	0.32
FEV1 - IRV	0.03	0.32*	0.85***
FEV1 - RV	0.33	0.1	0.02
VLCins - PEF	0.1	0.18	0.66**
VLCins – FEF25%	0.05	0.17	0.45*
VLCins – PEF50%	0.35	0.03	0.36
VLCins – PEF75%	0.31	0.12	-0.01
FVC - PEF	0.24	0.17	0.58**
FVC - FEF25%	0.26	0.12	0.29
FVC - FEF50%	0.58**	-0.08	0.10
FVC – FEF75%	0.49**	-0.33*	-0.24
FEV1 – PEF	0.48**	0.30*	0.86***
FEV1 – FEF25%	0.49**	0.29*	0.65**
FEV1 – FEF50%	0.43*	0.1	0.41
FEV1 – FEF75%	0.41*	0.11	0.1
PEF – FEF25%	0.86***	0.94***	0.9***
PEF – FEF50%	0.43*	0.5**	0.6**
PEF – FEF75%	0.4*	0.38**	0.27
FEF25% - FEF50%	0.58**	0.59***	0.76***
FEF25% - FEF75%	0.49**	0.46**	0.47*
FEF50% - FEF75%	0.78***	0.66***	0.66**

Note: The correlation between the indicators is statistically significant:
* - $p < 0.05$ - ** $p < 0.01$ - *** $p < 0.001$.

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COMPARATIVE ANALYSISOF SOMATOMETRIC AND ORCHIDOMETRIC INDICATORS OF YOUNG MEN LIVING IN THE REPUBLIC OF SAKHA (YAKUTIA), ENGAGED AND NOT ENGAGED IN SPORTS

In sports practice, high motor activity is heavily demanding on the physique of a person and body composition – a factor which largely affects body's functional capabilities. Many authors emphasize the urgent need for constant monitoring of the physiological development of the reproductive functions of the male body. This determined the purpose of the study: to conduct a comparative morphological analysis of somatometric and orchidometric parameters in young men living in the Republic of Sakha (Yakutia) and their sports activity.

We have established statistically significant intergroup differences between young men not engaged in sports and engaged in sports: there were higher indicators of body weight, body mass index, higher phase angle indicators, rates of lean body mass (LBM), active cell mass (ACM), %ACM, and ejection fraction (EF) yet the latitudinal dimensions of the body are inferior to those of young men not engaged in sports. In addition, in this group, there were marked differences between the minimum and maximum values of weight, height and body mass index. This indicates a more intense metabolism and the level of metabolic processes of basal metabolic rate (BMR) and mass-specific basal metabolic rate (mass-specific BMR) in young men involved in sports.

A comparative analysis showed that the volume of the left testicle in non-athletes is greater than that of athletes, while the right testicle is the opposite.

All orchidometric parameters of the studied groups had statistically significant bilateral differences with their right-sided predominance. The results of the study can become an information basis for the consultative and diagnostic practice of sports medicine doctors, exercise therapy. These results can also help trainers dealing with practical issues of clinical, instrumjental, and laboratory monitoring of the current state of athletes and working on methods of maintaining and improving sports performance.

Keywords: somatometry, orchidometry, body composition, athletes, young men.

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Introduction. In sports practice, motor activity imposes special requirements on the physique of a person, largely affecting their functional capabilities — that being the manifestations of physical qualities (speed, strength, endurance, etc.). One of the most adequate approaches in assessing the physical condition of a person is the method of complex research, which allows to control the health status and dynamics of the development of athletes objectively, effectively, and based on standardized approaches [5, 7, 13].

The most widely recommended somatometric measurements include body length and weight, body mass index (BMI), and circumference of body parts. Other useful measurements include the shoulder, thigh, and lower leg, the thickness of the subcutaneous fat fold on the back and inner surface of the shoulder and forearm, thigh and lower leg, as well as the abdominal region [3, 5, 7]. Also, many authors emphasize the urgent need for constant monitoring of the physiological development of the reproductive functions of the male body [8]. It should be noted that some domestic and foreign