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COMPARATIVE CHARACTERISTICS OF MORPHOFUNCTIONAL INDICATORS OF PHYSICAL DEVELOPMENT OF YOUNG MEN

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Abstract. This article presents the comparative characteristics of the dynamics of indicators of physical development of young men. The study aims to carry out a comparative analysis of the dynamics of morphological and functional indicators of physical development and the functional state of male bodies at the youthful stage of ontogenesis. We have analysed the results of the one-time study (1999 and 2019) of 1st-year students; in total, 760 young male students were examined in 1999, and 273 students in 2019 (aged 17-18). To reveal research results of physical development indicators, we have carried out a comprehensive study of somatoscopic, somatometric, and functional indicators of young men. Analysis of the morphological and functional indicators of men in Yakutia at the youthful stage of ontogenesis over time (20 years of difference). We take into account the individual typological characteristics of the organism, manifested at the structural and functional level (somatotype), and reflected in the main anatomical and anthropological indicators of the organism. This makes it possible to state the impact of external factors (environmental, social influences; a complex of genetic and cultural characteristics) on the indigenous people of the North.

Keywords: morphological and functional indicators, sociotype, physical development, individual-typological characteristics.

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Relevance. The centuries-old long-term residing of indigenous peoples on the territory of the Sakha Republic has contributed to the formation of a morphological and functional ecotype that is maximally adapted to local extreme climatic and geographical conditions. However, recently there have been significant socio-economic changes in the areas of residence of the peoples of Yakutia, which had a significant impact on the health of the population. [9]

One has to agree that any hasty breakdown of an existing lifestyle can lead to changes in the morpho-functional state of the human body. [6] Recently, a decrease in the level of physical activity has been recorded; along with this, malnutrition and an improper lifestyle have been noted, which in turn leads to a decrease in the health indicators of learning youth. [1, 2, 5, 8].

In this regard, it became relevant to study the individual typological characteristics of the physical development of the indigenous population of Yakutia in

specific periods of ontogenesis (adolescence). The revealed features are necessary for preventive medicine and the development of targeted programs of physical education for the younger generation in the North-East of Russia.

Research Objective is a comparative assessment of the morphological and functional indicators of physical development and the functional state of male bodies at the youthful stage of ontogenesis.

Research Materials and Methods. In this work, we have analysed the results of a one-step study (1999 and 2019). The age range of the subjects is 17-18 years old. We included first-year students in random sampling; in total, 760 young male students (Group 1) were surveyed in 1999 and 273 students in 2019 (Group 2).

This study uses data from the work by Permyakova S.P. titled "Patterns of Morphological and Functional Development of Sakha Republic's Indigenous Population's Young Men" (2002) [9].

The research was carried out according to a comprehensive program; at the initial stage we carried out a questionnaire survey and analysis of the student's medical data. The second stage involved the study of the physical development of students, which was carried out using standard anthropometric techniques – somatometric indicators were determined: total body dimensions (body weight, height, chest circumference); partial body dimensions characterizing the dimensions of individual parts of the body, longitudinal, latitudinal and girth dimensions of the body, and caliperometry data. In addition, we assessed the physiometric parameters of young men (hand strength, back strength, lung capacity, heart rate, and blood pressure). Statistical processing of the results obtained was carried out using the SOMAX database analytics system. [4]. For data with a normal distribution, we calculated the mean (M) and standard deviation (σ). When comparing sample means for data with a normal distribution, we used the t-test. For analysis, p values < 0.05 were considered statistically significant.

Results and Discussion. The analysis of the morphological parameters of young men's organisms was carried out taking into account the ethnic character and revealed differences in the physical development of young men in the Sakha Republic during different periods of the study. As a result of the study, it was found that in the analysed groups there were significant differences in the length of the body depending on the year of the study. Our data show that the greatest indicators of body length are determined in the second group of boys, and lower numbers – in the young men of the first group (Table 1).

The body length of the men of the second group exceeds (on average) the given indicator of the men of the first group by 3.64 cm, which characterizes the accelerated growth rate and energy expenditures of the body and is of hygienic significance. The body mass index in the young men of the second group is 4.36 kg higher than in the men of the first group, which also has significant differences ($P < 0.05$). Higher values of body weight in young men of the second group is explained by their longer body length since these indicators have a high correlation. At the same time, the BMI value (the ratio of body weight in kg to the square of the body length) also has differences in the studied groups, but these indicators can be seen as the "norm" when assessing the physical development of young men in the territory of the Sakha Republic.

Table1

Main Morphological Indicators of Young Men's Bodies (M $\pm\sigma$)

	Group 1 (1999) N = 760 (M $\pm\sigma$)	Group 2 (2019) N = 273 (M $\pm\sigma$)	P <
Body Length, cm	170.05 $\pm$ 6.16	173.69 $\pm$ 5.59	0.05
Body Weight, kg	59.87 $\pm$ 8.0	64.23 $\pm$ 10.42	0.05
Chest Circumference, cm	85.70 $\pm$ 6.05	87.59 $\pm$ 6.71	0.05
Quetelet Index	351.62 $\pm$ 41.02	369.57 $\pm$ 56.07	0.05
Body Mass Index	20.68 $\pm$ 2.27	21.27 $\pm$ 3.15	0.05
Rohrer Index	1.22 $\pm$ 0.14	1.22 $\pm$ 0.19	-
Body Area*	1.70 $\pm$ 0.12	1.78 $\pm$ 0.14	0.05
Specific Weight	1.04 $\pm$ 0.01	1.03 $\pm$ 0.05	0.05

Since bodyweight is an indicator that is sensitive to changes in the intensity of metabolic processes in the body, we carried out a deeper analysis of this indicator. The component composition of body weight was studied and analysed, the data on which are presented in Table 2. As can be seen from the Table, the absolute and relative content of bone, adipose, and muscle tissue also have significant differences between the 2 groups.

Analysis of the component composition of body weight indicates an increase in the bone and fat components and a decrease in the content of muscle tissue after 20 years ($P < 0.05$). Perhaps this is due to the peculiarities of nutrition and metabolism of modern youth.

Analysis of fat fold thickness indices and assessment of absolute and relative values of body fat in the study groups also revealed statistically significant differences ($P > 0.05$) (Table 3).

The Rohrer index, which reflects the

density of the body, largely depends on the linear dimensions and body weight. The results of our study did not reveal statistically significant differences in young men in both groups. They tend to have high rates of the Rohrer index (1.22 ± 0.01) and (1.22 ± 0.19), which in turn is the main feature determining the medical anthropology characteristics of the northern ecotype. This is explained by the high ecological valency of the organism of young men of the Sakha Republic's indigenous population, and it characterizes the high adaptability of the organism [4]. When analysing body length, it is of interest to clarify the question of how this indicator is predominantly formed. The main segments of body length are leg length and body length. From Table 4, it can be seen that significant differences were revealed in the indicators of the length-wise body size of young men. In the young of the second group, the indicators of the length of the body, arms, legs, hands,

Table2

Young Men's Body Composition (M $\pm\sigma$)

	1-я группа (1999г) N=760	2-я группа (2019г) N=273	P<
Absolute Bone Mineral Density. kg	11.09 $\pm$ 1.21	14.21 $\pm$ 18.07	0.05
Relative Bone Mineral Density. %	18.67	21.75	0.05
Absolute Body Fat. kg	7.30 $\pm$ 2.97	11.09 $\pm$ 6.13	0.05
Relative Body Fat. %	12.03	16.66	0.05
Absolute Muscle Density. kg	28.86 $\pm$ 4.32	29.61 $\pm$ 5.07	0.05
Relative Muscle Density. %	48.21	46.39	0.05

Table3

Indicators of Young Men's Bodies' Fat Folds Thickness (M $\pm\sigma$)

	1-я группа (1999 г.) N=760 (M $\pm\sigma$)	2-я группа (2019 г.) N=273 (M $\pm\sigma$)	P<
Chest Fat Folds	5.51 $\pm$ 2.16	9.06 $\pm$ 5.86	0.05
Shoulder Fat Folds (Front)	4.25 $\pm$ 1.75	6.24 $\pm$ 3.5	0.05
Shoulder Fat Folds (Back)	8.21 $\pm$ 3.48	9.27 $\pm$ 4.94	0.05
Forearm Fat Folds	5.14 $\pm$ 1.56	5.59 $\pm$ 2.6	0.05
Back Fat Folds	7.49 $\pm$ 2.35	10.74 $\pm$ 7.08	0.05
Abdomen Fat Folds	9.17 $\pm$ 4.71	14.13 $\pm$ 9.04	0.05
Thigh Fat Folds	6.87 $\pm$ 3.22	10.61 $\pm$ 5.66	0.05
Knee Fat Folds	5.73 $\pm$ 2.52	9.17 $\pm$ 5.01	0.05

Table4

Young Men's Length-Wise Body Sizes (M±σ)

	1-я группа (1999 г.) N=760	2-я группа (2019 г.) N=273	P<
Body Length, cm	170.05±6.16	173.69±5.59	0.05
Body Length, cm	89.87±3.68	91.39±11.54	0.05
Arm Length, cm	75.28±3.25	76.78±3.86	0.05
Brush Length, cm	17.30±0.93	17.10±3.35	-
Leg Length, cm	88.0±4.95	91.93±6.45	0.05
Foot Length, cm	25.08±1.16	25.08±2.77	-
Skelic Index, %	89.26±17.92	92.2±18.26	0.05

It is known that the transverse dimensions of the body have a significant effect on the body's overall proportionality (Table 5). Of the transverse body dimensions, the data on the shoulder width indicators (acromial diameter meter) are of greatest interest. According to our data, the shoulder width in the first group of young men was 39.84 ± 2.56 cm, and significantly exceeds this indicator when compared to the second group (38.24 ± 0.16 cm; $P < 0.05$).

Almost all latitudinal dimensions of the bodies of young men, except for the width of the pelvis and the diameter of the shoulders, are significantly larger in young men of the second group ($P < 0.05$).

The magnitude of body massiveness and its segments is characterized by girth dimensions, which make it possible to more objectively assess both the body type and the expressiveness of individual components of body weight (table 6).

As can be seen from Table 6, the girth dimensions of the forearm, wrist, abdomen, thigh, lower leg, and above the ankles in young men of the first group are

lower than in the second group ($P < 0.05$). This corresponds to the main dimensions of their body (length, body weight, thoracic organs).

According to the absolute indicators of the size of the shoulder girth, there were no significant differences between the young men of both groups ($P > 0.05$). But at the same time, reliable differences were obtained in the indicators of the shoulder girth when tensed; in the second group, this indicator is significantly higher than in the young men of the first group.

The main indicators characterizing the functional state of the body of the studied groups of young men are presented in Table 7.

As can be seen from Table 7, higher values of the absolute muscle strength (right and left hand) were observed in young men of the second group ($P < 0.05$). The absolute value of the back strength in the second group is significantly lower and amounted to 97.03 ± 48.74 kg, while in the first group this indicator was 121.56 ± 26.94 kg.

The study of lung capacity allowed us to reveal the following features: higher values of the absolute indicator were in the young men of the second group (4024.56 ± 1290.48 ml). The representatives of the first group showed indicators of 3573.30 ± 611.04 ml; we also revealed significant differences ($P > 0.05$) in relative terms (LC per kg of body weight).

Analysis of hemodynamic parameters of the body (heart rate, blood pressure) in the studied groups showed that heart rate is statistically significantly higher in modern young men ($P > 0.05$), which is presented in Table 7.

Thus, a comparative analysis of the functional indicators of the organism of young men, which are to a greater extent a phenotypic trait, has revealed significant differences in the studied groups. This may be due to a change in lifestyle

Table5

Young Men's Width-Wise Body Sizes (M±σ)

	1-я группа (1999 г.) N=760	2-я группа (2019 г.) N=273	P<
Acromial Diameter	38.24±2.28	39.84±2.56	0.05
Cross-Section Diameter	26.75±1.62	27.27±2.39	0.05
Front-to-Back Diameter	17.78±1.59	18.2±1.99	0.05
Pelvis Width	27.52±1.49	27.36±2.35	-
Shoulder Diameter	6.91±0.41	7.04±1.17	-
Forearm Diameter	5.69±0.32	5.58±0.42	0.05
Thigh Diameter	9.67±0.51	10.82±6.26	0.05
Shin Diameter	7.16±0.43	7.8±4.48	0.05
Shoulder Width Index	22.49±1.23	22.94±1.38	0.05
Pelvis Width Index	16.08±0.8	15.76±1.27	0.05

and feet were significantly higher than in the young men of the first group.

Manouvrier's Skelic Index in young men of the second group is 92.2%, which indicates macroskelia (90% and higher indicates macroskelia).

Among the representatives of the first group, it corresponds to 89.26% and speaks of mesoskelia (85-89.9% – mesoskelia). In other words, modern youths of indigenous nationality are characterized by the high length of the lower limbs, even though in many literary sources of the 20th century (Shreiber S.E., 1931; Levin M.G., 1945; Klevtsova N.I., 1976), attention is drawn to locals' "short legs". [9].

Girth Measurements of Young Men's Bodies (M±σ)

Обхват	1-я группа (1999 г.) N=760	2-я группа (2019 г.) N=273	P<
Chest	85.70±6.05	87.59±6.71	0.05
Shoulder	26.12±2.53	26.25±2.55	-
Shoulders (Tensed)	28.69±2.7	29.52±3.71	0.05
Forearms	25.09±1.74	24.76±1.77	0.05
Wrists	16.42±0.86	16.12±1.54	0.05
Abdomen	72.26±5.91	75.39±11.68	0.05
Hips	50.77±4.07	52.31±6.53	0.05
Shins	33.59±2.21	35.29±4.57	0.05

Table6

Table 7

Young Men's Functional Indicators (M $\pm$ σ)

	1-я группа (1999 г.) N=760	2-я группа (2019 г.) N=273	P<
Right Hand Strength, kg	38.67 $\pm$ 7.81	40.5 $\pm$ 7.94	0.05
Left Hand Strength, kg	35.91 $\pm$ 7.72	39.35 $\pm$ 7.23	0.05
Stan Force, kg	121.56 $\pm$ 26.94	97.03 $\pm$ 48.74	0.05
Lung Capacity, ml	3573.30 $\pm$ 611.04	4024.56 $\pm$ 1290.48	0.05
Life Index (LC / BW), ml/kg	60.04 $\pm$ 11.54	63.68 $\pm$ 20.93	0.05
Diaphragmatic Excursion, cm	6.59 $\pm$ 1.91	6.25 $\pm$ 1.91	0.05
Heart Rate, beats per minute	73.19 $\pm$ 7.78	81.7 $\pm$ 14.96	0.05
Systolic Blood Pressure, mm Hg	112.87 $\pm$ 12.5	112.39 $\pm$ 12.3	-
Diastolic Blood Pressure, mm Hg	71.67 $\pm$ 8.86	72.43 $\pm$ 11.58	-
Pulse Blood Pressure, mm Hg	41.20 $\pm$ 9.84	39.95 $\pm$ 12.37	-

(dietary habits, physical activity, and other factors). The revealed significantly low values of the absolute backbone muscle strength in the second group indicate a decrease in the level of development of skeletal muscles.

In clinical practice abroad, the method of somatotyping according to the Rice-Eysenck index (1945) is widely used. [10] In accordance with this scheme of constitution diagnostics, the surveyed contingent of young men was divided into the following groups: dolichomorphic, mesomorphic, and brachymorphic somatotypes. Among young men of the first group, the dolichomorphic type was found in 51.32% of cases, mesomorphic – 43.95%, and brachymorphic – 4.73%. Among the young men of the second group, there were more dolichomorphic and brachymorphic somatotypes – 58.33% and 9.09%, respectively. The number of mesomorphic types decreased and amounted to 32.58% of cases. As can be seen from the presented material, the manifestation of dolichomorphic and brachymorphic types was the most frequent among today's young men, which is combined with the highest indicators of longitudinal and latitudinal body dimensions revealed in the latter, as well as higher values of body fat folds.

Conclusions. Thus, we have analysed of morphological and functional indicators of young men in the Sakha Republic over time (difference of 20 years). We took into account the individual typological characteristics of the organism, manifested at the structural and function-

al level (somatotype) and reflected in the main anatomical and anthropological indicators of the body (body length, weight body, chest circumference, body surface area). This allowed us to state the impact of external factors (environmental, social influences, a complex of genetic, cultural characteristics of the way of life) on the indigenous people of the North. Constitutional diagnostics showed that over 20 years there has been an increase in the number of dolichomorphic and brachymorphic body types, along with a decrease in the number of mesomorphic body types. The revealed individual typological features of the physical development of the male population of Yakutia at the adolescent stage of ontogenesis. This makes it possible to assess their physical development as disharmonious. The data obtained can be used in practical work (preventive and military medicine, medical control of physical education courses).

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