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Age Characteristics of the Body Proportions of the Older Age Groups of the Republic of Sakha (Yakutia)

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ABSTRACT
The aim of the study was to identify age-related features of body proportions of Yakut men of older age groups. The analysis of the somatometric survey of 591 men of three age groups was carried out: the second mature period, the elderly and the senile ages. The obtained material was processed by the method of variation statistics by SPSS application package for Windows (version 17.0). The result of the research revealed that representatives of the second mature age had overall size of the body (length and weight of the body), the length of the lower limb, chest circumference, buttock circumference, the diameter of the shoulders and the transverse diameter of the chest. The study of variability in the physique proportionality of male Yakuts showed the presence of age differences in the index of the skeleton, the relative width of the pelvis and the body shape. At the same time, senile men had pelvic diameter of significantly greater values compared to the rates of older and second mature age. The established age characteristics of the somatometric characteristics of male Yakuts of 36-89 years old were consistent with the theory of secular trend observed throughout the world and with the trend towards asthenization of a younger generation.

Keywords: *age characteristics, body proportions, somatometrics, Republic of Sakha, Yakutia.*

1. INTRODUCTION

Studies of the last decade show that life quality decline of the population of older age groups is mainly due to the physical component of health [1]. The high level of physical health determines the functional independence of a person, his social self-sufficiency. In recent years, there are works about populations of people of older age groups from the perspective of biomedical and clinical anthropology [2]. Morphological aspects of human aging remain a relevant field of anthropology and gerontology. The Republic of Sakha (Yakutia) belongs to regions with extra small natural and climatic living conditions. A sharply continental climate with long cold winters and short hot summers, long periods of high atmospheric pressure, critically reduced partial pressure of oxygen in the atmosphere, increased geomagnetic activity suggest an extremely high degree of adaptation of the indigenous population.

Yakuts belong to the Arctic adaptive type. According to T.I. Alekseeva, characteristic of the Arctic type is a high thick-set, determined by the ratio of body mass to body surface area and by ponderal index, a large cylindrical thorax, a massive skeleton, and a tendency to brachymorphy.

Numerous data confirm the morphofunctional characteristics of the indigenous peoples of the North, which allow them to be considered as a product of long-term evolution and adaptation of man to unfavourable living conditions. At the same time, the indigenous population of Yakutia of older age groups from the standpoint of integrative anthropology remains to be unstudied.

Thus, the study of the morphofunctional status of the population of older age groups living in extreme climatic conditions is relevant. The purpose of the work was to identify the age characteristics of the body proportions of men of the older age groups of the Republic of Sakha (Yakutia).

2. MATERIALS AND METHODS

The paper presents the analysis of the somatometric survey of 591 Yakut men of older age groups. According to the age periodization scheme proposed at the international symposium on the problems of age morphology, physiology and biochemistry, the examined people were divided into age groups: the second mature period (36–60 years old), old age (61–74 years old) and senile age (75–89 years old). During the somatometric examination, the principles of volunteerism, individual rights and freedoms and exclusion criteria (refusal of examination and acute chronic diseases at the time of examination) were observed. The survey was conducted with written consent. The anthropometric study was carried out on the basis of the Department of Anatomy of the Medical Institute of M.K. Ammosov North-Eastern Federal University. Medical expeditions to the uluses of the republic were organized, where the examination was carried out during preventive examinations of the population at the bases of central district hospitals. Ethnicity was established on the basis of questionnaire data, the appearance of the examined, self-consciousness and no miscegenation with representatives of other ethnic groups for three generations.

Anthropometric research was carried out in accordance with the requirements for medical and anthropological examination, all measurements were done due to the accepted WHO standards and V.V. Bunak's methodology. The examination involved measuring body length and lower limb length with an anthropometer to 0.1 cm accuracy; determination of body weight on medical scales up to 0.05 kg; chest circumference, buttocks with a centimeter accuracy of 0.1 cm; the transverse diameter of the chest and the anterior-posterior diameter of the chest with a spreading circle with 0.1 cm accuracy; distal diameters of long tubular bones with a sliding circle with an accuracy of 0.1 cm; fat folds with a caliper circle.

Proportionality indices were used to determine age-related features of body proportions: relative length of lower limb, pelvic width index and body shape [3].

The relative length of the lower limb (index of the skeleton) is the ratio of the absolute length of the lower limb to the length of the body, expressed in percent. At the same time, the index value less than 54.9 % is defined as brachiskelia (short leg), the values of 55.0–56.9 % correspond to the middle leg (metrioskelia), 57.0 % and higher – macroskelia (long leg).

Pelvic width index is the percentage ratio of intercostal diameter to body length. Index values up to 15.9 % correspond to stenopielia (narrow pelvis), from 16.0 to 17.9 % – metriopielia (middle pelvis), 18.0 % or more – euripielia (wide pelvis).

The shape of the body was determined by the percentage ratio of pelvic width to shoulder width. Three hull shapes were distinguished: trapezoidal (with an index value of up to 69.9 %), average (with index values from 70.0 to 74.9 %) and rectangular body type (75.0 % or more).

The method of indices is used to estimate mass-growth ratios. Detection of people with normal body weight, its excess or deficiency was carried out on the value basis of the Quetelet index according to the formula BMI = body weight / growth ^{2}. According to WHO, the normal body weight corresponds to BMI value lying in the range of 18.5–25.0 kg/m^2, index values above 25.0 kg/m^2, allow excess body weight, and a value below 18.5 kg/m^2 – about insufficient body weight. The Rohrer index was determined by formula IR = body weight / height ^{3}. Normal values of Rohrer index are within 1.16–1.30 kg/cm^3.

The somatotype was determined by the Rees-Eysenck index, expressed by the formula (Body length x 100 / Transverse diameter x 6). According to the Rees-Eysenck index, three somatotypes are distinguished: picnical (the index size is 96), normostenic (the value is from 96 to 106) and astenic (more than 106).

The J. Mateigka method was used to determine the mass of tissue components. The absolute mass of fat tissue was determined based on measurements of eight fat folds on the trunk and limbs, the mass of muscle tissue – by the size of the radii of the segments of the limbs, the mass of bone tissue – based on measurements of the distal diameters of long tubular bones. When comparing the mass indicators of fat, muscle and bone components, along with absolute values, relative values were calculated, determined as a percentage of body weight.

The obtained material was processed by the variation statistics method by SPSS application package for Windows (version 17.0). The pattern of distribution of each feature is determined with subsequent calculation of the arithmetic mean and its error M ± m. Methods of parametric and non-parametric statistics [4] were used in the research. The evaluation of intergroup differences was performed by Student's t-test. The difference between the compared rows at significance level $p < 0.05$ was considered significant.

3. RESULTS AND DISCUSSION

A somatometric examination showed that the body length of yakut men of the second mature age period was on average 166.13 ± 0.43 cm, which is significantly higher than similar indicators of elderly and senile age (Table 1). At the same time, no significant differences in body length were found between older men and senile men. Body weight had a similar character of age differences: its highest values were noted in men of the

second mature period (on average 73.09 ± 0.93 kg). No differences were found between mean body weight values of elderly and senile persons. The length of the lower limb in representatives of the second mature age period was 82.42 ± 0.39 cm, which was significantly higher than similar indicators for men of older age groups. The same age characteristics were revealed as a result of the analysis of chest circumference, buttocks girth, shoulder diameter and transverse chest diameter. The values of the listed sizes for men of the second mature age period were: chest circumference – 98.15 ± 0.66 cm, buttock circumference – 97.96 ± 0.57 cm, shoulder diameter – 38.79 ± 0.14 cm and transverse chest diameter – 29.33 ± 0.20 cm. A comparison of pelvic parameters of men of three age groups determined that the pelvic diameter had reliably large values in men of senile age (29.10 ± 0.25 cm).

The identified age features of somatometric indicators are consistent with the hypothesis of secular trends. According to the researchers, changes in anthropometric features follow social transformations, which is reflected in the parameters of physical development of the population [5].

The obtained somatometric indicators made it possible to calculate physique indices and assess the proportionality of Yakuts male development depending on the age group. Analysis of the data showed the following results (Table 2). According to the relative length of the lower limb, brachycelia (short leg) was detected in all examined men of old and senile age (100 %). At the same time, the typological characteristic of the skelia index was different in men of the second mature age period. So the predominant proportional type was brachiskelia, which was determined in 74.26 % of men of this age group. Among representatives of this age period, metrioskelia was recorded in 18.14 % of cases. Macroscelia was rare (7.60 %).

Analysis of the relative width of the pelvis showed that the narrow and wide pelvis in the second mature age period occur with almost the same frequency (in 23.21 and 21.94 %, respectively). Subsequently, from the second period of adulthood to old age, the proportion of stenopielia decreases to 6.08 %, and the proportion of euripielia, on the contrary, increases, making 34.46 % in old age. Metriopielia at all age periods was observed significantly more often ($p < 0.001$). In the second mature age period, metropielia was recorded in 54.85 % of men, in old age – in 65.53 %, in older men this type of proportion was found in 59.46 % of cases. The obtained indicators show an epochal variability of proportionality of men's physique towards asthenization and gracialization of younger generation [6, 7].

To assess the physical status of a person, the index method is common. In this case, the ponderal index and body mass index are most often used. Many researchers of morphofunctional features of northerners consider the ponderal index as the most significant, and consider the high values of this index as an adaptive sign to Arctic living conditions [8].

Table 1. Somatometric indicators of male Yakutsk in Yakutia

Parameters	II mature, n=237	elderly, n =206	senile n =148
	1	2	3
Body length, cm	166.13±0.43	162.07+0.35	163.20±0.49
Reliability distinctions	$P_{1-2} < 0.001$; $P_{1-3} < 0.05$		
Body weight, kg	73.09+0.93	64.55+0.63	65.00+0.85
Reliability distinctions	$P_{1-2} < 0.001$; $P_{1-3} < 0.01$		
Leg length, cm	82.42±0.39	80.47±0.42	81.03±0.47
Reliability distinctions	$P_{1-2} < 0.001$		
Chest circumference, cm	98.15±0.66	94.00±0.55	94.31±0.64
Reliability distinctions	$P_{1-2} < 0.001$; $P_{1-3} < 0.05$		
Buttocks circumference, cm	97.96±0.57	95.16±0.46	95.21±0.65
Reliability distinctions	$P_{1-2;1-3} < 0.01$		
Shoulder diameter, cm	38.79±0.14	36.59±0.23	36.34±0.23
Reliability distinctions	$P_{1-2;1-3} < 0.001$		
Pelvic diameter, cm	28.51±0.19	28.27±0.16	29.10±0.25
Reliability distinctions	$P_{2-3} < 0.05$		
Chest transverse diameter, cm	29.33±0.20	27.12±0.15	27.77±0.24
Reliability distinctions	$P_{1-2;1-3} < 0.01$		
Anterior-posterior chest diameter, cm	22.38±0.20	22.60+0.12	22.99+0.19
Reliability distinctions	–		

The Rohrer index in the studied population was in the second mature age period 1.54 ± 0.01 kg/cm^3, in the elderly – 1.55 ± 0.01 kg/cm^3, in old age the index was equal to 1.52 ± 0.01 kg/cm^3. Comparison of the indicators revealed no statistically significant age differences. The average body mass index in the group of men of the second maturity period was 25.28 ± 0.16 kg/m^2. In old and senile age, this parameter was equal to 26.11 ± 0.15 kg/m^2 and 24.81 ± 0.16 kg/m^2, respectively. The evaluation of mass-growth ratios using the Rohrer index and body mass index showed that their average values are outside the norm and have no age characteristics

In terms of body mass index, examined patients showed normal, excess or insufficient body weight. We revealed that insufficient body weight, which, according to WHO recommendations, was considered an indicator of chronic energy failure, was extremely rare and amounted to 0.38 %. Men with normal and overweight in the population were distributed in almost equal proportions – 53.71 % and 45.90 %, respectively. Analysis of ponderal index and body mass index measures by age revealed no statistically significant differences.

According to the body shape, the significant majority of men of the second mature age period had a medium and rectangular shape, the frequency of which did not significantly differ (36.29 % and 35.86 %, respectively). The trapezoidal shape of the body in men of the second mature age period was recorded in 27.85 %, which is significantly ($p < 0.001$) more often than in older groups. However, in old age and senile age, the rectangular shape is predominant, reaching 68.45 % and 77.02 %, respectively.

Somatotypological diagnostics of men was carried out according to the Rees-Eysenck index (Table 3). It was found that the majority of men of the II mature age had a picnical body type, its share was 55.30 %. The normostenic type was determined in 36.41 % of the examined patients. The astenic body type accounted for the smallest share in the distribution of somatotypes (8.29 %) in this age group. In old age, the normostenic body type was predominant. Astenic and picnical types were found in reliably indistinguishable proportions. In senile age, the predominant somatotype is also normostenic (57.60 %). At the same time, there is a tendency to increase the percentage of astenic somatotype. The presented somatotypological picture characterizes the age-related features of the distribution of somatotypes.

Since somatotyping using the Rees-Eysenck method is based only on two parameters – the length of the body and the transverse diameter of the chest, we considered it appropriate to trace the differences in overall dimensions and component composition of the body among representatives of different somatotypes. The results are presented in table 4.

Table 2. Age-specific features of body proportions of yakuts (Yakutia)

	1 II mature n=237	2 older n=206	3 senile n=148
Relative length of the lower limb			
Brachyskelia*	74.26 % (176)	100.00 %	100.00 %
Metrioskeliya**	18.14 % (43)	0.00 %	0.00 %
Macroskeliya***	7.60 % (18)	0.00 %	0.00 %
Significance of differences	$P^*_{1\text{-}2;\,1\text{-}3}<0.001$ $P^{**}_{1\text{-}2;1\text{-}3}<0.001$ $P^{***}_{1\text{-}2;\,1\text{-}3}<0.001$		
Relative pelvic width			
Stenopieliya*	23.21 % (55)	11.17 % (23)	6.08 % (9)
Metriopieliya**	54.85 % (130)	65.53 % 135)	59.46 % (88)
Euripieliya***	21.94 % (52)	23.30 % (48)	34.46 %(51)
Significance of differences	$P^*_{1\text{-}2;\,1\text{-}3}<0.001$ $P^{**}_{1\text{-}2}<0.05$ $P^{***}_{1\text{-}3}<0.05$		
Body forms			
Trapezoid*	27.85 % (66)	1.94 % (4)	0.68 %(1)
Average**	36.29 % (86)	29.61 % (61)	22.30 % (33)
Rectangular***	35.86 % (85)	68.45 %(141)	77.02 %(114)
Significance of differences	$P^*_{1\text{-}2;\,1\text{-}3}<0.001$ $P^{**}_{1\text{-}3}<0.05$ $P^{***}_{1\text{-}2;\,1\text{-}3}<0.001$		

Table 3. Distribution of somatotypes of yakut men depending on the age group

	1 II mature n=237	2 older n=206	3 senile n=148
Astenic, %	8.29	18.03	29.60
Normostenic, %	36.41	60.11	12.80
Picnic, %	55.30	21.86	57.60

The average values of body length in representatives of astenic, normostenic and picnic somatotypes did not have significant differences. Body weight in men of the picnical type significantly exceeded similar parameters in astenic and normostenic types, with a confidence level of $p<0.001$. The astenic somatotype is characterized by the lowest average values of chest circumference, transverse and anteroposterior chest diameters, shoulder width, pelvic width. On the contrary, the picnical somatotype is characterized by high average values of these parameters.

Table 4. Somatometric indicators of yakut men depending on the somatotype

Parameters	Astenic n=100	Normostenic n=229	Picnic n=262
	1	2	3
Body length, cm	164.05+0.19	163.74±0.12	164,17±0,23
	–		
Body weight, kg	62.29±0.11	64.94±0.03	74,50±0,07
	$P_{1-2;2-3;1-3}$<0.001		
Chest circumfe-rence, cm	88.29±0.08	93.20±0.02	101,77±0,05
	$P_{1-2;2-3;1-3}$<0.001		
The transverse diameter of the chest, cm	24.67±0.02	27.21±0.01	30,68+0,01
	$P_{1-2.2-3;1-3}$<0.001		
Anteroposterior diameter of the chest, cm	21.44±0.03	22.05±0.01	23,73±0,01
	$P_{1-2;2-3;1-3}$<0.001		
Shoulder width, cm	34.33±0.06	37.20±0.01	38,82±0,01
	$P_{1-2;2-3;1-3}$<0.001		
Pelvic width, cm	27.10±0.04	27.84±0.01	30,03+0,02
	$P_{1-2;2-3;1-3}$<0.001		
Absolute fat mass, kg	12.64±0.08	14.80±0.02	22,33±0,05
	$P_{1-2;2-3;1-3}$<0.001		
Relative fat mass, %	20.11±0.11	22.51±0.03	29,28±0,05
	$P_{1-2;2-3;1-3}$<0.001		
Absolute muscle mass, kg	26.23±0.08	28.26±0.02	32,16±0,03
	$P_{1-2;2-3;1-3}$<0.001		
Relative muscle mass, %	43.24±0.10	43.74±0.13	43,60±0,13
	–		
Absolute bone mass, kg	10.70+0.02	11.20±0.01	12,24±0,01
	$P_{1-2;2-3;1-3}$<0.001		
Relative bone mass, %	17.32±0.03	17.52±0.01	16,62+0,01
	P_{1-2}<0.01 $P_{2-3;1-3}$<0.001		

The absolute values of fat, bone and muscle components are represented by the highest average values ($p<0.001$) in the picnical somatotype, the lowest – in the astenic one. Similar data were obtained for the average values of relative fat mass. There were no significant differences between somatotypes in the relative content of muscle tissue. The relative bone mass in the normostenic somatotype was significantly higher than in the astenic and picnical ones. Men of the picnical type had the lowest values of relative bone tissue.

4. CONCLUSION

The physical development of the older population has always attracted the attention of scientists, but from the point of view of constitutional anthropology and due to age characteristics, this group of the population has not been studied enough.

The analysis of the obtained somatometric parameters of the body of Yakut men 36–89 years old revealed large values of the overall size of the body (length and weight of the body), the length of the lower limb, chest and buttocks circumference, the diameter of the shoulders and the transverse diameter of the chest in representatives of the second mature age. The study of variability in the physique proportionality of male Yakuts showed the presence of age differences in the index of the skeleton, the relative width of the pelvis and the shape of the body. The findings are consistent with the secular trend theory observed worldwide. It is known that the secular trend is a process of epochal change in the size and body shape of the population from generation to generation. Changes can be multidirectional, both in increasing and decreasing.

Our study found that, pelvic diameter had significantly greater values in senile men compared to those of older and second mature age, suggesting a younger generation of asthenization.

The established age characteristics of the somatometric characteristics of male Yakuts 36-89 years old correspond to modern trends in the variability of a person's physical status.

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