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ANTHROPOMETRIC CHARACTERISTICS AND COMPONENT COMPOSITION OF BODY WEIGHT IN MALE MIGRANTS OF THE FAR NORTH WITH ARTERIAL HYPERTENSION

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Purpose. *The study of anthropometric characteristics and component composition of body weight in male migrants of the Far North with arterial hypertension.*

Materials and methods. *The study involved 155 men aged 30–79 y.o. A study group comprised 66 patients with hypertension, previously living in the Far North, who later moved to a permanent place of residence in Central Siberia. The examination included clinical, instrumental, functional and laboratory research methods and anthropometry followed by constitution type determination.*

Results. *It was revealed that over a half (57.6%) of examined male migrants of the Far North with hypertension had the muscular constitution type, whereas the male residents of Krasnoyarsk diagnosed with hypertension are usually characterized by having the abdominal constitution type (62.0%). Male residents of Krasnoyarsk without hypertension are more often characterized by having the muscular constitution type (33.3%).*

When compared with men who have moderate and mild hypertension degree, male migrants of the Far North with 3-degree hypertension showed higher indicators of fat and bone components as well as had a statistically significant difference.

Conclusion. *This study has allowed to identify and quantify the constitutional types distribution of the Far North male migrants. It has shown that it is usually men with the muscular somatotype who have hypertension. Body mass index and body fat component were higher in male migrants of the Far North with 3-degree hypertension*

Keywords: *Far North; hypertension; somatotype; body weight.*

АНТРОПОМЕТРИЧЕСКИЕ ОСОБЕННОСТИ И КОМПОНЕНТНЫЙ СОСТАВ МАССЫ ТЕЛА У МУЖЧИН МИГРАНТОВ КРАЙНЕГО СЕВЕРА С АРТЕРИАЛЬНОЙ ГИПЕРТОНИЕЙ*

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Цель. *Изучение антропометрических особенностей и компонентного состава массы тела у мужчин мигрантов Крайнего Севера с артериальной гипертонией.*

Материалы и методы. *Обследовано 155 мужчин в возрасте 30–79 лет. Основную группу составили 66 пациентов с артериальной гипертонией (АГ), проживающие ранее на Крайнем Севере и переехавшие в дальнейшем на постоянное место жительства в Центральную Сибирь. Обследование включало клинические, инструментальные, функциональные и лабораторные методы исследования, а также антропометрию с последующим соматотипированием.*

Результаты. *Выявлено, что более половины (57,6%) обследуемых мужчин мигрантов Крайнего Севера с АГ имели мускульный тип конституции, в то время как среди мужчин г. Красноярска с АГ, наиболее часто (62,0%) встречаются представители брюшного типа конституции. Среди мужчин г. Красноярска без АГ несколько чаще, на уровне тенденций, встречались представители мускульного типа конституции (33,3%). У мужчин мигрантов Крайнего Севера с АГ 3 степени, в сравнении с мужчинами, имеющими умеренную и легкую степени АГ, показатели жировой и костной компоненты были выше и имели статистически значимые различия.*

Заключение. *Проведенное исследование позволило выявить и количественно охарактеризовать распределение мужчин мигрантов Крайнего Севера по конституциональным типам. Показано, что наиболее часто АГ среди обследованных мужчин мигрантов Крайнего Севера отмечалась у лиц с мускульным соматотипом. Индекс массы тела и жировой компонент массы тела были выше у мужчин мигрантов Крайнего Севера с АГ 3 степени.*

Ключевые слова: *Крайний Север; артериальная гипертония; соматотип; масса тела.*

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Every year, quite a few people leave the Far North region within the return migration trend leaving for more comfortable albeit contrasted mid-latitude climate. It is established that the significant factors related to the migration process are migrating population health changes, especially the ones in the cardiovascular system [1, p. 55–57; 2, p. 92–95].

Climatological conditions play a specific role in human body readaptation to living in a new environment [3, p. 88–90; 4, p. 337–339; 5, p. 213–217; 6, p. 157–162].

Numerous studies show that living in unfavorable climatographical conditions combined with the anthropogenic stress leads to a more intensive use of adaptation recourses and, thus, their exhaustion, whereas the environment influence on human body is noted while observing certain difference of the population's anthropometric parameters [7, p. 208–214; 8, p. 238–241; 9, p. 393–407; 10, p. 705–709; 11, p. 5–7; 12, p. 955–958; 13, p. 27–31; 14, p. 201–202; 41, p. 71; 42, p. 128–142].

Human specific typological features can be markers that represent clinical implications patterns of various diseases and allow predicting their morbidity [15, p. 64–69].

It is shown that constitutional diagnostic determines correlation between human anthropometric features and a clinical implication intensity of a particular pathology [16, p. 87–90; 17, p. 19–23; 18, p. 38–41; 19, p. 442–449; 20, p. 1158–1168].

Certain studies aimed at figuring out the relation between specific constitutional groups and diseases pay much attention to the role of human constitution in cardiology [21, p. 563–568; 22, p. 252–256; 16, p. 87–90; 23, p. 40–42; 24, p. 127–132].

Some authors consider that for every constitutional type there is a special reaction of the cardiovascular system [25, p. 87–111]. It is established, that people with the abdominal somatotype have a slightly higher systolic and diastolic arterial tension as well as vascular tone compared to people with the thoracic somatotype [26, p. 15; 17, p. 19–23; 22, p. 252–256].

For objective estimation of a somatotype the somatodiagnostic complex is to include the body component composition analysis [27, p. 10–14; 28, p. 3–22; 29, p. 649–680; 30, p. 523].

The ratio of muscle, bone and fat components significantly depends on environment, nutrition habits, physical activities and stress factors influence [31, p. 330–333; 32, p. 468; 13, p. 27–31].

The importance of studying the correlation between these components in theory and practice of constitutionology has been noted by numerous authors [33, p. 1470–1477; 34, p. 66; 35, p. 14–19].

It is known that finding body mass index (BMI) is the most common method to determine whether the person is overweight or obese [36, p. 26–46]. This method does not divide fat and muscle weight, but it is highly associated with them [31, p. 330–333].

It is the changes of the body weight fat component that vividly represent the influence of the environmental factor. Anomalies of both content and type of fat distribution in the human body are important diagnostic signs of numerous pathologies [37, p. 14-21; 13, p. 27-31; 38, p. 45].

Therefore, studying anthropometric features and body weight components composition of the Far North migrants with arterial hypertension is of great significance.

Research purposes: studying anthropometric features and body weight components composition of the Far North migrants with arterial hypertension.

Methods and materials: The research included 155 men aged 30–79 y.o. (average age 53.3 y.o. (95% CI 51.5–55.03)), the main group included 66 patients with arterial hypertension (AH), who lived in the Far North and then moved to Central Siberia (the cities of Krasnoyarsk and Minusinsk) for permanent residency, the respondents' average age is 61.8 y.o. (95% CI 59.4-64.3). The control set included 50 men with AH (average age 47.8 y.o. (95% CI 45.9-49.7) and 39 men without AH (average age 46 y.o. (95% CI 43.6-48.4)) living in Krasnoyarsk.

The research protocol included medical examination, questionnaire survey, double arterial tension examination, echocardiography, electrocardiography, anthropometry (measurement of height, body weight, body mass index calculation) followed by somatotyping, determination of biochemical parameters: triglyceride level (TG), high-density lipoprotein cholesterol (HDL cholesterol), blood serum glucose.

Height was measured while standing, with coats and shoes off, using a standard height meter. Body weight was measured with coats and shoes off, using portable medical scales, which had passed a metrological control. The measurement accuracy was 0.1 kg. Body mass index (BMI) was calculated by the formula: BMI (kg/m^2) = weight (kg) / height^2 (m^2). According to WHO criteria (1997), the following parameter was estimated: prevalence of insufficient (low) body mass (BMI less than 18.5 kg/m^2); normal body weight (BMI 18.5-24.9 kg/m^2); overweight (BMI 25.0-29.9 kg/m^2); 1-degree obesity (BMI 30.0-34.9 kg/m2); 2-degree obesity (BMI 35.0-39.9 kg/m^2); 3-degree obesity (BMI more than 25.0 kg/m^2). Besides that, total prevalence of overweight and 1-, 2- and 3-degree obesity was estimated (25.0-40 kg/m^2 and more).

Anthropometric research was performed according to generally accepted rules of anthropometric measurement and included definition of longitudinal, transverse, circumferential body dimensions, weight and strength.

Skin-fat folds thickness, distal bones diameters (shoulder, forearm, hip and shin) and circumference of the shoulder, forearm, hip, and shin were determined according to a method by J. Matiegka (1921). To determine the component composition of body weight the method of fractioning body weight to muscle, bones and fat components was used. Special formulas were used to calculate fat, muscle and bone components of body weight.

Somatotyping was carried out using the method by V.V. Bunak (1931) [39, p. 123–125] as modified by V.P. Chtetsov et al. (1978) [40, p. 43–52]. It based on a five-score scale measurement of three components of the human body composition: fat, muscle and bone ones. In determining the somatotype, the terminology, proposed by Bunak V.V. (1931) was used: thoracic, breast-muscular, muscular-thoracic, muscular, muscular-abdominal, abdominal-muscular, abdominal, thoracic, abdominal-thoracic types, etc. The somatotypes were defined according to a scheme of possible score combination.

Statistical processing of the research results was performed using *Statistica 6.1* software. The obtained data is presented as the median line and interquartile range (25^{th} and 75^{th} percentiles), average values and confidential interval. The two independent groups were compared using the Mann-Whitney U test. An analysis of frequency difference in the two independent group was performed using Fisher's exact test with a two-sided confidence probability and χ^2 criterion with Yates correction. The differences with $p < 0.05$ were considered statistically significant.

Results and discussion: To determine individual-typological characteristics all the examined men were divided based on their anthropometric somatotype data (Table 1). In men that had migrated from the Far North, the thoracic constitution type was found in 4 cases out of 66 (6.1%), muscular type – in 38 cases (57.6%), abdominal type – 19 (28.8%). In 5 cases (7.5%) it was not possible to determine a particular constitutional type (unclassified constitution). In male migrants with the thoracic constitution type, the dominant somatotypes were thoracic broad-chested (50%) and thoracic gracial (50%), no men with asthenic, basketball-breasted and thoracic-muscular somatotypes were found in the migrants according our data (Table 2). In men with the muscular constitution type, 42.1% have the muscular-abdominal somatotype, 57.9% had the muscular somatotype. In the male migrants with the abdominal constitution type, in 35% of the cases the abdominal-muscular somatotype was found, in 48.4% of cases – abdominal somatotype. In the men with AH, living in Kras-

noyarsk, in 5 cases out of 50 (10%) the thoracic constitution type was found, 5 cases (10%) showed the muscular constitution type, 31 cases (62%) – abdominal type. In 9 cases (18%) the unclassified constitution type was found. In the men living in Krasnoyarsk without arterial hypertension there were more representatives of the muscular constitution type – 33% (Table 1).

Summarizing the above, it should be noted, that more than half of the examined men with AH that had migrated from the Far North have the muscular constitution type, while the male residents in Krasnoyarsk with AH normally had the abdominal one. Those residents without AH were as often as not determined to have the muscular constitution type (Table 1).

Table 1.

Frequency of occurrence of different somatotypes in the examined men that had migrated from the Far North as well as residents of Krasnoyarsk

Somatotype	a) Male migrants of the Far North with AH (n=66)	b) Residents if Krasnoyarsk with AH (n=50)	c) The Men Krasnoyarsk without AH (n=39)	*p*
	Абс.(%)	Абс.(%)	Абс.(%)	
1. Thoracic	4(6.1)	5(10)	10(25.7)	$p_{a,b}=0.32876$ $\boldsymbol{p_{a,c}=0.00583}$ $\boldsymbol{p_{b,c}=0.04769}$
2. Muscular	38(57.6)	5(10)	13(33.3)	$\boldsymbol{p_{a,b}=0.00001}$ $\boldsymbol{p_{a,c}=0.01354}$ $\boldsymbol{p_{b,c}=0.00700}$
3. Abdominal	19(28.8)	31(62)	9(23)	$\boldsymbol{p_{a,b}=0.00033}$ $p_{a,c}=0.34365$ $\boldsymbol{p_{b,c}=0.00032}$
4. Unclassified	5(7.5)	9(18)	7(18)	$p_{a,b}=0.07852$ $p_{a,c}=0.09441$ $p_{b,c}=0.60886$
p	$\boldsymbol{p_{1,2}=0.00001}$ $\boldsymbol{P_{2,3}=0.00072}$ $\boldsymbol{p_{1,3}=0.00048}$ $\boldsymbol{p_{2,4}=0.00001}$ $p_{1,4}=0.49999$ $\boldsymbol{p_{3,4}=0.00138}$	$p_{1,2}=0.62966$ $\boldsymbol{P_{2,3}=0.00001}$ $\boldsymbol{p_{1,3}=0.00001}$ $p_{2,4}=0.19403$ $p_{1,4}=0.19403$ $\boldsymbol{p_{3,4}=0.00001}$	$p_{1,2}=0.31001$ $P_{2,3}=0.09566$ $p_{1,3}=0.49999$ $p_{2,4}=0.09707$ $p_{1,4}=0.29214$ $p_{3,4}=0.38995$	

The obtained results correspond to the study by E.V. Zorina et al. (2014) [17, p. 19–23], according to which the largest group of the examined men with 1-, 2-degree AH were representatives of the abdominal (47%) and muscular (26%) somatotypes. The study by E.V. Derevyannyh (2016) [22, p. 252–256] showed high frequency of AH occurrence in male health workers of the city of Krasnoyarsk with the abdominal somatotype – 52.2% and low frequency of

AH occurrence in the same category with the unclassified somatotype – 11.5%. A similar result was achieved in the E.V. Taptigina et al. study (2007) [18, p. 38–41], according to which high frequency of AH occurrence was found in men with the abdominal somatotype – 50.9% ($p<0.01$), thoracic somatotype – 20.6%, muscular – 16.7% and unclassified – 11.8% respectively.

Table 2.

Ratio of constitution types of men with an arterial hypertension according to the constitutional scheme by V.V. Bunak

Somatotypes		Migrants of the Far North (n=66)	*p*	Male residents of Krasnoyarsk (n=50)	*p*
Groups	Types	Абс.(%)		Абс.(%)	
Thoracic	a. Asthenic b. Thoracic c. Thoracic broad-chested d. Thoracic gracile e. Basketball-breasted f. Breast-muscular	0(0) 0(0) 2(50) 2(50) 0(0) 0(0)	$p_{в,г}=0.69039$	0(0) 0(0) 0(0) 5(100) 0(0) 0(0)	
Muscular	a. Muscular-thoracic b. Muscular c. Muscular-abdominal	0(0) 22(57.9) 16(42.1)	$p_{б,в}=0.16827$	0(0) 4(70.4) 1(29.6)	$p_{а,б}=0.18108$
Abdominal	a. Abdominal b. Abdominal-muscular	12(48.8) 7(35.0)	$p_{а,б}=.,16072$	20(58.8) 11(23.5)	$p_{а,б}=\mathbf{0.04141}$
Unclassified		5(100)		9(100)	

The obtained data on the quantitative distribution of different constitution types in men with normal blood pressure correspond to the result of somatometry of apparently healthy men aged 17–35 y.o. in Krasnoyarsk [26, p. 15], which showed that the thoracic somatotype was found in 30.4% cases, muscular – 28.9%, abdominal – 19%, unclassified – 21.7%. The results of our earlier studies also show that in men with normal blood pressure the most common somatotype is the thoracic one – 36.96%, then muscular – 21.74%, abdominal – 23.9% and unclassified – 16.67% [26, p. 15; 18, p. 38–41; 15, p. 64–69].

It is the analysis of blood pressure levels and the measuring of body weight components of men who had migrated from the Far North with different somatotypes that was performed. In men with AH the average SBP and DBP values failed to have a significant difference. When comparing blood pressure values of different somatotypes' representatives, the highest SBP value was in men with the abdominal constitution type – 147.5 mm Hg, while the highest DBP of 96.0 mm Hg was in men with the thoracic somatotype (Table 3).

Table 3.

Blood pressure levels and body weight components values of male migrants from the Far North with different somatotypes

	1. Thoracic Me [Q25-Q75]	2. Muscular Me [Q25-Q75]	3. Abdominal Me [Q25-Q75]	4. Unclassified Me [Q25-Q75]	*p*
SBP (mm Hg)	152.5 [141.0-165.0]	150.5 [140.0-170.0]	147.5 [130.0-160.0]	155.0 [136.0-170.0]	$p_{1,2}$=0.49950 $p_{1,3}$=0.51641 $p_{1,4}$=0.80649 $p_{2,3}$=0.17297 $p_{2,4}$=0.79085 $p_{3,4}$=0.78062
DBP (mm Hg)	96.0 [90.0-100.0]	90.0 [700-110.0]	86.0 [80.0-100.0]	85.0 [82.0-94.0]	$p_{1,2}$=0.56296 $p_{1,3}$=0.91509 $p_{1,4}$=0.22067 $p_{2,3}$=0.14779 $p_{2,4}$=0.28877 $p_{3,4}$=0.22373
Body length (cm)	168.75 [167.5-170.75]	172.75 [168.0-176.0]	171.5 [169.0-172.0]	165.3 [164.0-165.5]	$p_{1,2}$=0.12294 $p_{1,3}$=0.20868 $p_{1,4}$=**0.03734** $p_{2,3}$=0.21032 $p_{2,4}$=**0.00637** $p_{3,4}$=**0.00318**
Body mass (kg)	66.5 [63.8-73.5]	86.5 [80.8-96.0]	86.0 [79.0-100.0]	73.7 [70.6-74.0]	$p_{1,2}$=**0.01219** $p_{1,3}$=**0.00138** $p_{1,4}$=0.62421 $p_{2,3}$=0.76059 $p_{2,4}$=**0.01379** $p_{3,4}$=**0.00658**
BMI (kg/m^2)	23.1 [22.4-25.6]	28.8 [24.9-33.0]	29.2 [28.0-34.1]	26.9 [25.0-27.5]	$p_{1,2}$=**0.02315** $p_{1,3}$=**0.00582** $p_{1,4}$=0.14165 $p_{2,3}$=0.26389 $p_{2,4}$=0.19769 $p_{3,4}$=**0.01725**

End of the table.

Fatty tissue (kg)	5.94 [4.84-7.32]	20.32 [13.9-24.9]	21.81 [21.26-26.6]	12.48 [12.43-13.52]	$p_{1,2}$=**0.00152** $p_{1,3}$=**0.00205** $p_{1,4}$=**0.00199** $p_{2,3}$=0.13191 $p_{2,4}$=**0.03718** $p_{3,4}$=**0.01431**
Muscle tissue (kg)	26.72 [24.22-31.05]	31.91 [30.21-36.04]	32.43 [26.58-38.3]	24.84 [24.51-24.94]	$p_{1,2}$=0.07896 $p_{1,3}$=0.19437 $p_{1,4}$=**0.01725** $p_{2,3}$=0.65984 $p_{2,4}$=**0.00215** $p_{3,4}$=0.32719
Bone tissue (kg)	12.56 [8.79-14.1]	13.8 [10.92-15.26]	11.43 [6.94-12.592]	10.44 [10.42-11.31]	$p_{1,2}$=0.46635 $p_{1,3}$=0.46539 $p_{1,4}$=0.14165 $p_{2,3}$=**0.04957** $p_{2,4}$=**0.02083** $p_{3,4}$=0.16572

The lowest BMI was shown in migrants with the thoracic constitution type – 23.1 kg/m^2. The highest BMI and fatty and muscle tissue parameters were found in representatives with the muscular and abdominal constitution types.

An analysis was conducted of body weight components of men depending on their AH degree according to the classification (WHO/MSOG 1999) (Table 4). There was not found any statistically significant difference in the average height of the examined individuals as men with 1-degree AH had the average height of 171.0 [168.0-175.0] cm, the ones with 2-degree AH – 171.0 [167.0-173.0] cm, 3-degree AH – 172.5 [172.0-175.0] cm. Men with 3-degree AH had the highest weight of 90.0 [80.0-96.9] kg, the ones with 2-degree AH – 80.9 [73.7-90.0] kg and 1-degree AH – 85.65 [81.5-94.00] kg. Also, men with 3-degree AH who had migrated from the Far North had the highest BMI of 29.71 [27.5-31.9] compared to the ones with 1- and 2- AH degree. Fatty and muscle tissue parameters of patients with 3-degree AH were statistically significantly higher than the parameters of patients with 1- and 2-degree AH (Table 4). According to the absolute amount of muscle tissue, the highest values were in patients with 1- and 3-degree AH. According to the absolute amount of bone tissue the highest values were in patients with 3-degree AH.

While analyzing the results, it should be noted, that male migrants from the Far North with 3-degree AH have higher and statically more significant difference of fat and bone components compared to men with 1- and 2-degree AH.

The obtained data on the difference of body weight components in men who had migrated from the Far North corresponds to the study by E.V. Derevyannyh (2016) [22, p. 252–256], according to which men with 3-degree AH have a higher body mass index and fat component of body weight. It can be assumed that high fatty tissue content in the examined men have strong effect on their AH parameters. Similar changes in lipid metabolism are relevant for any extreme situation. There is an expansive growth of lipid subgroup amount when stressed, which can be interpreted as switching the body from the carbohydrate metabolism type to the lipid one [4, p. 337–339]. Changes in lipid metabolism of migrants from northern regions, perhaps, lead to accumulation of fatty tissue in body, resulting in overweight and obesity in the future.

Table 4.

Body weight components characteristics in male migrants from the Far North depending on arterial hypertension degree

Indicators under study	1. 1-degree AH (n=20)	2. 2-degree AH (n=13)	3. 3-degree AH (n=13)	*p*
	Me [Q25-Q75]	Me [Q25-Q75]	Me [Q25-Q75]	
Body length, cm	171.0 [168.0-175.0]	171.0 [167.0-173.0]	172.5 [172.0-175.0]	$p_{1,2}$=0.43548 $p_{1,3}$=0.49549 $p_{2,3}$=0.07493
Body mass, kg	85.65 [81.5-94.00]	80.9 [73.7-90.0]	90.0 [80.0-96.9]	$p_{1,2}$=0.14975 $p_{1,3}$=0.48391 $p_{2,3}$=0.08111
BMI, kg/m^2	28.87 [27.29-32.59]	27.9 [24.91-31.14]	29.71 [27.5-31.9]	$p_{1,2}$=0.32625 $p_{1,3}$=0.58050 $p_{2,3}$=0.17967
Fatty tissue (kg)	22.86 [14.02-29.23]	16.45 [12.48-21.72]	24.1 [15.46-30.06]	$p_{1,2}$=**0.05068** $p_{1,3}$=0.79648 $p_{2,3}$=**0.01573**
Muscle tissue (kg)	32.16 [27.38-36.6]	31.03 [26.57-35.01]	31.17 [29.65-35.01]	$p_{1,2}$=0.51479 $p_{1,3}$=0.91199 $p_{2,3}$=0.55821
Bone tissue (kg)	12.78 [10.87-14.64]	1.,07 [10.44-12.79]	14.82 [12.87-16.17]	$p_{1,2}$=0.17744 $p_{1,3}$=**0.04664** $p_{2,3}$=**0.00269**

Conclusion: Therefore, the conducted research allowed to identify and quantify the distribution of men who had migrated from the Far North according to their constitution type. The main characteristic of such distribution is thought to be the prevalence of the muscular and abdominal somatotypes over thoracic and unclassified ones. The data was obtained on height-weight

parameters, body components composition of representatives of different somatotypes with AH. Male migrants from the Far North with 3-degree AH have higher BMI and fat component of body weight. The data on body measurements and component composition in the new climatographical conditions in male migrants from the Far North with AH obtained while carrying out the research show that it should be taken into account for a complex health assessment of this population group.

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