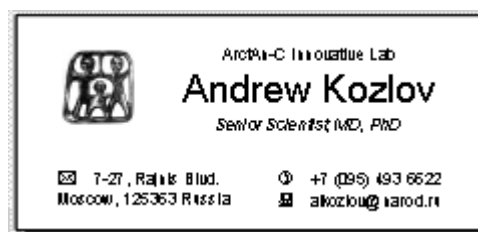


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Anthropological Science, 106 (3): 245–252, 1998

The Morphological Peculiarities of the Populations of Eastern and Western Siberia

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Abstract. The influence of climatic-geographic factors on the Russians of Western and Eastern Siberia and on the Buryats of Eastern Siberia was investigated. A comparison of important ecotypological characteristics such as body mass index and topography of subcutaneous adipose tissue confirmed better adaptability in the Russian males than the females to the stressful influence of the severe continental climate of Eastern Siberia. It suggests the possibility that the "conservatism" of the female gene pool can lead to chronic stress caused by incomplete adaptation to the influence of a severe continental climate.

Keywords: morphology, adaptation, climate, Russians, Buryats

Introduction

The ecological and climatic peculiarities of an area where an anthropological group was formed influence human morphophysiological characteristics. The influence of extremely strong climatic factors may lead to genetic adaptation and evolutionary changes in a gene pool from generation to generation, thereby enhancing the biological success of a population (Wolanski, N., 1990). This process results in the formation of highly adapted groups, i.e., ecotypes. The ecotypes (adaptive types) display a tendency towards physiological and morphological changes in the direction favorable for surviving in a particular environment (Alexeeva T., 1986).

However, morphofunctional adaptation to particular geographical conditions can be traced in a population not at once, but long after the population's arrival in the new ecological environment. In some cases an organism's "conservatism" can lead to incomplete adaptation for several generations. One example of this situation is the old-resident population of Eastern Siberian (Trans-Baikal) Russians, living in the territory of the Buryat Republic.

The Buryat Republic is located in the Trans-Baikal region of Eastern Siberia, in a zone of severe continental climate with an annual temperature fluctuation of more than 48 degrees. It is assumed that these climatic extremities exert an influence on the human organism. The Buryats are the indigenous population in the Trans-Baikal region; their peculiar morphological complex was formed in the Bronze Age in this region, where the modern Buryats reside (Alexeev, V., Gochman, I., 1983). The number of Buryats in the Russian Federation is 385 thousand. On the other hand, as many as 648 thousand Russians live in the same territory. The first immigration of the Russian population into Buryatia goes back to the 17th century. Thus, the modern Trans-Baikal Russian residents are the result of Russian and Buryat mixing which took place over eight or nine generations. The serological index of the mixture in the Russians of Buryatia is about 40% (Bounak, V., 1963).

Subjects and Methods

The subjects of this research were representatives of indigenous and old Russian residents of Eastern and

Western Siberia. Anthropometric examination was undertaken on young adults (304 males and 391 females between ages 18 and 25) free of any genetic or chronic diseases; they were all students of Tjumen (Western Siberia) University and Ulan-Ude (Buryat Republic, Eastern Siberia) University. The subjects' parents and grandparents had been born and lived in the same regions where the examination was undertaken, and no subject's pedigree included interethnic marriage for at least two prior generations.

According to the climatic and geographical conditions these subjects are subdivided into two ecotypological groups (ecotypes), i.e., a temperate climate group (the Russians of Western Siberia) and severe continental climate groups (the Buryats and the Russians of the Buryat Republic, Eastern Siberia).

Anthropometric dimensions were measured by a single observer (AK), including stature, weight, circumferences (upper arm, forearm, thigh and calf), diameters (elbow, wrist, knee and ankle), and skinfold thicknesses (eight in the males and seven in the females). All subjects were measured in light clothing without shoes following standard methods outlined in Lothman et al. (1988). Following traditional Russian anthropological practice all dimensions were taken on the right side (Bounak, V., 1941).

Weight was determined to within 0.1 kg using a standing weighing scale (SECA Corporation). Stature was measured using a field anthropometer, circumferences were measured with plastic tapes, and diameters were determined with a spreading caliper (instruments produced by Courtesy Sibner Henger & Co.). The dimensions were determined to within 0.1 cm. Skinfold thicknesses were taken at the subscapular, suprailiac, biceps, and triceps points, and on the forearm, thigh and calf (all subjects) and at the chest (the males only) using a Lange caliper.

In a study of the body constitution the Body Mass Index (BMI, or Quetelet-Kaup-Gould, or Quetelet-2 Index) is usually employed. However this index is less sensitive to a subject's stature than some other indices (Komenda, S., 1986), although stature is a significant adaptive characteristic. Moreover, as was shown by Alexeeva (1977), the Rohrer index (RI) is preferable for the investigation of climatic and geographical adaptation in adults. Thus we use the RI in this study, but in the tables of results (Tables 1 and 2) we present the data of the both BMI and RI.

Table 1 Anthropometric data (Males)

	Temperate climate		Continental climate			
	Russians of Western Siberia N=175		Russians of Eastern Siberia N=38		Buryats N=91	
	Mean	SD	Mean	SD	Mean	SD
Stature (cm)	172.0	6.4	173.4	6.9	169.5	5.8
Weight (kg)	66.2	9.6	67.5	8.1	62.8	6.5
Skinfolds (mm): Subscapular	8.45	3.15	9.00	3.54	8.47	2.49
Triceps	7.44	2.98	7.49	2.46	7.43	2.21
Suprailiac	9.85	4.53	8.79	4.09	8.13	3.00
Calf	9.25	2.82	9.21	2.93	8.88	2.75
Body Mass Index	22.35	2.68	23.10	2.55	22.16	2.51
Rohrer Index	1.28	0.13	1.29	0.11	1.29	0.14
Muscular tissue component (%)	48.15	2.78	48.70	4.21	47.51	3.43
Fat tissue component (%)	11.67	2.27	12.91	4.67	11.62	2.76

Table 2 Anthropometric data (Females)

	Temperate climate		Continental climate			
	Russians of Western Siberia N=200		Russians of Eastern Siberia N=75		Buryats N=116	
	Mean	SD	Mean	SD	Mean	SD
Stature (cm)	161.3	4.5	161.2	5.7	158.9	4.9
Weight (kg)	56.8	7.4	58.0	7.0	56.5	6.0
Skinfolds (mm): Subscapular	12.22	3.78	14.54	4.45	15.69	4.21
Triceps	15.33	3.42	15.61	3.82	15.55	3.32
Suprailiac	14.56	5.07	15.85	4.45	16.84	4.55
Calf	14.66	3.69	16.05	3.99	13.59	3.06
Body Mass Index	21.86	2.29	22.99	3.19	22.74	2.63
Rohrer Index	1.36	0.15	1.39	0.13	1.45	0.20
Muscular tissue component (%)	43.10	2.73	41.76	4.68	41.71	3.17
Fat tissue component (%)	22.97	3.75	24.02	4.13	23.43	4.64

The body build components of each subject were calculated using Matiegka's (1921) formulas. Namely, the amount of muscular tissue (M , kg) was calculated according to the formula:

$$M = L \times r^2 \times 6.5,$$

where L is the stature (cm), and r is the mean average of upper arm, forearm, thigh and calf radiuses (excluding the thickness of subcutaneous fat and skin) (cm).

The amount of fat tissue (D , kg) was calculated according to the formula:

$$D = 0.5 \times d \times S \times 0.13,$$

where d is the average skinfold thickness (mm), and S is the body surface area (sq.m), the latter calculated according to the formula:

$$S = W^{0.425} \times L^{0.175} \times 74.66,$$

where W is weight (kg), and L is stature (cm).

Body build components in each subject were compared in relative figures (percentage to weight).

Topography of subcutaneous fat was estimated from four skinfold thicknesses: subscapular, triceps, suprailiac and calf. The amount above the waist (AW) was defined as the sum of subscapular and triceps skinfolds; that below the waist (BW) as the sum of suprailiac and calf skinfolds; that of the trunk (TR) as subscapular and suprailiac skinfolds; and that of the extremities (EXT) as triceps and calf skinfolds. The largest among these four sums in a given subject determines the type of this subject's subcutaneous fat topography. The percentage of subjects in each type of fat topography was obtained in each group.

In order to evaluate body proportions, we classified the relative shoulder breadth to stature of each subject into the three groups:

1. less than Mean - 0.67·SD (dolichomorph group),
2. Mean ± 0.67·SD (mesomorph group), and
3. greater than Mean + 0.67·SD (brachimorph group).

STATISTICA software (StatSoft Inc., 1993) was used for the statistical analysis of the data (descriptive

statistics, the t-test, the Chi-square test, and the Analysis of Variance).

Results

In tables 1 and 2, the mean and SD of six measurements, two indices, and relative muscular and fat tissue components to weight are presented for males and females independently.

The two groups of Siberian Russians of either sex were taller and heavier than the Buryats ($P < 0.05$ in all cases, except the weight between Western Siberian Russian women and Buryat women).

As for relative shoulder breadth to stature, the distribution among the Western and Eastern Siberian Russians is close to normal distribution, i.e., to the Gaussian curve, where 50% of the subjects correspond to the second group (Mean ± 0.67 -SD, mesomorph group) and the remainder belong to the first and third groups (the dolichomorph and brachimorph groups each with 25%). Thus the frequency of dolicho-, meso- and brachimorphs among the Russians of Eastern and Western Siberia is approximately 25%, 50%, and 25% respectively.

However, of the Buryat males and females up to 70% are characterized mesomorphs, and about 30% of the Buryats belong to marginal groupings, i.e., 15% dolicho- and 15% brachimorphs. The Chi-square test shows their distribution in either sex is significantly different from the normal distribution ($P < 0.05$).

The amount of muscular tissue M varies only slightly among the three investigated groups. In contrast, the differences in the amount of fat tissue D are more substantial. Although the results of skinfold thickness studies have been widely published (Leonard, W. et al., 1994), we give the data of the four main skinfolds (the subscapular, triceps, suprailiac, and calf) in Tables 1 and 2. But in the following analysis we use the derivatives: the amount of fat tissue D and the topography of subcutaneous fat.

The topography of subcutaneous fat is an important characteristic in these different groups (Figures 1, 2). In the males, subcutaneous fat is mostly located below the waist; more precisely, adipose tissue in Western Siberian Russian men is mostly located on the lower trunk (the suprailiac), while in Buryat men it is located on the lower limbs (the calf), and in Eastern Siberian Russian men almost equally on the lower trunk and limbs. In the Western and Eastern Siberian Russian females, subcutaneous fat tissue is mostly concentrated on the trunk below the waist and the lower limbs. In contrast, the Buryat women are characterized by a greater amount of fat tissue on the trunk.

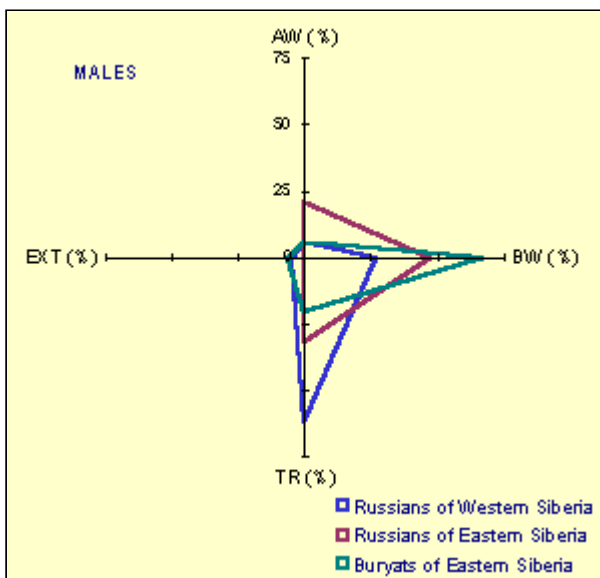


Figure 1 Percentage of subjects displaying each type of subcutaneous fat topography (Males).

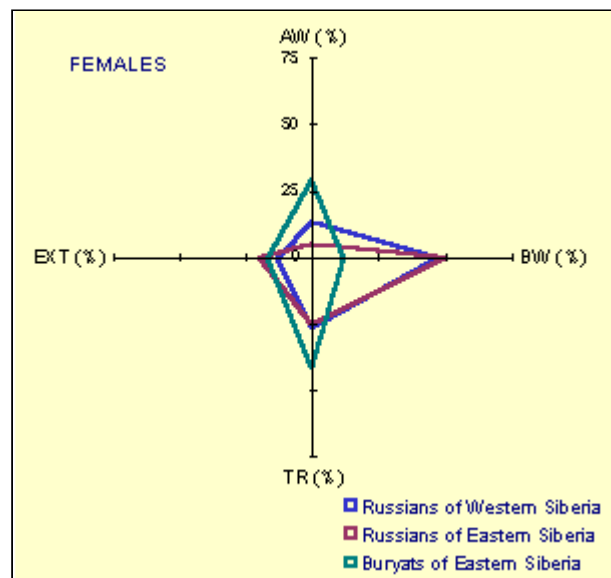


Figure 2 Percentage of subjects displaying each type of subcutaneous fat topography (Females).

Discussion

The Analysis of Variance (ANOVA) shows that the Rohrer index of both the males and females is significantly influenced by the ecotype (Table 3). In the males, both the muscular and fat components are similar in the different climatic groups (Table 1, 3). In the females, however, the muscular and fat components confirm the influence of the ecotype factor ($P<0.05$), according to the ANOVA; that is to say, the ecotypological groups in the severe continental climate (the Buryat and Eastern Siberian Russian women) and in the temperate climate (the Western Siberian Russian women) are opposed to each other.

Table 3 Significance of the ecotype membership factor for some anthropometric data (ANOVA)

	Stature	Rohrer Index	Muscular tissue component	Fat tissue component	Subcutan. fat topography	Shoulder breadth/stature distribution
Males	NS	$P<0.05$	NS	NS	$P<0.05$	NS
Females	NS	$P<0.05$	$P<0.05$	$P<0.05$	NS	NS

On the other hand, the body proportions do not manifest any relationships between the climatic and geographical conditions in either sex. The weight-stature indices (the Rohrer index and the BMI) and the relative muscular and fat components are variable, since they vary in accordance with social conditions, nutritional differences and so on.

As Purunjan and Deriabin (1979) indicated, stature, body proportions and the topography of subcutaneous fat tissue are more stable, because they are regulated by the endocrine system, which is less susceptible to change under the influence of climatic factors. In our subjects, stature and body proportions were stable in either sex, but as for relative muscular and fat components to weight these were stable only in the males whereas for subcutaneous fat topography these was so only in the females.

As for ethnic membership factors (Table 4), the Rohrer index and relative fat component were stable in either sex, but the relative muscular component was stable only in the females and subcutaneous fat topography only in the males. Thus the Russians of Eastern Siberia retain their generic morphological characteristics in spite of the fact that they reside in foreign climatic conditions and have become partially mixed with the indigenous peoples. The peculiarity of body proportion distribution among the Buryats is not a result of their Asian origin. In other Asian and European populations the distribution of body proportion is close to the normal curve (Kozlov, A., Vershubsky, G., 1994). We assumed that relative shoulder breadth is an independently variable characteristic, and that it partly reflects the genetic processes ongoing in a given population. The endogamy and traditional nomadic life style typical of the Buryats in the past might have led to the high homogeneity within this ethnic group. The Russians of Eastern Siberia preserve their original body proportion distribution.

Table 4 Significance of the ethnic membership factor for some anthropometric data (ANOVA)

	Stature	Rohrer Index	Muscular tissue component	Fat tissue component	Subcutan. fat topography	Shoulder breadth/stature distribution
Males	$P<0.05$	NS	$P<0.05$	NS	NS	$P<0.05$
Females	$P<0.05$	NS	NS	NS	$P<0.05$	$P<0.05$

The peculiar topography of subcutaneous fat tissue can be traced in the males' ecotypological groups (Fig. 1) vs. females' groups (Fig. 2). According to the ANOVA the ecotype factor is important for this characteristic in the males ($P<0.05$), but is not significant in the females. The Russian females differ from the Buryat females according to their subcutaneous fat topography; i.e., the former retain their original fat topography even in the severe continental climate of Eastern Siberia (Fig. 2; Table 4). This is evidence of their being less adapted to climatic conditions.

Conclusion

The Eastern Siberian Russians preserved the main traits which characterize the original type of temperate climatic zone population.

The stressful influence of the East Siberian continental climate led to morphological changes in the Russian inhabitants of the region. However, morphological adaptation to this climatic influence was more complete in the Russian males than females. In respect of such important ecotypological characteristics as weight-stature interrelationships and subcutaneous fat topography the Eastern Siberian Russian males were closer to the indigenous population of the severe continental climatic zone (the Buryats) than to the Russians of the temperate climatic zone.

In the same respect (stature, proportions, subcutaneous fat distribution) the Russian Eastern Siberian females were closer to representatives of their own ethnic group still living in the temperate climate conditions. This is evidence of their being less adapted to the climatic conditions.

We assume that in this case the "conservatism" of the female gene pool can lead to chronic stress caused by incomplete adaptation to the influence of a severe continental climate.

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