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(A similar but different article in English by LV Bets is here, by the way: https://www.jstage.jst.go.jp/article/jpa/24/4/24_4_451/_pdf)

[Logo that says "Nature" in Russian]

No. 1, 2005

L.V. Bets

"Hormonal portrait" of a person

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Scientific interests are related to hormonal anthropology.

The term "hormone" (Greek. ορμαω - set in motion, encourage) appropriated in 1905 physiologist E. Starling a substance that is normally produced in the cells of one part of the body is transferred to another part and acts there in a very low concentrations, regulating cell growth or activity. True, the time of occurrence endocrinology itself, science, studying hormones can be dated back to 1849, when Berthold, who was involved in the transplantation of testes in birds, suggested that these gonads secrete some substance carried by the blood and necessary for the development of secondary sexual characteristics of the male. The substance turned out to be testosterone, which was isolated in its pure form and synthesized in 1935.

By chemical structure hormones are surprisingly diverse: they can be amino acids and their derivatives, purines, derivatives of fatty acids acids, short and long peptides, steroids and diterpene compounds with complex ring structure. Means, “hormone” is not a chemical concept, since it does not refer to a specific class of chemical compounds, rather, it is a physiological term. According to biochemical Essentially, hormones are signaling molecules, chemical messengers that transfer information, i.e. signal to the target cell. It is not surprising that, being so active, hormones control all the main processes of the body (from the transport of ions across the cell membrane to DNA transcription) and its development from birth to old age. Hence, hormones provide chemical regulation and coordination in addition to that carried out by the nervous system system.

Among the many existing hormones, a special place occupy sex hormones - androgens (male) and estrogens (female). These steroid compounds are synthesized in the body from cholesterol and affect metabolism, stimulate the synthesis of complex compounds from simpler ones, determine the rate of human development, determine his gender, biological age and physique, and are associated with general reactivity and resistance. Not it is excluded that shifts in the biological maturation of modern humans are associated with changes in endocrine status. It is therefore clear that in in the second half of the 20th century, foreign and domestic anthropologists, who had already extensively studied the variability of biological status, began to characterize characterize it in hormonal terms.By the beginning of the 70s, a new direction, hormonal anthropology, had taken shape at our department. Its purpose is to collect information about the variability of endocrine status during a person’s life and to determine the

boundaries of variations, to develop methods for studying hormonal status in normal and pathological conditions. Here we will talk only about sex hormones.

Individual status

The causes of human diseases do not lie on the surface, since pathological processes in the body arise and develop as a result of the complex interaction of biological, environmental and social factors. It is in pathology that the influence of sex hormones becomes especially clear, but in order to identify anomalies in their content, you need to know what the norm is.

What is hormonal status, what is its variability throughout a person's life, is hormonal activity the same in different people and, finally, do human populations and ethnic groups have different levels of hormones? All these questions were to be answered in research begun at our department concerning sex hormones.

The first step is to determine your individual hormonal levels. To do this, we analyzed the concentrations of androgens and estrogens in each subject from two groups: Moscow girls (average age 8 years) and Moscow State University students (average age 22 years). As a result, it turned out that any individual is characterized by his own level of hormones produced by the body and it stabilizes quite early. The ratio of androgens and estrogens also remains unchanged: it was absolutely stable in 81.1% of the examined Moscow children and, as later data show, in 77.8% of young Moscow women. In men aged 21 to 23 years, the secretion of sex hormones is also strictly individual.

It is known that a person's belonging to a specific type of development is determined by his endocrine formula. Now we can include indicators of sex hormone levels here.

Judging by our results, accelerated, medium and slow development options correspond to different characteristics of hormonal status. Thus, in people of average development, the endocrine formula is most harmonious, i.e. close to the average level of hormonal indicators. In groups different in size, age and gender, this middle variant (A 2 E 2) predominated, while the extreme (A 1 E 1, A 3 E 3) and "disharmonious" (A 1 E 3, A 3 E 1) variants predominated were quite rare (no more than 11-13%). Consequently, "genetic homeostasis" maintains the optimum hormonal activity of the growing organism and the range of its variability. This is what ensures the possibility of the necessary shift when environmental conditions and life circumstances change. Exceptionally high individuality in the secretion of the most important components of the endocrine formula is typical for a long ontogenetic period.

In the city and in the countryside

Hormones, which control all the main processes of the body, also determine adaptation to changing environmental conditions. We tried to find out whether the level of sex steroids is stable or variable in people from areas with very different environmental parameters. To do this, we analyzed the hormonal status of girls from Moscow and the Ryazan region. Against the background of the individuality of hormonal profiles, interesting differences emerged: in the Moscow group there was a higher level of estrogen secretion, and in the Ryazan group - androgens. Since the production of estrogen increases during puberty, it means that in Moscow girls it occurs earlier. Another remarkable feature of the

Moscow group is the significant heterogeneity of hormonal status in terms of androids and estrogens, especially androgens. Apparently, this is due to the greater reactivity of adrenal hormones to external factors. (In the adrenal glands, androgens and estrogens are synthesized in small quantities, but together with other substances of this paired endocrine organ they participate in the regulation of vital functions and in the body's adaptation to unfavorable conditions.)

Thus, greater heterogeneity in the distribution of sex hormones in the Moscow group and earlier puberty distinguish the highly urbanized Moscow population from the rural Ryazan population. The revealed heterogeneity in the Moscow group indicates an expansion of the boundaries of the population norm as a result of intense adaptation of the organism to the urban environment. It should be noted that the differentiation of hormonal status in children of the same ethnic group in the phase of development that is most sensitive to external conditions, established, by the way, for the first time, can shed light on the hormonal basis and mechanisms of the acceleration phenomenon.

Таблица 1 Table 1

Содержание половых гормонов у молодых русских мужчин из разных городов Content of sex hormones in young Russian men from different cities

Город City	n	Тестостерон, нг/мл Testosterone, ng/ml		Эстрадиол, пг/мл Estradiol, ng/ml	
		min—max	X	min—max	X
Москва Moscow	81	1.16—14.99	7.48	8.20—66.00	24.35
Ташкент Tashkent	45	3.64—14.00	8.20	12.40—45.00	24.17
Владивосток Vladivostok	37	4.12—11.20	7.28	12.40—40.30	22.74
Аннаба (Алжир) Annaba (Algeria)	25	2.98—13.00	7.29	11.50—34.80	21.34

Примечание. Здесь и далее: n — количество обследованных; min—max — диапазон показателей от минимального до максимального; X — среднее значение.
Note. Here and below: n—number of people examined; min—max—range of indicators from minimum to maximum; X is the average value.

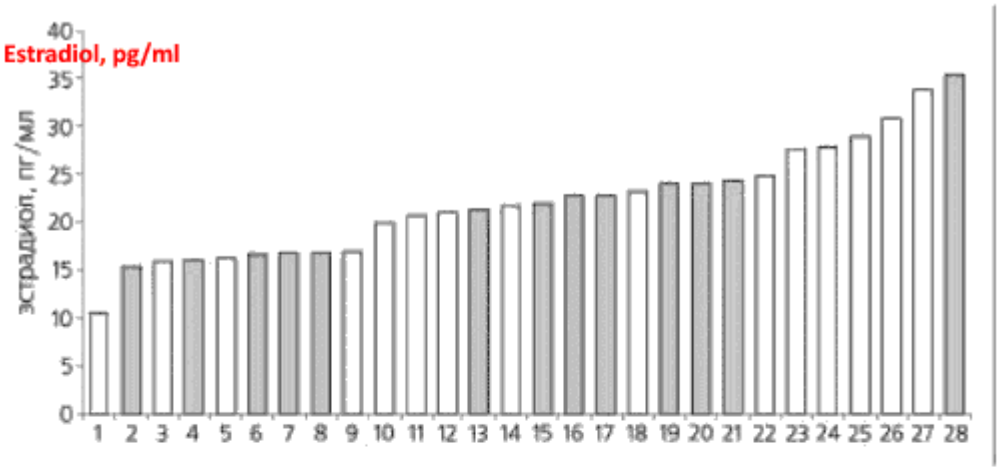
It is noteworthy that the average levels of sex steroid secretion in groups of Russian men living in different large cities remain stable (Table 1). Are there ethnic differences?

Environment and ethnic groups

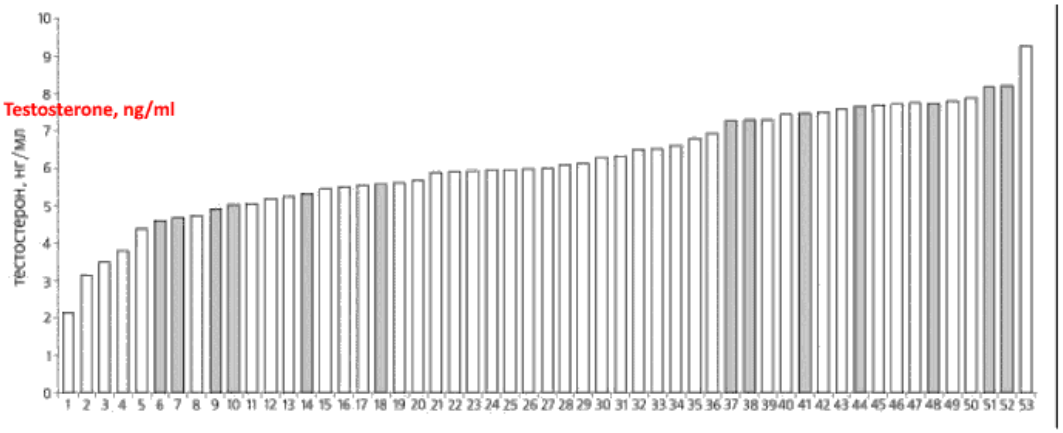
Having found out that among representatives of one ethnic group - urban Russians - the average content of sex steroids remains stable (apparently due to the similarity of a highly urbanized environment), we became interested in their levels in the population of different ethnic groups. By the time we began our analysis, the literature contained information about the concentrations of testosterone (the most active male hormone) and estradiol (the most active female hormone) in men of many ethno-territorial groups of the world. By combining literature and our own data and constructing histograms, we obtained a very interesting picture. Individual values of the level of testosterone secretion in men of reproductive age in different populations of the world range from 2.16 to 9.29 ng/ml. For residents of the temperate zone, the average statistical values of hormone concentrations turned out to be very close, regardless of the

ethnicity of the populations studied. Perhaps this similarity is due to a certain neutrality of the environment. Clear differences appear only in ethnic groups living in areas where environmental conditions are consistently extreme. Thus, among indigenous Azerbaijanis from the Karabakh highlands (more than 2000 m above sea level), the concentration of testosterone was the lowest (2.16 ± 0.2 ng/ml), slightly higher among Russian residents of the same highlands, who migrated from the central regions of Russia more than a century and a half ago (3.13 ± 0.17 ng/ml). The greatest androgenic activity was among residents of Magadan - descendants of the newcomer population in the second or third generation.

Estrogen levels in men from different world populations are also subject to change. Thus, the amount of secretion of the female sex hormone estradiol ranges from 10.47 to 33.89 pg/ml. Its lowest concentration was found among the northern people (Khanty), and the highest



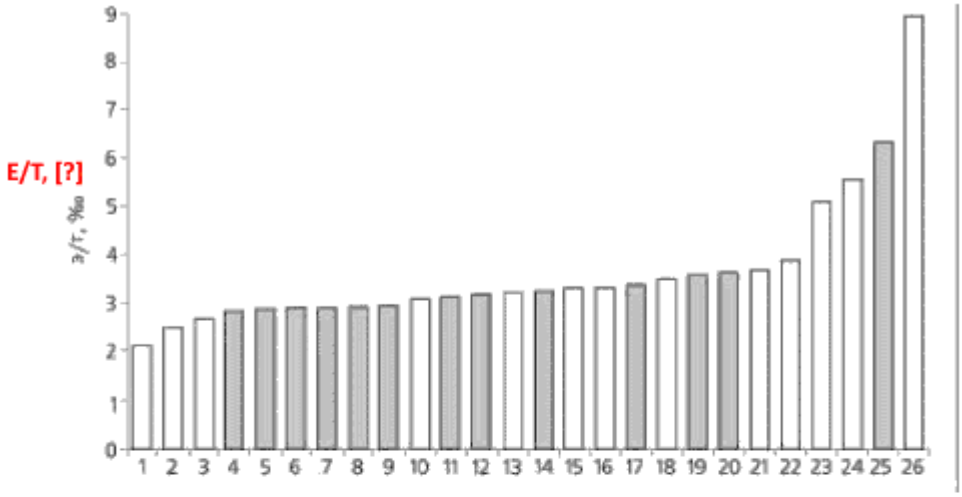
Levels of estradiol secretion in men from different ethno-territorial groups of the world. 1 - Russia, northern Khanty (Salyukov, 1991); 2 - Pamir, Pastkhuf, Tajiks (Betz, 1986); 3 – Zambia, Lusaka, Asian population (Briggs et al., 1972); 4 - Pamir, Khuf, Tajiks (Betz, 1986); 5 - Russia, Evens (Shvareva, 1993); 6 – Pamir, Jirgatal, Kyrgyz (Betz, 1986), 7 - Pamir, Murgab, Kirghiz (Betz, 1986); 8 - Pamir, Murgab, Tajiks (Betz, 1986); 9 - Germany, Munich (Pirke et al., 1973); 10 - USA, California (Kelch et al., 1972); 11 – Germany, Munich (Bidlingmaer et al., 1973); 12 - Zambia, Lusaka, European population (Briggs et al., 1972); 13 - Algeria, Annaba, Russians (Betz, 1976); 14 - Germany, Dusseldorf (Kley et al., 1980); 15 - Algeria, Annaba, Arabs (Betz, 1976); 16 - Russia, Vladivostok, Russians (Betz, 1978); 17 - Uzbekistan, Andijan, Uzbeks (Betz, 1977); 18 - Japan, Fukuoka (Muta et al., 1981); 19 - Uzbekistan, Tashkent, Uzbeks (Betz, 1978); 20 - Uzbekistan, Tashkent, Russians (Betz, 1978); 21 — Russia, Moscow, Russians (Betz, 1978); 22 - France, Paris (Guechot et al., 1988); 23 - Ukraine, Kyiv (Vorontsova, 1984); 24 - USA, Maryland (Sherins et al., 1973); 25 - Zambia, Lusaka, African population (Briggs et al., 1972); 26 - Russia, Magadan (Maksimov et al., 1995); 27 – Russia, Magadan, indigenous peoples (Bartosh et al., 1997); 28 – Russia, Novgorod region, Russians (Bets, Stepanova, 2004).
Here and in the following figures, own data is highlighted in gray.



Testosterone concentrations in men from different ethno-territorial groups of the world. 1 – Azerbaijan, Azerbaijanis (Ena et al., 1988); 2 - Azerbaijan, Russians (Ena et al., 1988); 3 – Finland, Oulu (Huhtaniemi et al., 1982); 4 - Russia, Magadan, indigenous peoples (Bartosh et al., 1997); 5 – Azerbaijan, Baku (Ibragimov et al., 1989); 6 - Pamir, Murgab, Tajiks (Betz, 1986); 7 - Pamir, Murgab, Kyrgyz (Bets, 1986); 8 - Russia, Chukchi (Polessky et al., 1980); 9 - Pamir, Jirgatal, Kirghiz (Betz, 1986); 10 - Pamir, Khuf, Tajiks (Betz, 1986); 11 - Scotland, Edinburgh (Fox et al., 1972); 12 – Zambia, Lusaka, African population (Briggs et al., 1972); 13 - Russia, Arkhangelsk region, Nenets, Komi (Sukhanov, 1991); 14 - Pamir, Pastkhuf, Tajiks (Betz, 1986); 15 - Germany, Munich (Pirke et al., 1973); 16 - USA, Maryland (Sherins et al., 1973); 17 - USA, Utah (West et al., 1973); 18 - Russia, Novgorod region, Russians (Bets, Stepanova, 2004); 19 - USA, Virginia (De Lacerda, 1973); 20 - Canada, Ontario (Clark et al., 1973); 21 - Germany, Dusseldorf (Kley et al., 1980); 22 - Hawaii, Honolulu (Furuyama et al., 1970); 23 - Japan, Fukuoka (Muta et al., 1981); 24 - USA, Michigan (Ismail et al., 1972); 25 - USA, California (Kelch et al., 1972); 26 — Japan, Hokkaido, Ainu (Okamoto et al., 1971); 27 - Russia, Arkhangelsk region, Russians (Sukhanov, 1991); 28 - Canada, Manitoba (Faiman et al., 1971); 29 - USA, Louisiana (Takahashi et al., 1983); 30 - Japan, Hokkaido, Japanese (Okamoto et al., 1971); 31 - Belgium, Ghent (Vermeulen et al., 1972); 32 - Germany, Hamburg (Horst et al., 1977); 33 - Russia, Evens (Shvareva, 1993); 34 - Bulgaria, Sofia (Maleeva, 1978); 35 - USA, Missouri (Wiest et al., 1978); 36 - Netherlands, Nijmegen (Smals et al., 1976); 37 - Russia, Vladivostok, Russians (Betz, 1978); 38 - Algeria, Annaba, Russians (Betz, 1976); 39 - Kazakhstan, Kostanay (City dweller, 1982); 40 - Belarus, Minsk (Livshits, 1977); 41 - Russia, Moscow, Russians (Betz, 1978); 42 – Zambia, Lusaka, Asian population (Briggs et al., 1972); 43 - France, Paris (Reinberg et al., 1975); 44 — Uzbekistan, Andijan, Uzbeks (Betz, 1977); 45 - France, Paris (Guechot et al., 1988); 46 - USA, Texas (Aiman et al., 1980); 47 - Sweden, Uppsala (Carstensen et al., 1973); 48 - Algeria, Annaba, Arabs (Betz, 1976); 49 - Zambia, Lusaka, European population (Briggs et al., 1972); 50 - Ukraine, Kyiv (Vorontsova, 1984); 51 - Uzbekistan, Tashkent, Uzbeks (Betz, 1978); 52 - Uzbekistan, Tashkent, Russians (Betz, 1978); 53 – Russia, Magadan, Russians (Maksimov et al., 1995).

Estrogen levels in men from different world populations are also subject to change. Thus, the amount of secretion of the female sex hormone estradiol ranges from 10.47 to 33.89 pg/ml. Its lowest concentration was found among the northern people (Khanty), and the highest - among Russian men from the Novgorod region, Magadan students who came to the city from ethnic villages, and descendants of immigrant Russians. Probably, the formation of hormonal status in Russian Magadan residents was influenced by both adaptive changes in the parental body and a complex of unfavorable factors of the northern environment, the effect of which occurred during critical periods of the formation of the endocrine system. There is another remarkable feature of the hormonal characteristics of the studied groups from Magadan: the indigenous peoples have a very low concentration of testosterone and a high level of estradiol secretion, while the Russians have increased levels of both hormones. Such changes may indicate an early hormonal imbalance.

It is necessary to say separately about the Novgorodians. We examined more than 100 practically healthy people aged from 18 to 55 years living in three districts (Volotovo, Parfinsky and Valdai) and obtained rather unusual results. The amount of testosterone secretion ranged from 1.99 to 10.85 ng/ml and, therefore, was significantly lower than in Russians from large cities,



Estradiol/testosterone index in men from different ethnic groups territorial groups of the world. 1 - Zambia, Lusaka, Asian population (Briggs et al., 1972); 2 - Russia, Evens (Shvareva, 1993); 3 - Zambia, Lusaka, European population (Briggs et al., 1972); 4 - Algeria, Annaba, Arabs (Betz, 1976); 5 - Pamir, Pastkhuf, Tajiks (Betz, 1986); 6 - Algeria, Annaba, Russians (Betz, 1976); 7 - Uzbekistan, Tashkent, Uzbeks (Betz, 1978); 8 - Uzbekistan, Tashkent, Russians (Betz, 1978); 9 - Uzbekistan, Andijan, Uzbeks (Betz, 1977); 10 – Germany, Munich (Pirke et al., 1973); 11 - Russia, Vladivostok, Russians (Betz, 1978); 12 - Pamir, Khuf, Tajiks (Betz, 1986); 13 - France, Paris (Guechot et al., 1988); 14 - Russia, Moscow, Russians (Betz, 1978); 15 – Russia, Magadan (Maksimov et al., 1995); 16 - USA, California (Kelch et al., 1972); 17 - Pamir, Jirgatal, Kyrgyz (Betz, 1986); 18 – Ukraine, Kyiv (Vorontsova, 1984); 19 - Pamir, Murgab, Kirghiz (Betz, 1986); 20 - Pamir, Murgab, Tajiks (Betz, 1986); 21 - Germany. Dusseldorf (Kley et al., 1980); 22 - Japan, Fukuoka (Muta et al., 1981); 23 - USA, Maryland (Sherins et al., 1973); 24 – Zambia, Lusaka, African population (Briggs et al., 1972); 25 – Russia, Novgorod region, Russians (Bets, Stepanova, 2004); 26 – Russia, Magadan, indigenous peoples (Bartosh et al., 1997).

and higher compared to the content of this hormone in Russian Old Believers of Azerbaijan living in an extreme environment and in isolation. The level of estradiol secretion, as just mentioned, was very high and varied from 11.58 to 52.73 pg/ml. At present, the physiological role of estrogens in the male body has not yet been sufficiently studied. Therefore, additional research is required to explain the increased estrogenization of Novgorod men. The ratio of estradiol and testosterone, i.e. The E/T index can also quantify the hormonal activity of the body. In the vast majority of cases, this ratio turned out to be stable. It seems to us that such stability is the result of biological adaptation in a complex chain of

interaction between a person and the environment. In extreme environments, the E/T index is a more sensitive indicator of the functional state of the endocrine system than the secretion value of each hormone.

In a hard-working endocrine system, adrenergic mechanisms predominate and, in accordance with this, the hormonal status changes. The nature of such shifts reflects the body's response to environmental conditions, determines the "payment for adaptation" and allows us to understand the pathogenetic mechanisms of the occurrence and course of a number of non-infectious diseases.

"Ecological portrait" of a person in the highlands

The influence of the habitat on the hormonal activity of the body, as follows from the analysis, is quite significant. But a connection with ethnic characteristics cannot be ruled out. Using two-factor analysis of variance, we assessed the share of environmental and ethnic contributions to the distribution of sex hormones. As a result, it turned out that both factors are reflected in the level of secretion of these steroids. True, the influence of the environment still has a stronger effect.

The indigenous people of the Pamirs are an example of a high and stable level of adaptability to the environment and therefore are ideally suited for our research. We assessed the content of sex steroids in Kyrgyz and Tajik people living in the mountains at altitudes of 2000, 3000 and 3640 m above sea level. (Table 2). Judging by the analyses, there are no significant differences in the concentration of androgens among Pamir men - the level of testosterone, for example, is relatively stable. Apparently, this is how adaptive resistance manifests itself in high mountain conditions, such as reduced atmospheric pressure (and its consequence - hypoxia), terrain, sudden changes in daily and seasonal temperatures, cold, dry air, intensity of solar radiation, as well as specific socio-economic and cultural factors.

The concentration of estradiol shows a noticeable tendency to increase among Tajiks and decrease among Kyrgyz people with increasing altitude of habitat. The E/T index differs between Kyrgyz and Tajiks,

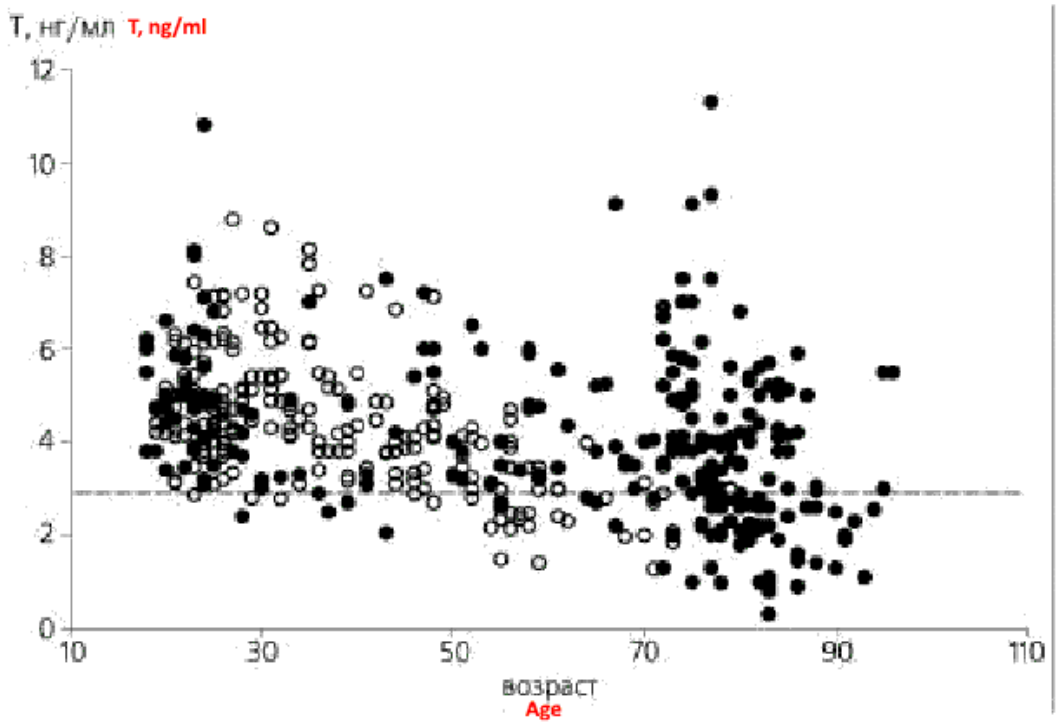
Таблица 2 Table 2

Main indicators of quantitative secretion of sex hormones among the indigenous inhabitants of the Pamirs

Основные показатели количественной секреции половых гормонов у коренных жителей Памира

Место обследования Place of examination	Этническая принадлежность Ethnicity	Тестостерон, нг/мл Testosterone, ng/ml		Эстрадиол, пг/мл Estradiol, pg/ml	
		min—max	X±S	min—max	X±S
Jirgatal 2000 m Джиргаталь, 2000 м	киргизы Kyrgyz	1.40—7.42	4.58±1.32	8.92—25.40	16.21±3.44
	киргизки Kyrgyz women	0.22—0.62	0.38±0.10	14.70—290.00	169.28±75.11
Pasthoof 2000 m Пастхуф, 2000 м	таджики Tajiks	1.97—8.77	4.34±1.38	8.70—20.80	14.58±2.95
	таджички Tajik women	0.20—0.68	0.45±0.12	10.00—272.00	160.58±69.64
Khuf 3000 m Хуф, 3000 м	таджики Tajiks	1.28—8.60	4.36±1.50	9.80—26.70	15.14±3.66
	таджички Tajik women	0.20—0.73	0.34±0.12	10.00—240.00	95.29±60.36
Murghab 3640 m Мургаб, 3640 м	киргизы Kyrgyz	1.49—8.12	4.25±1.25	7.90—24.70	15.41±4.09
	киргизки Kyrgyz women	0.22—0.70	0.32±0.12	10.00—268.50	100.93±63.36
Murghab 3640 m Мургаб, 3640 м	таджики Tajiks	2.34—7.25	4.60±1.31	9.50—20.40	16.76±3.64

Примечание. ±S — отклонение от средней величины.
Note. ±S - deviation from the average value.



Индивидуальная изменчивость уровня секреции тестостерона в мужских группах. Светлыми кружками отмечена концентрация гормона у коренных жителей Памира, темными — у мужчин других групп (Stearn E.L. et al. // Amer. J. Medic. 1974. V.57. №11. P.761—766). Пунктирная линия соответствует нижней границе нормы гормона для мужчин 45 лет.

Individual variability in testosterone secretion levels in male groups. Light circles indicate the concentration of the hormone in the indigenous inhabitants of the Pamirs, dark circles in men of other groups (Stearn E.L. et al. // Amer. J. Medic. 1974. V.57. No11. P.761-766). The dotted line corresponds to the lower limit of the hormone norm for men 45 years old.

Таблица 3 Table 3

Показатели репродуктивного потенциала в женских группах Памира Indicators of reproductive potential in female groups of the Pamirs

Место обследования Place of examination	Возраст наступления половой зрелости Age of puberty	Возраст наступления менопаузы Age at menopause	Число живых детей Number of living children	Число живых детей, % от числа беременностей Number of living children, % of the number of pregnancies	Число умерших детей Number of children who died	Число умерших детей, % от числа беременностей Number of children who died, % of the number of pregnancies	Частота выкидышей, % Miscarriage rate, %	Показатель общей плодовитости General fertility indicator
Пастхуф, 2000 м Pasthoof, 2000m	16 лет 16 years	48 лет 48 years	6.65±0.53	81.90	2.00±0.36	12.38	5.71	7.62
Хуф, 3000 м Khuf, 3000m	16 лет 11 мес 16 years 11 months	45 лет 45 years	6.66±0.54	69.50	2.36±0.28	18.13	12.36	8.39
Мургаб, 3640 м Murghab, 3640m	16 лет 2 мес 16 years 2 months	45 лет 4 мес 45 years 4 months	3.88±0.33	54.44	2.90±0.37	32.66	12.89	5.85

and in addition, depends on environmental conditions.

In general, the content of androgens and estrogens in the indigenous population of the Pamirs was significantly lower compared to the norms for residents of the plains and low mountains.

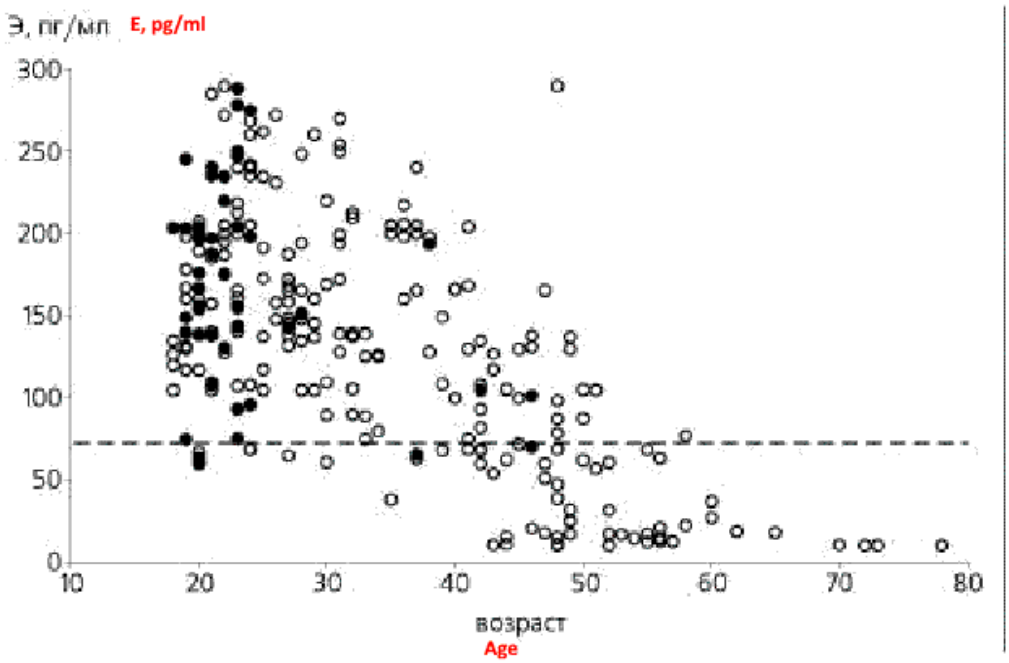
In the female groups studied, ethnic differences in the concentration of estradiol and its decrease with increasing altitude are also statistically significant. At high altitudes, natural conditions have a stronger effect than ethnicity.

For the female body, which is responsible for preserving and maintaining the population of ethnic groups, the effects of high mountain conditions are especially unfavorable (Table 3).

Girls become sexually mature 3-3.5 years later; in women, there is a tendency to reduce the age at which menopause occurs. In high mountains, infertility and miscarriages are more common than in low mountain areas, and the rate of spontaneous abortion increases with altitude. Thus, in the middle mountains (2000 m) there are 12 miscarriages for every 210 pregnancies; in the high mountains (3000 m) 45 out of 364 pregnancies are interrupted; 349 residents of the village cannot bear the same number. Murghab (3640 m).

Sex steroids are known to play an important role in the hormonal control of aging. However, the nature of age-related variability in the levels of these steroids is still interpreted ambiguously. True, it has already been established that the hormonal function of the testes decreases with age not as significantly as previously thought. Judging by the amount of testosterone in men from 18 to 97 years old, it changes little until the age of 70. Later, the level of secretion clearly decreases, but only 29% are beyond the lower limit of the concentration of the main male hormone, which is typical for 45-year-old men. Among Pamir highlanders, testosterone levels decrease by 1.5-2 times by the age of 50, which indicates an accelerated rate of aging of the body.

Women age even faster. By the age of 40, in most indigenous women, the secretion of sex hormones is reduced to subthreshold values.



Индивидуальная изменчивость уровня секреции эстрадиола у москвичек (темные кружки) и коренных жительниц Памира. Пунктиром показана нижняя граница нормы гормона.

Individual variability in the level of estradiol secretion in Muscovites (dark circles) and indigenous women of the Pamirs. The dotted line shows the lower limit of normal for the hormone.

So, among the indigenous inhabitants of the Pamirs, with age, shifts in the production of sex hormones appear, creating an unusual ratio: in men, by the age of 50, the synthesis of estrogens increases, and androgens decreases. This leads to premature age-related changes in metabolism, creates favorable conditions for the emergence and development of pathological processes, and contributes to a decrease in life expectancy.

The connection between sex hormones and physique has already been mentioned here. What do the indigenous highlanders of the Pamirs look like? Among them, there is a tendency for the predominance of chest and muscular body types, the number of men with abdominal type does not exceed 4.61%. Although the Pamir aborigines have a lower general level of secretion of sex hormones, they still combine the muscular type: the stronger the androgenization of the body, the brighter the features of this type.

Morphological variability affects primarily the shape and size of the chest, the length of the lower limbs and the width of the shoulders. All these signs are increased in highlanders. Probably, it is in them that the uniqueness of mountain conditions is most manifested. The indigenous population of the Pamirs, in the process of long-term adaptation to oxygen deficiency, adapted to energy-efficient gas exchange: a large chest provides a higher vital capacity of the lungs; due to the enlargement of the long bones of the skeleton, the bone marrow is somewhat hypertrophied, as a result of which hematopoiesis is enhanced. This is the unique “ecological portrait” of the indigenous population of the Pamirs. Its characteristic

complex of hereditarily fixed traits characterizes the “high-mountain adaptive type” described by T.N. Alekseeva.

Norm and pathology (bottom of page 8)

Sex hormones quite significantly influence a person’s physique. Among the Pamir mountaineers, as has been said, the pectoral and muscular types predominate. Are other ethnicities and plains people different? Among young Moscow men there are all body types, but there are slightly more muscular ones (Table 4). It is characterized by the highest level of testosterone secretion, average estradiol secretion and their optimal ratio. It turned out that the muscular type, associated with increased androgenization of the body, is also characteristic of 20-year-olds

Таблица 4 Table 4
Sex steroids in young men and their constitution types
Половые стероиды у молодых мужчин и типы их конституции

Тип телосложения Body type	n, %	Тестостерон, нг/мл Testosterone, ng/ml	Эстрадиол, пг/мл Estradiol, pg/ml	Эстрадиол/тестостерон, ‰ Estradiol/testosterone, %
		X±S	X±S	X±S
Chest Грудной	18	5.56±1.13	20.22±7.83	3.75±1.40
Muscular Мускульный	54	7.73±2.01	22.90±7.09	3.03±0.90
Abdominal Брюшной	16	7.50±2.20	39.38±12.29	6.00±2.67
Muscular-thoracic Мускульно-грудной	6	6.57±2.58	17.62±2.19	3.04±1.41
Muscular-abdominal Мускульно-брюшной	6	6.50±2.38	33.49±8.13	5.31±0.92

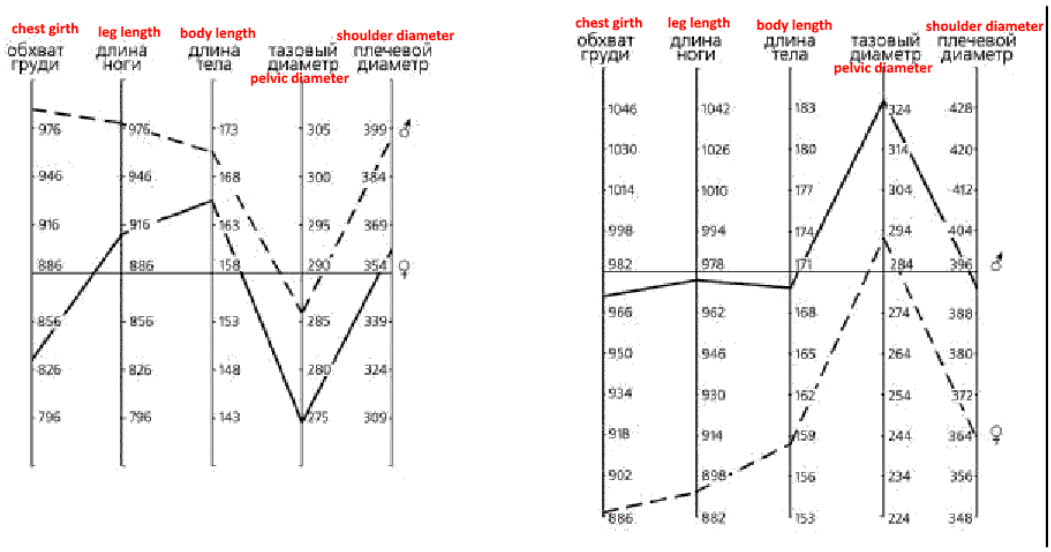
from Moscow young people and adolescents during puberty.

Among the Novgorodians, who differ from other studied groups of Russians in the ratio of sex steroids, the largest body type was 31.4%. The muscular type, which predominates among Muscovites, was only 17.14% among Novgorod residents. Over the course of about 30 years, Novgorodians (we conducted the first series of examinations in the mid-70s) became taller, their limbs became longer, and their chests increased in the transverse direction. All these are signs of dolichomorphy of proportions (relatively short and narrow body and long limbs) and general gracilization of the skeleton. What causes such changes remains to be seen.

The breast type *[tr. "chest type" ?]* is associated with a reduced level of androgens in the body, a moderate amount of estrogens and a slight increase in the E/T index. The abdominal type is characterized by the highest concentration of estrogens and decreased androgens. Estrogenization of the body (for example, with the production of estradiol) is associated with the formation of fat folds, muscle development and anteroposterior diameter of the chest; The diameter of the lower jaw and the height of the upper lip depend on the amount of the same estradiol, and the height of the nose depends on the concentration of testosterone. All this relates to the characteristics of the human constitution. It turns out that by its variability, or more precisely, by the variability of anthropometric data, one can judge pathologies, for example, transsexualism (by the way, diabetes too). The essence of this anomalous state of personality is the discrepancy between biological and civil sex and a person’s mental

perception of it.

Morphological changes during transsexualism primarily affect the signs of sexual dimorphism: in women, traits characteristic of men of the same age predominate; in men, female characteristics accumulate



Некоторые антропометрические показатели при женском (слева) и мужском транссексуализме. Пунктирная кривая на первом графике соответствует морфограмме здоровых мужчин, сплошная линия — больных женщин; на втором графике приведена пунктирная морфограмма здоровых женщин и сплошная — больных мужчин. На оси абсцисс отложены среднеарифметические значения признаков для здоровых женщин (слева) и мужчин.

Some anthropometric indicators for female (left) and male transsexualism. The dotted curve in the first graph corresponds to the morphogram of healthy men, the solid line corresponds to sick women; The second graph shows a dotted morphogram of healthy women and a solid morphogram of sick men. The arithmetic mean values of the traits for healthy women (left) and men are plotted on the x-axis.

(for example, the transverse dimensions of the pelvis increase, the shoulders narrow). It is quite natural that sex hormones make a significant contribution to the formation of the phenotype of transsexuals (Table 5). We examined their variability in individuals with female (initially female) and male (initially male) transsexualism and found that the hormonal characteristics coincide not with the biological gender, but with its mental perception by the individual. Simply put, estrogens predominated in men, and androgens in women. Such disturbances in the content of male and female sex hormones correspond to the sexual self-identification of the examined individuals, i.e. inversely altered mental gender.

The results of studies of hormonal levels in transsexualism suggest that the pathogenesis of this condition is associated with disturbances in early embryogenesis, even during the formation of the brain.

Таблица 5 Table 5

Content of sex hormones in persons with transsexualism

Содержание половых гормонов у лиц с транссексуализмом

Men's group | Women's group

Гормон Hormone	Мужская группа		Женская группа	
	МТС MTS	норма Norm	ЖТС ZhTS	норма Norm
Тестостерон, нг/мл Testosterone, ng/ml	9.90±1.71 (1.35–16.20) n = 10	7.56±2.35 (1.16–14.99) n = 188	6.29±0.96 (3.72–14.14) n = 14	0.47±0.11 (0.24–0.93) n = 50
Эстрадиол, пг/мл Estradiol, pg/ml	61.83±6.80 (45.0–89.0) n = 10	23.15±8.31 (8.20–66.00) n = 188	157.84±30.02 (50.0–348.0) n = 14	фолликулярная фаза: 60–165 follicular phase: 60-165 преовуляторный пик: 278–535 preovulatory peak: 278-535 лютеинизирующая фаза: 139–272 luteinizing phase: 139-272

Примечание. В первых строках приведены среднеарифметические величины и их отклонения, в скобках – индивидуальные (минимальные и максимальные); n – количество обследованных.

Note. The first lines show the arithmetic mean values and their deviations, in brackets - individual values (minimum and maximum); n is the number of people examined.

* * *

So, human adaptation to environmental conditions occurs with the participation of hormones. And although only sexual ones were considered here, their content and relationships provide information about the hormonal status of an individual, population and ethnic group, about the hormonal activity of the body in normal and pathological conditions, in extreme conditions of existence. Variants of the norm reflect different methods of adaptation and can serve as a basis for environmental monitoring of human health.

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