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HUMAN CHROMOSOMAL Q-HETEROCHROMATIN POLYMORPHISM AND ITS RELATION TO BODY HEAT CONDUCTIVITY

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Abstract- It is found that approximately 15-20% of non-coding part of human DNA is constitutive heterochromatin. There are two types of constitutive heterochromatin: C- and Q-heterochromatin. C-heterochromatin regions (C-HRs) are found in the genome of all higher eukaryotes, while Q-heterochromatin regions (Q-HRs) are only in the genome of three higher primates (*Homo sapiens, Pan troglodytes* and *Gorilla gorilla*). Human chromosomes possess both types of constitutive heterochromatin. In man C-heterochromatin is present in all his chromosomes, varying mainly in size, while Q-heterochromatin can only be detected on seven autosomes and the Y-chromosome. In this case individuals in a population differ from each other on the number, location, size and intensity of staining (fluorescence) of chromosomal Q-HRs. However, the question of possible biological role of chromosomal Q-HRs in human life remains open. A hypothesis that amount of Q-HRs in genome is possibly connected with human body thermal conductivity (BHC) has been proved. Results obtained show that individuals in population truly differ from each other in BHC and its level depends on the amount of chromosomal Q-HRs in human genome. The question of place and possible role of human BHC in norm and pathology is also being discussed.

Keywords- Human Chromosomal Q-Heterochromatin, Human Body Heat Conductivity, Cell Thermoregulation, Human Adaptation

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Introduction

It is found that non-genic part of human genome makes about 98% of cell nucleus DNA. Approximately 15-20% of this non-coding part of human DNA is constitutive heterochromatin [1]. There are two types of constitutive heterochromatin: C- and Q-heterochromatin. Human chromosomes possess two types of constitutive heterochromatin: C- and Q-heterochromatin [2-7]. In man C-heterochromatin is present in all of his chromosomes, varying mainly in size, while Q-heterochromatin can only be detected on seven autosomes and the Y-chromosome [7,8]. Chromosomal C-heterochromatin regions (C-HRs) are found in the genome of all higher eukaryotes, while Q-heterochromatin regions (Q-HRs) are only in the genome of three higher primates (*Homo sapiens, Pan troglodytes* and *Gorilla gorilla*) [2,3]. However, there is a fundamental difference between them: quantitative variability of chromosomal Q-HRs in the genome exists only in human populations [7,8].

Chromosomal Q-HRs is distributed in human genome not accidentally. Specifically: a) The amount of chromosomal Q-HRs in human population genome depends on climate and geographical conditions of permanent residence and not their ethnic and racial peculiarities.

The largest amount of chromosomal Q-HRs is found in the genome of populations living in low altitude subequatorial Africa and India, and the least - in Northern Siberia aborigines, as well as indigenous people of Tien-Shan and Pamir high altitudes and Ethiopian upland [9-15]; b) Individuals capable of successfully adapting themselves to the extreme high-altitude climate (e.g. mountaineers) and newcomers of the Far North (e.g. oil industry workers of the Jamal peninsula of polar Eastern Siberia) are characterized by extremely low amounts of QHRs in their genome [16,17]; c) The amount of Q-HRs per individual in a population is greatest in newborns than in older age groups [18,19] despite the fact that the number, location and size of Q-HRs do not change in ontogenesis; d) The amount of chromosomal Q-HRs appeared to be the highest in infants died at first weeks, months or years of their lives [20]. These data show that there is some connection between the amount of Q-heterochromatin in human genome and his adaptability to some physical environmental conditions.

It is generally considered that the human is well adapted to hot climate. Probably this is connected with the fact that the human as a biological species developed in tropical climate of East Africa. Nevertheless he managed to populate cold Earth areas including circumpolar zone of Northern Hemisphere, as well as high altitudes. Some morphophysiological adaptive characteristics of organisms of North and high altitude aborigines are clarified. But the finest biological, including genetic mechanisms of human adaptation are still

unknown. At present, the search of genetic basis of human adaptation to extreme environmental conditions is mainly conducted in high altitude populations. But perennial studies for hypothetical structural genes facilitating human adaptation to hypoxia in genome of high altitudes population did not bring any positive results. Anyway, researches in this direction are still being carried out in all mountain provinces, from the Tibet to the Andes [21,22,24]. Our own experience in search for genetic basis of human adaptation to Northern Siberia, as well as the Pamir and the Tien-Shan high altitudes showing that the human, at the process of genetic adaptation to the cold probably used non-genic part of his genome [1-14,16,17,19,20,23]. Despite the fact that chromosomal HRs has been studied since the 20s of the past century, its biological role remains unclear on the whole. This circumstance is also reflected in variety of hypothesis, none of which is supported with necessary experimental data (for details see: [1,28-35]). Moreover, all these hypotheses generally refer to C-HRs, but not to Q-HRs.Since human chromosomal C- and Q-HRs have no structural genes, the traditional "genotype → phenotype" approach is unacceptable in this case. To search a way out of the situation, we came back to the hypothesis of cell thermoregulation (CT) [36,37]. CT is the process of equalization of temperature difference between cytoplasm and nucleus and finally inside of the whole cell. Structural basis of CT is peripheral layer of condensed chromatin (CC) which is chromosomal C- and Q-HRs. We assume that thermal energy transfer between the cytoplasm and the nucleus is carried out through this dense layer of peripheral CC, located inside of the nuclear envelope.

Certainly, CT hypothesis should be checked *in vivo* on the cell level. But we have not had such opportunity till present. Nevertheless, we have checked this hypothesis on the level of human organism assuming that CT is the basis for heat conductivity of whole cell part of body [38,39]. These researches showed that in fact there are differences in the body heat conductivity (BHC) between individuals in population. In particular, we were able to show that individuals in a population significantly differ from each other in terms of BHC level. It was found that the level of BHC is affected by sex, age and climate and geographical features of the individual's place of origin. However, the level of BHC is not affected by weight, height, values of arterial pressure, pulse rate and respiration [38,39]. In other words, there are some parallels in the distribution of the amount of chromosomal Q-HRs and variability of BHC at the level of human populations. Therefore it became necessary to test the hypothesis; whether there is a connection between the number of chromosomal Q-HRs in the human genome and its level of BHC?

But some questions still remain unsolved including methodical ones in studying the human BHC variability. In particular, it is still not possible to develop a method to accurately measure the BHC of human, as it is done on homogeneous non-living objects by thermal physicists. Existing methods, at best, only allow assessing the level of human BHC [39]. This work presents new data on human BHC variability obtained by using more advanced methods.

Materials and Methods

Object of the given study was a sample of girls (n = 136) aged 17-22. Selecting only female individuals was due to the fact that karyotype of males has Y chromosome, which contains the largest block of Q- heterochromatin in human genome. Moreover, the Y chromosome differs in its broad interindividual and interpopulation variability on the size of Q-heterochromatin band [7,8].

Chromosomal preparations were made using short-term cultures of peripheral blood lymphocytes. The cultures were processed according to slightly modified [40] conventional methods [41]. The dye used was quinacrine mustard. The calculation and registration of chromosomal Q-HRs variants performed using the criteria and methods described in detail elsewhere [12,16].

The following quantitative characteristics of chromosomal Q-HRs variability were used:

1. The distribution of individuals according to the number of Q-HRs in their karyotype in population (distribution of the number of Q-HRs);

2. The derivative of this distribution, an important population characteristic, is the mean number of Q-HRs per individual;

BHC estimation of individuals was conducted indoors at a temperature of 20ºC - 22ºC.

The researches were being carried out not earlier than in two hours after having a meal. At first the individual's oral cavity and palms temperatures were measured. Temperatures of the palm were measured using a pyrometer for non-contact temperature measurement of the human body (electronic medical infrared thermometer F -1000, B.Well, UK). A medical electronic thermometer WT-03 of the same company was used to measure the temperature of the oral cavity.

Measuring the left palm temperature was necessary for preparation of 'hot' water to determine heat conductivity of body by calorimetric method. 'Hot' water was prepared by adding of number nine to the thermometer reading. For instance, if an individual's palm temperature was 31.0ºC, then 'hot' water temperature for his hand should be 40.0ºC. Measuring the left palm temperature was necessary for preparation of 'hot' water to determine thermal conductivity of body by calorimetric method. 'Hot' water was prepared by adding of number nine to the thermometer reading. For instance, if an individual's palm temperature was 31.0ºC, then 'hot' water temperature for his hand should be 40.0ºC. 'Hot' water was prepared to create a thermal gradient between the left hand and its surrounding. We also tried to hold this gradient the same for all surveyed individuals (9.0 °C).

The examinee sits down on a chair with his body upright, head is raised, and hands hang down naturally on both sides of his body and muscles are relaxed. Then the examinee plunges slowly his left hand up to the wrist in everyday food vacuum flask (volume 5.0 liter) placed against shin and filled with 'hot' water. Soon after a hand plunge into the flask up to the wrist the water surface was covered with tea spoonful of refined vegetable oil to decrease evaporation. Any other additional measures of protection from the air temperature of the room where the experiment was taking place were not taken. During the heat conductivity measuring which takes 20 minutes, the individual under test should not divert his attention away, keep the hand in water and not press it against the flask walls.

Throughout the whole thermal load the right palm temperatures were minutely measured alternately with ten pyrometers, as this device gives the correct indication only after 5-10 minute rest. Measuring the right palm temperature was necessary for determining the amount and rate of thermal energy passed from the wrist of left hand to the wrist of right hand.

The distribution of the numbers and mean number of Q-HR per individual in samples were compared using the Student *t*-test.

Results

The aim of this work was to look for a possible link between the amount of Q-HRs in the genome and human BHC, that is, whether a random set of chromosomal Q-HR in the human genome can determine the level of conductivity of his body? If the determining the amount of chromosomal Q-HRs in the human genome is a well-established procedure, the same cannot be said about assessing human BHC due to the complete lack of any experience in this regard.

It is still early to determine the thermal conductivity of the human body with accuracy, unlike what thermal physicist do with metal. At best, we can hope for a rough estimate of the level of human BHC: high, medium and low. Our own experience has shown that the evaluation of human BHC requires only some parts and not the whole body [38,39]. Through trial and error we have identified areas of the body and the thermal load mode, which allows to roughly estimating the level of human BHC. Our experience has shown that the most informative are (in descending order): a) the time the peak temperature takes place on the surface of the right palm during a thermal load; b) temperature (*T*) difference between the surface of the right palm and the oral cavity before the thermal load; c) *T* amount of the right palm the moment the peak temperature occurs and d) *T* of the right palm at rest. Magnitude of values of *T* decrease of water in flasks and changes of *T* in the oral cavity during the thermal load were the least informative (these data are not presented here). Temperature of the left palm was used only for the preparation of 'hot' water for each individual, as it could not be directly measured in the experiment.

[Table-1] shows the relationship between the number of chromosomal Q-HRs in the human genome and the rate of reaction of the body to the controlled thermal load, which was determined by the time (in minutes) of occurrence of the peak temperature on the surface of the right palm.

Table 1- Distribution of the numbers and mean number of chromosomal Q-HRs and time of occurrence of the peak temperature on the surface of the right palm.

Number of Q-HR	1 to 5 minutes (n = 34)	6 to 10 minutes (n = 75)	11 minutes and over (n = 27)	Total (n = 136)
	I	II	III	
2		14	5	19
3	2	12	9	23
4	5	29	8	42
5	14	7	4	25
6	8	3	1	12
7	3	7		10
8	2	3		5
Total	181	306	95	582
Mean number	5.32 ± 0.206	4.08 ± 0.189	3.51 ± 0.209	4.28
	$t_{I, II}$ = 3.975; df = 107; P =<0.001;*			
Statistics	$t_{II, III}$ = 1.656; df = 100; P =0.101;			
	$t_{I, III}$ = 6.083; df = 59; P =<0.001;*			

*these differences are statistically significant.

As it can be seen from [Table-1], there is a statistically significant relation between the number of chromosomal Q-HRs in the human genome and the reaction of the body to the controlled thermal load. Individuals, the genome of which contain more than the average in the population chromosomal Q-HRs, the peak temperature occurs in the first five minutes of the thermal load, and vice versa.

Relationship between the amount of chromosomal Q-HRs and the temperature difference between the surfaces of the right palm and the oral cavity at rest is shown in [Table-2].

Table 2- Distribution of the numbers and mean number of chromosomal Q-HRs and the temperature difference between the surfaces of the right palm and the oral cavity.

Number of Q-HR	0.1°C to 1.0°C (n = 32)	1.0°C to 2.0°C (n = 71)	2.1°C to 3.0°C (n = 33)	Total (n = 136)
	I	II	III	
2		10	9	19
3		12	11	23
4	9	26	7	42
5	9	14	2	25
6	7	4	1	12
7	5	3	2	10
8	2	2	1	5
Total	174	291	117	582
Mean number	5.44 ± 0.220	4.10 ± 0.168	3.54 ± 0.275	4.28
	$t_{I, II}$ = 4.607; df = 101; P =<0.001;*			
Statistics	$t_{II, III}$ = 1.786; df = 102; P = 0.077;			
	$t_{I, III}$ = 5.349; df = 63; P =<0.001;*			

*these differences are statistically significant.

As we see in [Table-2], the more the chromosomal Q-HRs in the human genome, the smaller the *T* difference between the oral cavity and the surface of the right palm, and vice versa.

[Table-3] shows the relationship between the number of chromosomal Q-HRs in the genome and the amount of *T* of the right palm at the moment of peak temperature occurrence during the controlled thermal load.

Table 3- Distribution of the numbers and mean number of chromosomal Q-HRs and temperature amount of the right palm at the moment the peak temperature occurrence.

Number of Q-HR	0.1 °C to 1.0 °C (n = 43)	1.0 °C to 2.0 °C (n = 65)	2.1 °C to 3.0 °C (n = 28)	Total (n = 136)
	I	II	III	
2		10	9	19
3	4	10	9	23
4	6	31	5	42
5	10	10	5	25
6	12			12
7	6	4		10
8	5			5
Total	240	252	90	582
Mean number	5.58 ± 0.198	3.87 ± 0.151	3.21 ± 0.208	4.28
	$t_{I, II}$ = 6.591; df = 106; P =<0.001*			
Statistics	$t_{II, III}$ = 2.474; df = 91; P = 0.015*			
	$t_{I, III}$ = 7.356; df = 69; P =<0.001*			

*these differences are statistically significant.

As shown in the [Table-3], there is a statistically significant relation between the number of chromosomal Q-HRs and the value of *T* of the right palm at the moment of peak temperature occurrence, namely, in individuals with a great number of Q-HRs in the genome *T* of the surface of the right palm rises less, and vice versa.

[Table-4] shows a different pattern: the more the number of chromosomal Q-HRs in the human genome, the higher the *T* of the surface of the right palm at rest, and vice versa.

Table 4- Distribution of the numbers and mean number of chromosomal Q-HRs and the temperature of the surface of the right palm.

Number of Q-HR	Below 35.0 °C (n = 36)	35.1°C to 36.0°C (n =74)	36.1°C and over (n = 26)	Total (n = 136)
	I	II	III	
2	5	14		19
3	6	17		23
4	16	23	3	42
5	7	7	11	25
6	2	5	5	12
7		6	4	10
8		2	3	5
Total	139	294	149	582
Mean number	3.86 ± 0.179	3.97 ± 0.185	5.73 ± 0.239	4.28
Statistics	t I, II = 0.380; df = 108; P = 0.704;			
	t II, III = 5.111; df = 98; P = <0.001*			
	t I,III = 6.395; df = 60; P = <0.001*			

*these differences are statistically significant.

How do we interpret the data? We believe that the time of occurrence of the peak temperature on the right palm reflects the rate of conductivity, while the value of *T* of the right palm surface at that moment seems to reflect the quantity of thermal energy in the individual's body. If the peak temperature on the surface of the palm occurs in the first five minutes after the thermal load, then such an individual is considered as a person with high BHC, and vice versa. In other words, we believe that a person with high BHC conducts heat through the body quicker and eliminate its excessive quantity through body shell quicker as well to maintain a constant level of inner body temperature.

Statistically significant relation between the number of chromosomal Q-HRs in the genome and the *T* difference between the oral cavity and the right palm at rest may also characterize the heat conducting ability of the human body, the smaller the *T* difference, the higher the BHC, and vice versa. We believe that the smaller *T* difference between the oral cavity and the palm reflects the high thermal conductivity ability of the body, in a sense that such an organism equalizes the *T* difference between the different parts of the body more effectively, thereby successfully avoiding overheating of the organism in hot conditions.

Temperature of the right palm at rest, presumably, also reflects the level of BHC; individuals with high *T* of palm may have higher BHC, and vice versa.

Discussion

Substantiation of the Chosen Approach of an Estimation of Heat Conductivity of a Human Body

It is known that of all physical environmental factors able to influence life, temperature is the most substantial. Role of temperature in biological life is obvious. And its highest form, mammals are able to maintain relatively permanent body temperature keeping high level of metabolism.

As is known, the heat conductivity caused by transfer of energy is one of the three phenomena of transfer existing in the Nature. From the point of view of physicists, heat conductivity (HC) is a transfer of energy from more heated sites of a body to less heated ones as a result of thermal movement and interaction of micro articles. HC leads to equalization of body temperature. All substances possess with HC: gases, liquids and solid bodies. The convection is impossible in solid bodies unlike gases and liquids; therefore transfer of heat is carried out only by heat conductivity.

Virtually, there is nothing new in the idea that the body of the human should possess some heat conductivity. Nevertheless, it (heat conductivity) has not drawn the attention of nor physicists, neither physiologists for the present as the important physical characteristic of a human body. Apparently, it is connected with known physical heterogeneity (in sense, density) of a human body. Besides, direct heat transfer (conduction) has rather small value at redistribution of heat in an organism since the majority of tissues badly conduct heat. Probably that's why, we did not manage to find in the literature not only a special method, but even any attempt to estimate BHC of alive organisms *in vivo* [38,39]. On the other hand, basic elements of organ-based physiological thermoregulation are well-known and now scientists' efforts are directed for research of their complex interactions on cellular and molecular levels (reviewed in: [42]).

In thermo physics, measurement of heat conductivity of solid bodies (f.e. metal) is carried out by determination of heat conductivity coefficient by a calorimetric method. Transfer of heat occurs through a metal rod, the ends of which are placed in a calorimeter with the water taken at temperatures *T1* and *T2* (*T1* > *T2*). It is necessary estimation of HC, where decrease of temperature to determine quantity of heat and time transferred through experiment to measure the heat conductivity coefficient of the given metal rod. It is obvious that direct transfer of a method of measurement of the heat conductivity, applied in thermo physics is unacceptable to a human body both for technical and ethical reasons. However we have tried to approximate to the decision of this problem indirectly, by an estimation of part of a human body. For this purpose, we had to modify the standard technique of physicists so that it was acceptable to the human.

Why we have chosen such approach? As is known inorganic and organic bodies have different mechanisms of equalization of temperature (*T*): in the first case it is carried out through HC, in the second, besides HC, liquids circulating on all body (blood, lymph, saps) participate. It is obvious that wide variability of BHC, found out by us, in human population cannot be connected with *T* of blood, because its *T* is under the strict control of the central (hypothalamus) organ based system of physiological thermoregulation. Therefore, in our opinion it was highly probable that the possible reason of differences of individuals in heat conductivity of their bodies in a population could be any other physical factor. Under the latter (the physical factor), we meant human body heat conductivity [38,39]. However the problem lies in an objective estimation of human body heat conductivity. As the direct transfer of the method generally accepted in thermo physics turned out unacceptable, we had to adapt it for human body, maintaining its main principle (a temperature gradient).

Since the literature does not have a special method for measuring human BHC, we could only use the method of trial and error to find the areas of the body, which at least allow to roughly estimating the transfer of thermal energy from environment into body and from one body part to another. For example, hand is selected from ethical and technical considerations (see more [38,39]).

In order to estimate the rate of thermal energy conductivity through

the body and its quantity in the human body, we resorted to measuring the surface temperature of the right palm during the thermal load. Our expectations were met; indeed, throughout the experiment, the temperature of the right palm rose to a certain value (peak temperature) and then began to fall, though differently in different individuals. Therefore, we judged the level of the BHC by the time of the occurrence of the peak temperature: if the temperature peak occurred in the first five minutes from the start of the thermal load, then such an individual was considered as a person with high BHC, and vice versa. The quantity of heat in the human body was judged by the value of *T* on the surface of the right palm at the moment of peak temperature. The *T* difference between the surface of the right palm and the oral cavity at rest, apparently, also reflects the ability of thermal conductivity of a human body, the smaller the *T* difference between the palm and the oral cavity, the greater the BHC of the given individual, and vice versa.

Our data on the temperature difference between the oral cavity and the palm could explain the data obtained in other research programs. Thus, the average difference between the oral and axillary temperatures of Indian children aged 6 - 12 was found to be only 0.1 °C (standard deviation 0.2 °C) [52] and the mean difference in Maltese children aged 4 - 14 between oral and axillary temperature was 0.56 °C [53]. These observations do not yet have a rational explanation. As part of our hypothesis (of a possible link between the number of Q-HRs and level of human BHC) these data could be explained by the fact that the amount of chromosomal Q-HRs in the genome of populations of India is significantly greater than that of the inhabitants of Europe [14,15]. We have also demonstrated that the natives of India are characterized by high levels of BHC, compared with the indigenous people of Central Asia [39]. Indian peninsula is known for it hot climate, where the maintenance of temperature homeostasis pose serious stresses for human body. Assuming our hypothesis - the larger the number of chromosomal Q-HRs, the higher the heat-conducting ability of the human body - the low *T* difference between the oral cavity and armpit among Indian children could be explained by the presumed selective value of the amount of Q-heterochromatin in human adaptation to hot climate (see more [35]). This, in turn, means that the body of Indian children has higher thermal conductivity than their Maltese counterparts, allowing them to better eliminate excess thermal energy to the environment and more effectively maintain the *T* difference between the different parts of the body.

Measuring the temperature of the oral cavity, we tried to learn core temperature change in the human body in the course of our experiment. It turned out that the temperature of the oral cavity does not change significantly. This may indicate that the mechanisms of physiological thermoregulation of human are developed enough so the thermal load equal to ours cannot significantly influence on the level of its core temperature.

And finally, is it possible to evaluate BHC of human without determining the number of chromosomal Q-HRs in the genome? We believe that this is possible. For this it is necessary to know: a) the time of occurrence of peak temperature in the controlled thermal load, b) value of *T* on the surface of the right palm at the moment of occurrence of peak temperature, c) the difference of *T* between the oral cavity and the surface of the right palm at rest, and d) *T* of the surface of the right palm at rest. If the peak temperature occurs in the first five minutes after a thermal load and at the same time the value of *T* of the surface of his right palm and the difference of *T* between the oral cavity and the right palm does not exceed 1.0°C, and *T* of the surface of the right palm at rest is above 36.0°C, then it is possible to expect that such a person will have high BHC, and vice versa.

Possible Role of BHC in Human Adaptation to Various Temperature Conditions

Unlike many animal species, man is unstable to live in an extreme cold environment. He is basically a tropical homoeothermic. However, due to various reasons, human populations have to live under conditions of low or high environmental temperature *(T)* where maintaining the temperature homeostasis is especially difficult. Naturally, all three effectors of thermoregulation systems mobilize: heat production, heat loss and thermoregulatory behavior. Though being important, they cannot be effective at long-term perspective. We suppose that *H. sapiens,* besides those inherent in all mammals possesses an additional but very fine and simple mechanism of thermoregulation. In the present case, in order to preserve temperature homeostasis under different environmental conditions, in addition to physiological, behavioral and biochemical mechanisms such as wide intra population variability by BHC was used. Possibly, for the *H. sapiens,* BHC diversity is necessary because no single genotype can possess a superior adaptadness in all environments.

On the whole, we see efforts for maintaining temperature homeostasis under conditions different from climate of the Eastern Africa as follows: 1) an individual with less chromosomal Q-HRs in the North maintain more effectively temperature homeostasis in organism because of low BHC, permitting to preserve additional amount of produced heat in organism longer and slow down the body cooling rate from external cold; 2) an individual with high BHC in the North, constantly loosing additional amount of metabolic heat through conduction which is necessary for organism in terms of cold climate and exposing to relatively fast cooling because of cold, has to produce larger amount of heat and/or consume more high-calorie food for heat production, which is not always simple and healthy; 3) an individual with low BHC in the South (where environment temperature is higher than body temperature) besides his own internal heat production receives additional heat from environment by means of conduction, which, as it is known, is not used in useful physiological work. That is why these individuals' bodies overheat faster and they have to return heat surplus (through sweating, polypnoe, forced rest, behavioral reactions and etc.) to environment at the cost of significant decrease of physical and mental activities that finally negatively influences on their adaptation to hot climate; 4) an individual with big amount of Q-HRs in genome in the South having body with high thermal conductivity perhaps adapts better to high temperature of environment, more effectively leveling temperature differences in different parts of the body and faster directing surplus heat flow from organism to environment, including the way of heat radiation.

Taking into consideration the mentioned all above, it can be explained why the amount of chromosomal Q-HRs is greater in the genome of newborns, then in senior age groups [18,19], and the same chromosomal material is found in greater quantity in the genomes of infants died during first weeks, months, and years of their life [20]. Prevalence of people with lesser quantity of Q-HRs in the genome in senior people groups may be connected with negative selection of individuals with greater amount of chromosomal Q-HRs during first years of their life. As it is well-known, infants' ratio of body surface to body capacity is higher than adults' ratio. When one

more physical factor (high BHC) superimposes on this, then these infants are more vulnerable to colds and their consequences.

Which of the existing biological phenomena could underlie of wide human BHC variability in population? First thing that comes to our mind is, of course, basal metabolic rate, which is well-known from the courses of physiology. But it is known that the core temperature of those living in the tropics is within a similar range to those dwelling in the Arctic regions. Apart from that, basal metabolic rate is influenced by such factors as height, weight, body constitution, pulse rate and environmental temperature, which contradicts our data [38,39].

As of possible genetic factors the most appropriate is the amount of chromosomal Q-heterochromatin in human genome. Certainly, the thickness of peripheral layer of CC around cellular nucleus depends on total amount of chromosomal C-heterochromatin in the genome. But as we suppose, packaging density (compactization) of CC itself is basically connected with the amount of chromosomal Q-heterochromatin. The point is that human populations do not differ significantly in the quantity of C-heterochromatin in their genome [27,43]. Wide quantitative variability at the level of populations is found only in the amount of Q-heterochromatin. Some quantity regularities in distribution of chromosomal Q- heterochromatin in population depending sex, age and peculiarities of permanent place residence are determined [9-11,15,18,26,28,44-51]. It is notable, that these regularities turned out to be very similar to the wide BHC variability in population [38,39]. To be exact, apparently, human BHC depends mainly on the amount of chromosomal Q-heterochromatin in his genome. As the amount of chromosomal heterochromatin does not change in ontogenesis, it is possible that the level of BHC may be a constitutional character, the same as the color of skin, eye shape, body constitution, height and other innate physical human peculiarities.

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