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Research Article

Human Body Heat Conductivity and Obesity: Cell Thermoregulation as A Modulator of Energy Balance.

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Abstract

Extensive data has been gathered on the role of global warming in the development of obesity [FASEB BioAdvances. 2025;7:e1487]. The role of global warming is considered in the light of core body temperature (CBT) regulation, assuming that 'CBT thermogenic regulation plays a crucial role in heat management through convection, radiation, and conduction processes to remove heat from the body'. It is time to analyze the concept of CBT in more depth, namely, what it represents and where it originated. We believe that the answer to these questions should be sought at the cellular level, whose normal functioning also depends on maintaining a relatively constant temperature. If at the level of CBT heat management is carried out through convection, radiation, and conduction processes, then at the cellular level temperature regulation is implemented only through conduction processes to remove heat from the nucleus to the cytoplasm and further into the intercellular space (cell thermoregulation). CBT reveals the temperature near major organs of the body, such as the heart, viscera, and brain, although in essence it reflects the temperature of the intercellular fluid circulating around these organs, rather than the temperature inside the cells. The temperature of the circulating fluid is a byproduct of cellular metabolism, inevitably accompanied by heat release, the excess of which must be dissipated outside the body (physiological thermoregulation). Cell thermoregulation is not carried out through physiological thermoregulation systems, as cells, with rare exceptions (endothelial cells lining the inner walls of blood vessels) do not directly contact circulation system. Therefore, the process of removing heat from the cell nucleus, which is always at a higher temperature than the cytoplasm, occurs only through heat conduction via the dense layer of condensed chromatin around the cell nucleus, representing chromosomal heterochromatic regions. The latest is inherited and does not change in ontogenesis, and for this reason cell thermoregulation is a physical, not a regulated physiological process. We believe that CBT is the physiological regulation of the temperature of circulating fluid (blood) in the body, while cell thermoregulation is the physical regulation of temperature within cells, forming the material basis of body heat conductivity. Therefore, their roles in the development of obesity in the context of global warming should be considered together.

Keywords: core body temperature; obesity; human body heat conductivity; cell thermoregulation; condensed chromatin; heterochromatin

Perspectives:

The article titled 'Global warming and obesity: External heat exposure as a modulator of energy balance', [FASEB BioAdvances. 2025;7:e1487] [1], has left a deep impression on us, and we decided to write the Perspectives confirming our complete agreement with some clarifications, drawing attention to:

1. As is known, core body temperature (CBT) refers to the temperature of the organs within the cranial, thoracic, and abdominal cavities in a healthy individual, which is typically maintained within a range of 35-37.5 °C. Essentially, CBT reveals the temperature of circulating blood near major organs of the body, such as the heart, viscera, and brain, and not the temperature inside the cells. CBT is the result of the work of an organ-based physiological system (the hypothalamus, the sweat glands, the skin, and the circulatory system) designed to regulate blood temperature (physiological thermoregulation) [2].
2. Cell thermoregulation (CT) is a physical process designed to equalize the temperature difference between the nucleus and the

cytoplasm, and it is implemented based on the second law of thermodynamics. Since the temperature of the nucleus is always higher than that of the cytoplasm, the cell uses a dense layer of condensed chromatin around the nucleus as a thermal conductor to release excess metabolic heat into the intercellular space, and further into the circulation system [3,4,5].

3. The material basis of CT is a dense layer of condensed chromatin (CC) around the nucleus, which consists of chromosomal heterochromatin regions (HR), representing the highest forms of organization of non-coding, short, highly repetitive sequences of nucleotides, also known as 'redundant' DNA. The layer of CC around the nucleus is the densest and, accordingly, the most heat conductive structure in the interphase cell. It has been established that the packing density (compactization) of CC depends on the number of chromosomal HRs and determines the level of human body heat conductivity (BHC) [4-6].
4. BHC refers to the body's ability to effectively equalize the temperature difference between different parts of the organism: the higher the BHC, the faster the temperature differences are equalized. It has been established that individuals in the population differ in their BHC [4-7].
5. It has been shown that there is a direct relationship between the number of chromosomal HRs and the level of human BHC: the more HRs in the genome, the higher the level of his BHC. In other words, BHC is a phenotypic manifestation of CT, allowing for an indirect assessment of the heat-dissipating (heat-removing) ability of the cells of this individual [2,4,5,7].
6. The mechanisms of removing heat from the body and cells are represented differently. The first process is well studied and is known as physiological thermoregulation. The mechanisms for equalizing the temperature difference between different parts of the cells (for example, between the nucleus and cytoplasm) and for removing excess heat from the cell are poorly understood, although it is clear that they represent physical processes based on the second law of thermodynamics (for details see [2,8].
7. The relationship between CBT and BHC should be regarded as a fundamental aspect of human physiology. However, they may react differently to global warming. In the article authors are analyzing, the role of global warming is considered in light of core body temperature (CBT) regulation, assuming that 'CBT thermogenic regulation plays a crucial role in heat management through convection, radiation, and conduction processes to remove heat from the body.' However, how individuals with different BHC may respond to global warming is still not the subject of targeted research [2,9].
8. The reactions of individuals with different BHC to cold and hot climates are well studied. The existence of individuals in a population with different BHC allowed for a human to adapt to different temperature conditions because: a) people with high BHC tolerate heat better due to their ability to effectively dissipate excess thermal energy into the environment; b) individuals with low BHC are better cope with the cold because of their ability to better retain heat in the body [10-15].
9. The mechanisms of physiological thermoregulation that are common to all humans are realized under different physical conditions. Individuals in a population differ from each other not in physiology, but in the physics of thermoregulation, specifically in the level of human BHC. This distinction is one of the fundamental characteristics of humans. Perhaps it is this circumstance that has enabled modern humans to inhabit all climatic conditions of the Earth, including extremes such as the Far North and high altitudes [5,6].
10. It has been shown that individuals with low BHC are predisposed to the development of alimentary obesity (AO). AO are individuals in whose cells chromosomal HRs are unable to form a sufficiently dense layer of CC around the nucleus to remove excess heat in a timely manner. This means that such individuals become unable to efficiently eliminate excess metabolic heat outside the body. There will always be excess energy in the body of such individuals, which over time can lead to the accumulation and deposition of fat cells [16,17].
11. This review emphasizes that: 'In obesity research, the importance of CBT regulation is often neglected. CBT thermogenic regulation, however, plays a crucial role in heat management through convection, radiation, and conduction processes to remove heat from the body, as well as metabolic processes that sequester heat through lipogenesis'. We, for our part, believe that in obesity research, the human BHC, as a new, previously unknown type of hereditary variability, should take its rightful place.

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