

The city of Yakutsk: a case of study for human brown adipose tissue in extremely cold conditions

Ilenia Severi¹, Tomskii Mikhail Innokentevich², Tikhonov Dmitrii Gavrilievich³, Loskutova Kiunniai Savvichna⁴, Isakov Evgeny Andreevich⁴, Antonio Giordano¹, Rosaria Gesuita⁵, Saverio Cinti¹

¹ Università Politecnica delle Marche, Dipartimento di Medicina Sperimentale e Clinica, Università, Ancona, Italy

- ² Yakut Scientific Center of Comprehensive Medical Problems, Siberian Department of the Russian Academy of Medical Sciences, Hospital, Yakutsk, Russia - ³ Research Institute of Health, the North-Eastern Federal University named after M.K. Ammosov, University, Yakutsk, Russia - ⁴ Republican Hospital № 1 National Center of Medicine of the Ministry of Health of the Republic of Sakha (Yakutia), Hospital, Yakutsk, Russia - ⁵ Università Politecnica delle Marche, Dipartimento di Scienze Biomediche e Sanità Pubblica, Università, Ancona, Italy

The discovery of the presence of functional brown adipose tissue (BAT) also in healthy humans [1-3] has focused the attention of the scientific community on the possibility to expand body BAT content as a therapeutic strategy for the treatment and prevention of obesity and the associated metabolic disorders. Indeed, white-to-brown adipocyte transdifferentiation, leading to “browning” of the adipose organ, has been shown to reduce body weight and improve metabolic parameters in obese and insulin-resistant animal models. BAT from subject exposed daily to extremely cold outdoor temperatures has never been studied through morphological techniques. In this context, an exciting case of study are the citizens of Yakutsk, an Eastern Siberian population exposed to the annual average temperature of -10 °C, that peaks up to -50°C during winter. In autoptic fat biopsies from a 54-year-old patient living in Yakutsk BAT is present in the perirenal and para-aortic fat specimens. Importantly, the mean adipocyte area of the subcutaneous fat from this patient is significantly lower than the mean area of subcutaneous adipocytes obtained from age- and sex-matched Italian patients. Statistical analysis of data obtained from the Territorial Organ of the Federal State Statistics Service of the Republic of Sakha (Yakutia), the Yakut Republican Medical Information and Analytical Center of the Ministry of Health of Yakutia showed a correlation between home heating and type-2 diabetes incidence during the years from 1994 to 2013, a period in which the indoor temperature increased significantly. The nutritional values of food consumed during these years also changed in parallel with the worsening of inhabitants metabolic health conditions.

Taken together these data suggest a possible link between the metabolic conditions of inhabitants of Yakutia and the living temperature experienced.

References

- [1] Zingaretti MC et al. (2009) The presence of UCP1 demonstrates that metabolically active adipose tissue in the neck of adult humans truly represents brown adipose tissue. *FASEB J.* 23:3113-3120.
- [2] Cypess AM et al. (2009) Identification and importance of brown adipose tissue in adult humans. *N. Engl. J. Med.* 360:1509-1517.
- [3] Virtanen KA et al., (2009) Functional brown adipose tissue in healthy humans. *N. Engl. J. Med.* 360:1518-1525.

Keywords

Brown adipose tissue; white adipose tissue; obesity; diabetes; low temperature.