INDIVIDUAL DIFFERENCES IN BODY TEMPERATURE AND THE RELATION TO ENERGY EXPENDITURE: THE INFLUENCE OF MILD COLD

A.M.J. van Ooijen, W.D. van Marken Lichtenbelt and K.R. Westerterp, Department of Human Biology, Maastricht University, Maastricht, The Netherlands.

Resting metabolic rate (RMR) adjusted for fat free mass (FFM) is subject to inter-individual variation. These differences in metabolic rate may be genetically determined and can have important health implications. Short-term exposure to cold is known to increase energy expenditure. This increase may also be specific for individuals. Moreover, it is not known which components of energy expenditure are involved and whether or not non-shivering thermogenesis contributes to the process.

Studies in animals and humans have shown that the differences in metabolic rate are related to differences in body temperature. However there is a controversy in results on the separate components of 24h energy expenditure (e.g. RMR, dietary induced thermogenesis, activity induced energy expenditure) and whether or not non-shivering thermogenesis contributes to the process.

The aim of this study was to determine the magnitude of inter-individual and gender differences in body temperature and RMR, during comfortable temperature and mild cold. The second goal was to study the relation between body temperature (BT) and RMR and the change of BT and RMR in reaction to a decrease in ambient temperature.

During the overnight stay at 22°C, sleeping metabolic rate (SMR) and intestinal temperature were measured. In the morning, RMR, intestinal, rectal and skin temperatures were measured for one hour at 22°C followed by three hours at 16°C. This experiment was conducted under standardised circumstances using a respiration chamber. Body composition was determined by underwaterweighing. Energy expenditure was corrected for body composition by calculation of residuals of the relation of energy expenditure versus fat free mass and fat mass.

Residuals of SMR and RMR were significantly related ($p<0.001$, $r^2=0.57$). It appears that individual levels of energy expenditure during the night remained during the day. We found a 5 % increase in RMR without an increase in electromyographic activity in response to a decrease in ambient temperature ($p<0.05$), indicating non-shivering thermogenesis.

Core and rectal temperatures were higher in women than in men ($p<0.01$) at both ambient temperatures. In spite of gender differences in skin temperature on specific sites, the average of proximal or distal skin temperatures was not significantly different and neither was average skin temperature. Temperature distribution in response to a decrease in ambient temperature was different between genders ($p<0.05$).

In search for a relation between heat production and heat loss, RMR was compared with body surface area (BSA) and the temperature gradient between skin and ambient temperature. Stepwise regression with RMR as dependent variable and BSA and the gradient between skin and ambient temperature as independent variables, showed a significant contribution of the temperature gradient in addition to BSA at 22°C and the last hour at 16°C (respectively $r^2 = 0.84$, $r^2 = 0.70$, $p < 0.001$). This shows that the gradient between skin and ambient temperature plays a role in the relation between heat production and heat loss.

markenlichtenbelt@HB.UNIMAAS.NL