



Brown adipose tissue volume in healthy lean south Asian adults compared with white Caucasians: a prospective, case-controlled observational study

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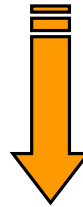
Lancet Diabetes Endocrinol 2014; 2: 210-217



South Asians: disadvantageous metabolic phenotype



1. obesity
2. type 2 diabetes
3. dyslipidemia



*20% world population
- 1.2 billion people -*

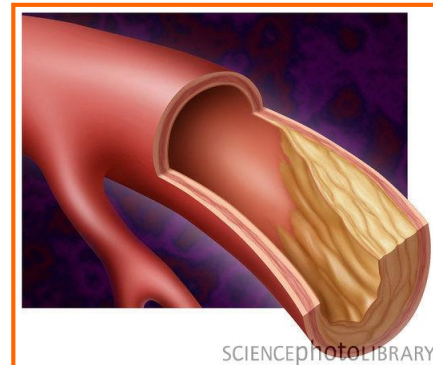


First myocardial infarction in SA:

- higher prevalence (+40%)
- 5-10 years earlier

compared to Caucasians

*Cardiovascular
disease*

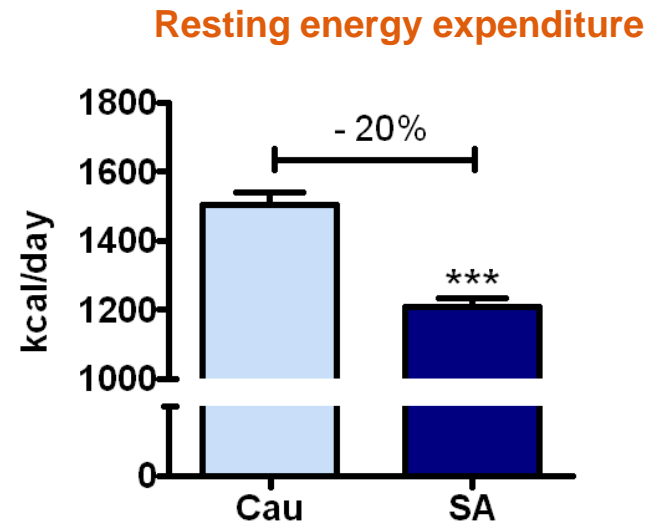


South Asians have decreased energy expenditure

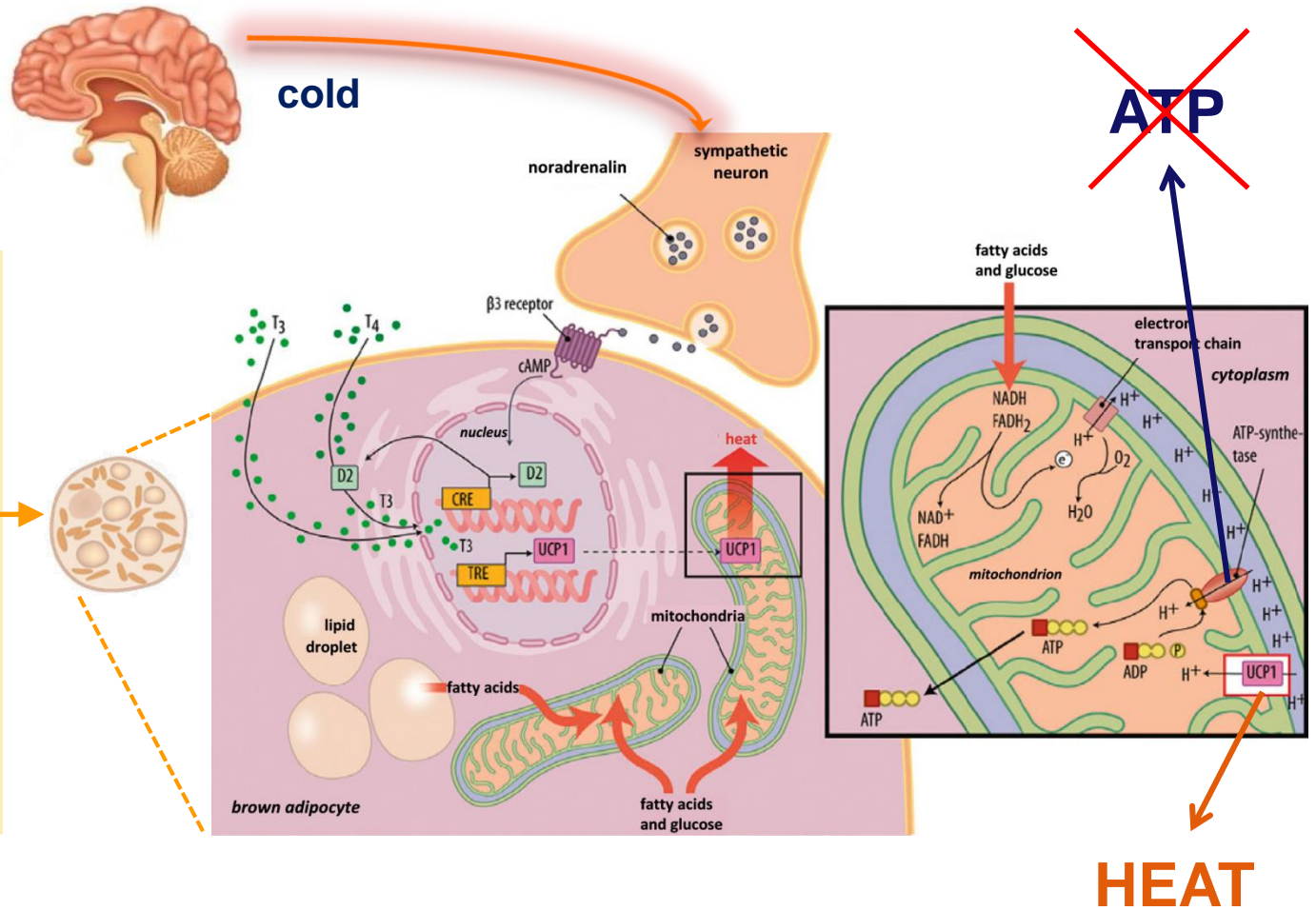
- 12 healthy Dutch South Asian and 12 Dutch Caucasian males
- Lean (BMI < 25)
- Age 22.1 ± 0.8 years
- Exclusion criterium: type 2 diabetes



Resting energy expenditure (kcal/day) =
 $(3 \cdot 9 \cdot \text{VO}_2 + 1 \cdot 1 \cdot \text{VCO}_2) \cdot 1.44$



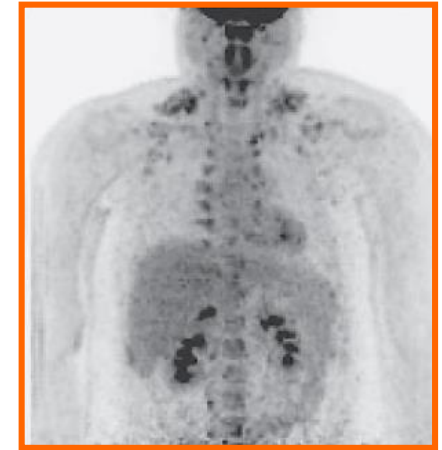
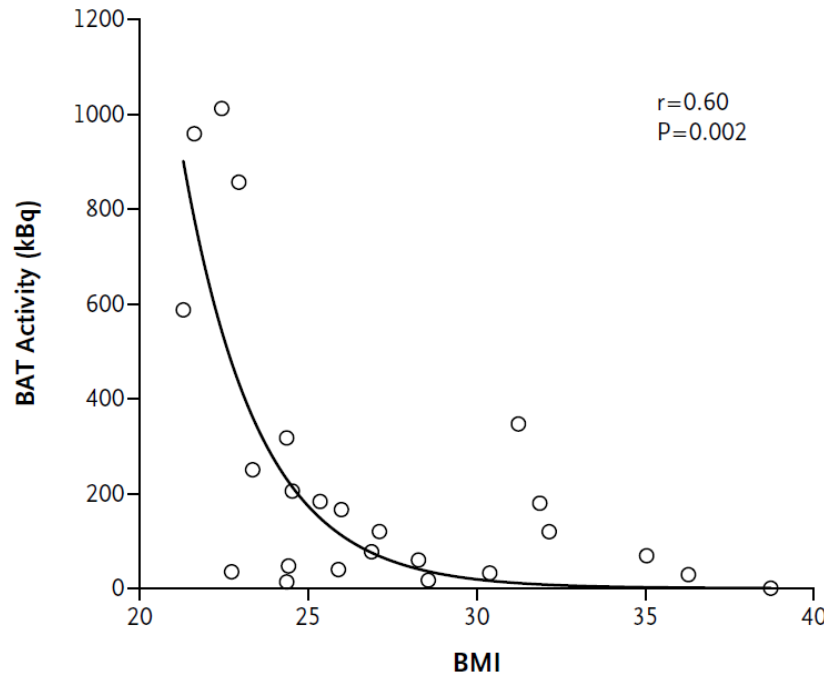
Brown adipose tissue: a novel player in energy expenditure that burns fatty acids towards heat



BAT activity is lower in people with obesity



Lean



Obese

Hypothesis:

Brown fat activity ↓

1. Metabolism ↓
2. Combustion glucose ↓
3. Combustion triglycerides ↓

1. Obesity
2. Diabetes
3. Hyperlipidemia



South Asians have lower BAT volume or BAT dysfunction that underlies their disadvantageous metabolic phenotype including lower energy expenditure



- **12 healthy Dutch South Asian and 12 Dutch Caucasian males**
- **Lean (BMI < 25)**
- **Age 24.1 ± 0.8 years**
- **Exclusion criteria:**
 - **Type 2 diabetes**
 - **Rigorous exercise**
 - **Smoking**
 - **Recent body weight change**

Study design

Rijnland Hospital, Leiderdorp

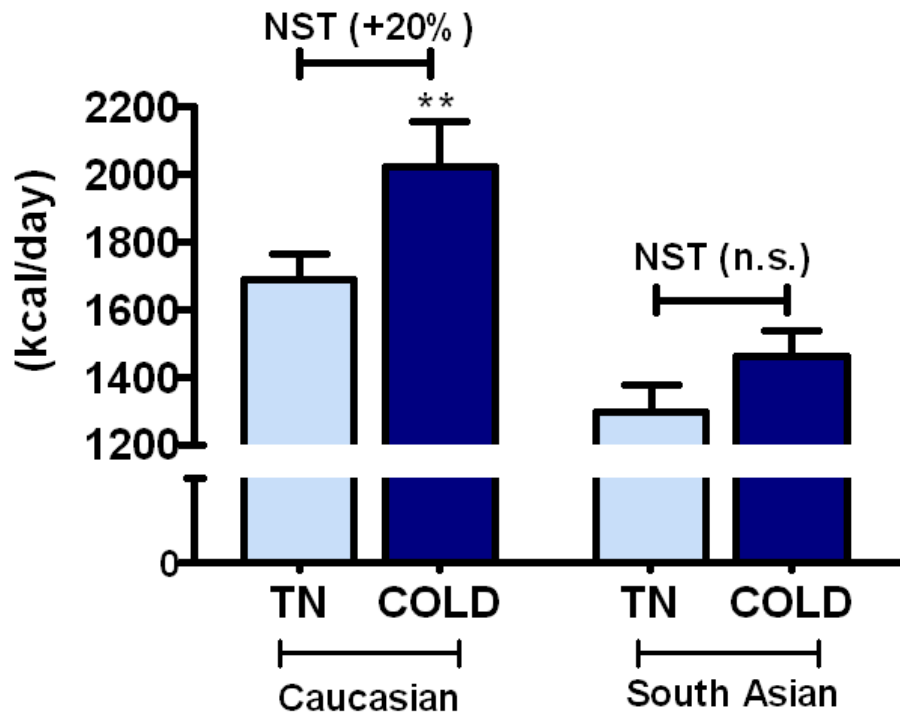
- 08.00 — Anthropometry, blood pressure
- 08.10 — DEXA
- 08.30 — Insert canula
- 08.35 — Indirect calorimetry (thermoneutral)
- 09.10 — Blood sample (basal)
- 09.15 — **t=0 Start personalized cooling**
- 10.15 — **t=60' Infuse ¹⁸F-FDG**
- 10.30 — **t=75' Indirect calorimetry (cold-induced)**
- 11.10 — **t=115' Blood sample**
- 11.20 — **t=120' PET-CT**
- 12.30 — home



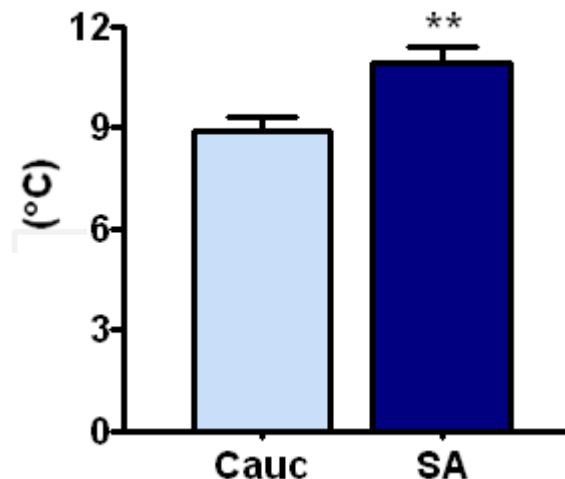
South Asians have decreased energy expenditure and non-shivering thermogenesis



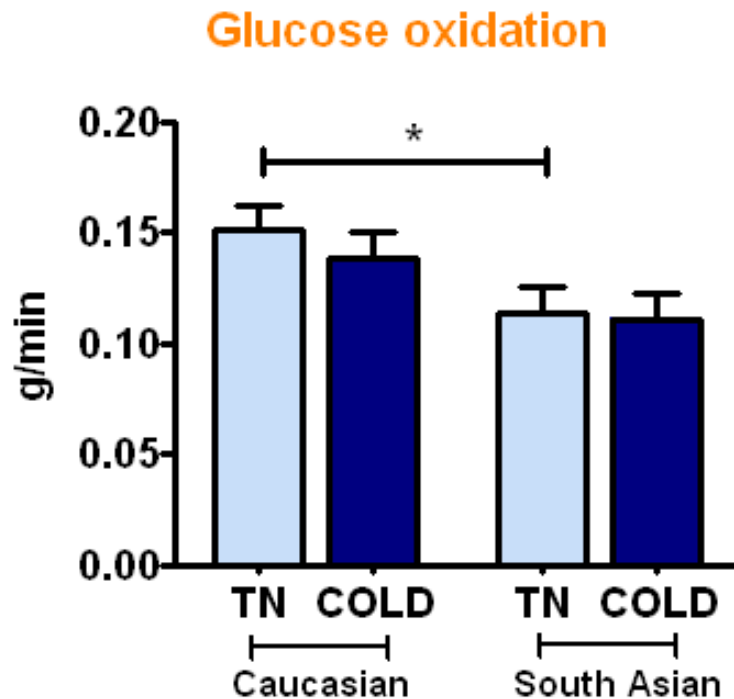
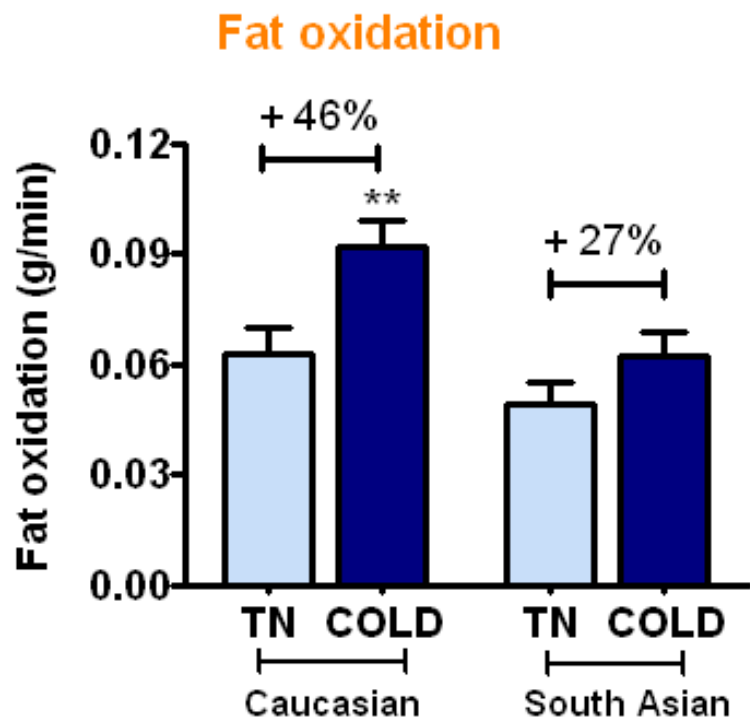
Resting energy expenditure



Shiver temperature

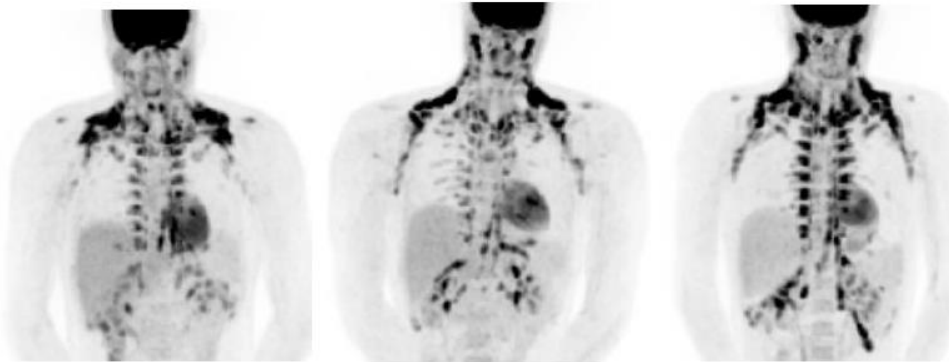


Cold exposure enhances fat oxidation, but not glucose oxidation in Caucasians

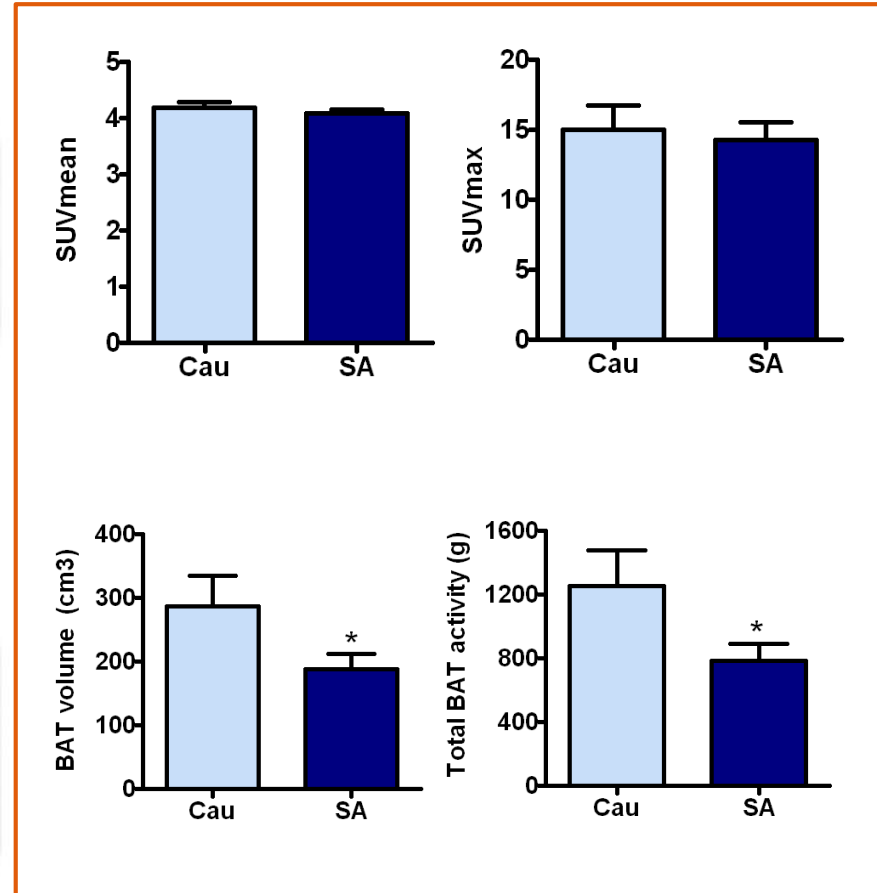
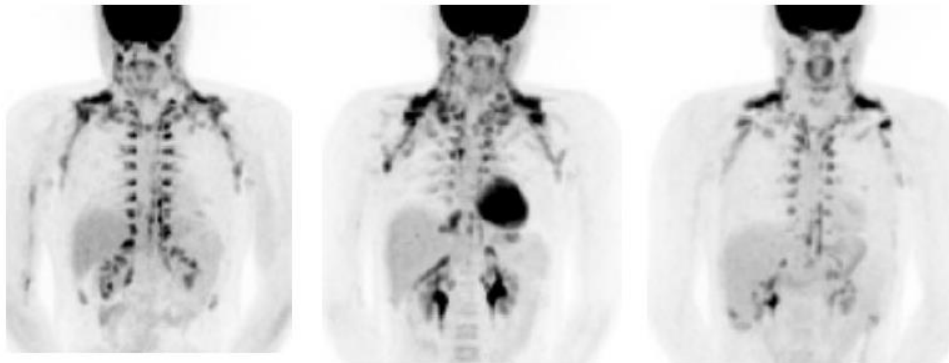


South Asians have reduced BAT volume and activity

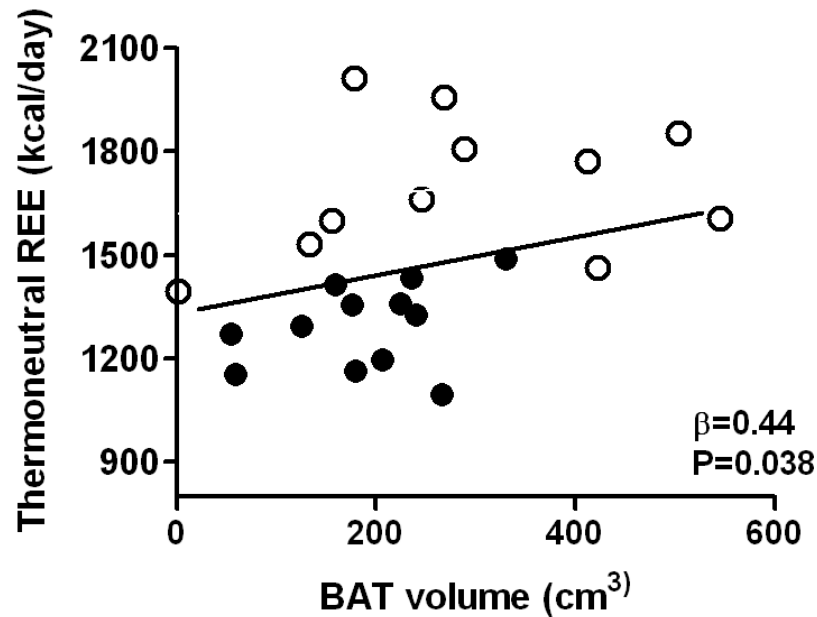
Caucasians



South Asians



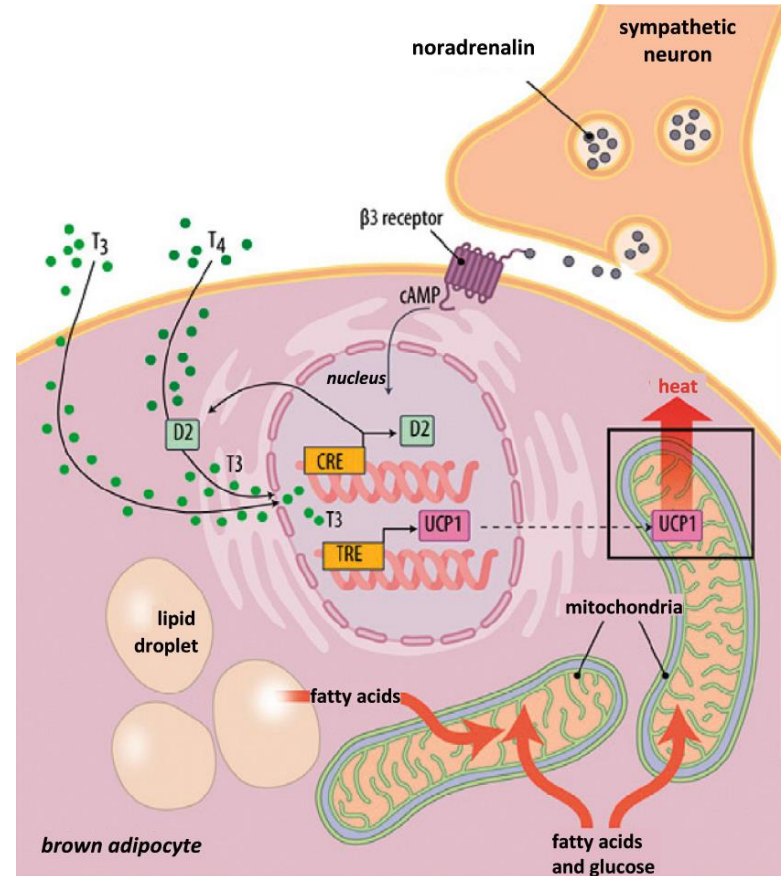
BAT volume correlates with resting energy expenditure



- **BAT is a key player in metabolism and importantly contributes to total energy expenditure by combustion of fatty acids towards heat**
- **South Asians have reduced energy expenditure, BAT volume and activity which might underlie their disadvantageous metabolic phenotype**
- **Because of its fat-burning capacity, BAT is an attractive target to combat obesity and related disorders including CVD in the South Asian and the general population**

Brown adipose tissue volume and activity can be (pharmacologically) stimulated

- **Cold induction**
(Khedoe et al., *J Lipid Res* 2014)
- **β 3-adrenergic agonist**
(Boon and Berbée et al., *Nature Commun*, conditionally accepted)
- **BMP7**
(Boon et al., *PLoS One* 2013)
- **Rimonabant**
(Boon et al., *FASEB J* 2014)
- **Metformin**
(Geerling and Boon et al., *Diabetes* 2013)
- **Salsalate**
(Van Dam et al., *Diabetes*, accepted)





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