Maternal diet and neonatal outcomes – which fat matters?

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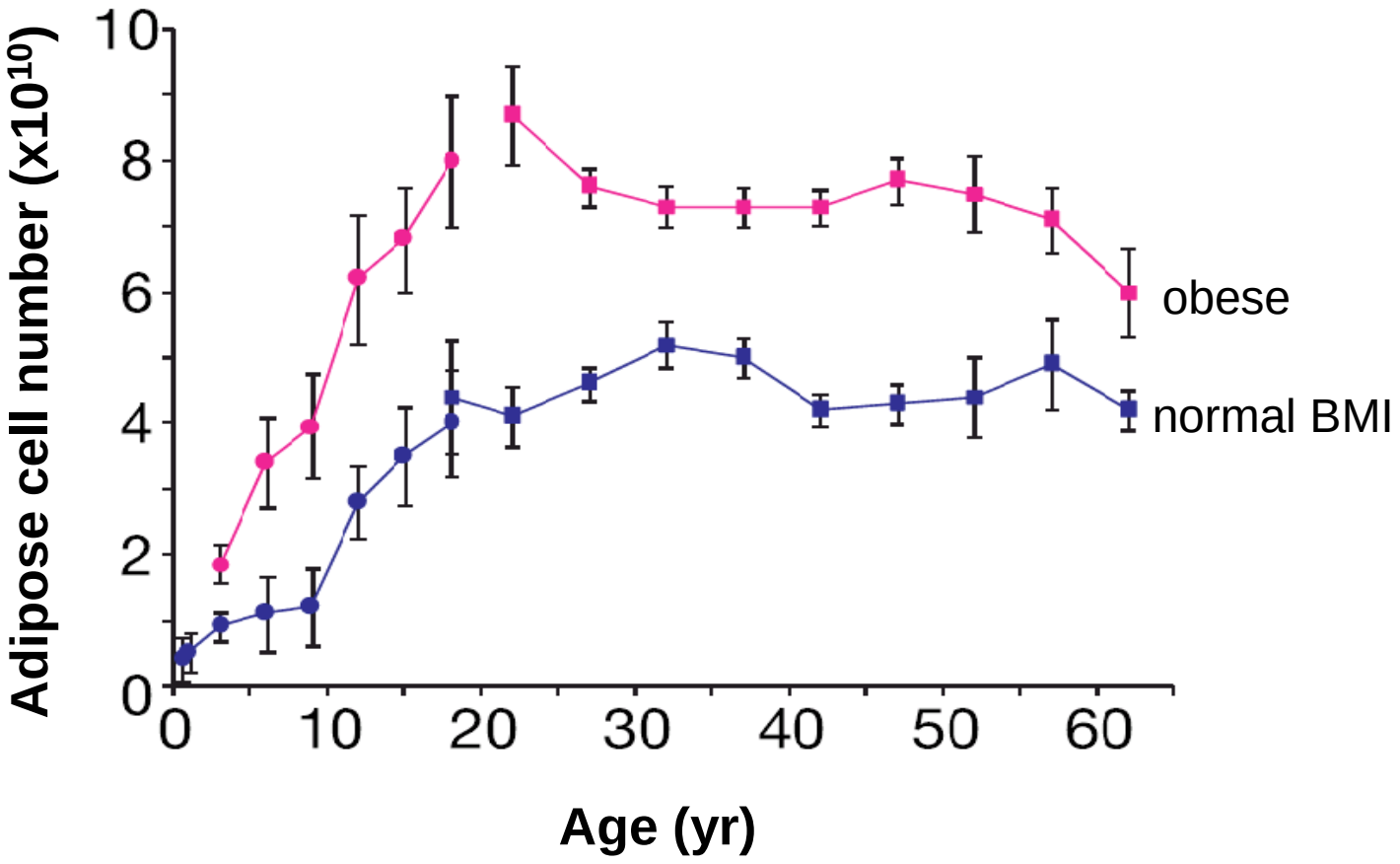
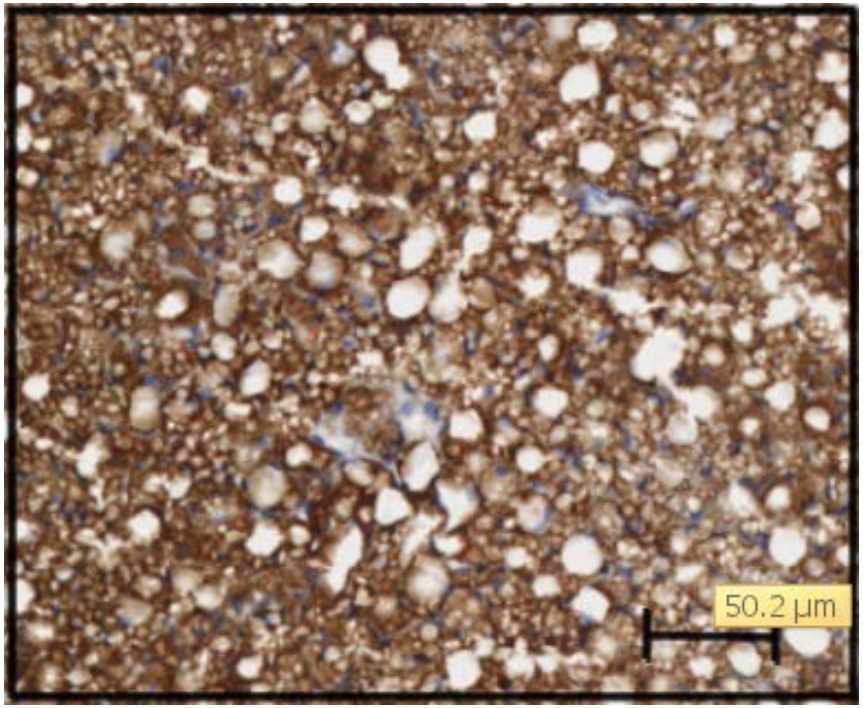
Adipocyte cell number is established early and is greater in obese individuals

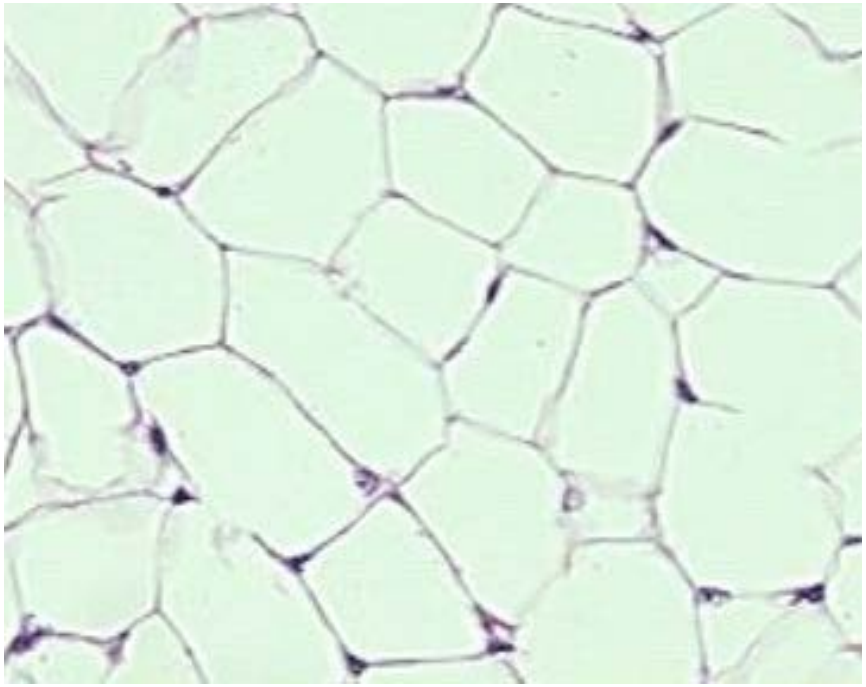


Knittle et al 1979; Spalding et al 2008; Catalano et al. 2009

Adipose tissue composition

Brown vs White adipose tissue





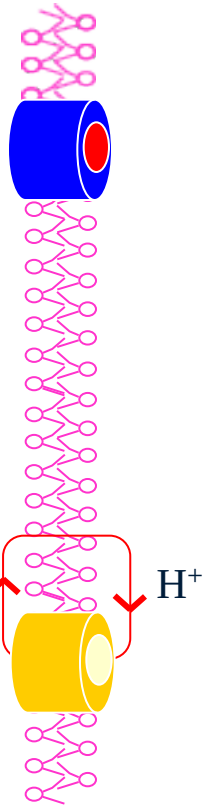
Mitochondria and heat production

inner mitochondrial membrane

outer mitochondrial membrane

UCP 2

- regulation of ROS production
- apoptosis?
- uncoupling?



UCP 1

- heat production in BAT

cyt c

- mobile component of electron transport chain

VDAC

- supply of ADP for energy production
- apoptosis?

Mitochondria and heat production - different progenitor cell types

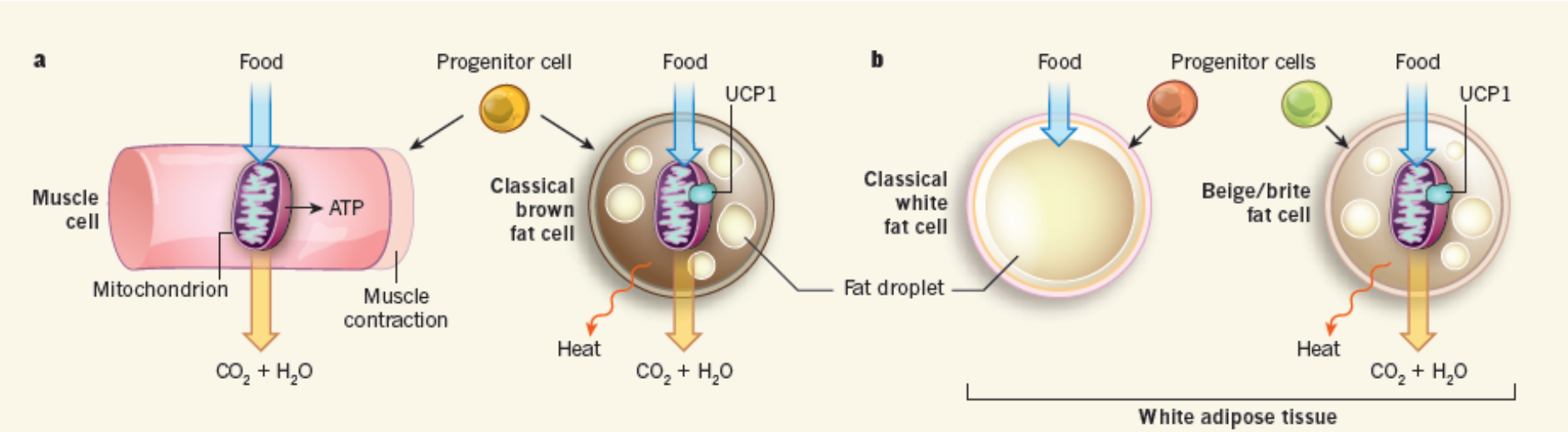
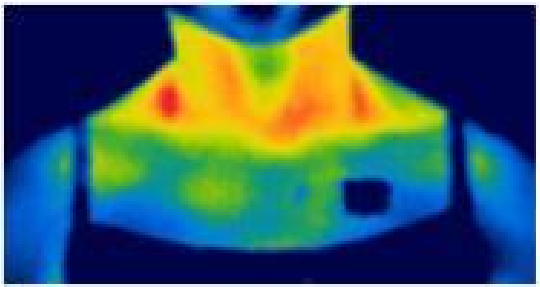
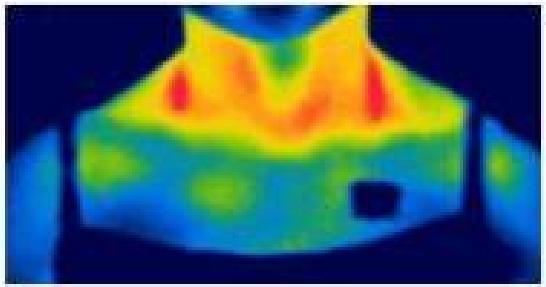
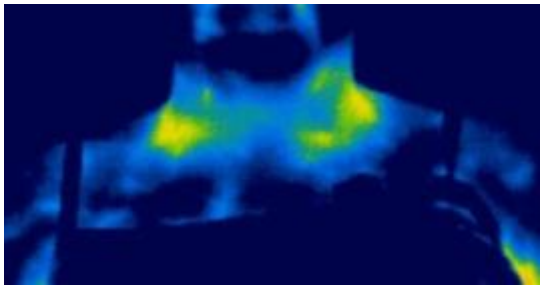
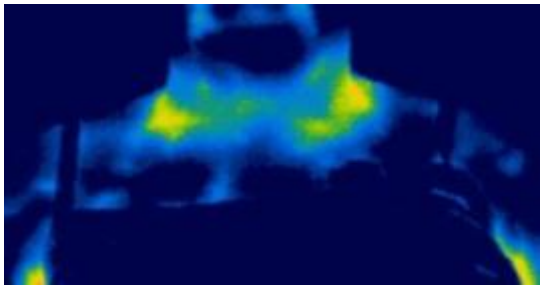
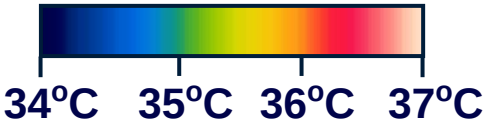


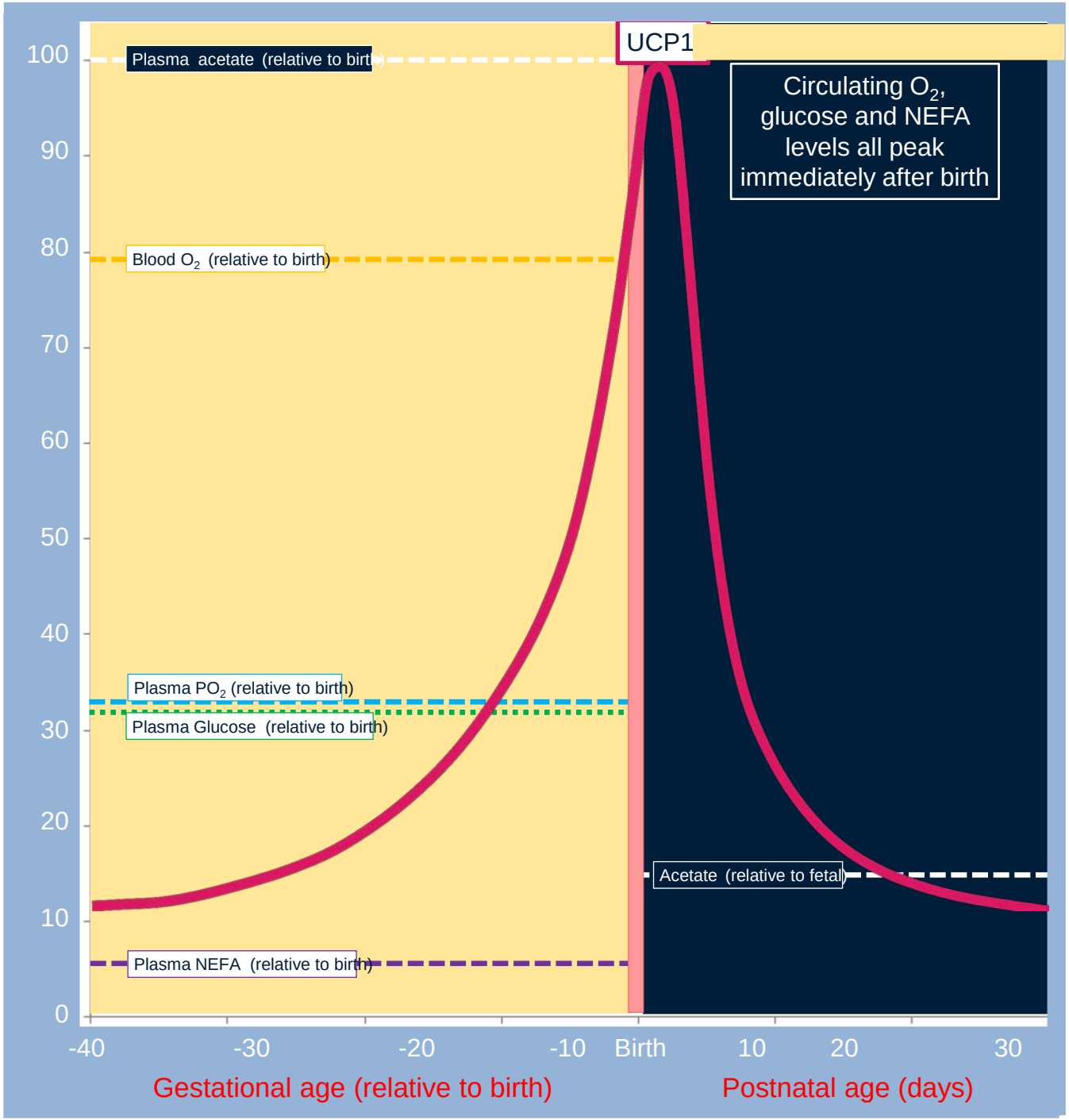
Figure 1 | Different progenitors, different colours. **a,** Cells that make up muscle and brown fat are derived from the same progenitor cells. Muscle cells and classical brown fat cells contain many mitochondria, organelles in which food is burned to produce carbon dioxide and water. The energy released is harvested in the form of ATP molecules that support contraction in muscles, whereas it is directly released as heat in brown fat. This heat generation requires the presence of the UCP1 protein. **b,** Wu *et al.*[1] identified two types of progenitor cell in mouse white adipose tissue. These cells give rise to classical white fat cells (which store energy in the form of fat droplets) and to 'beige' or 'brite' fat cells. Beige/brite cells express UCP1 and are functionally similar to brown cells, in spite of being derived from different progenitors.

Supraclavicular temperature response is reduced with increased BMI

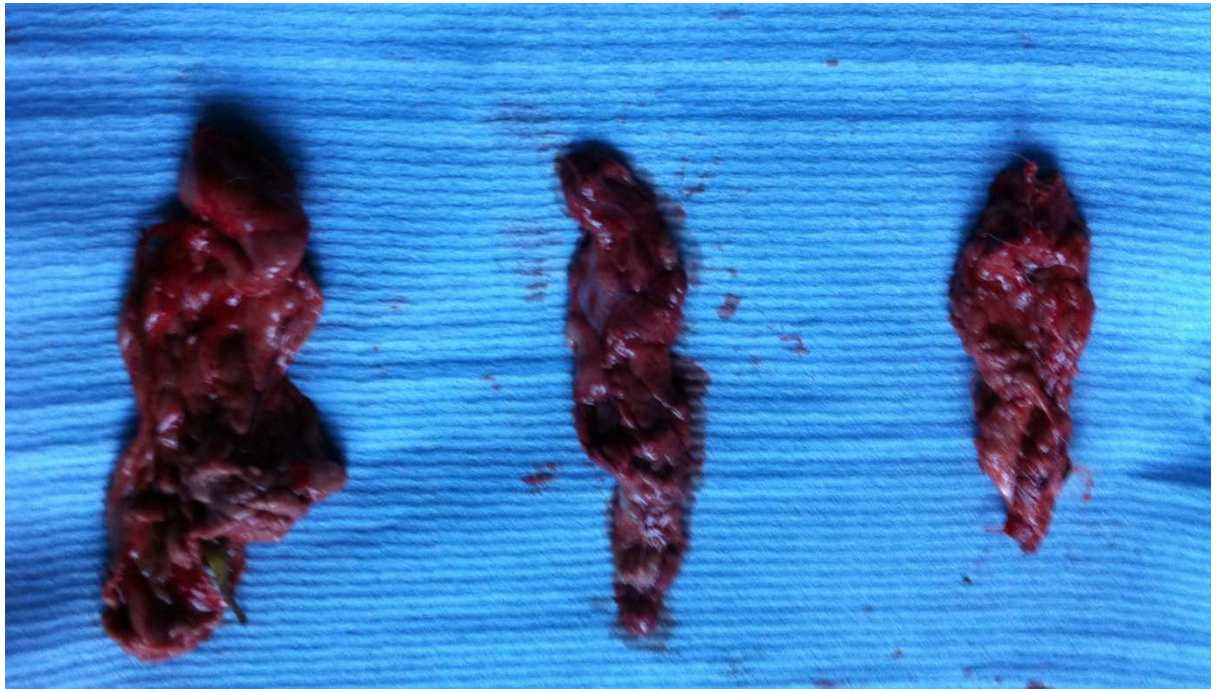
	Pre-cool challenge	5 mins post challenge
7 yr old female 25th BMI Centile		
7 yr old female 98th BMI Centile		



Robinson et al. 2014 J Pediatrics

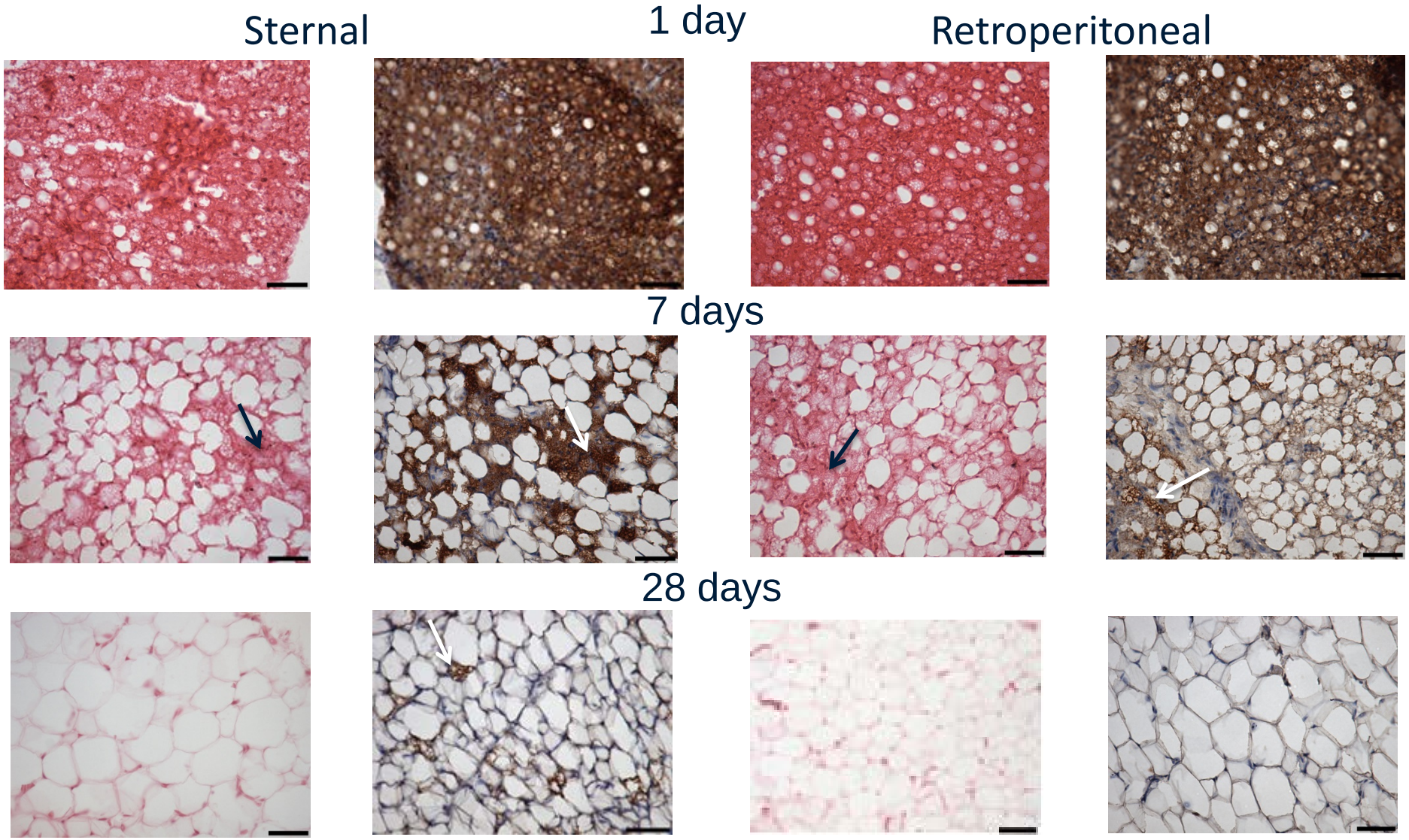

UCP1
Circulating O_2, glucose and NEFA levels all peak immediately after birth
Plasma acetate (relative to birth)
Blood O_2 (relative to birth)
Plasma PO_2 (relative to birth)
Plasma Glucose (relative to birth)
Plasma NEFA (relative to birth)
Acetate (relative to fetal)
100
90
80
70
60
50
40
30
20
10
0
-40
-30
-20
-10
Birth
10
20
30
Gestational age (relative to birth)
Postnatal age (days)

Comparison of the three major BAT depots in neonatal sheep

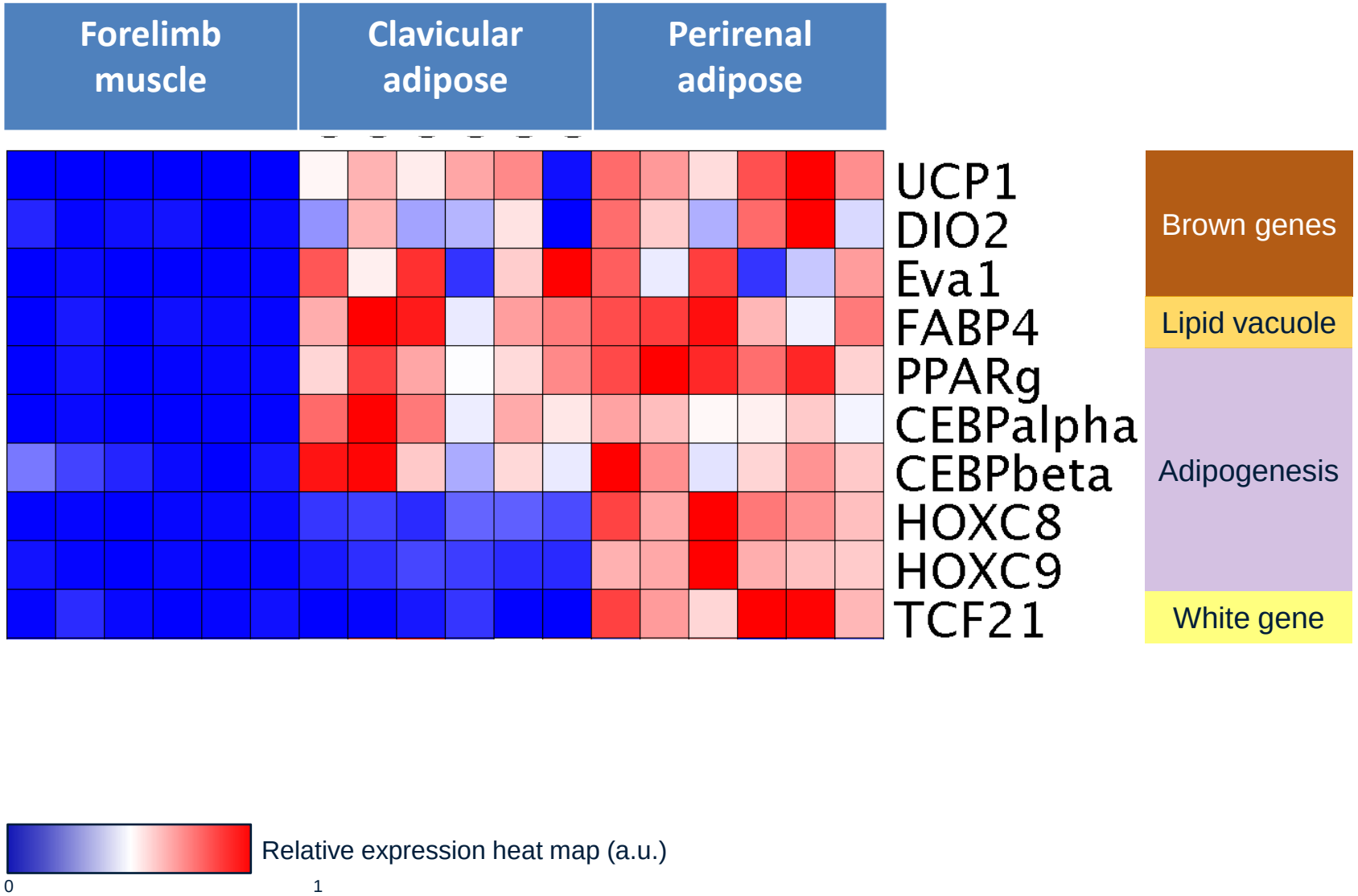


Perirenal **Pericardial** **Supraclavicular**

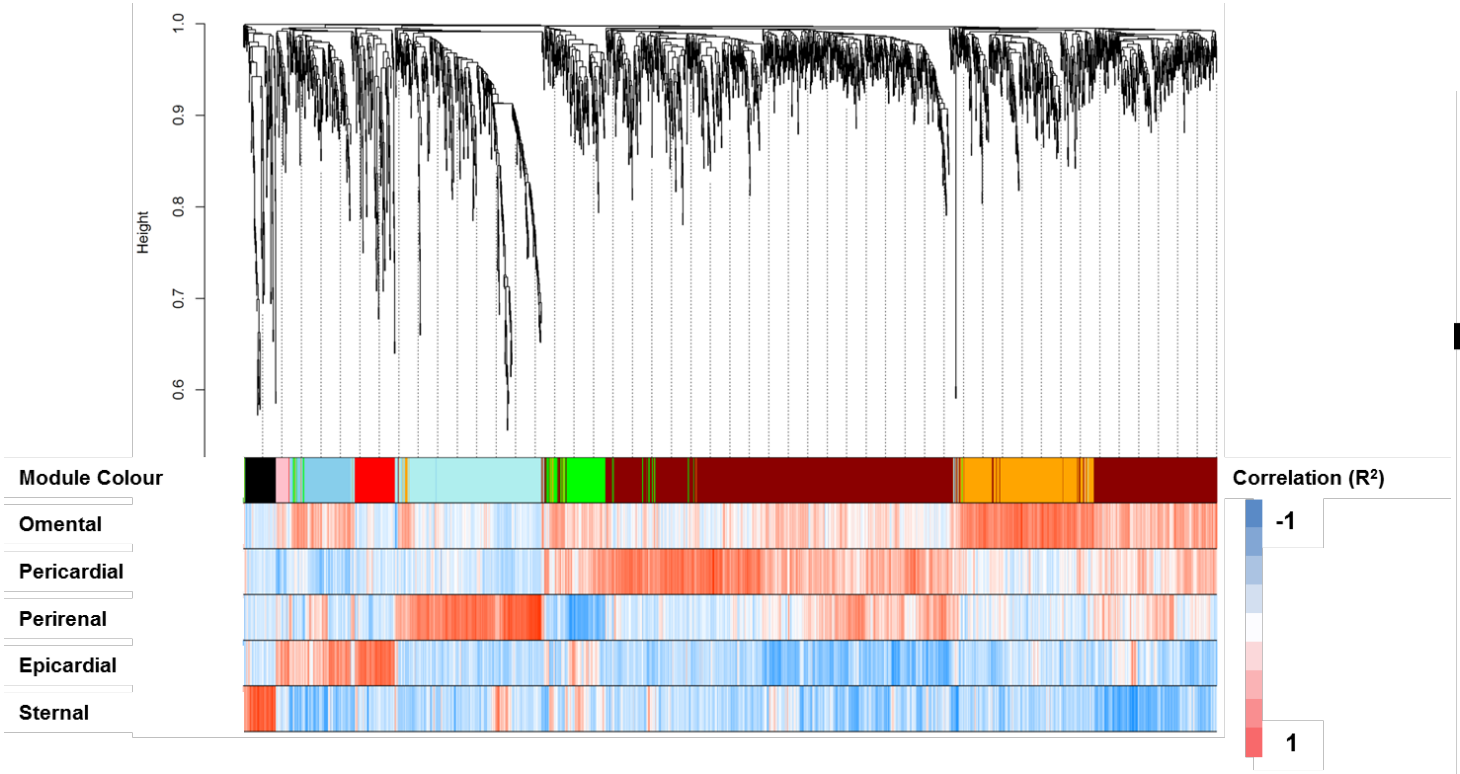
Each fat depot has a different developmental trajectory

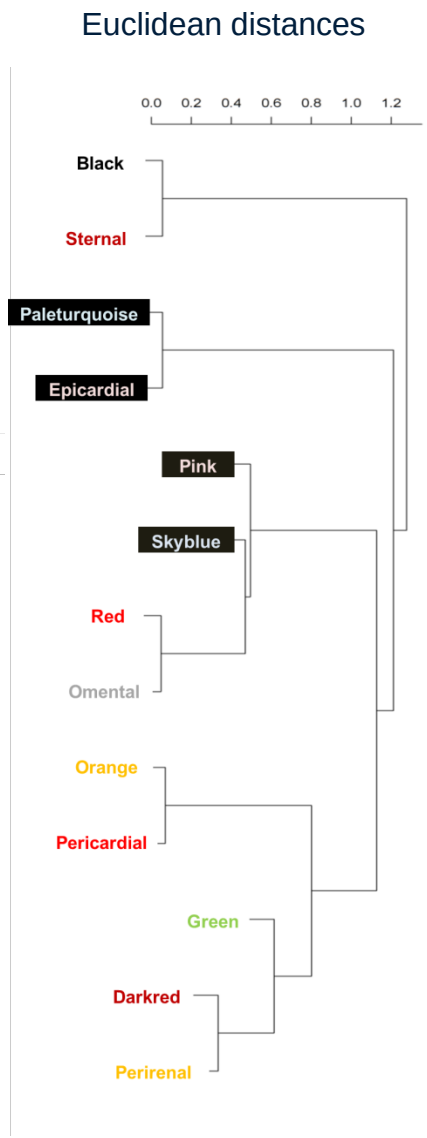


Heat map of gene expression between BAT and muscle at 7 days of age



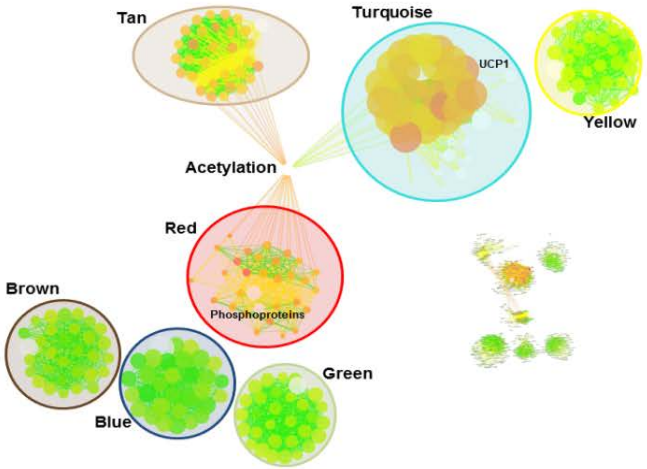
Network analysis 7 days – each depot unique

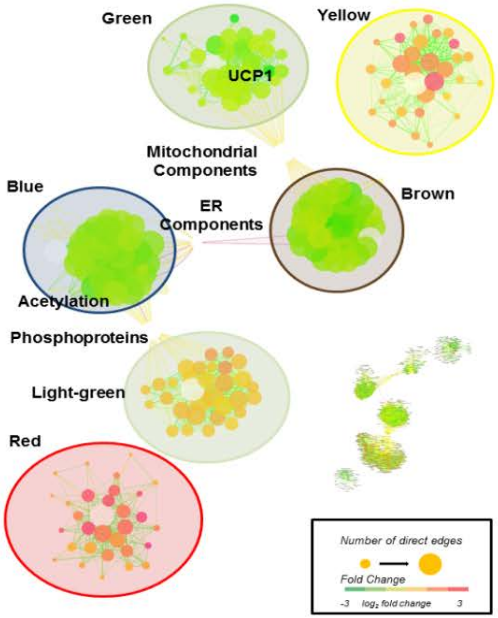




- The network analysis produces 8 distinctive modules
- Every module approximately represents a depot
- Every module represents a gene function

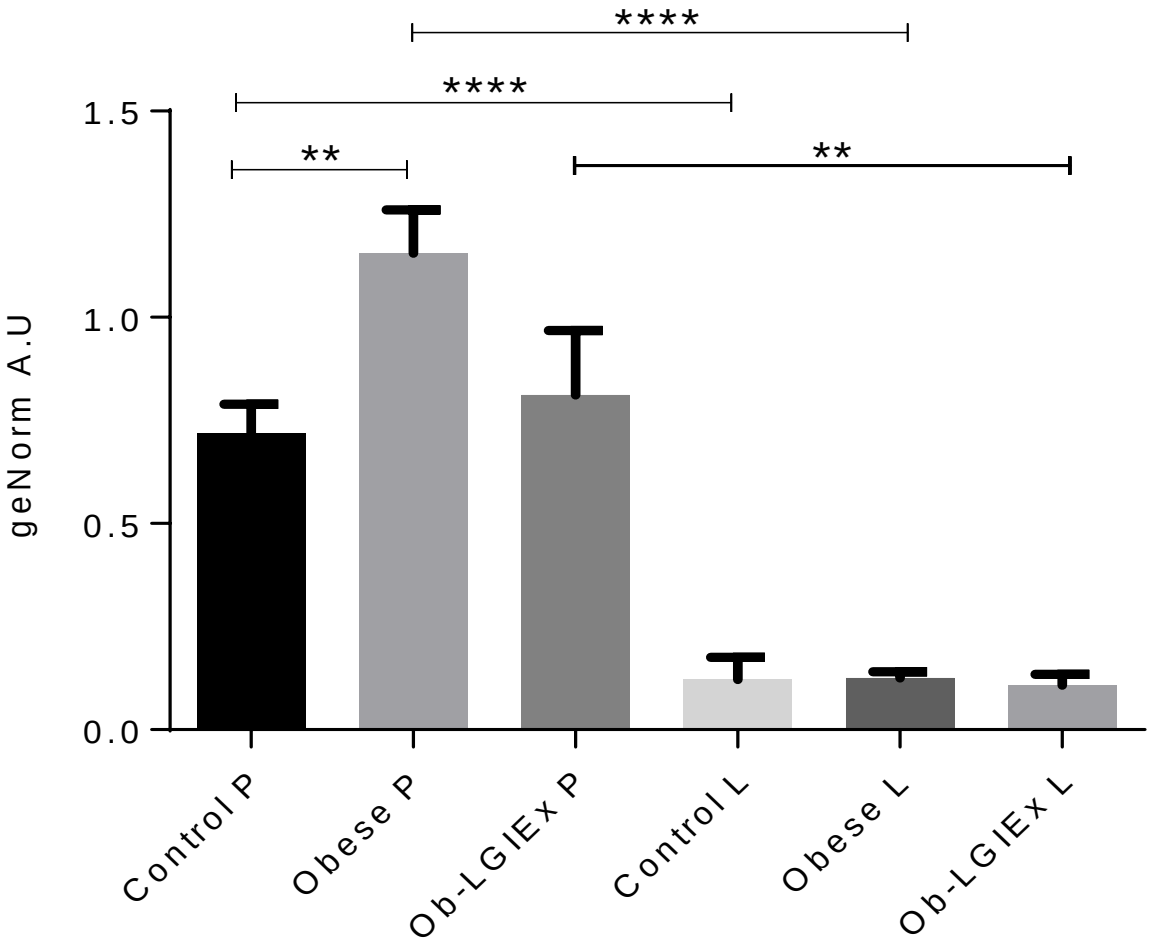
Schematic summary of changes in human epicardial adipose tissue





Ojha, Fainberg et al. 2016 JCI Insight

Gene expression inguinal adipose tissue: Pregnancy v lactation



Expression shown in:

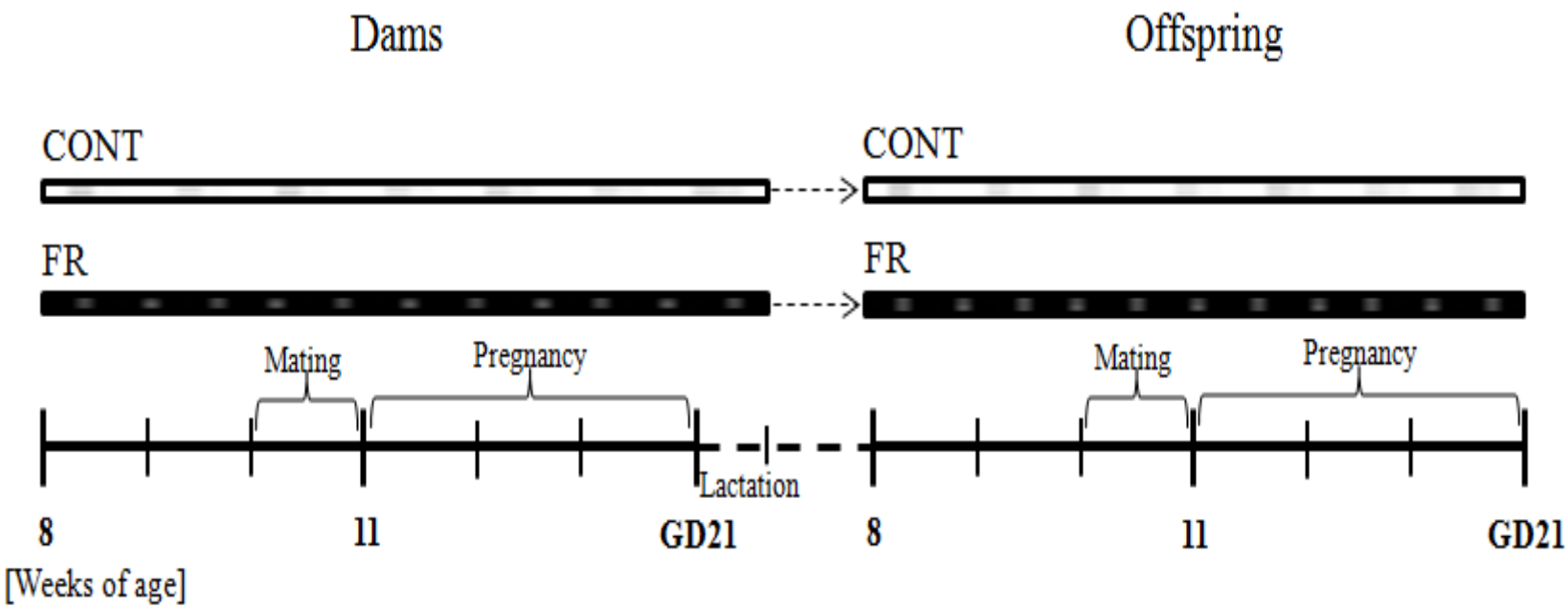
Energy signalling genes
Protein kinase b
Insulin receptor substrate 1
Insulin receptor substrate 2
Mammalian target of rapamycin

Lipid handling genes
Lipoprotein lipase
Fatty acid translocase
Fatty acid transport protein 4

Inflammatory genes
Toll-like receptor 4
Tumour necrosis factor α

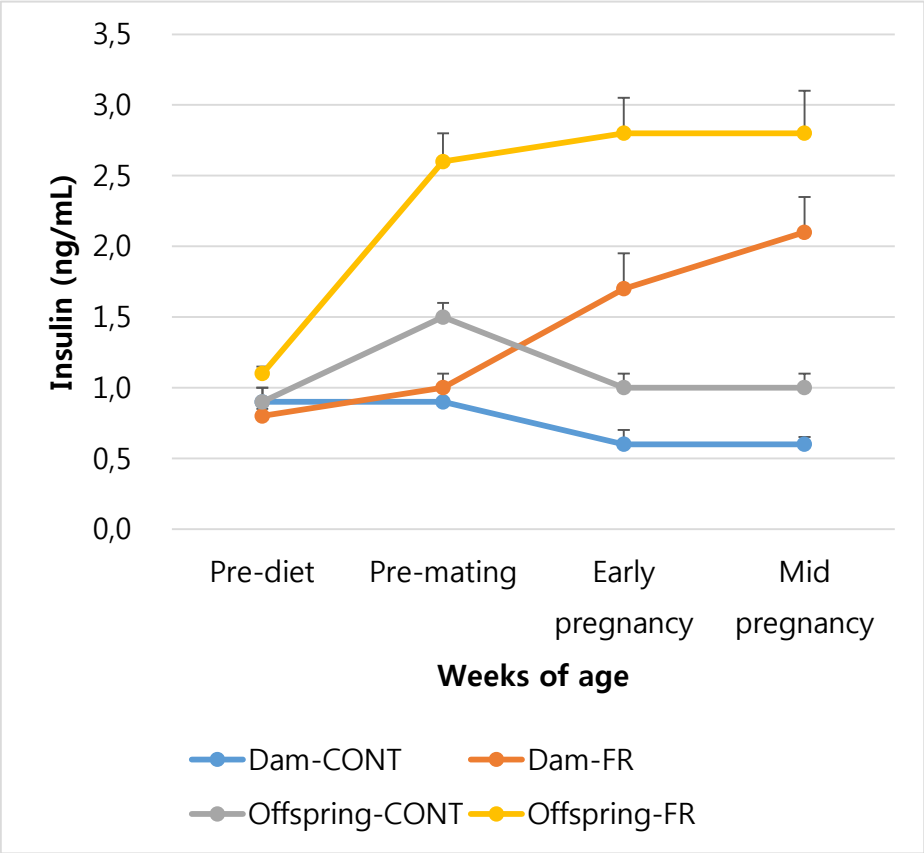
Significant findings
- ↑ with obesity in pregnancy
- removed with intervention
- ↓ with lactation, all groups

Generational effects on metabolic homeostasis in pregnancy

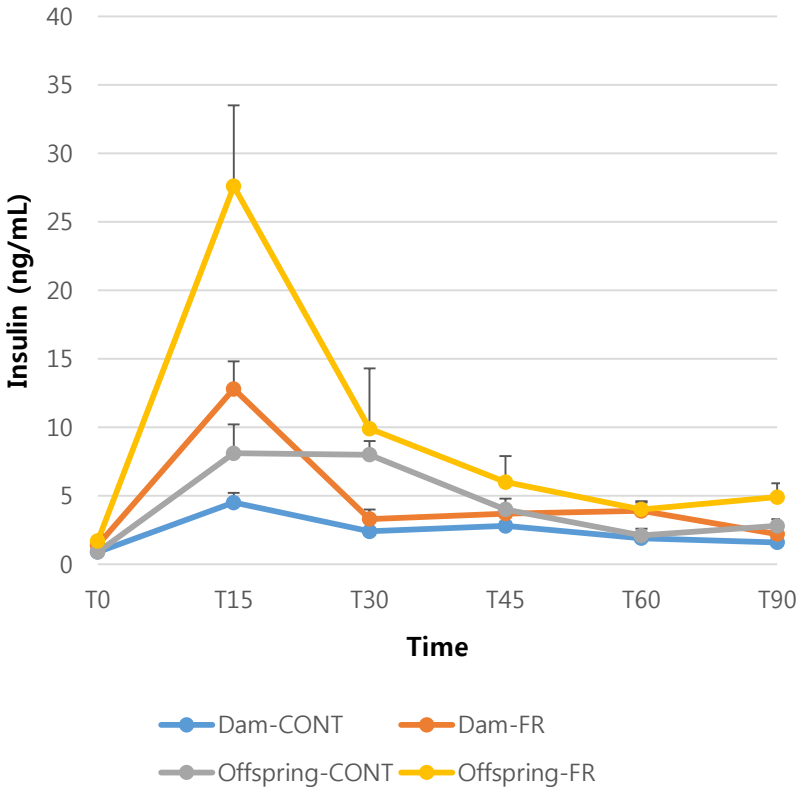


- Dam-CONT (N=10)
- Dam-Fr (N=10)
- Offspring-CONT (N=8)
- Offspring-F (N=8)

Generational determinant of insulin response to pregnancy amplification of fructose feeding



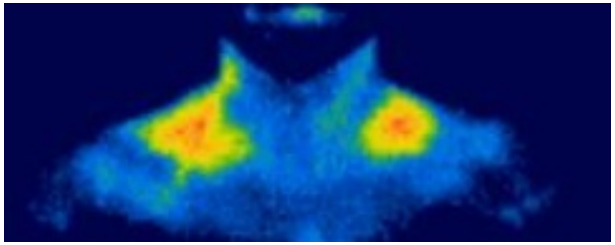
Late gestation



Summary of potential factors promoting BAT

Birth
Squeezing through the birth canal - intense endocrine stimulation

Cold exposure
↑Thyroid hormones and sympathetic nervous activity



Dietary factors

Stress

BAT - impact

SENSATIONAL
Exoskeleton helps paralysed people feel again
NewScientist
THE FAT THAT MAKES YOU THIN
How to ignite your inner lean machine
MAKING A CRUST
The mystery origin of Earth's dry land
OILY MORALS
What we burn fuels what we think
MYTHOLOGY VS SCIENCE
Telescopic battle over Hawaii's sacred mountain
ICE-AGE MASTERCHEF
What's on the Neanderthal menu?

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EARNEST

British Heart Foundation

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