

Human variability- a basis for precision and personalised nutrition

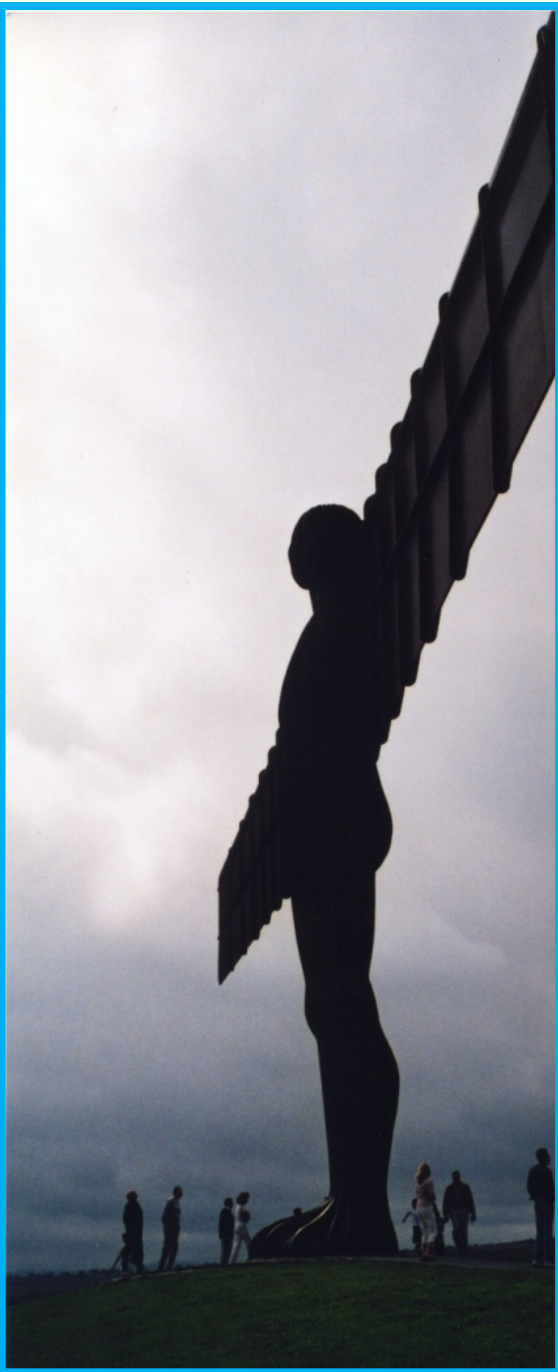
John Mathers

Human Nutrition Research Centre

Centre for Healthier Lives

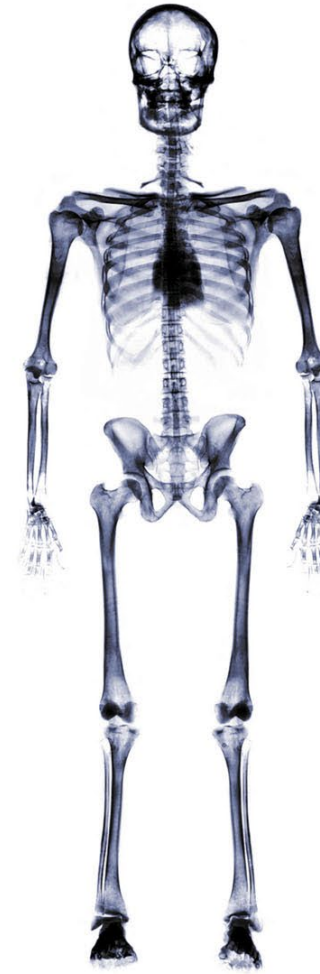
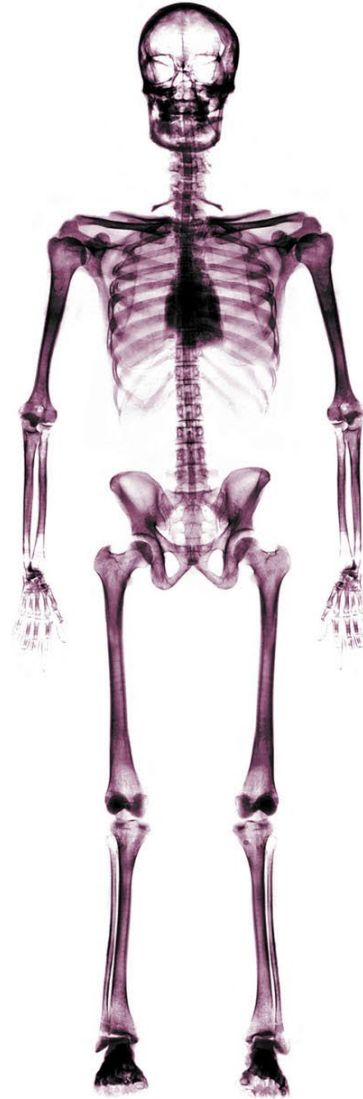
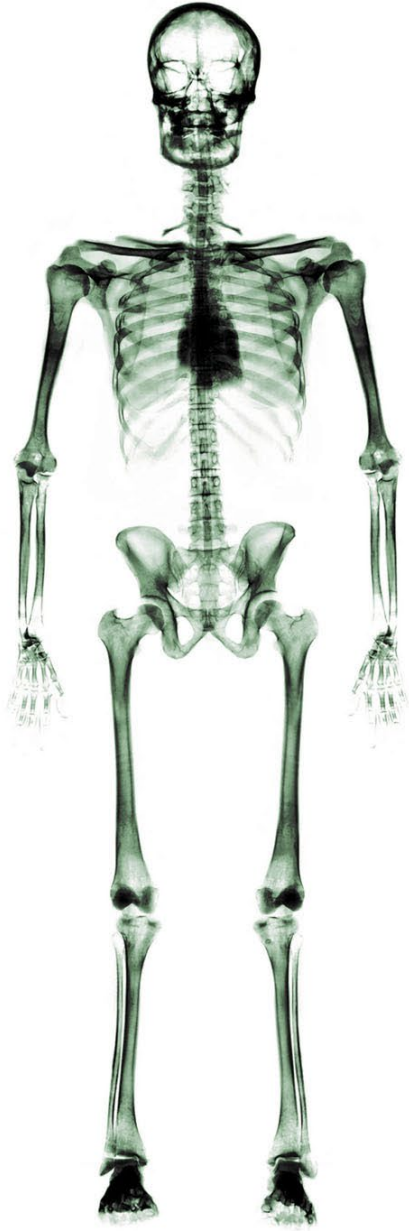
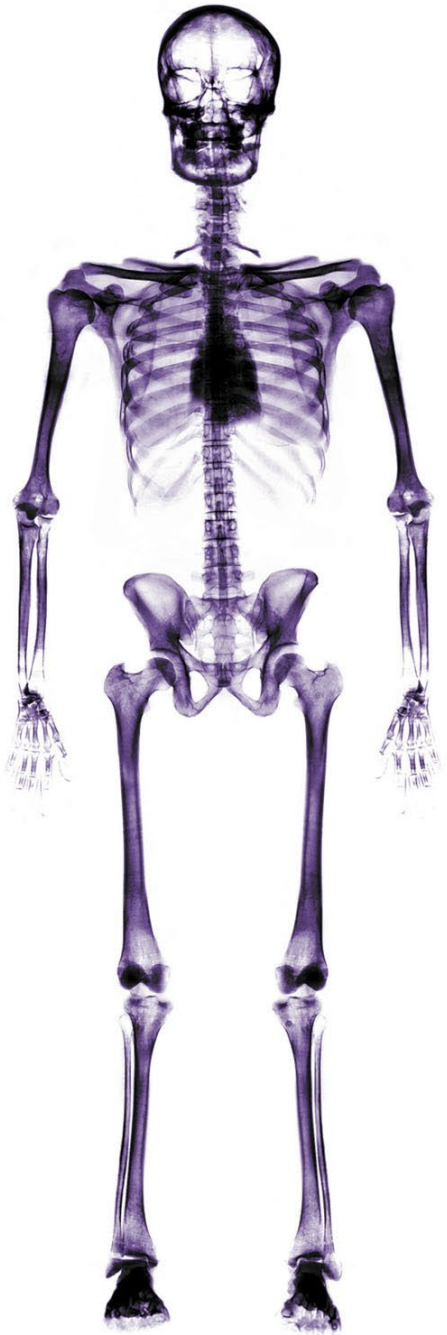
Newcastle University

UK



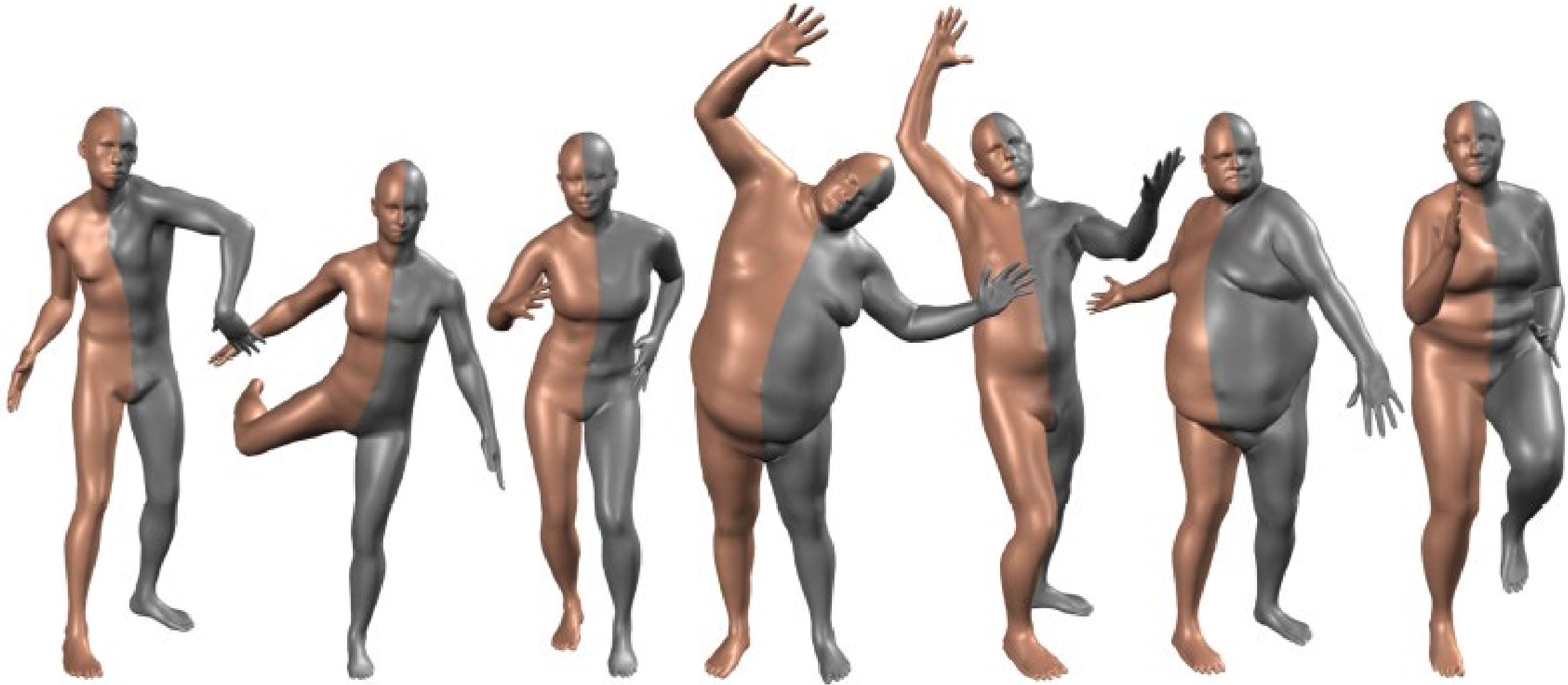
I have no conflicts of interest

We're all different





We have different body shapes





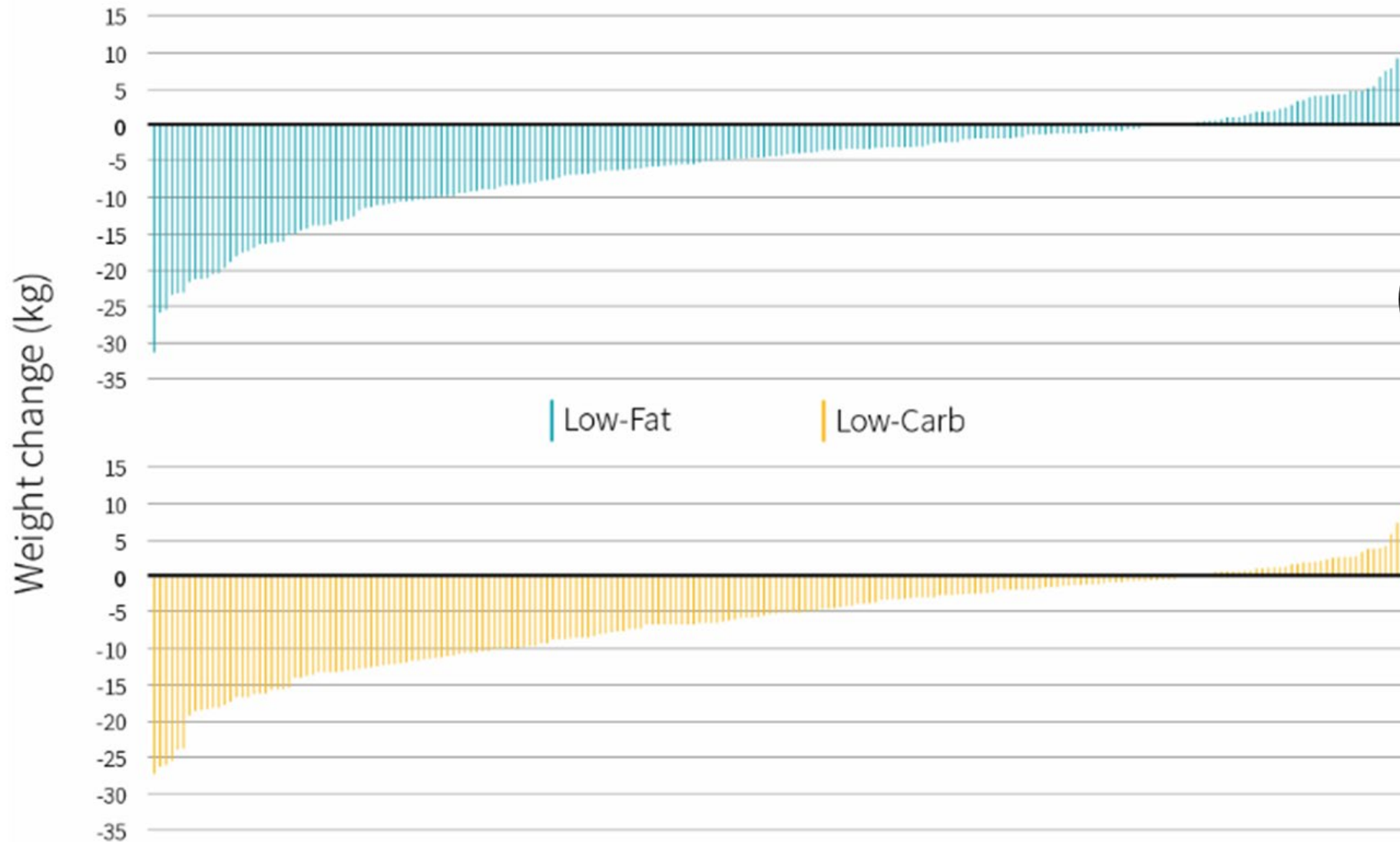
**Usain Bolt winning the
100m race in 2008 at the
Beijing Olympics**

We differ in how fast we grow and how rapidly we age



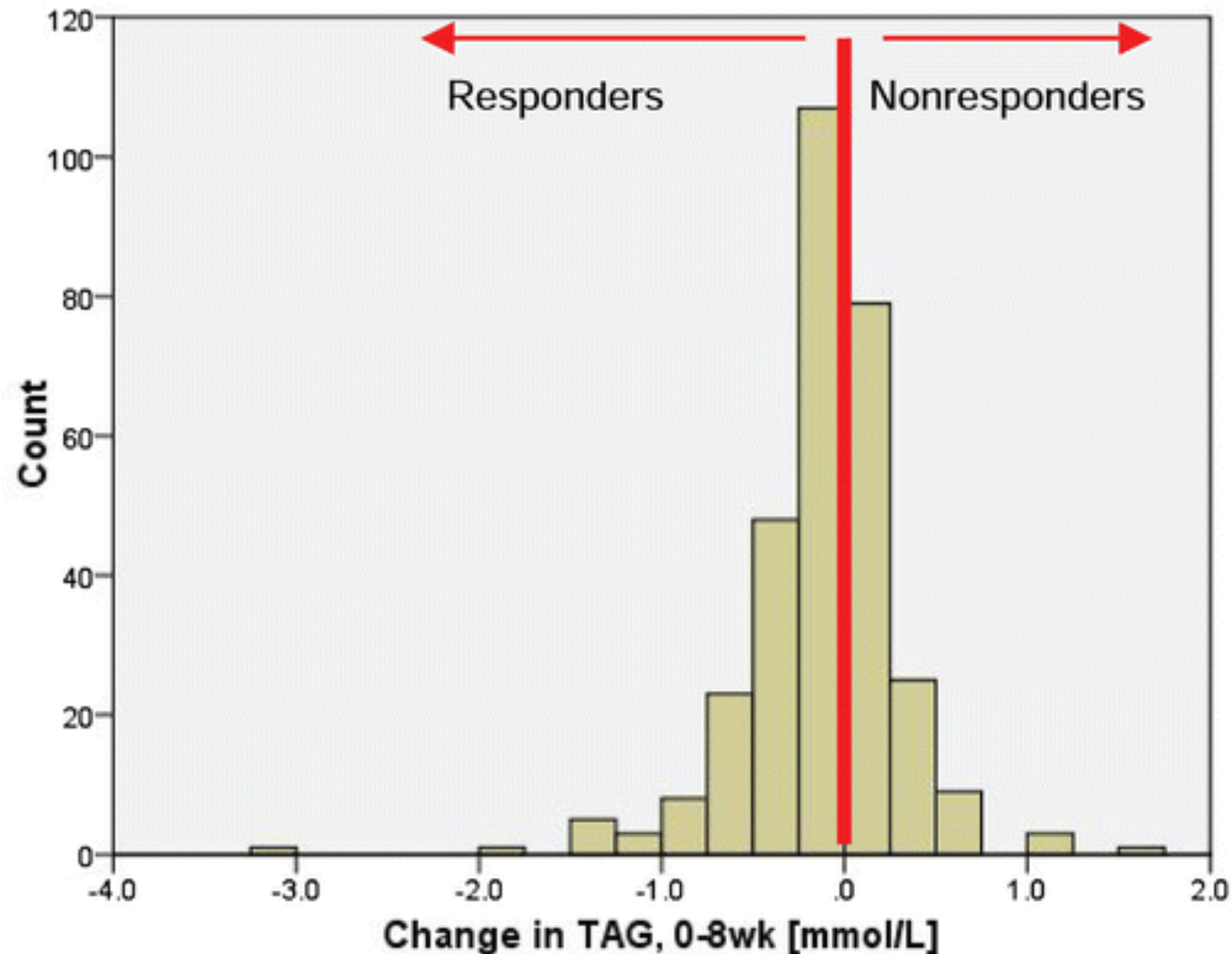
Inter-individual differences in responses to diet

Individual variation in weight loss in DIETFITS study



609 adults
12 months
trial

Inter-individual differences in response to fish-oil supplementation

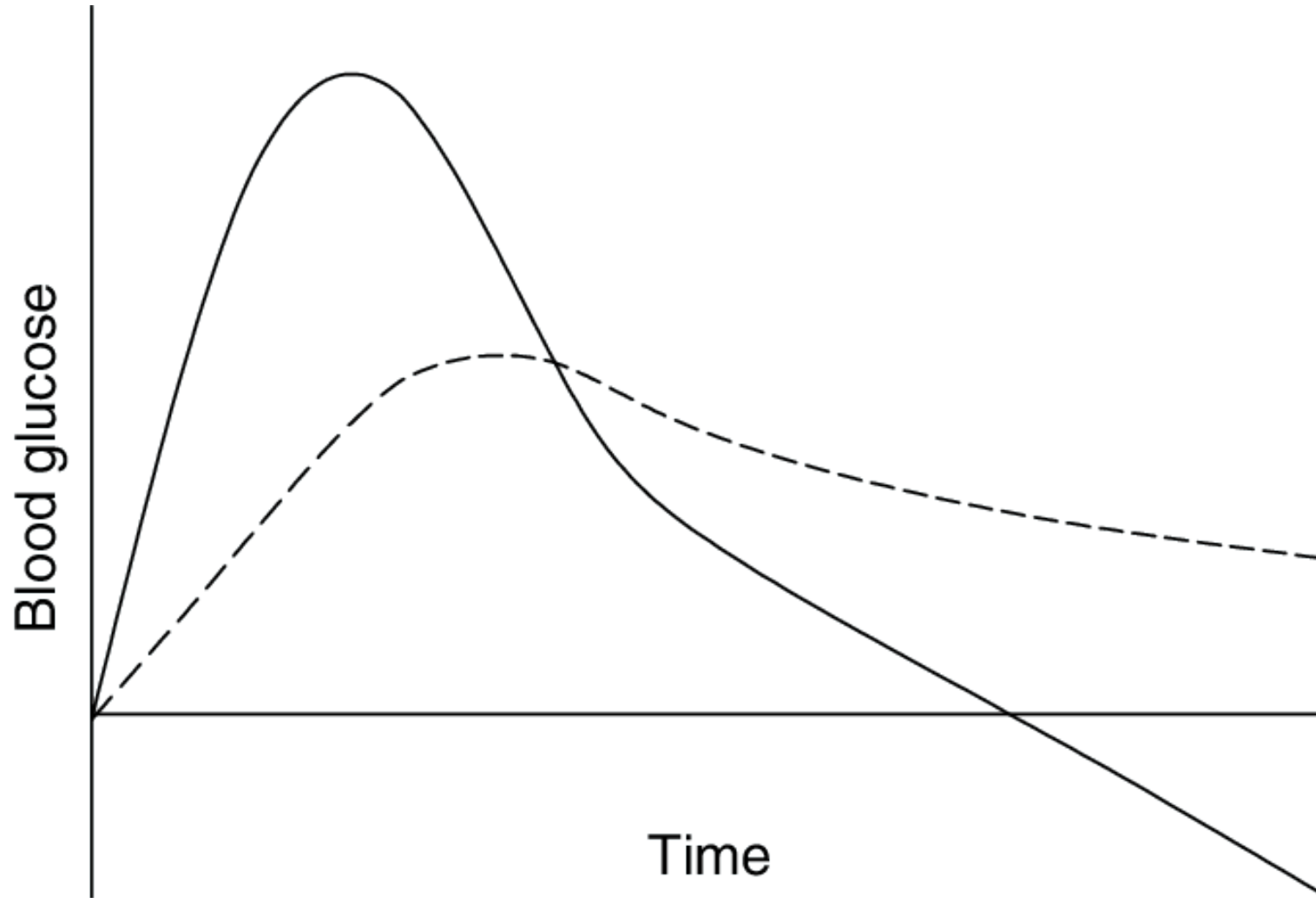


312 adults given
fish-oil capsules



Madden J *et al.* (2011) *Annu. Rev. Nutr.* **31**,
203-234

Inter-individual differences in glycaemic responses to eating



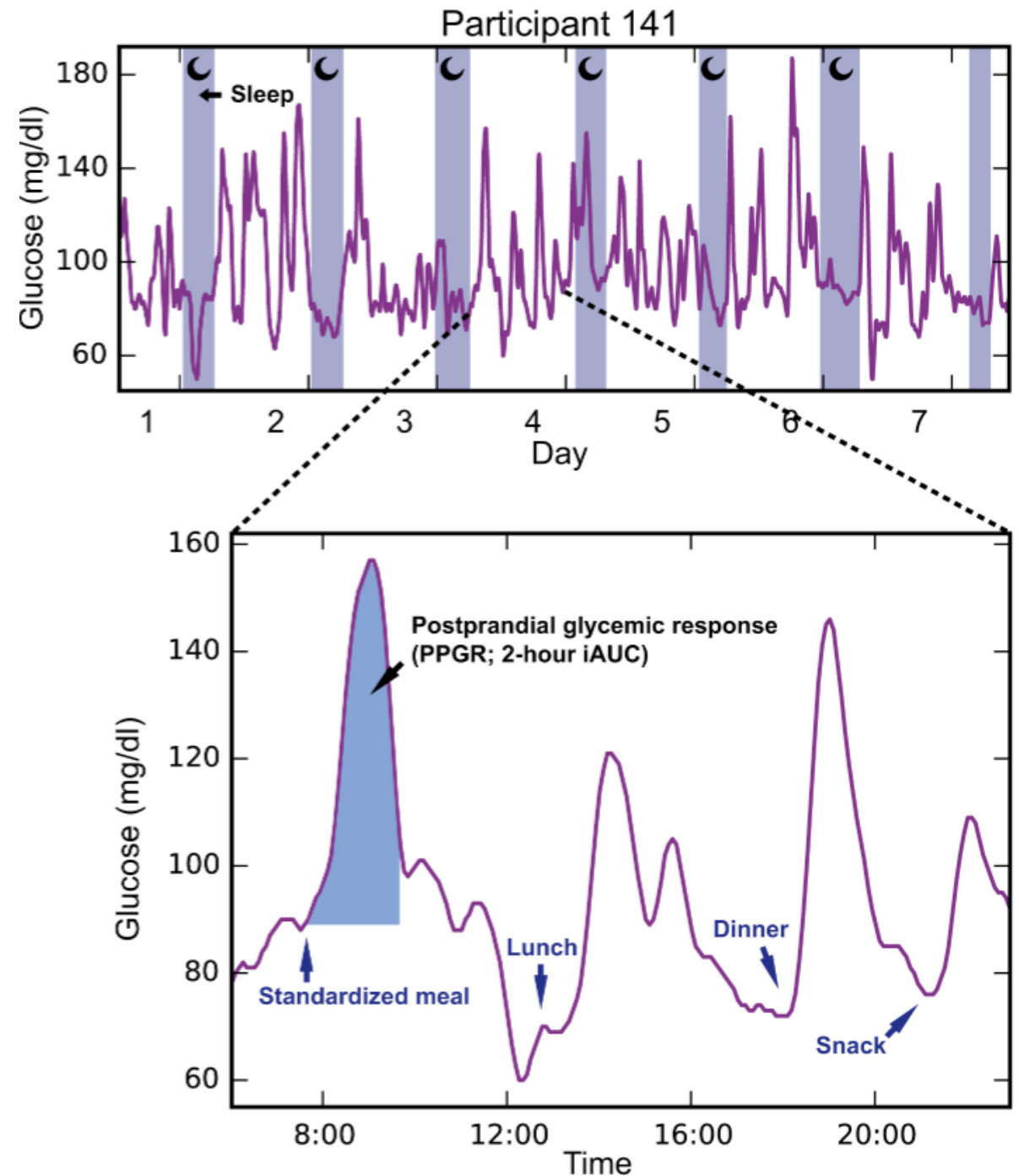
- ✓ Easy to measure
- ✓ Low burden for participants
- ✓ May be related to health outcomes
- ✓ Differs between people



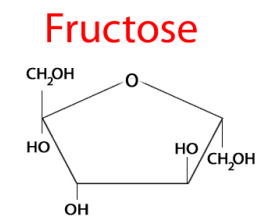
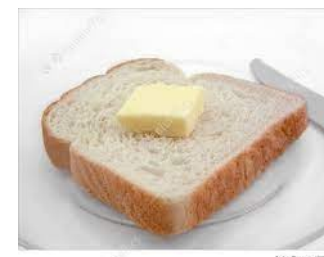
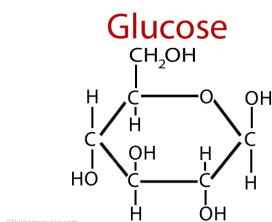
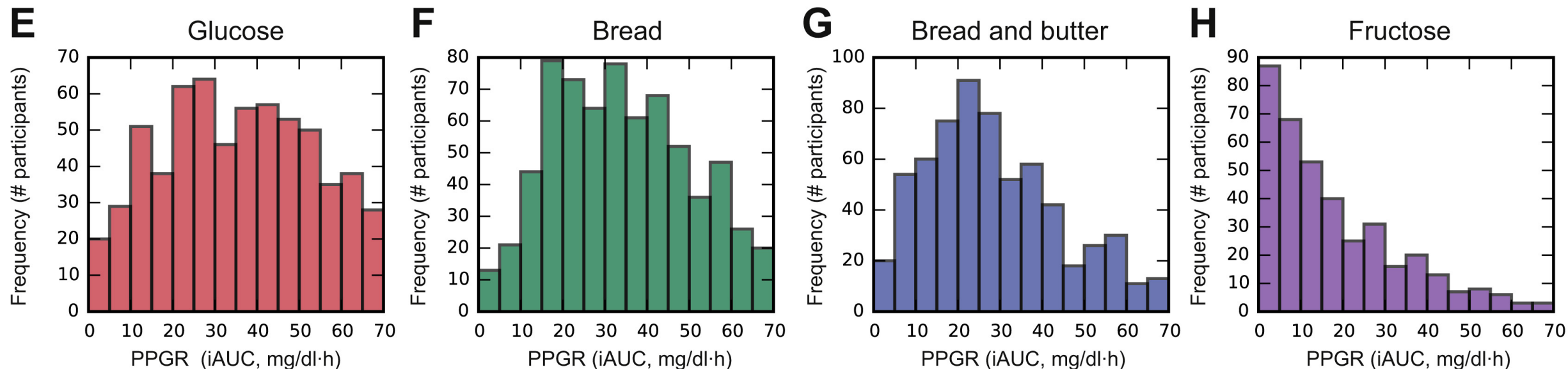
Continuous monitoring of (blood) glucose concentration to estimate glycaemic responses



Zeevi D *et al.* (2016) *Cell* **163**, 1079-1094

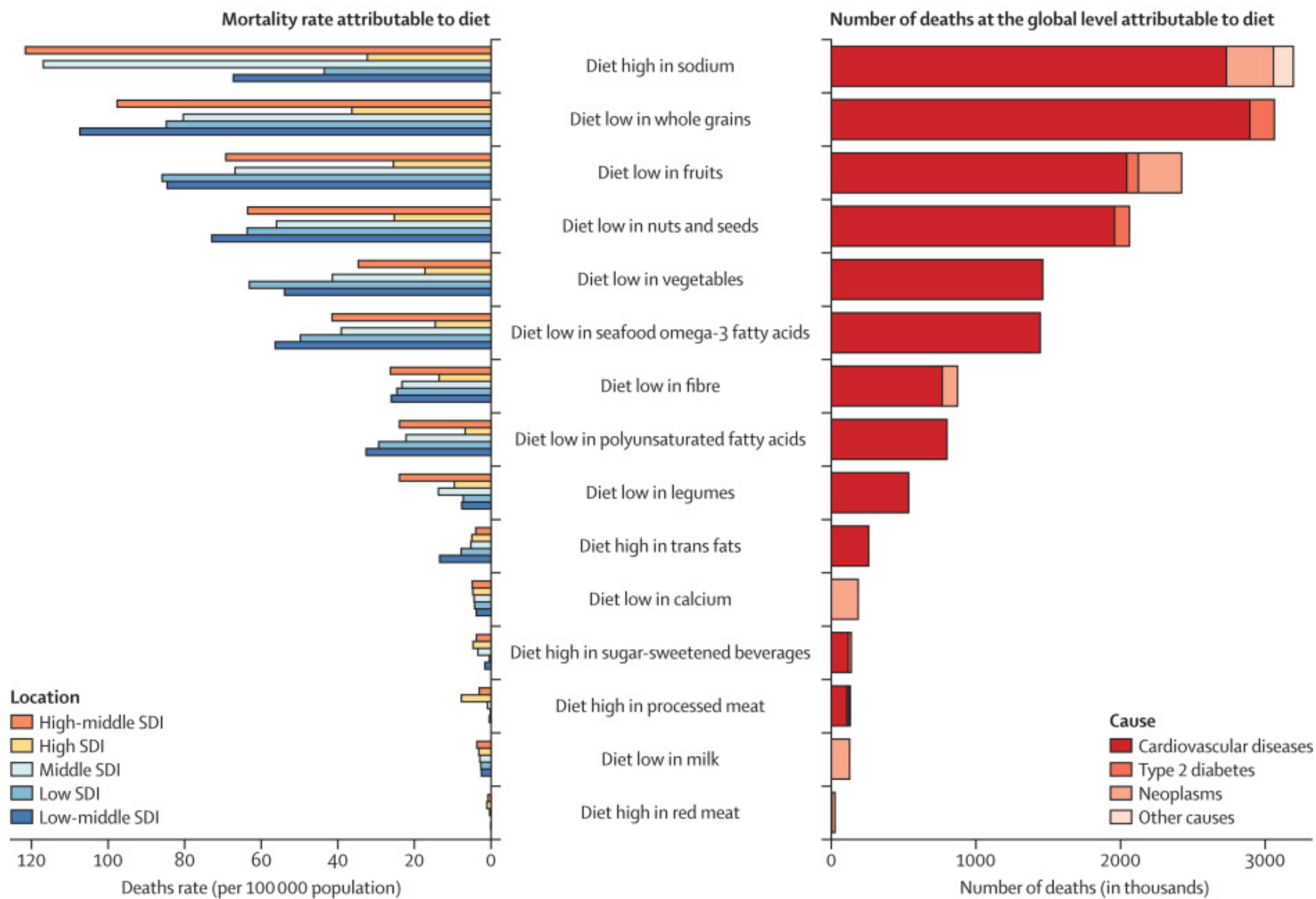


Inter-individual variability in glycaemic response (PPGR) to specific foods and nutrients



Towards better public health

Diet is major contributor to health



GBD 2017 Diet
Collaborators (2019)
Lancet **393**, 1958-1972

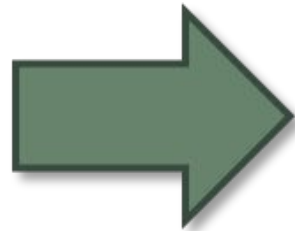


**The challenge:
to improve
everyone's
eating habits
and so
improve
public health**

Current public health approaches are relatively ineffective. Can a Precision or Personalised Nutrition approach do better?



“One size fits all”



Personalised nutrition

Definitions

Personalised Nutrition: An approach that uses information on individual characteristics to develop targeted nutritional advice, products, or services.

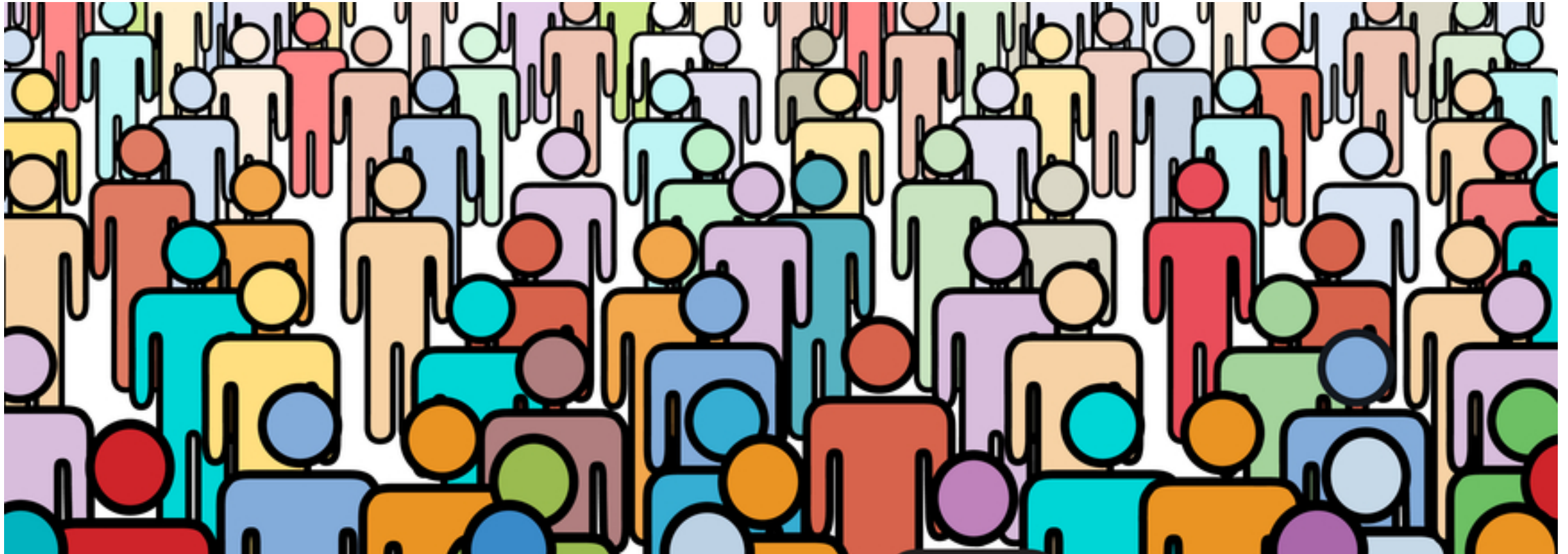
Precision Nutrition: The most ambitious*... It suggests that it is possible to have sufficient quantitative understanding about the complex relationships between an individual, his/her food consumption, and his/her phenotype (including health) to offer nutritional intervention/advice, which is known to be individually beneficial.

* Demands much greater scientific certainty



Key questions

- What is the (biological) basis for this inter-individual variation?

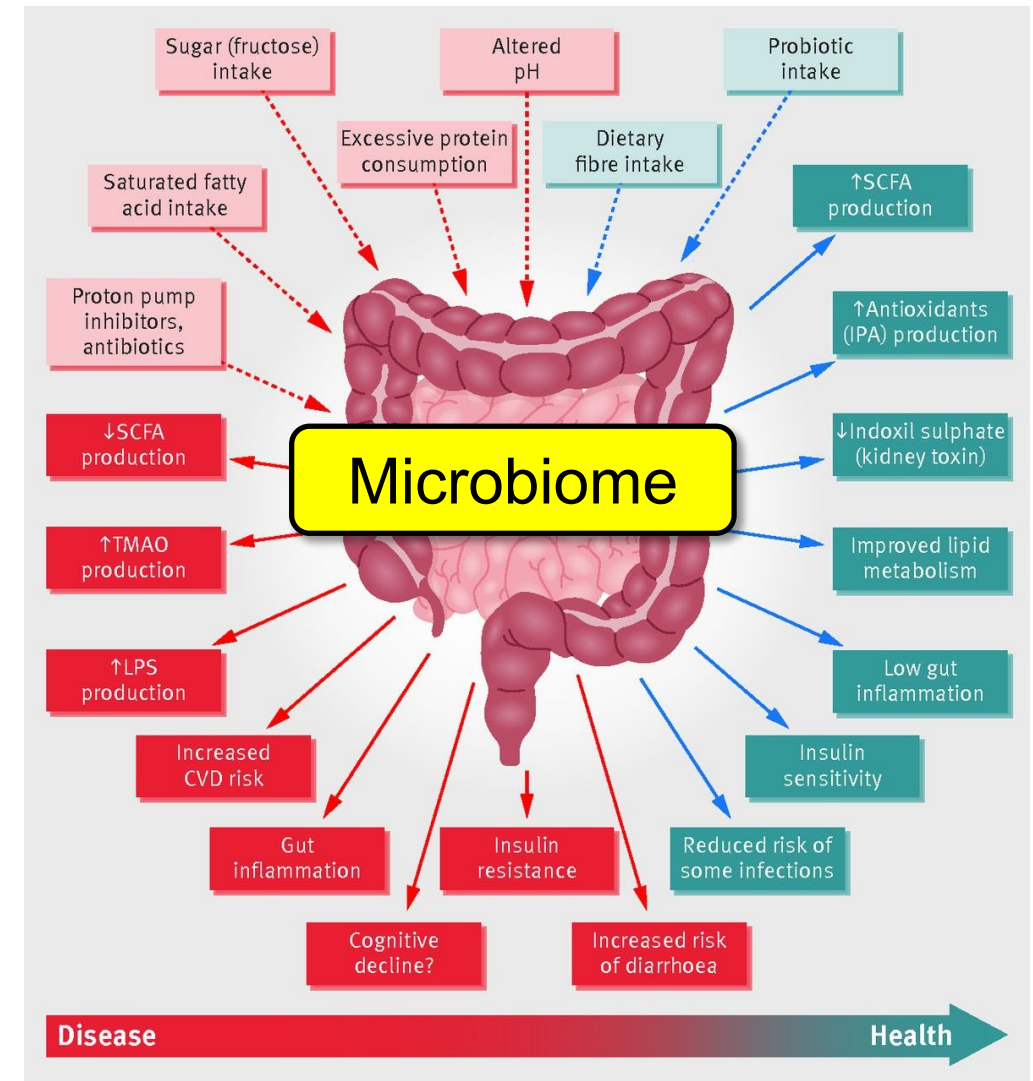
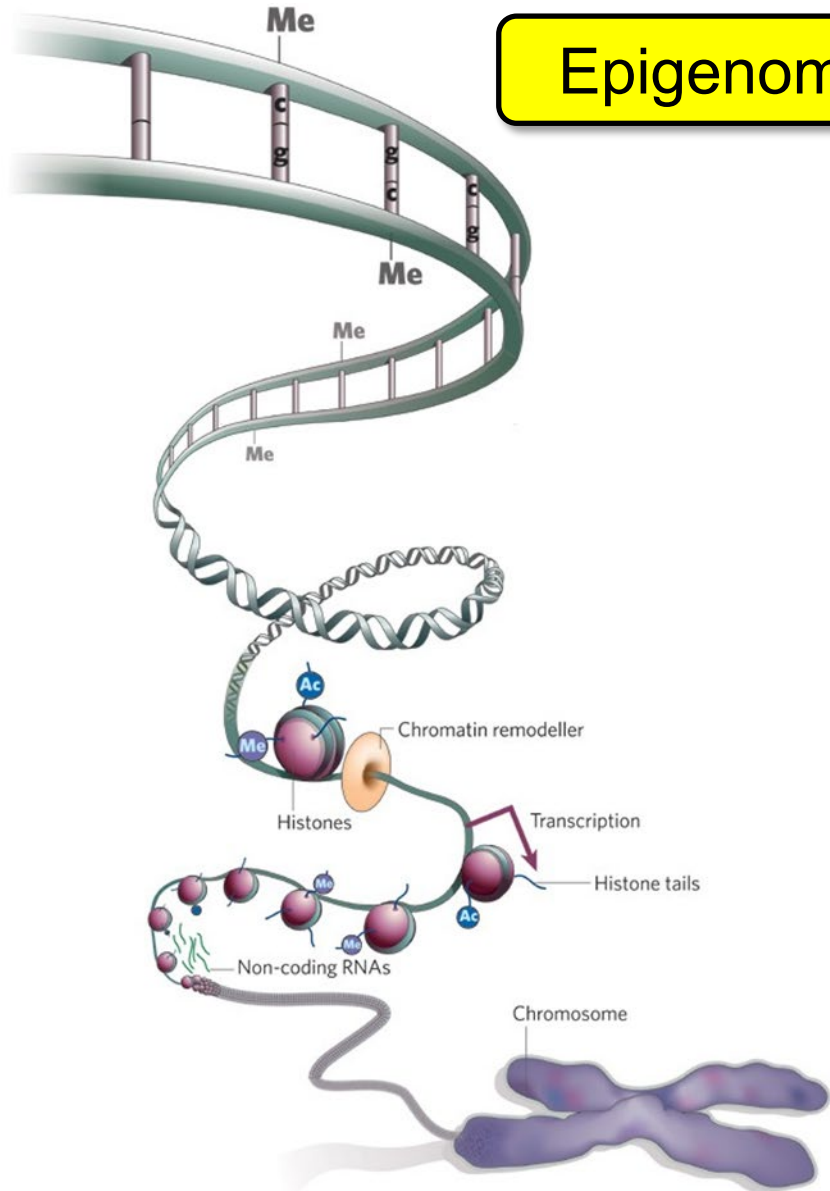


- Could knowledge of the (biological) basis of inter-individual variation be used to develop more effective Personalised or Precision nutrition?

Genotype matters

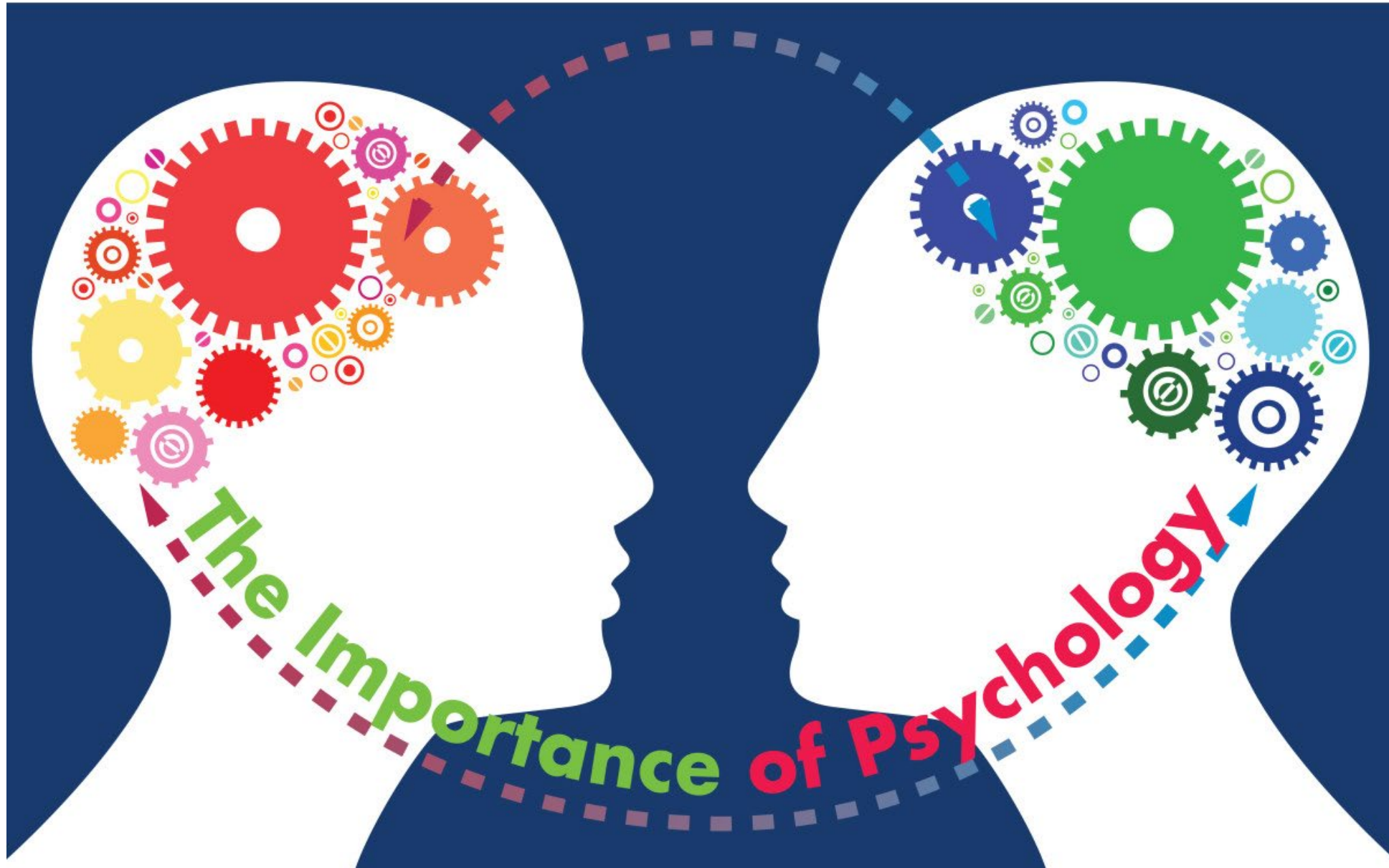


Other relevant biological factors

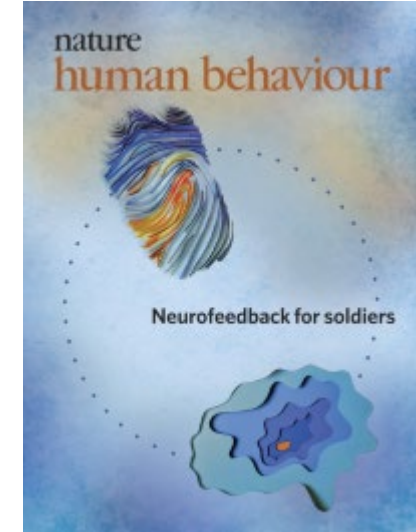
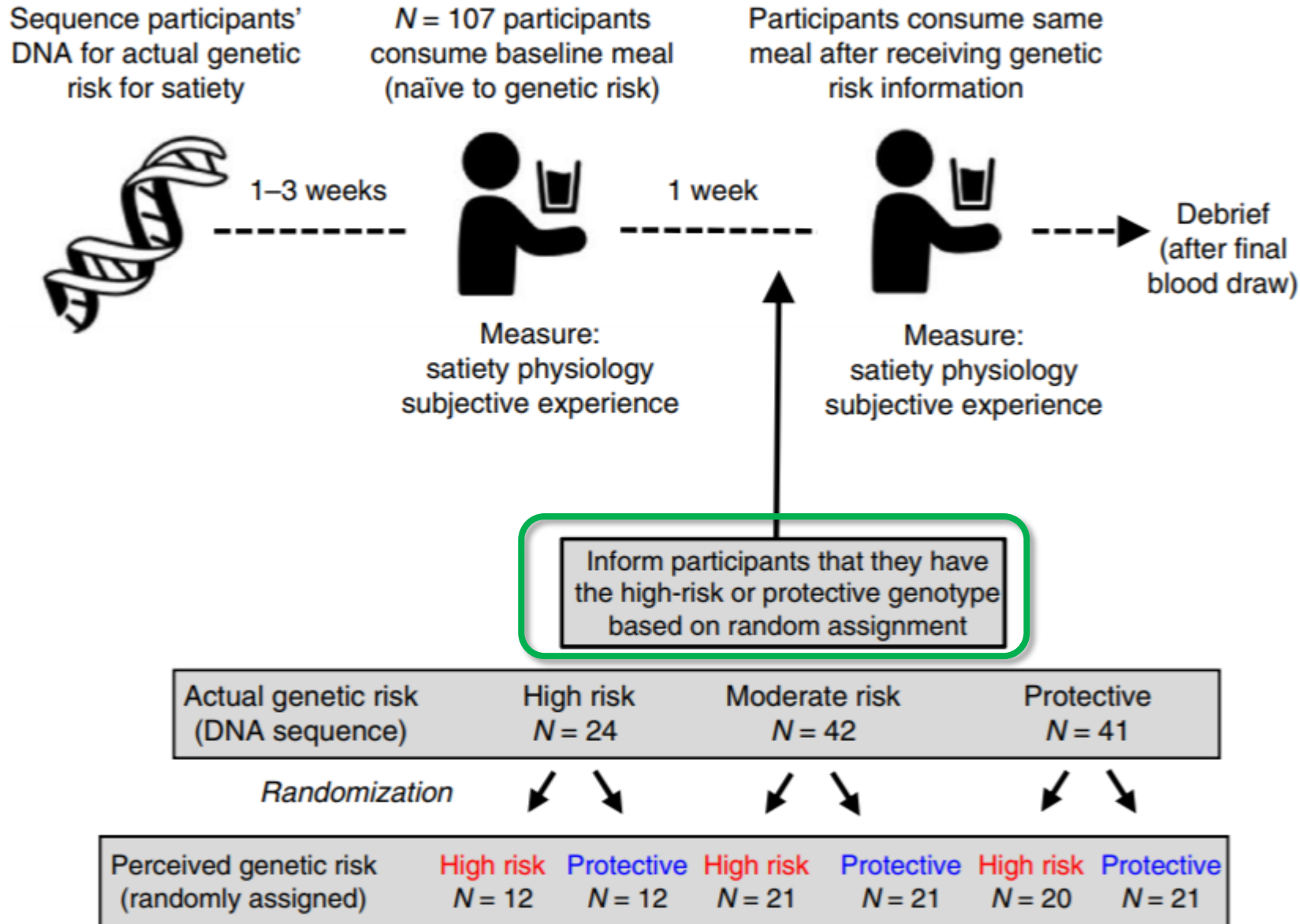


Valdes AM *et al.* (2018) *BMJ* **361**: k2179

Psychology matters



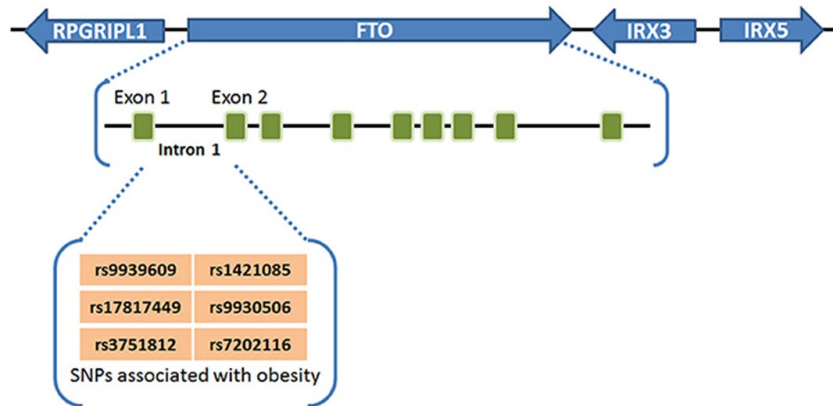
Effect of “knowledge” of genetic risk on satiety



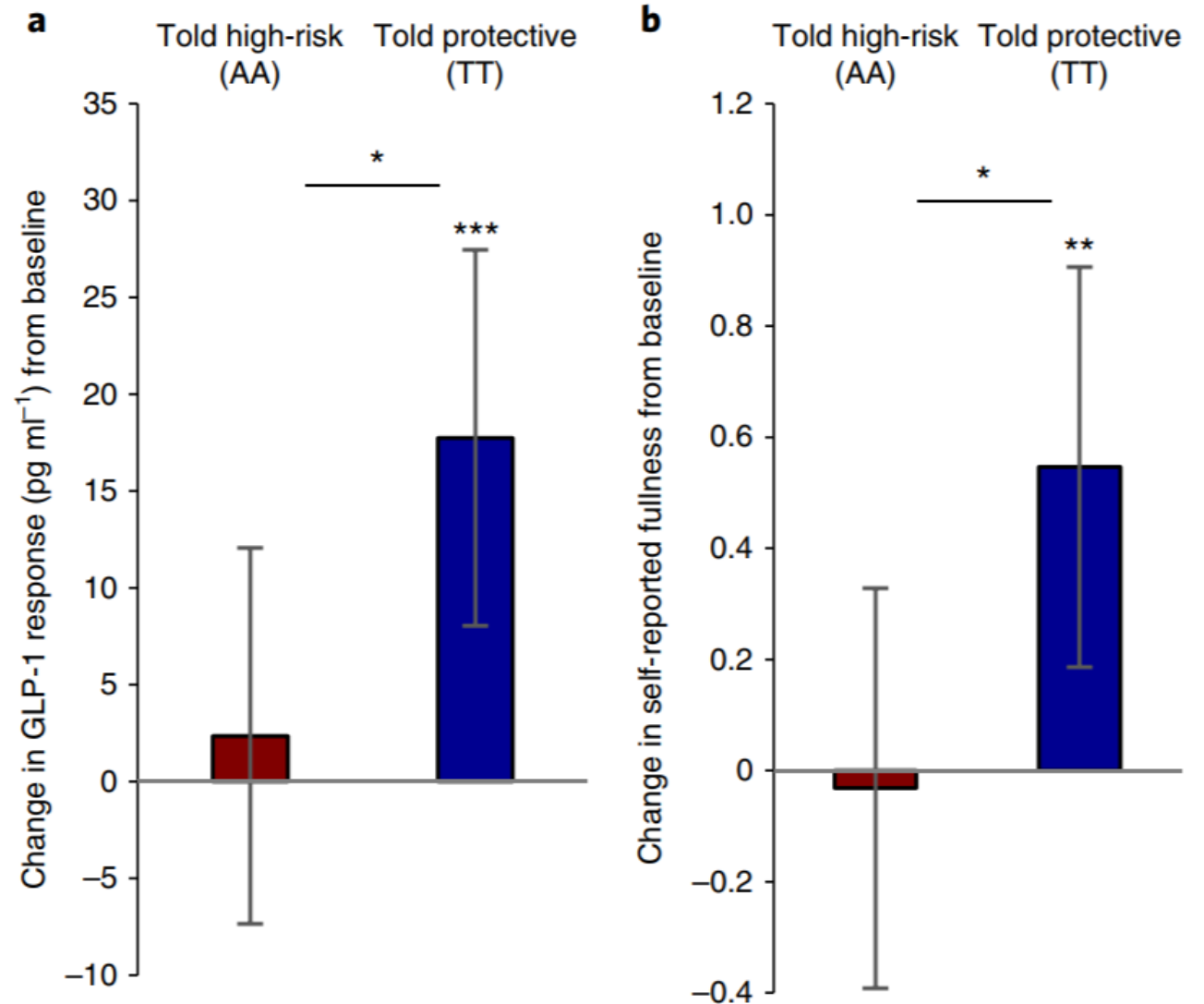
Turnwald BP *et al.* (2019) *Nature Human Behaviour* 3, 48-56.

Being informed of low genetic risk $\uparrow$ physiological response and satiety perception after eating

“Test” gene = *FTO*



Turnwald BP *et al.* (2019) *Nature Human Behaviour* 3, 48-56.



What are the implications for using genetic information in design of Precision or Personalised Nutrition interventions?

nature
human behaviour

LETTERS

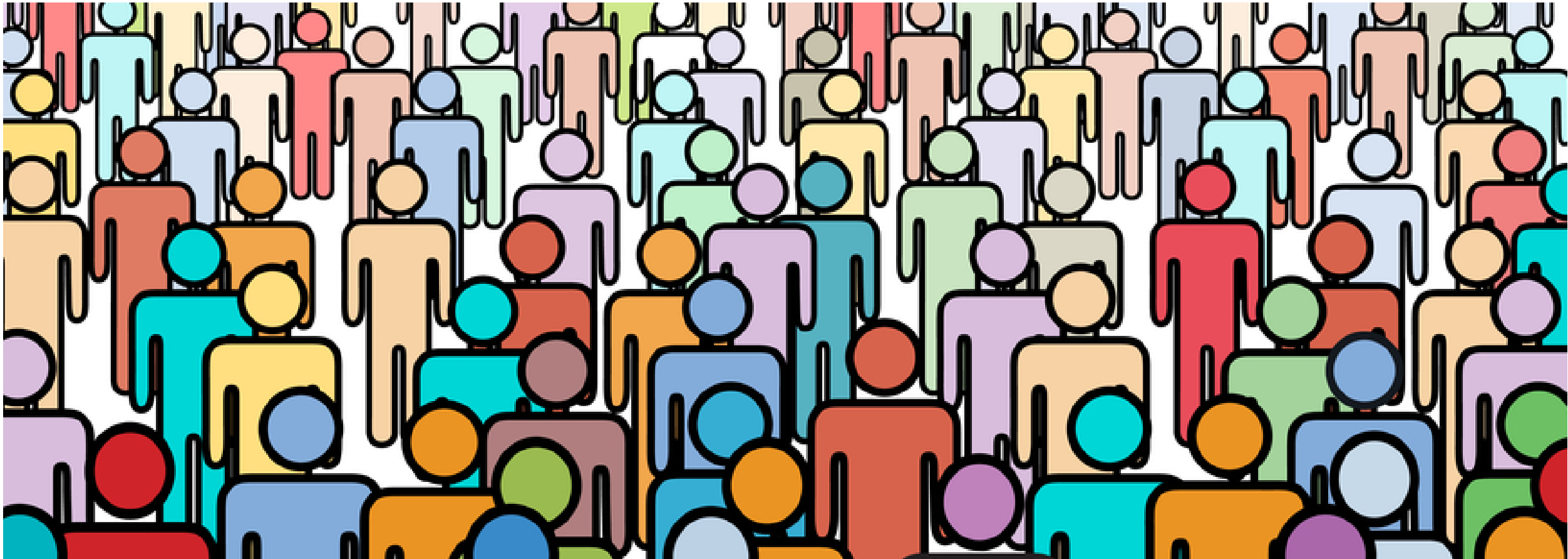
<https://doi.org/10.1038/s41562-018-0483-4>

Learning one's genetic risk changes physiology independent of actual genetic risk

Bradley P. Turnwald ^{1*}, J. Parker Goyer¹, Danielle Z. Boles¹, Amy Silder², Scott L. Delp² and Alia J. Crum¹

Further questions for personalised nutrition

- What is the basis for inter-individual variation in responses to diet?



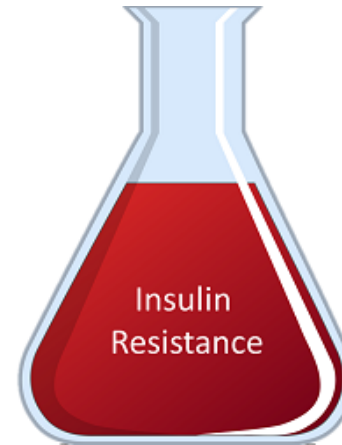
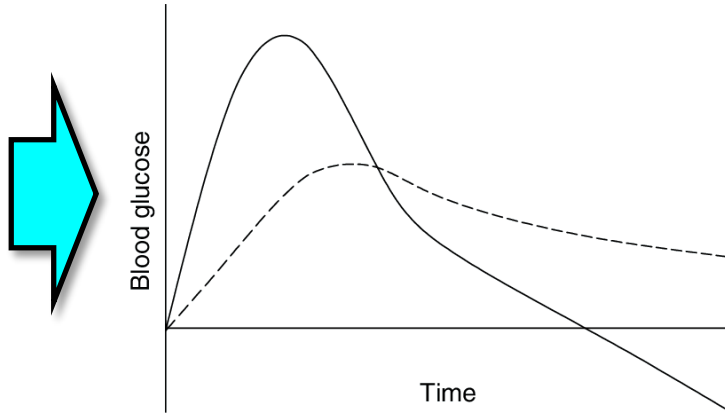
Time-scale matters



JANUARY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	FEBRUARY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28	MARCH S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	APRIL S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
MAY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	JUNE S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	JULY S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	AUGUST S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
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Importance of biology depends on outcome

Inter-individual variation

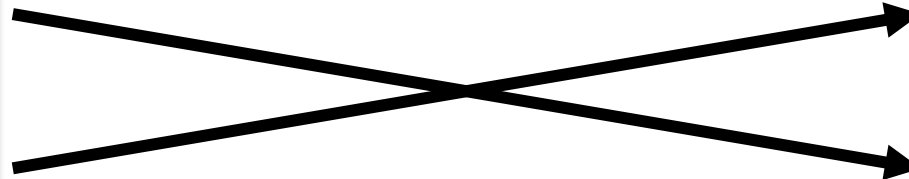


Diabetes



Biology

Psychology
Social factors



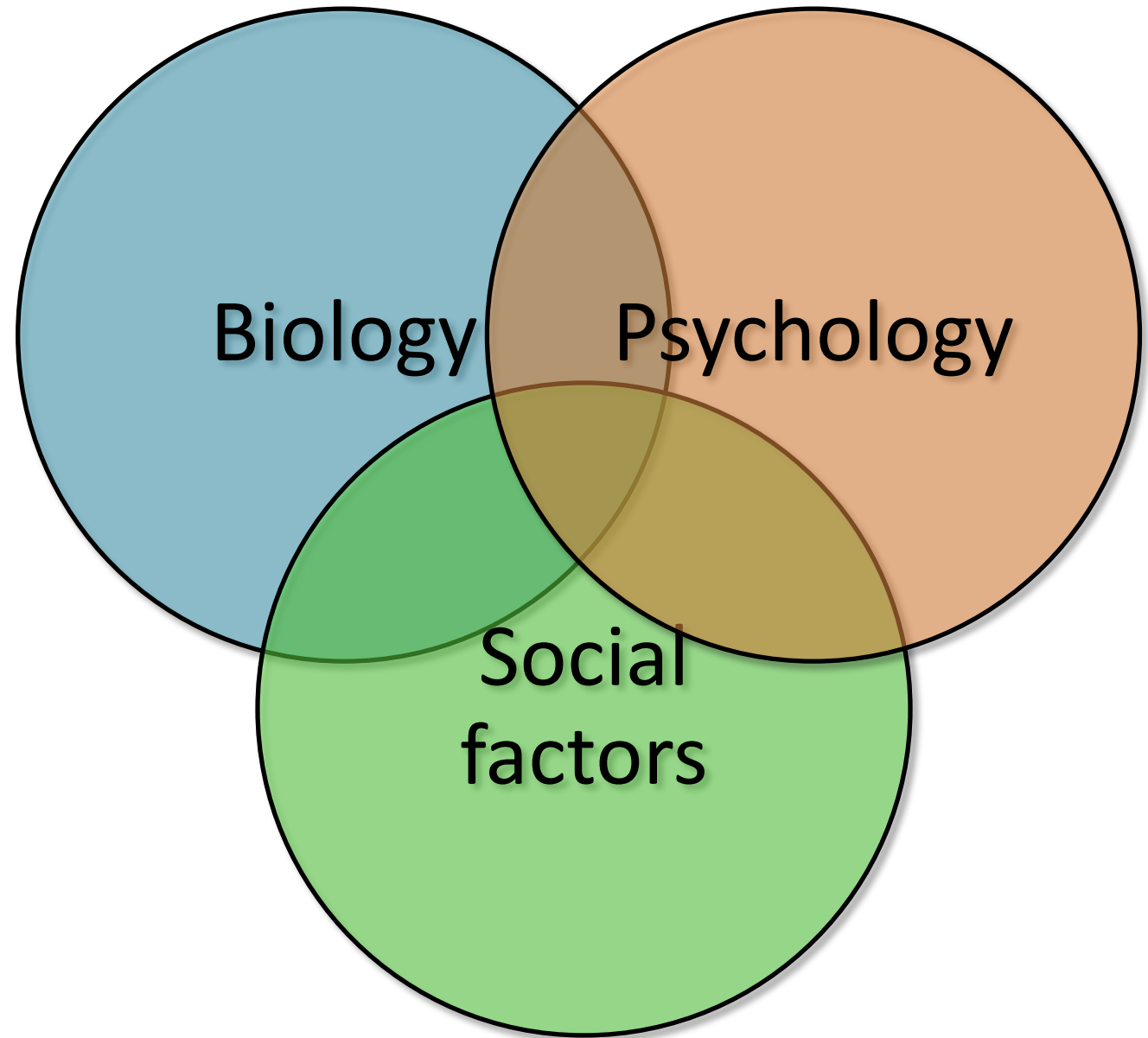
Social factors

Psychology
Biology

Contributing factors

**Causes of inter-
individual
variation:**

**Biopsychosocial
model**



Translation in Precision and Personalised Nutrition

Why should individuals engage with Precision or Personalised Nutrition?



We have different aims/ ambitions



We have different likes and dislikes



Inter-individual variation in food preferences

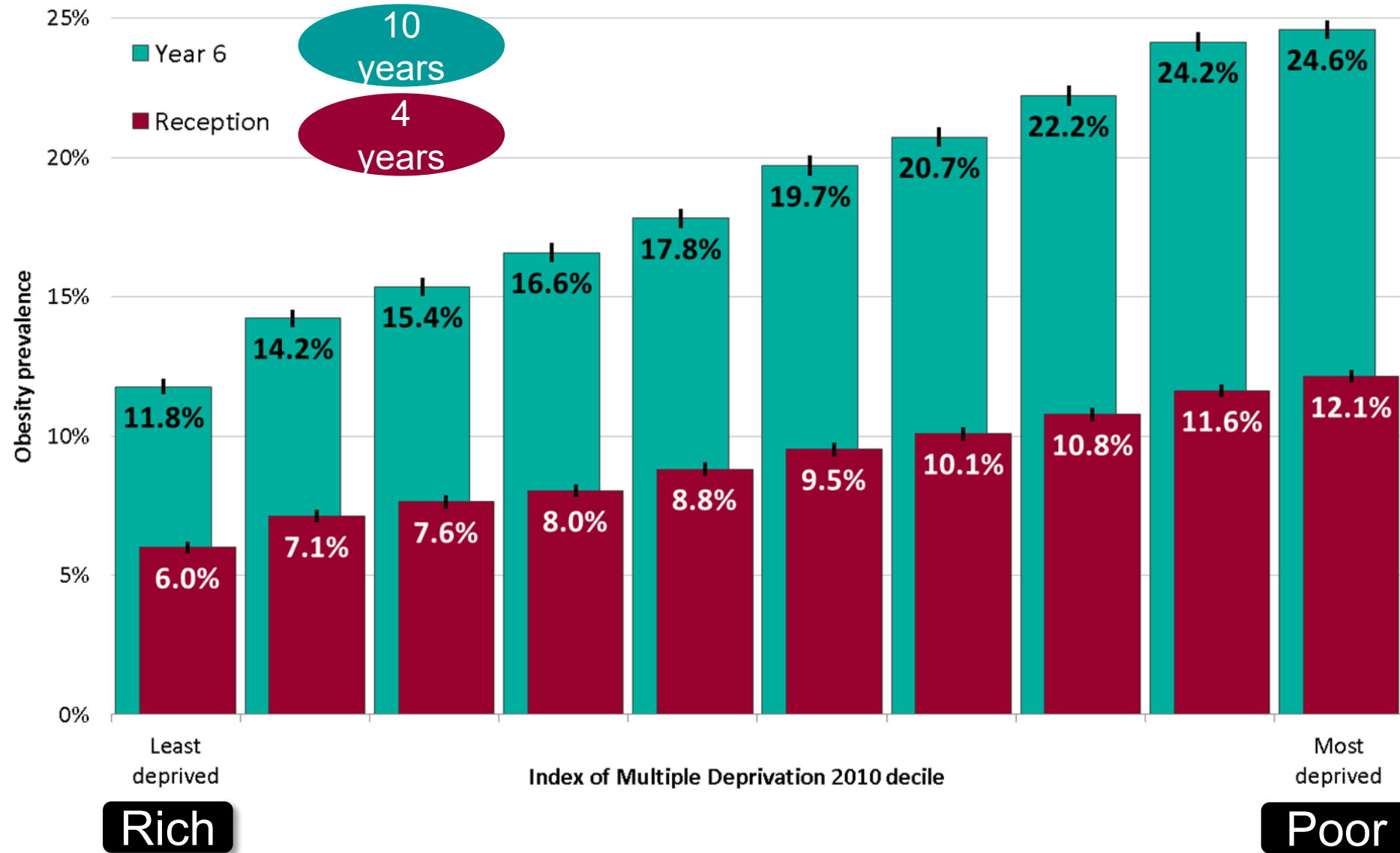


Individual barriers and facilitators for dietary change



Inequity in diet and health

Deprivation drives obesity risk in children in the UK

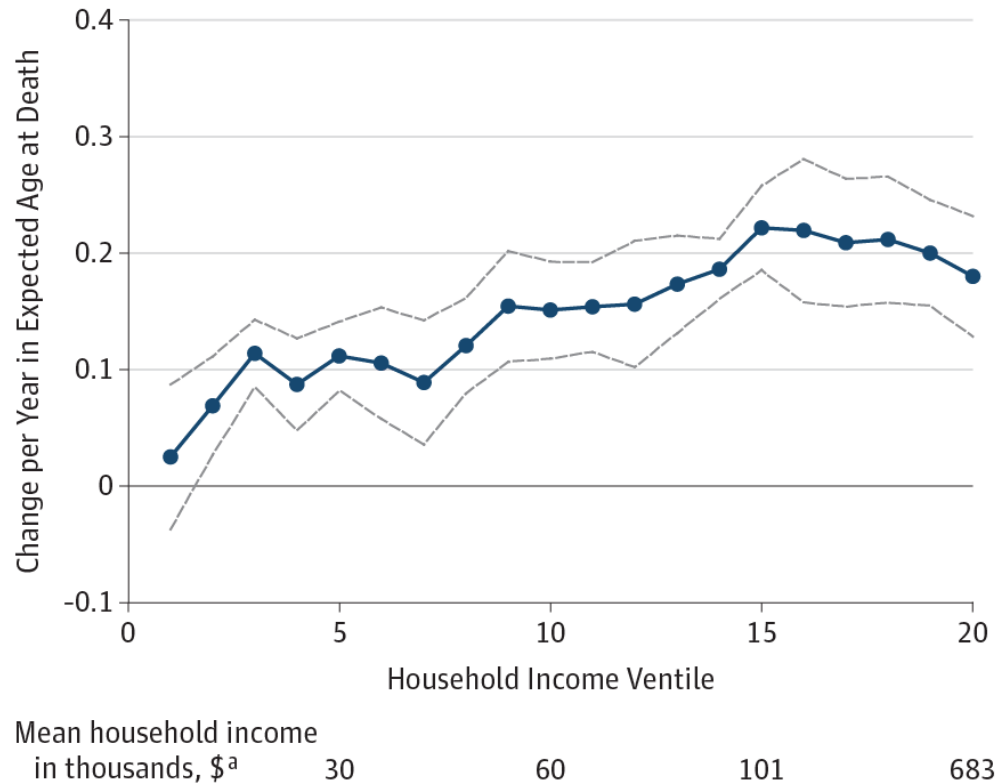


No change in life expectancy for poorest between 2000 and 2014 in USA

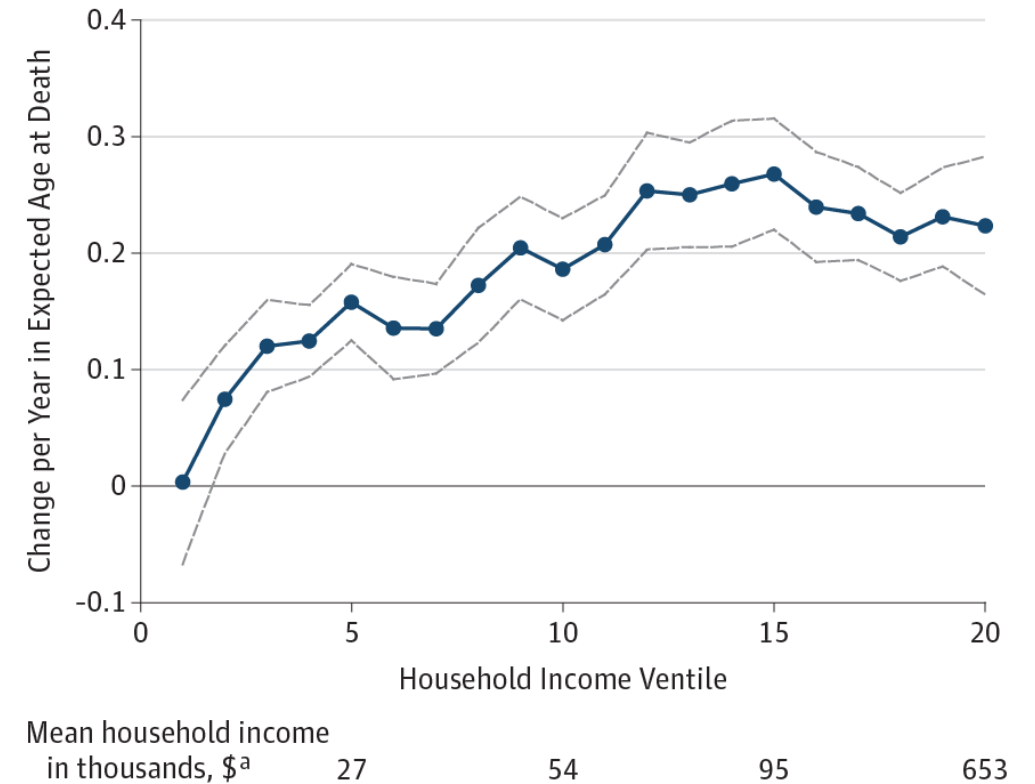


B Mean annual change in life expectancy

Men



Women



Chetty R *et al.* (2016) *JAMA* **315**, 1750-1766

Addressing inequity (improving opportunity)

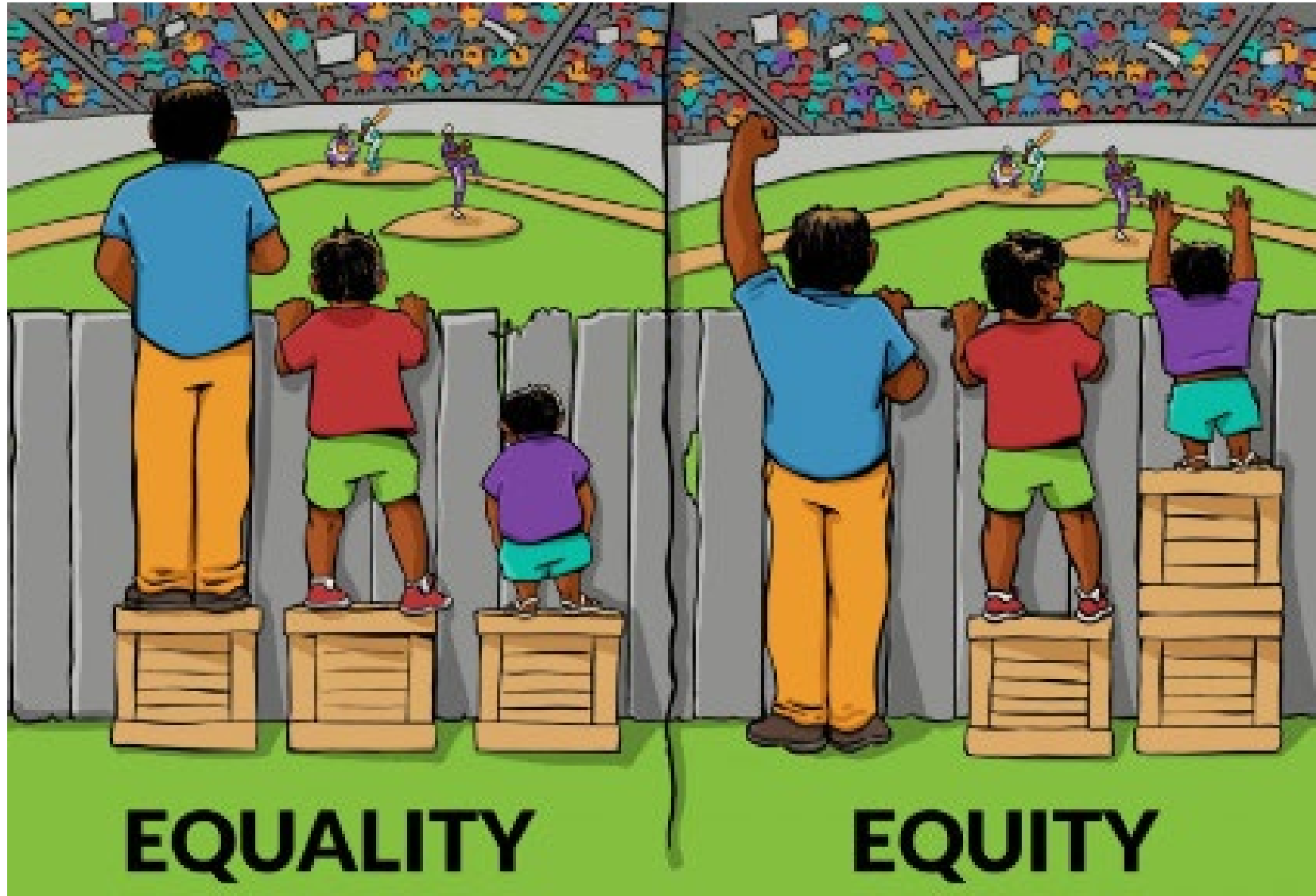
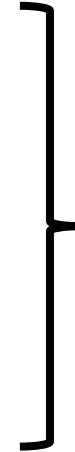


Image: Interaction Institute for Social Change | Artist: Angus Maguire. Available @ madewithangus.com.

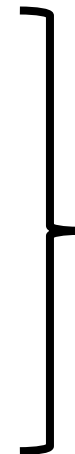
Challenges for Precision and Personalised Nutrition

- ✓ Be more accessible
- ✓ Be more attractive and acceptable
- ✓ Motivate and create opportunity



For the
individual

- ✓ Have greater reach
- ✓ Be more affordable and cost effective
- ✓ Be sustainable



For society

Personalised Nutrition approaches can improve dietary intake



Celis-Morales C *et al.* (2017) *Int. J. Epidemiol.* **46**, 578-588

11
studies

REVIEW



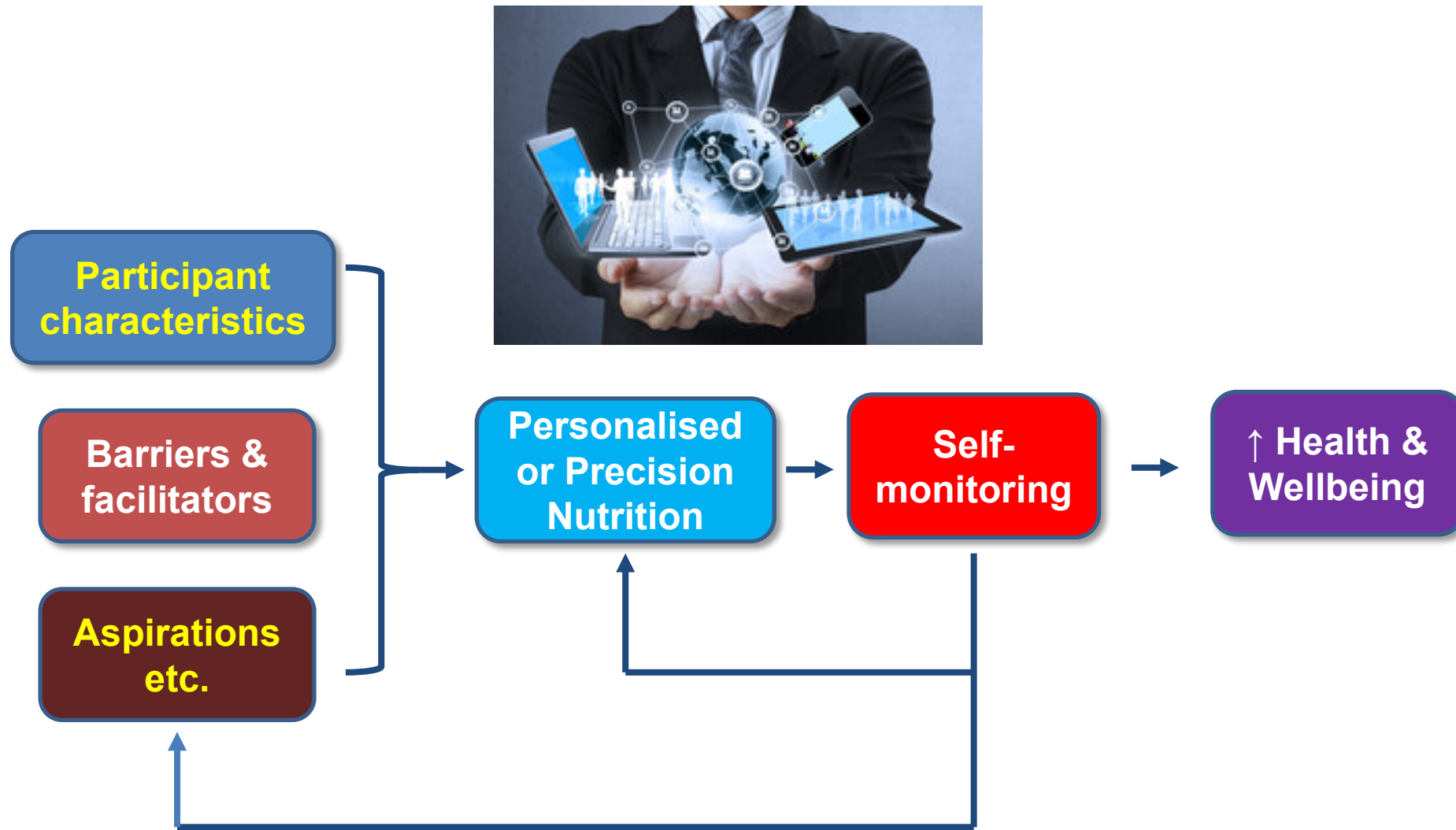
Does Personalized Nutrition Advice Improve Dietary Intake in Healthy Adults? A Systematic Review of Randomized Controlled Trials

Rachael Jinnette,¹ Ai Narita,¹ Byron Manning,¹ Sarah A McNaughton,² John C Mathers,³ and Katherine M Livingstone²

¹School of Exercise and Nutrition Sciences, Deakin University, Geelong, Australia; ²Institute for Physical Activity and Nutrition, School of Exercise and Nutrition Sciences, Deakin University, Geelong, Australia; and ³Human Nutrition Research Centre, Centre for Healthier Lives, Population Health Sciences Institute, Newcastle University, Newcastle on Tyne, United Kingdom

Jinnette R *et al.* (2021) *Adv. Nutr.* **12**, 657-669

Systems approaches for more effective Precision and Personalised Nutrition



Summary

- We all differ in many different ways
- Genetic factors explain some of those inter-individual differences
- Other relevant biological factors include epigenome and microbiome
- Psychological (and sociological) factors are likely to be critical in implementing effective Precision and Personalised Nutrition strategies that improve public health
- Future developments of Precision and Personalised Nutrition should include greater focus on individual aspirations, barriers and facilitators and should address inequities

