Institute of Metabolic Science

MRC Epidemiology Unit

UNIVERSITY OF CAMBRIDGE

Modern trends, new science
Childhood Obesity

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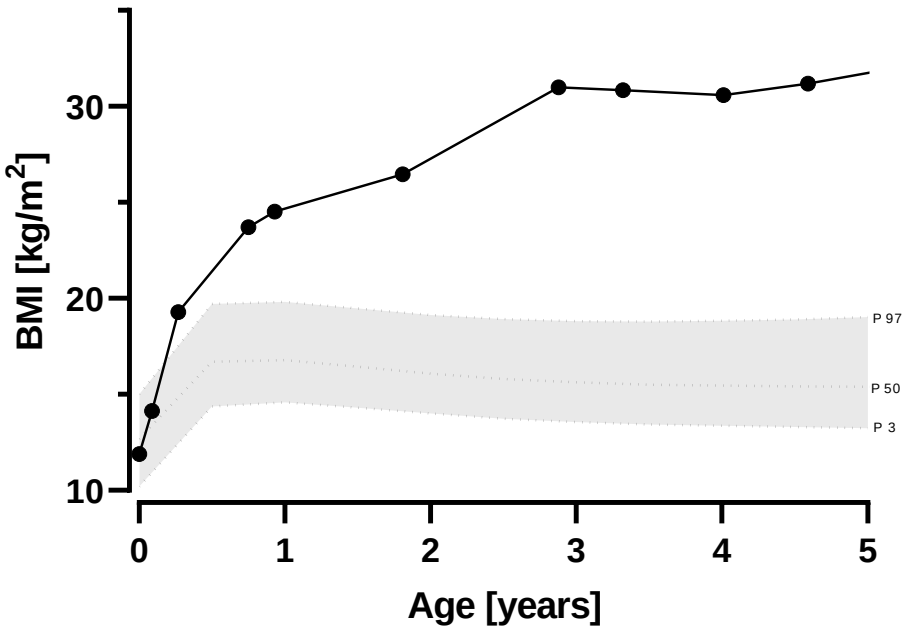
Rare monogenic causes of obesity

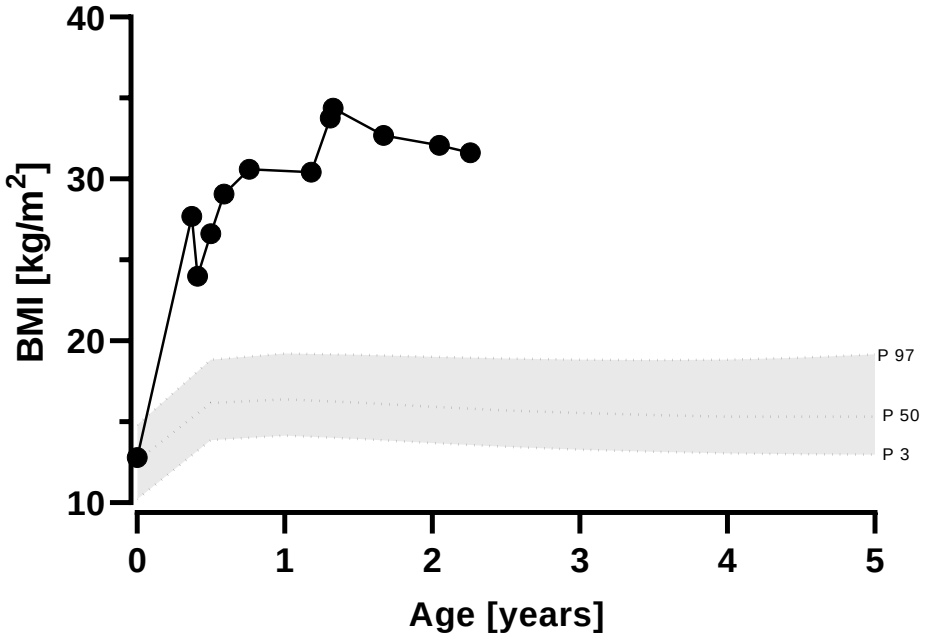
Characterised by
- Early-onset severe obesity
- Rapid weight gain from infancy
- Excessive appetite (‘hyperphagia’)

E.g.

Bioinactive Leptin mutations - Wabitsch et al. *NEJM* 2015

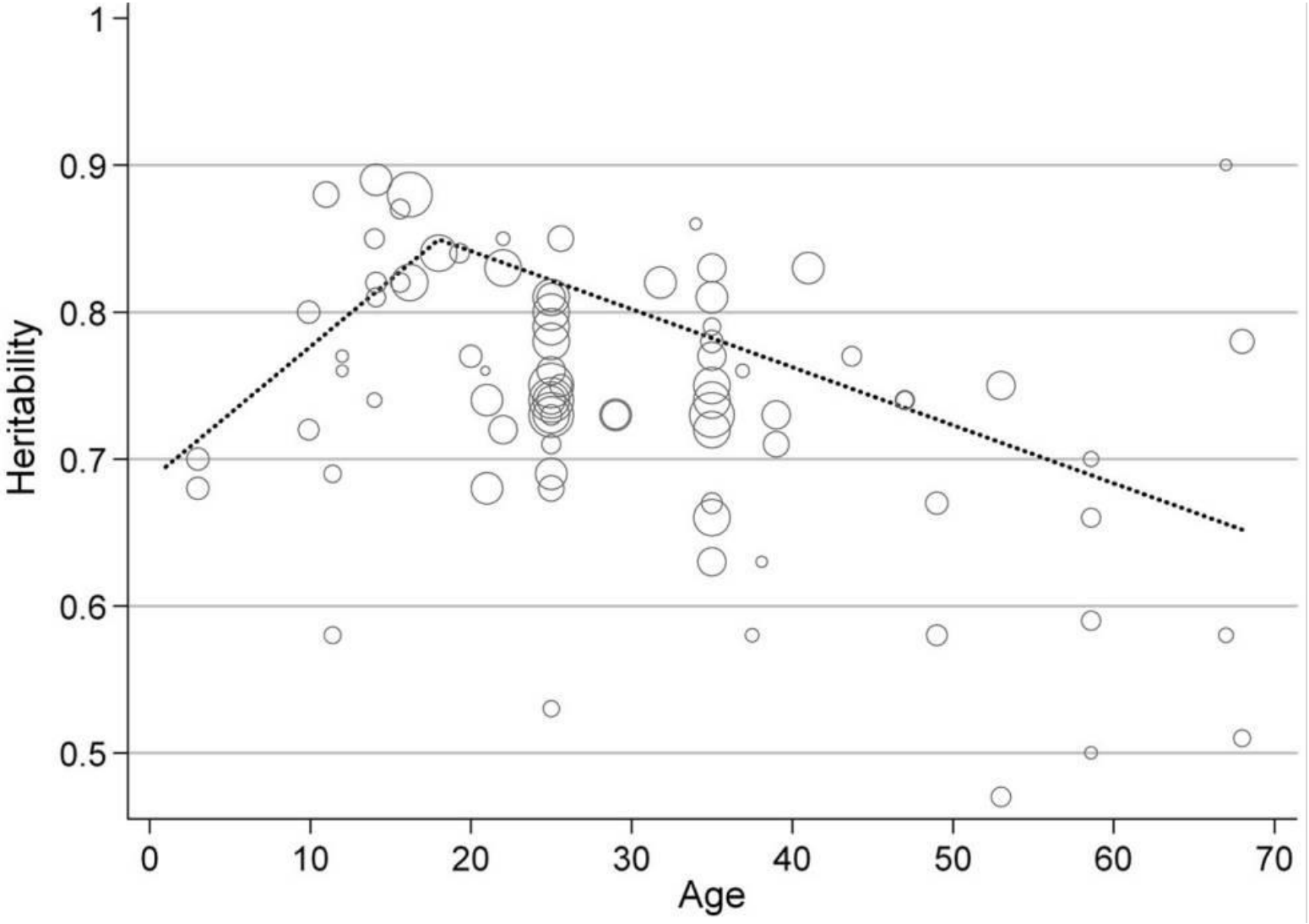
Antagonistic Leptin mutations - Funcke et al. *NEJM* 2023





Additional unpublished data to Funcke et al. *NEJM* June 2023
Prepared and shared by Stefanie Zorn and Martin Wabitsch

Heritability of BMI: a review of twins studies

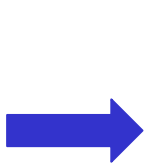


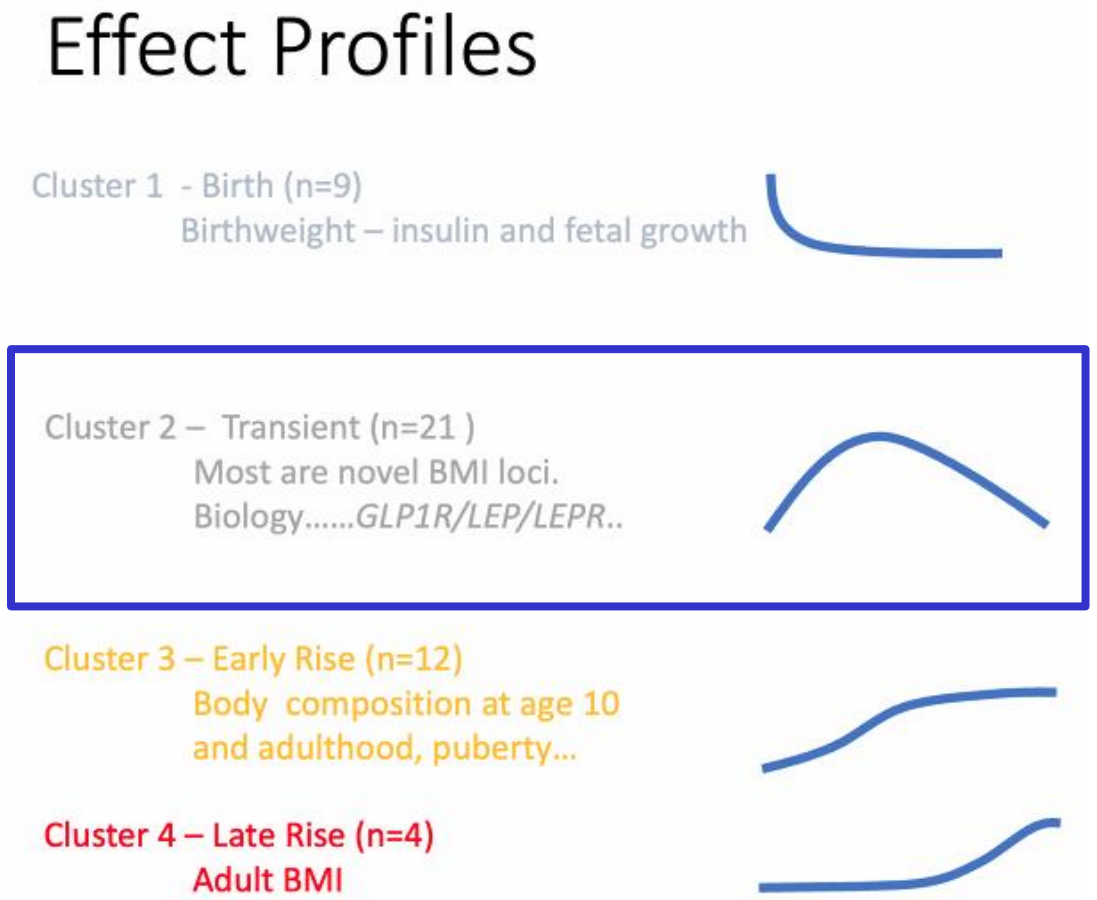
Elks et al. *Frontiers in Endocrinology* 2012

Genetic architecture of infant and early childhood BMI

Genome-wide association studies (GWAS) of BMI across 12 time points from birth to 8 years in 28,681 children in MoBa
(the Norwegian Mother and Child Cohort)

A major influence of common variation in the leptin–melanocortin system in early life



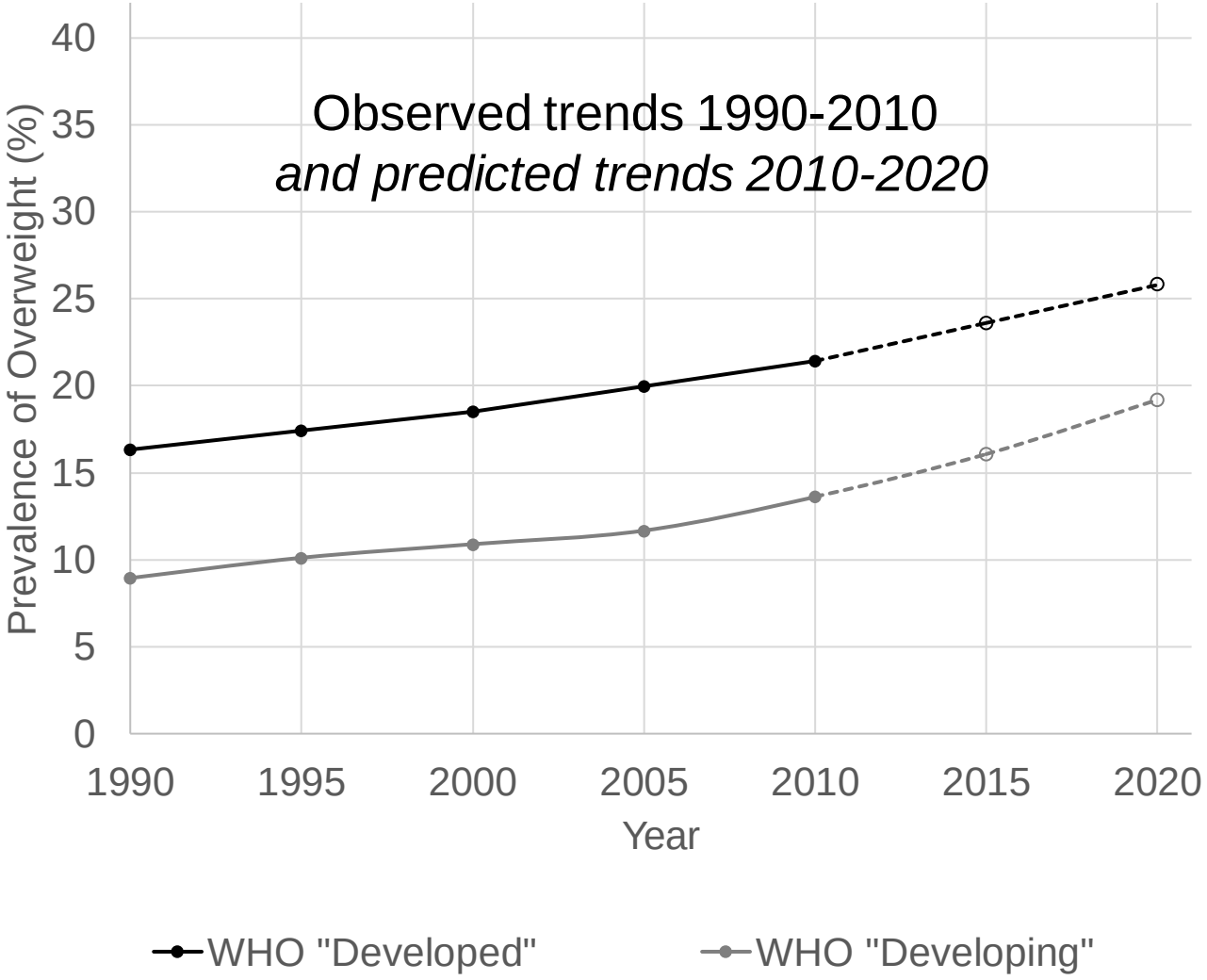


Helgeland et al. *Nature Metabolism* | March 2022 | 344–358 | www.nature.com/natmeta

Childhood co-morbidities of Childhood Obesity

- Metabolic
  - Type 2 diabetes
  - Type 1 diabetes
  - Dyslipidaemia
  - PCOS
  - Fatty Liver & Cirrhosis
- Psychosocial
  - Anxiety and Depression
  - Social isolation
  - Eating disorders
  - School absence
- Neurological
  - Benign intracranial hypertension
- Respiratory
  - Obstructive sleep apnoea
  - Asthma
  - Reduced lung capacity
- Dermatological
  - Acanthosis nigricans
  - Striae rubrae
- Orthopaedic
  - Slipped femoral epiphyses
  - Coxa vara
  - Perthes disease
  - Limited mobility

Prevalence of overweight in preschool children (BMI or Wt-F-Ht > 85th centile at 4-5 years)



de Onis et al, *Public Health Nutrition* 2010
Maessen et al, *BMJ* 2023

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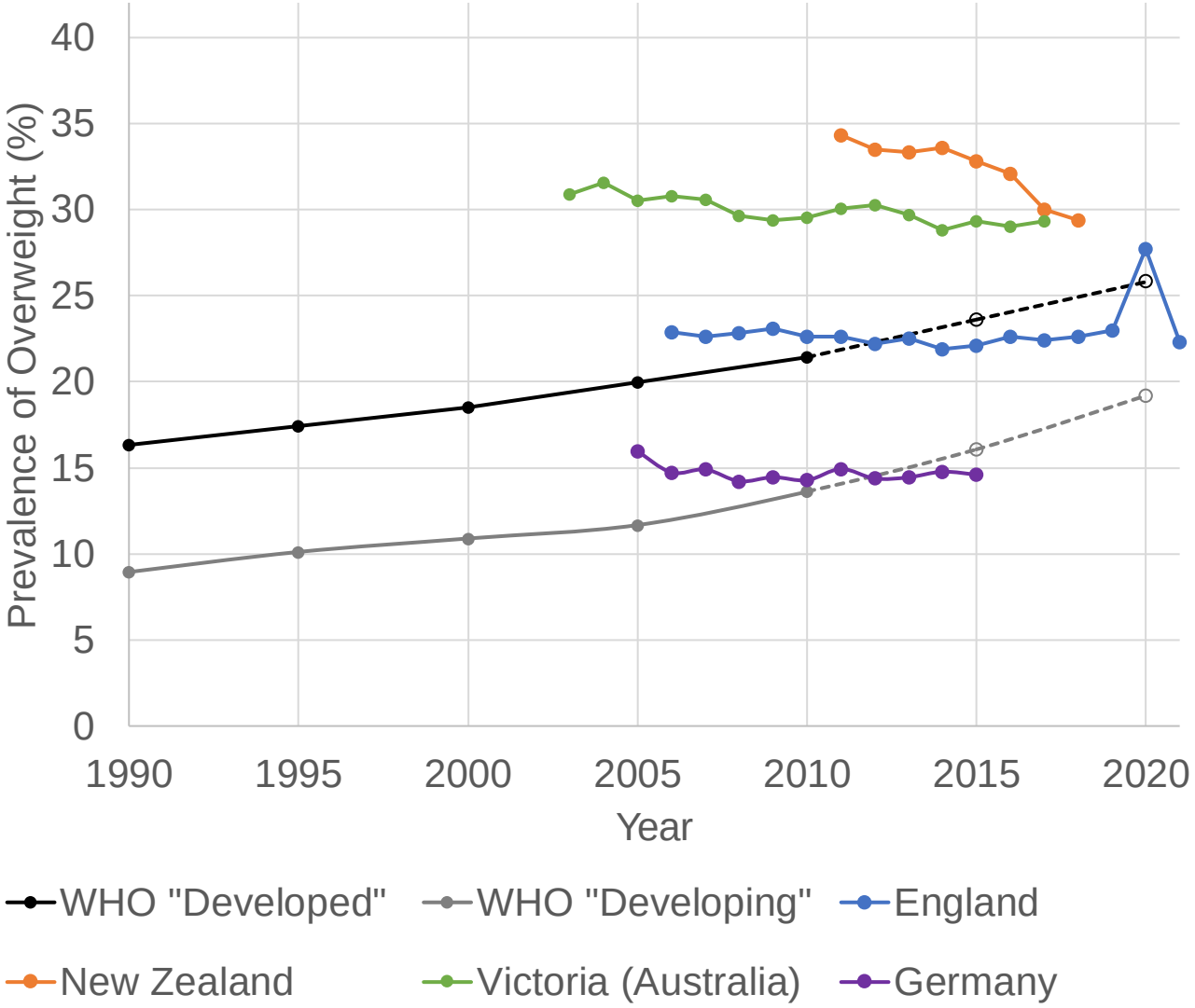


Relative reductions:

-15% in New Zealand

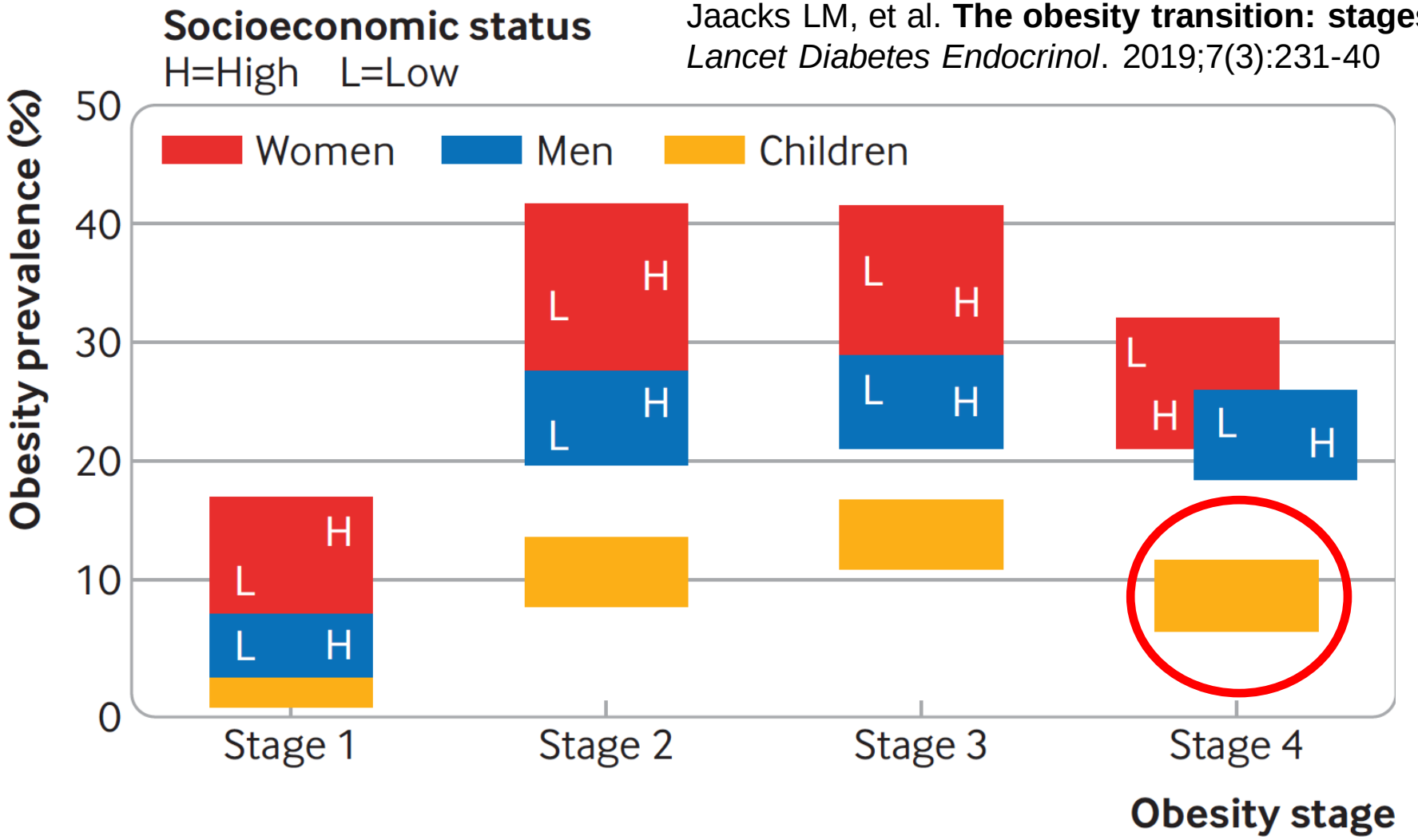
-5% in Victoria (Australia)

-3% in England

-9% in Germany

de Onis et al, *Public Health Nutrition* 2010
Maessen et al, *BMJ* 2023

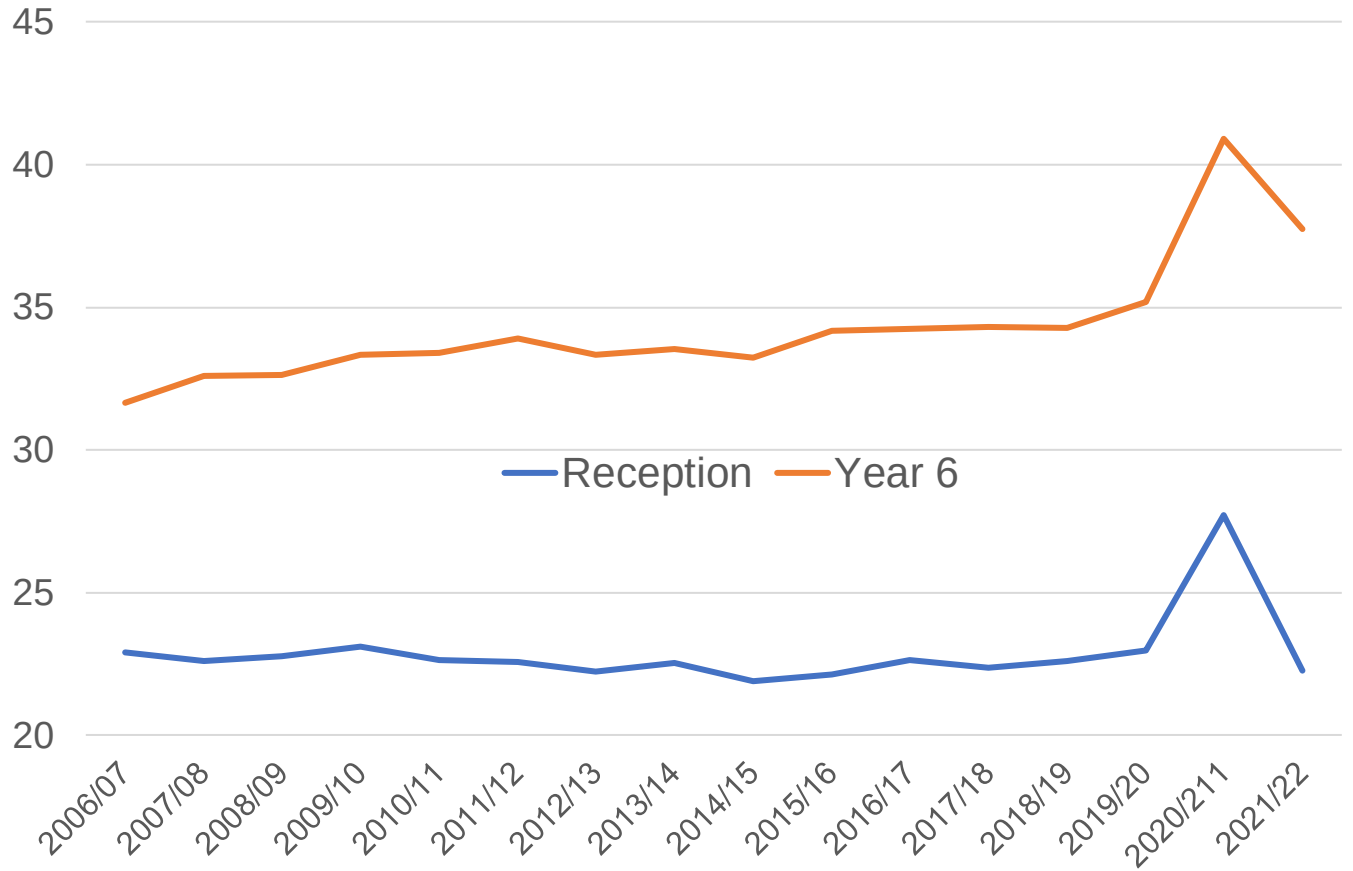
Four stages of the obesity epidemic



Reproduced with permission from:
Jaacks LM, et al. **The obesity transition: stages of the global epidemic**. *Lancet Diabetes Endocrinol*. 2019;7(3):231-40

Maessen et al, *BMJ* 2023

Prevalence of overweight in children in England



Relative changes:

+19% in Year 6 (age 10-11)

-3% in Reception (age 4-5)

National Child Measurement Programme, England, 2021/22 school year - NDRS (digital.nhs.uk)

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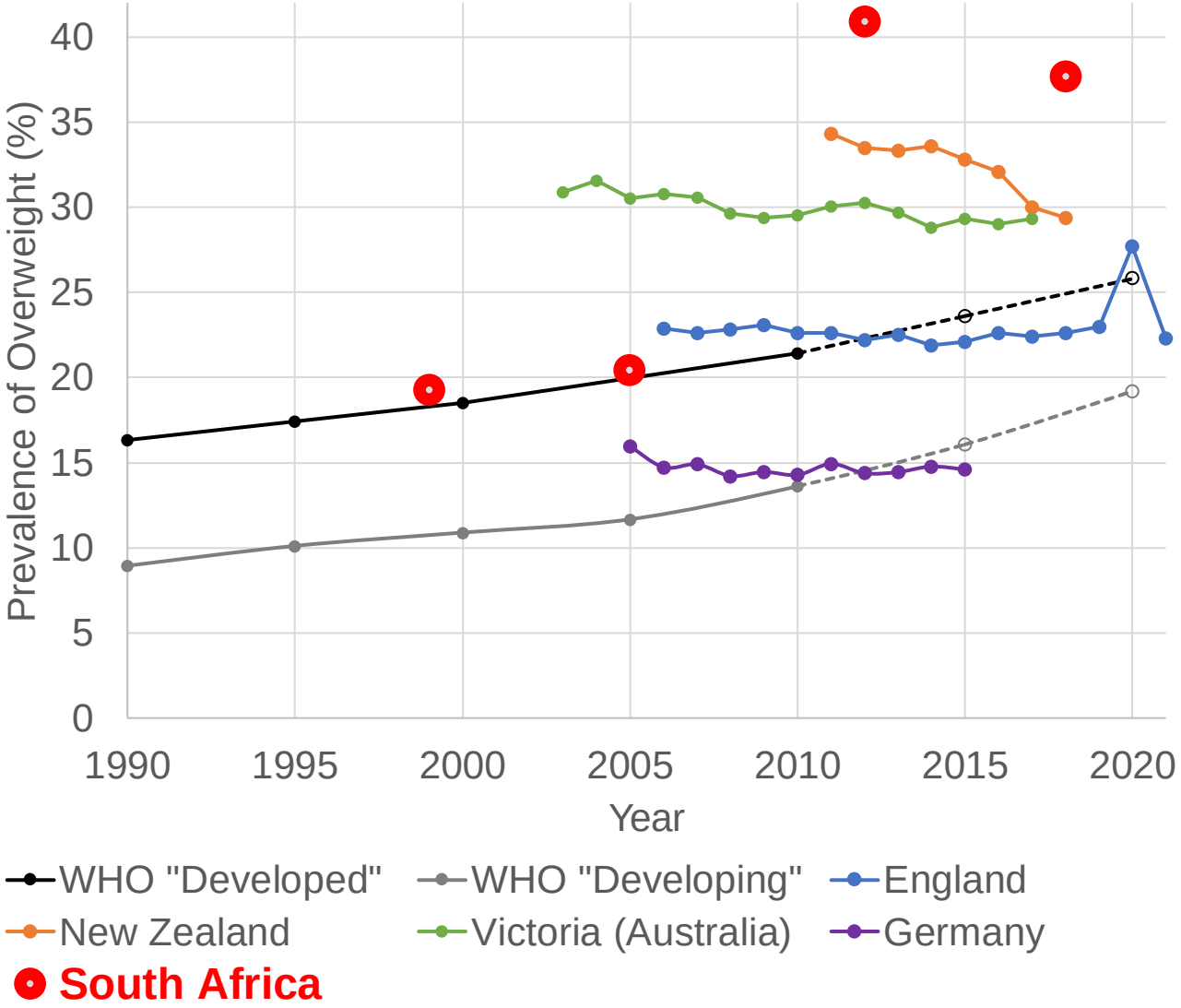

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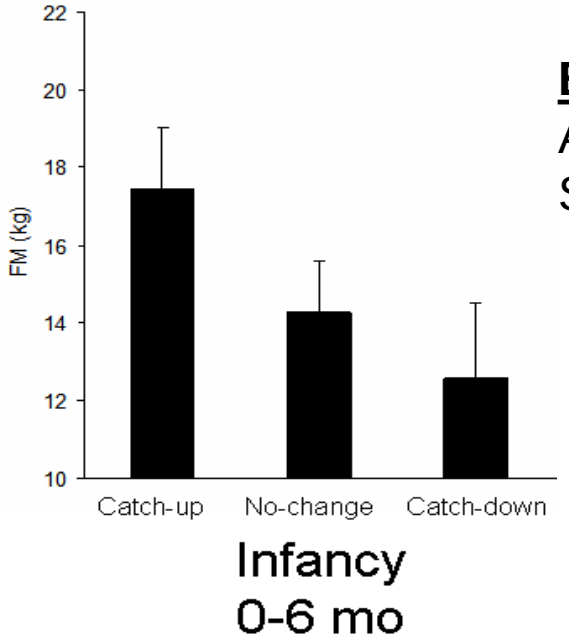
Reasons are likely mutifactorial

- Awareness of infancy and early childhood overweight → dietary and policy changes

Rapid Infancy Weight Gain and Subsequent Obesity

Fat mass
at 17 years



<u>Early primary studies</u>, e.g.
ALSPAC cohort. Ong et al, *BMJ* 2000
SWEDES cohort. Ekelund et al, *AJCN* 2006

<u>Systematic Reviews:</u>

Monteiro & Victora *Obes Rev* 2005	13 studies
Baird et al. *BMJ* 2005	10 studies
Ong & Loos *Acta Paediatrica* 2006	21 studies
Woo-Baidal et al. *Am J Prev Med* 2016	***+ve association in 45/46 studies***

Trials of obesity prevention in infancy

- BabyMilk (Cambridge, UK) – *Arch Dis Child* 2018
- NOURISH (Australia) – *Pediatrics* 2015
- INSIGHT (USA) – *JAMA* 2018
- Many others

Overnutrition in UK infants

UK Scientific Advisory Committee on Nutrition (SACN) report

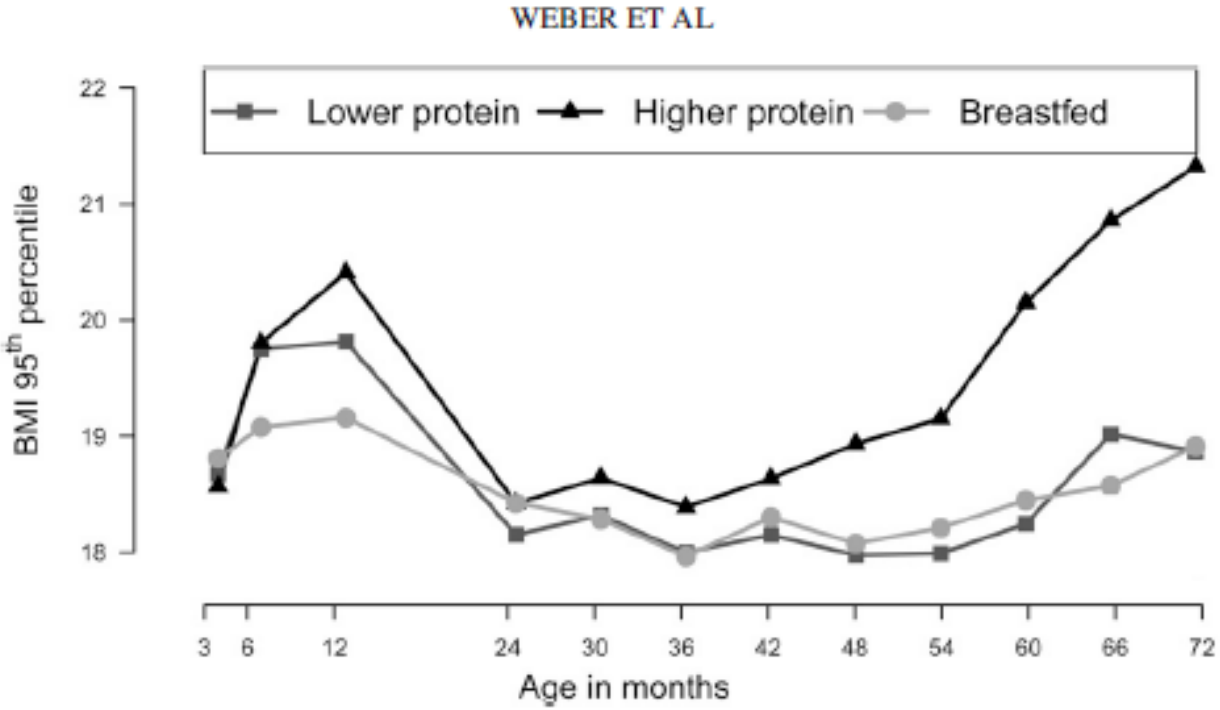
- 75% of infants (aged 4 to 18 months) have intakes that exceed the UK EAR for energy.
- The same proportion exceed the WHO growth standard median for weight.
- These findings suggest that UK infants are exceeding their energy requirements.

DNSIYC National Survey 2013

Feeding in the 1st Year of Life SACN report 2018

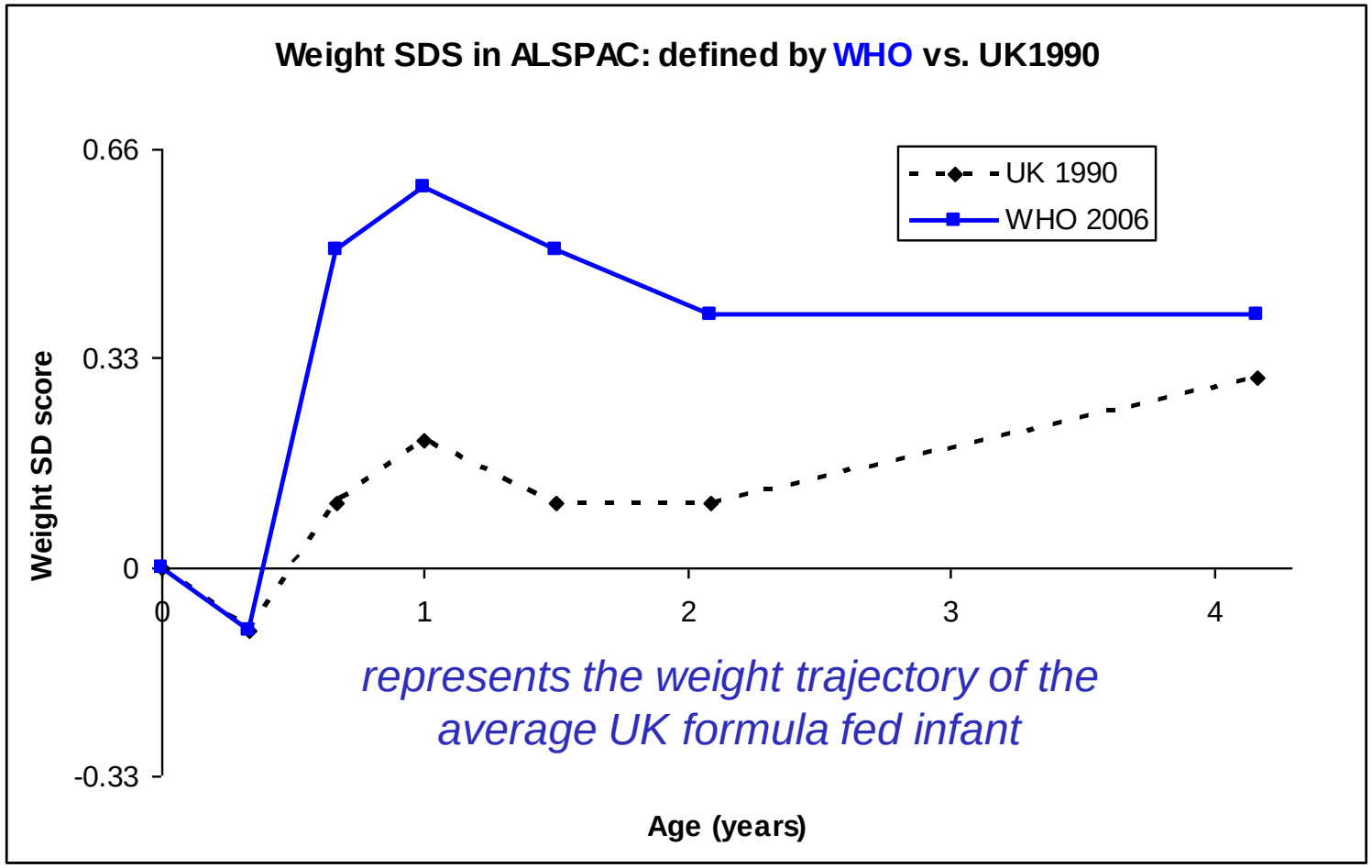
Formula milk composition and infant weight gain

Lower protein (1.77 vs. 2.9 g/100 kcal) → Lower Weight gain and BMI



Koletzko et al. *Am J Clin Nutr* 2009
Weber et al. *Am J Clin Nutr* 2014

The WHO 2006 Growth Standard: defines optimal growth



Application of WHO Growth Standards in the UK. *SACN* 2007
Lakshman et al. *Arch Dis Child*. 2008

Structural determinants of healthy weight in young children

- **Environment** - e.g. space and facilities for outdoor play; infrastructure for active travel to school; density of take-away outlets;
- **Social** - e.g. awareness of early childhood overweight; maternal smoking in pregnancy
- **Policy** - e.g. provision of early years education and childcare; provision and promotion of healthy food and physical activity in early education settings
- **Commercial** - e.g. reduction in protein content of infant milk formulas; reformulation of foods and drinks to reduce free sugars

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Reductions in maternal smoking:

New Zealand: 16.2% to 13.1% from 2006 to 2018

Australia: 13.7% to 9.2% from 2010 to 2020

England: 15.8% to 9.1% from 2006/7 to 2021/22

Maessen et al, *BMJ* 2023

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Early years education/childcare:

New Zealand: Paid parental leave from 2002.

20 hours/wk early childhood education in 2000s

Australia: increasing use of centre-based childcare over the last 10-15 years

England: 15-30 hours/wk childcare for all 3- and 4-year-olds since 2010

Germany: Day Care Expansion Act increasingly implemented since 2005

Maessen et al, *BMJ* 2023

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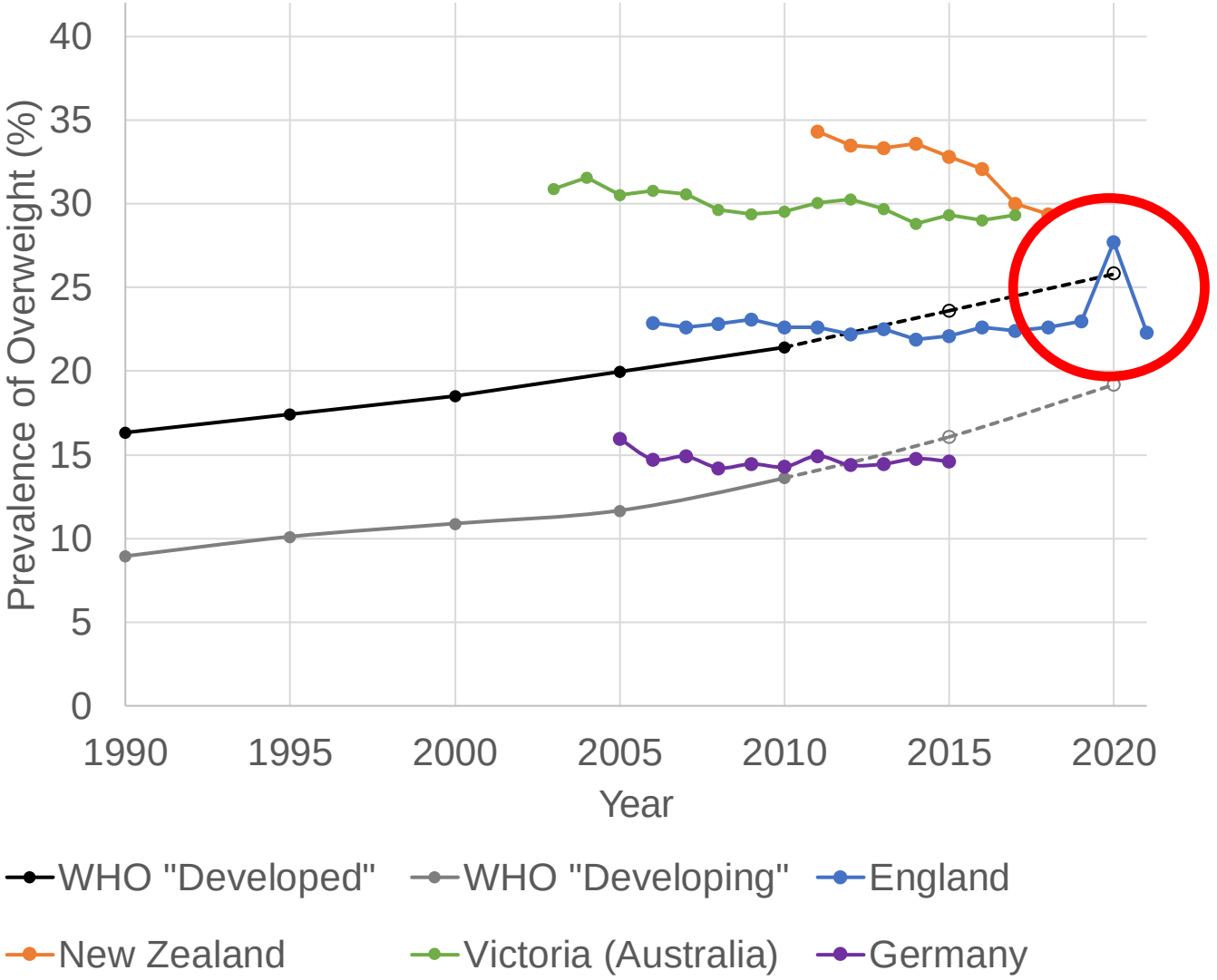

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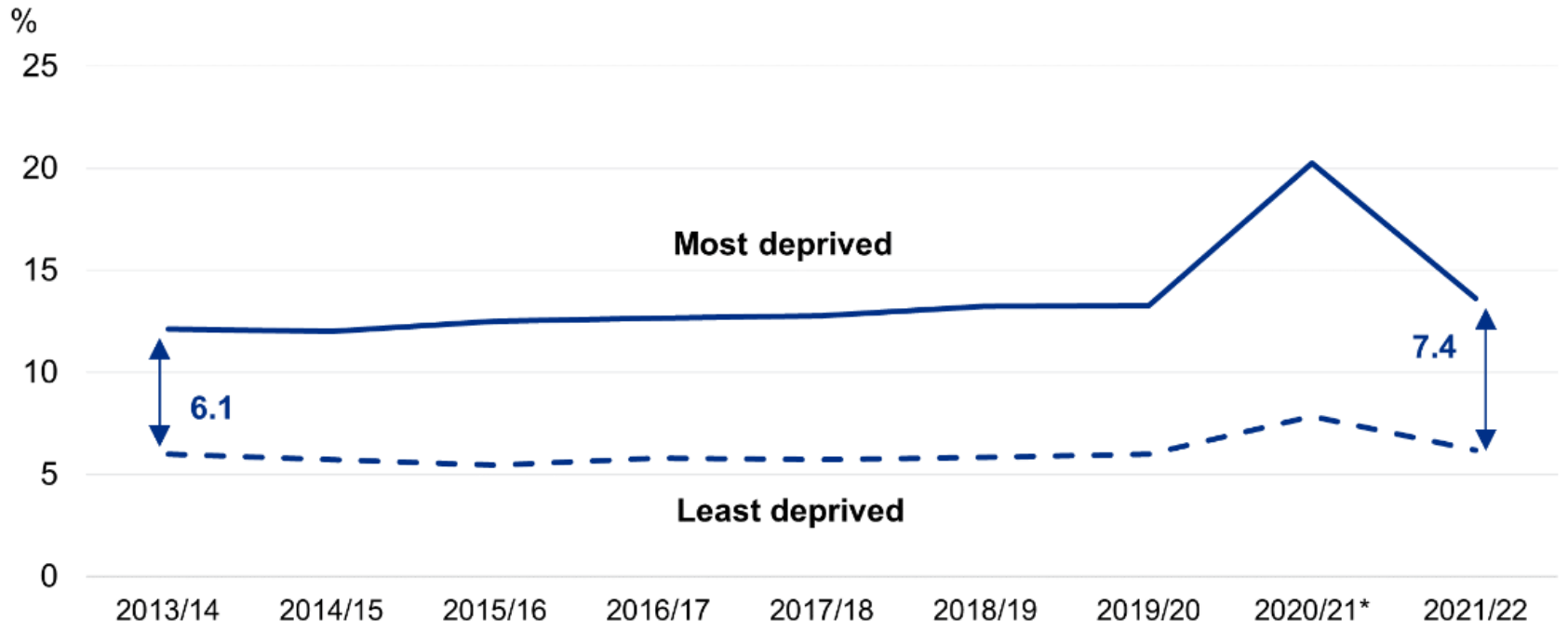
Summary – recent trends in preschool age overweight

1. Recent trends are encouraging!
2. The reasons are likely multifactorial – *including: attitudes & beliefs, monitoring, diet, maternal smoking, early education*
3. Efforts needs to be maintained and strengthened
4. Ensure that all families benefit

Prevalence of obesity in Reception age children in England, by Deprivation

Prevalence of children living with obesity in Reception by most and least deprived IMD deciles (based on postcode of pupil), 2013/14 to 2021/22



* Figures for 2020/21 are based on weighted data, see Methodology and Data Quality section in 2020/21 report for more information.
For more information: Table 6e National Child Measurement Programme, England, 2021/22 School Year

National Child Measurement Programme, England, 2021/22 school year - NDRS (digital.nhs.uk)

JAMA Pediatrics | Original Investigation

Variation in the Heritability of Child Body Mass Index by Obesogenic Home Environment

Stephanie Schrempft, PhD; Cornelia H. M. van Jaarsveld, PhD; Abigail Fisher, PhD; Moritz Herle, PhD; Andrea D. Smith, PhD; Alison Fildes, PhD; Clare H. Llewellyn, PhD

Gene-environment twin study of 925 UK families (1850 twins)

Heritability of BMI at mean age 4.1 years

- much higher among more obesogenic households* – **86%**
- than among low risk households* – **34%**

*Assessed by parent-reported food, physical activity, and media influences in the home

Schrempft S, *JAMA Pediatr.* 2018
doi:10.1001/jamapediatrics.2018.1508

Summary – recent trends in preschool age overweight

1. Recent trends are encouraging!
2. The reasons are likely multifactorial – *including: attitudes & beliefs, monitoring, diet, maternal smoking, early education*
3. Efforts needs to be maintained and strengthened
4. Ensure that all families benefit – *including: low & middle income settings, deprived and high risk groups*

FOOD FOR THOUGHT 2023

High but decreasing prevalence of overweight in preschool children: encouragement for further action

Sarah E Maessen, [1,2] Melanie Nichols, [3] Wayne Cutfield, [1,4] Shane A Norris, [5,6] Christoph Beger, [7] Ken K Ong[8]