

Long term consequences of childhood body size

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EASO Summer School Masterclass

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Outline

Part 1: Childhood body size: how to classify it?

Part 2: Childhood body size and future disease

What is obesity?

Adipocyte (fat cell)



- Overweight and obesity are medical conditions marked by an abnormal and/or excessive accumulation of body fat that presents a risk to health
- Obesity is a chronic relapsing disease, which in turn acts as a gateway to a range of other non-communicable diseases, such as diabetes, cardiovascular diseases and cancer

Adiposity: how is it assessed?

- Adiposity is commonly assessed by body mass index
 - $\text{BMI} = \text{weight (kg)} / \text{height (m)}^2$
 - Is a *proxy* for adiposity
- Can also be assessed by
 - Waist circumference
 - Measures of adipose tissue (e.g. DEXA, skinfold thickness, bioimpedance)
 - Considerations about accuracy, precision, reproducibility, acceptability



Classification of body size by BMI

Characteristics	Adults	Children
Rationale	Associations with health risks	Placement in a statistical distribution or approximates adult categories
Age	Constant from 18 years	Age-specific
Sex	Same for men & women	Different for boys & girls
Usage	International	National & international

Defining obesity in children

Classification system	Aim	Usage	Data source(s)
International Obesity Task Force	To link adult overweight and obesity cut-offs to BMI centiles in children to provide cut-off points for overweight and obesity	International comparisons	Brazil, Great Britain Hong Kong, the Netherlands, Singapore and the United States
US Centers for Disease Control	Update and improve an older reference	Clinic and research	United States
WHO 2007 growth reference	Create growth curves that align with the WHO growth standards and adult BMI cut-offs	Clinic and public health	United States

Strengths and limitations of the classifications

- Strengths:
 - Consistent with adult classifications
 - Based on best available evidence of what is 'normal' and what is not
 - Based on charts derived from more contemporary populations with the most advanced statistical methodology
- Limitations:
 - Based only upon statistical distributions
 - Reflect differences in underlying reference populations and statistical methodology used to construct them
 - A single definition does not exist

Importance of plotting BMI

BMI-for-age GIRLS

5 to 19 years (percentiles)

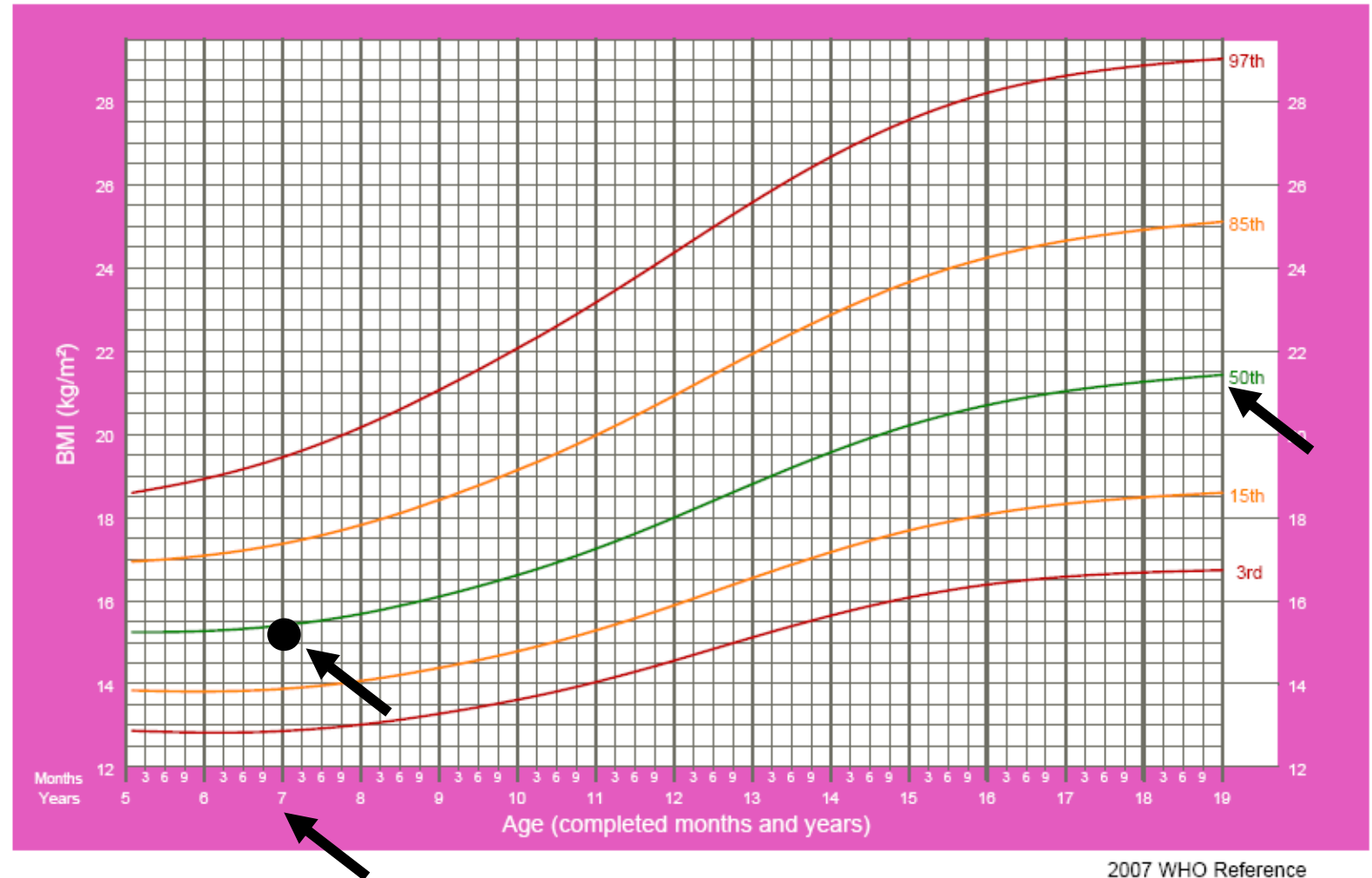


Julie, 7 year-old-girl

Height: 124.5 cm

Weight: 24.5 kg

$$\text{BMI} = \frac{24.5}{1.245 \times 1.245} = 15.8$$



2007 WHO Reference

Importance of plotting BMI (and height & weight!)

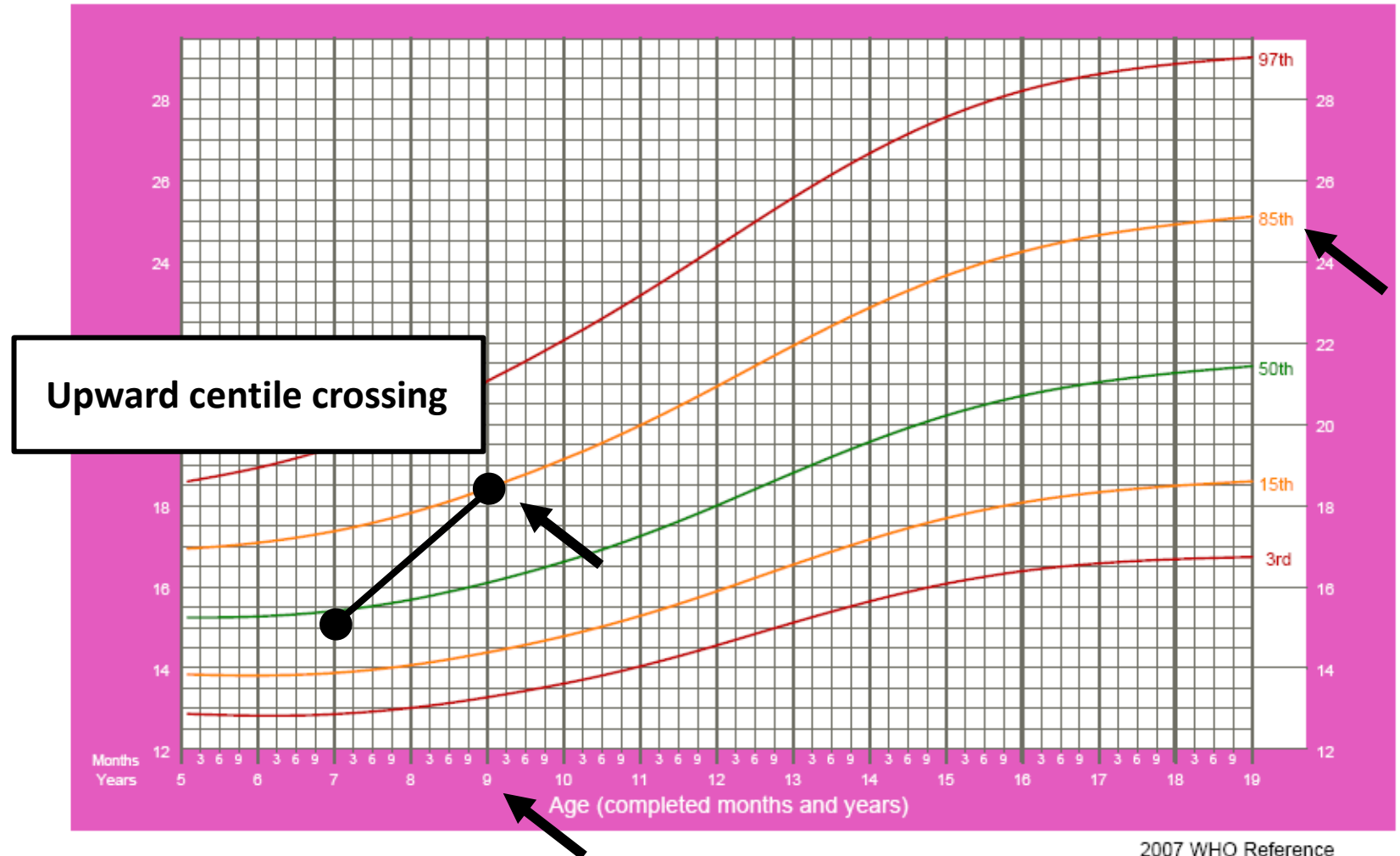
BMI-for-age GIRLS

5 to 19 years (percentiles)



Julie, at 9 years
Height: 134 cm
Weight: 33 kg

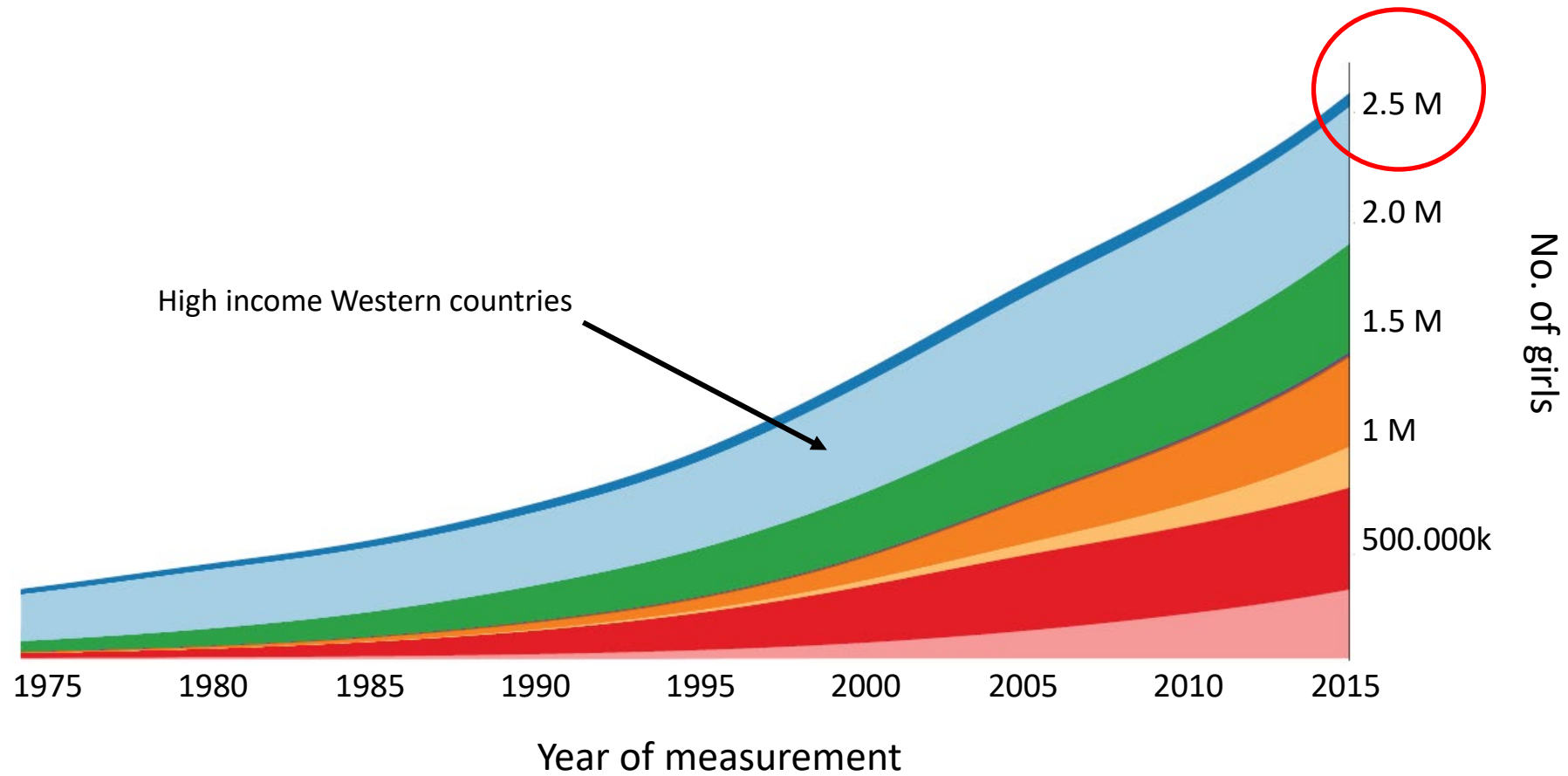
$$\text{BMI} = \frac{33.0}{1.34 * 1.34} = 18.4$$



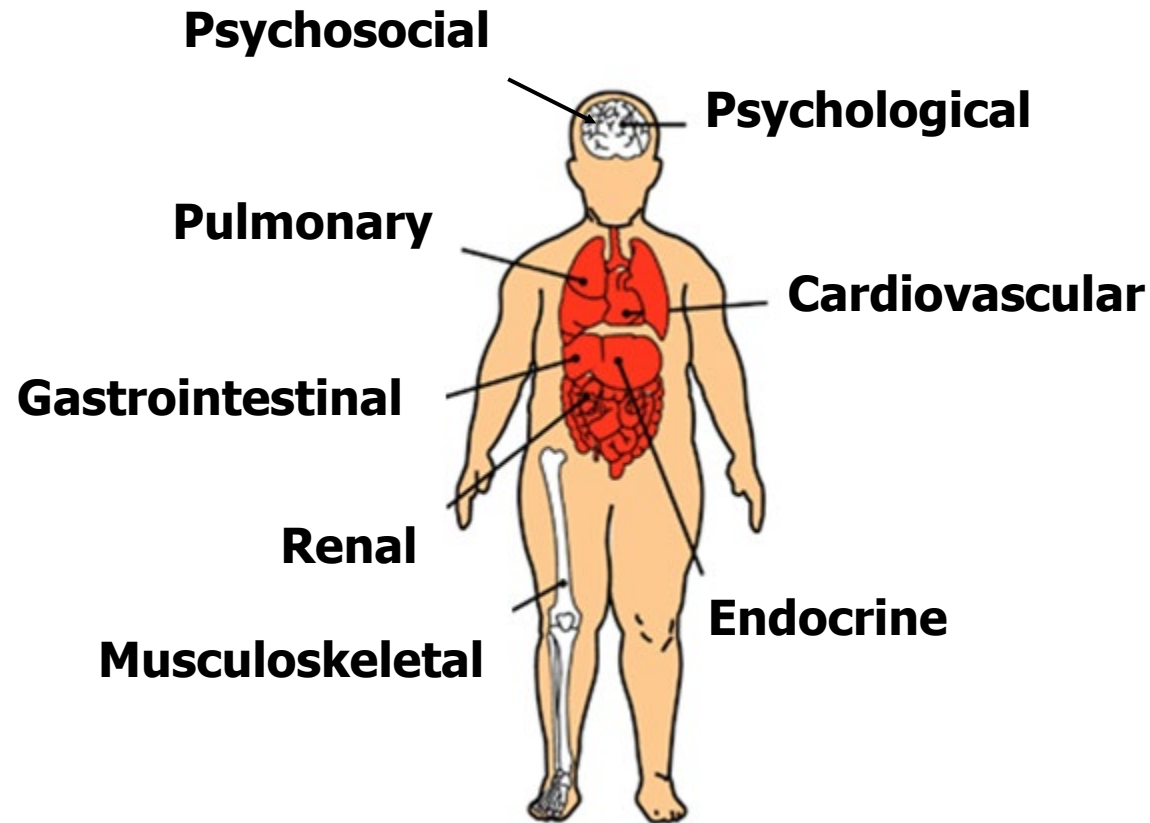
General considerations

- Changes in height growth require spacing of approximately 3 months
- Weight is a sensitive measurement
 - It can change from one day to another due to e.g. hydration, acute illness, etc.
 - Changes in short-term weight do not tell us which body tissue is being affected
- It is the *total pattern of weight, height and BMI changes* that give the best insight into a child's health

Worldwide prevalence of obesity in girls (IOTF criteria)

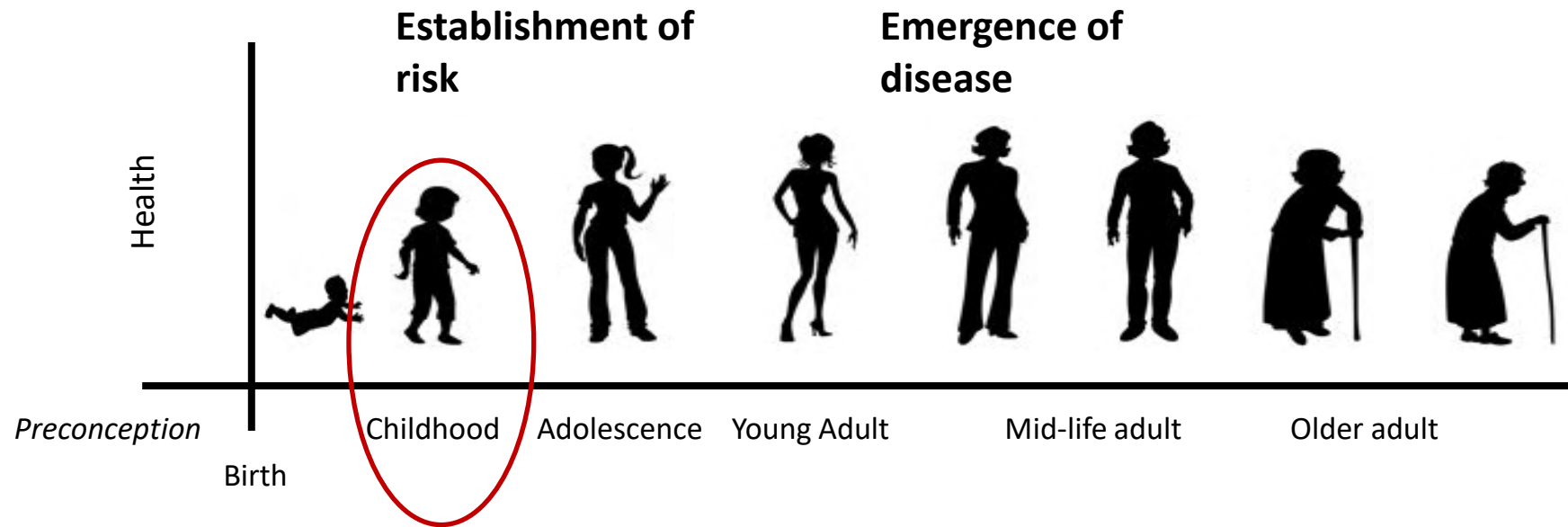


Acute consequences of obesity in childhood



but what are the future consequences?

Child body size and disease



How to study the *long-term* consequences of obesity in children

- Prospective measurements of children
- Large numbers of children
- Reasonably defined age; i.e. <14 years
- Need a long period of follow-up in order for the outcomes to develop
- Need to track the children into adulthood with minimal loss to follow-up



The Copenhagen School Health Records Register (CSHRR)

406,350 boys and girls born from 1930 to 1996

- Annual measurements of height and weight from 7 to 13 years of age
- Includes virtually all schoolchildren in Copenhagen
- Computerized, and additional years are being added



What information is computerized?

- Overall cohort
 - Basic information (name, sex, date of birth)
 - Birth weight (maternal/parental recall at school entry, for those born from 1936 onwards)
 - Measurements of height and weight, date of the examination
 - **Personal identification number**
- Subsets have additional information

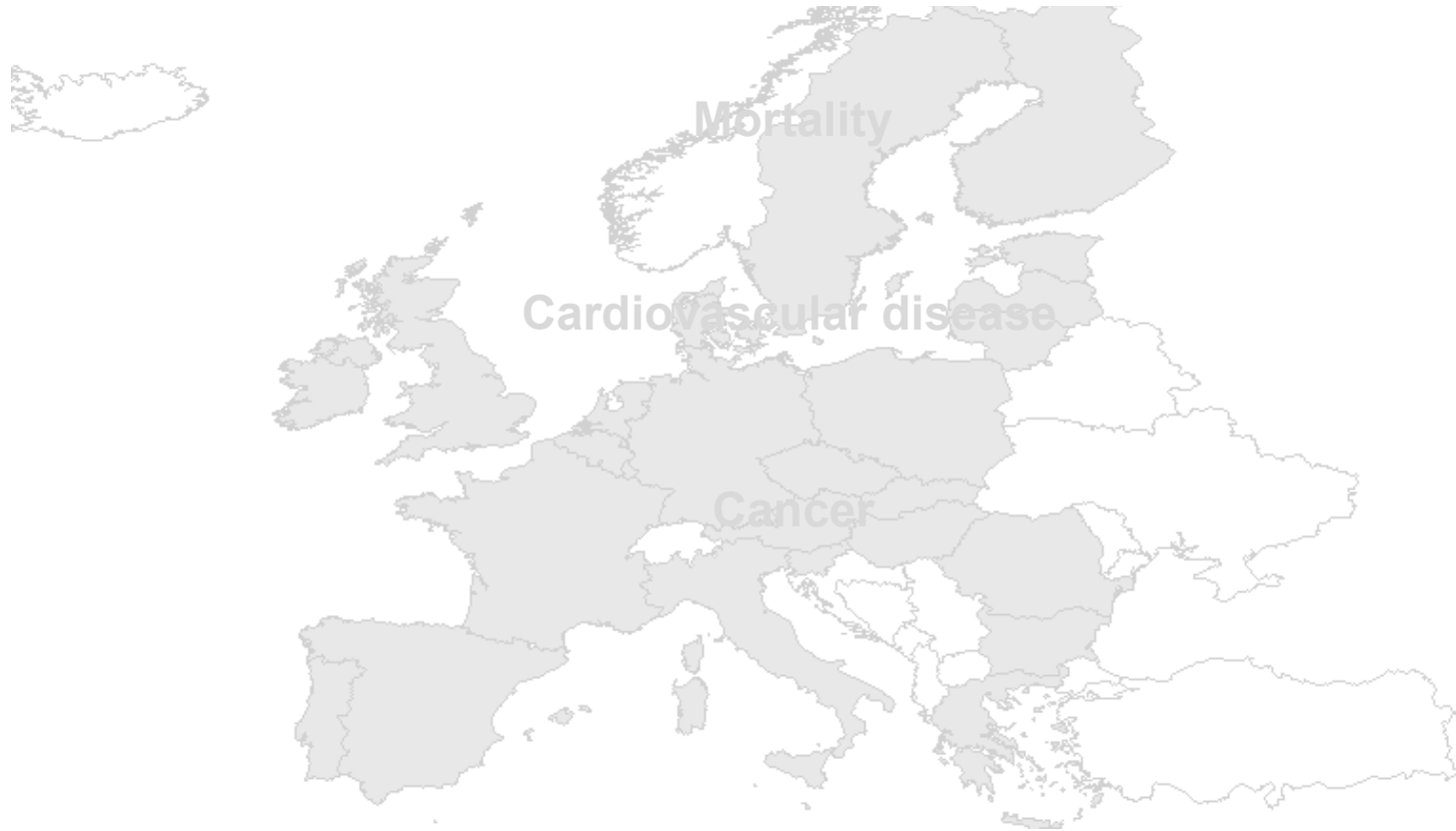


Long-term outcomes

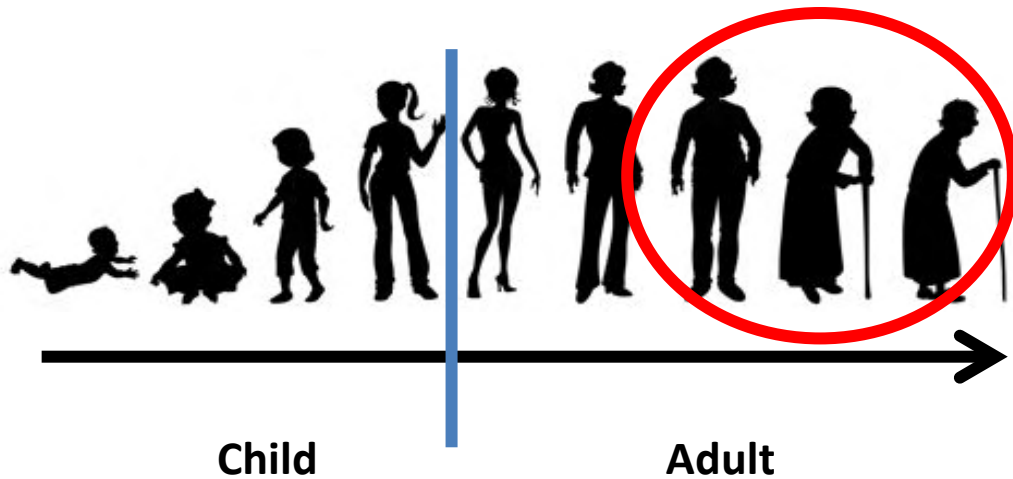


Long-term outcomes

Overweight and obesity

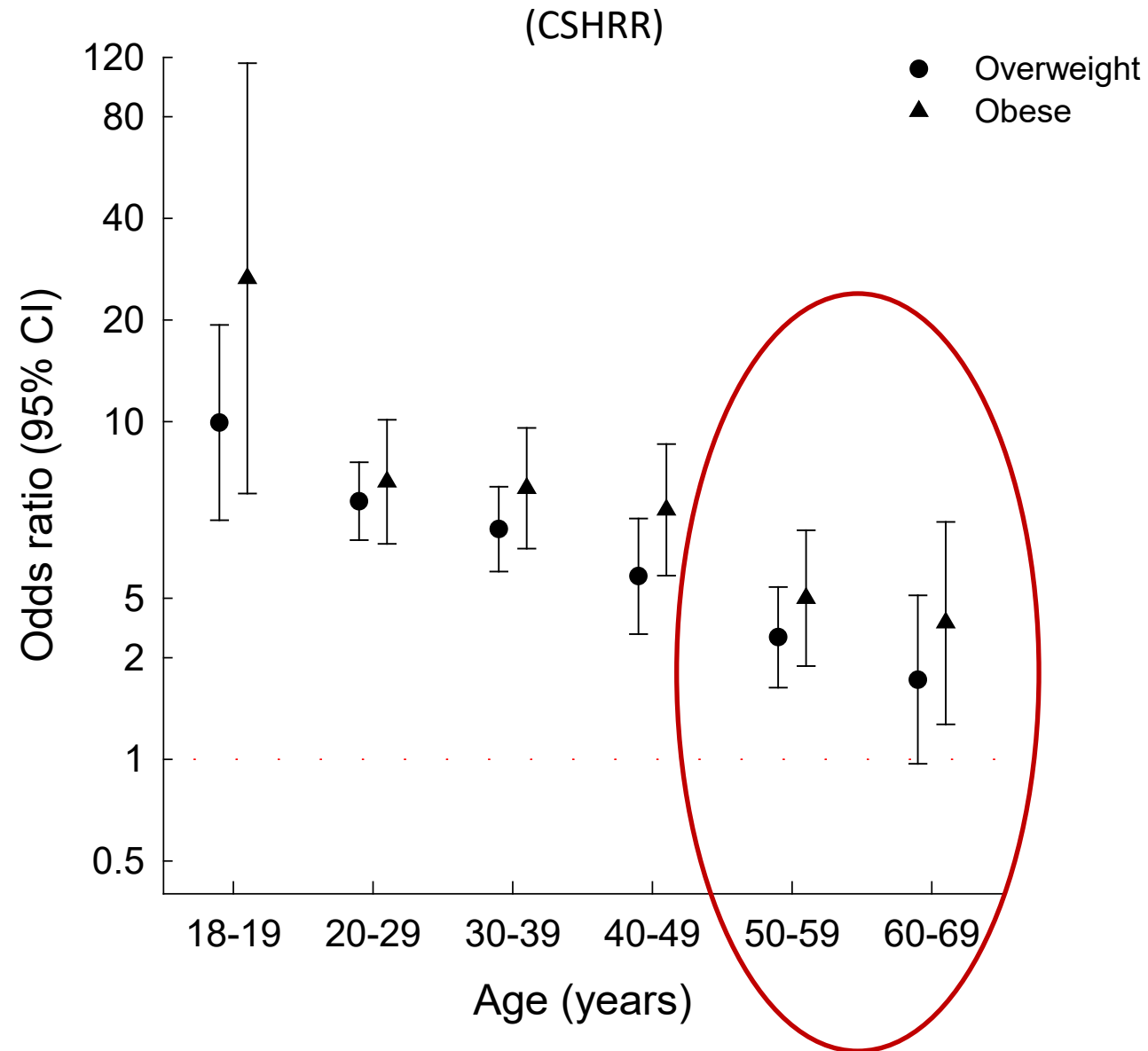


Issue: tracking across the lifespan



- Many studies worldwide, but *very* heterogenous
- Tracking estimates differ widely, depends on:
 - Duration of follow-up
 - Sample size
 - Definition of childhood
- Systematic reviews: no firm conclusions

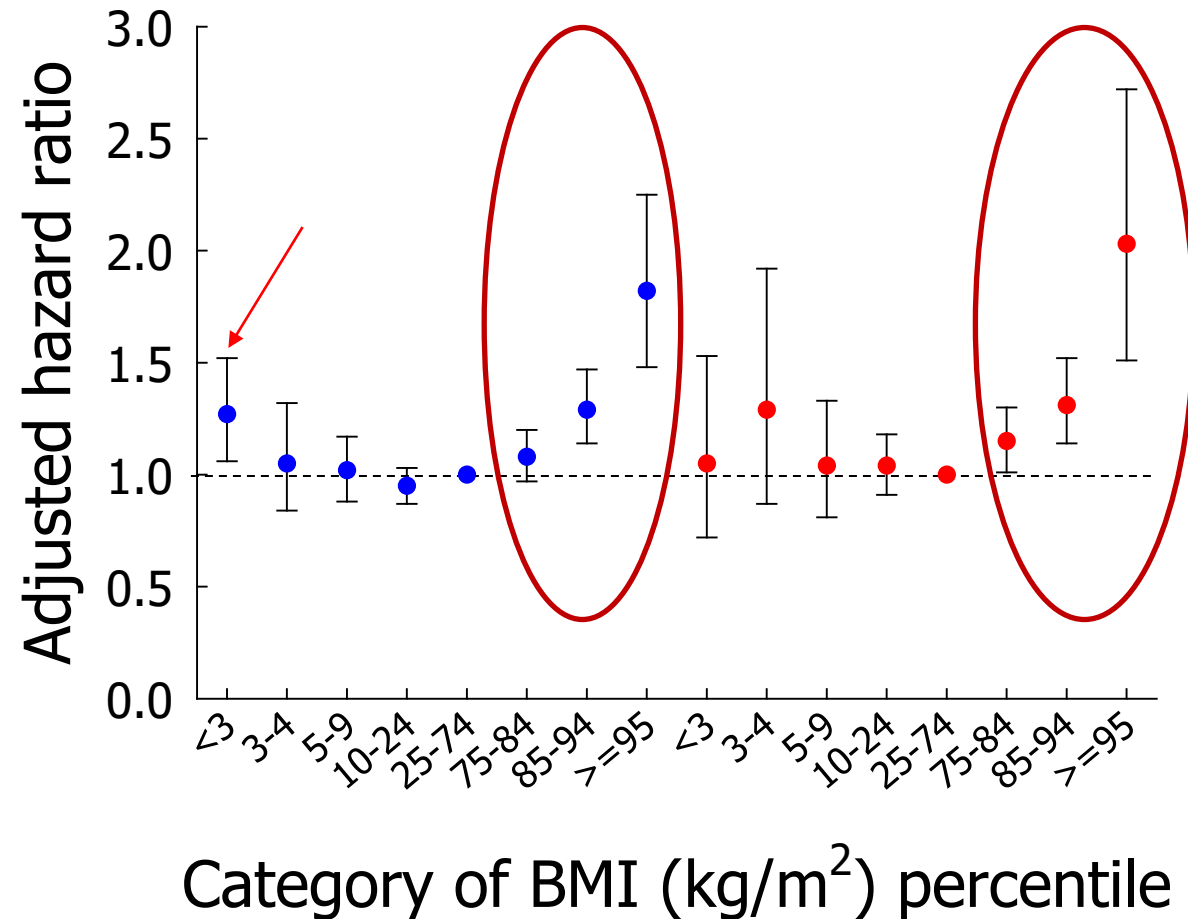
Tracking of overweight and obesity in women



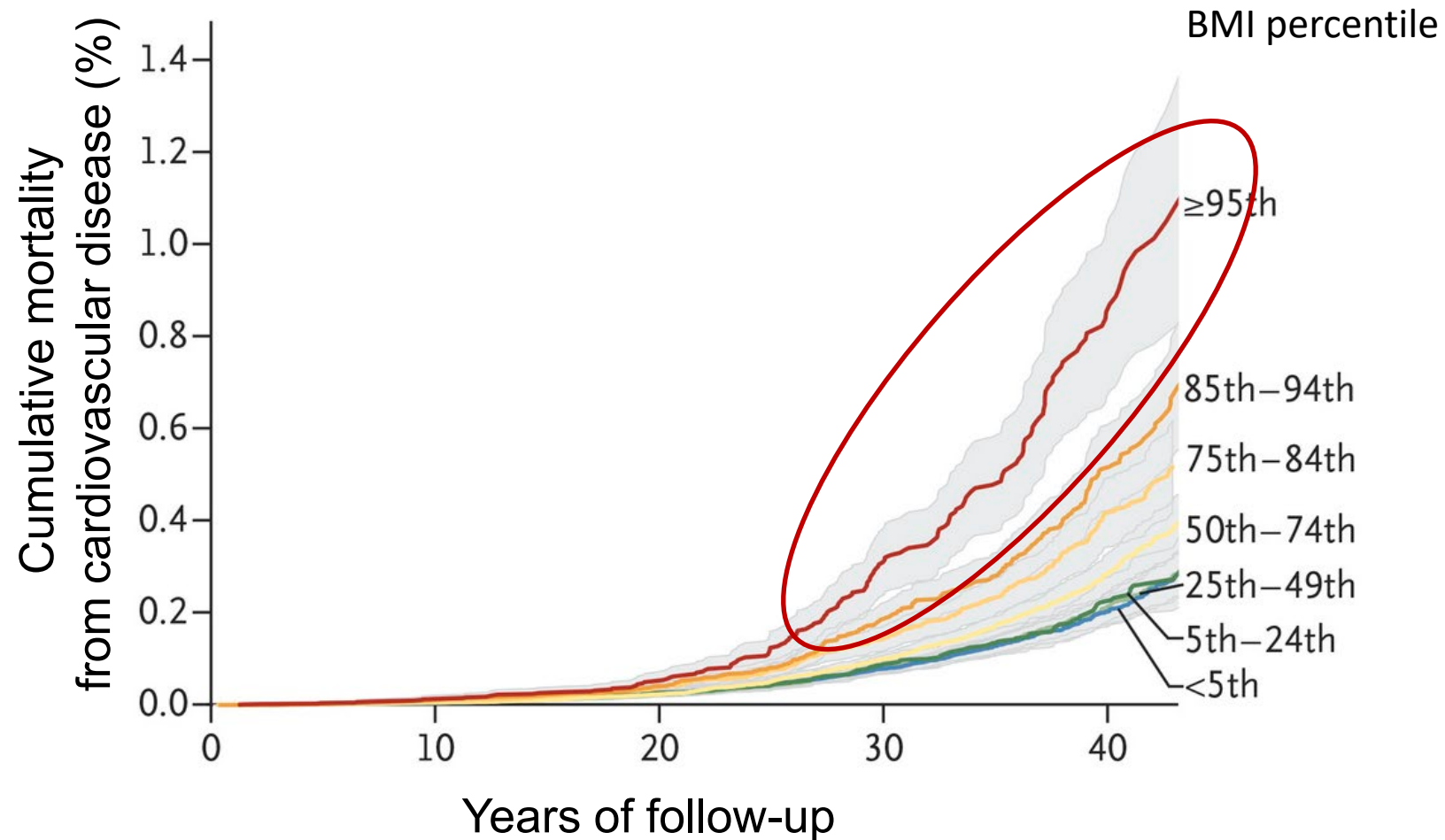
Long-term outcomes



Adolescent BMI and all-cause mortality



Adolescent BMI and cardiovascular disease mortality

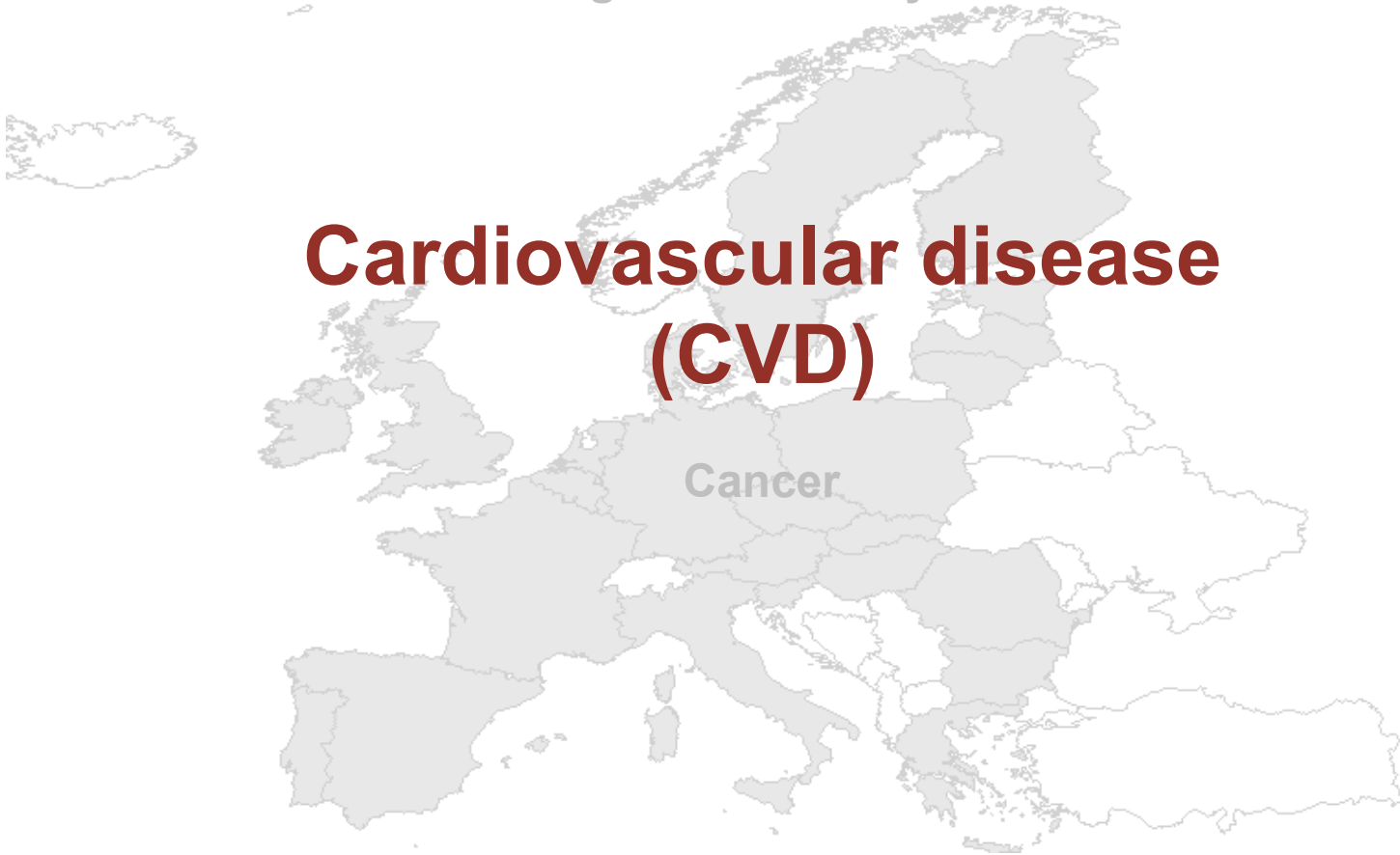


Long-term outcomes

Overweight and obesity

**Cardiovascular disease
(CVD)**

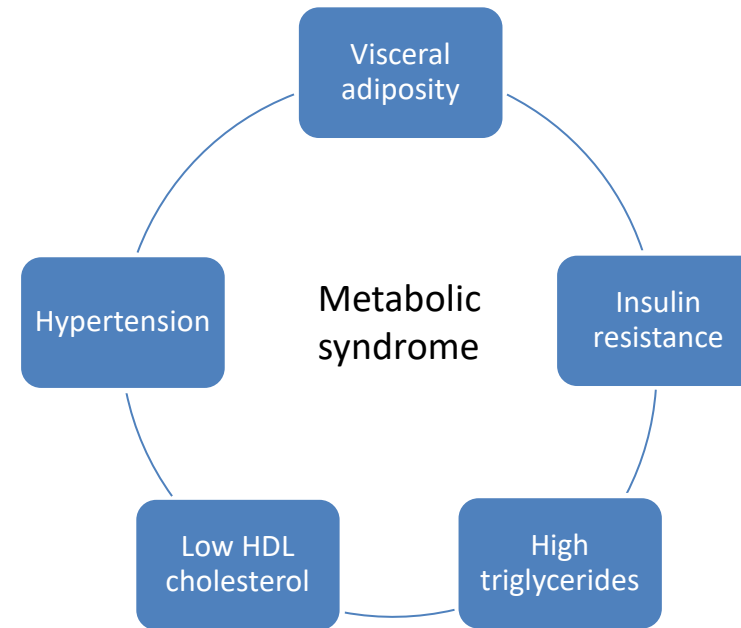
Cancer

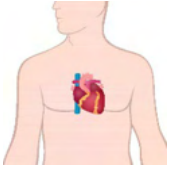


Childhood body size and CVD: potential mechanisms

Early establishment and continued exposure to

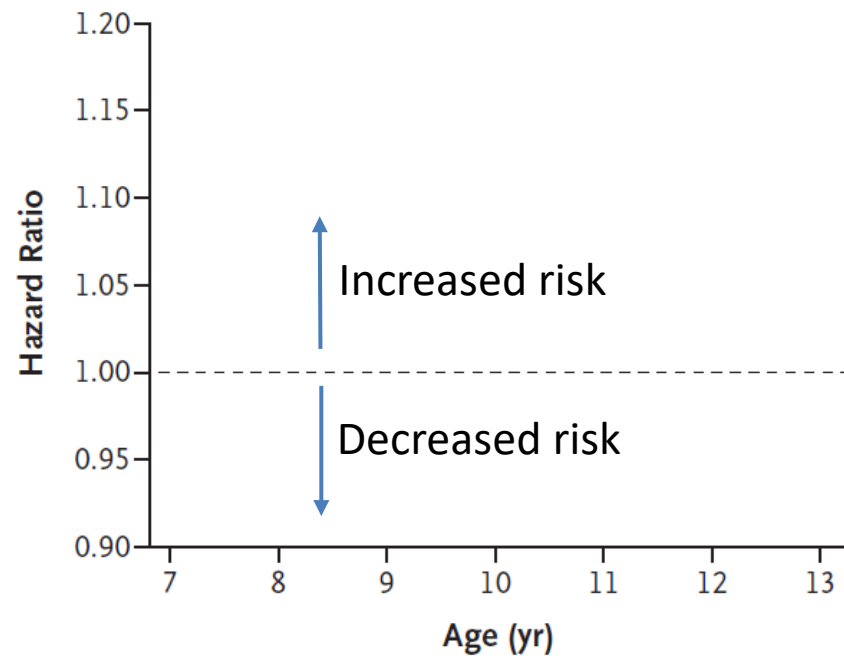
- Atherosclerotic damage
- Dyslipidemia, hypertension, insulin resistance
- Systemic inflammation

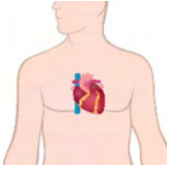




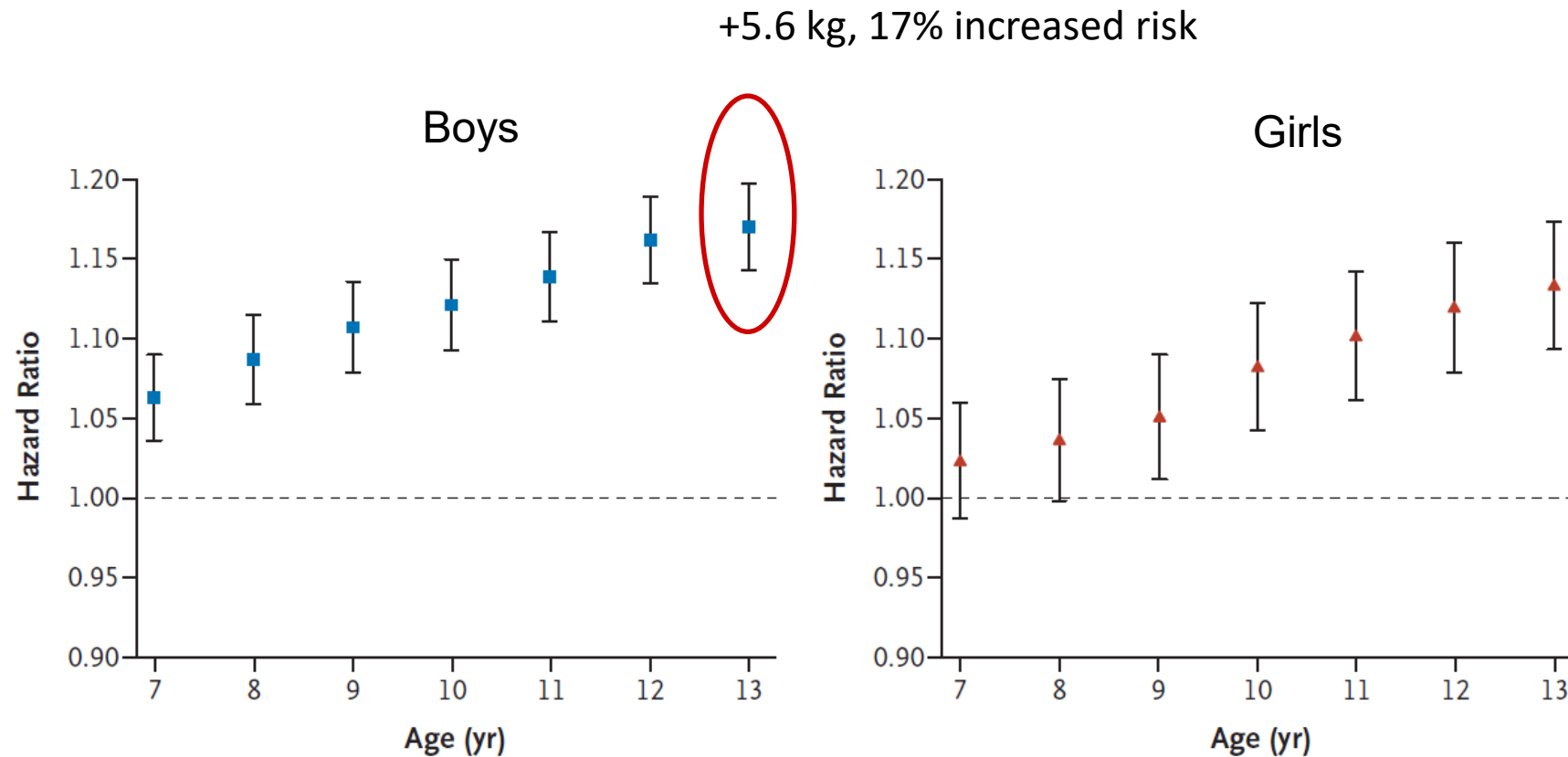
Childhood BMI and coronary heart disease

(CSHRR)





Childhood BMI and coronary heart disease (CSHRR)



Source: Baker J et al. New England Journal of Medicine 2007;357:2329-2337

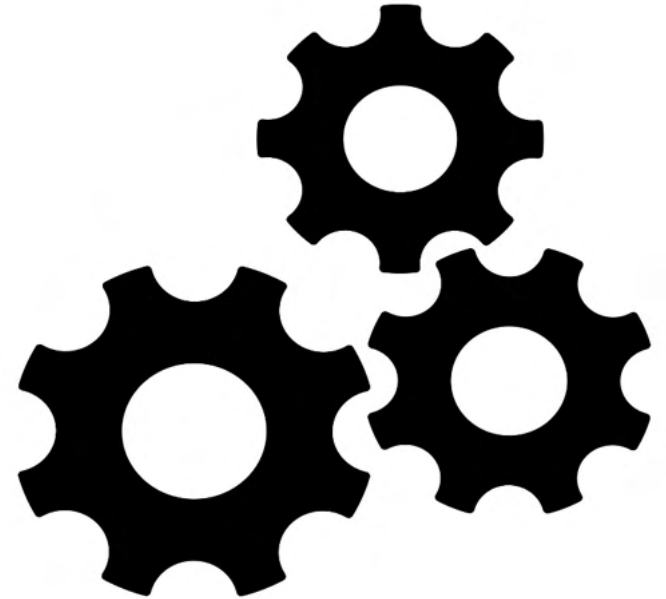
Source: Baker J et al *New Engl J Med* 2007;357:2329-2337

Long-term outcomes

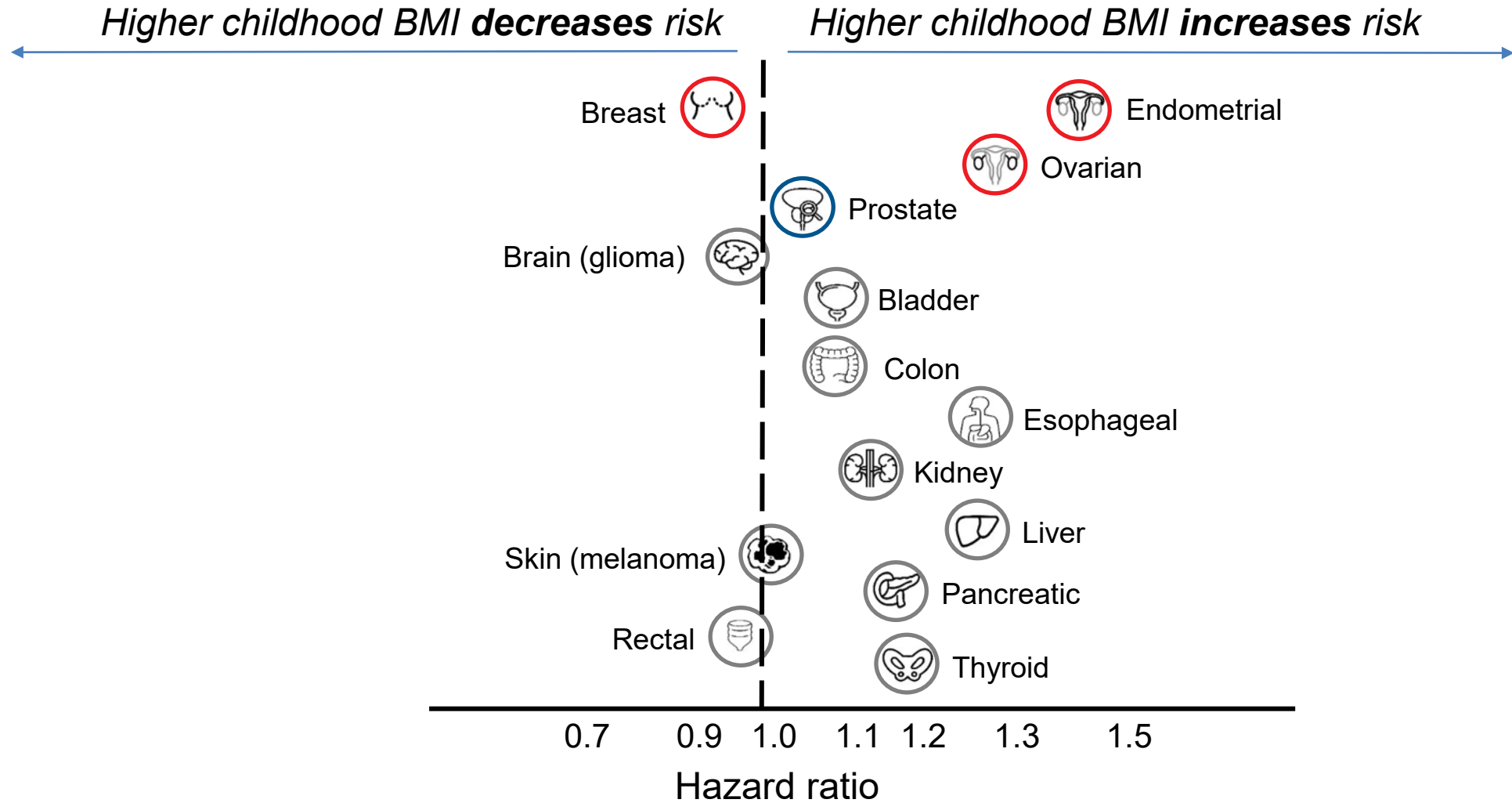


Childhood body size and cancer: potential mechanisms

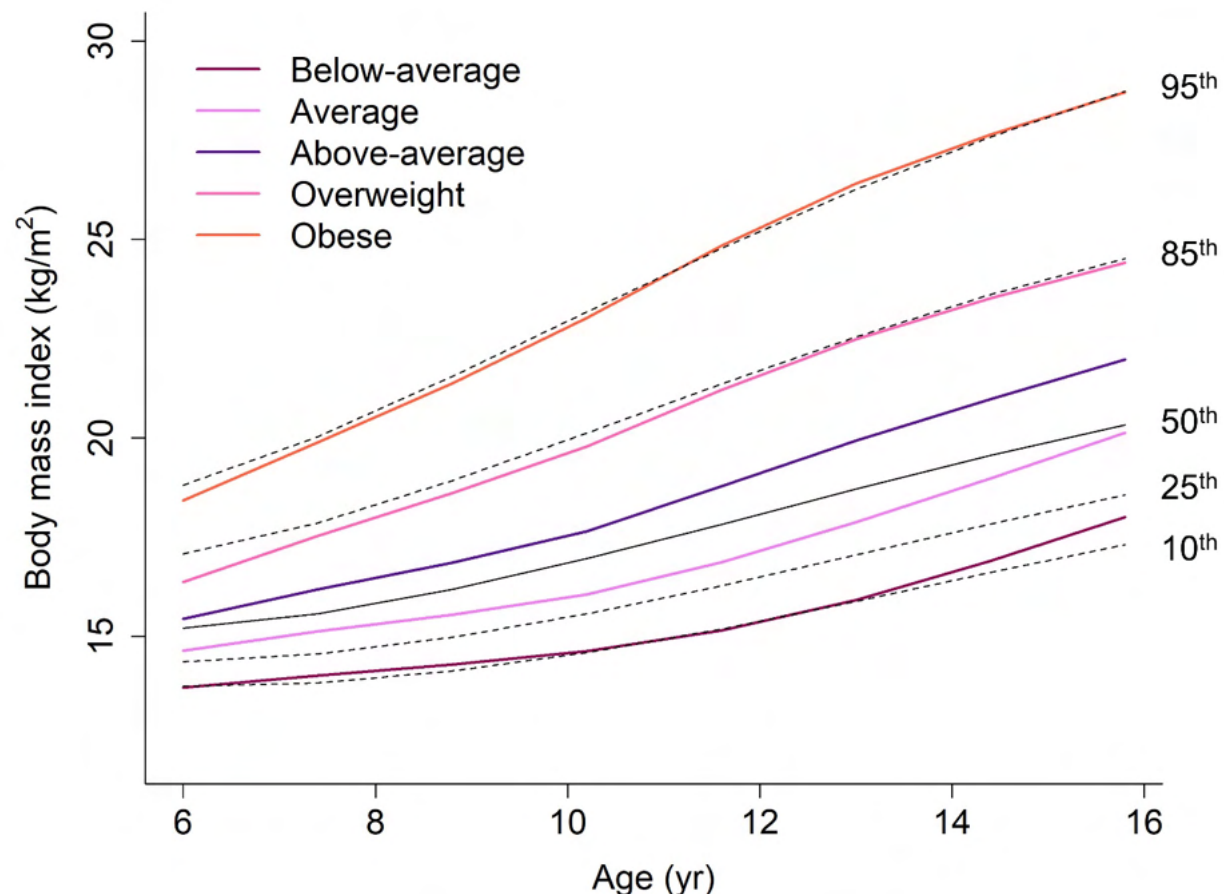
- Vary widely by cancer site
- Hypothesized to include:
 - Insulin like growth factor 1 activity
 - Hormonal exposures during growth and puberty
 - Period of rapid cell division- more opportunities for cellular damage?
- Tracking of body size



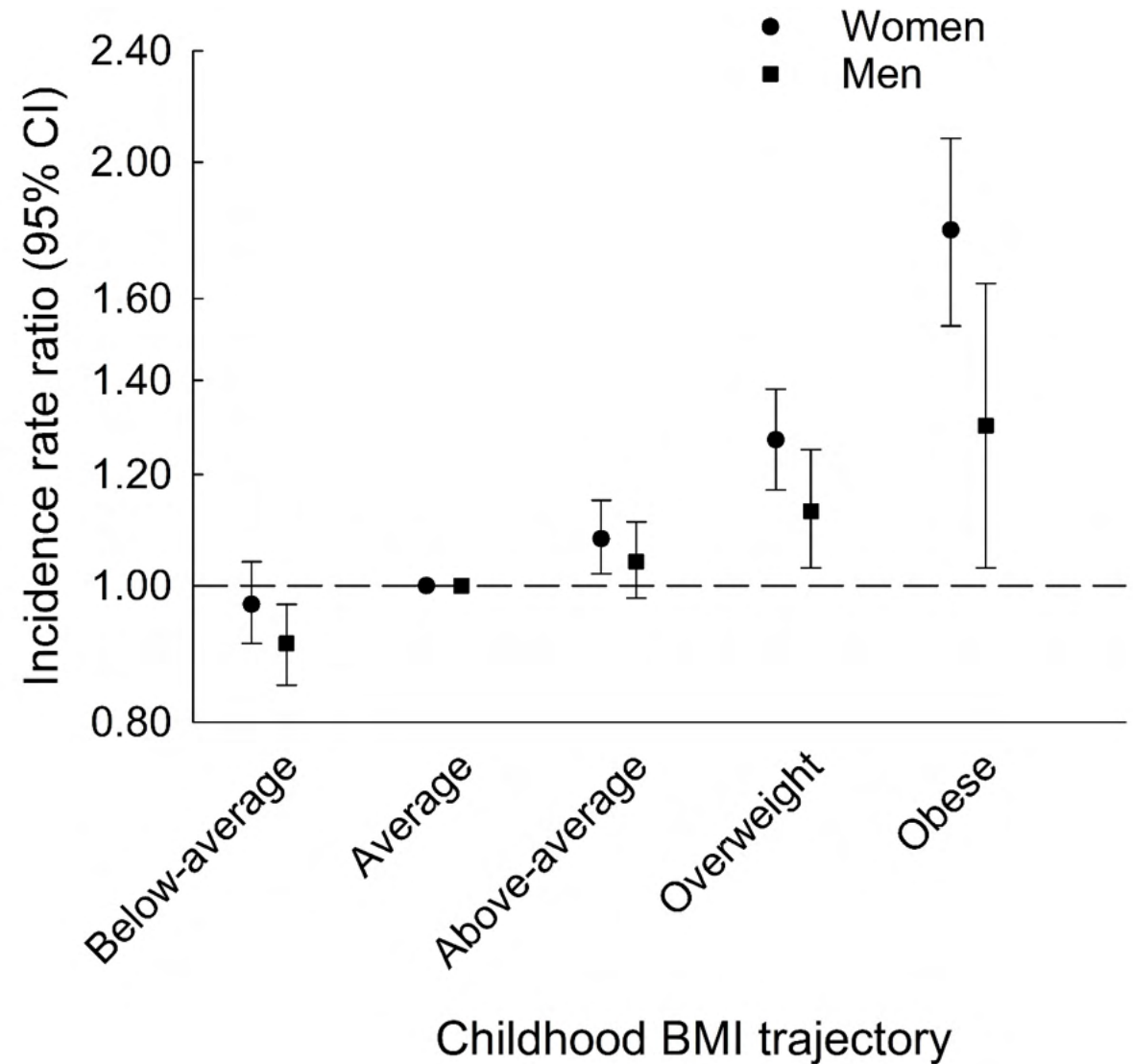
Childhood BMI and adult cancer



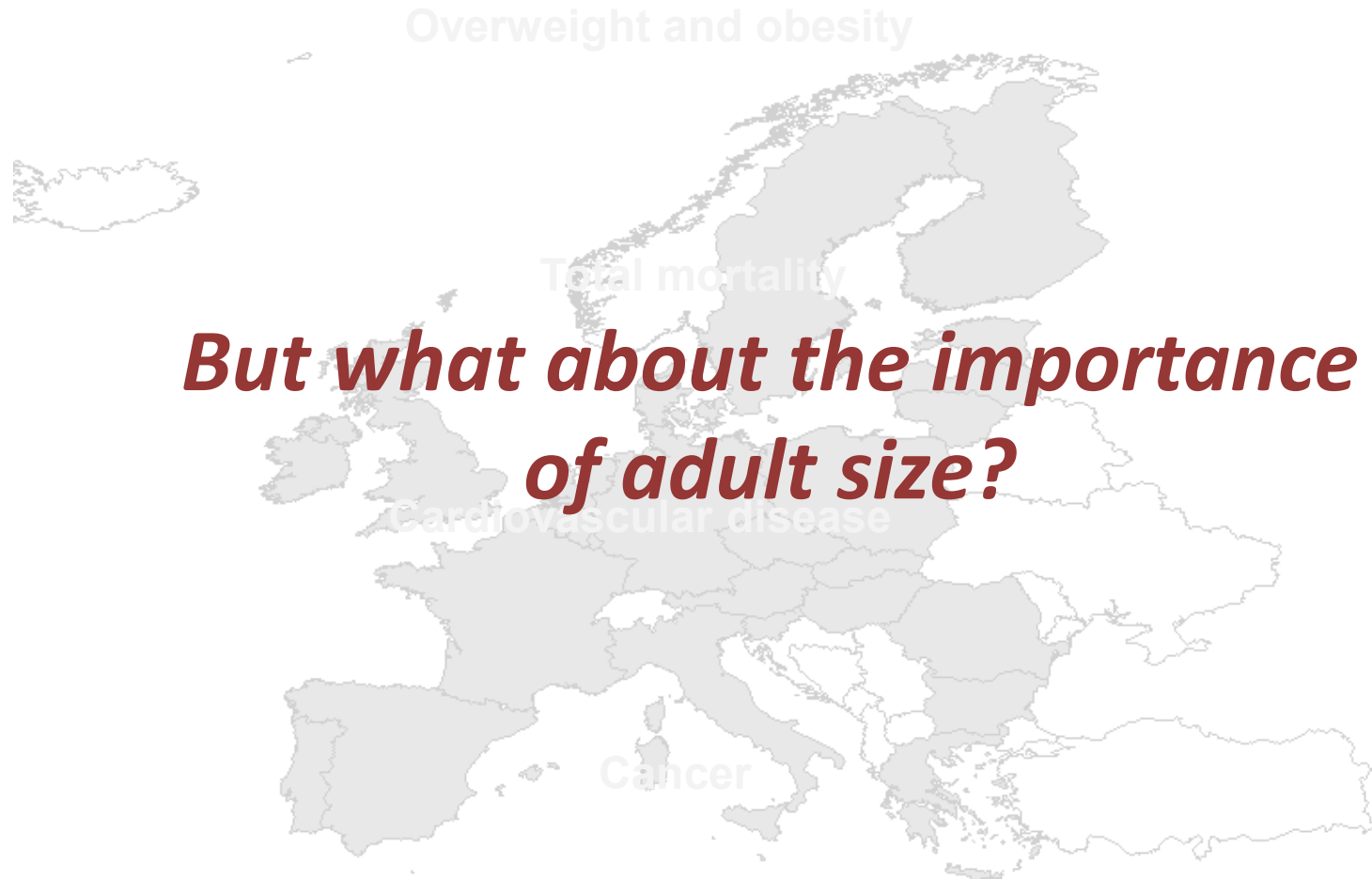
Trajectories of childhood BMI

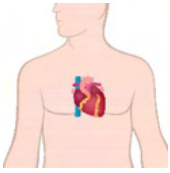


Childhood BMI trajectory and risk of obesity-related cancer

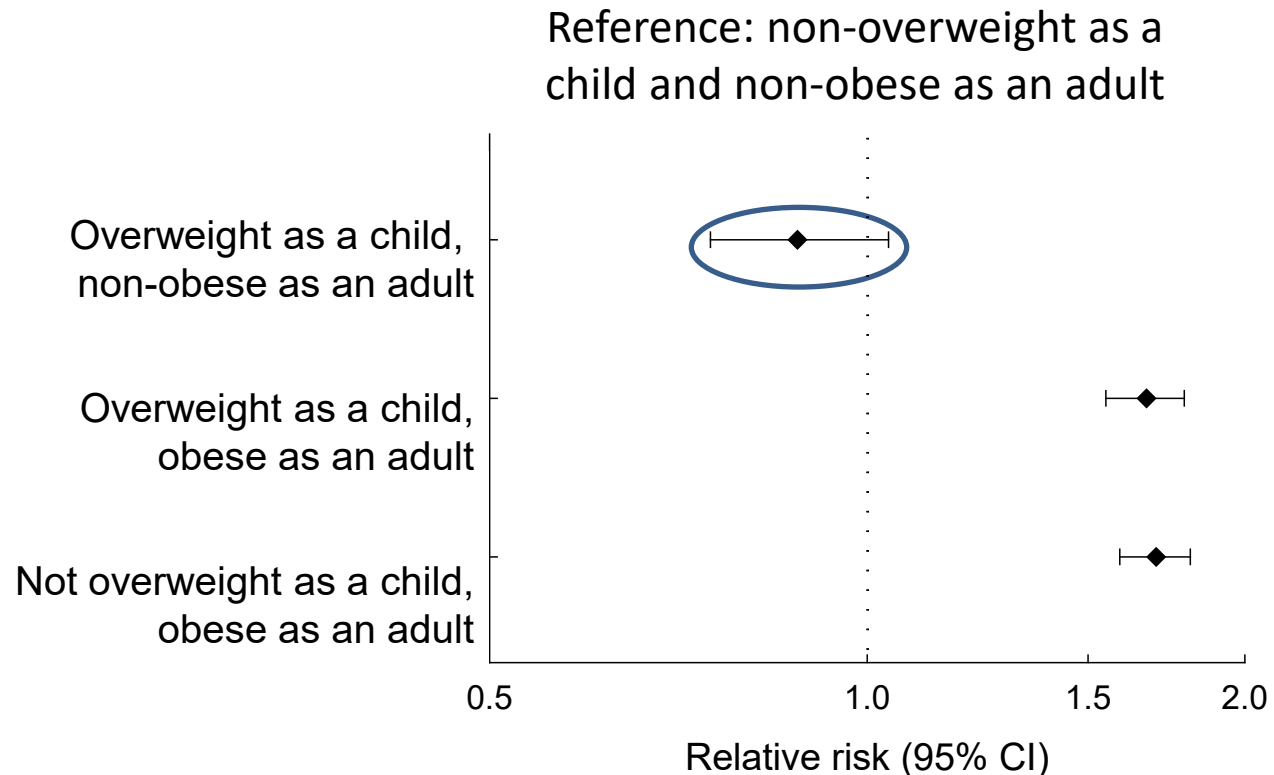


Long-term outcomes



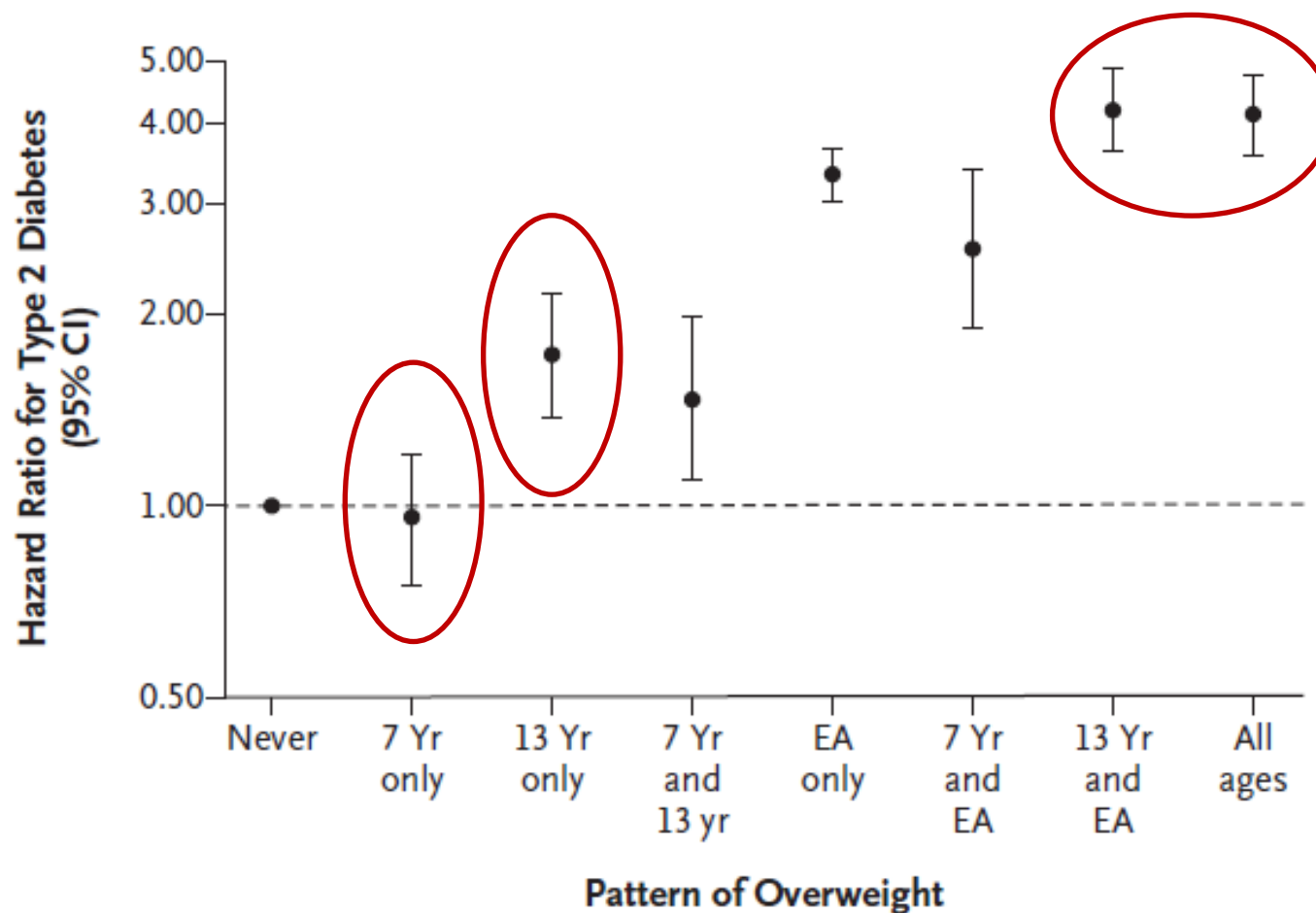


Change between child and adult weight status and ≥ 1 CVD risk factor in adulthood



Overweight pattern and type 2 diabetes in men at 30-60 years of age

(CSHRR)



Summary of long-term consequences of high BMI in childhood

CORONARY HEART DISEASE	TYPE 2 DIABETES	AUTOIMMUNE Crohn's disease Lupus Psoriasis (women only) Rheumatoid arthritis (women only)		ENDOCRINE Gestational diabetes Polycystic ovarian syndrome
		CARDIOVASCULAR Atrial fibrillation Intracerebral hemorrhage (men only) Ischemic stroke Gestational hypertension Pre-eclampsia Venous thromboembolism	OTHER Asthma Chronic kidney disease Hidradenitis supprativa Multiple sclerosis Pre-term birth	
CANCER	Cardiovascular & all-cause MORTALITY*			

*Adolescents

Take home messages

- Definitions of obesity in childhood vary widely
- BMI does not perfectly track from child to adult ages
 - In mid-life, most adults have overweight
- Risks of many diseases are identified at BMI levels in children ***below*** values classified as overweight or obese
 - However, a high BMI is **not** associated with all diseases
- Remission from overweight reduces risks of CVD and type 2 diabetes in adult life

Perspective

- BMI is only an indicator of adiposity
 - Other methods are needed and are being developed
- Incorporating body size across the lifecourse is essential
 - However there are statistical and interpretation challenges
- The “critical age” by which remission from overweight / obesity reduces future health risks the most is yet to be determined

Thank you

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