Is there really a link between low parental income and childhood obesity?

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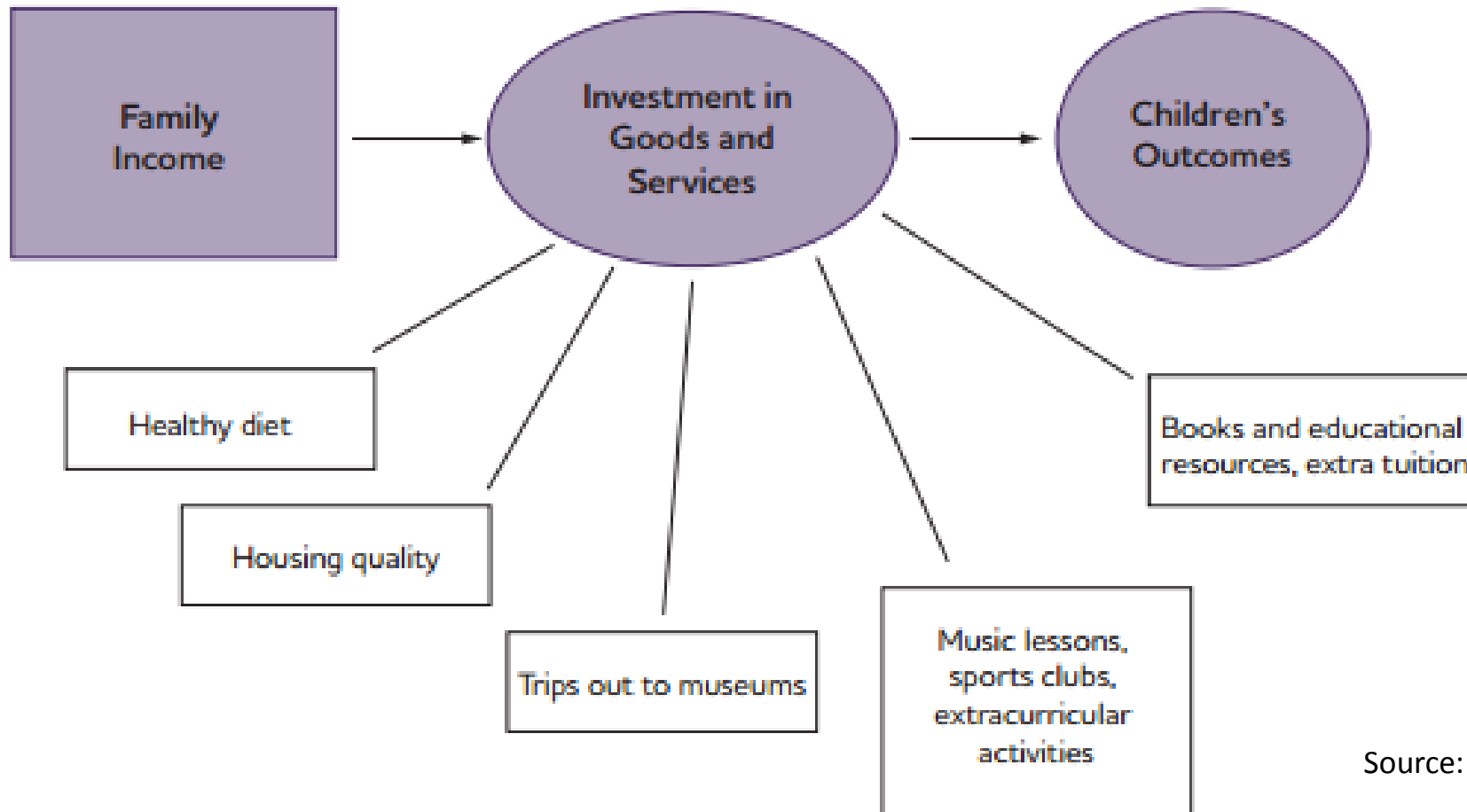
Background
Income and childhood outcomes

- Rich literature on how familial income influences childhood outcomes
  - Children from "poor" families generally have worse educational, behavioural, and health outcomes than children from more affluent families.

- Susan Mayer
  - 2002 → report for ministry of social development NZ: The influence of parental income on children's outcomes
  - *"People's income depends on their skills, their work efforts and other factors. These factors can also affect children's outcomes. Research that estimates the correlation between parental income and children's outcomes cannot tell us anything about the causal relationship between parental income and children's outcomes because such estimates do not control for all such parental characteristics." (Mayer, 2002, p. 12)*

- Cooper & Stewart (2013) → Joseph Rowntree foundation report: does money affect children's outcomes?

Studies by country and method	Positive results	Mixed results	No significant results	Total
Canada		1	1	2
– Exogenous variation		1		1
– Fixed effects			1	1
Mexico	1			1
– Randomised controlled trials	1			1
Norway	2	1	1	4
– Natural experiments	1		1	2
– Exogenous variation	1	1		2
US	17	4	1	22
– Randomised controlled trials	3	1		4
– Natural experiments	5		1	6
– Exogenous variation	1	1		2
– Fixed effects	8	2		10
US and Canada	1			1
– Randomised controlled trials	1			1
UK	2		2	4
– Natural experiments	1			1
– Fixed effects	1		2	3
All countries				
– Randomised controlled trials	5	1		6
– Natural experiments	7		2	9
– Exogenous variation	2	3		5
– Fixed effects	9	2	3	14
TOTAL	23	6	5	34

Background
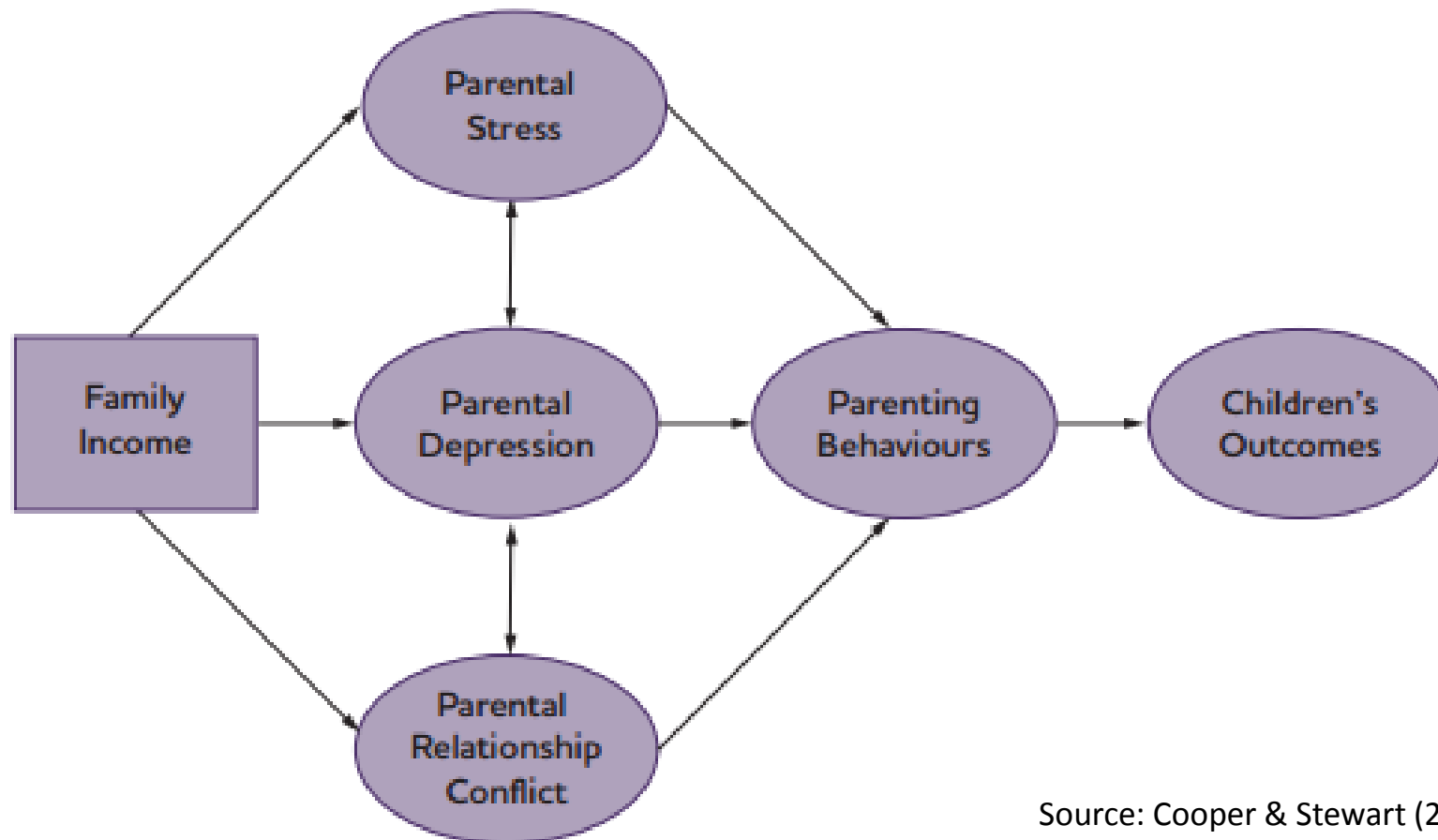## Income and childhood outcomes

The Investment Model

Source: Cooper & Stewart (2013)

Background
Income and childhood outcomes
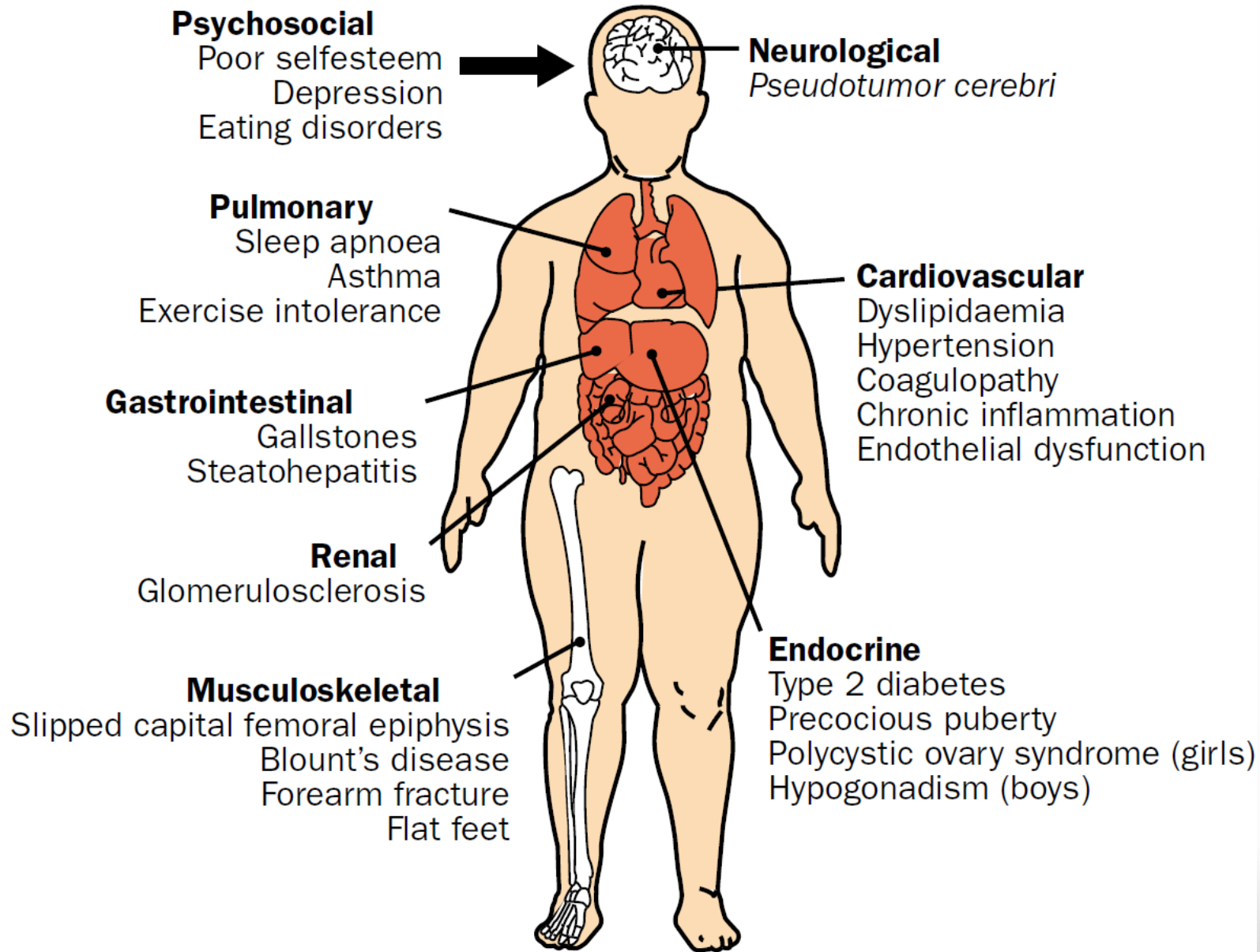

The Family Stress Model

Source: Cooper & Stewart (2013)

Background
Motivation for considering income and child obesity

- WHO 2013 → child obesity "most serious global public health challenges"

- Consequences of child obesity (NOO)
  - Raised blood pressures/raised cholesterol
  - Type II diabetes/Asthma
  - Adult Obesity

Psychosocial
Poor selfesteem
Depression
Eating disorders

Neurological
Pseudotumor cerebri

Pulmonary
Sleep apnoea
Asthma
Exercise intolerance

Cardiovascular
Dyslipidaemia
Hypertension
Coagulopathy
Chronic inflammation
Endothelial dysfunction

Gastrointestinal
Gallstones
Steatohepatitis

Renal
Glomerulosclerosis

Endocrine
Type 2 diabetes
Precocious puberty
Polycystic ovary syndrome (girls)
Hypogonadism (boys)

Musculoskeletal
Slipped capital femoral epiphysis
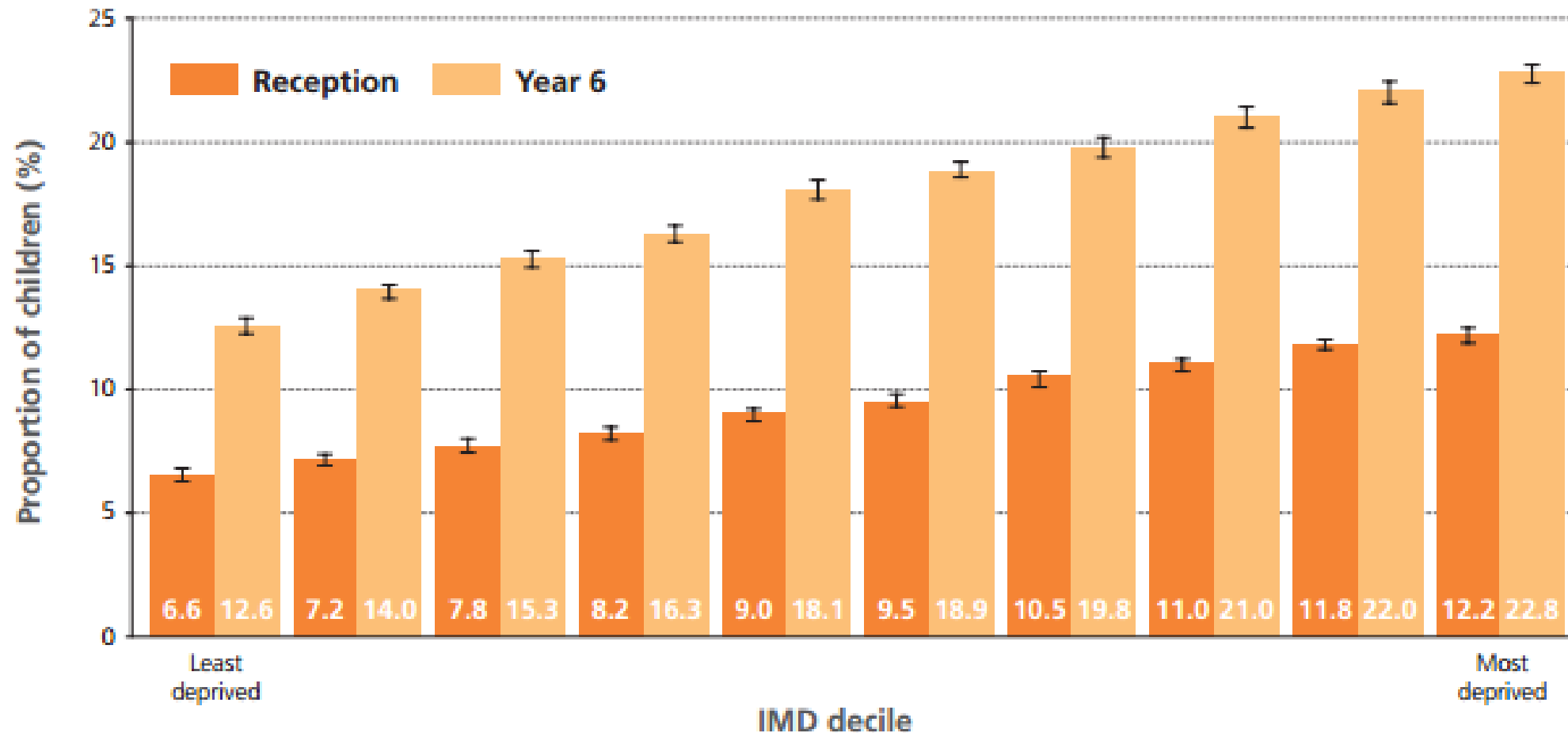Blount's disease
Forearm fracture
Flat feet

Ebbeling, C. B., Pawlak, D. B., & Ludwig, D. S. (2002). Childhood obesity: public-health crisis, common sense cure. *The lancet, 360*(9331), 473-482.

Background
Motivation for considering income and child obesity

FIGURE 1: Prevalence of obesity in children by school year and IMD decile, 2008/09
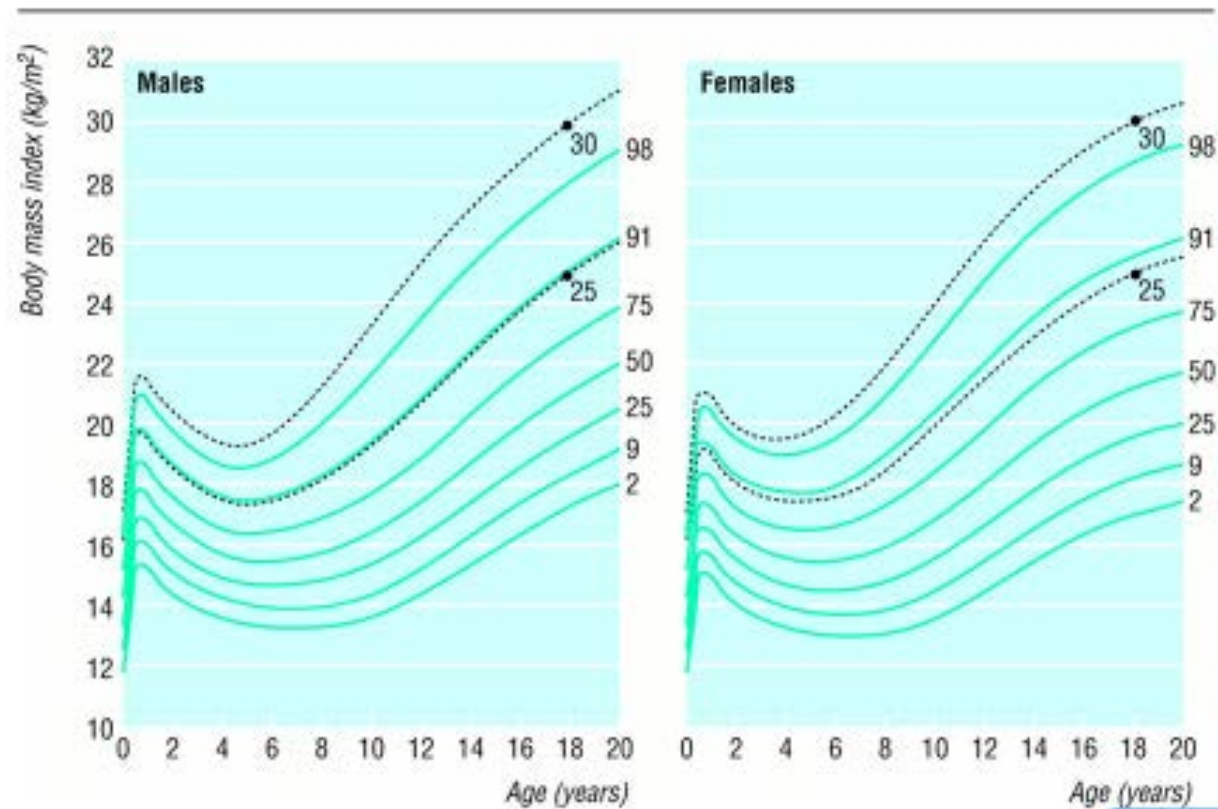
Methods
Data

- Millennium Cohort Study
  - England, Wales, Scotland, Northern Ireland 2000-2001
  - PSU electoral wards
  - 9 months 18818 children
  - 3 years   15808 children
  - 5 years   15459 children
  - 7 years   14043 children 81% of those eligible
  - <u>11 years</u>
  - **<u>14 years</u>**

Methods
measuring childhood excessive weight

shown are body mass index values of 25 and 30 kg/m2 at age 18, with extra centile curves drawn through them.

Tim J Cole et al. BMJ 2000;320:1240
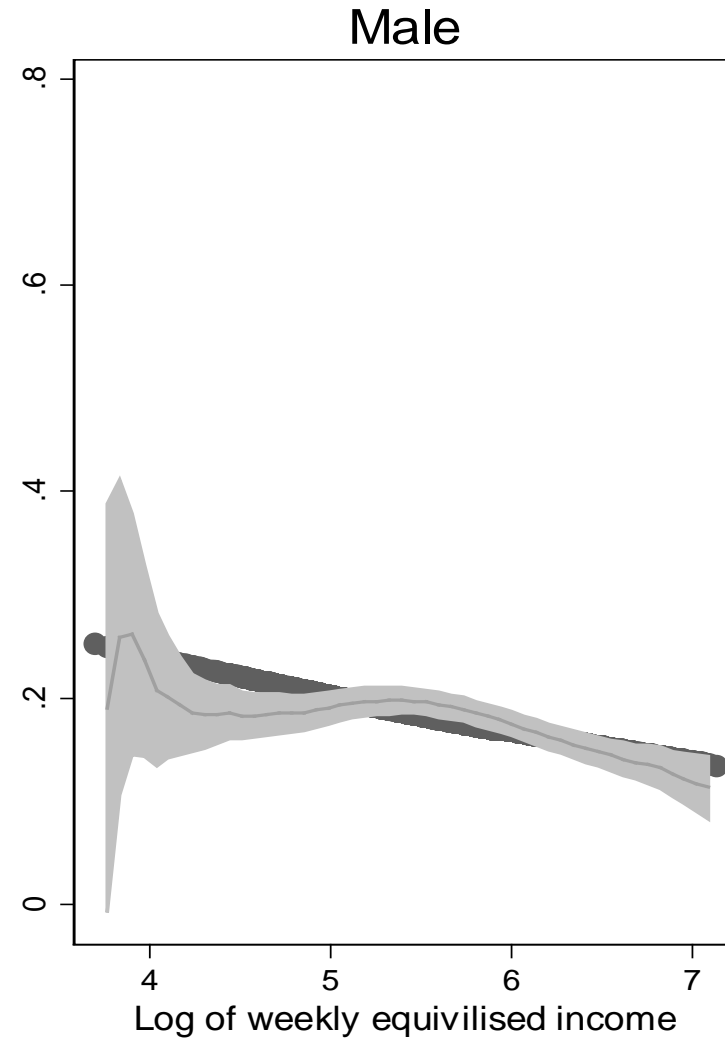
thebmj

Methods
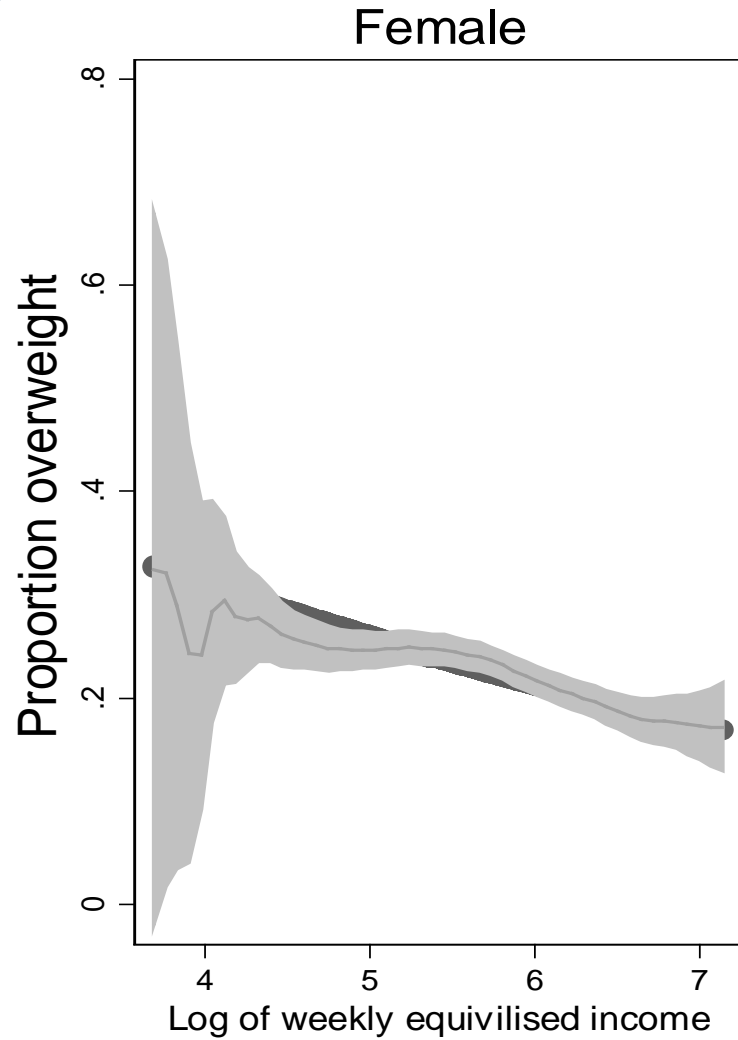## measuring income

- Income
  - OECD equivalised **<u>NET</u>** weekly income
    - Weighting: 0.67 first adult, 0.33 second adult, 0.33 child aged 14-18, 0.20 children <14
    - Transitory income → classical measurement error
    - Time averaged income
    - Log of income

Methods
measuring income

Methods
measuring income

N	Sample	Not in sample
Overweight	13,799	244
	20%	N/A
Equivalised income mean (SD)	346 (197)	269 (167)
Quintiles of income	Mean (range)	
Quint 1	134 (40–172)	
Quint 2	214 (172–258)	
Quint 3	307 (258–360)	
Quint 4	424 (360–502)	
Quint 5	666 (502–1258)	

Results
FEMALES sequentially adjusted

Female	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5
Tran income Q2	0.98 (0.10)					
Tran income Q3	0.96 (0.10)					
Tran income Q4	0.82 (0.08)+					
Tran income Q5	0.73 (0.08)**					
TA income Q2		1.00 (0.11)	1.06 (0.12)	1.09 (0.12)	1.09 (0.12)	1.11 (0.13)
TA income Q3		0.89 (0.09)	0.94 (0.10)	0.99 (0.12)	1.02 (0.12)	1.07 (0.14)
TA income Q4		0.84 (0.09)	0.90 (0.11)	0.97 (0.13)	1.03 (0.13)	1.13 (0.16)
TA income Q5		0.64 (0.07)***	0.67 (0.09)**	0.75 (0.11)*	0.85 (0.12)	0.94 (0.14)
N	6830	6830	6830	6830	6830	6830

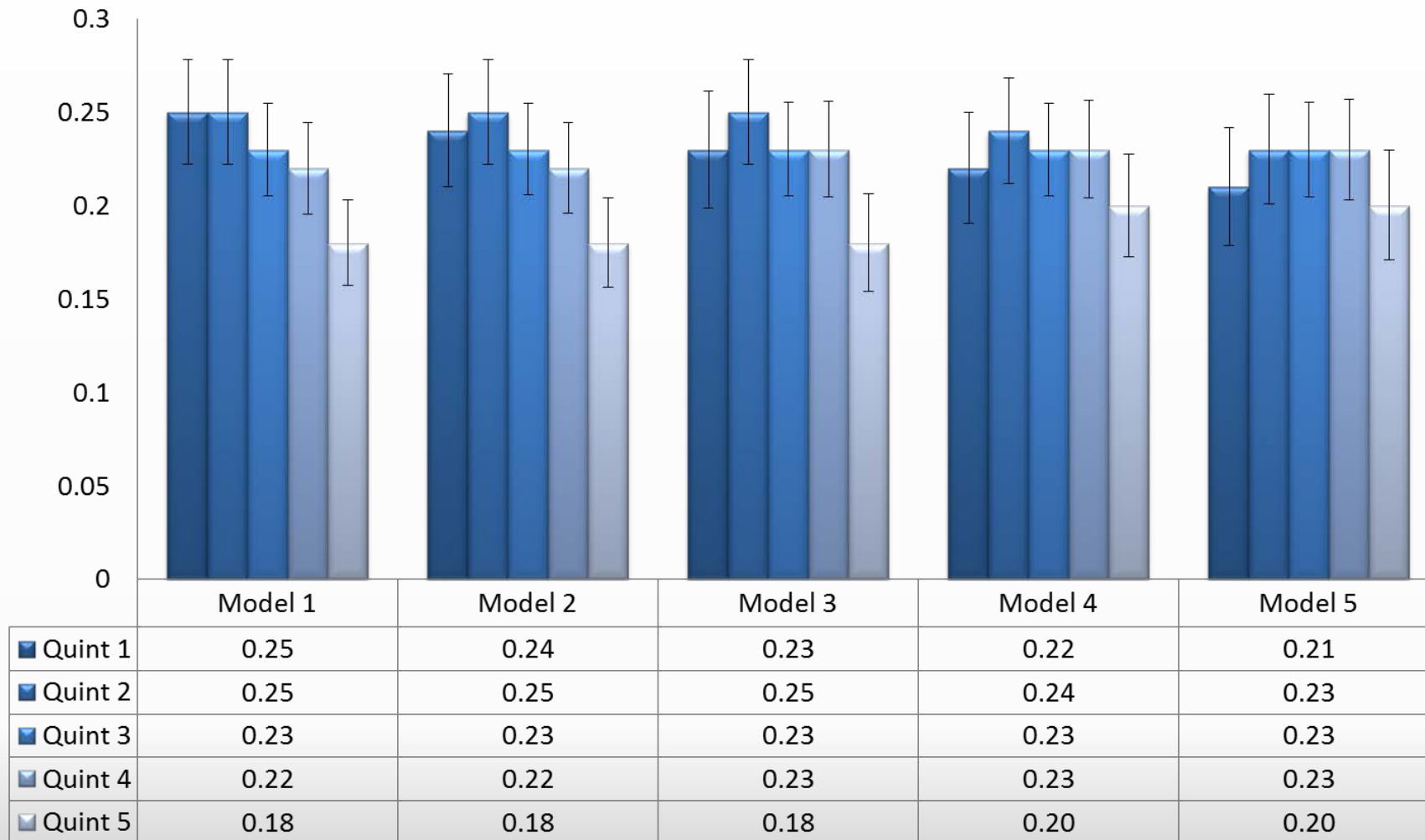$+p<0.1$; $*p<0.05$; $**p<0.01$; $***p<0.001$.
Model 0 = transitory income; Model 1 = time-averaged income; Model 2 = Model 1 + ethnicity, longstanding illness/disability, region, parental age; Model 3 = Model 2 + main respondent education; Model 4 = Model 3 + partner respondent education; Model 5 = Model 4 + highest social class of parents.
Estimates weighted using dovwt2 survey design and attrition weight.

Results
FEMALES sequentially adjusted

	Model 1	Model 2	Model 3	Model 4	Model 5
Quint 1	0.25	0.24	0.23	0.22	0.21
Quint 2	0.25	0.25	0.25	0.24	0.23
Quint 3	0.23	0.23	0.23	0.23	0.23
Quint 4	0.22	0.22	0.23	0.23	0.23
Quint 5	0.18	0.18	0.18	0.20	0.20

Results
MALES sequentially adjusted

Male	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5
Tran income Q2	1.20 (0.13)+					
Tran income Q3	1.23 (0.14)+					
Tran income Q4	0.97 (0.11)					
Tran income Q5	0.83 (0.10)					
TA income Q2		1.22 (0.14)+	1.29 (0.16)*	1.31 (0.17)*	1.33 (0.17)*	1.34 (0.17)*
TA income Q3		1.09 (0.13)	1.20 (0.16)	1.24 (0.19)	1.31 (0.20)+	1.33 (0.21)+
TA income Q4		0.87 (0.09)	0.95 (0.13)	1.03 (0.16)	1.12 (0.17)	1.16 (0.19)
TA income Q5		0.75 (0.09)*	0.80 (0.11)	0.92 (0.14)	1.06 (0.16)	1.14 (0.19)
N	6969	6969	6969	6969	6969	6969

More active due to lack of home entertainment?
Simply not enough food to become overweight?
Working poor?
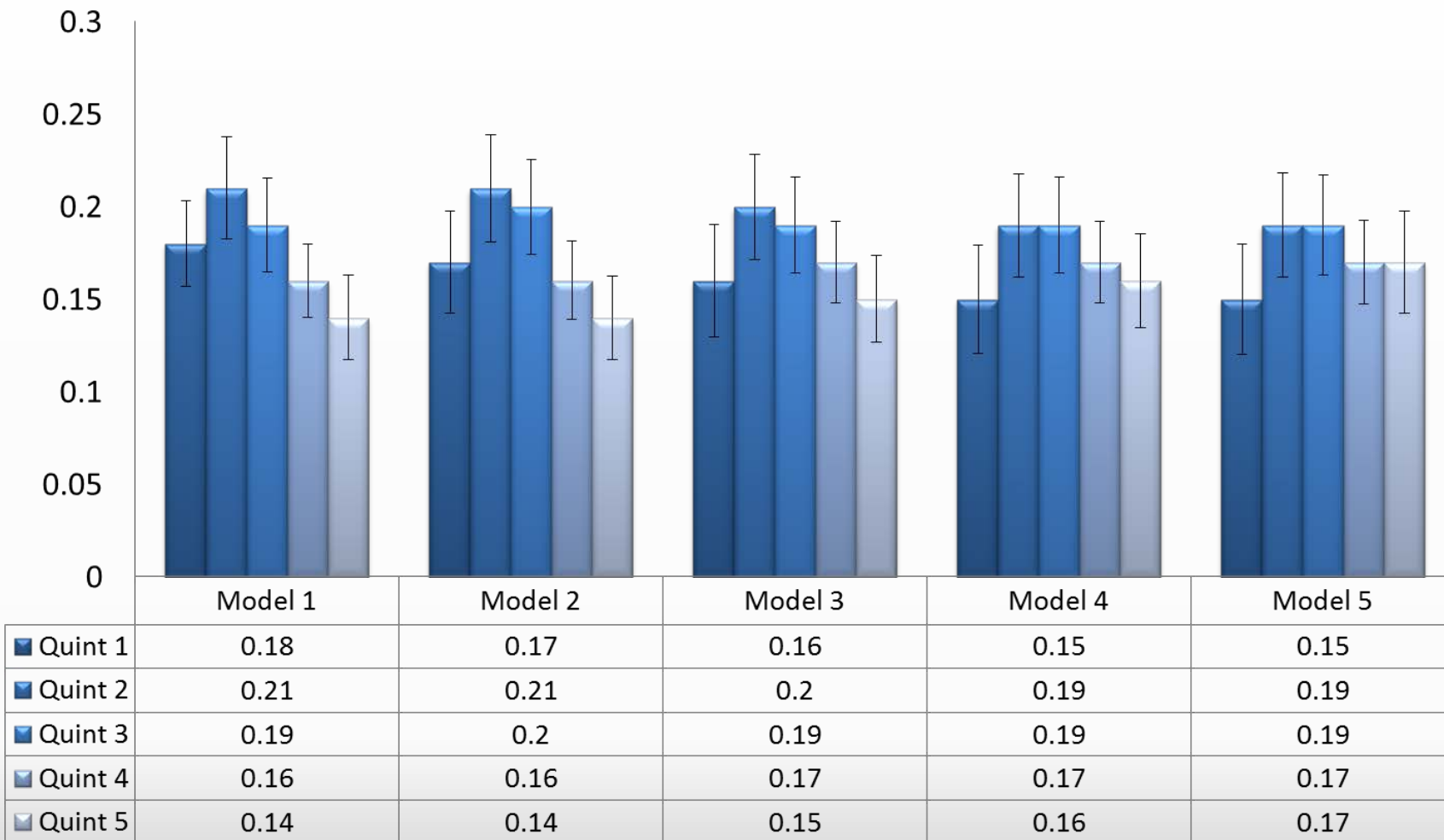
+p<0.1; *p<0.05; **p<0.01; ***p<0.001.
Model 0=transitory income; Model 1=time-averaged income; Model 2=Model1+ethnicity, longstanding illness/disability, region, parental age; Model 3=Model 2+main respondent education; Model 4=Model 3+partner respondent education; Model 5=Model 4+highest social class of parents.
Estimates weighted using dovwt2 survey design and attrition weight.

Results
MALES sequentially adjusted

	Model 1	Model 2	Model 3	Model 4	Model 5
Quint 1	0.18	0.17	0.16	0.15	0.15
Quint 2	0.21	0.21	0.2	0.19	0.19
Quint 3	0.19	0.2	0.19	0.19	0.19
Quint 4	0.16	0.16	0.17	0.17	0.17
Quint 5	0.14	0.14	0.15	0.16	0.17

Results
Longitudinal analysis

- Random effects or fixed effects?
  - Trade off between bias and variance

- Fixed:
  - controls for unobserved fixed characteristics that do not change over time
  - Addressing omitted variable bias

- Random:
  - More efficient uses both within and between person variation
  - Assumes residuals are not correlated to covariate

Longitudinal analysis

WITHIN

Looking at changes in the same unit over time

Example – effects of smoking during pregnancy

RANDOM

BETWEEN

Looking at changes in different units over time

Example – effects of smoking during pregnancy

Results
Longitudinal analysis

- Income: Standardised log equivalised weekly income
  - transitory

- No evidence of a relationship
  - FE Males (-0.002, SE=0.001, n=8706, N=21757)
  - FE females (0.001, SE=0.001, n=8401, N=21243)
  - RE Males (OR=1.01, SE=0.03, n=8704, N=21727)
  - RE females (OR=1.04, SE=0.04, n=8397, N=21215)

Results
What about changing the definition of low income?

- OECD defined income poverty
  - Time averaged income: 0.6*median income = poverty threshold (185.04)
  - Transitory income: frequency family below the poverty line
  - FE

Males	Model 1	Model 2	Model 3	Model 4	Model 5
Below poverty line	1.11	0.97	0.91	0.86	0.85
	(0.10)	(0.11)	(0.11)	(0.11)	(0.11)
	6969	6969	6969	6969	6969
Females					
Below poverty line	1.14	1.02	0.93	0.90	0.85
	(0.09)+	(0.10)	(0.10)	(0.09)	(0.09)
	6,830	6,830	6,830	6,830	6,830

$+p < 0.1$; $*p < 0.05$; $**p < 0.01$; $***p < 0.001$.
Model 1 = unadjusted, Model 2 = Model 1 + ethnicity, longstanding illness/disability, region, parental age; Model 3 = model 2 + main respondent education; Model 4 = Model 3 + partner respondent education; Model 5 = Model 4 + highest social class of parents.
Not below poverty line is reference category. Estimates weighted using dovwt2 survey design and attrition weight.

Results
What about cutting income differently

Female	Model 1	Model 2	Model 3	Model 4	Model 5
Income Tertile 1	Reference				
Income Tertile 2	0.94	0.98	1.03	1.05	1.10
	(0.07)	(0.08)	(0.09)	(0.09)	(0.10)
Income Tertile 3	0.73	0.78	0.86	0.94	1.01
	(0.06)***	(0.08)*	(0.10)	(0.11)	(0.13)
	6,830	6,830	6,830	6,830	6,830
Male	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Income Tertile 1	Reference				
Income Tertile 2	1.09	1.22	1.25	1.30	1.31
	(0.10)	(0.13)+	(0.14)*	(0.14)*	(0.15)*
Income Tertile 3	0.76	0.84	0.94	1.04	1.07
	(0.07)**	(0.10)	(0.11)	(0.13)	(0.14)
	6,969	6,969	6,969	6,969	6,969

$+ p<0.1$; $* p<0.05$; $** p<0.01$; $*** p<0.001$

Model 1 = Time averaged Income; Model 2 = Model1 + Ethnicity, longstanding illness/disability, region, parental age; Model 3 = Model 2 + Main respondent education; Model 4 = Model 3 + Partner respondent education; Model 5 = Model 4 + Highest social class of parents.
Estimates weighted using dovwt2 survey design & attrition weight

Results
What about …

- Separating out the underweight group
  - No change

- Changed the measure of overweight
  - Still no strong relationship

Results

What about a different data set?

- Growing up in Scotland survey
    - 3477 children aged 5/6
    - began in 2004/2005
    - Time averaged income: annual equivalised net income averaged across six sweeps of data collection

Results
What about a different data set?

ALL	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5
Tran Income Q2	1.28					
	(0.18)+					
Tran Income Q3	0.97					
	(0.14)					
Tran Income Q4	0.90					
	(0.13)					
Tran Income Q5	0.80					
	(0.12)					
TA Income Q2		1.00	1.18	1.20	1.18	1.24
		(0.16)	(0.20)	(0.21)	(0.20)	(0.21)
TA Income Q3		1.06	1.36	1.37	1.34	1.47
		(0.16)	(0.23)+	(0.24)+	(0.24)+	(0.27)*
TA Income Q4		0.85	1.13	1.21	1.22	1.35
		(0.13)	(0.20)	(0.23)	(0.23)	(0.27)
TA Income Q5		0.79	1.08	1.23	1.34	1.49
		(0.12)	(0.19)	(0.24)	(0.27)	(0.31)+
N	3,477	3,477	3,477	3,477	3,477	3,477

$+ p<0.1$; $* p<0.05$; $** p<0.01$; $*** p<0.001$

Model 0 = Transitory Income; Model 1 = Time averaged income; Model 2 = Model1 + parental ethnicity, longstanding illness/disability, parental age; Model 3 = Model 2 + Main parental respondent education; Model 4 = Model 3 + Partner respondent education; Model 5 = Model 4 + Household social class of parents.
Estimates weighted using the sweep 6 cross sectional analysis weight (DfWTbrth).

Discussion
So which model does the UK data support?

- At most a weak bivariate relationship

- Disappears completely after adjustment for parental education

- Washbrook et al (2013) using ALSPAC data – similar findings

- SUSAN MAYER – it is not the amount of income itself, but the parental characteristics that result in low income that explain the relationship.

Discussion
Caveats

- Not accounted for wealth

- The effect could take time to manifest

- Focus only on young children – the effect likely differs with age

- Measures of poverty are income based – as this is the focus of the paper, but material deprivation, means tested benefits, perceived financial situation may be better measures of poverty

- The FE models likely underestimate the impact of changes in income on changes in child overweight

Discussion
Conclusions

- No immediate effect of low income on young children's excessive weight in the UK

- If we want to tackle inequalities we might be better looking at parental education and social class

Questions?

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Results
What about treating income as continuous?

Male	Model 1	Model 2	Model 3	Model 4	Model 5
STD log income	0.87	0.88	0.93	0.97	0.99
	(0.03)***	(0.04)*	(0.05)	(0.05)	(0.06)
STD log income sq	0.91	0.88	0.90	0.91	0.91
	(0.04)*	(0.04)**	(0.04)*	(0.04)*	(0.04)*
	6,969	6,969	6,969	6,969	6,969
Female	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
STD log income	0.86	0.87	0.91	0.95	0.98
	(0.03)***	(0.04)**	(0.04)*	(0.05)	(0.05)
STD log income sq	0.96	0.94	0.94	0.96	0.96
	(0.03)	(0.03)+	(0.03)+	(0.03)	(0.03)
	6,830	6,830	6,830	6,830	6,830

Model 1 = Time averaged Income; Model 2 = Model1 + Ethnicity, longstanding illness/disability, region, parental age; Model 3 = Model 2 + Main respondent education; Model 4 = Model 3 + Partner respondent education; Model 5 = Model 4 + Highest social class of parents.

Estimates weighted using dovwt2 survey design & attrition weight
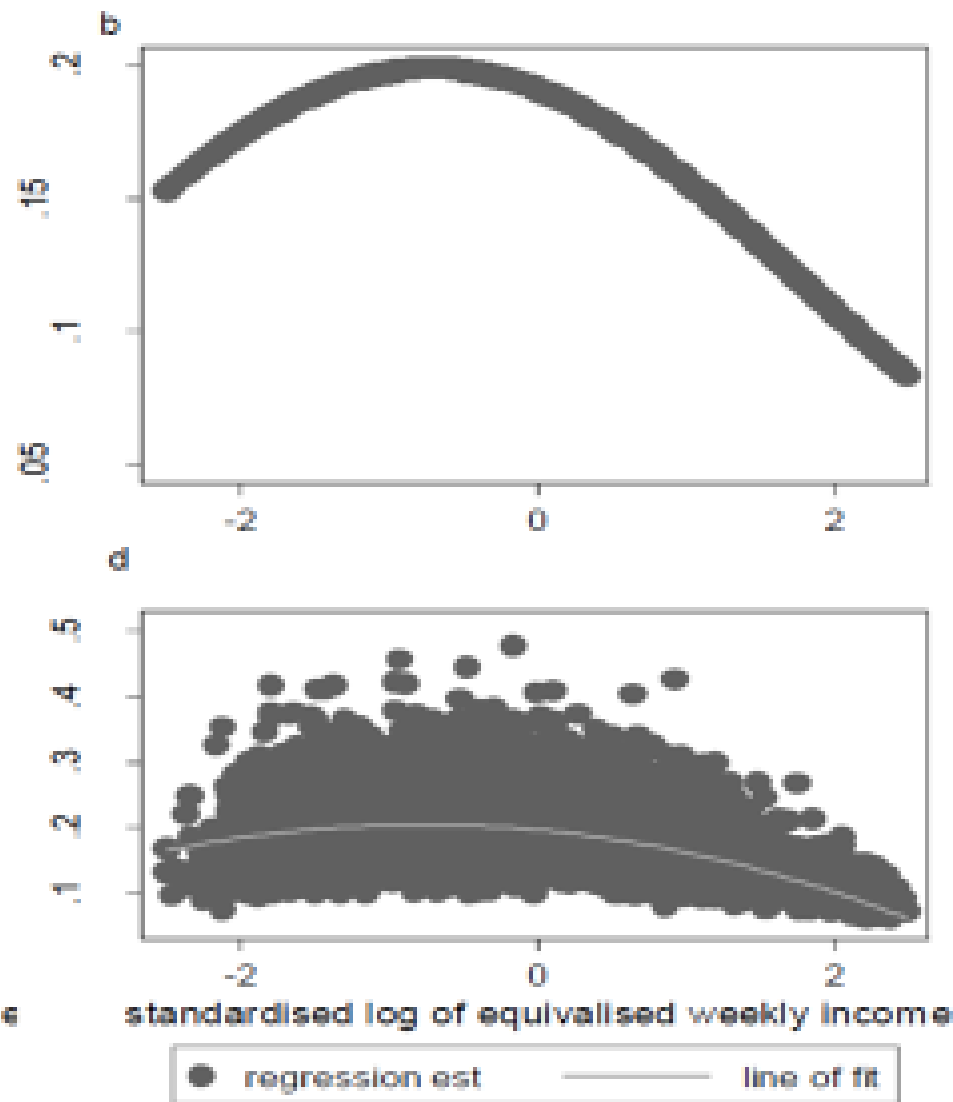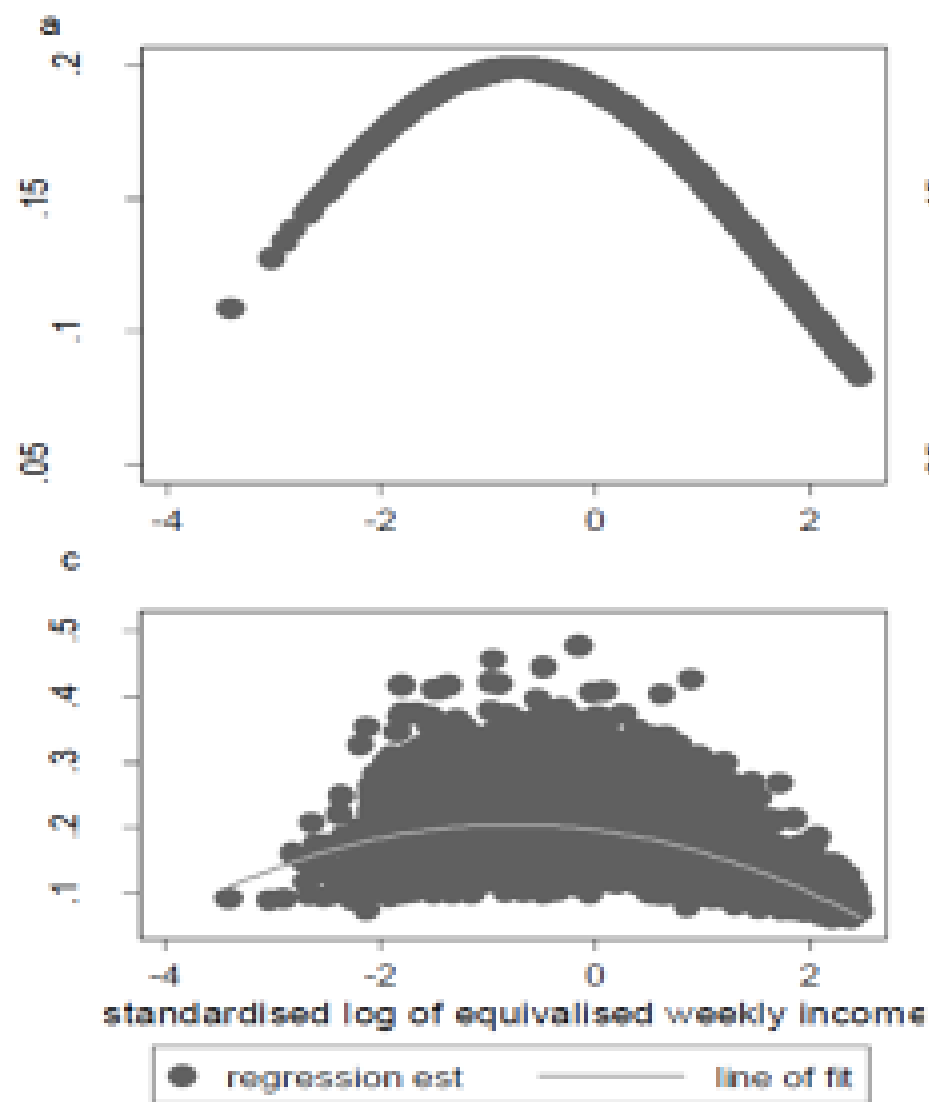
Figures a and b, show the unadjusted relationship between income and overweight, figures c and d show the relationship after full adjustment of the model. The two figures on the right hand side, figures b and d only show the distribution of equivalised log income from -2.5SD.
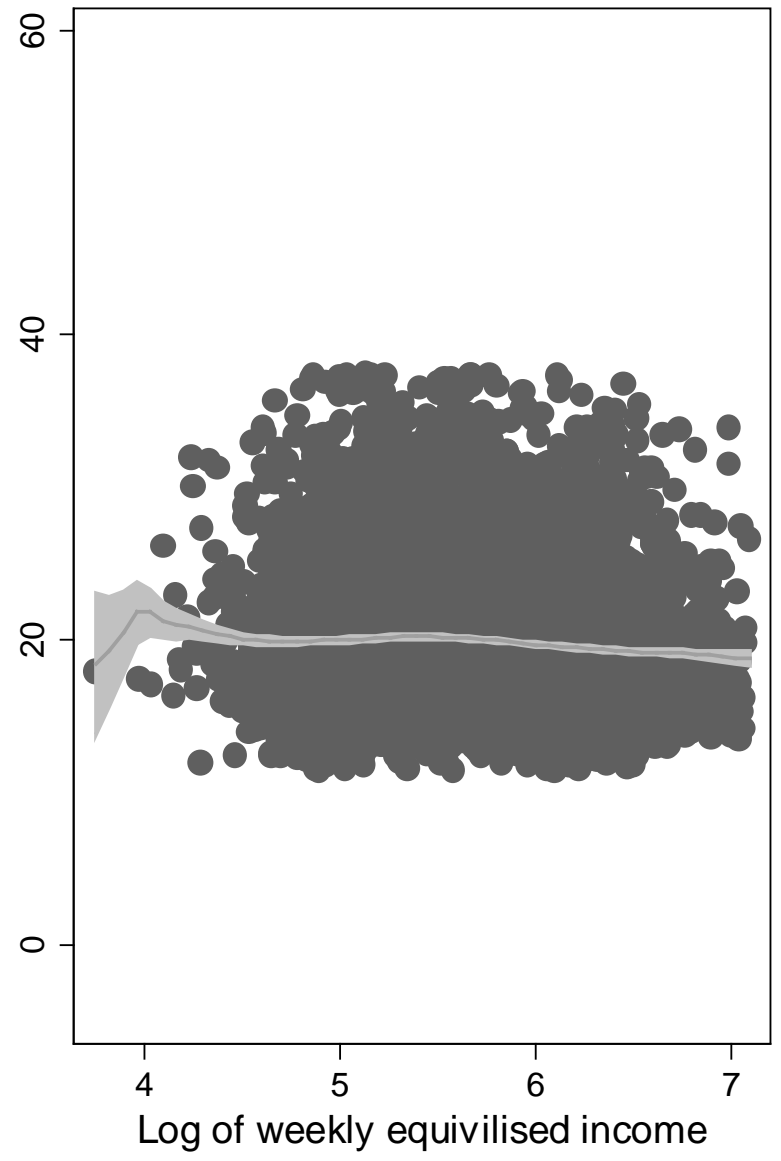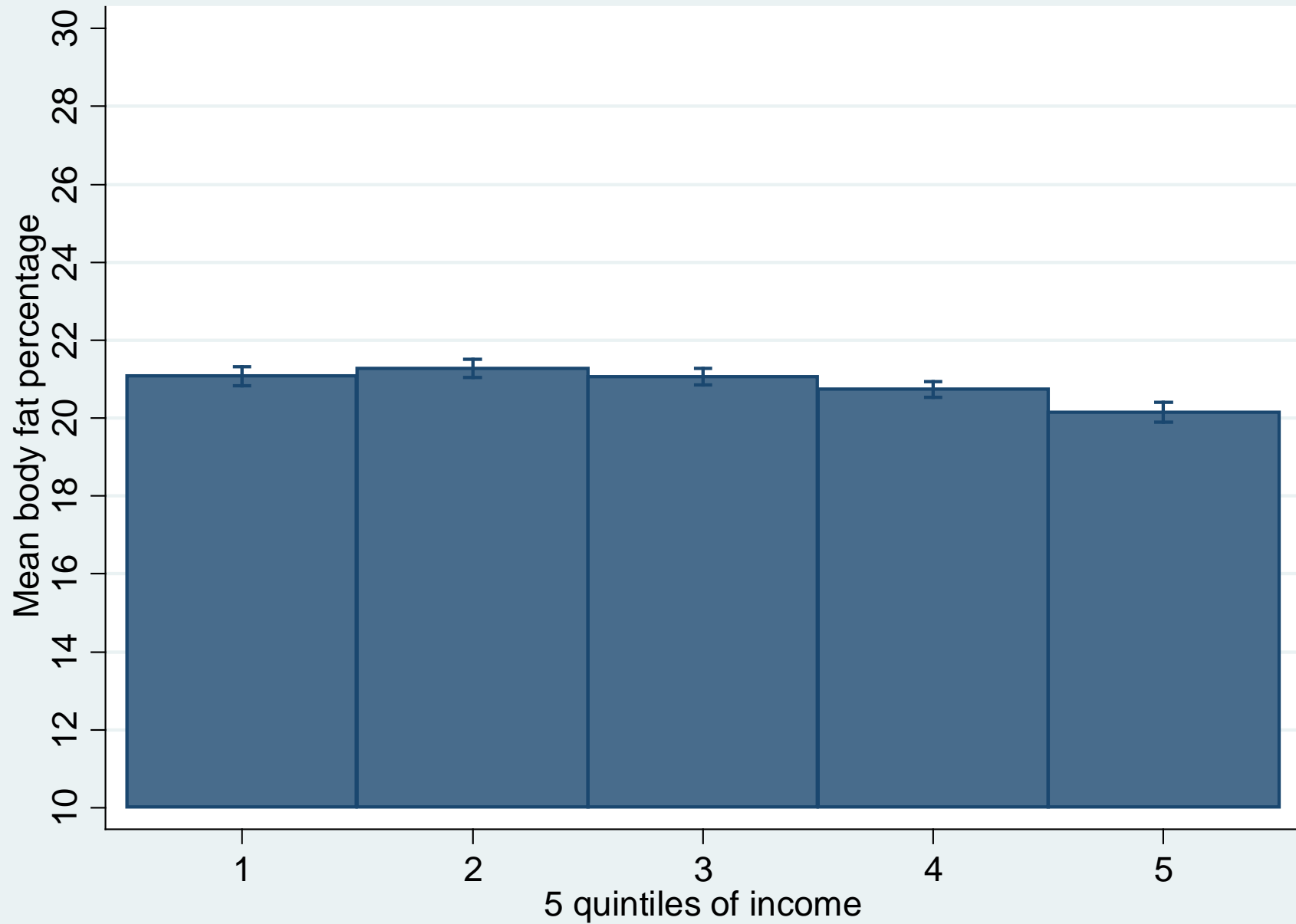
Body fat %

- 13619 children   (424 children did not provide % body fat)
- Body fat measured by BIA
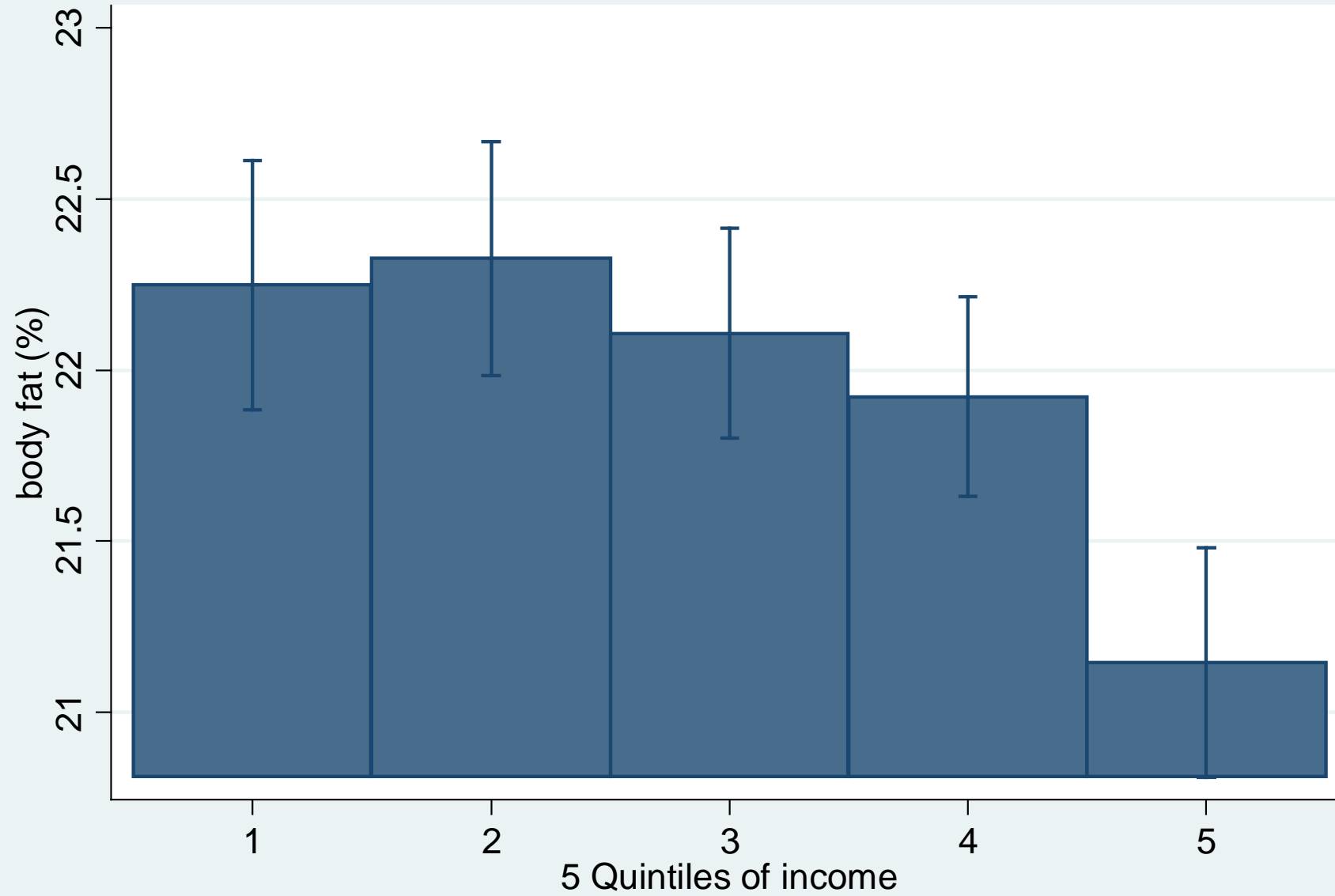- 13169 – no issues with measurement
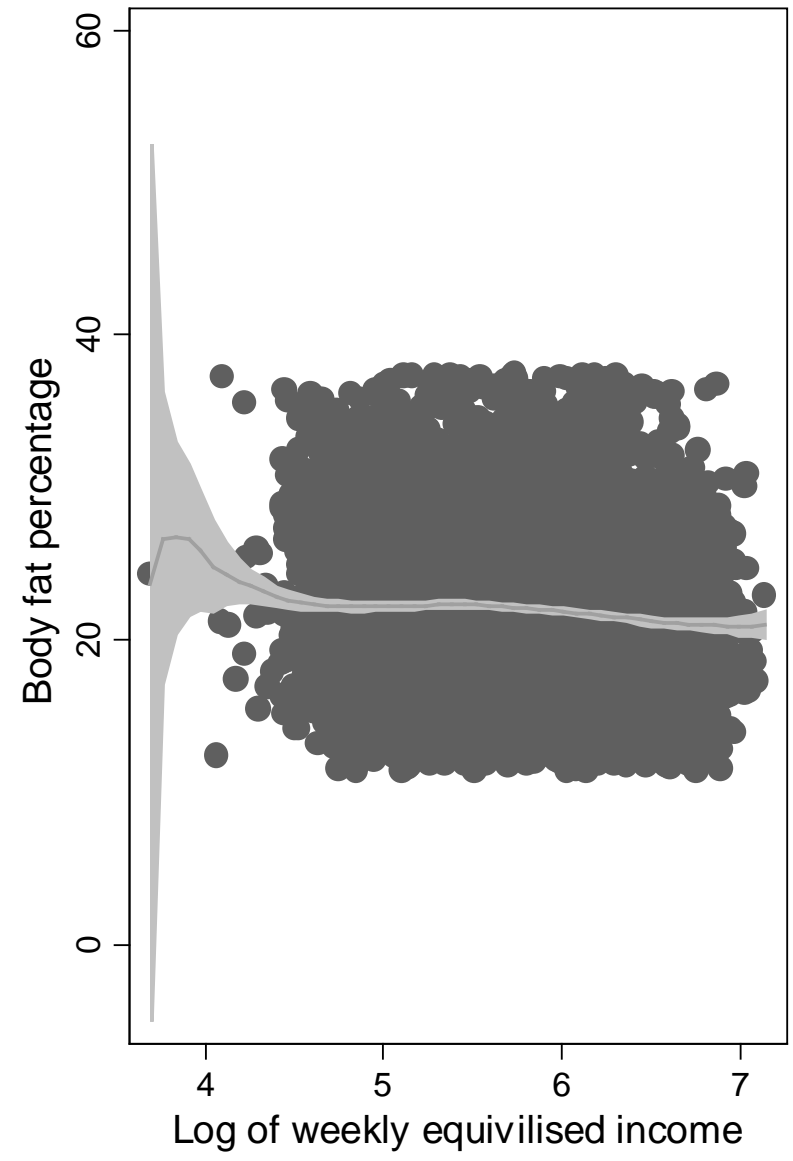
Female - small y axis

Males - small y axis