From birth to childhood: investigating socio-economic differences in health trajectories in the Scottish Longitudinal Study

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Introduction

Background

- Growing childhood obesity epidemic in recent decades, leading to health problems in childhood, obesity in adulthood.
- Socio-economic disadvantage → increased obesity.
- Socio-economic disadvantage → lower birth weight.
- Higher birth weight → increased obesity.

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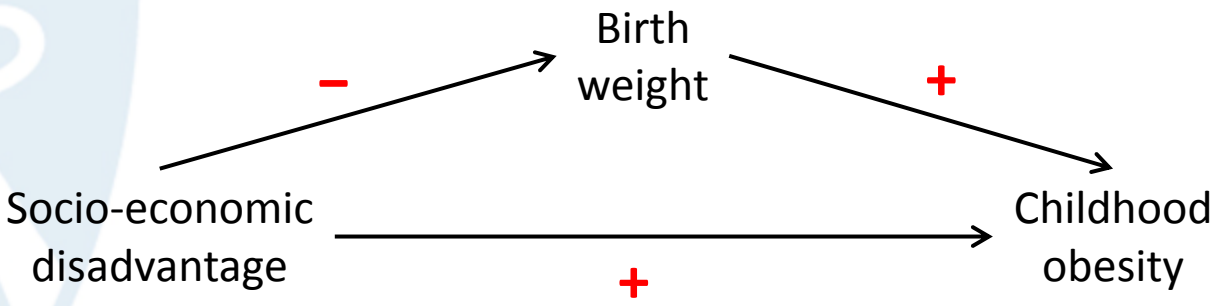

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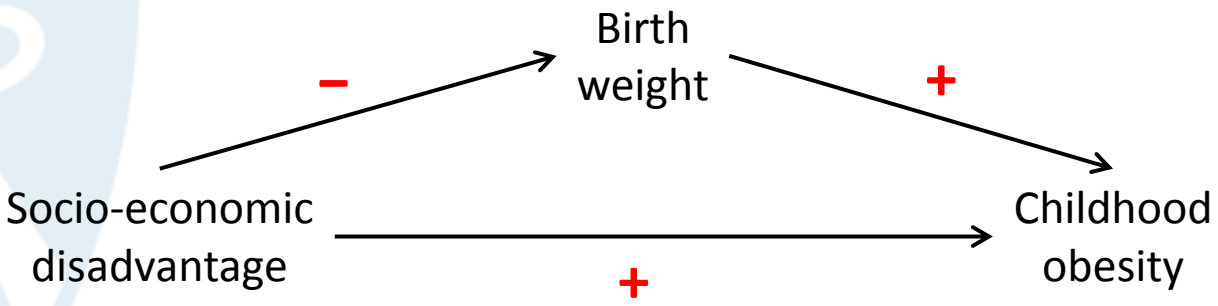


Aims:

- To examine the association between social disadvantage and childhood obesity in the Scottish Longitudinal Study;
- To elucidate the mediatory role of birth weight in this association.

Methods

Study participants

- Scottish Longitudinal Study (SLS) is a large-scale, anonymised linkage study and is a 5.3% sample of the Scottish population, selected using 20 birth dates.
- Linked census and vital registration data from 1991.
- We are examining health trajectories and outcomes of ~30,000 babies born to female members of the SLS from 1991 to 2005.
- Linkage to other data sources: birth variables from birth records; childhood growth data from health visitor and primary school health assessments.
- No identifiable individual level data. Derived from linkages that are anonymised prior to handover to the research team.

Methods

Synthetic weekly income

- Income often missing or poorly measured due to its complexity and sensitivity.
- Clemens & Dibben (2014) derived a synthetic measure of weekly wage using multilevel random effects model of wage predicted by Standard Occupational Classification (SOC) in the UK Labour Force Survey (2001–2010) (plus age and sex). Externally validated and tested.
- Applied in SLS to mother's and father's reported occupation at birth of child.
- Estimate of income also made for parents not in paid employment, on the basis of typical social security payments.
- Household income calculated as sum of mother's and father's incomes.
- Income equalisation multiplier of 1.6 applied for single mothers.
- Analysed as fourths of the distribution.

Methods

Anthropometric data

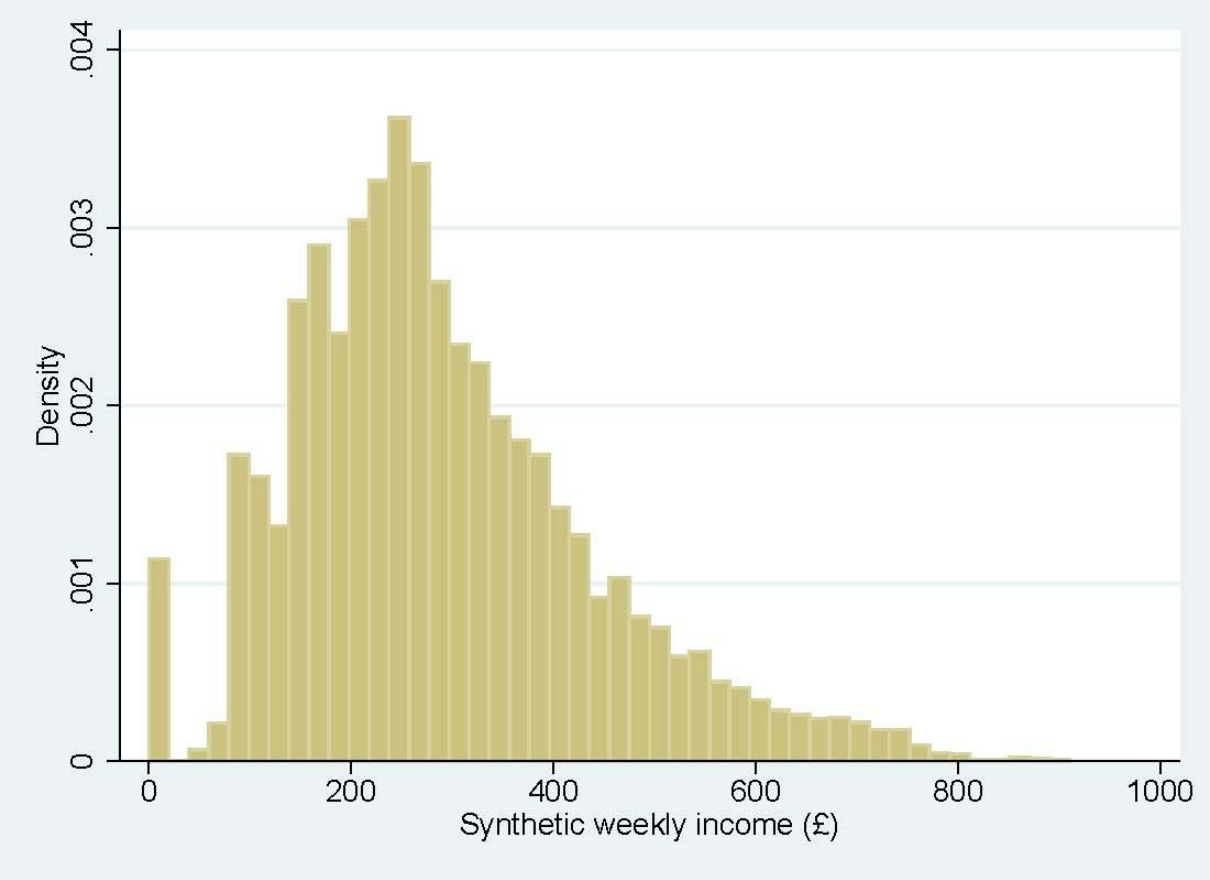
- Height, weight and age data at ages 21-24 months, 39-42 months, 48 months, Primary 1 and Primary 7.
- At each time point height, weight and age data cleaned in an iterative manner, repeating until no further recoding is necessary:
  1. Calculate z-scores using the sample SD.
  2. Recode heights and weights outside [-5, 5] (ages outside [-3, 5]) to missing.
- BMI calculated and similarly cleaned.
- Overweight at each time point calculated using the international age- and sex-specific cut-offs of Cole et al (2000).

Potential confounders

- Year of birth (1991-1994, 1995-1999, 2000-2005), Health Board (10 regions), sex, mother's age (<20, 20-24, 25-29, 30-34, 35+), ethnic group (white, non-white).

Results

Synthetic weekly income



Source: Scottish Longitudinal Study

Results

Childhood BMI & overweight

Age	Mean (SD) age (years)	Males				Females		
		n	Mean (SD) BMI	% over-weight		n	Mean (SD) BMI	% over-weight
21-24 months	1.9 (0.1)	6407	17.1 (1.6)	18.2		6049	16.7 (1.7)	18.3
39-42 months	3.4 (0.2)	9494	16.3 (1.5)	15.6		9073	16.1 (1.6)	17.2
48 months	4.6 (0.3)	6399	16.1 (1.6)	15.8		6105	15.9 (1.7)	19.7
Primary 1	5.6 (0.3)	3674	16.1 (1.6)	15.3		3397	16.1 (1.8)	22.5
Primary 7	11.5 (0.4)	3018	19.1 (3.4)	24.1		2801	19.8 (3.8)	29.9

Source: Scottish Longitudinal Study

Results

Overweight at Primary 7

n = 3957

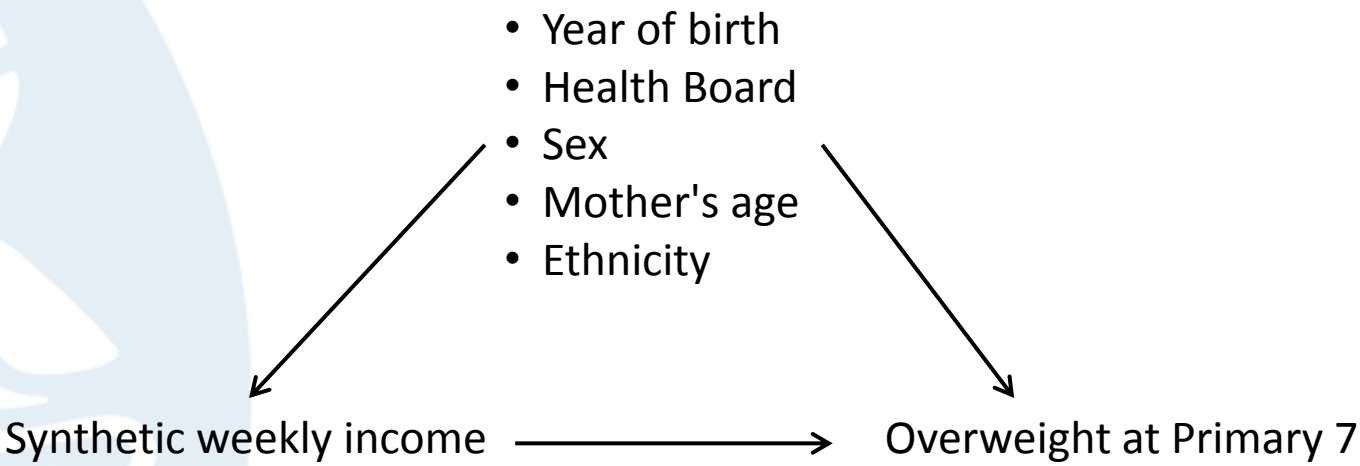
Synthetic income fourth	Unadjusted				Fully adjusted[A]		
	OR	95% CI	p overall (p trend)		OR	95% CI	p overall (p trend)
1 (lowest)	(ref)		0.20 (0.04)		(ref)		0.02 (0.003)
2	0.98	0.82, 1.17			0.96	0.80, 1.14	
3	0.88	0.73, 1.06			0.80	0.65, 0.98	
4 (highest)	0.80	0.63, 1.02			0.68	0.51, 0.89	

[A]Adjusted for year of birth, Health Board, sex, mother's age, ethnicity.

Source: Scottish Longitudinal Study

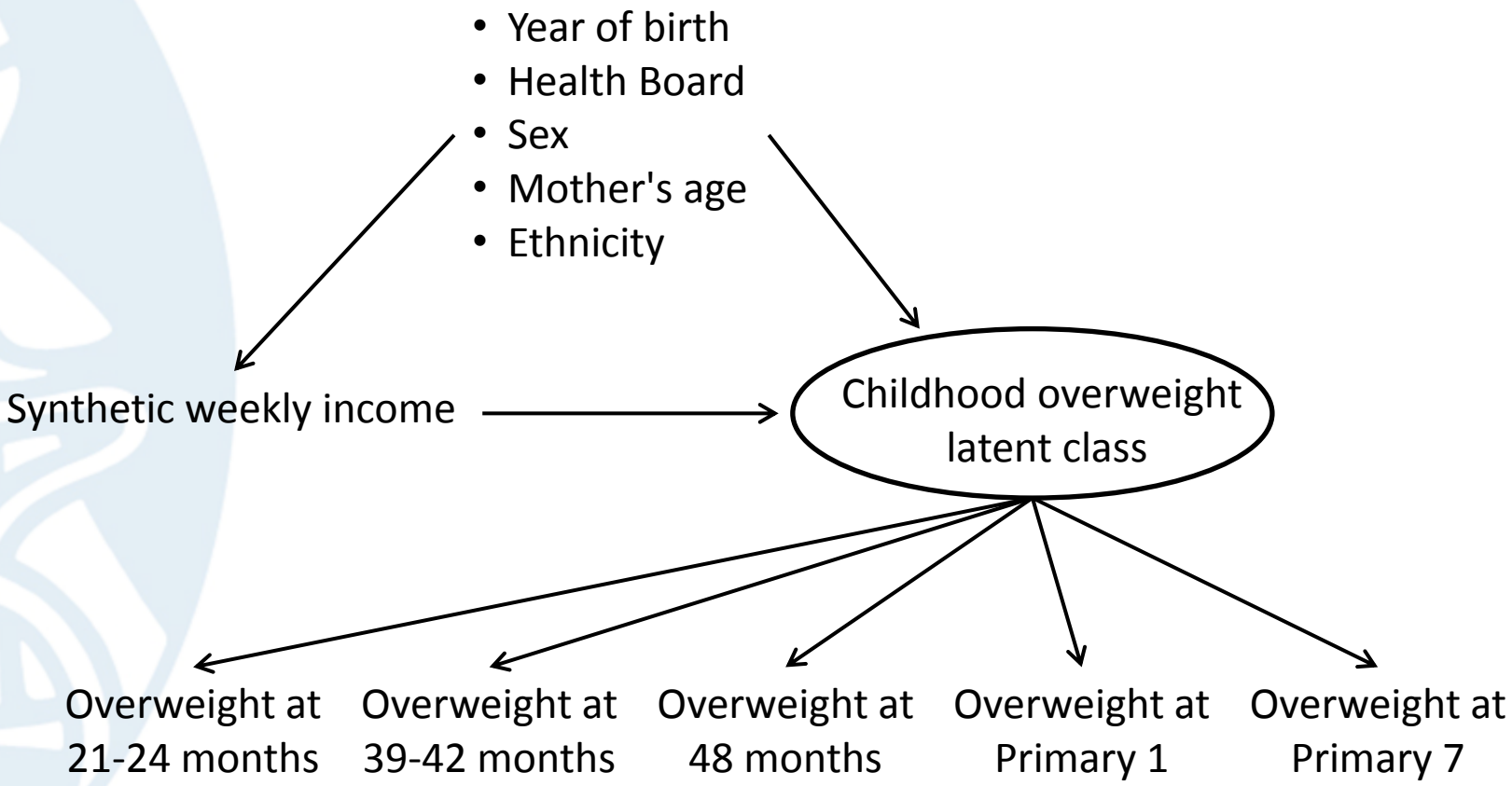
Methods

Longitudinal latent class analysis



Methods

Longitudinal latent class analysis



- Using `gllamm` in Stata (Skrondal & Rabe-Hesketh, 2004).

Results

Overweight latent class analysis

At least two overweight observations between age 2 and 11

	Males (n = 9260)			Females (n = 8758)		
	1 class	2 classes	3 classes	1 class	2 classes	3 classes
Log-likelihood	-11680.5	-10658.2	...	-12099.9	-10833.7	...
AIC	23371.0	21338.4	...	24209.7	21689.4	...
BIC	23406.7	21416.9	...	24245.1	21767.2	...
aBIC	23390.8	21381.9	...	24229.2	21732.3	...
Entropy		0.715	...		0.702	...
Smallest class size (%)		1441 (15.6)	...		1719 (19.6)	...

Source: Scottish Longitudinal Study

Results

Overweight latent class analysis

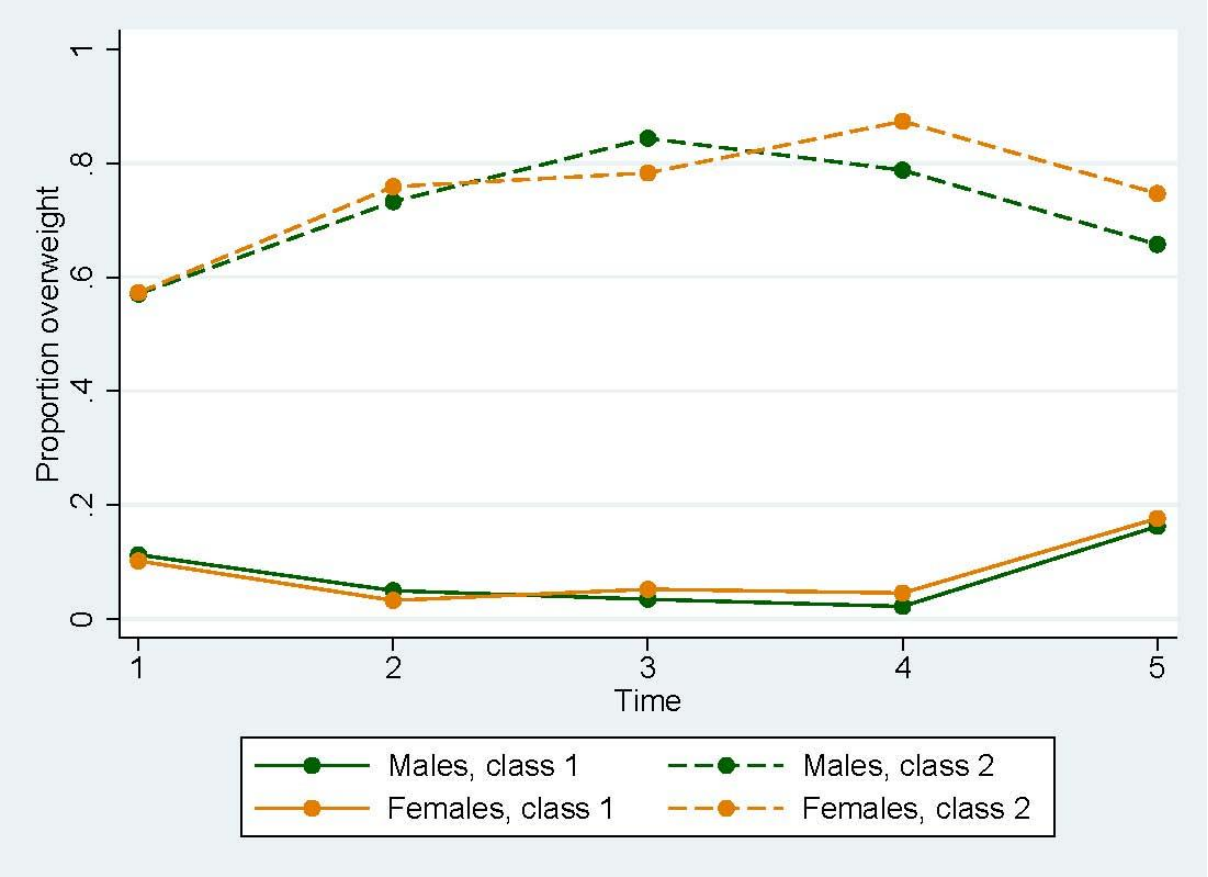
Complete overweight data between age 2 and 11

	Males (n = 294)			Females (n = 281)		
	1 class	2 classes	3 classes	1 class	2 classes	3 classes
Log-likelihood	-687.3	-587.8	-583.1	-691.4	-563.3	-556.1
AIC	1384.6	1197.6	1200.3	1392.8	1148.6	1146.3
BIC	1403.0	1238.2	1262.9	1411.0	1188.6	1208.1
aBIC	1387.2	1203.3	1209.0	1395.1	1153.7	1154.2
Entropy		0.854	0.838		0.844	0.779
Smallest class size (%)		55 (18.7)	24 (8.2)		71 (25.3)	26 (9.3)

Source: Scottish Longitudinal Study

Results

Overweight latent trajectory



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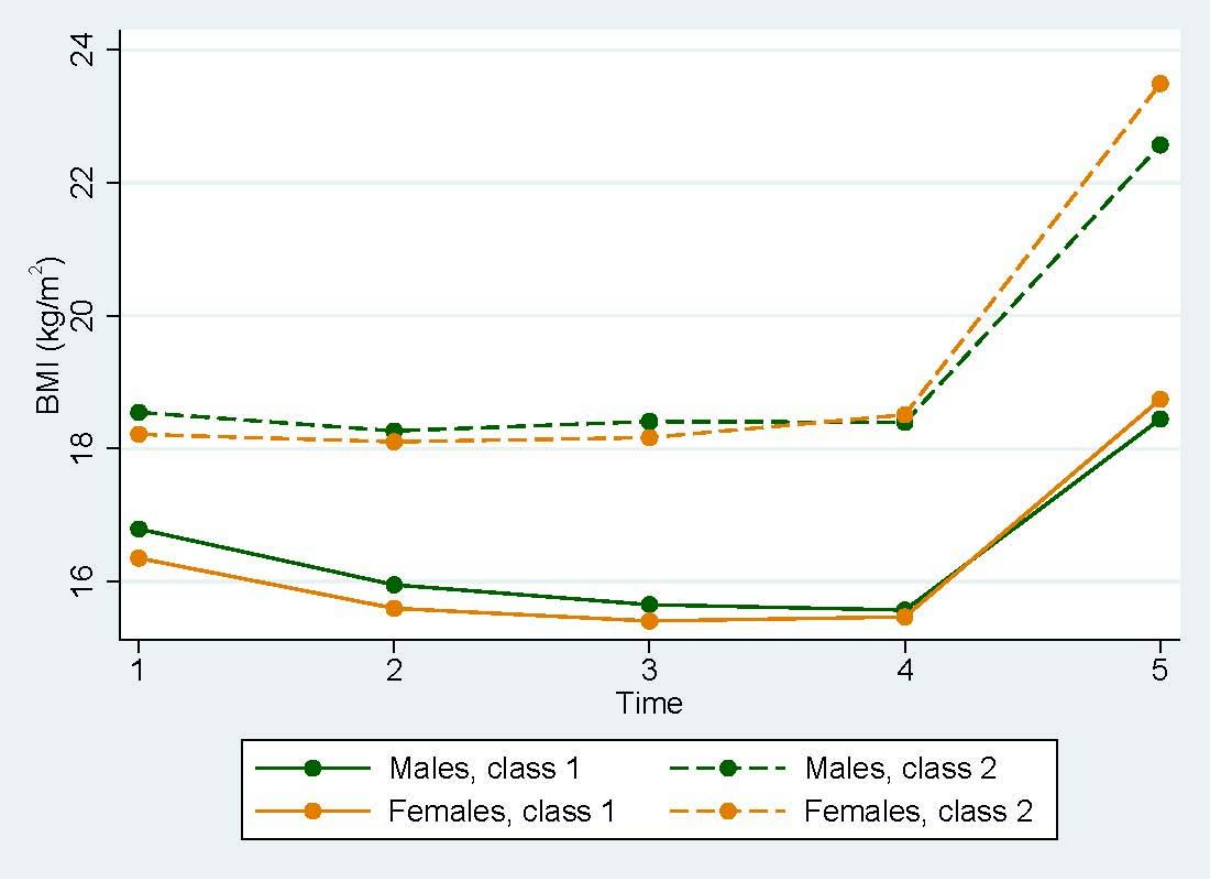

Source: Scottish Longitudinal Study

Results

Overweight latent trajectory

n = 13547

Synthetic income fourth	Unadjusted				Fully adjusted[A]		
	OR	95% CI	p overall (p trend)		OR	95% CI	p overall (p trend)
1 (lowest)	(ref)		0.97 (0.97)		(ref)		0.98 (0.99)
2	1.01	0.89, 1.14			1.00	0.88, 1.14	
3	1.02	0.90, 1.15			1.02	0.89, 1.16	
4 (highest)	0.99	0.86, 1.13			0.99	0.85, 1.16	

[A]Adjusted for year of birth, Health Board, sex, mother's age, ethnicity.

Source: Scottish Longitudinal Study

- What's going on? Selection bias?

Results

Overweight latent trajectory

Restricted to study members non-missing for overweight at Primary 7

n = 3957

Synthetic income fourth	Unadjusted				Fully adjusted[A]		
	OR	95% CI	p overall (p trend)		OR	95% CI	p overall (p trend)
1 (lowest)	(ref)		0.45 (0.64)		(ref)		0.55 (0.96)
2	1.05	0.85, 1.30			1.04	0.84, 1.29	
3	1.17	0.94, 1.45			1.11	0.87, 1.40	
4 (highest)	0.96	0.72, 1.27			0.90	0.65, 1.24	

[A]Adjusted for year of birth, Health Board, sex, mother's age, ethnicity.

Source: Scottish Longitudinal Study

Results

Overweight at Primary 7: Mediation by birth weight

Restricted to study members non-missing for birth weight

n = 3785

Synthetic income fourth	Fully adjusted[A]				Fully adjusted[A] + birth weight		
	OR	95% CI	p overall (p trend)		OR	95% CI	p overall (p trend)
1 (lowest)	(ref)		0.01 (0.002)		(ref)		0.01 (0.001)
2	0.93	0.78, 1.12			0.91	0.76, 1.10	
3	0.81	0.66, 0.99			0.79	0.64, 0.98	
4 (highest)	0.64	0.49, 0.85			0.62	0.47, 0.82	

[A]Adjusted for year of birth, Health Board, sex, mother's age, ethnicity.

Source: Scottish Longitudinal Study

Summary

- Strong, graded relationship between socio-economic disadvantage (synthetic weekly income) and overweight at Primary 7.
- Seemingly no mediation of the effect of income on overweight at Primary 7.
- Results from relatively small sub-sample with complete data.
- Synthetic income seems a useful measure of socio-economic disadvantage, but some measurement error (retirees, children in care,…).

Summary

- Strong, graded relationship between socio-economic disadvantage (synthetic weekly income) and overweight at Primary 7.
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- Results from relatively small sub-sample with complete data.
- Synthetic income seems a useful measure of socio-economic disadvantage, but some measurement error (retirees, children in care,…).

Future work:

- LLCA allows the reduction of repeated measurements into a small number of trajectories with appropriate handling of missing data. Data sparsity pushing method too far here? Alternative approaches?
- Mediator-outcome confounding? Intermediate confounding? G-formula?
- Other outcomes: Cognitive and social measures in early years and at school.
- Other mediators: feeding patterns in infancy.

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Results

Descriptive statistics (1)

Variable	Primary 7 analysis		Latent class analysis	
	n (%)	Overweight (%)	n (%)	Overweight (%)
Synthetic income fourth				
1 (lowest)	1863 (35.7)	522 (28.0)	4655 (27.4)	794 (17.1)
2	1597 (30.6)	446 (27.9)	4752 (27.9)	845 (17.8)
3	1189 (22.8)	300 (25.2)	4557 (26.8)	802 (17.6)
4 (highest)	565 (10.8)	135 (23.9)	3042 (17.9)	535 (17.6)
Sex				
Male	3018 (51.9)	728 (24.1)	9260 (51.4)	1441 (15.6)
Female	2801 (48.1)	837 (29.9)	8758 (48.6)	1719 (19.6)
Year of birth				
1991-1994	3051 (52.4)	792 (26.0)	5241 (29.1)	916 (17.5)
1995-1999	2425 (41.7)	671 (27.7)	10250 (56.9)	1806 (17.6)
2000-2005	344 (5.9)	102 (29.7)	2527 (14.0)	438 (17.3)

Source: Scottish Longitudinal Study

Results

Descriptive statistics (2)

Variable	Primary 7 analysis			Latent class analysis	
	n (%)	Overweight (%)		n (%)	Overweight (%)
Ethnic group					
Non-white	71 (1.5)	23 (32.4)		413 (2.9)	52 (12.6)
White	4640 (98.5)	1257 (27.1)		13948 (97.1)	2466 (17.7)
Mother's age					
<20	440 (8.4)	113 (25.7)		1268 (7.5)	212 (16.7)
20-24	1134 (21.8)	305 (26.9)		3045 (17.9)	533 (17.5)
25-29	1817 (34.9)	502 (27.6)		5480 (32.2)	963 (17.6)
30-34	1316 (25.3)	330 (25.1)		5046 (29.7)	890 (17.6)
35+	504 (9.7)	152 (30.2)		2155 (12.7)	378 (17.5)

Source: Scottish Longitudinal Study

Results

BMI observations

CHSP: Child Health Systems Programme

Source: Scottish Longitudinal Study

Health Board	CHSP Pre-school implementation	CHSP School implementation
Ayrshire & Arran	1993	2007
Borders	1995	1995
Argyll & Clyde	1991	2001
Fife	1994	2000
Greater Glasgow	1995	2008
Lanarkshire	1992	1999
Lothian	1994	2004
Tayside	1995	2002
Forth Valley	1997	2005
Dumfries & Galloway	2000	2004

Results

Overweight at Primary 7

(n = 3957)

[A]Adjusted for year of birth, Health Board.
[B]Adjusted for sex, mother's age, ethnicity.
[C]Adjusted for year of birth, Health Board, sex, mother's age, ethnicity.
Source: Scottish Longitudinal Study

Synthetic income fourth	Unadjusted			Partially adjusted[A]		
	OR	95% CI	p overall (p trend)	OR	95% CI	p overall (p trend)
1 (lowest)	(ref)		0.20 (0.04)	(ref)		0.02 (0.003)
2	0.98	0.82, 1.17		0.95	0.80, 1.13	
3	0.88	0.73, 1.06		0.82	0.67, 0.99	
4 (highest)	0.80	0.63, 1.02		0.69	0.53, 0.89	

Synthetic income fourth	Partially adjusted[B]			Fully adjusted[C]		
	OR	95% CI	p overall (p trend)	OR	95% CI	p overall (p trend)
1 (lowest)	(ref)		0.22 (0.05)	(ref)		0.02 (0.003)
2	0.99	0.83, 1.18		0.96	0.80, 1.14	
3	0.87	0.72, 1.06		0.80	0.65, 0.98	
4 (highest)	0.80	0.62, 1.03		0.68	0.51, 0.89	

Results

Overweight latent trajectory (n = 13547)

[A]Adjusted for year of birth, Health Board.
[B]Adjusted for sex, mother's age, ethnicity.
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Source: Scottish Longitudinal Study

Synthetic income fourth	Unadjusted			Partially adjusted[A]		
	OR	95% CI	p overall (p trend)	OR	95% CI	p overall (p trend)
1 (lowest)	(ref)		0.97 (0.97)	(ref)		0.96 (0.75)
2	1.01	0.89, 1.14		1.01	0.89, 1.14	
3	1.02	0.90, 1.15		1.03	0.91, 1.17	
4 (highest)	0.99	0.86, 1.13		1.01	0.88, 1.14	

Synthetic income fourth	Partially adjusted[B]			Fully adjusted[C]		
	OR	95% CI	p overall (p trend)	OR	95% CI	p overall (p trend)
1 (lowest)	(ref)		0.96 (0.80)	(ref)		0.98 (0.99)
2	1.00	0.88, 1.13		1.00	0.88, 1.14	
3	1.01	0.89, 1.14		1.02	0.89, 1.16	
4 (highest)	0.97	0.84, 1.12		0.99	0.85, 1.16	

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1	(ref)		0.45 (0.64)	(ref)		0.48 (0.97)
2	1.05	0.85, 1.30		1.05	0.84, 1.28	
3	1.17	0.94, 1.45		1.13	0.90, 1.41	
4	0.96	0.72, 1.27		0.90	0.67, 1.23	

Synthetic income fourth	Partially adjusted[B]			Fully adjusted[C]		
	OR	95% CI	p overall (p trend)	OR	95% CI	p overall (p trend)
1	(ref)		0.51 (0.63)	(ref)		0.55 (0.96)
2	1.06	0.86, 1.31		1.04	0.84, 1.29	
3	1.16	0.93, 1.46		1.11	0.87, 1.40	
4	0.97	0.72, 1.31		0.90	0.65, 1.24	