

**Life course neighbourhood deprivation effects on body mass index:
quantifying the importance of selective migration.**

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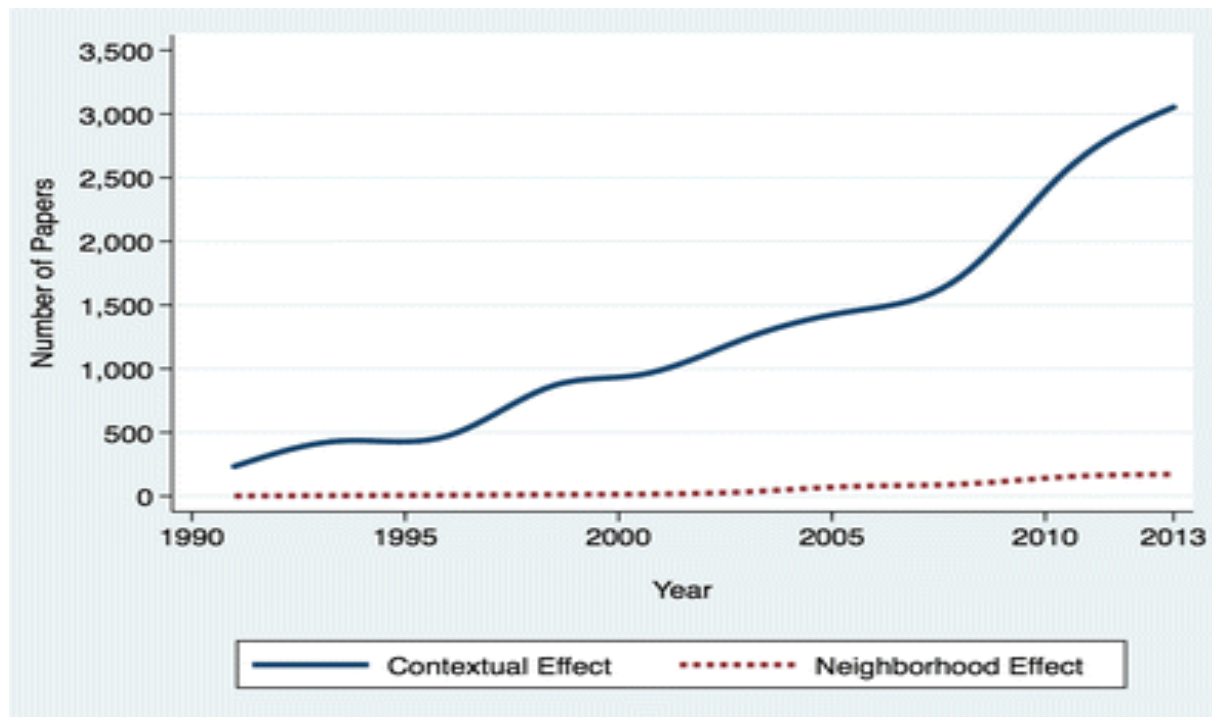
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Background



Over the past 20+ years, a considerable number of publications have shown associations between properties of where people live and their health.



Oakes, J.M., Andrade, K.E., Biyoow, I.M. et al. *Curr Epidemiol Rep* (2015) 2: 80.
<https://doi.org/10.1007/s40471-015-0035-7>

Background

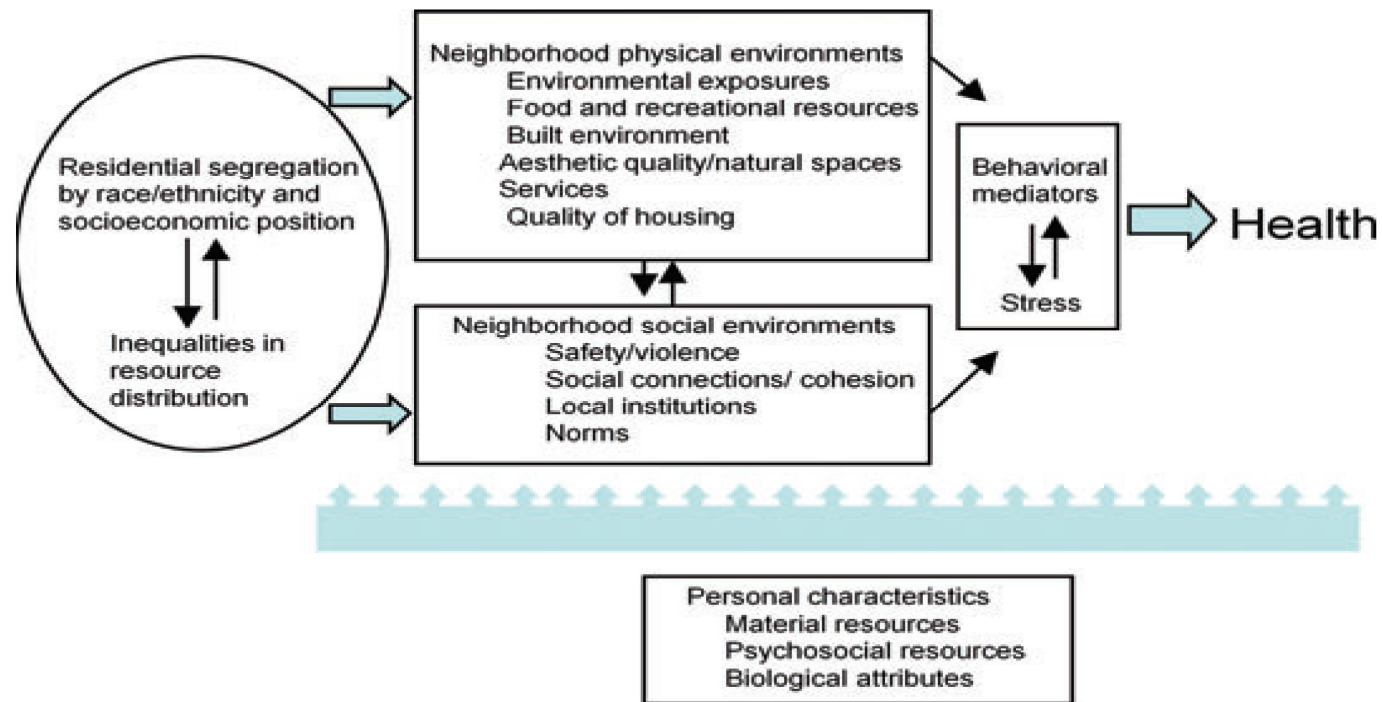
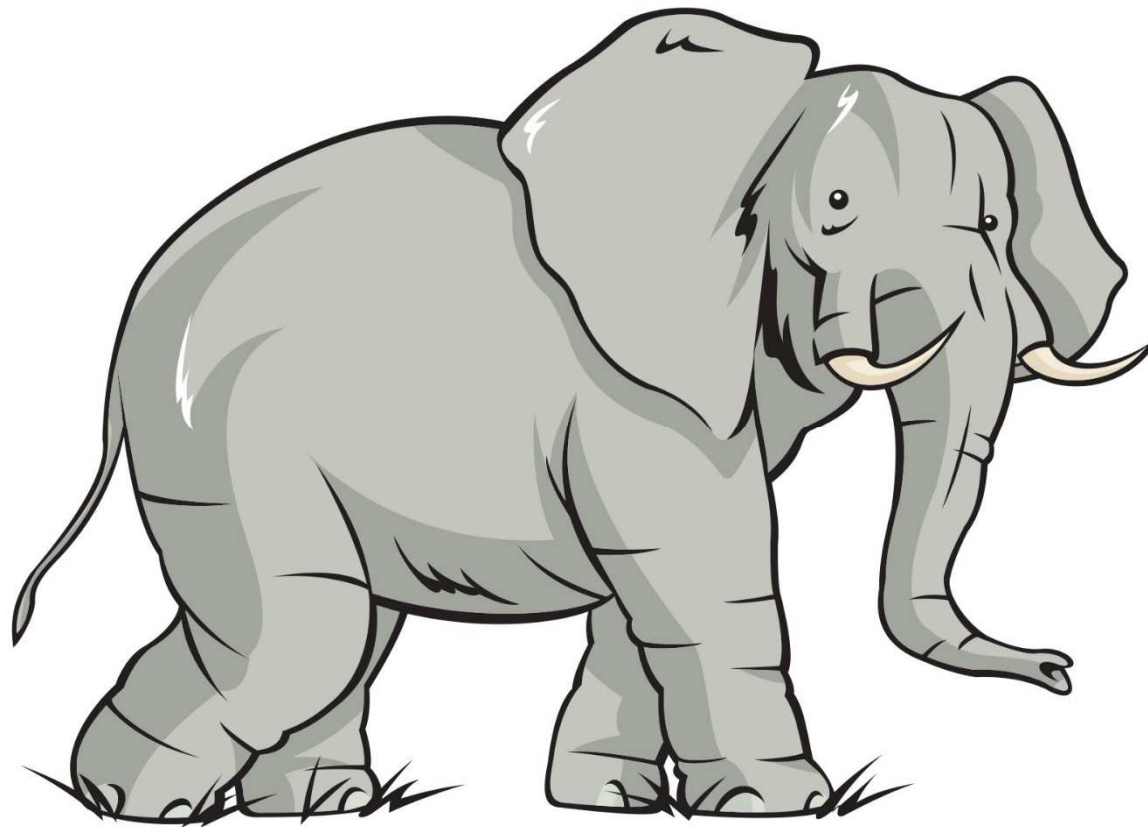
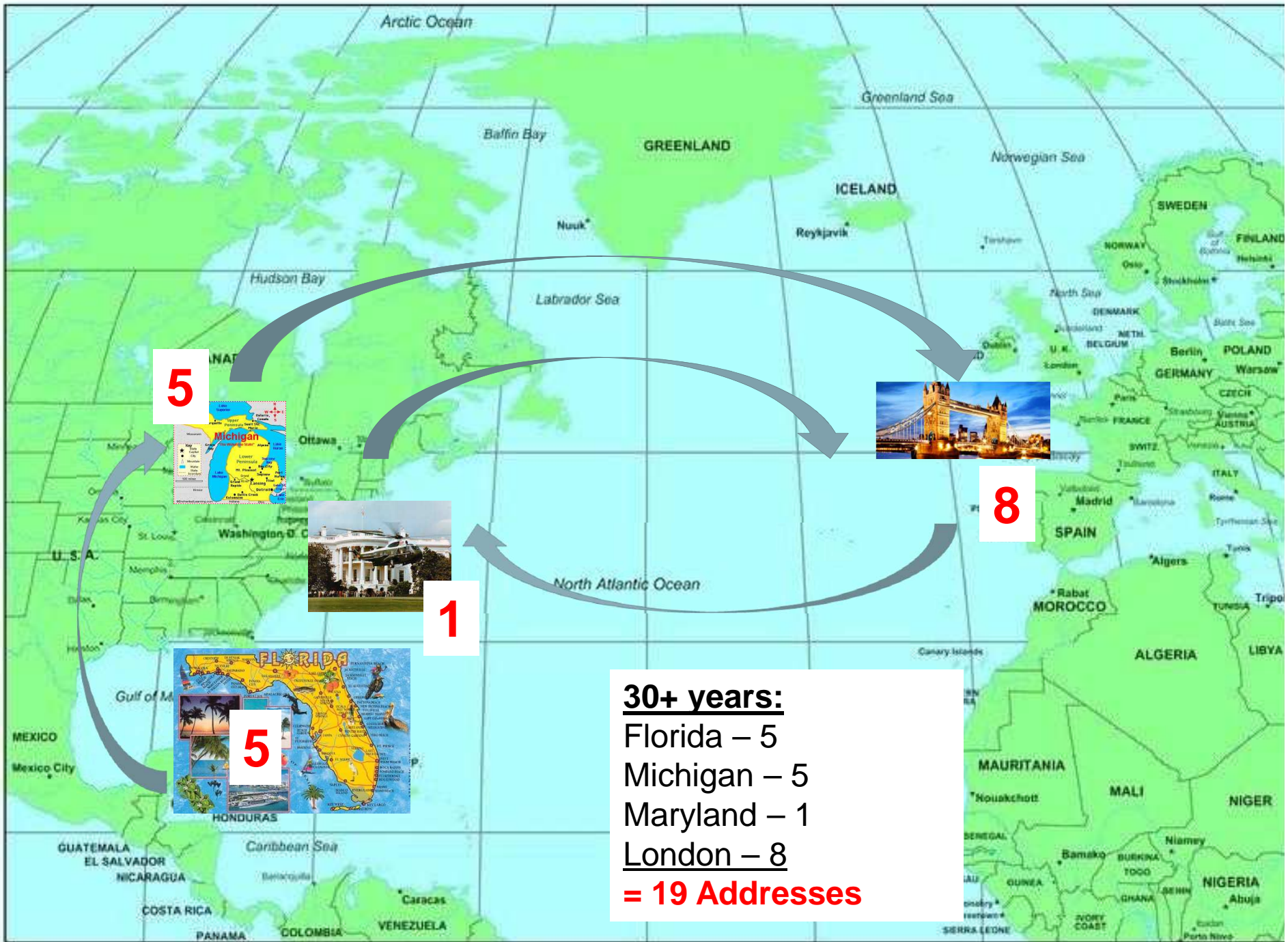


Figure 1. Schematic representation of the contributions of neighborhood environments to health inequalities.

Very large elephant in the room:



RESIDENTIAL SELECTION

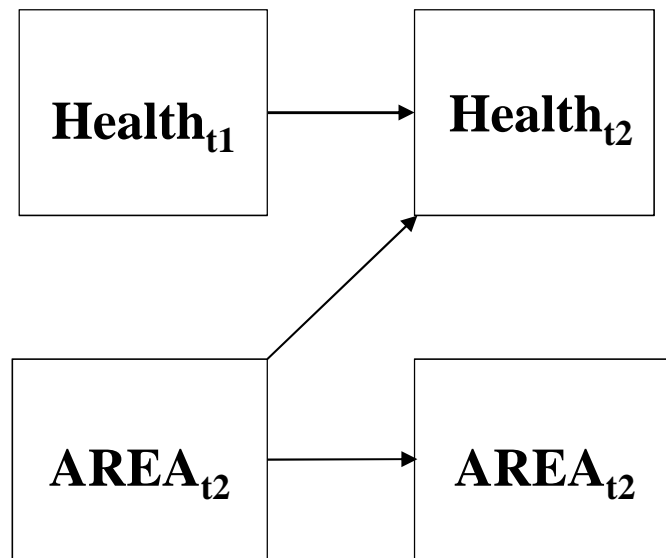


30+ years:
 Florida – 5
 Michigan – 5
 Maryland – 1
 London – 8
= 19 Addresses

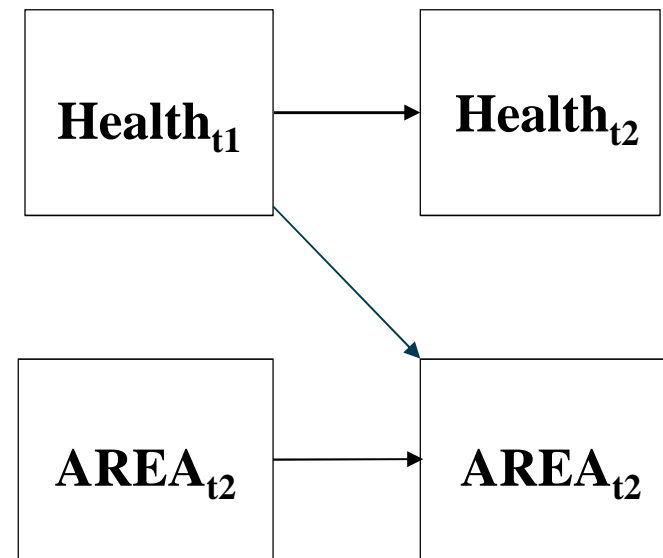
Hypothesized life course models



Model 1: Area effects only



Model 2: Health selection by BMI only



Objective: Examine the role of selective migration in the relationship between life course neighborhood deprivation and body mass index.

Data

Decade of life	1958 Cohort (NCDS)	1970 Cohort (BCS)	variables
Birth	Birth	Birth	Weight, gender
	7 (1965)	5 (1975)	
Childhood	11 (1969)	10 (1980)	Social class, health
Teens	16 (1974)	16 (1986)	BMI, LSOA
20's	23 (1981)	26 (1996)	BMI, TOWN, moved
	-	30 (2000)	
30's	33 (1991)	34 (2004)	BMI, TOWN, moved
40's	42 (1999)	42 (2012)	BMI, TOWN, moved
	46 (2004)	-	
	50 (2008)	-	
50's	55 (2013)	-	BMI, TOWN, moved

Exposure: Townsend deprivation index

- Inputs

- Unemployment
- Non-home ownership
- No car access
- Overcrowding

- Standardised using z-scores
- Summed to be index scores

CONSISTENT BOUNDARIES OVER TIME:

Townsend deprivation scores measured at censuses, 1971-2001, converted to reflect 2011 lower super output boundaries

Statistical analysis: Part I (Imputation)



- Multiple imputation, 50 imputed data sets.
- Wide format, where one row per person.
 - Include all model variables,
 - Plus auxiliary variables predictive of missingness:
 - Childhood social class
 - Child health
 - Birth weight
 - Birth gender

- Structural Equation modelling (SEM) in Mplus.
- Multiple imputation, 50 imputed data sets.
- Analysis plan:
 - Step 1: Examine if area deprivation associated BMI across the life course.
 - Step 2: Examine if residential selection by BMI exists across the life course.
 - Step 3: Assess whether area deprivation effects explained by residential selection.
 - Step 4: Assess whether relationships vary by residential mobility.
 - (i) Do people who move have lower/higher BMI's or TOWN scores?
 - (ii) Interaction terms between each path and moved over interval.

Results



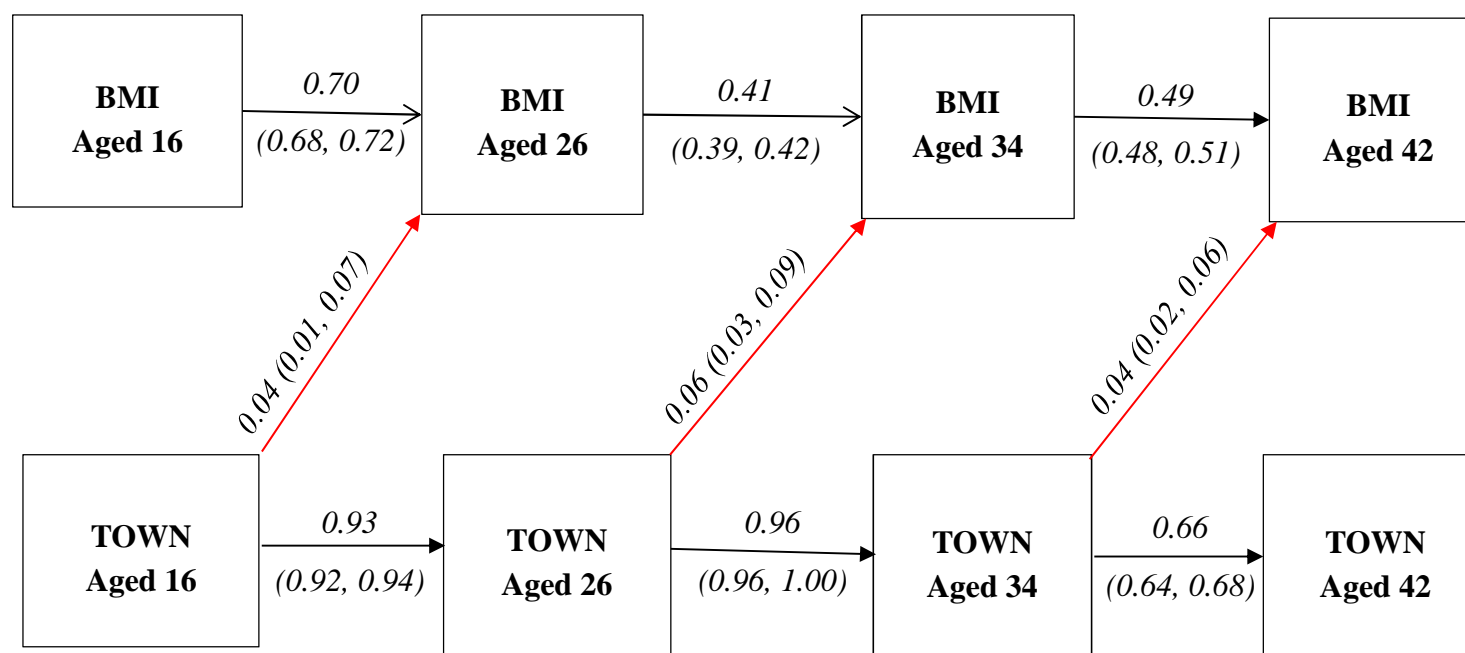
Table 4. Sample characteristics, 1970 British Cohort Study (BCS) and National Child Development Study (NCDS).

	1958 British Cohort Study (BCS) (n=18,555)				1970 British Cohort Study (NCDS) (n=18,639)			
	Age	Mean	SD	Rate of missing	Age	Mean	SD	Rate of missing
Body Mass Index:								
Sweep 1	16	20.64	0.03	0.26	16	21.12	0.03	0.455
Sweep 2	23	22.65	0.03	0.23	26	23.86	0.05	0.559
Sweep 3	33	25.13	0.05	0.26	34	26.00	0.05	0.407
Sweep 4	42	26.05	0.05	0.35	42	27.00	0.06	0.395
Sweep 5	55	27.65	0.06	0.51	-	-	-	-
Area deprivation (Townsend):								
Sweep 1	16	0.22	0.03	0.34	16	-0.20	0.03	0.206
Sweep 2	23	0.44	0.03	0.21	26	0.05	0.03	0.400
Sweep 3	33	-0.27	0.03	0.35	34	-0.30	0.02	0.373
Sweep 4	42	-0.59	0.02	0.26	42	-0.58	0.03	0.451
Sweep 5	55	-0.83	0.02	0.36	-	-	-	-
Moved between interval:								
Interval 1	16 to 23	0.81	n/a	0.31	16 to 26	0.83	n/a	0.557
Interval 2	23 to 33	0.87	n/a	0.44	26 to 34	0.79	n/a	0.627
Interval 3	33 to 42	0.50	n/a	0.35	34 to 42	0.69	n/a	0.510
Interval 4	42 to 55	0.29	n/a	0.43	-	-	n/a	-

**Step 1: Examine if area deprivation is associated
BMI across the life course.**

Model 1: Area effects only, 1970 British Cohort (n=18,639).

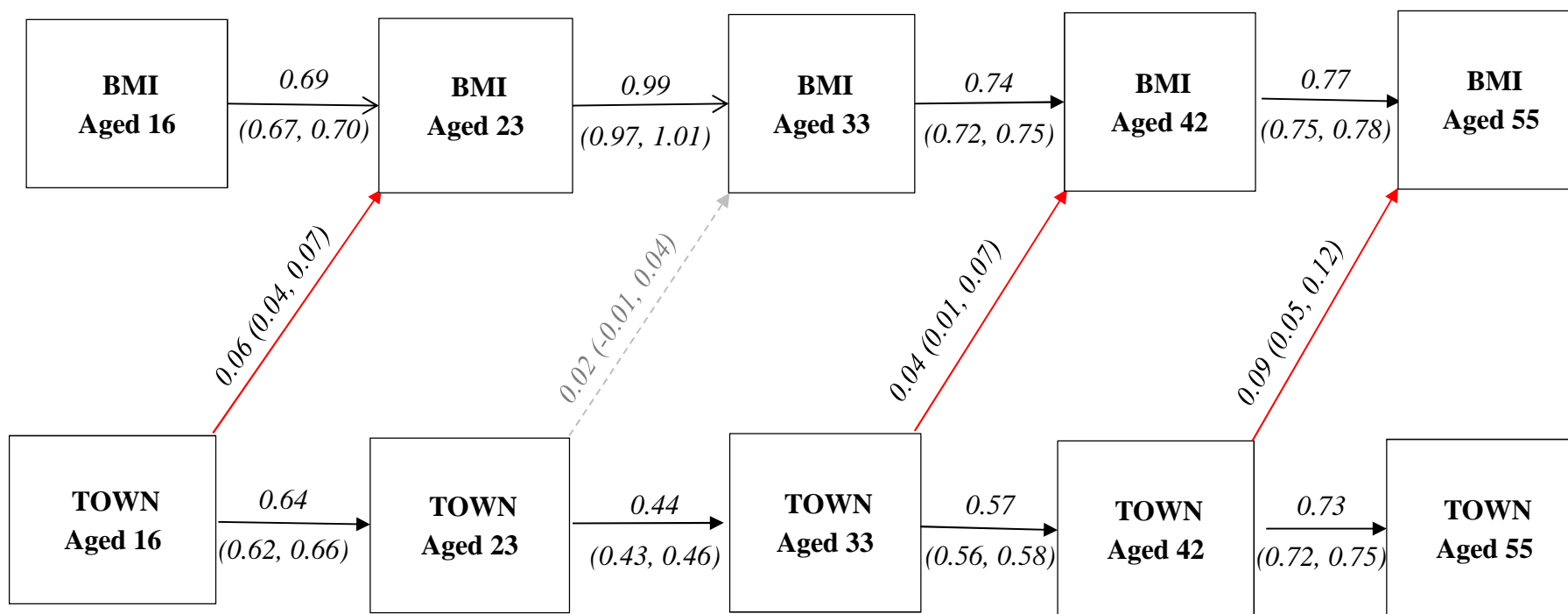
Figure 1a. Structural equation model with area deprivation across the life course only model. Dotted line indicates non-significant paths ($p>0.05$). BMI=body mass index; TOWN=townsend area deprivation score.



RED line = Area effect; **BLUE** line = Health selection

Model 1: Area effects only, 1958 British Cohort (n=18,555).

Figure 1b. Structural equation model with both area deprivation across the life course only. Dotted line indicates non-significant paths ($p>0.05$). BMI=body mass index; TOWN=townsend area deprivation score.

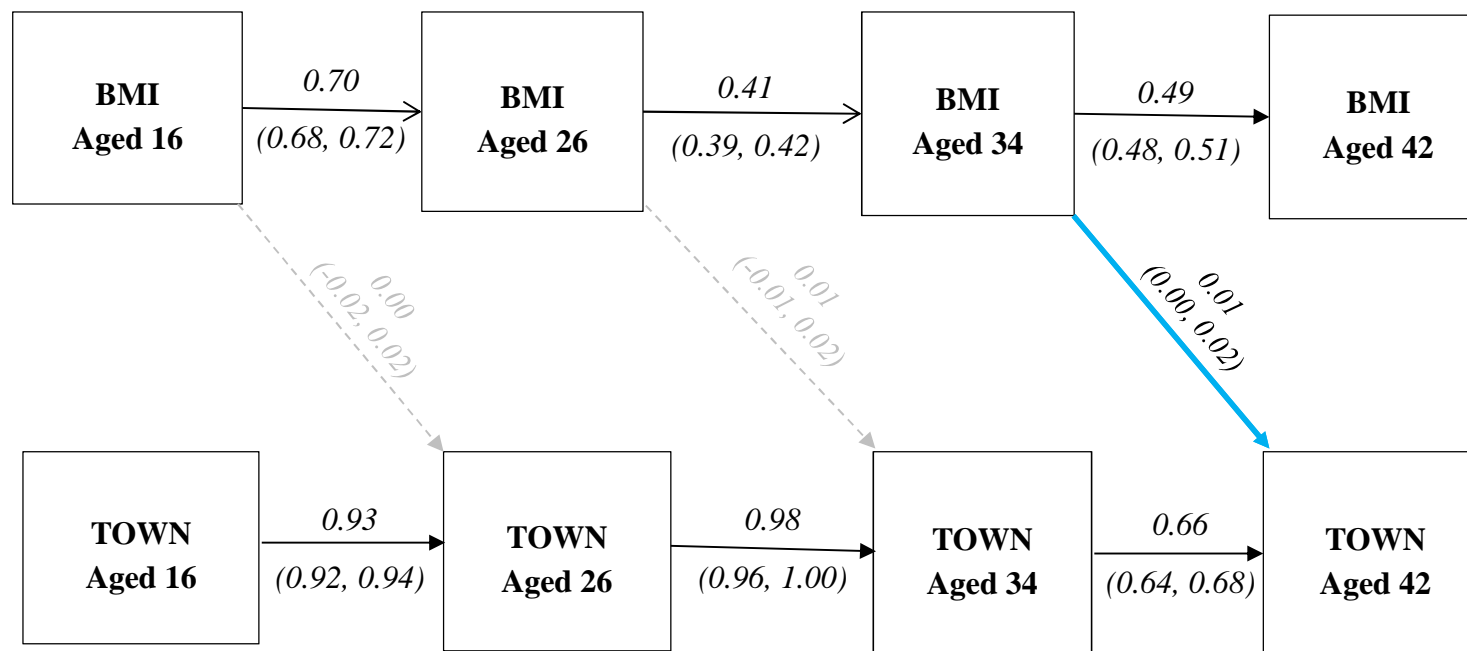


RED line = Area effect; **BLUE** line = Health selection

Step 2: Examine if residential selection by BMI exists across the life course.

Model 2: Residential selection by BMI only, 1970 British Cohort (n=18,639)

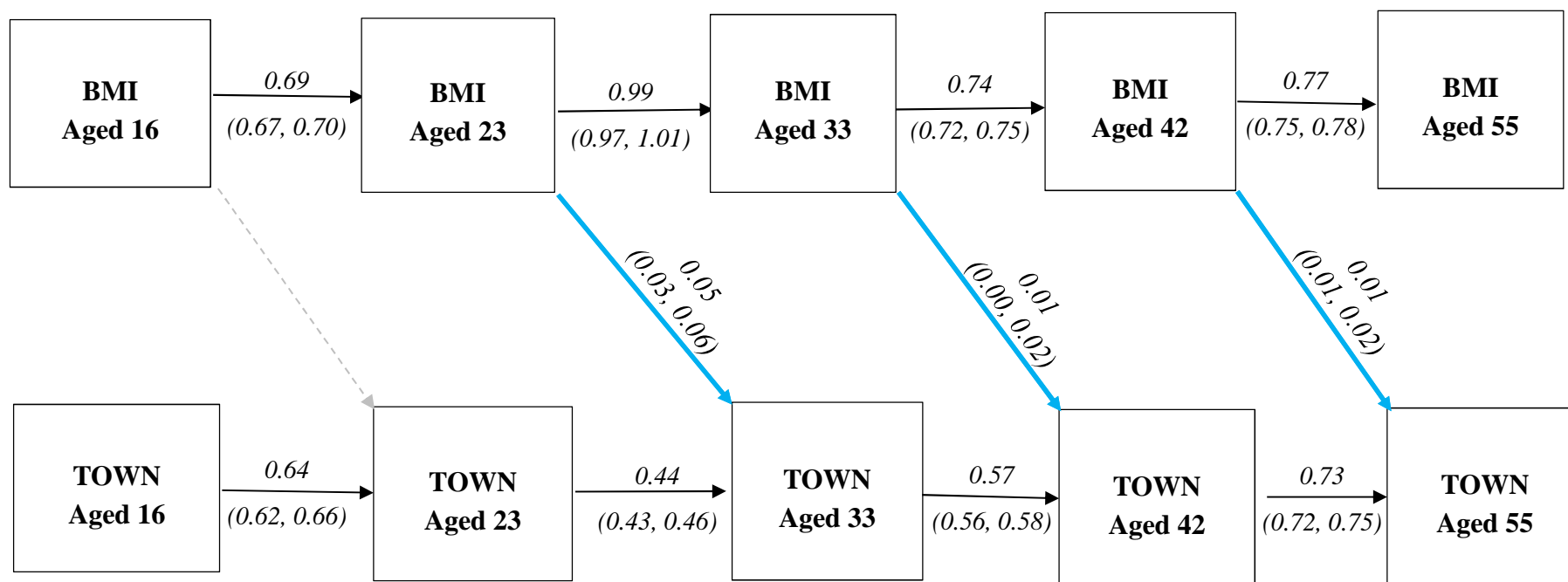
Figure 2a. Structural equation model with health selection across the life course only model. Dotted line indicates non-significant paths ($p>0.05$). BMI=body mass index; TOWN=townsend area deprivation score.



RED line = Area effect; **BLUE** line = Health selection

Model 2: Residential selection by BMI only, 1958 British Cohort (n=18,555).

Figure 2b. Structural equation model with both area deprivation and health selection across the life course. Dotted line indicates non-significant paths ($p>0.05$). BMI=body mass index; TOWN=townsend area deprivation score.



RED line = Area effect; **BLUE** line = Health selection

Step 3: Assess whether area deprivation effects explained by residential selection.

Step 4: Assess whether relationships vary by residential mobility.

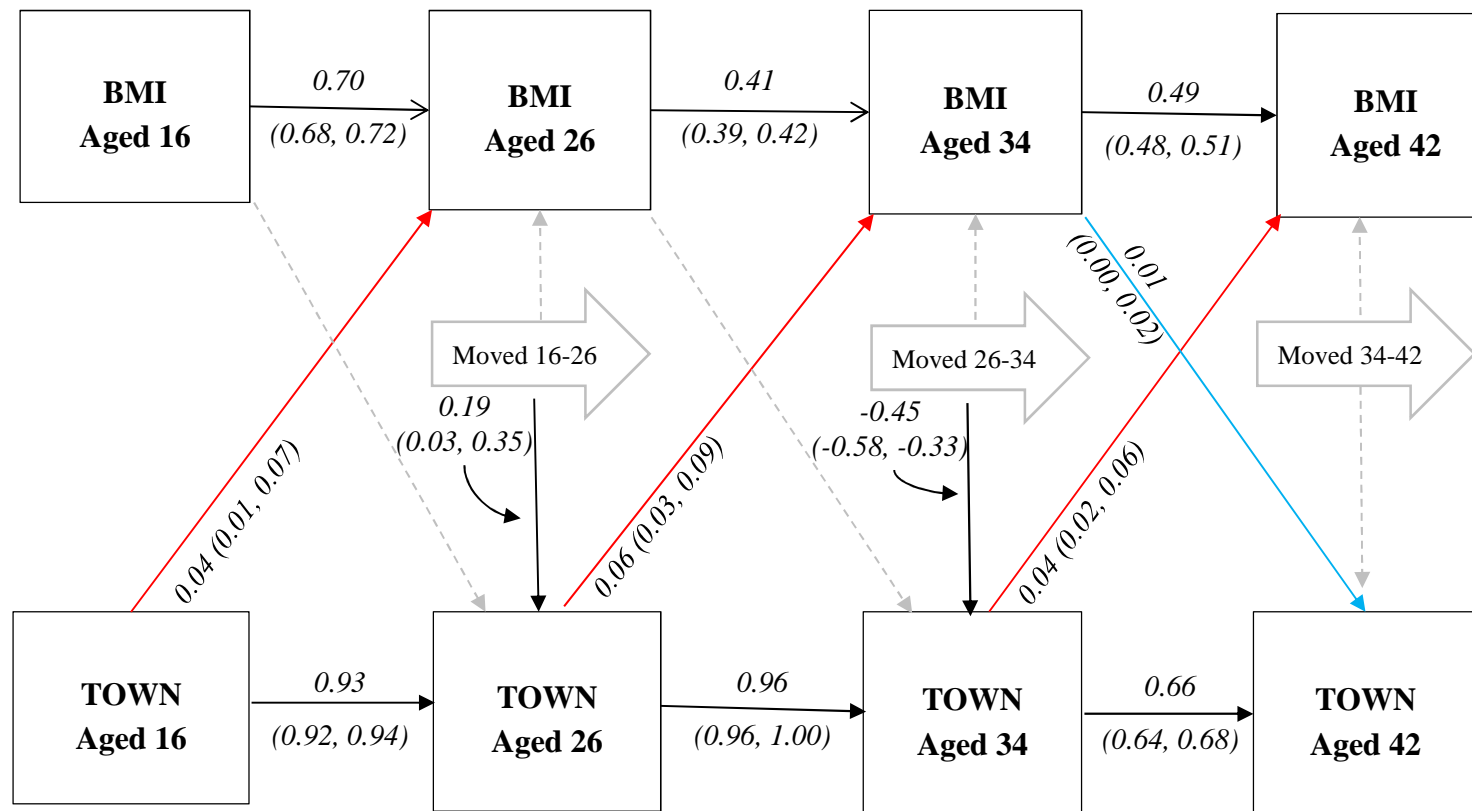
- (i) Do people who move have lower/higher BMI's or TOWN scores?**
- (ii) Interaction terms between each path and moved over interval.**

Results: Residential mobility



- **Inconsistent relationships between moving over an interval and both BMI and TOWN at the end of the interval by cohort:**
 - 1958 cohort:
 - Movers → lower BMI's at end interval (all except 42_55)
 - Movers → lower TOWN's at end interval (all except 16_23)
 - 1970 cohort:
 - No relationships between moving → BMI.
 - Movers 16_26 → higher TOWN's at age 26.
 - Movers 26_34 → lower TOWN's at age 34.
- No evidence of effect modification by moved/not moved (14 tests).

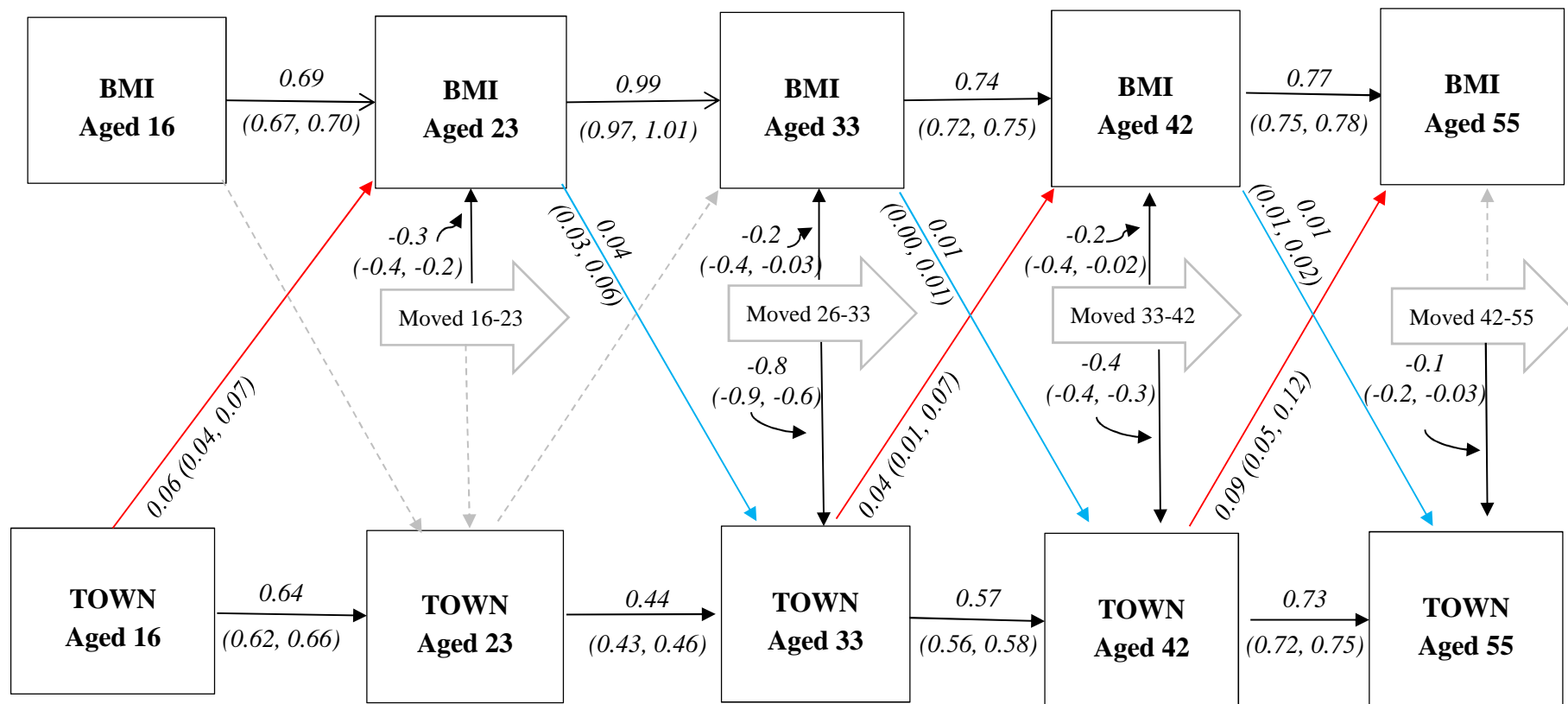
Figure 3a. Structural equation model with both area deprivation, health selection and mobility paths across the life course: **1970 British Cohort (n=18,639)**. Dotted line indicates non-significant paths ($p>0.05$). BMI=body mass index; TOWN=townsend area deprivation score.



RED line = Area effect; **BLUE** line = Health selection

Model fit: $\chi^2=777.3$, $df=26$, $RMSEA=0.039$, $CFI=0.967$, $TLI=0.943$ and $SRMR=0.034$.

Figure 3b. Structural equation model with both area deprivation, health selection and mobility paths across the life course: **1958 British Cohort (n=18,555)**. Dotted line indicates non-significant paths ($p>0.05$). BMI=body mass index; TOWN=townsend area deprivation score.



RED line = Area effect; **BLUE** line = Health selection

Model fit: $\chi^2=2920.3$, $df=51$, $RMSEA=0.055$, $CFI=0.925$, $TLI=0.888$ and $SRMR=0.052$.

Conclusions



1. Cohort members who lived in more deprived neighbourhoods generally had higher BMIs at the next study sweep, in both cohorts.
2. Direct health selection by BMI was present, but less consistent, across the life course.
3. Direct health selection did not explain relationships between area deprivation and BMI.
4. Neither area deprivation effects or health selection varied by whether a cohort members had moved or not over the study sweep.



Outcome: Body Mass Index

	Sweep Target age (date)	Assessment type	System of measurement	Precision of weight measurement	Precision of height measurement
1958 NCDS	16 (1974)	Measured (medical officer)	Metric or imperial	0.01 to 0.454 kg	0.006 to 0.01 m
	23 (1981)	Self-reported (administered questionnaire)	Imperial	0.454 kg	0.025 m
	33 (1991)	Measured (trained interviewer)	Metric	0.1 kg	0.01 m
	42 (2000)	Self-reported (CAPI)	Metric or imperial	0.454 to 1 kg	0.01 to 0.025 m
	55 (2013)	Self-reported (CAPI)	Metric or imperial	0.454 to 1 kg	0.01 to 0.025 m
1970 BCS					
	16 (1986)	Measured (medical officer) or self-reported (questionnaire)	Metric or imperial	0.028 to 0.1 kg	0.005 to 0.006 m
	26 (1996)	Self-reported (postal questionnaire)	Metric or imperial	0.454 to 1 kg	0.01 to 0.025 m
	34 (2004)	Self-reported (CAPI)	Metric or imperial	0.454 to 1 kg	0.01 to 0.025 m
	42 (2012)	Self-reported (CAPI)	Metric or imperial	0.454 to 1 kg	0.01 m

Modified from: Johnson W et al (2015) PLOS Med.

Residential mobility



	Sweep Interval	Survey question assessing of moved since last interval	Coding of moved variable
1958 NCDS			
16-23	23	Number of places lived since 16.	Moved: >=1 Not moved: <=1
23-33	33	No. addresses lived at since 16 + year moved into address (max 16)	Moved: >1 & year moved 1982-1991 Not moved: 0 or (1 & year moved 1956-1981)
33-42	42	Year moved into current address	Moved: year 1992-2000 Not moved: year 1958-1991 or 9999
42-55	50*	Whether Cohort member living at same address as last interview/Jan2000	Moved: Yes, same address Not moved: No, different address
	55*	Whether living at same address as last interview	Moved: Yes, same address OR Same address, incorrect details. Not moved: No
1970 BCS			
16-26	26	Year moved into current address	Moved: year 1987-1996 Not moved: year 1970-1986
26-34	30*	Lived somewhere else for 1mth+ since Ref data + year moved in	Moved: yes + year 1997-2000 Not moved: year 1986-1996
	34*	Whether living at the same address during last interview	Moved: yes Not moved: No
34-42	42	Whether living at the same address during last interview	Moved: Yes, same address Not moved: No, different address