Intergenerational persistence of weight status and the income gradient of youth obesity in Australia

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Outline

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Obesity: persistence and inequality

- Intergenerational persistence of adiposity and socioeconomic gradient in obesity prevalence perpetuate health inequalities
- Obesity consequences include, *inter alia*, ...
  - Lower future wages
  - Higher rates of attempted suicide
  - Poorer educational performance
  - Higher risk of premature death
  - Higher risk of adult disability
- Annual direct and indirect costs of obesity in Australia: $8.6 billion
- Projected annual cost of $87.7 billion by 2025

Our tasks

- Estimate intergenerational transmission of body mass in Australia
- Account for individual-level unobserved heterogeneity
- Estimate a concentration index to examine the inequality in youth obesity over the income gradient
- Decompose the inequality to better understand its determinants

Contributions

- Accounting for unobserved heterogeneity allows for a more credible analysis of pathways through which persistence operates.
- Constructing concentration indices quantifies the degree of inequality and allows for a decomposition of its determinants.

Outline

Establishing pathways

- Available data makes an "environment vs. genetics" analysis difficult
- But a panel allows for "time-varying vs. time-invariant"
- That is, "FE vs. OLS" allows us to estimate...
  - Strength of relationship between mother and offspring BMI
  - Proportion of relationship accounted for by genetics and permanent environment
  - Proportion of relationship accounted for by time-varying environment

Estimating inequality of youth obesity

Concentration index

We calculate a concentration index as

$$CI = \frac{2}{N\overline{Y}} \sum_{i=1}^{N} Y_i R_i - 1,$$

where Y_i, with $i = 1, 2, \ldots, N$, is the obesity status of the i^{th} adolescent, $\overline{Y}$ is the sample mean of youth obesity, and youths are ranked by equivalized household income R_i. As suggested by Wagstaff [2005], the CI is normalized to ensure $CI \in [-1, 1]$ as follows:

$$CI_n = \frac{\text{CI}}{1 - \overline{Y}}.$$

Estimating inequality of youth obesity

- The CI allows us to quantify the magnitude of inequality.
- It also lends itself to a numerical decomposition of the drivers of inequality.

Decomposition of inequality

- First, a probability model for youth obesity is estimated via probit.
- Then, we calculate average marginal effects for each regressor.

Decomposition

The normalized CI is decomposed as follows:

$$CI_n = \left(\frac{\beta_r \overline{X}_r}{\overline{Y}}\right) CI_r + \sum_{k=1}^{K-1} \left(\frac{\beta_k \overline{X}_k}{\overline{Y}}\right) CI_k + \frac{GCI_g}{\overline{Y}},$$

where $\overline{X}_r$ is the mean equivalized household income, β_r is the marginal effect of equivalized household income, CI_r is its concentration index. The terms in the summation are defined analogously for the rest of the $K-1$ regressors while GCI_g is the generalized CI for the error term.

Decomposition of inequality

Again, the normalized CI can be decomposed:

$$CI_n = \left(\frac{\beta_r \overline{X}_r}{\overline{Y}}\right) CI_r + \sum_{k=1}^{K-1} \left(\frac{\beta_k \overline{X}_k}{\overline{Y}}\right) CI_k + \frac{GCI_g}{\overline{Y}}.$$

Each term on the right-hand side is the contribution of each K regressor and the contribution of factors unexplained by the probit regression. The percentage contribution to inequality in obesity can be calculated by dividing each term by the overall concentration index CI_n.

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Dataset

- HILDA 2006–2014
- Sample exclusions: adolescents not residing with mothers, pregnant mothers, observations with missing values
- Constructed a balanced panel with 2,772 adolescents aged 15–19 matched with 1,642 mothers

Variables of interest

Table: Control variables

	Variables
Youth-specific	Birth order, number of siblings, age, sex
Mother-specific	Education level, age, marital status, employment status
Household-specific	Equivalized household income, SEIFA decile
Proxy variables	Mother's smoking status (time preference), death of a close friend (emotional distress)

Descriptive statistics

Table: Control variables by offspring BMI category

Variable	Obese	Overweight	Normal weight	Underweight
Mother smokes	27.24%	21.57%	17.78%	18.51%
Mother divorced	22.67%	20.67%	18.18%	17.94%
Mother employed FT	35.81%	39.55%	38.46%	32.63%
Mother unemployed	3.62%	2.25%	2.18%	3.82%
Household income	$36,080.54	$39,954.36	$43,403.71	$41,508.06

Notes.—Percentages are calculated as the proportion of offspring in a BMI category who have mothers with described characteristics. Household income is equivalised.
Source.—Authors' calculations based on HILDA 2006–2014.

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Main results

Table: Intergenerational transmission of BMI

Variable	OLS	Youth FE
Mother's BMI (log)	0.239***	0.039*
	(0.011)	(0.021)
Observations	6,877	6,877

Notes.—The dependent variable is adolescent's BMI (log). Robust standard errors are enclosed in parentheses. Regressions control for birth order, number of siblings, age, sex, mother's education level, age, marital status, and employment status, equivalized household income, SEIFA decile, mother's smoking status, and the death of a close friend.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source.—Authors' calculations based on HILDA 2006–2014.

Main results

- Genetics and permanent environment account for 83.7% of the intergenerational transmission of adiposity.
- Time-varying environment accounts for 16.3% of this transmission.

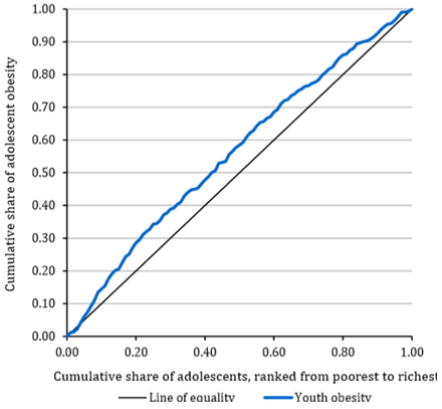
Other results

Table: Intergenerational transmission of obesity from mothers to offspring

Probit average marginal effects	Mother obese	Observations
Full sample	0.092***	6877
Household income sub-samples		
$<25^{th}$ quartile	0.134***	1721
25–50^{th} quartile	0.078***	1718
50–75^{th} quartile	0.071***	1719
$>75^{th}$ quartile	0.080***	1698

Notes.—The dependent variable is adolescent's obesity status. Regressions control for birth order, number of siblings, age, sex, mother's education level, age, marital status, and employment status, equivalized household income, SEIFA decile, mother's smoking status, and the death of a close friend.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source.—Authors' calculations based on HILDA 2006–2014.

Figure: Concentration curve of adolescent obesity



Source.—Authors' calculations based on HILDA 2006–2014.

Concentration index

- "Pro-poor" inequality of youth obesity in Australia (–0.1225)
- To achieve perfect equality, 12.25% of youth obesity will have to be redistributed from the poorest half of the population to the richest half.

Decomposition exercise

Table: Decomposition of concentration index

Variable	Contribution to CI	Contribution in percent
Low SES postal code	−0.0221	18.14
Obese mother	−0.0215	17.57
Equivalized household income	−0.0186	15.21
Mother smokes	−0.0119	9.70

Source.—Authors' calculations based on HILDA 2006–2014.

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Comparison with previous results

Table: Intergenerational transmission of obesity from mothers to offspring

Study	Increased probability in %	Country
Costa-Font and Gil [2013]	4.20–4.60	Spain
Whitaker et al. [2010]	4.36	England
James, Mendolia, and Paloyo [n.d.]	9.20	Australia
Classen [2010]	31.70	USA
Coate [1983]	20.00	USA

Summary

- Evidence of intergenerational persistence of adiposity in Australia
  - Genetics and permanent environment explains 83.7% of transmission.
  - Time-varying environment accounts for 16.3% of the transmission.
- Evidence of pro-poor inequality of adolescent obesity in Australia, primarily driven by...
  - Low SES postal code
  - Maternal obesity
  - Equivalised household income
  - Maternal smoking

Concluding remarks

- Limitations of BMI as a measure of adiposity.
- Research could be extended by examining the intergenerational transmission of BMI and obesity for younger children (LSAC).
- If data becomes available, future research could explore the intergenerational transmission of BMI at similar stages in the mother and offspring's lifecycle.