Social Networks and Childhood Obesity

H. Shelton Brown, III,[1] Lisa Yarnell,[1] Deanna M. Hoelscher,[1] and Steven H. Kelder[1]

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Outline

The Utility Approach from Economics

- Economic perspective: even fully informed, wealthy, relatively healthy people are not health-maximizers
- Maximize utility derived from a basket of choices, including health
  - Most don't enjoy exercise *per se*
  - Most like donuts (but like the first one more than the fifth)
- So why, with all of the firewalls against obesity caving in, aren't more people obese?
  - Economists have begun to incorporate weight-based social norms into utility functions
    - People who like donuts and hate exercise nonetheless do not enjoy standing out as obese or the *most* obese

Types of Networks

- Both Christakis and Fowler and Trogdon *et al.* view social networks as known peers
  [Christakis & Fowler, 2007, Trogdon et al., 2008]
  - Trogdon *et al.* in particular, focused on reciporically nominated friends within classrooms using Add Health data
  - Found that increasing friends' average BMI of 10% leads to a 5.6% increse in own BMI.
- But there are many types of networks: schools, grades, classrooms, associations, etc.
- Observable distributions

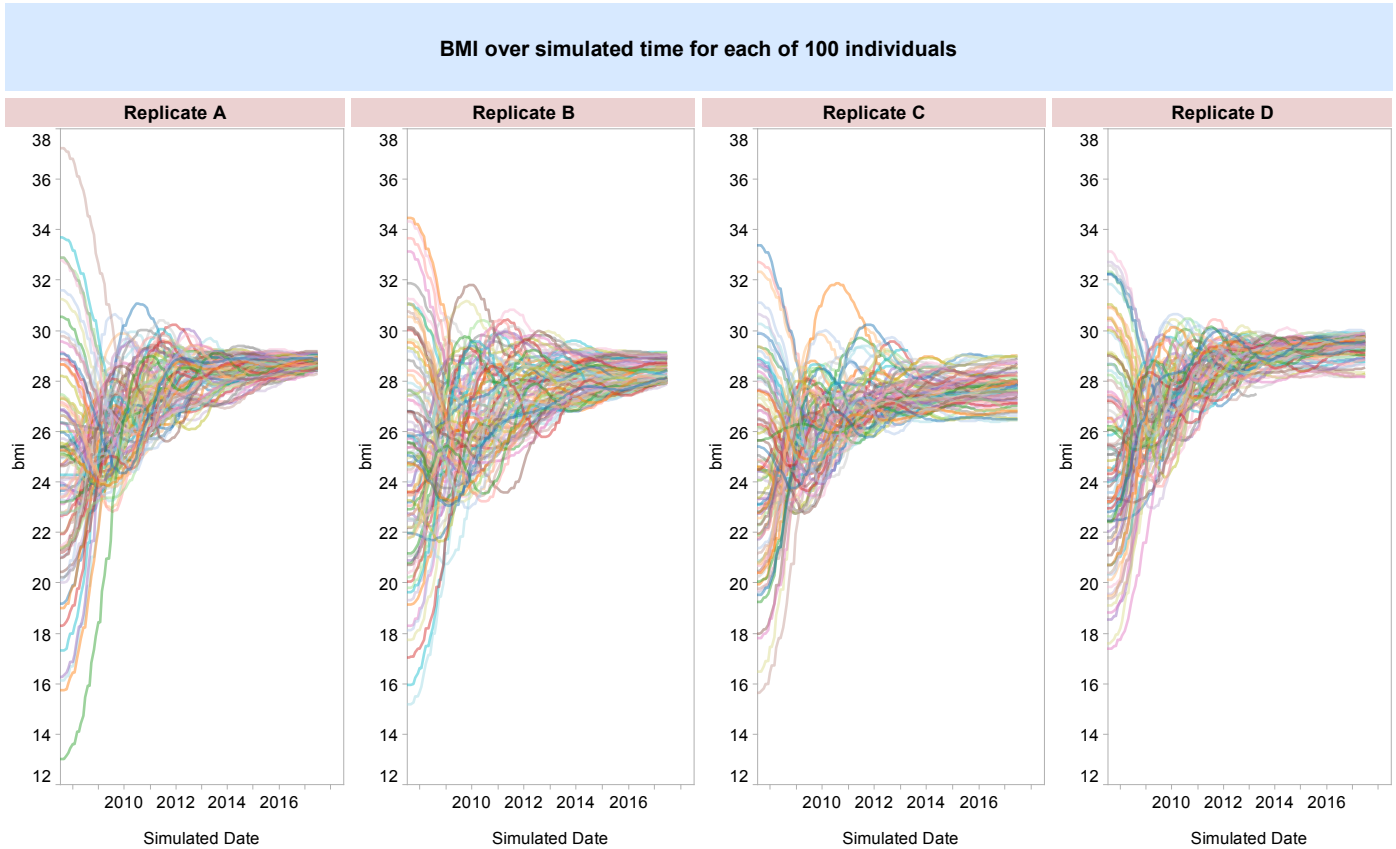
Exogenous Versus Endogenous

- There may be "exogenous" or "fixed" norms [Philipson & Posner, 1999, Cutler et al., 2003]
  - Adults identify clinical definitions of obesity ($>$ 30 BMI) as the norm
  - Children identify clinical definitions of obesity (top five percent for sex and age) as the norm
- There may be "endogenous" "evolving" norms [Burke & Heiland, 2007]
  - People may look rightward on the BMI distribution and update the norm as the right tail (the heavy end) shifts in or out over time
  - Burke and Heiland show that BMI for those who are obese shift out as the tails have shifted out [Burke & Heiland, 2007]

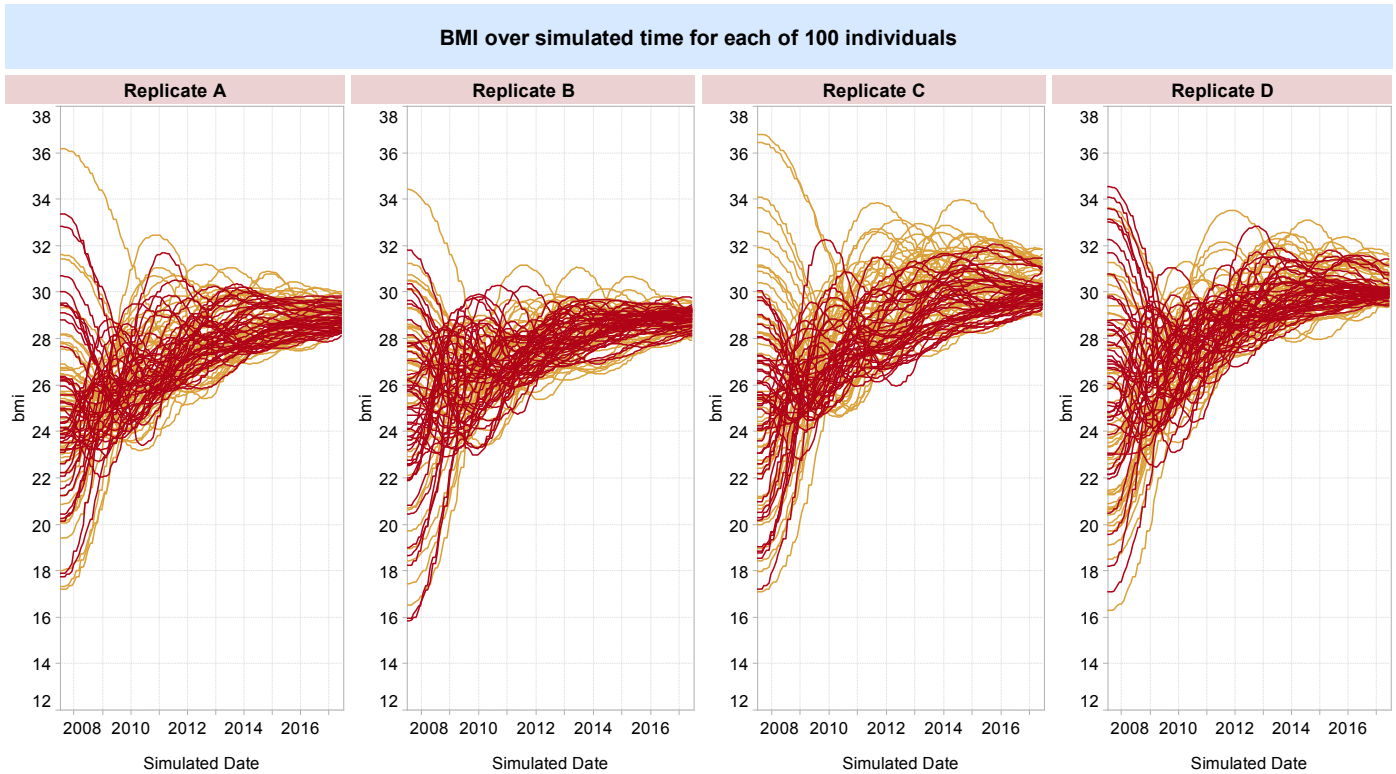
Influential Points Within Networks

- Both Christakis and Fowler and Trogdon *et al.* focused on mean BMI of known peers
  [Christakis & Fowler, 2007, Trogdon et al., 2008]
  - Other options: Min, max, median, percentiles, etc.
- How do people know they aren't tall? They may look at the right tail of the distribution

Model of Social Networks and Childhood Obesity



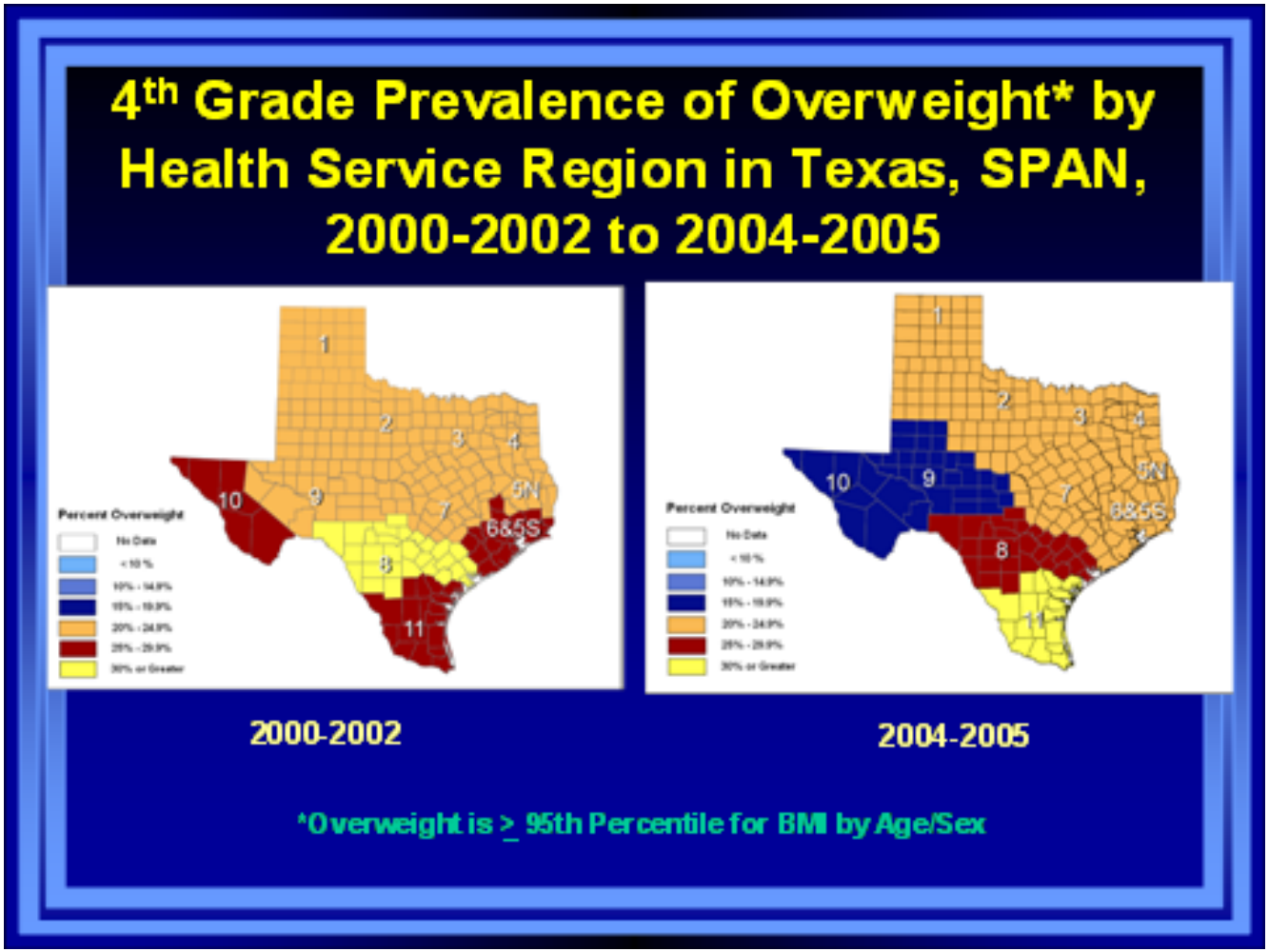
Model of Social Networks and Childhood Obesity: Fruit and Vegetable Subsidies



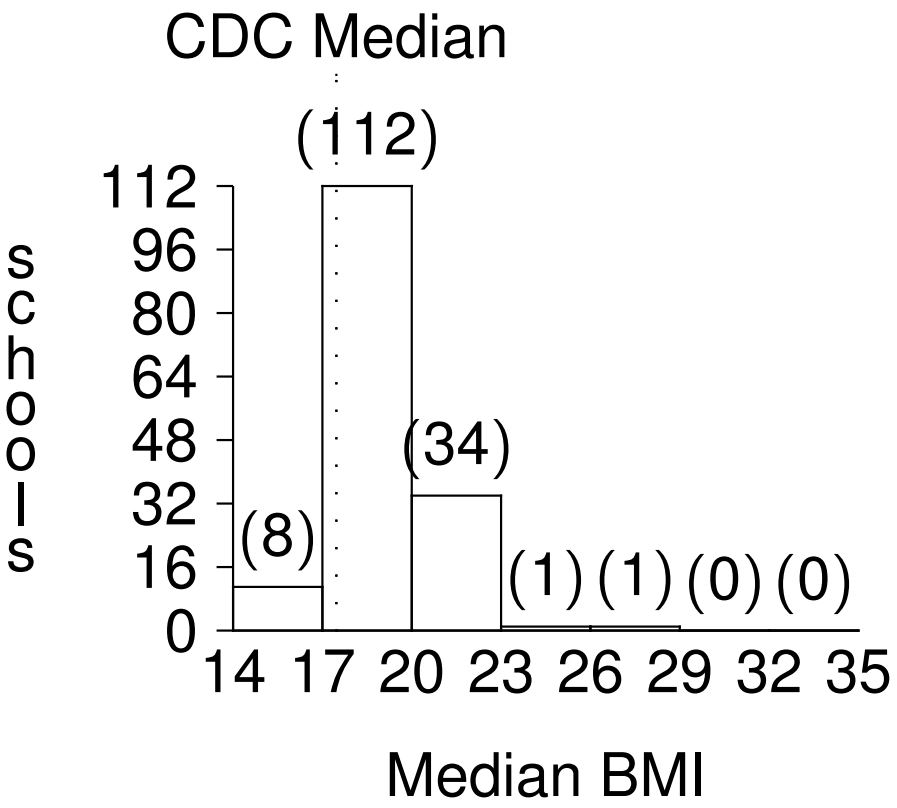
Regional Variation

- Despite the clear national trend towards greater obesity prevalence, there is huge variation in obesity prevalence for adults and children across and within states
- In the border area of Texas, approximately 50% of children are obese, based on preliminary estimates.
- The right tail of the BMI distribution also varies geographically

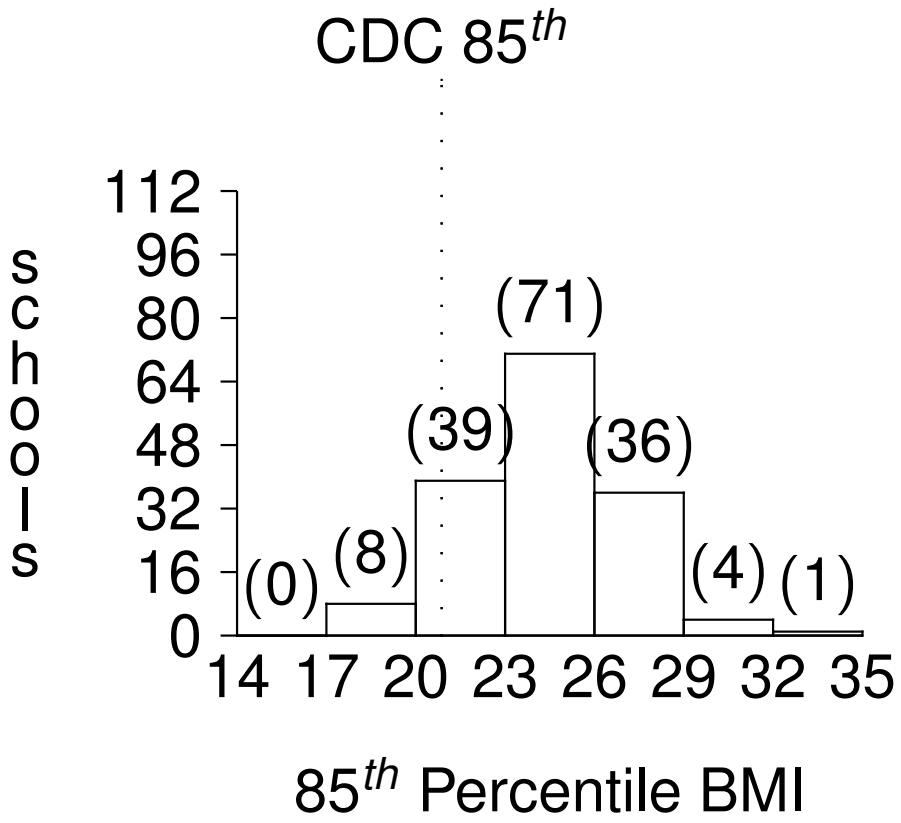
Within State Variation, 4^{th} Graders



Histogram of School Median BMI in Texas, Girls 4th Grade



Histogram of School Median BMI in Texas, Girls 4^{th} Grade



Grades as Networks

- School children observe a reasonably stable comparison group
- Public schools in the U.S. are often more ethnically and racially diverse than workplaces and other places where people gather.

Objective

- We want to be able to see how points on the BMI distribution variably affect the body weight of children along the BMI distribution
- Which points on the BMI distribution are more influential for overweight and obese children, and how do the effects vary by BMI among overweight and obese children?

The Empirical Model

- Unfortunately, without arbitrary (and power-sapping) data segmentation, regression analysis is insufficient for our research questions
- Quantile regression

The Empirical Model

- With quantile regression, the objective is to minimize the absolute value of residuals rather than the sum of squared residuals.
- While the mean is the solution to the regression problem, the median is the solution to the 50^{th} quantile regression problem
- Quantile regression allows for estimation for any percentile.

The Empirical Model

$$\min_{\beta \in \Re^P} \sum \rho_\tau (y_i - \xi(x_i, \beta)). \quad (1)$$

- ρ_τ is a function which asymmetrically weights the residuals according to sign.

2004-2005 School Physical Activity and Nutrition Survey

- A child obesity surveillance system developed and implemented by the University of Texas School of Public Health with support from the Texas Department of State Health Services
- A stratified, multistage probability sample of public school children in Texas
- Includes representative samples of White/other, Black or African American (AA), and Mexican-American-Latino or Hispanic youth
- Regionally representative
- 4^{th} grade, 8^{th} grade and 11^{th} grade for high school
- Questionnaire and measured heights and weights

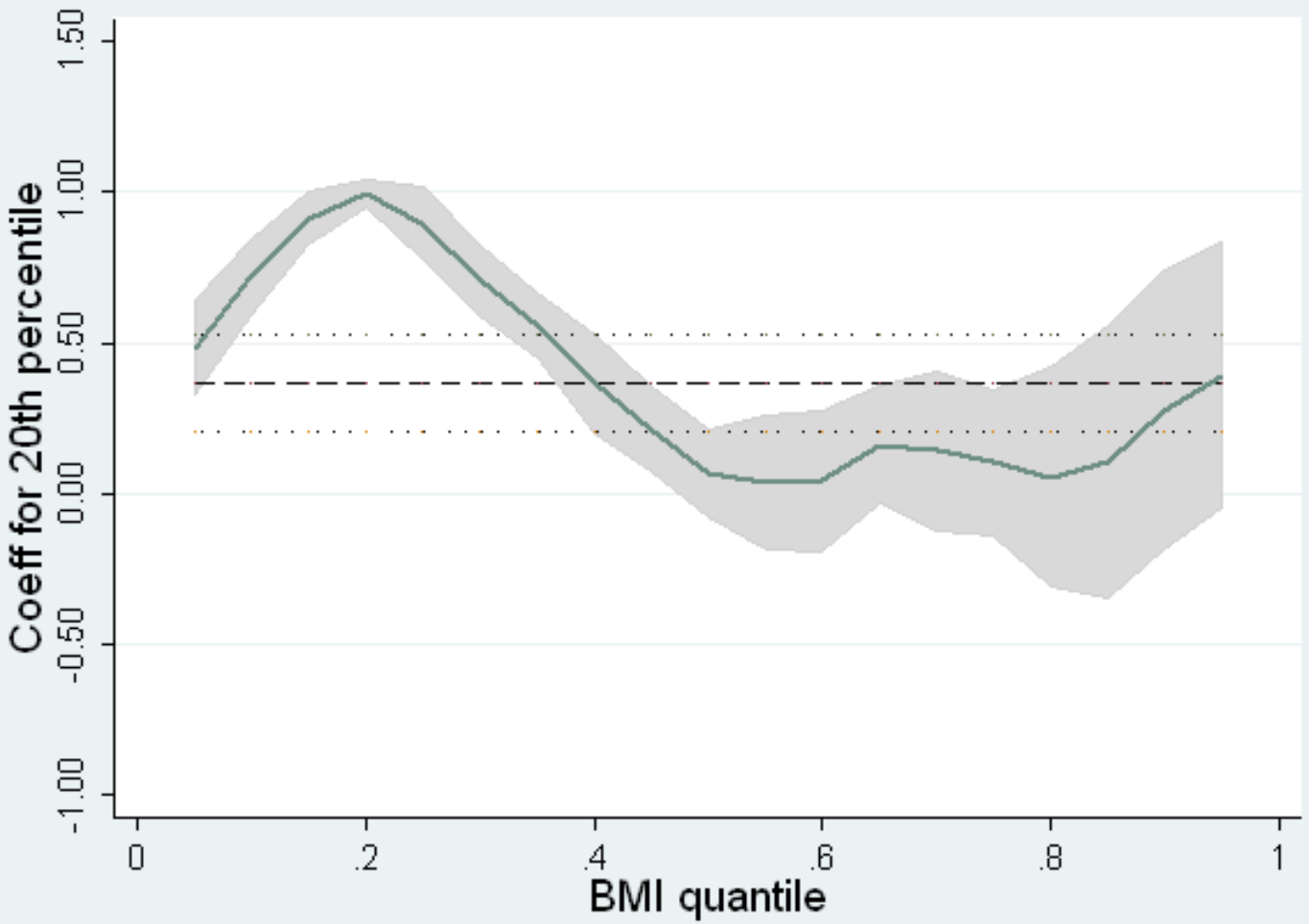
Table: Means and Proportions by Grade

	4^{th} Grade		8^{th} Grade		11^{th} Grade	
Variable	**Prop**	**Std. Dev.**	**Prop**	**Std. Dev.**	**Prop**	**Std. Dev.**
Obese (1=yes, 0=no)	0.234	0.017	0.175	0.016	0.173	0.014
Obese or overweight (1=yes, 0=no)	0.421	0.010	0.355	0.024	0.336	0.020
Boy (1=yes, 0=no)	0.512	0.019	0.508	0.013	0.505	0.023
African-American (1=yes, 0=no)	0.134	0.019	0.147	0.030	0.142	0.027
Hispanic (1=yes, 0=no)	0.446	0.035	0.417	0.043	0.369	0.026
Spanish Language at Home (1=yes, 0=no)	0.252	0.049	0.220	0.029	0.169	0.021
Other language at Home (1=yes, 0=no)	0.040	0.013	0.026	0.008	0.021	0.007
Percentage Disadvantaged at School	0.632	0.035	0.571	0.035	0.437	0.034
Body Mass Index (BMI)	20.2	0.237	22.8	0.232	24.6	0.296
	n=7,907		n= 8,827		n=6,456	
	N=248,838		N= 291,672		N=233,753	

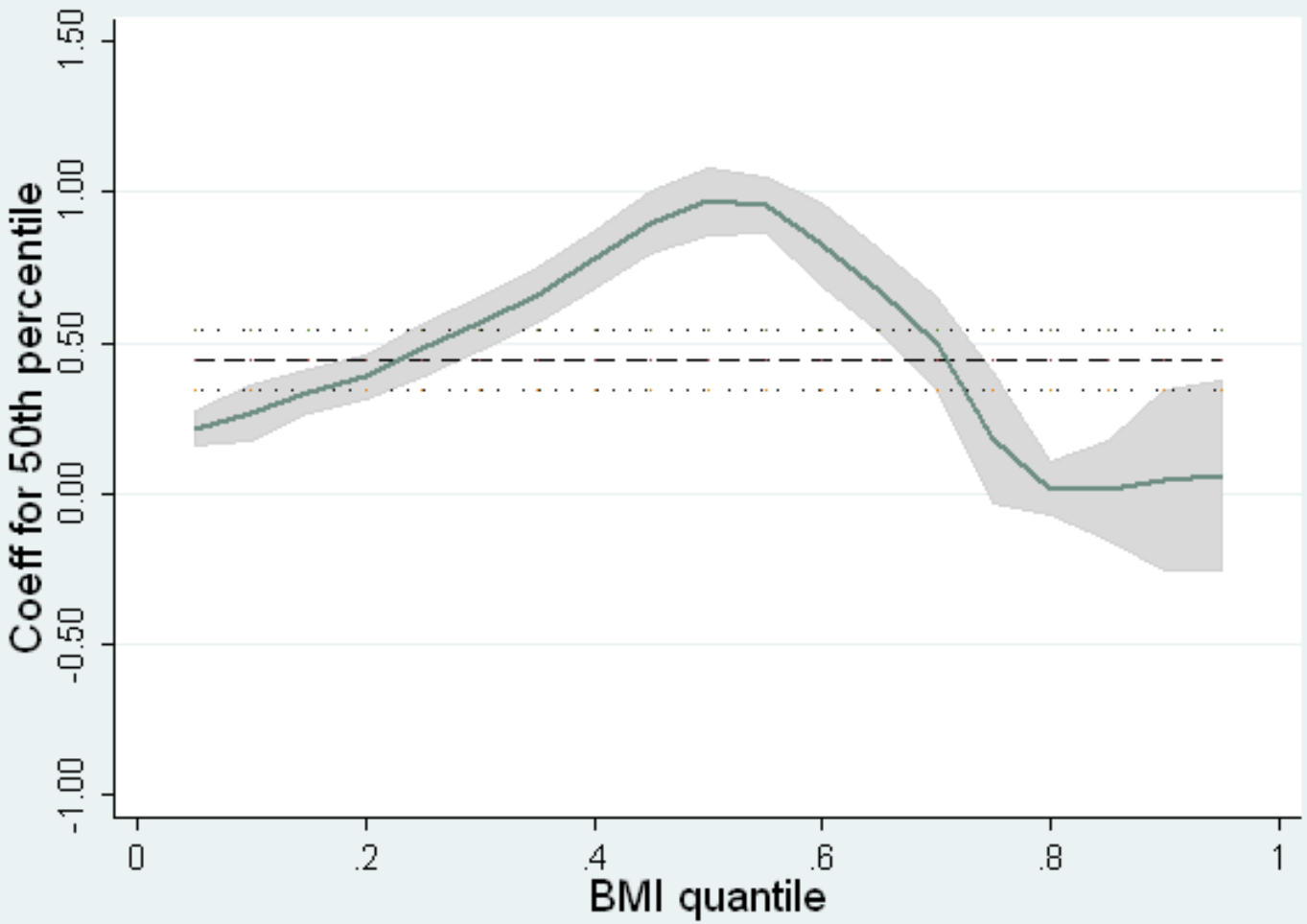
Table: Mean BMI Percentiles by School

Grade	20^{th} percentile BMI		50^{th} percentile BMI		80^{th} percentile BMI	
	Boys	Girls	Boys	Girls	Boys	Girls
4^{th}	16.48	16.32	19.05	18.92	23.79	23.20
8^{th}	18.92	19.41	21.83	22.29	26.92	26.97
11^{th}	20.83	20.26	23.91	23.19	29.22	28.16

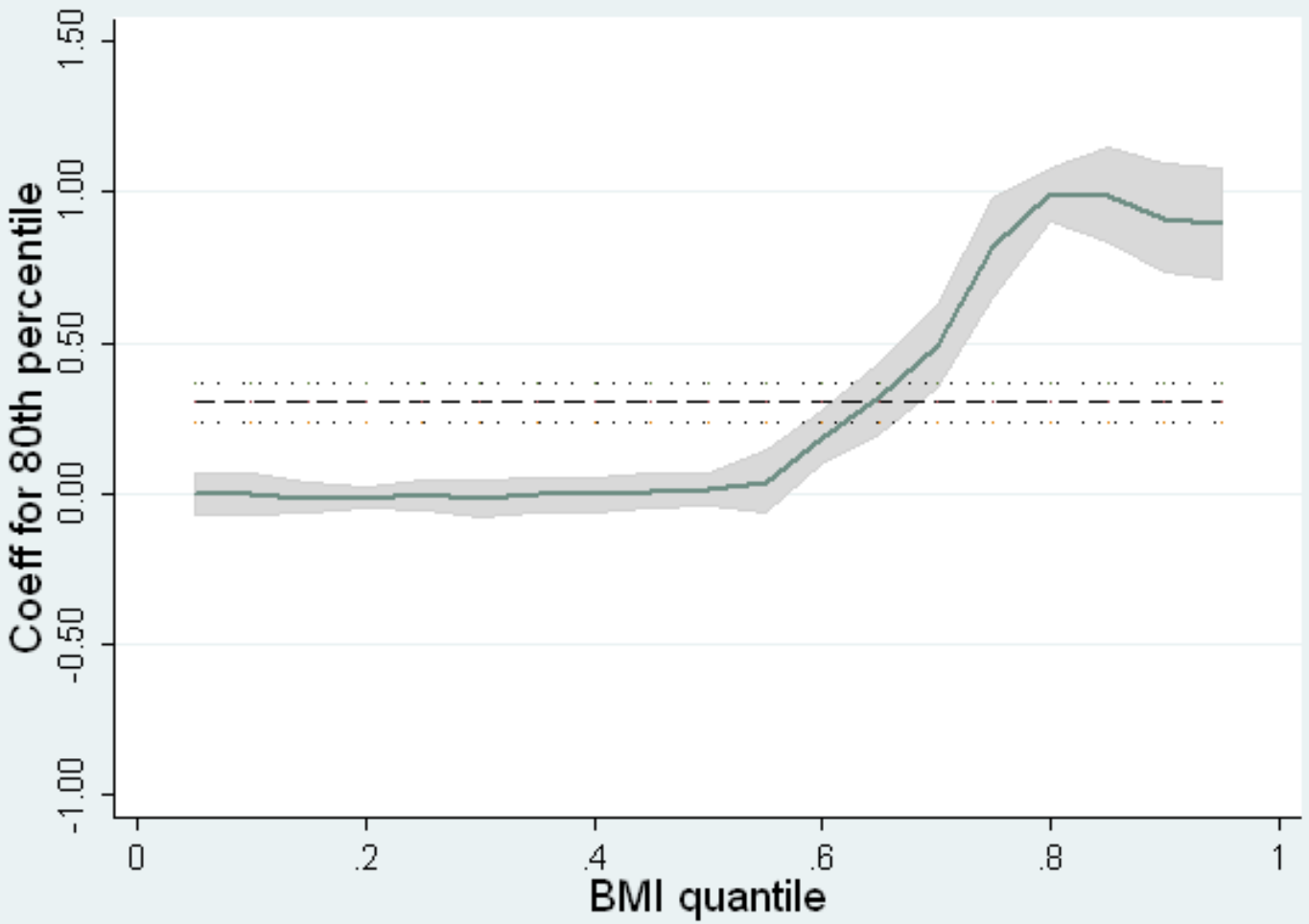
Effect of 20^{th} percentile, 4^{th} Graders



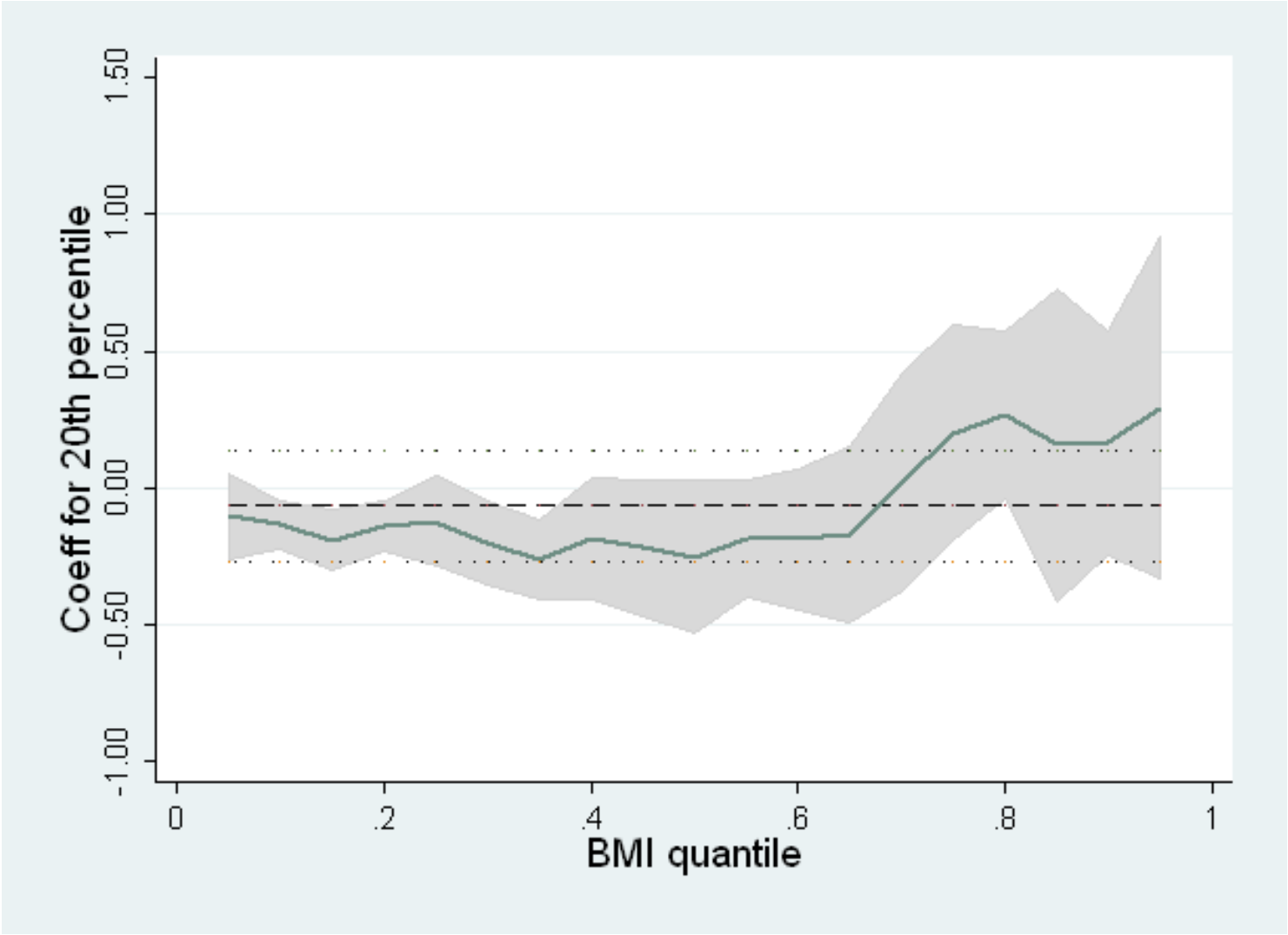
Effect of 50^{th} percentile, 4^{th} Graders



Effect of 80^{th} percentile, 4^{th} Graders



Effect of 20^{th} percentile, Obese and Overweight 4^{th} Graders



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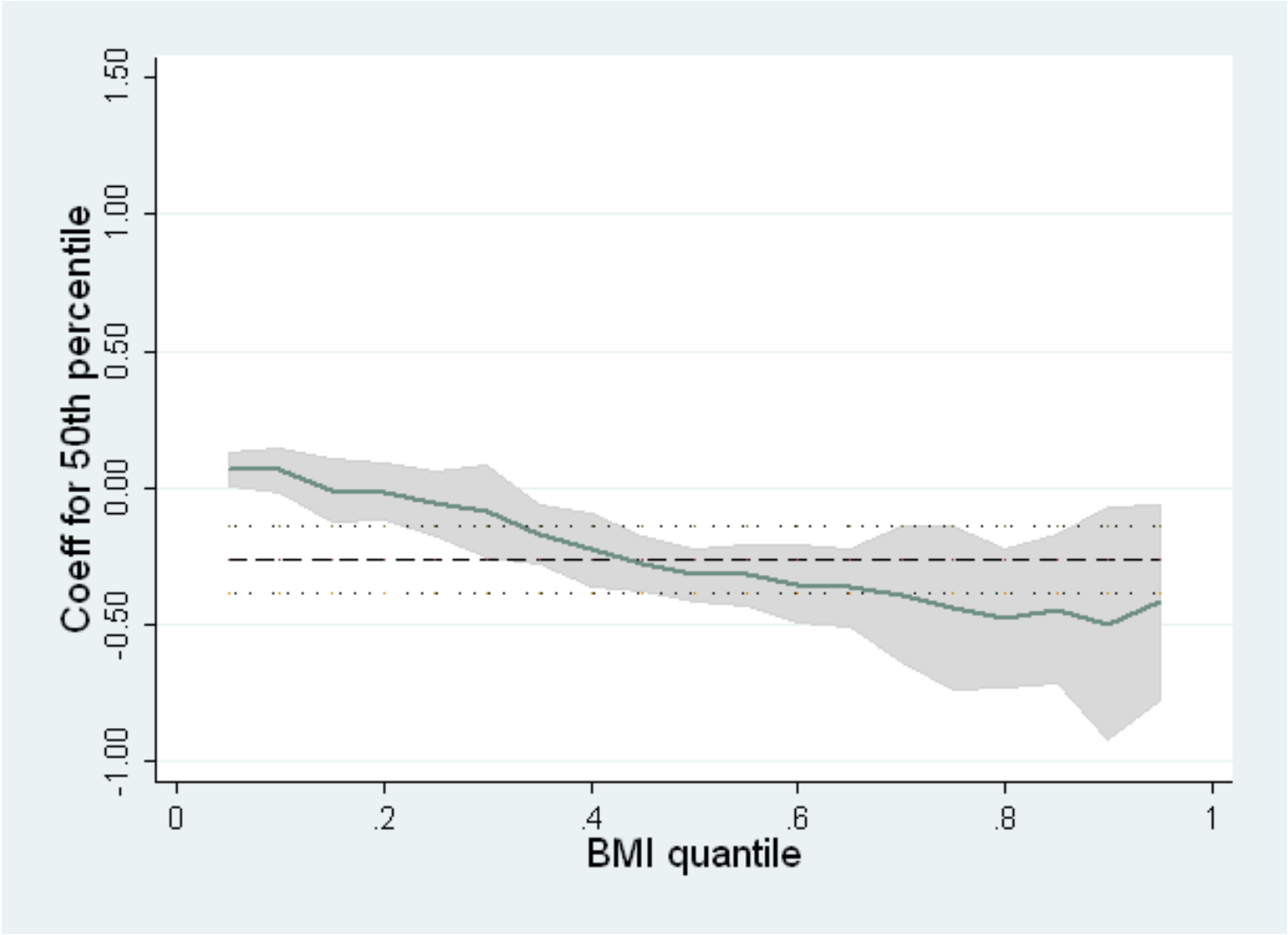

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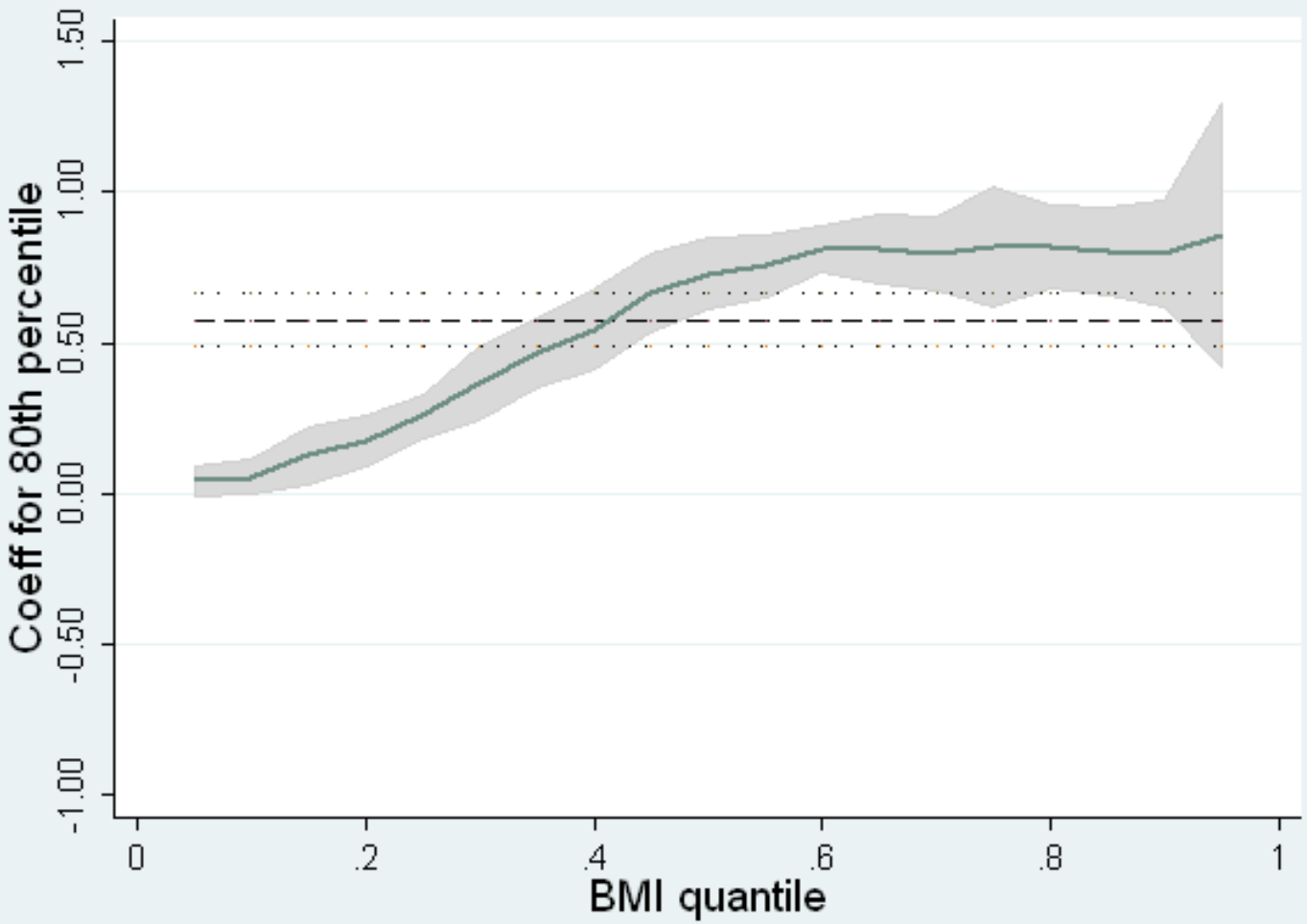

Summary

- Children are near-focused in terms of body weight influence
  - Magnitudes of association are similar for 20^{th}, 50^{th} and 80^{th} percentiles
  - the size of the spheres of influence are similar for 20^{th}, 50^{th} and 80^{th} percentiles
  - Patterns of association are similar for 4^{th}, 8^{th} and 11^{th} grades
- BMIs for overweight and obese children are associated with the 80^{th} percentile

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