Published in final edited form as:

J Adolesc Health. 2011 June ; 48(6): 644–646. doi:10.1016/j.jadohealth.2010.09.010.

Does early school entry prevent obesity among adolescent girls?

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INTRODUCTION

Childhood obesity has become a public health crisis in the US [1]. Meanwhile, eating disorders have become a particular concern among adolescent girls, who are vulnerable to social and peer pressures [2,3]. It is challenging to measure these pressures. One way of doing so is to examine the role of schooling on their weight status. Ideally, girls would be randomized into schooled and non-schooled groups, which is unethical. Alternatively, age of enrollment works as a natural proxy for the number of years of schooling [4,5]. State-specific age-enrollment policies require children born after a given cut-off date to delay admission until a year later than those born prior to that date [4]. Therefore, children born a few days apart may be in different grades. Stratifying by age-at-enrollment creates two comparable groups with similar developmental stages but with a one year difference in their level of schooling. We utilized this approach to examine whether earlier school enrollment was negatively associated with weight status among adolescent girls.

METHODS

Data

This study used the National Longitudinal Survey of Youth 1997 cohort (NLSY97), an annual survey of a nationally representative cohort of adolescents born between 1980 and 1984. We utilized data collected between 1997 and 2006, restricting our sample to girls not yet graduated from high school and excluding those with missing body measures, those who were pregnant, and those who had repeated or skipped grades. Our final sample included 14,413 person-year records.

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Conflict of interest: There is no conflict of interest.

Financial disclosure: Dr. Q. Zhang was partially supported by National Institute of Child Health and Human Development (R03 HD056073).

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Measures

The body mass index (BMI) is defined as $\frac{\text{weight (kg)}}{(\text{height (m)})^2}$ ¹. We calculated participants' BMI z-score following the CDC's formula for the age-specific percentile [7]. Overweight and obesity were defined as BMI $\geq$ 85th percentile and $\geq$ 95th percentile, respectively [8].

School entry status was defined as (a) "early birth date", i.e., respondents' birth dates were before the admission cut-off dates, (b) "late-starting" means a one year delay of normal admission into the education system². The interactive term indicates the marginal effect of early birth date on late starters. For example, if the cut-off-date was September 1, 2000, girls born on August 31, 1994 were late starters if they started their first grade on September 1, 2001, while girls born on September 2, 1994 were late starters if they started on September 1, 2002. Therefore, late starters born in August 1994 still had one more year of schooling than late starters born in September 1994.

Statistical analysis

Linear and logistic models were used with controlling year- and state-fixed effects. Age, race/ethnicity, maternal education and maternal body weight status were controlled. Model A used the school year as an explanatory variable, which was approximately the age effect. For Model B, we created three subgroups whose birth dates were within 1, 3, and 6 months of the cutoff-dates. Hypothetically, the effect of early school entry on obesity should be the most significant between girls born no earlier or later than ("within") one month of the cutoffs, while the schooling effect should be gradually dominated by the age effect within the 3 and 6 months' gap. Huber-White standard errors were estimated.

RESULTS

The mean respondent age was 16.6 years. About 51.5%, 26.4%, and 22.1% of the sample were white, black, and Hispanic, respectively. Forty-percent of the girls had mothers who were overweight or obese; 46.9% had mothers who attended college, 32.8% of their mothers graduated from high-school and 20.2% of their mothers were high-school dropouts. The mean BMI of the girls was 23.4, with 18% being overweight and 12.2% being obese. About half of the girls were born before the admission cut-off-dates. Overall, 10% of girls with early birthdates and 3.4% with late birthdates entered school later than expected. Late starters had higher BMIs and a higher prevalence of overweight and obesity; the results were consistent across age groups (Table 1).

Model A in Table 2 shows that one additional year of schooling was correlated with a reduced BMI, meaning adolescent girls who had more schooling were less likely to be obese (OR = 0.862, $p < 0.001$).

Model B in Table 2 demonstrates the effect of school entry on body weight status. For BMI and BMI z-score, all except one coefficient of an early birth date were significantly negative, indicating that one additional school year was associated with reduced BMIs. Among girls with birthdays within one-month of the cutoff-dates, the coefficient of late starting was significantly positive ($\beta = 0.311$; $p = 0.02$), indicating that late starting may be correlated with weight gain in adolescence. The interactive term was significantly negative in the sample within one month of the cut-off dates, indicating that late starters with early

¹To correct for the potential self-reporting bias, we regressed measured height and weight on self-reported measures using National Health and Nutrition Survey data, using regression coefficients to predict the measured height and weight in NLSY97 [6].

²Specifically, a student was a "late starter" if the calculated number of years of schooling based on her birth-date and the state's admission cut-off-date was larger than her reported highest grade attended or completed.

birthdays were slimmer than those with later birthdays, possibly due to the additional one year of schooling. As expected, these terms became insignificant within 3 and 6 months of the cutoff-dates.

For overweight and obesity, all ORs of early birth date were below 1, indicating that one additional school year for girls decreased the risk of overweight and obesity in adolescence.

DISCUSSION

This study explores the impact of the age of starting education on obesity among adolescent girls. It found that early school entry may reduce girls' likelihood of becoming obese in their teen years. Girls born a few days earlier than the cut-off dates were thus likely to interact with more mature adolescents in their educational cohort who might be more motivated to be slim [8]. An additional motivational factor may be the U.S. school health curriculum, which is grade-specific [9].³ Adolescent girls who were admitted to school earlier may benefit from the higher standard of the more advanced-grade curriculum to maintain their body weight.

Our research suggests that earlier admission to school may have a long-term protective effect in terms of adolescent girls' obesity risks. It indicates that utilizing the age at enrollment, a natural experiment to assign students randomly into different amounts of schooling, better estimates the effect on obesity of time spent in school. This study improves the measurement of schooling on obesity among adolescent girls.

Acknowledgments

We are very grateful to John Cawley, Jordan Matsudaira, Kosali Simon, Donald Kenkel, George Jakubson, Byung-Kwang Yoo, and Obesity Luncheon at Cornell for many valuable suggestions. Thanks also go to Pinky Chandra at the Cornell Restricted Access Data Center (CRADC) for her assistance to work on NLSY97-Geocode files. Dr. Q. Zhang was partially supported by National Institute of Child Health and Human Development (R03 HD056073).

References

1. Ogden CL, Carroll MD, Curtin LR, et al. Prevalence of overweight and obesity in the United States, 1999–2004. *JAMA*. 2006; 295:1549–1555. [PubMed: 16595758]
2. Field AE, Camargo CA, Taylor CB, et al. Peer, parent, and media influences on the development of weight concerns and frequent dieting among preadolescent and adolescent girls and boys. *Pediatrics*. 2001; 107(1):54–60. [PubMed: 11134434]
3. Von Hippel PT, Powell B, Downey DB, et al. The effect of school on overweight in childhood: gain in body mass index during the school year and during summer vacation. *Am J Public Health*. 2007; 97:696–702. [PubMed: 17329660]
4. Cascio E, Lewis E. Schooling and the Armed Forces Qualifying Test: evidence from school-entry laws. *J Hum Resour*. 2006; 41:294–318.
5. McEwan P, Shapiro J. The benefits for delayed primary school enrollment. *J Hum Resour*. 2007; 43:1–29.
6. Burkhauser R, Cawley JH. Beyond BMI: the value of more accurate measures of fatness and obesity in social science research. *J Health Econ*. 2008; 27:519–529. [PubMed: 18166236]
7. Kuczmarski, RJ.; Ogden, C.; Grummer-Strawn, L., et al. CDC Growth Charts: United States. Atlanta, GA: Centers for Disease Control and Prevention; 2000.
8. Finnerty T, Reeves S, Dabinett J, et al. Effects of peer influence on dietary intake and physical activity in schoolchildren. *Public Health Nutr*. 2009; 10.1017/S1368980009991315

³For example, Maryland's Voluntary State Curriculum for Physical Education provides a "grade specific delineation of what students know and be able to do" [10].

9. National Association of Sports and Physical Education (NASPE). Moving into the Future: National Standards for Physical Education. AAHPERD Publications; Oxon Hill, MD: 2004.
10. Maryland State Department of Education. Maryland Physical Education State Content Standards. [accessed on September 19, 2009].
http://www.marylandpublicschools.org/MSDE/divisions/instruction/physical_education.htm

Table 1

Body weight status of adolescent girls by age group, birth dates, and admission status

	N	% of Late Starters	BMI	SE	Overweight (%)	SE	Obesity (%)	SE
Total	14413		23.40	4.98	18.00	0.32	12.20	0.27
Early birth date	7049		23.32	4.99	17.71	0.38	11.47	0.32
Normal admission	6367	90.32	23.28	4.98	17.62	0.38	11.33	0.32
Late Starter	682	9.68	23.73	5.03	18.62	0.39	12.76	0.33
Late birth date	7364		23.53	4.97	18.31	0.39	12.90	0.34
Normal admission	7113	96.59	23.51	4.94	18.28	0.39	12.81	0.33
Late Starter	251	3.41	24.17	5.51	19.52	0.40	15.53	0.36
Age 12–14	1602		20.98	4.55	15.23	0.36	10.04	0.30
Early birth date	743		20.96	4.57	15.34	0.36	9.69	0.32
Normal admission	681	91.66	20.88	4.56	16.00	0.37	9.10	0.28
Late Starter	62	8.34	21.79	4.66	8.06	0.27	16.13	0.37
Late birth date	859		20.99	4.52	15.13	0.36	10.36	0.30
Normal admission	823	95.81	21.03	4.54	15.19	0.35	10.57	0.31
Late Starter	36	4.19	20.04	4.01	13.89	0.36	5.56	0.23
Age 15–16	3633		22.66	4.61	15.19	0.36	10.34	0.31
Early birth date	1791		22.55	4.63	14.13	0.35	10.01	0.30
Normal admission	1684	94.03	22.55	4.63	14.07	0.35	9.35	0.30
Late Starter	107	5.97	22.63	4.55	14.95	0.36	10.27	0.29
Late birth date	1842		22.77	4.59	16.23	0.37	9.64	0.31
Normal admission	1806	98.05	22.77	4.58	16.22	0.37	8.33	0.31
Late Starter	36	1.95	22.79	4.83	16.67	0.38	10.69	0.28
Age 17–18	9178		24.16	5.01	19.63	0.40	13.28	0.34
Early birth date	4515		24.02	5.03	19.53	0.40	12.27	0.33
Normal admission	4002	88.64	23.99	5.02	19.39	0.40	12.17	0.33
Late Starter	513	11.36	24.20	5.1	20.66	0.41	13.06	0.34
Late birth date	4643		24.30	4.99	19.73	0.40	14.26	0.35
Normal admission	4484	96.58	24.26	4.95	19.67	0.40	14.07	0.35
Late Starter	179	3.86	25.28	5.47	21.23	0.41	18.99	0.39

Table 2

Results of linear models for the association between body weight status and early school status among adolescents aged 12–19 years in the National Longitudinal Survey of Youth 1997 (NLSY97)*

	BMI		BMI Z-Score		Overweight		Obesity	
	Beta	P-Value	Beta	P-value	OR	P-value	OR	P-value
Model A without birth date control	-0.137	0.029	-0.021	0.099	0.939	0.02	0.862	<0.001
Model B with birth date control								
Within 1 month of cut-off date								
Early birth date	-0.359	0.00	-0.069	0.02	0.78	0.04	0.73	0.02
Late starting	1.266	0.08	0.311	0.02	1.26	0.49	1.22	0.83
Early birth date * Late Starting	-1.721	0.03	-0.373	0.02	0.84	0.15	0.56	0.00
Within 3 months of cut-off date								
Early birth date	-0.03	0.02	-0.018	0.17	0.97	0.18	0.87	0.19
Late starting	0.396	0.36	0.106	0.20	1.25	0.32	0.96	0.90
Early birth date * Late Starting	-0.426	0.40	-0.111	0.07	0.77	0.32	0.71	0.76
Within 6 months of cut-off date								
Early birth date	-0.275	0.04	-0.067	0.02	0.93	0.23	0.84	0.05
Late starting	0.327	0.33	0.053	0.45	1.03	0.16	1.18	0.40
Early birth date * Late Starting	-0.438	0.25	-0.075	0.36	0.94	0.78	0.85	0.49

* Models were controlled for age, gender, race/ethnicity, maternal education, maternal body weight status