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TRAJECTORIES OF OVERWEIGHT AMONG US SCHOOL CHILDREN: A FOCUS ON SOCIAL AND ECONOMIC CHARACTERISTICS

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Abstract

Much of the research examining the patterns, timing, and socioeconomic characteristics of child overweight has been limited by the lack of longitudinal nationally representative data with sufficiently large or diverse samples. We used the Early Childhood Longitudinal Study- Kindergarten Cohort (ECLS-K), a nationally representative sample of US kindergartners, to identify three distinct patterns of weight gain from kindergarten through eighth grade. The largest group (boys: 59%, girls: 55%) was characterized as having consistently normal weight whereby BMI percentile remained below the 85th percentile. The remaining children (boys: 41%, girls: 45%) fell either into a class characterized as always overweight/at risk of overweight (boys: 27%, girls: 25%) or gradually becoming overweight/at risk for overweight (boys: 15%, girls 20%). We found some evidence that the relationship between socioeconomic status and children's health may operate differently across gender. Among girls, low parental income and education were both significant risk factors for the gradual onset of overweight after beginning Kindergarten. Parental income or changes in parental income were not related to boys' risk of developing overweight after entering Kindergarten; only parents' education. We found that while children of immigrants display higher levels of overweight / at risk for overweight at each grade level, the children of immigrant parents who have had less exposure to the US were more likely to experience early and sustained overweight throughout elementary and middle school, particularly among boys. High rates of overweight as early as kindergarten, combined with race/ethnic differences suggest that interventions should focus on pre-school children's environments.

Introduction

In the past 25 years, the prevalence of overweight and at-risk for overweight children quadrupled, increasing from roughly four to sixteen percent (1). It is important to document both the prevalence of overweight and the timing of weight gain among children because those who experience early onset weight gain are more likely to be heavier later in adulthood than children with later onset (2). Overweight children (with a body mass index (BMI) at or above the 95th percentile) are more likely to become obese adults (3). Among children ages 8 to 15 who were overweight or at-risk for overweight (with a BMI at or above the 85th percentile), three-quarters were also overweight or obese as young adults (4). Further, if overweight begins before 8 years of age, obesity in adulthood is more likely to be severe (5).

Unfortunately, much of the research examining the patterns and timing of child overweight has been limited by the lack of longitudinal nationally representative data with sufficiently large or diverse samples. A recent study of rural non-Hispanic white children aged 9 to 13 found that 15% remain chronically overweight through middle childhood into adolescence (6). Another study using a select sample of children ages 2 to 20 found that 11% of children experience early and sustained obesity from childhood through adolescence (7). Yet little is known about the basic gender, racial-ethnic, nativity, and family SES variations in children's weight trajectories.

Past research has identified the economic and demographic groups that appear to be most vulnerable to the risk of overweight. For example, overweight is particularly common among racial and ethnic minority children. Among children ages 6 to 11, 22 percent of Hispanic children and 20 percent of African American children are overweight compared to just 14 percent of non-Hispanic white children (8). Children in some economically disadvantaged families may also face higher risks of overweight. The association between family SES and children's weight is negative for non-Hispanic whites (9), although the relationship is less clear for other groups (10-11) and depends on which indicator of SES is

examined (12-13). Children of immigrants also appear to be more vulnerable to the risk of overweight. Children of recently arrived immigrant parents, particularly boys, tend to weigh more and are at greater risk of overweight than are the children of natives (14-15, 13).

Findings such as these provide insights about the kinds of social and economic contexts that serve to raise or lower the risk of overweight among children (16), and further help identify vulnerable groups for intervention and further research. However, the age when at-risk groups are likely to become overweight or at-risk for overweight remains unclear. The current focus on cross-sectional differentials in weight may thus mask important health disparities. Some groups may be more likely to be overweight at earlier ages or for more sustained periods of time than others and thus may be at greater risk of obesity and other health problems later in life. In addition, information about the timing of weight gain may be helpful for the development of effective interventions. For example, if at-risk children tend to gain weight before starting kindergarten, this would suggest that interventions should focus on pre-school children's environments (i.e., families and childcare environments rather than elementary schools).

The purpose of the current study is to extend the extant research on children's health by identifying possible trajectories of overweight and at risk for overweight separately by gender and to measure the associations of social and economic factors with trajectory membership. We address two general research questions: 1) what are the distinct trajectories of overweight/at risk for overweight by gender? and 2) what demographic, social and economic factors characterizes weight group membership?

Methods and Procedures

Data and Sample

We use the Early Childhood Longitudinal Study- Kindergarten Cohort (ECLS-K), a nationally representative sample of US kindergartners, to identify overweight trajectories and explore the

relationship between weight patterns and key demographic and socioeconomic characteristics. The ECLS-K data are ideal for these analyses because they include measures of weight and height (necessary to establish BMI) which are assessed up to 7 times (twice in Kindergarten and first grade, once in third, fifth and eighth). We include only those cases with at least three data points, the minimum required for trajectory analysis. In addition, these data are measured by the interviewer, and are not based on parent's reports, which may be biased. The ECLS data include an oversample of Asian/Pacific Island and Hispanic children. ECLS staff interviewed parents who spoke languages other than English by translating the parent questionnaire into Spanish, Chinese, Lakota, and Hmong.

Of the roughly 21,400 children in the longitudinal ECLS-K, ninety seven percent had a BMI measurement in Kindergarten (Fall and/or Spring); 74.1% had an assessment in First grade (Fall and/or Spring), 64.6% had an assessment during fall Third grade; 51.6% had an assessment in Fall Fifth grade and 41% had an assessment in fall eighth grade. Less than 2 percent had no BMI measurement. For the trajectory analysis, we use children who had at least one measurement in Kindergarten, one in First grade and one measurement at a later grade (N~14,000). Like most longitudinal national datasets, the ECLSK has some missing data. To account for missing values in the covariates, we utilized the ICE procedure in Stata 10 to fill in missing values. The rates of missing data across trajectory classes did not vary significantly.

Measures

BMI. Prior research on child obesity has established body mass index (weight/height^2) as a suitable adiposity index for children (17). BMI is also a preferred measure because height and weight are easy to obtain with a reasonable degree of accuracy across different settings. In the ECLS-K, children's height and weight were assessed by ECLS-K staff at each wave of data collection and recorded using a Shorr Board and a digital scale. Algorithms provided by the Centers for Disease Control and Prevention based on 2000 growth charts are used to classify any outliers in weight or height. We use

the CDC guidelines to classify children with a BMI $\geq$85th percentile for their gender-specific BMI-for-age as overweight or at risk for overweight.

Race/Ethnicity/Parental Nativity. Children are divided into the following categories based on parents report: Hispanic (of any race), and non-Hispanic white, Black, Asian, and Other (includes children of more than one race and American Indians/Alaskan Natives). The children of immigrants are defined here as children having at least one foreign born parent, and the children of natives as having two native born parents. To assess the possible effect of exposure to the US we also distinguish among children of the 1.5 generation parents (arrived in the U.S. ages 0-11, or Settled Immigrants), children of 1.0 generation parents (arrived in the U.S. age 12 and older, or Newly Arrived Immigrants), and children of U.S.-born native parents (reference category).

Socioeconomic Status. Following Braveman et al. (18), we include several measures to explore the impact of SES on children's overweight trajectories: family income in kindergarten (logged), change in income between kindergarten and eighth grade, and parental educational attainment. Unfortunately, the ECLS-K data provide only categorical measures of income past the baseline interview; a continuous measure of income is available only for kindergarten. To obtain continuous income measures, we apply coefficients from a prediction equation regressing Kindergarten family income on parent's highest education, SES scale (a composite constructed by NCES) and income category to eighth grade data. The resulting predicted value is a normally distributed value that captures income in 8^{th} grade. To measure change, we subtract income in kindergarten from the 8^{th} grade income estimate.

Household, Family and Individual Measures. We also examine the association of a number of other characteristics with children's weight trajectories, including the children's weight at birth (19), number of children in the household, children's general health status (measured on a 5 point scale ranging from excellent (1) to poor (5) health), children's television viewing habits (20), mother's full-time work status (21-22), family structure (23), and place of residence (region and urbanicity) (24), all of

which may have an impact on the development of overweight.

Analyses

We proceeded in several stages. First, we estimated the prevalence of overweight/at risk of overweight by gender from Kindergarten through eighth grade. Next, we fitted semiparametric mixture models (SPMM) of the repeated measures of binary overweight indicators over age to identify distinct trajectories in overweight which allow for heterogeneity in growth trajectories (25). These models are similar to cluster analysis in that they identify groupings of individuals in the data, except that they incorporate entire trajectories in weight status rather than weight status at a single point in time. We fitted four different semiparametric mixture models of at risk for overweight or overweight (BMI>=85th percentile) over age separately by gender. Initial steps included fitting a two class model with quadratic terms, followed by three class models, then four class models. Each model contained terms for both linear and quadratic effects of age. Decisions on model fit were decided based on several factors. First, we used the Bayesian Information Criteria (BIC) to decide on the appropriate number of individual classes. Although no set rule has been established, the general rule is that the smallest BIC value is the preferred choice. Second, we examined the posterior probabilities of group membership which is a collective measure of group membership and also provide a guide as to how well the models fit the data with a probability of 1.0 suggesting perfect prediction of group membership and a 0 probability for the remaining groups (26). Nagin (27) suggests that a minimum average posterior probability of .70 for all trajectory groups is ample evidence of an acceptable model. A final part of this decision included the relative size of each class such that no one class held less than 10 percent of the sample.

Once membership was established, we produced descriptive statistics of children in each weight trajectory category by gender that account for the complex sample design. Finally, we examined how race/ethnicity and parental generation status as well as family and household characteristics helped to distinguish each overweight trajectory from one another using multinomial logistic regression. We

estimated these models separately by gender.

Results

The weighted distribution of sample characteristics by gender is presented in Table 1. Well over a quarter of Kindergartners were overweight or at risk for overweight (BMI$\geq 85^{th}$ percentile), increasing to roughly 34% by eighth grade. Twenty percent of the children are Hispanic and one in five children in the sample comes from an immigrant family, a majority of which came to the United States more recently. Fewer than half of the children had mothers who worked full time, and three quarters had two parents residing in the household. Average annual base year income was $33,000, and 89% of children had a parent who had attained at least a high school degree. On average, Kindergarteners in the sample were in good to excellent health, watched about 7 hours of television per day, and weighed seven pounds at birth.

Child Overweight/ At Risk of Overweight by Gender. Figure 1 displays the prevalence of overweight/at risk for overweight for the children by gender. The prevalence of overweight or at risk for overweight (BMI $\geq 85^{th}$ percentile) was 27% for boys and 26% for girls in Kindergarten. The prevalence of overweight/at risk for overweight rises steadily through elementary school peaking during fifth grade at roughly 40% for boys and 37% for girls, respectively. Overweight/at risk for overweight declines to 34% for boys, and to just 36% for girls by eighth grade.

Developmental Trajectories of Child Overweight and at risk of Overweight. Based on the criteria for evaluating model fit described in the previous section, a three class model was selected for each gender (Figure 2), with the mean posterior probability for boys and girls by assigned group presented in Table 1. The first trajectory class represents children with little or no probability of being at risk for overweight or overweight (59% boys, 55% girls); the second class represents gradual onset of overweight / at risk or overweight (15% boys, 20% girls); and the final class represents children with a high probability of sustained overweight or at risk of overweight Kindergarten through 8^{th} grade (27%

boys, 25% girls). We refer to these weight trajectories as "Normal" weight, "Gradual Onset" of overweight / at risk of overweight and "Always" overweight / at risk of overweight.

Overweight /At Risk for Overweight Trajectories. Table 3 presents the weighted distribution of children across the three identified weight trajectories by individual and family risk factors. We created ranked terciles of the continuous variables (low, middle and high). While a majority of children are in the "Normal" weight trajectory, clear differences exist across race and ethnic categories for boys and girls. Similar to the results of cross sectional studies, over a third of Hispanic boys (35%) and 31% of black girls experiencing continuous overweight/at risk for overweight. A large proportion (35%) of the sons and 28% of the daughters of recently arrived immigrants (children of newcomers) also experience continuous overweight. Possessing better health, having a lower birth weight and more siblings and watching less television appeared to increase the chance of maintaining a normal weight throughout the course of the study, as did having higher levels of parental income and education.

Table 4 presents the results of multinomial logistic regression models predicting trajectory membership separately by gender. The odds ratios measure the direct association of each characteristic with the relative risk of always being overweight /at risk for overweight or experiencing a gradual onset compared with having normal weight net of all other factors. Turning first to the more serious "Always Overweight" category, Hispanic boys and girls (OR: 1.71, $p<.001$ for boys; OR: 1.49, $p<.001$ for girls) are more likely than non-Hispanic white children to experience continuous overweight. Additional correlates of membership in the "Always overweight" category for both boys and girls include television viewing, higher than average birth weight, having a full time working mother, lower levels of parental education, lower baseline family income, and residing in the Northeastern US. Having more children in the household reduces the risk of sustained overweight compared to having a normal weight trajectory among girls and boys as well.

Some gender differences emerged. Parental education is a weaker predictor of sustained

overweight among boys (OR: .813, p<.049) than among girls. Among boys only, having more recently arrived immigrant parents significantly increases the odds of membership in the "Always Overweight" class compared to the Normal weight class (OR: 1.44, 95%CI: 1.1 to 1.8). Finally, among girls only, black children experience a much higher risk of sustained overweight than non Hispanic white children (OR: 1.694 p<.001).

Turning next to the "gradual onset of overweight" category, the key protective factor for both boys and girls is parental education. Increasing levels of parental education reduce the risk of children experiencing the onset of overweight after they enter kindergarten and progress through elementary and middle school. Among boys, other factors that predict membership in the "gradual onset" category are the number of daily television viewing hours (OR: 1.03, p<.006), and black ethnicity (OR: .690, p<.021). Among girls, significant predictors include parent's annual income and changes in parental income between kindergarten and eighth grade. That is, higher levels of income in Kindergarten as well as upward shifts in income over time are associated with reduced risk of transitioning into overweight net of other factors including parent's education. In addition, girls with higher than average birth weight, as well as those living in rural areas are at an increased risk of experiencing a gradual onset of overweight through their school years.

Discussion

Using a national longitudinal sample of US kindergartners, we identified three distinct patterns of weight gain from kindergarten through eighth grade. The largest group (boys: 59%, girls: 55%) was characterized as having consistently normal weight whereby BMI percentile remained below the 85th percentile. The remaining children (boys: 41%, girls: 45%) fell either into a class characterized as always overweight/at risk of overweight (boys: 27%, girls: 25%) or gradually becoming overweight/at risk for overweight (boys: 15%, girls 20%). Thus, of those classified as always overweight/at-risk or gradually becoming overweight or at-risk, the majority is in the "always" category and therefore appears to have

been at risk as early as kindergarten (boys: 66%, girls: 56%). Significantly, no group was identified as moving from the overweight/at risk to the normal weight category over time. Although some individual children may have lost weight, such events are sufficiently rare that they were not captured by the semiparametric mixture models. Overall, these results confirm and extend earlier findings by Li et al. (7) who identified similar trajectories but did not examine possible differences by gender nor the development of at risk for overweight [BMI $\geq 85^{th}$ percentile]. It is important to expand the analyses of weight trajectory patterns to include being 'at risk of overweight' because prior research has shown that these children are a considerable risk of negative health outcomes.

By analyzing the trajectories separately by gender we are able to see that the onset of overweight / at risk of overweight which begins around age seven occurs more gradually among girls than among boys. The more serious condition of sustained overweight, characterized by practicing sedentary behaviors such as television viewing, possessing an above average birth weight and having a mother who works full time may deserve more concerted attention. This condition of early and sustained overweight disproportionately affects Hispanic boys and girls and children with low levels of family income and parental education. Given that race and ethnic differences are evident as early as Kindergarten and that racial and ethnic gaps in the incidence of obesity widen as children move through high school and beyond (9, 28), it will be important to identify and target family or community based interventions even before children enter elementary school.

We also found some evidence that the relationship between socioeconomic status and children's health may operate differently across gender. Among girls, low parental income and education were both significant risk factors for the gradual onset of overweight after beginning Kindergarten. This was not true for boys. Parental income or changes in parental income were not related to boys' risk of developing overweight after entering Kindergarten; only parents' education appears to play a role. Parental education may reduce the risk of overweight if education is related to

health knowledge and better child feeding practices. However, the effects of income may be more complex because income can be used to purchase healthier food, but can also increase consumption of obesity-promoting goods and activities (e.g., video games and fast food). Regardless, it remains unclear why the effects of income and education vary by gender.

Another interesting finding of this study concerns the children of immigrants, a group which has been disproportionately affected by the obesity epidemic. Even though children of immigrants display higher levels of overweight / at risk for overweight at each grade level in the study (results not shown), the children of immigrant parents who have had less exposure to the US (i.e. the children of Newcomers) were substantially more likely to experience early and sustained overweight throughout elementary and middle school, particularly among boys. We also found that the children of immigrants with more exposure to the US (i.e. settled immigrant parents) did not exhibit higher prevalence of overweight/at risk of overweight nor did we find evidence that children of settled immigrants were more likely to experience gradual onset or sustained of overweight / at risk of overweight.

The differences in overweight / at risk for overweight among children may be explained by other unmeasured characteristics of immigrant parents. It could be that immigrant parents who spent most of their life in their home countries (the 1.0 generation or Newcomers) may be unfamiliar with US foods and grocery stores, unaware of the health risks of American junk food, and uniformed about opportunities for their children to participate in sports or other school related activities (15, 29). They may be coming from environments characterized by food scarcity and under nutrition (14 , 30) and may not consider over indulgence in food among their children a problem. In environments in which food sources are less secure (such as in some less-developed countries), overweight may be a marker of status, or at least is not perceived as unhealthy. Parents with the means may therefore use their resources to indulge their children (31-32). Immigrants may bring such inclinations with them to the United States, and their effects may become manifested early in children's lives.

There are some limitations to our study. We are unable to more fully examine differences by race/ethnicity, generational status and gender given the data constraints imposed by SPMM. Although the ECLS-K oversamples children in Asian and Hispanic subgroups making it ideal for research on children from immigrant families, given the data requirements necessary for trajectory analysis, we are unable to examine more detailed race/ethnic groups and generational status. In addition, the ECLS-K data do not include various early risk factors of child obesity such as maternal pre-pregnancy weight, breastfeeding history, or maternal smoking. Nonetheless, by utilizing a diverse nationally representative sample our research provides important information on the weight trajectories of boys and girls in the US, identifying those who remain overweight and those who become overweight throughout middle childhood. We find some indication that financial capital measured as family income, and human capital measured as parental education may have different effects on the timing and risk of weight gain among boys and girls. Future research which more fully examines variations in socioeconomic factors by gender, race, and ethnicity is warranted.

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Table 1: Sample characteristics, weighted means (standard error)

	Boys		Girls	
Overweight or at risk of overweight				
Kindergarten	.263	(.007)	.260	(.007)
First grade	.270	(.007)	.264	(.007)
Third grade[a]	.353	(.007)	.337	(.007)
Fifth grade[a]	.396	(.008)	.366	(.009)
Eighth grade	.335	(.007)	.346	(.009)
Hispanic	.197	(.011)	.201	(.012)
Non Hispanic				
Asian	.031	(.003)	.033	(.003)
Black	.134	(.012)	.135	(.013)
White	.590	(.017)	.583	(.019)
Other	.048	(.012)	.049	(.01)
Children of Native Born	.782	(.011)	.785	(.010)
Children of Immigrants	.218	(.011)	.215	(.010)
Newly arrived immigrant parents	.168	(.009)	.161	(.009)
Settled immigrant parents	.051	(.004)	.054	(.003)
Health Scale (1: excellent - 5: poor)[a]	1.71	(.015)	1.64	(.015)
Number of hours TV per day(base year)[a]	7.07	(.077)	6.61	(.069)
Birthwt (ounces)[a]	120.4	(.351)	116.1	(.310)
Family and Household Characteristics				
Base year income (logged)	10.43	(.038)	10.44	(.034)
Change in income (K-8th grade)	0.08	(.017)	0.06	(.017)
Parents educational attainment				
No High School degree	.108	(.006)	.098	(.005)
High School Degree	.260	(.009)	.263	(.009)
Some College	.321	(.008)	.326	(.008)
College	.311	(.011)	.313	(.011)
Mother works full time	.458	(.009)	.457	(.010)
Two parents in household	.769	(.009)	.767	(.011)
Number of siblings in household	1.62	(.022)	1.61	(.021)
Region				
Northeast	.184	(.008)	.186	(.009)
Midwest	.240	(.013)	.249	(.011)
South	.355	(.013)	.342	(.011)
West	.222	(.008)	.223	(.009)
Central city	.344	(.019)	.354	(.018)
Large town	.425	(.027)	.419	(.026)
Small town	.232	(.021)	.227	(.02)
Unweighted N	7,070		6,900	

Note: a: difference between boys and girls significant $p < .05$. The sample Ns have been rounded to the nearest 10 to comply with the restricted data license of the National Center for Education Statistics.

Table 2. Mean posterior probability of latent growth profile membership by assigned group

	Male			Female		
	Never	Gradual Onset	Always	Never	Gradual Onset	Always
Group 1	0.96	0.04	0.01	0.91	0.09	0.00
Group 2	0.08	0.84	0.07	0.02	0.91	0.07
Group 3	0.01	0.02	0.97	0.00	0.06	0.94

Table 3: Weighted means of sample characteristics by trajectory classes of at risk for overweight or overweight (BMI>=85th percentile)and gender. K-8th grade.

	Boys			Girls		
	Gradual Onset	Always	Normal Weight	Gradual Onset	Always	Normal Weight
Individual Characteristics						
Hispanic	.171 (.011)	.353 (.014)	.476 (.016)	.219 (.013)	.298 (.014)	.482 (.016)
Non Hispanic						
White	.151 (.007)	.232 (.008)	.616 (.009)	.200 (.008)	.219 (.008)	.580 (.011)
Black	.134 (.013)	.268 (.013)	.597 (.016)	.230 (.017)	.312 (.021)	.457 (.025)
Asian	.153 (.024)	.284 (.023)	.563 (.025)	.161 (.021)	.181 (.02)	.659 (.029)
Other	.155 (.024)	.284 (.034)	.561 (.028)	.234 (.028)	.277 (.032)	.489 (.047)
Parental Nativity						
Children of Natives	.149 (.006)	.246 (.007)	.605 (.008)	.211 (.007)	.243 (.007)	.546 (.009)
Children of Newcomers	.162 (.011)	.348 (.018)	.490 (.017)	.207 (.014)	.277 (.015)	.516 (.018)
Children of Settled	.184 (.024)	.293 (.027)	.524 (.030)	.179 (.022)	.258 (.024)	.563 (.03)
Health Scale (1: excellent - 5: poor)						
Highest third	.141 (.007)	.258 (.009)	.601 (.011)	.197 (.008)	.231 (.008)	.572 (.010)
Middle third	.165 (.011)	.265 (.012)	.570 (.014)	.219 (.010)	.274 (.011)	.507 (.013)
Lowest third	.159 (.011)	.280 (.015)	.561 (.017)	.222 (.014)	.258 (.014)	.520 (.017)
Number of hours TV (base year)						
Lowest third	.135 (.008)	.226 (.009)	.639 (.010)	.201 (.008)	.225 (.009)	.574 (.012)
Middle third	.160 (.010)	.282 (.012)	.558 (.013)	.200 (.011)	.261 (.012)	.539 (.014)
Highest third	.167 (.008)	.294 (.010)	.539 (.011)	.226 (.010)	.274 (.012)	.500 (.013)
Birthwt (ounces)						
Lowest third	.165 (.009)	.196 (.010)	.638 (.013)	.207 (.010)	.201 (.008)	.592 (.012)
Middle third	.151 (.009)	.265 (.010)	.584 (.011)	.213 (.010)	.245 (.012)	.543 (.013)
Highest third	.145 (.008)	.320 (.010)	.535 (.011)	.206 (.012)	.321 (.013)	.473 (.013)
Family and Household Characteristics						
Base year income (logged)						
Lowest third	.158 (.009)	.296 (.011)	.545 (.012)	.232 (.010)	.288 (.011)	.480 (.015)
Middle third	.170 (.008)	.261 (.010)	.569 (.011)	.217 (.009)	.252 (.009)	.531 (.011)
Highest third	.123 (.008)	.230 (.010)	.646 (.011)	.169 (.010)	.199 (.010)	.632 (.014)
Income change (K-8)						
Decline income	.161 (.008)	.272 (.010)	.567 (.011)	.215 (.010)	.258 (.013)	.527 (.015)
Stable income	.143 (.008)	.262 (.010)	.594 (.011)	.212 (.011)	.248 (.011)	.540 (.012)
Increasing income	.155 (.01)	.260 (.013)	.585 (.015)	.199 (.010)	.243 (.012)	.558 (.015)
Parents educational attainment						
No high school degree	.161 (.015)	.328 (.019)	.511 (.020)	.264 (.018)	.317 (.022)	.419 (.024)
High School Degree	.197 (.009)	.279 (.011)	.524 (.012)	.245 (.01)	.262 (.012)	.494 (.015)
Some College	.147 (.009)	.263 (.010)	.590 (.012)	.208 (.01)	.268 (.011)	.525 (.013)
College	.119 (.007)	.230 (.011)	.651 (.011)	.160 (.009)	.197 (.008)	.642 (.011)
Mother works full time	.157 (.008)	.293 (.009)	.550 (.011)	.205 (.009)	.272 (.010)	.524 (.013)
Two parents in household	.152 (.006)	.257 (.007)	.591 (.007)	.205 (.006)	.240 (.006)	.555 (.008)
Number of siblings in household						
Lowest third	.147 (.008)	.275 (.008)	.578 (.011)	.208 (.007)	.256 (.008)	.536 (.009)
Middle third	.173 (.009)	.245 (.010)	.582 (.012)	.196 (.010)	.245 (.012)	.559 (.014)
Highest third	.138 (.01)	.265 (.015)	.597 (.016)	.232 (.014)	.237 (.014)	.532 (.018)
Region						
West	.149 (.012)	.287 (.014)	.564 (.017)	.203 (.010)	.240 (.013)	.557 (.017)
Northeast	.143 (.010)	.305 (.014)	.552 (.017)	.178 (.012)	.270 (.014)	.553 (.016)
Midwest	.138 (.010)	.234 (.014)	.628 (.015)	.216 (.012)	.220 (.012)	.564 (.016)
South	.169 (.009)	.253 (.01)	.578 (.01)	.223 (.01)	.265 (.011)	.512 (.016)
Largetown	.151 (.007)	.248 (.011)	.601 (.011)	.200 (.008)	.244 (.011)	.556 (.013)
Smalltown / Rural	.157 (.011)	.282 (.015)	.562 (.013)	.249 (.012)	.256 (.017)	.496 (.021)
Central City	.153 (.008)	.274 (.009)	.573 (.011)	.193 (.010)	.252 (.009)	.555 (.013)
	1,050	1,880	4,150	1,380	1,700	3,830

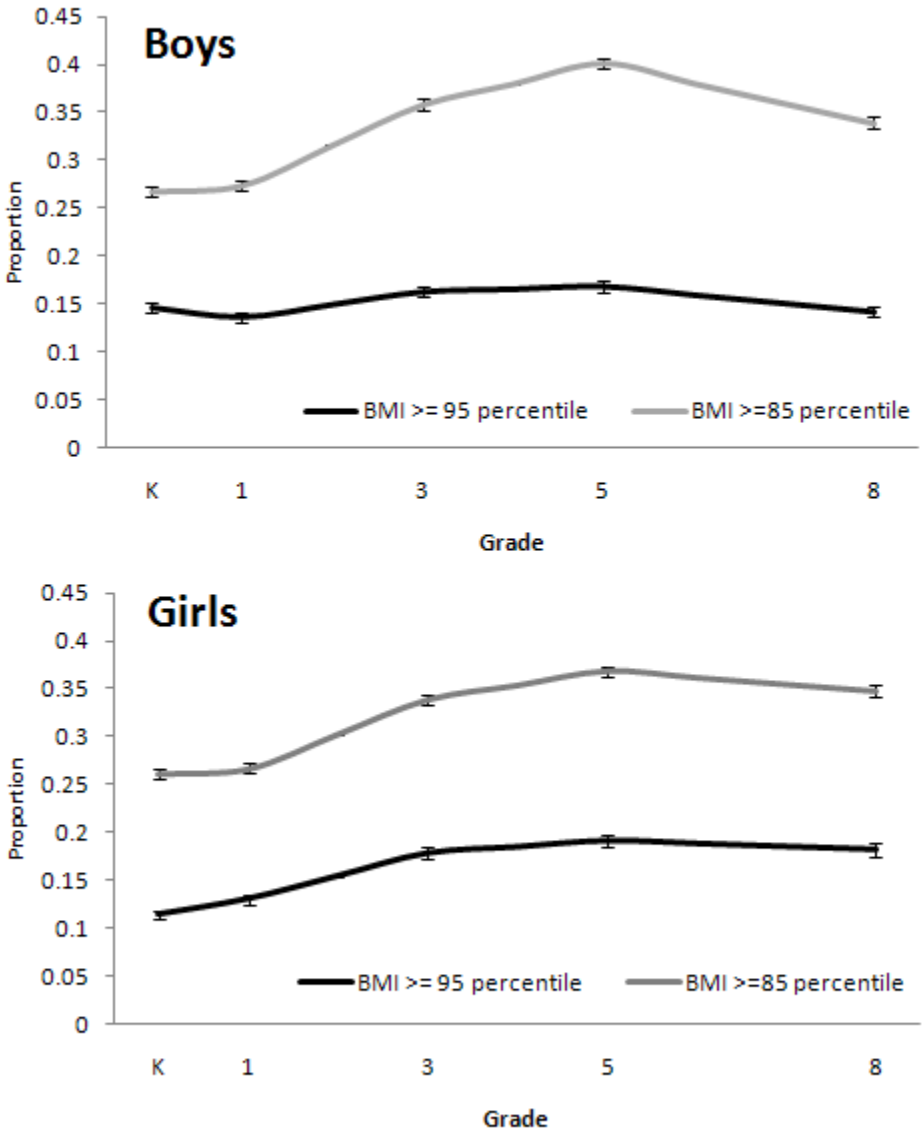
NOTE: Means sum across to 1 for each gender. These data are weighted with the cross sectional weight from Spring Kindergarten. The sample is restricted to those cases which have at least one BMI measurement in Kindergarten, one in first grade and one measurement at either third, fifth or eighth grade. The sample Ns have been rounded to the nearest 10 to comply with the restricted data license of the National Center for Education Statistics.

Table 4: Odds ratios of detailed parental generation, family, household and individual characteristics for overweight/at risk of overweight trajectories, ECLS-K cohort Kindergarten through 8th grade

	BOYS				GIRLS			
	Gradual Onset of Overweight/At Risk for Overweight		Always Overweight or at Risk of Overweight		Gradual Onset of Overweight/At Risk for Overweight		Always Overweight or at Risk of Overweight	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Individual Characteristics								
Hispanic	1.176	(.89 , 1.6)	1.708	(1.4 , 2.1)	1.182	(.90 , 1.5)	1.491	(1.2 , 1.9)
Non Hispanic								
Black	0.690	(.50 , .95)	1.069	(.87 , 1.3)	1.254	(.99 , 1.6)	1.694	(1.3 , 2.3)
Asian	1.030	(.69 , 1.5)	1.212	(.89 , 1.6)	0.811	(.55 , 1.2)	0.825	(.56 , 2.3)
Other	1.042	(.74 , 1.5)	1.283	(.90 , 1.8)	1.197	(.84 , 1.7)	1.432	(.97 , 2.1)
(White)								
Children of Newly Arrived Immigrants	1.219	(.92 , 1.6)	1.440	(1.1 , 1.8)	0.971	(.73 , 1.3)	1.071	(.84 , 1.4)
Children of Settled Immigrants	1.354	(.93 , 2.0)	1.239	(.91 , 1.7)	0.815	(.57 , 1.2)	0.971	(.72 , 1.3)
(Children of Natives)								
Health Scale (1-5)	1.013	(.92 , 1.1)	0.964	(.87 , 1.1)	1.031	(.94 , 1.1)	1.061	(.97 , 1.2)
Number of hours TV (base year)	1.028	(1.0 , 1.0)	1.044	(1.0 , 1.1)	1.013	(1.0 , 1.0)	1.027	(1.0 , 1.0)
Centered Birthwt (ounces)	1.003	(1.0 , 1.0)	1.016	(1.0 , 1.0)	1.006	(1.0 , 1.0)	1.018	(1.0 , 1.0)
Family and Household Characteristics								
Base year income (logged)	0.974	(.88 , 1.1)	0.918	(.85 , 1.0)	0.906	(.82 , 1.0)	0.898	(.81 , 1.0)
Income change (K-8)	0.923	(.84 , 1.0)	0.939	(.88 , 1.0)	0.914	(.84 , .99)	0.916	(.83 , 1.0)
Parents educational attainment								
No high school degree	0.792	(.60 , 1.1)	1.022	(.83 , 1.3)	1.272	(.96 , 1.7)	1.358	(1.0 , 1.8)
(High School Degree)								
Some College	0.683	(.56 , .84)	0.908	(.77 , 1.1)	0.831	(.70 , .99)	1.033	(.85 , 1.3)
College	0.514	(.42 , .64)	0.813	(.66 , 1.0)	0.591	(.47 , .74)	0.725	(.60 , .88)
Mother works full time	1.175	(.99 , 1.4)	1.382	(1.2 , 1.6)	1.012	(.85 , 1.2)	1.194	(1.0 , 1.4)
Two parents in household	1.019	(.82 , 1.3)	0.964	(.82 , 1.1)	1.127	(.91 , 1.4)	1.068	(.88 , 1.3)
Number of siblings in household	0.972	(.90 , 1.1)	0.896	(.84 , .96)	0.962	(.90 , 1.0)	0.890	(.83 , .95)
Region								
Northeast	1.144	(.86 , 1.5)	1.386	(1.1 , 1.7)	0.963	(.76 , 1.2)	1.332	(1.1 , 1.7)
Midwest	0.950	(.71 , 1.3)	0.907	(.73 , 1.1)	1.074	(.87 , 1.3)	1.013	(.81 , 1.3)
South	1.241	(.95 , 1.6)	1.020	(.85 , 1.2)	1.125	(.92 , 1.4)	1.174	(.95 , 1.4)
(West)								
Large town	1.007	(.85 , 1.2)	0.971	(.84 , 1.1)	1.162	(.97 , 1.4)	1.117	(.95 , 1.3)
Small town	1.046	(.83 , 1.3)	1.243	(1.0 , 1.5)	1.414	(1.1 , 1.8)	1.242	(.98 , 1.6)
(Central city)								

Early Child Longitudinal Study-Kindergarten Cohort 1999. OR, odds ratio; CI, confidence interval. Normal weight trajectory class is the referent group.

Figure 1 Overweight or at risk for overweight by gender and parental nativity, ECLS-K cohort Kindergarten through Eighth Grade



Note:Weighted means using base year cross sectional Taylor series weights. Error bars indicate +/- one standard error of the mean.

Figure 2: Probability of overweight/at risk of overweight (BMI ≥ 85th percentile) of 3 trajectory groups classified by the most likely class membership