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Do Weight Status and Television-Viewing Influence Children's Subsequent Dietary Changes? A National Longitudinal Study in the United States

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Abstract

Objective—It is unknown how children's dietary changes would vary by overweight/obese status and length of TV-viewing. This study examined whether US children's weight status and TV-viewing duration influenced their subsequent dietary behavioral changes.

Methods—A national representative sample of the Early Childhood Longitudinal Study – Kindergarten Cohort were followed between 5th and 8th grades during 2004–2007 (N=7,720). Children's daily TV-viewing hour and weight status were measured at 5th grade. Children reported their dietary behaviors at the 5th and 8th grades, including fruit/vegetable consumption 5 times/day (five-a-day), daily fast food and soft drink consumption. Logistic models were used to estimate the odds ratio (OR) of dietary behavioral changes by children's baseline weight status and TV-viewing duration. Gender and race/ethnicity differences in the ORs were examined. Sampling weight and design effect were considered for the analysis.

Results—Among those without five-a-day at 5th grade, overweight/obese children were more likely to develop the five-a-day behavior at 8th grade than normal weight children (for overweight: OR=1.65, 95% CI=1.14-2.39; obese: OR=1.35, 95% CI=0.81-2.23). Among girls, overweight group was more likely to develop eating vegetable 3 times/day than normal weight group, but 1 more hour/day of TV-viewing at baseline was associated with lower odds of developing eating vegetable 3 times/day. Overweight/obese black and Hispanic children were significantly more likely to develop five-a-day than their normal weight counterparts. TV-viewing did not show modification effect on the association between weight status and subsequent dietary changes.

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Conflict of interest

The authors have no conflict of interest.

Conclusions—Overweight/obese children were more likely to improve their subsequent FV consumption than normal weight children, but TV-viewing's independent relationship with dietary changes may counteract the weight status-associated dietary improvement.

Keywords

obesity; overweight; diet; child; adolescent; television

INTRODUCTION

In the United States, more than one-third of children are overweight or obese.^{1, 2} Improving overweight/obese children's diets might contribute to their healthier weight management and/or adiposity reduction,^{3, 4} while cross-sectional studies have shown overweight children eat less fruit and vegetables than normal-weight children do.^{5, 6} Overweight and obese children may try to control weight using various weight loss methods,^{7–11} but the differences in food preferences and dietary habits between genders^{12, 13} and race/ethnicities^{14–17} may lead to different dietary changes driven by weight status. It is unknown whether overweight and obese children would be more likely to improve dietary habits than normal weight children. This study aims to explore children's weight-related dietary changes by gender and race/ethnicity.

In addition, TV-viewing habits could affect children's weight status-associated dietary behaviors. TV-viewing is associated with children's unhealthy dietary behaviors and lower fruit and vegetable intakes,^{18–25} although some studies find non-significant association between TV-viewing and dietary outcomes.^{23, 26} Several hypotheses explain the link between TV-viewing and children's diets. For example, advertisements of soft drinks and snacks on TV could promote viewers' consumption of the advertised foods.²⁷ Meanwhile, the internalized ideal body images from TV may trigger viewers' dissatisfaction with their own body shape and increase the risk of acquiring eating disorders and the adoption of unhealthy diets.^{28–30} Nowadays, school-aged children and adolescents' daily TV-viewing hours are increasing in the US.^{31–33} Understanding the role of TV-viewing on children's dietary behaviors could reveal the potential value of TV for obesity prevention and control and the promotion of healthy eating.

As weight status and TV-viewing are correlated and could have opposite influences on children's dietary changes,^{34, 35} the present study examines US children's longitudinal dietary data by their body weight status and TV-viewing habits. The research questions were examined using the national longitudinal, 3-year follow-up data (from 5th to 8th grade) of the Early Childhood Longitudinal Study – Kindergarten (ECLS-K) cohort.

METHODS

Study design and subjects

ECLS-K is a cohort study of a U.S. nationally representative sample of kindergarteners that has been conducted since 1998–99. The subjects were recruited from 1280 schools based on a multistage stratified clustered sampling scheme and were followed up to their 8th grade

year. There were a total of 7 waves of follow-up, at each of which the sampled children, their parents/guardians, and the school teachers and administrators answered questions regarding the child's daily behaviors and family/school environments. The ECLS-K obtained parental consent for the survey.³⁶ The secondary data analysis study was approved by the Institutional Review Board of Johns Hopkins School of Public Health.

Our study focused on the data collected at 5th grade (as baseline, in the year 2004) and 8th grade (as follow-up in the year 2007), because the children's food consumption data were only collected at these 2 follow-ups. Children with complete dietary data in both surveys were eligible subjects (n = 8250). Those who had missing values of TV-viewing time (n = 380) or missing BMI (n = 150) were excluded from analysis, resulting in a final sample size of 7720.

Outcome variables: food consumption

Food consumption were assessed using a self-administered food frequency questionnaire adapted from the questions used in the US Youth Risk Behaviors Surveillance System (YRBSS).³⁶ The children reported the frequency of their food consumption in the 7 days prior to the interview, including (1) green salads, (2) carrots, (3) potatoes (excluding French fries, fried potatoes or potato chips), (4) other vegetables, (5) fruits, (6) 100% juice beverages and (7) soft drinks (soda pop, sports drinks or fruit drinks that are not 100% juice). In addition, the ECLS-K asked about the frequency of eating snacks/meals in the past week from fast food stores ("How many times did you eat a meal or snack from a fast food restaurant such as McDonald's, Pizza Hut, Burger King, KFC [Kentucky Fried Chicken], Taco Bell, Wendy's and so on?"). The food frequency questionnaire used a 7-point scale: not consumed in the past week, 1–2 times in the past week, 3–4 times in the past week, 1 time/per day, 2 times/day, 3 times/day, 4 times/day. The answers were converted into daily frequency of consumption: 0, 0.2, 0.5, 1, 2, 3, and 4 times/day, respectively.

Total daily vegetable consumption was the sum of the daily frequencies of following items: green salads, carrots, potatoes and other greens. Total daily fruit consumption included consuming fruits and 100% juice. Five binary dietary behavior outcomes were created for the analysis: five-a-day (≥ 5 times of fruit and vegetable [FV] consumption per day), vegetable consumption (≥ 3 times of vegetable consumption per day), fruit consumption (≥ 2 times of fruit consumption per day), daily fast food consumption (≥ 1 time daily) and daily soft drink consumption (≥ 1 time daily).

Exposure variables: baseline weight status and TV-viewing time

Children's body weight and height were directly measured on a digital bathroom scale (Seca model 840, Seca North America West, Chino, California) and the Shorr's board (Shorr Productions LLC, Olney, Maryland), respectively. BMI was calculated as weight/height² (kg/m²). Trained test administrators conducted the measurements in a school classroom or library. The 2000 US Center for Disease Control and Prevention's Growth Reference sex-age-specific BMI percentiles were used to classify children's overweight (≥ 85th and < 95th percentile) and obese status (≥ 95th percentile) at baseline.³⁷

TV-viewing hours (including watching TV, videotapes and DVDs) on typical weekdays and weekends at 5th grade were reported by the children's parents, who were asked about the child's average hours of weekday TV-viewing: before 8 AM, between 3 PM and dinner time, and after dinner time. Answers to these three questions were summed up to obtain the child's total TV-viewing time per weekday. In addition, two more questions asked parents about the child's average hours of TV-viewing on Saturdays and Sundays. The weekday and weekend TV-viewing hours were weighted by 5 and 2, respectively, and then the weighted sum of weekday and weekend TV-viewing hours was divided by 7 to obtain the daily TV-viewing hours.

Other covariates

Children's gender, age, race/ethnicity, household income levels (13-level categorical variable: 5000, 5001-10000, 10001-15000, 15001-20000, 20001-25000, 25001-30000, 30001-35000, 35001-40000, 40001-50000, 50001-75000, 75001-100000, 100001-200000, 200001 USD), maternal employment status (not in labor force, looking for job, <35 hours/week, 35+ hours/week), and family reception of food stamps (yes/no) were collected based on the parent's report at the wave of 5th grade. The sum of all food consumptions was used to indicate children's overall food consumption. Children's self-reported awareness (yes/no) of soft drinks, sweets, and salty snacks being sold in their school when they were in 5th grade was also considered, as school environment may influence children's dietary behaviors and weight status at both grades. Parents reported whether the child transferred to another school between these two grades. Missing values of categorical covariates were indicated by auxiliary flag dummy variables.

Statistical analysis

The distributions of outcome and explanatory variables were examined by children's weight status at 5th grade. Next, the proportions of children who changed their dietary behaviors from 5th to 8th grade, i.e., developing/discontinuing the outcome dietary behaviors, were calculated and compared across baseline weight status.

Logistic regression models were fitted to examine the relationships between the dietary changes and baseline weight status and TV-viewing. To capture the dietary behavioral changes, the analysis was separated by children's baseline dietary behavior. For instance, the odds ratio (OR) of developing the five-a-day habit was estimated among children who did not have five-a-day at baseline, while the OR of discontinuing five-a-day was estimated among children who had practiced it at baseline. The two major explanatory variables of interest (weight status and TV-viewing) entered the model to adjust for each other. Models were adjusted for the children's gender, race/ethnicity, age, maternal employment status, family income, household food stamp reception, overall food consumption, children's awareness of soft drinks, sweets, and salty snacks being sold in school, child's school transfer status, and auxiliary dummy indicators of missingness on categorical covariates.

To explore gender differences, interaction terms of gender and baseline weight-status and of gender and TV-hour entered the models in order to prevent small sample sizes after

stratification. The linear combinations of the regression coefficients give the associations (OR) of interest for boys and girls. For example, a simplified model structure was:

$$\begin{aligned} \text{logit}(Y) = & \beta_0 + \beta_1 TV + \beta_2 \text{Overweight} \\ & + \beta_3 \text{Obese} + \beta_4 \text{Gender} + \beta_5 TV * \text{Gender} \\ & + \beta_6 \text{Overweight} * \text{Gender} + \beta_7 \text{Obese} * \text{Gender} \end{aligned}$$

Assuming gender = 1 for boys and 0 for girls, β_1 denotes the log odds of outcome of interest (Y) associated with one more hour of TV-viewing among girls (i.e. when gender = 0), and $\beta_1 + \beta_5$ is the corresponding log odds for boys (i.e. when gender = 1). Likewise, β_2 represents the log odds difference between overweight and normal weight girls, while $\beta_2 + \beta_6$ represents the log odds difference between overweight and normal-weight boys. Furthermore, β_5 , β_6 and β_7 stand for gender differences in the associations between independent variables and outcome (Y). In the tables, we present the exponent β linear combination estimates, i.e. ORs for boys and girls, as ORs would be more intuitive to interpret. Using similar modeling strategies, race/ethnicity interaction terms were used to test the racial/ethnic differences in the associations between weight/TV-viewing and dietary behavioral changes. Asian and other races were not included for analysis due to small sample sizes.

The interaction between TV-viewing and weight status was also tested, but the coefficients were not statistically significant, $p > 0.05$. Thus, the final models did not include the interaction terms. All analyses considered survey design and longitudinal sampling weight between 5th and 8th grades to estimate appropriate variances by Taylor-linearization method, carried out in SAS 9.2, 2008 (SAS Institute, Cary, NC).

RESULTS

Demographic characteristics varied with children's baseline weight status. Proportions of boys, Hispanics, and blacks were higher among obese than among normal-weight group. Among 5th graders, 22.8% had five-a-day, 29.6% drank soft drinks daily, and 11.6% ate snacks or meals from fast food restaurants every day. The prevalence of these dietary behaviors declined to 20.0%, 27.4%, and 7.9%, respectively in 8th grade. The dietary behaviors at 5th and at 8th grades did not differ significantly by children's baseline weight status before the confounders were controlled (Table 1).

Although the prevalence of the reported dietary behaviors changed less than 5% in three years (Table 1), the dynamics of the reported behaviors from 5th to 8th grade were drastic (Table 2). For example, among children reporting not eating fruits 2 times/day or not drinking soft drinks 1 time/day, more than 20% of them reported having these behaviors at follow-up. Meanwhile, more than 50% of children reported discontinuing the dietary behaviors that they had at baseline. Furthermore, the crude proportions of changes in dietary behaviors varied little with children's baseline weight status. Only daily fast food and soft drink consumption at follow-up differed significantly by baseline weight status among girls and in the Hispanic group.

Dietary behaviors developed at 8th grade follow-up

Logistic regression models were used to examine the relationship between dietary changes and children's baseline weight status and TV-viewing. Final models did not include the interaction term between baseline TV-viewing and weight status since it was not significant. Table 3 shows the association of development of the five dietary behaviors with baseline weight status and daily TV-viewing time among those without the dietary behavior at baseline. In general, compared to normal-weight children, overweight 5th graders were significantly more likely to develop healthier dietary behaviors (five-a-day and vegetables 3 times/day). Obese 5th graders were less likely to report daily fast food consumption at 8th grade than their normal-weight counterparts.

Gender-specific analysis showed that obese and overweight boys were more likely to develop five-a-day and vegetable consumption behaviors than were normal-weight boys. Overweight girls were more likely to develop vegetable consumption behavior than normal-weight girls did (OR = 1.66, 95% CI = 1.02–2.69). Comparing obese to normal-weight boys, the OR of developing daily fast food consumption was 0.39 (95% CI = 0.18–0.81). Nevertheless, overweight was associated with a greater OR of daily soft drink consumption among girls (OR = 1.67, 95% CI = 1.14–2.45), but not so among boys. TV-viewing hours had significantly independent association with girls' lower odds of developing vegetable consumption behaviors.

The association between baseline weight status and the subsequent development of fruit and/or vegetable consumption was significant for black and Hispanic, but not for white, children. Hispanic obese children were less likely to develop daily soft drink consumption behaviors than their Hispanic normal-weight counterparts. This weight-related OR for Hispanic children of developing daily soft drink consumption behaviors was significantly different than that for white children (p for weight status-race/ethnicity interaction = 0.0052).

Dietary behaviors discontinued between 5th and 8th grades

Children's body weight and TV-viewing were associated with the odds of discontinuing dietary behaviors (Table 4). In general, obese children, compared to normal-weight ones, had lower ORs of discontinuing five-a-day (OR = 0.50, 95% CI = 0.26–0.95) and fruit consumption (OR = 0.61, 95% CI = 0.40–0.92). Overweight girls were more likely to discontinue daily soft drink consumption than normal-weight girls, but there was no significant difference in discontinued soft drink consumption between overweight and normal-weight boys (p for gender-overweight interaction = 0.012).

Baseline obese status was associated with lower likelihood of discontinuing five-a-day dietary behavior in Hispanic and white children. Meanwhile, obese Hispanic children were more likely to discontinue daily soft drink consumption than the Hispanic normal-weight group (OR = 0.30, 95% CI = 0.15–0.60); the obesity-related ORs of quitting daily soft drink consumption were significantly different between Hispanic and white groups (p for interaction = 0.008). As for blacks, overweight children were more likely to discontinue vegetable consumption (OR = 0.25, 95% CI = 0.06–0.96) than the normal-weight

counterparts, and the OR associated with overweight status and discontinued vegetable consumption was significant between black and white groups (p for interaction = 0.012).

TV-viewing was associated with girls' greater odds of discontinuing five-a-day and vegetable consumption. This direction of association between TV-viewing and vegetable consumption was also found among white children. Moreover, one more hour of TV-viewing was associated with greater odds of stopping daily soft drink consumption in the Hispanic group (OR = 1.18, 95% CI = 1.01–1.38).

DISCUSSION

The longitudinal data of US schoolchildren showed that compared to normal-weight children, overweight or obese children were more likely to improve dietary behaviors three years later, e.g., more FV and less soft drink consumption. Overweight and obese groups were less likely to develop daily soft drink consumption 3 years later than normal-weight groups in boys, blacks and Hispanic children. Further, development of five-a-day FV consumption was related to baseline weight status among boys, blacks and Hispanics, but not among girls or whites. In addition, TV-viewing at baseline was associated with the development of vegetable consumption among girls, and TV-viewing was associated with discontinued daily soft drink consumption among blacks. The association between TV-viewing hours and the subsequent dietary changes did not vary by children's weight status.

As expected, overweight/obese children were more likely to improve their dietary behaviors than normal-weight children. Overweight/obese children were more likely to have weight-loss intentions and weight-related concerns than normal-weight children, and such psychological propensity drives the weight-control behaviors.^{38–40} Research suggests that overweight/obese children who intended to control their body weight were more likely to choose dietary approaches to achieve normal weight rather than to take on an active lifestyle.^{8, 9} Our previous study using the ECLS-K data found that overweight and obese children would be still less physically active than normal-weight children,⁴¹ but our present study shows that overweight/obese children were more likely to develop better FV intake behaviors than normal-weight children. Nevertheless, it is unsure whether intermediate psychological and behavioral factors, such as weight concerns and satisfaction, may affect the association between children's weight status and dietary change. More in-depth longitudinal research is needed to help delineate the complex pathway between weight status and dietary behavior improvements among children.

This study demonstrated gender differences in the associations of children's dietary changes with their baseline weight status and TV-viewing. Among those who did not have five-a-day at baseline, weight status-related improvement in the five-a-day habit was significant among boys, instead of among girls. Moreover, overweight girls were more likely to both develop and discontinue daily soft drink consumption than normal-weight girls were, which was not found among boys. The literature shows that the association between weight status and children's intention to change weight was stronger among boys than girls, although girls were more likely to perceive themselves as overweight than boys were.^{16, 42} Meanwhile, girls may be more likely than boys to use unhealthy weight-reduction strategies such as

taking diet pills or inducing vomiting, while boys tended to exercise more and eat fewer calories.⁴² Nevertheless, children's unhealthy weight-loss practices were not collected at the baseline of this study, which are essential to answer the question of whether overweight/obese girls' lack of improvement of dietary behaviors was because they had already used other weight-loss approaches.

As shown in the present study, Hispanic and black children were more responsive to their own body weights than white children in terms of developing/discontinuing higher FV consumption. Comparing black and white children, however, black children were less aware of their own overweight status than white children,¹⁶ our study shows that overweight status may have a greater influence on black children than on white and Hispanic children. The YRBSS in 2007 showed that among black adolescents, 6.2% of those who were not overweight perceived themselves as overweight and 54.8% of those who were overweight accurately perceived themselves as overweight (proportion ratio of self-perceived overweight among overweight vs. normal weight adolescents = 8.8). The corresponding proportions were 14.5% and 71.8% (proportion ratio = 5.0) among white adolescents and 15.5% and 67.8% (proportion ratio = 4.4) among Hispanic adolescents, respectively.¹⁶ This suggests higher relative odds of self-perceived overweight status among blacks than among whites and Hispanics, which may explain black children's greater relative odds of overweight-related dietary improvement.

Comparing Hispanic and white children, family dietary practices may contribute to their different behavioral changes.¹⁷ Mexican/Hispanic people's diets had greater variety and more plant-based foods than white people's.^{14, 15} Such race/ethnicity-related differences in food preferences, practices, choices and preparation may influence children's weight-related dietary behaviors.

Despite children's probable dietary changes in response to their weight status, an array of factors may affect children's success in improving dietary behavior.⁴³⁻⁴⁸ As our study shows, one such factor is TV-viewing. Research shows that media like TV and the Internet could be associated with unhealthy dietary behaviors.⁴⁹ This association had gender and racial/ethnic differences. A cross-sectional study reported that TV-viewing hours were significantly associated with lower FV consumption among white girls,¹⁹ which was supported by our longitudinal study. Girls' FV consumption may be more negatively influenced by TV or media than boys'. Girls were more likely to internalize the thin body ideals on TV than boys,^{30, 50} which leads to gender differences in body weight overestimation and differences in the risk of adopting unhealthy dieting and poor eating quality.^{50, 51} In addition, advertisements and food brand appearances in TV programs could promote viewers' interest in and consumption of these products.^{52, 53} Our study did not find modification effect of TV-viewing on the association between weight status and dietary changes. This suggests TV-viewing effect on children's undesirable dietary changes may be independent of weight status. However, the TV-viewing association with undesirable dietary changes may offset obese/overweight children's dietary improvement, as children's weight status was associated with TV-viewing hour (Table 1).

To our knowledge, this is the first study exploring the relationship of children's dietary behavior changes with children's weight status and TV-viewing. Gender- and race/ethnicity-differences in children's weight-related dietary changes suggest intervention targets for childhood obesity prevention and control. Meanwhile, mass media such as TV could serve as an intervention target for specific subgroups. For example, girls and white children were more likely to have undesirable direction of dietary changes associated with a longer time of TV-viewing. How to design gender- and race/ethnicity-focused interventions will be one next important obesity research topic.

This study has several key strengths. First, this is a follow-up study in which the temporality between the explanatory variables and outcomes is clearer. Second, this study used nationally representative data. The findings could be generalizable to the US population as a whole. Moreover, ECLS-K's brief dietary questions were adapted from those in the YRBSS, enabling comparison to that survey as well as to other studies using that instrument.

This study also has weaknesses, mainly related to the limitations of the ECLS-K data. First, the dietary questionnaire is brief and only measured the frequency of consumption in the week prior to the interview; thus, it may not have measured children's usual eating patterns. However, overall FV intake measurement by this brief questionnaire was close to the FV intake measured by 24-hour dietary recall among high school students. Whether the same relationship exists with younger children needs validation.⁵⁴ Second, the self-report on dietary behaviors may be subject to information bias. Overweight/obese children may over-report healthier food consumption and under-report less healthy food consumption,⁵⁵ which is a measurement bias shared by all types of self-report-based dietary assessment tools. Third, children's satisfaction with their own weight status and their weight-change attempts were not measured. Therefore, it is unknown whether overweight/obese children's dietary improvement resulted from their intention to change weight. Nevertheless, our study indicates the behavioral tendencies among different weight status groups at large. Finally, although we tried hard to control for socioeconomic status, there could still be residual confounding from unmeasured factors or pathways, such as parents' weight status or the underlying genetic factors that associate children's weight status and the inclination to dietary changes.

In summary, this unprecedented study of children's dietary changes by weight status shows that overweight and obese American children were more likely to change their food consumption behaviors to eat healthier than their normal weight counterparts, i.e., consuming more fruits and vegetables and less fast food and soft drinks, especially among boys, blacks and Hispanic groups. However, television viewing was associated with worsened dietary behavior changes, which may hinder overweight/obese children's spontaneous dietary improvements. Therefore, messages delivered on TV would be important targets to intervene, with respect to preventing undesirable dietary behaviors disseminated on TV and to promoting overweight/obese children's potential voluntary dietary improvements.

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Table 1
Main characteristics and food consumption of US children by weight status at the 5th grade: ECLS-K^a 2004–2007

	N ^b	Characteristics and dietary behaviors by weight status ^c at 5 th grade											
		All			Normal weight (59.6%)			Overweight (18.7%)			Obese (21.7%)		
		Mean or %	SE	SE	Mean or %	SE	SE	Mean or %	SE	SE	Mean or %	SE	SE
Gender, boys (%)	8250	51.3	0.9	48.4	1.3	52.5	2.3	56.9	1.9	56.9	1.9	**	
Race/ethnicity (%)													
Asian	8230	3.1	0.3	3.5	0.4	2.3	0.4	3.0	0.4	3.0	0.4	***	
Black		16.9	1.1	15.6	1.3	18.1	2.1	18.6	1.9	18.6	1.9		
Hispanic		18.0	1.3	15.3	1.3	19.8	2.3	25.1	1.8	25.1	1.8		
Other		4.1	0.9	3.8	0.8	4.2	1.1	5.2	1.5	5.2	1.5		
White		58.0	1.7	61.8	1.8	55.6	2.7	48.1	2.4	48.1	2.4		
Age (Month)	8240	134.9	0.1	134.8	0.1	134.9	0.2	134.8	0.3	134.8	0.3		
TV time (Hr/day)	7870	3.1	0.03	2.9	0.04	3.1	0.1	3.5	0.1	3.5	0.1	***	
School transfer 5th-8th grade (%)	8210	85.0	1.1	85.1	1.1	84.8	1.7	84.8	1.8	84.8	1.8		
Dietary at 5th grade													
Five-a-day ^d (%)	8250	22.8	0.6	22.5	0.8	20.9	1.8	24.1	1.7	24.1	1.7		
Vegetables 3 times/day (%)	8250	16.5	0.6	16.5	0.8	14.3	1.8	18.4	1.5	18.4	1.5		
Fruits 2 times/day (%)	8250	33.9	0.9	34.4	1.1	30.6	1.8	35.3	2.0	35.3	2.0		
Fast-food 1 time/day (%)	8250	11.6	0.7	10.9	0.8	10.9	1.5	13.5	1.2	13.5	1.2		
Soft drinks 1 time/day (%)	8250	29.6	0.8	29.4	0.9	31.5	2.2	28.7	1.8	28.7	1.8		
Dietary at 8th grade													
Five-a-day ^d (%)	8250	20.0	0.8	19.6	0.9	19.9	1.7	21.1	1.6	21.1	1.6		
Vegetables 3 times/day (%)	8250	13.2	0.6	12.9	0.7	13.7	1.6	14.0	1.3	14.0	1.3		
Fruits 2 times/day (%)	8250	35.0	0.9	35.4	1.2	33.3	1.9	34.3	1.8	34.3	1.8		
Fast-food 1 time/day (%)	8250	7.9	0.5	8.4	0.6	7.0	1.1	6.9	1.2	6.9	1.2		
Soft drinks 1 time/day (%)	8250	27.4	0.9	27.5	1.2	27.4	2.2	26.3	1.7	26.3	1.7		

^aECLS-K: Early Childhood Longitudinal Study – Kindergarten cohort.

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^b Sample sizes rounded to the nearest 10 according to the ECLS-K requirement for restricted-use data, based on 8250 children with complete dietary data in both waves. SE: standard error of the population projected mean or percentage.

^c Weight status: normal weight (< 85th BMI-for-age percentile), overweight (85th and < 95th BMI-for-age percentile), and obese (95th BMI-for-age percentile)

^d Five-a-day: reported total vegetables and fruits consumption was 5 times/day. Dietary behaviors were assessed based on children's recall on food consumption in the previous week.

* p<0.05;

** p<0.01;

*** p<0.001. Chi-square (categorical variables) or ANOVA F-test (continuous variables) for difference across three weight status groups.

Table 2

Dietary behavioral change in US children by baseline weight status ^a; stratified by gender, race/ethnicity: ECLS-K 2004–2007

Weight status and dietary behaviors at baseline	Five-a-day ^b			Vegetables: 3 times/d			Fruits: 2 times/d			Fast-food: 1 time/d			Soft drinks: 1 time/d		
	%	SE	%	%	SE	%	%	SE	%	%	SE	%	%	SE	
(I) Among children without the food behavior at baseline: proportion of developing the dietary behavior															
All															
Obese	15.8	(1.8)	10.6	(1.4)	26.2	(2.2)	4.4	(1.0)	23.7	(2.2)					
Overweight	15.9	(1.8)	12.4	(1.7)	26.8	(2.4)	6.3	(1.3)	23.4	(2.3)					
Normal weight	16.4	(1.0)	10.5	(0.8)	30.2	(1.5)	6.9	(0.6)	21.8	(1.3)					
Boys															
Obese	16.6	(2.1)	11.7	(1.8)	25.7	(2.7)	4.6	(1.3)	23.5	(2.6)					
Overweight	16.6	(2.8)	12.9	(2.5)	27.8	(3.5)	7.3	(2.1)	21.1	(3.1)					
Normal weight	16.8	(1.3)	11.1	(1.1)	30.2	(2.1)	9.5	(1.1)	26.9	(1.9)					
Girls															
Obese	14.8	(2.6)	9.1	(1.7)	26.9	(3.5)	4.2	(1.3)	23.9	(3.4)					
Overweight	15.1	(2.8)	12.0	(2.6)	25.6	(3.4)	5.1	(1.3)	25.9	(3.0)					
Normal weight	16.1	(1.5)	9.9	(1.2)	30.2	(2.0)	4.6	(0.7)	17.4	(1.4)	**				
Black															
Obese	26.2	(6.4)	15.3	(4.2)	29.3	(6.3)	9.3	(4.3)	33.5	(6.5)					
Overweight	22.1	(5.2)	18.1	(5.4)	25.7	(6.5)	13.2	(3.9)	20.0	(5.9)					
Normal weight	23.7	(2.5)	13.3	(2.3)	41.4	(4.2)	20.8	(2.8)	33.8	(3.7)					
Hispanic															
Obese	12.0	(1.9)	7.6	(1.3)	27.0	(3.9)	4.7	(1.1)	20.4	(3.7)					
Overweight	16.6	(3.3)	12.3	(3.2)	36.8	(4.0)	11.1	(3.3)	29.6	(4.4)					
Normal weight	15.3	(2.2)	9.8	(1.8)	30.4	(3.2)	8.3	(1.3)	26.9	(2.7)	*				
White															
Obese	13.1	(2.0)	9.7	(1.7)	24.2	(2.8)	2.5	(1.0)	23.0	(2.5)					
Overweight	14.6	(2.5)	11.0	(2.2)	25.2	(3.3)	2.9	(1.1)	23.5	(3.0)					
Normal weight	14.3	(1.1)	9.6	(0.9)	27.5	(1.8)	4.0	(0.6)	18.7	(1.3)					
(II) Among children with the food behavior at baseline: proportion of discontinuing the dietary behavior															
All															

Weight status and dietary behaviors at baseline	Five-a-day ^b		Vegetables : 3 times/d		Fruits: 2 times/d		Fast-food: 1 time/d		Soft drinks: 1 time/d	
	%	SE	%	SE	%	SE	%	SE	%	SE
Obese	62.4	(3.8)	70.9	(4.3)	50.9	(3.0)	77.7	(6.3)	67.2	(3.6)
Overweight	65.0	(4.1)	78.9	(3.9)	51.8	(3.4)	86.5	(4.6)	63.8	(4.0)
Normal weight	69.2	(2.1)	75.0	(2.2)	54.6	(2.0)	79.7	(2.6)	58.6	(2.8)
Boys										
Obese	63.6	(5.4)	68.1	(5.9)	53.7	(4.1)	85.7	(5.1)	65.8	(5.0)
Overweight	62.2	(6.6)	83.1	(4.7)	45.8	(5.1)	87.2	(5.7)	54.3	(5.8)
Normal weight	69.2	(3.2)	78.0	(3.1)	54.1	(2.9)	80.6	(3.7)	54.7	(3.2)
Girls										
Obese	60.9	(5.7)	74.6	(6.2)	47.5	(4.8)	69.5	(10.2)	69.1	(5.3)
Overweight	68.3	(5.3)	73.7	(6.4)	57.5	(5.4)	85.8	(6.5)	74.3	(4.4)
Normal weight	69.3	(2.8)	71.9	(3.4)	55.1	(2.7)	78.6	(3.8)	63.3	(3.8)
Black										
Obese	70.8	(8.4)	85.0	(6.9)	51.2	(8.0)	51.8	(13.7)	74.1	(6.9)
Overweight	71.1	(7.3)	88.5	(4.4)	65.0	(10.7)	84.2	(9.6)	76.1	(8.6)
Normal weight	65.9	(6.1)	86.3	(3.7)	55.8	(5.4)	71.3	(5.9)	62.2	(6.3)
Hispanic										
Obese	57.9	(6.0)	69.8	(5.5)	43.9	(5.1)	77.4	(8.8)	79.4	(4.4)
Overweight	52.5	(8.8)	64.5	(9.7)	44.8	(7.0)	83.7	(9.3)	54.2	(7.4)
Normal weight	64.1	(4.6)	69.7	(5.3)	49.4	(3.9)	77.5	(4.8)	57.7	(4.6)
White										
Obese	60.7	(5.4)	64.9	(6.5)	55.9	(4.9)	95.7	(2.6)	57.6	(5.2)
Overweight	70.7	(6.0)	83.9	(4.6)	52.6	(5.3)	87.4	(6.4)	63.8	(4.9)
Normal weight	72.6	(2.7)	73.5	(3.6)	56.2	(2.4)	91.9	(2.7)	57.0	(3.4)

^aN=7720; 530 subjects were excluded from the sample (n=8250) due to missing values on TV-viewing hour or BMI-for-age percentile.

^bFive-a-day: reported total vegetables and fruits consumption was 5 times/day. Dietary behaviors were assessed based on children's recall on food consumption in the previous week.

* p<0.05;

** p<0.01. Wald's Chi-square testing for the distribution across three weight status groups

Table 3

Odds ratios (ORs) for developing the dietary behaviors at the 8th grade by baseline (at the 5th grade) weight status and TV-viewing, among US children without the dietary behaviors at baseline ^a; ECLS-K 2004–2007

n ^c =	Odds ratios of developing the outcome dietary behavior												
	Five-a-day ^b	Vegetables : 3 times/day	Fruits: 2 times/day	Fast food: 1 time/day	Soft drinks: 1 time/day	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
All													
Obese vs. normal	1.35 (0.81, 2.23)	1.34 (0.85, 2.09)	0.87 (0.59, 1.27)	0.47 (0.28, 0.76)	0.99 (0.72, 1.36)								
Overweight vs. normal	1.65 (1.14, 2.39)	1.92 (1.22, 3.02)	0.96 (0.69, 1.33)	0.77 (0.48, 1.24)	1.15 (0.85, 1.54)								
Per 1 more hour/day viewing TV	0.92 (0.79, 1.07)	0.94 (0.81, 1.08)	1.00 (0.89, 1.11)	1.03 (0.91, 1.15)	1.02 (0.93, 1.12)								
By gender:													
Boys													
Obese vs. normal	1.92 (1.02, 3.60)	1.69 (0.88, 3.26)	1.11 (0.71, 1.76)	0.39 (0.18, 0.81)	0.77 (0.50, 1.19) [*]								
Overweight vs. normal	2.41 (1.29, 4.50)	2.26 (1.14, 4.49)	1.20 (0.77, 1.87)	0.73 (0.39, 1.37)	0.79 (0.52, 1.22) ^{**}								
Per 1 more hour/day viewing TV	0.98 (0.77, 1.23)	1.00 (0.82, 1.22)	0.97 (0.85, 1.10)	0.93 (0.79, 1.09)	0.98 (0.87, 1.11)								
Girls													
Obese vs. normal	0.80 (0.34, 1.87)	0.95 (0.48, 1.88)	0.61 (0.33, 1.13)	0.61 (0.33, 1.12)	1.35 (0.91, 1.98)								
Overweight vs. normal	1.08 (0.65, 1.80)	1.66 (1.02, 2.69)	0.73 (0.47, 1.12)	0.81 (0.38, 1.75)	1.67 (1.14, 2.45)								
Per 1 more hour/day viewing TV	0.83 (0.69, 1.01)	0.84 (0.72, 0.98)	1.03 (0.89, 1.20)	1.18 (0.99, 1.39)	1.07 (0.95, 1.21)								
By race/ethnicity:													
Black													
Obese vs. normal	1.82 (0.38, 8.68)	2.61 (1.08, 6.29)	0.34 (0.10, 1.19)	0.37 (0.12, 1.13)	0.98 (0.48, 2.03)								
Overweight vs. normal	4.91 (1.002, 24.1)[*]	7.53 (2.18, 26.0)	0.77 (0.19, 3.06)	0.58 (0.25, 1.33)	0.53 (0.24, 1.17) [*]								
Per 1 more hour/day viewing TV	0.94 (0.61, 1.45)	0.79 (0.56, 1.11)	1.05 (0.80, 1.38)	0.99 (0.84, 1.16)	1.07 (0.88, 1.30)								
Hispanic													
Obese vs. normal	3.31 (1.20, 9.11)	2.05 (0.66, 6.32)	1.45 (0.76, 2.79)	0.62 (0.32, 1.21)	0.53 (0.31, 0.88)^{**}								
Overweight vs. normal	2.63 (1.17, 5.89)	3.47 (1.16, 10.4)	1.70 (0.91, 3.18)	1.64 (0.74, 3.64)	1.09 (0.63, 1.89)								
Per 1 more hour/day viewing TV	1.08 (0.79, 1.46)	1.01 (0.82, 1.25)	1.00 (0.82, 1.23)	0.97 (0.83, 1.14)	1.07 (0.90, 1.27)								
White													

	Odds ratios of developing the outcome dietary behavior															
	Five-a-day ^b	Vegetables: 3 times/day	Fruits: 2 times/day	Fast food: 1 time/day	Soft drinks: 1 time/day	Five-a-day ^b		Vegetables: 3 times/day		Fruits: 2 times/day		Fast food: 1 time/day		Soft drinks: 1 time/day		
n ^c	OR ^d	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Obese vs. normal	1.07	(0.52, 2.20)	1.13	(0.62, 2.06)	0.86	(0.52, 1.42)	0.50	(0.20, 1.25)	1.32	(0.88, 1.96)	0.56	(0.25, 1.22)	1.41	(0.96, 2.07)	0.96	(0.86, 1.08)
Overweight vs. normal	1.25	(0.74, 2.10)	1.30	(0.73, 2.33)	0.92	(0.59, 1.42)	0.56	(0.25, 1.22)	1.41	(0.96, 2.07)	0.96	(0.86, 1.08)	0.96	(0.86, 1.08)	0.96	(0.86, 1.08)
Per 1 more hour/day viewing TV	0.84	(0.69, 1.04)	0.95	(0.78, 1.15)	0.97	(0.83, 1.13)	1.05	(0.84, 1.32)	0.96	(0.86, 1.08)	0.96	(0.86, 1.08)	0.96	(0.86, 1.08)	0.96	(0.86, 1.08)

^a Logistic models were adjusted for child's gender, race/ethnicity, age, maternal employment status, family income, household food stamp reception, school transfer status between 5th and 8th grades, total food consumption, child's perceptions of school food environments.

^b Five-a-day: reported total vegetables and fruits consumption was 5 times/day. Dietary behaviors were assessed based on children's recall on food consumption in the previous week.

^c n: the number of children without the dietary behaviors at baseline.

^d Odds ratio; bolded OR is significantly different from 1.0.

* p<0.05;

** p<0.01: Testing the gender-interaction (comparing boys to girls) and race/ethnicity-interaction (comparing Black/Hispanic to White) terms in the logistic models

Table 4

Odds ratios (ORs) for discontinuing the dietary behaviors at the 8th grade associated with baseline (at the 5th grade) weight status and TV-viewing, among children having the dietary behaviors at baseline ^a; ECLS-K 2004–2007

n ^c =	Odds ratios of discontinuing the outcome dietary behavior									
	Five-a-day ^b		Vegetables : 3 times/d		Fruits: 2 times/d		Fast-food: 1 time/d		Soft drinks: 1 time/d	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Children with the food behavior at baseline										
All										
Obese vs. normal	0.50	(0.26, 0.95)	0.63	(0.34, 1.16)	0.61	(0.40, 0.92)	1.34	(0.59, 3.07)	1.43	(0.92, 2.24)
Overweight vs. normal	0.56	(0.32, 0.98)	1.06	(0.45, 2.49)	0.75	(0.45, 1.25)	1.46	(0.65, 3.25)	1.28	(0.74, 2.21)
Per 1 more hour/day watching TV	1.21	(1.01, 1.45)	1.11	(0.95, 1.31)	1.06	(0.95, 1.19)	1.00	(0.84, 1.20)	0.94	(0.85, 1.04)
By gender:										
Boys										
Obese vs. normal	0.51	(0.24, 1.06)	0.31	(0.13, 0.74)*	0.61	(0.34, 1.09)	1.07	(0.29, 3.89)	1.44	(0.82, 2.52)
Overweight vs. normal	0.80	(0.38, 1.68)	1.43	(0.35, 5.77)	0.66	(0.34, 1.29)	1.28	(0.40, 4.05)	0.85	(0.49, 1.48)*
Per 1 more hour/day watching TV	0.94	(0.75, 1.17)**	0.94	(0.74, 1.19)*	0.97	(0.83, 1.15)	1.21	(0.90, 1.64)	0.96	(0.84, 1.10)
Girls										
Obese vs. normal	0.46	(0.16, 1.30)	1.22	(0.52, 2.85)	0.60	(0.32, 1.13)	1.73	(0.66, 4.51)	1.41	(0.75, 2.64)
Overweight vs. normal	0.31	(0.13, 0.74)	0.76	(0.30, 1.91)	0.83	(0.40, 1.70)	1.39	(0.46, 4.14)	2.33	(1.02, 5.31)
Per 1 more hour/day watching TV	1.56	(1.20, 2.03)	1.38	(1.09, 1.75)	1.17	(1.00, 1.36)	0.82	(0.62, 1.09)	0.91	(0.78, 1.06)
By race/ethnicity:										
Black										
Obese vs. normal	4.55	(2.21, 96.76)	3.70	(0.49, 28.11)	1.16	(0.37, 3.66)	1.65	(0.41, 6.66)	1.19	(0.31, 4.55)
Overweight vs. normal	0.32	(0.05, 1.87)	0.25	(0.06, 0.96)*	1.23	(0.28, 5.34)	1.58	(0.45, 5.53)	2.00	(0.65, 6.23)
Per 1 more hour/day watching TV	1.39	(0.76, 2.55)	0.71	(0.49, 1.05)*	0.93	(0.71, 1.21)	0.92	(0.70, 1.21)	0.83	(0.69, 1.00)
Hispanic										
Obese vs. normal	0.35	(0.14, 0.87)	0.51	(0.13, 2.03)	0.39	(0.18, 0.87)	0.74	(0.18, 3.15)	3.31	(1.66, 6.58)**
Overweight vs. normal	0.27	(0.08, 0.92)	0.62	(0.09, 4.21)	0.60	(0.15, 2.42)	2.73	(0.57, 13.00)*	1.05	(0.48, 2.29)

Odds ratios of discontinuing the outcome dietary behavior											
n ^c	Five-a-day ^b		Vegetables : 3 times/d		Fruits: 2 times/d		Fast-food: 1 time/d		Soft drinks: 1 time/d		
	OR	d	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Per 1 more hour/day watching TV	1.34		(0.99, 1.82)	1.23	(0.87, 1.73)	1.07	(0.86, 1.33)	1.17	(0.84, 1.63)	1.18	(1.01, 1.38)*
White											
Obese vs. normal	0.33		(0.14, 0.77)	0.49	(0.23, 1.02)	0.60	(0.33, 1.10)	1.60	(0.26, 9.70)	1.15	(0.67, 1.98)
Overweight vs. normal	0.75		(0.38, 1.49)	1.93	(0.77, 4.82)	0.75	(0.43, 1.32)	0.35	(0.10, 1.21)	1.25	(0.66, 2.37)
Per 1 more hour/day watching TV	1.01		(0.80, 1.28)	1.31	(1.01, 1.69)	1.12	(0.94, 1.33)	1.07	(0.78, 1.46)	0.89	(0.77, 1.03)

^a Logistic models were adjusted for child's gender, race/ethnicity, age, maternal employment status, family income, household food stamp reception, school transfer status between 5th and 8th grades, total food consumption, child's perceptions of school food environments.

^b Five-a-day: reported total vegetables and fruits consumption was 5 times/day. Dietary behaviors were assessed based on children's recall on food consumption in the previous week.

^c n: number of children having the dietary behavior at baseline

^d Odds ratio; bolded OR is significantly different from 1.0.

* p<0.05,

** p<0.01: Testing the gender-interaction (comparing boys to girls) and race/ethnicity-interaction (comparing Black/Hispanic to White) terms in the logistic models