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# Association of Consumption of Fried Food Away From Home With Body Mass Index and Diet Quality in Older Children and Adolescents

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**ABSTRACT.** *Objectives.* Rates of overweight have increased dramatically among children in the United States. Although an increase in consumption of food prepared away from home has paralleled overweight trends, few data exist relating food prepared away from home to change in BMI in children. The goals of this study were to (1) examine the cross-sectional and longitudinal associations between consumption of fried foods away from home (FFA) and BMI and (2) examine the cross-sectional associations between intake of FFA and several measures of diet quality.

*Methods.* We studied a cohort of 7745 girls and 6610 boys, aged 9 to 14 years, at baseline in 1996. We obtained BMI from self-reported height and weight, measures of diet quality from a food frequency questionnaire, and weekly servings of FFA during the previous year. We performed linear regression analyses to assess the longitudinal associations between change in consumption of FFA on change in BMI, using data from three 1-year periods from 1996 through 1999. We also related consumption of FFA with intake of selected foods and nutrients at baseline.

*Results.* In cross-sectional analyses, adjusting for potential confounders, mean (SE) BMI was 19.1 (0.13) among children who ate FFA "never or <1/week," 19.2 (0.13) among those who responded "1 to 3 times/week," and 19.3 (0.18) among those who responded "4 to 7 times/week." In longitudinal multivariate models, increasing (over 1 year) consumption of FFA "never or <1/week" to "4 to 7/week" was associated with increasing BMI ( $\beta = 0.21 \text{ kg/m}^2$ ; 95% confidence interval: 0.03–0.39) compared with those with low consumption of FFA at baseline and 1 year later. At baseline, frequency of eating FFA was associated with greater intakes of total energy, sugar-sweetened beverages, and trans fat, as well as lower consumption of low-fat dairy foods and fruits and vegetables.

*Conclusions.* These data suggest that older children who consume greater quantities of FFA are heavier, have

greater total energy intakes, and have poorer diet quality. Furthermore, increasing consumption of FFA over time may lead to excess weight gain. *Pediatrics* 2005; 116:e518–e524. URL: [www.pediatrics.org/cgi/doi/10.1542/peds.2004-2732](http://www.pediatrics.org/cgi/doi/10.1542/peds.2004-2732); *fried food, obesity, diet quality.*

ABBREVIATIONS. FFA, fried foods away from home; CI, confidence interval.

Over the last 30 years, the prevalence of overweight has increased dramatically among children in the United States for reasons that remain incompletely understood.<sup>1</sup> Although the origin of childhood overweight is most likely influenced by a complex interplay of genetic, social, and environmental factors, several potentially toxic environmental and lifestyle patterns have emerged in recent years while the population has remained genetically stable. One prevalent dietary pattern that might contribute to the epidemic increase in overweight is the shift away from home-prepared food.

Increased consumption of food prepared away from home has paralleled the rise in overweight prevalence.<sup>2,3</sup> Consumption by 12- to 17-year-old adolescents of food prepared away from home increased from 20% and 22% of total energy intake in boys and girls, respectively, in the 1970s to 35% of total energy intake between 1994 and 1996.<sup>2</sup> The vast amount of this increase has resulted from a more than doubling of the energy consumed at restaurants and fast food establishments.<sup>4,5</sup> Greater consumption of foods prepared away from home may be associated with poorer diet quality among adolescents<sup>2,6</sup> and is usually accompanied by other unhealthy dietary properties such as large portion sizes<sup>7</sup> and high energy density,<sup>8</sup> which are known to contribute to body weight.<sup>9</sup> In addition, foods prepared away from home and fast foods are more likely to be fried, making them a common source of saturated and partially hydrogenated (trans) fat,<sup>10</sup> which is known to increase cardiovascular disease risk.<sup>11</sup> Despite this evidence in adolescents and studies in adults suggesting that increased consumption of food prepared away from home contributes to increased overweight<sup>12–14</sup> and body fatness,<sup>15</sup> few studies have related food prepared away from home to body weight<sup>6,16</sup> and diet quality in older children and adolescents,<sup>2,6,17</sup> and none has examined the effects of fried foods. The aims of this study were to exam-

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ine the cross-sectional and longitudinal associations between consumption of fried foods away from home (FFA) and BMI and to examine the associations between intake of FFA and several measures of diet quality in a large national sample of older children and adolescents.

## METHODS

### Study Population

The ongoing Growing Up Today Study, established in the fall of 1996, consists of 16 882 children who reside in 50 states and are offspring of Nurses' Health Study II participants. The study was designed to assess prospectively determinants of adolescent dietary intake, physical activity, and inactivity. We collect all data by means of annual mailed self-administered questionnaires.

Details of initial recruitment are available elsewhere.<sup>18</sup> The baseline 1996 sample included 8843 girls and 7650 boys, 9 to 14 years old. In the fall of 1997, 1998, and 1999, we mailed participants follow-up questionnaires to update all information. Response rates for girls were 81% in 1997, 87% in 1998, and 79% in 1999. Response rates in boys were 72% in 1997, 81% in 1998, and 68% in 1999. For the current analyses, we excluded 107 girls and 72 boys with conditions that affected their growth (juvenile rheumatoid arthritis, inflammatory bowel disease, and cerebral palsy). We excluded girls and boys who reported bingeing and/or purging behavior in all years to examine the association between fried food consumption and BMI among children with healthy weight control and activity behaviors. Bingeing was defined as eating a very large amount of food at least monthly and feeling out of control and unable to stop during the eating episodes. We defined purging as at least monthly use of laxatives or vomiting to control weight. We also excluded 327 girls and 493 boys who had missing or implausible physical activity levels and 408 girls and 377 boys who were missing BMI, had an outlying BMI,<sup>19</sup> or were missing fried food intake data. Thus, our final sample size was 7745 girls and 6610 boys. Human Subjects Committees at the Harvard School of Public Health and Brigham and Women's Hospital approved the study.

### Measurements

#### BMI

Children self-reported their heights and weights each year. Our questionnaire provided specific instructions for measuring height and weight but suggested asking someone to help. Previous studies reported high validity for self-reported heights and weights in preadolescents<sup>20</sup> and adolescents.<sup>21</sup> BMI was computed using the formula  $BMI = \text{weight}/\text{height}^2$  ( $\text{kg}/\text{m}^2$ ) from the heights and weights reported by children each year from 1996 to 1999.

#### Intake of FFA

On each questionnaire from 1996 through 1999, we asked, "How often do you eat fried food away from home (eg, French fries, chicken nuggets)?" Response categories to this question, which formed our exposure variable, were "never or less than once per week, 1 to 3 times per week, 4 to 6 times per week, and daily." Because the top category, "daily," was sparse, we grouped these individuals with those who reported "4 to 6 times per week" in our analyses.

We were interested in knowing whether fried food consumption away from home is a reasonable proxy for fast food consumption. In the 2001 Growing Up Today study questionnaire, in addition to the FFA question, we asked participants the question, "In the past year, on average, how often did you eat something from a fast food restaurant (McDonald's, Burger King, Taco Bell, etc)?" Response categories to this question were "never or less than once per month," "1 to 3 times per month," "once per week," "2 to 4 times per week," "5 to 6 times per week," and "once per day or more." Having both questions in the 2001 survey allowed us to establish whether a direct correlation existed between FFA and fast food consumption. We found the fast food and fried food questions to be moderately to strongly correlated (Spearman correlation coefficients = 0.58 for girls and 0.56 for boys among a sample of 4862 boys and girls), indicating that FFA is a reasonable proxy for fast food consumption.

### Diet Quality and Energy Intake

We chose our diet quality variables on the basis of current knowledge of food groups, nutrients, and dietary behaviors that are associated with increased or decreased risk for diseases of adolescence and adulthood, including iron-deficiency anemia, diabetes, osteoporosis, cardiovascular disease, and cancer.<sup>11,22-25</sup> To estimate food and nutrient intake, we used a self-administered semiquantitative food frequency questionnaire, designed by members of our group specifically for older children and adolescents.<sup>26</sup> This food frequency questionnaire for youths has been shown to be valid and reproducible.<sup>27</sup> It included questions regarding usual frequency of intake of 132 specific food items during the past year. Using nutrient composition databases, food portion sizes, and each child's reported intake of each food, we estimated daily intakes of dietary fiber, glycemic load, trans and saturated fat, fruit, vegetable, dairy, sugar-sweetened beverage, and red meat; multivitamin use; and total energy.

### Covariates

#### Physical Activity and Inactivity

We developed specifically for youths a physical activity questionnaire that asked the participants to recall the typical amount of time spent, within each season during the past year, in various activities and team sports.<sup>28</sup> We defined moderate activity as any activity assigned a metabolic value of <6, including baseball, biking, dancing, hard work outdoors, skateboarding, walking, gymnastics, exercises, and volleyball. Vigorous activity was any activity that was assigned a metabolic value of 6 or more, including basketball, hockey, swimming, in-line skating, soccer, tennis, jogging, football, and karate.<sup>29</sup> We computed each child's typical hours spent per week in total physical activity for each season and during the entire year. Estimates of total physical activity that exceeded 40 hours/week were excluded as implausible. For watching television and videos and for time spent playing video/computer games, children reported for each their typical hours per day, separately for weekdays and for weekends. Totals that exceeded 80 hours/week were excluded as implausible.

#### Other

At baseline, children reported their racial/ethnic group. Each year, children reported their Tanner maturation stage in 5 categories of pubic hair development using a validated self-rating measure,<sup>30</sup> and girls reported whether/when their menstrual periods began. Dieting was assessed with the question, "During the past year, how often did you diet to lose weight or to keep from gaining weight," adapted from the Youth Risk Behavior Surveillance System questionnaire.<sup>31</sup> The response categories were "never," "less than once a month," "1 to 3 times a month," "once a week," "2 to 6 times per week," or "every day."

### Statistical Analysis

We used linear regression models with estimation by generalized estimating equations<sup>32</sup> to examine (1) the cross-sectional relationship between consumption of FFA and BMI, adjusting for correlations among the small numbers of siblings in the cohort, and (2) the 3-year longitudinal relationship between change in consumption of FFA and change in BMI, adjusting for correlated observations. We also examined the cross-sectional relationship of consumption of FFA with baseline total energy intake and measures of diet quality. All models were fit separately for boys and girls; we combined results and adjusted for gender when gender-specific estimates were similar. We also assessed for effect modification by age by examining the relationship between consumption of FFA and BMI within 2 baseline age strata: 9 to 12 years and  $\geq 13$  years.

The cross-sectional multivariate models that predicted BMI included the main predictor of interest, servings per week of FFA as a categorical variable, unadjusted and adjusted for potential confounding factors. We considered 2 groups of confounders: sociodemographic and physical factors (including age, Tanner maturation stage, baseline height, race/ethnicity, and girls' menstrual status) and physical activity and inactivity. To examine the effects of these factors on the relationship between consumption of FFA and BMI, we sequentially entered these covariates into regression models of our outcome and main predictor.

In multivariate longitudinal analyses, we assessed the relationship between change in consumption of FFA and annual change in BMI by combining data from each of the three 1-year intervals from 1996, 1997, 1998, and 1999. All models adjusted for age and race/ethnicity, and to account for increases in BMI that typically occur during growth and maturation, we included height growth during the same year, menstrual history, Tanner stage, previous BMI z score, and nonlinear age trends. Models also adjusted for activity and inactivity during the year of BMI change. Finally, we included total energy intake and dieting in additional, separate models as hypothesized intermediaries in the pathway between change in consumption of FFA and change in BMI. If either of these factors was in the intermediate pathway, then we would expect the effect estimates to be attenuated when they are added separately to the models.

As secondary outcomes, we examined the cross-sectional relationships between baseline servings per week of FFA and measures of both diet quality and total energy intake. We adjusted all analyses for age, age<sup>2</sup>, and gender. We conducted all analyses using SAS, version 8.0 (SAS Institute, Cary, NC).

## RESULTS

### Participant Characteristics

Baseline characteristics of study participants are summarized in Table 1. Mean (SD) BMI in girls was 18.4 (3.1) kg/m<sup>2</sup> in 9- to 12-year-olds and 20.2 (3.1) kg/m<sup>2</sup> in 13- to 14-year-olds. Approximately 18% of 9- to 12-year-old girls and 14% of 13- to 14-year-old girls had a BMI >85th percentile according to US national reference data.<sup>33</sup> In boys, the mean (SD) BMIs were 19.2 (3.4) kg/m<sup>2</sup> in 9- to 12-year-olds and 19.3 (3.3) kg/m<sup>2</sup> in 13- to 14-year-olds. Thirty-one percent of 9- to 12-year-old boys and 15% of 13- to 14-year-old boys had a BMI >85th percentile. The cohort was 93.7% non-Hispanic white, reflecting the race/ethnicity representation of their mothers, who are participants in the Nurses' Health Study II.

### Consumption of Fried Food Away From Home

At baseline in 1996, 3.5% of girls and 6.0% of boys reported consuming 4 to 7 servings per week of FFA. Overall, girls and boys 13 to 14 years of age consumed more FFA than those between the ages of 9 and 12 years (Table 1). Approximately 3.1% of girls and 4.7% of boys aged 9 to 12 years consumed FFA 4 to 7 times a week compared with 4.4% of girls and 7.7% of boys aged 13 to 14 years ( $\chi^2 P = .01$  for girls and  $< .0001$  for boys). By 1999, the proportion of girls and boys who consumed 4 to 7 servings per week of FFA had more than doubled, to 7.5% and 12.7% for girls and boys, respectively. This increase was attributable to both increasing age and secular trend (data not shown).

### FFA and BMI at Baseline

After adjusting for age, gender, race/ethnicity, Tanner stage, menarche (girls), and physical activity and inactivity (TV/videos/video games), we found that BMI was greater across increasing categories of FFA. This observed trend was significant only for boys (Table 2).

In age-specific analyses, the observed direct relationship between consumption of FFA and BMI was apparently limited to girls and boys aged 9 to 12 years. Mean BMI (SE) was 18.8 (0.27) among 9- to 12-year-old girls who consumed FFA "never or <1/week," 19.0 (0.26) among those who responded "1 to 3 times/week," and 19.0 (0.35) among those who responded "4 to 7 times/week" (trend  $P = .06$ ). Among girls 13 to 14 years of age, mean BMI (SE) across the categories of consumption of FFA was 22.1 (0.87), 22.2 (1.28), and 20.4 (1.21), respectively (trend  $P = .47$ ). In 9- to 12-year-old boys, the corresponding values were 18.9 (0.19), 19.2 (0.19), and 19.5 (0.28; trend  $P = .001$ ). Among boys 13 to 14 years of age, mean BMI (SE) across the categories of consumption of FFA were 19.3 (0.48), 19.3 (0.48), and 19.1 (0.55), respectively (trend  $P = .68$ ).

### Consumption of FFA and Change in BMI at Follow-up

In longitudinal multivariate models using data from 1996, 1997, 1998, and 1999, children who increased their consumption of FFA from "never or <1/week" to "4 to 7/week" gained  $\sim 0.21$  kg/m<sup>2</sup> (95% confidence interval [CI]: 0.03–0.39). The reference group in the longitudinal analyses were children who consumed FFA "never or <1/week" at baseline and 1 year later. Estimates were similar for girls ( $\beta = 0.19$ ; 95% CI:  $-0.05$  to  $0.43$ ) and boys ( $\beta = 0.22$ ; 95% CI:  $-0.06$  to  $0.49$ ; Table 3). Children in the intermediate categories (those who consumed FFA "1–3/week" at baseline and either increased or decreased their consumption of FFA 1 year later) had only small, nonsignificant BMI changes over the 1-year period. The effect estimates for children who consumed FFA "1 to 3/week" at baseline and increased their FFA consumption to "4 to 7/week" 1 year later was  $-0.03$  (95% CI:  $-0.12$  to  $0.06$ ) and  $-0.04$  (95% CI:  $-0.09$  to  $0.02$ ) for those who decreased their FFA consumption to "never or <1/week" 1 year later.

Adjusting for total energy intake minimally reduced the overall estimate to  $0.19$  kg/m<sup>2</sup> (95% CI:  $0.01$ – $0.37$ ). Age group-specific analyses of these as-

**TABLE 1.** Baseline (1996) Values for 14 355 Growing Up Today Study Participants

Age, y	N	BMI, kg/m <sup>2</sup> (mean [SD])	Total Energy Intake, kcal/d (mean [SD])	Physical Activity, h/wk (mean [SD])	Inactivity, h/wk* (mean [SD])	Consume 4–7 Servings/Week of FFA, %	Tanner Stages 3–5†, %	Menstrual Periods Begun, %
Girls								
9–12	5460	18.4 (3.1)	2039 (630)	13.5 (8.1)	25.0 (14.2)	3.1	39.1	12.7
13–14	2285	20.2 (3.1)	2038 (627)	17.3 (9.1)	25.4 (15.1)	4.4	97.5	77.7
Boys								
9–12	4739	19.2 (3.4)	2285 (718)	16.5 (8.8)	30.8 (15.9)	5.5	44.3	–
13–14	1871	19.3 (3.3)	2318 (729)	19.1 (9.3)	33.1 (16.6)	7.2	53.4	–

\* Total hours per week watching television and videos and for time spent playing video/computer games.

† Tanner stage of pubic hair development.

**TABLE 2.** Baseline Adjusted BMI\* in Each Category of FFA for 7745 Girls and 6610 Boys Who Participated in the Growing Up Today Study.

Frequency of FFA	All (N = 14 355)		Girls (N = 7745)		Boys (N = 6610)	
	Participants, n (%)	BMI, mean (SE)	Participants, n (%)	BMI, mean (SE)	Participants, n (%)	BMI, mean (SE)
Never or <1/wk	5757 (40.1)	19.1 (0.13)	3515 (45.4)	19.0 (0.21)	2242 (33.9)	19.0 (0.18)
1–3/wk	7934 (55.3)	19.2 (0.13)	3961 (51.1)	19.1 (0.21)	3973 (60.1)	19.2 (0.18)
4–7/wk	664 (4.6)	19.3 (0.18)	269 (3.5)	19.1 (0.27)	395 (6.0)	19.3 (0.24)
Trend P		.002		.21		.02

\* Adjusted means calculated from generalized estimating equations (GEE) linear regression models with adjusting for correlations among siblings of the same gender and age, race/ethnicity, Tanner stage, menarche (girls), and physical activity and inactivity (TV/videos/video games).

**TABLE 3.** Multivariate Adjusted\* Annual Change in BMI Associated With Change in Consumption of FFA: Longitudinal Data From the 1996, 1997, 1998, and 1999 Growing Up Today Surveys

Previous Year Consumption of FFA	Change in BMI, kg/m <sup>2</sup> ( $\beta$ [95% CI]), Subsequent Year Consumption of FFA	
	Never or <1/Wk	4–7/Wk
All		
Never or <1/wk	0.0 (ref), N = 6494	0.21 (0.03 to 0.39), N = 222
4–7/wk	–0.03 (–0.25 to 0.19), N = 128	–0.09 (–0.22 to 0.05), N = 387
Girls		
Never or <1/wk	0.0 (ref), N = 4373	0.19 (–0.05 to 0.43), N = 113
4–7/wk	0.27 (–0.02 to 0.56), N = 65	0.05 (–0.15 to 0.25), N = 152
Boys		
Never or <1/wk	0.0 (ref), N = 2121	0.22 (–0.06 to 0.49), N = 109
4–7/wk	–0.31 (–0.62 to 0.00), N = 63	–0.12 (–0.39 to 0.06), N = 235

\* Estimates from GEE regression models adjusting for correlated observations, age, age<sup>2</sup>, race/ethnicity, baseline and follow-up menstrual status (girls) and Tanner stage, baseline height, annual change in height, previous BMI z score, physical activity and inactivity, and (in overall analyses) gender.

sociations revealed effect modification and differences in patterns among girls and boys. Girls who were aged 9 to 12 and increased their consumption of FFA from “never or <1/week” to “4 to 7/week” gained ~0.52 kg/m<sup>2</sup> (95% CI: 0.10–0.93) compared with 0.03 kg/m<sup>2</sup> (95% CI: –0.26 to 0.31) among girls  $\geq$ 13 years of age. Conversely, among boys, those who were  $\geq$ 13 years of age gained more weight ( $\beta$  = 0.46 kg/m<sup>2</sup>; 95% CI: 0.10–0.83) compared with boys 9 to 12 years of age ( $\beta$  = –0.04 kg/m<sup>2</sup>; 95% CI: –0.44 to 0.35).

Boys who decreased their consumption of FFA from “4 to 7/week” to “never or <1/week” decreased their BMI ( $\beta$  = –0.31; 95% CI: –0.62 to 0.00). However, in girls, decreasing consumption of FFA from “4 to 7/week” to “never or <1/week” seemed to be associated with weight gain ( $\beta$  = 0.27; 95% CI: –0.02 to 0.56) when compared with the referent group. Because of the possibility that girls in this category could have started dieting, which itself is related to weight gain in adolescence,<sup>34</sup> we adjusted for dieting in additional models. Adjustment did not attenuate the observed effect in girls ( $\beta$  = 0.28 kg/m<sup>2</sup>; 95% CI: –0.01 to 0.57).

#### Fried Food Consumption, Diet Quality, and Total Energy Intake

Table 4 shows intakes of selected foods and nutrients in each category of consumption of FFA at baseline. We found that participants who ate FFA reported higher intakes of total energy, whole dairy foods, sugar-sweetened beverages, red and pro-

cessed meats, and trans fat, as well as higher glyce-mic loads. They also consumed less low-fat dairy foods, fruits, and vegetables; had a lower ratio of polyunsaturated-to-saturated fats; and consumed fewer multivitamins.

#### DISCUSSION

In this study, we report associations between 1-year changes in consumption of FFA and weight gain among 9- to 14-year-old US adolescents. Our results show that adolescents who increased their consumption of FFA over 1 year gained weight over and above the expected gain from normal growth and maturation during the adolescent period. We also observed that cross-sectionally, adolescents who consumed greater amounts of FFA were heavier and were more likely to have poorer diet quality.

Our results confirm and extend a small literature among adolescents and adults relating consumption of food away from home to weight and weight gain. In the only longitudinal study in adolescents that examined the relationship between foods purchased away from home and change in BMI z score, Thompson et al<sup>16</sup> found that adolescent girls who ate food purchased away from home twice a week had greater mean increase in BMI z score compared with those who ate food purchased away from home once a week or not at all. The study was limited, however, by a small sample size (N = 101) and including only girls. In other studies of adults, consumption of foods purchased away from home in restaurants or fast food outlets was associated with increased body

**TABLE 4.** Intake of Selected Foods and Nutrients at Baseline (1996), By Category of Consumption of FFA, Among 14 355 Girls and Boys Aged 9 to 14 Years From the Growing Up Today Study

Food/Nutrient	Frequency of Consumption of FFA*			Trend <i>P</i>
	Never ( <i>N</i> = 5757) Mean (±SE)	1–3/Wk ( <i>N</i> = 7934) Mean (±SE)	4–7/Wk ( <i>N</i> = 664) Mean (±SE)	
Total energy intake, kcal	2024 (8.9)	2198 (7.9)	2446 (29.0)	<.0001
% of energy intake from total fat	29.3 (0.07)	31.3 (0.05)	33.2 (0.16)	<.0001
% of energy intake from trans fat	1.63 (0.006)	2.18 (0.005)	2.96 (0.02)	<.0001
% of energy intake from saturated fat	10.5 (0.03)	11.2 (0.02)	11.8 (0.08)	<.0001
Ratio of polyunsaturated/saturated fats	0.57 (0.002)	0.54 (0.002)	0.53 (0.005)	<.0001
Dietary fiber, g	16.7 (0.09)	16.8 (0.07)	17.1 (0.25)	.11
Glycemic load/4200 kJ	13 916 (66.8)	15 098 (60.0)	16 577 (221.1)	<.0001
Fruits and vegetables, servings/d†	2.46 (0.02)	2.22 (0.02)	2.08 (0.06)	<.0001
Skim or 1% dairy foods, servings/d	1.34 (0.02)	1.23 (0.02)	1.17 (0.06)	<.0001
Whole dairy foods, servings/d	0.49 (0.01)	0.53 (0.01)	0.63 (0.03)	<.0001
Sugar-sweetened beverages, servings/d	1.94 (0.03)	2.43 (0.02)	2.85 (0.08)	<.0001
Red and processed meats, servings/d	0.64 (0.006)	0.75 (0.005)	0.88 (0.02)	<.0001
Multivitamin use, <i>n</i> /wk	2.25 (0.04)	2.14 (0.03)	2.05 (0.11)	.02

\* Least square means adjusted for age and gender.

† Potatoes, potato salad, potato chips, or French fries are not included in the calculation of vegetable intake.

fatness.<sup>12,15,35</sup> Finally, consumption of fast food was associated directly with body weight and insulin resistance over 15 years among young black and white adults.<sup>36</sup> In our study of >14 000 girls and boys, we found not only cross-sectionally that greater consumption of FFA was evident in heavier adolescents but also that increasing consumption of FFA over time led to an increase in BMI.

Several factors related to consumption of FFA may increase risk for weight gain. First, as we observed in this study and as others have shown, consumption of food prepared away from home is associated with higher energy intake.<sup>2</sup> In our study, we also found that the relationship between increasing consumption of FFA and weight gain was partially mediated by total energy intake. Excessive weight gain in children and adolescents results from an imbalance between energy intake and expenditure, and previous studies have found a strong relationship between total energy consumed and adiposity.<sup>37</sup> Second, the high energy density and palatability of fat in fried food may promote excess weight gain through overconsumption. In addition, high levels of dietary fat have been associated with greater adiposity in some studies.<sup>38–40</sup> Third, portion sizes of foods eaten away from home have markedly increased since the late 1970s. A recent study of food portion sizes has found that the largest portions of food are consumed at fast food establishments.<sup>7</sup> Although we did not study fast food directly, our measure of FFA was a reasonable proxy for fast food consumption and therefore may share some of the qualities found in fast food, including portion size. Evidence in children suggests that large portion sizes may contribute to overeating as children respond less to internal satiety cues than to environmental stimuli.<sup>41</sup>

We observed both age- and gender-specific differences in the relationship between consumption of FFA and BMI. In both cross-sectional and longitudinal analyses, the direct association between consumption of FFA and BMI was greatest among the youngest girls. This finding could be important in developing effective interventions to prevent exces-

sive weight gain during this period of adolescence. Also among girls, we observed that those who decreased their consumption of FFA over a 1-year period seemed to gain weight. One possible explanation for the apparent weight gain among girls who decreased their consumption of FFA is that they very recently eliminated fried food because of weight gain. Another explanation for this finding is that girls who decreased their consumption of FFA had started dieting, which itself is related to weight gain among adolescents. However, we did not observe any effect modification by history of dieting.

Adolescents in our study who consumed FFA more frequently reported higher total energy intakes, intakes of saturated and trans fats, sugar-sweetened beverages, and red and processed meats and higher glycemic loads. They also reported lower intakes of foods and nutrients that reflect diet quality, such as fruits and vegetables. These results are consistent with those of 3 previous studies that found that consumption of food prepared away from home has an adverse effect on adolescents' diet quality.<sup>6,17,42</sup> Our findings suggest that consumption of FFA is associated with dietary patterns related to excessive weight gain (eg, consumption of sugar-sweetened beverages<sup>43,44</sup>), atherosclerotic heart disease (eg, high consumption of trans and saturated fats<sup>11</sup>), cancer (eg, low consumption of fruits and vegetables<sup>45</sup>), and type 2 diabetes (eg, high glycemic load<sup>25</sup>). These findings suggest that early educational efforts to reduce consumption of food prepared away from home may help to prevent excessive weight gain and chronic disease risk in youths.

In addition to its prospective design, our study has several strengths, including a larger sample size than previous studies, the ability to examine both BMI and diet quality together, and the ability to control for sociodemographic and other previously identified predictors of weight gain in children. Our study, however, should be interpreted keeping in mind several limitations. We measured consumption of FFA and not fast food consumption or food purchased away from home directly. Second, although we ob-

served cross-sectional and longitudinal associations between consumption of FFA and BMI, these associations were inconsistent across age and gender. Third, we used self-reported heights and weights to calculate BMI. Because overweight individuals underreport weight more than nonoverweight individuals, this could lead to a differential misclassification. Finally, although the participants in this study come from all 50 US states, generalizability may be limited because the participants are sons and daughters of registered nurses and the cohort is >90% white.

## CONCLUSION

In this prospective study, we found that children who increase their consumption of FFA tend to gain weight. Although the effect may seem small, it is of practical significance because it is the effect of 1 year of intake of FFA. Our study suggests that eating large quantities of FFA, year after year, accumulates to larger weight gains that are clinically significant. Findings from this and other recent studies suggest that consumption of FFA and fast foods may have pernicious effects on body weight and diet quality. Clinicians should consider encouraging adolescents to limit their intake of food prepared away from home and encourage them to eat family dinners together, the benefits of which seem to include improved diet quality and reduced high-risk adolescent behaviors such as tobacco, alcohol, and marijuana use.<sup>46</sup> In addition, because families may eat dinners together but away from home in fast food outlets or restaurants, one public health strategy for promoting adolescent weight maintenance may be to increase nutrition education for adolescents and their parents on the importance of a well-balanced diet.

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## Association of Consumption of Fried Food Away From Home With Body Mass Index and Diet Quality in Older Children and Adolescents

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