Differential associations of fast food and restaurant food consumption with 3-y change in body mass index: the Coronary Artery Risk Development in Young Adults Study[1–3]

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ABSTRACT

Background: Away-from-home food consumption has rapidly increased, though little is known about the independent associations of restaurant food and fast food intake with body mass index (BMI) and BMI change.

Objective: The aim was to compare the associations of restaurant food and fast food consumption with current and 3-y changes in BMI.

Design: Multivariate linear regression models, with control for demographic and lifestyle factors, were used to examine cross-sectional and longitudinal associations of away-from-home eating with BMI by using data from subjects of the Coronary Artery Risk Development in Young Adults Study ($n = 3394$) obtained at exam years 7 (1992–1993) and 10 (1995–1996).

Results: Forty percent of the sample increased their weekly consumption of restaurant or fast food, though mean (±SD) changes were -0.16 ± 2.39 times/wk ($P = 0.0001$) and -0.56 ± 3.04 times/wk ($P < 0.0001$), respectively. Cross-sectionally, fast food, but not restaurant food, consumption was positively associated with BMI. Similarly, higher consumption of fast food at year 7 was associated with a 0.16-unit higher BMI at year 10. After adjustment for baseline away-from-home eating, increased consumption of fast food only (β: 0.20; 95% CI: 0.01, 0.39) and of both restaurant food and fast food (β: 0.29; 95% CI: 0.06, 0.51) were positively associated with BMI change, though the estimates were not significantly different ($P = 0.47$). Increased consumption of restaurant food only was unrelated to BMI change (β: -0.01; 95% CI: -0.21, 0.19), which differed significantly ($P = 0.014$) from the estimate for an increase in both restaurant food and fast food intake.

Conclusions: We found differential effects of restaurant food and fast food intakes on BMI, although the observed differences were not always statistically significant. More research is needed to determine whether the differential effects are related to consumer characteristics or the food itself. *Am J Clin Nutr* 2007;85:201–8.

KEY WORDS Energy intake, fast food, restaurant, body weight change, body mass index, young adults

INTRODUCTION

Substantial evidence suggests that the increase in prevalence and incidence of obesity in early adult years continues into late adulthood (1–4). Although the explanatory role of diet on these trends is not completely clear, the past several decades can be characterized by considerable shifts in energy density and increased energy intake in this age group, particularly because fast food has assumed a larger role in provision of daily energy intake (5). Additionally, there has been a significant increase in the percentage of away-from-home food consumption (5–7), which now provides anywhere from 30–42% of total daily calories. Consumption is particularly high among young adults (8). Typically, away-from-home food, defined as food obtained from fast food or traditional sit-down family style restaurants, is higher in total and saturated fat, total calories, and cholesterol (8–10).

Increased consumption of food prepared outside the home has occurred concurrently with rapid weight gain. Many studies, some small in scale, have shown positive associations between the frequency of fast food consumption and body fatness, weight gain, overweight or obesity (3, 10–17), and total energy intake (8, 11, 13, 18) among both adolescents and adults. Longitudinal studies have also provided evidence that fast food adversely affects weight and weight gain among black and white men and women (11, 18).

A limitation common to these studies is that they either do not distinguish between fast food and other restaurant food sources (3, 19) and instead group all food obtained away-from-home into a single category or they only examine fast food and not other

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restaurant food (11, 13, 15–18). One study examined trends in portion sizes for fast food, restaurant food, and at-home foods and found a much larger increase in portion sizes for fast food than restaurant-prepared identical food items (20). With limited information regarding the nutritional differences between fast food and other restaurant food sources, the results from studies that do not distinguish between the 2 may not be appropriately capturing the associations between away-from-home eating and energy intake or weight gain.

The present study was designed as an attempt to examine the independent associations of restaurant food and fast food consumption with change in body mass index (BMI) over a 3-y period with the use of data from US black and white young adults. We will build on previous work with this population that examined BMI associations with fast food only (18). To address our aims, we will assess the following: *1*) the cross-sectional associations of year 7 (and year 10) fast food and restaurant food consumption with year 7 (and year 10) BMI, *2*) year 7 restaurant food and fast food consumption on year 10 BMI, *3*) the change in restaurant food and fast food consumption on change in BMI, and finally *4*) the effect of increasing weekly consumption of fast food compared with restaurant food relative to increases in both restaurant and fast food use.

SUBJECTS AND METHODS

Study sample

The Coronary Artery Risk Development in Young Adults (CARDIA) Study is a prospective epidemiologic study of the determinants and evolution of cardiovascular disease risk factors among young adults. Participants were recruited from 4 urban areas including Chicago, IL; Birmingham, AL; Minneapolis, MN; and Oakland, CA. Specific recruitment procedures are described elsewhere (21). At baseline (1985–1986), 5115 eligible participants aged 18–30 y were enrolled with balance according to age, sex, ethnicity, and education. Follow-up examinations were conducted in 1987–1988 (year 2), 1990–1991 (year 5), 1992–1993 (year 7), 1995–1996 (year 10), and 2000–2001 (year 15) with retention rates of 90%, 86%, 81%, 79%, and 74%, respectively. For the present study, data from exam years 7 and 10 were used. These are the only 2 CARDIA exams to incorporate a measure of restaurant food consumption patterns along with a measure of fast food consumption patterns. Both time points included detailed assessments of typical cardiovascular disease risk factors, dietary and physical activity patterns, and medical and family histories. Persons with no missing values data for outcome, exposure, or any covariate were used in the present analysis for a final sample size of 3394 persons.

Exposure and outcome measures

Body mass index

Our 2 primary outcomes of interest were BMI at years 7 and 10 and change in BMI from year 7 to year 10. We used BMI as an indicator of body mass (and body mass change) to account for differences in height among persons. For anthropometric measures, the participants were standing and dressed in light clothing. Weight was measured to the nearest 0.2 kg by using a calibrated balance beam scale, and height was measured with a vertical ruler to the nearest 0.5 cm. BMI was calculated as weight (in kg)/ height^2 (in m) by using these measured height and weight values. The use of weight and weight change as the outcome measure in these analyses did not significantly affect results; therefore, BMI is presented here. Change in BMI was treated as a continuous variable and calculated as the difference between the 2 measurements. All conversions from BMI to kg are based on one BMI unit equal to 7.0 pounds for a person measuring 70 inches (177.8 cm) tall.

Away-from-home eating

Away-from-home eating habits, including frequency and location, were assessed at years 7 and 10, which were the only CARDIA exams to include both restaurant food and fast food measures. Consumption of fast food was quantified from participant responses to the following question: "How often do you eat breakfast, lunch, or dinner in a place such as McDonald's, Burger King, Wendy's, Arby's, Pizza Hut, or Kentucky Fried Chicken?" Questions were open ended but calculated to reflect a per-week frequency. Restaurant food consumption was assessed with the question: "How many times in a week or month do you eat breakfast, lunch, or dinner at a restaurant or cafeteria?" Again, responses were calculated to reflect a per-week frequency. From the year-specific frequencies, a measure of continuous change was calculated for fast food and restaurant food use independently by subtracting year 7 values from those obtained at year 10.

In addition to the continuous measure of change in away-from-home food consumption, we examined the effects of increasing, compared with maintaining or decreasing, consumption of restaurant food, fast food, or both over the 3-y period. Four mutually exclusive categories were created. Persons were classified as increasing fast food (or restaurant food) intake if year 10 intake was greater than that at year 7. If both restaurant and fast food intakes were greater at year 10 than year 7, the person was classified as increasing both. Persons who either maintained or decreased consumption of either food source served as the referent group.

Additional covariates

Standardized questionnaires were used at both exam years to ensure consistency in the assessment of demographic factors, including race, sex, age, and education. Level of education, assessed as the highest grade completed, ranged from 6 y to ≥20 y and was treated as a continuous measure. Smoking status was quantified as ever smoked within study period compared with never smoked and included smoking cigarettes, pipes, or cigars. Separating current and former smokers did not significantly affect the results. Family structure was defined by using mutually exclusive categories including the following: *1*) single, no children; *2*) married or living as married, no children; *3*) single with children; and *4*) married or living as married with children. The CARDIA physical activity questionnaire assessed the usual participation, in minutes per week, of leisure, occupational, and household physical activity over the past year. In the present study, a measure of total physical activity, expressed as Exercise Units (EU; a product of intensity × frequency) was used to quantify the activity level.

Statistical analysis

All statistical analyses were carried out with the use of STATA version 9 (Stata Corp, College Station, TX). Descriptive statistics were computed for frequency of eating at restaurants and fast food facilities, total energy intake, and demographic variables; percentages were calculated for categorical variables and means and standard errors for continuous variables.

We used multivariate linear models to estimate the cross-sectional and longitudinal association between fast food or restaurant use and BMI. For the year-specific, cross-sectional estimates and estimates of the association between year 7 fast food and restaurant intake and year 10 BMI, we regressed fast food and restaurant food intake (continuous) on BMI (continuous) with control for demographic [including race (black compared with white), sex, age (continuous), education (continuous), family structure (married with no children, single with children, and married with children compared with single), and study center (AL, IL, and MN compared with CA, which was the referent)] and lifestyle [including physical activity (continuous Exercise Units per day)] factors, baseline calories (except for year 10 cross-sectional model), and smoking status (smoked within study period compared with never smoked). Interactions between fast food and restaurant intake and race and sex were tested by including the appropriate cross-product terms in the model. Likelihood ratio tests were nonsignificant and interaction terms were subsequently removed. Backward elimination of lifestyle and demographic factors, including a race × sex interaction, resulted in a >10% change in the estimated effect measures; thus, all initial variables were retained in these cross-sectional models. These cross-sectional models were used to investigate whether increasing fast food compared with restaurant food consumption may have differential associations with change in BMI over time.

We then estimated the longitudinal association of change in restaurant food and fast food intake with change in BMI using both fully continuous and categorical measures of exposure. The continuous model assessed the relation between change in restaurant and fast food intake (continuous) and change in BMI (continuous), whereas the categorical exposure model assessed the association of increased fast food consumption, increased restaurant food consumption, or an increase in both restaurant food and fast food consumption (compared with the referent category: neither fast food consumption nor restaurant food consumption increased) with change in BMI (continuous). Initially, the models had control for race, sex, age, and study center and for baseline measures of education, total caloric intake, physical activity, family structure (as noted above), and smoking status. Inclusion of baseline exposure values (per week consumption of restaurant food and fast food) resulted in a >10% change in the estimated effect measures for fast food and restaurant food intake and were thus retained in the final model.

Effect measure modification by race and sex on the longitudinal relation between fast food and restaurant intake and BMI was examined by entering the appropriate cross-product terms and performing a likelihood ratio test. All tests were nonsignificant, and these cross-product terms were subsequently removed. Demographic and lifestyle covariates were removed from the model by using backward elimination if removal did not result in >10% change in either the fast food or restaurant food estimate.

Because the question regarding restaurant food intake included allowance for cafeteria eating, we ran various tests to determine whether there was an association between the reported restaurant frequency and currently being in school, which is a frequent venue for cafeteria eating. Inclusion of an "in school" variable at both years 7 and 10 and interaction between "in school" and restaurant frequency did not significantly change estimates and were removed for the sake of parsimony. We further tested the effects of being in school by excluding persons <24 y of age at year 7 and 27 y at year 10, which we determined to be an appropriate age for completion of undergraduate schooling, when cafeteria use would most likely be at its peak. Our estimated measures of effect remained unchanged, thus all participants were used in the final analysis.

RESULTS

Descriptive characteristics

Basic demographic and dietary characteristics for each study year are presented in **Table 1**. The sample was approximately equally balanced with respect to race and sex. Over the 3-y period, there was an increase in the mean BMI as well as in the percentage overweight and percentage obese, with more than twice as many people increasing than decreasing BMI. Fast food and restaurant food consumption were both positively skewed; mean restaurant food intake was slightly higher than fast food intake. Mean (±SD) change in restaurant food and fast food intakes were −0.16 ± 2.4 and −0.54 ± 3.05 times/wk, respectively. Compared with those who increased both fast food and restaurant food consumption [$\bar{x}$ (±SE) change: 17% ± 0.006%], more people increased either fast food (24% ± 0.007%) or restaurant food (23% ± 0.007%) consumption only.

Cross-sectional and year 7 intake with year 10 BMI models

As justification for assessing associations between change in away-from-home food consumption and change in BMI, we examined the cross-sectional associations with fast food and restaurant intake at Year 7 and Year 10. As shown in **Table 2**, the cross-sectional estimates of the year-specific frequencies of restaurant and fast food intake with BMI are oppositional. For both Year 7 and 10, fast food consumption was positively associated with BMI in the corresponding year: each one unit increase in fast food consumption (1 time/wk) was associated with a 0.13 increase in BMI at year 7 (β: 0.13; 95% CI: 0.04, 0.22; $P = 0.003$) and a 0.24 increase in BMI at year 10 (β:0.24; 95% CI: 0.13, 0.34; $P = 0.0001$). Conversely, for each increase in restaurant consumption of 1 time/wk, the estimated decrease in BMI was minimal and nonsignificant (β −0.02; 95% CI: −0.09, 0.04; $P =$ 0514 for year 7; β: −0.02; 95% CI: −0.11, 0.08; $P = 0.756$ for year 10). At both years these estimates were statistically different from one another (year 7, $P = 0.006$; year 10, $P = 0.0013$).

Results estimating the association between year 7 away-from-home consumption and year 10 BMI are also presented in Table 2. The effect estimates were similar in direction and magnitude to the cross-sectional models. A one unit increase in fast food consumption (1 time/wk) at year 7 was associated with an increase in year 10 BMI (β: 0.16; 95% CI: 0.06, 0.25; $P = 0.001$). On the other hand, for each increase in restaurant food consumption of 1 time/wk, there was an estimated decrease in year 10 BMI, though the effect was minimal and nonsignificant (β: −0.02; 95% CI: −0.08, 0.05; $P = 0.676$).

TABLE 1
Basic characteristics of the study population of 3394 black and white young adults

	Year 7 (1992–1993)	Year 10 (1995–1996)	Change from years 7–10
Men (%)[1]	45.6 ± 0.009	No change	—
Black (%)[1]	46.5 ± 0.009	No change	—
Age (y)[2]	25.1 ± 3.6	28.1 ± 3.6[3]	—
Education (%)[4]			
Less than high school[1]	5.5 ± 0.004	5.8 ± 0.004	—
High school degree[1]	21.9 ± 0.007	21.8 ± 0.007	—
More than high school[1]	72.6 ± 0.008	72.3 ± 0.008	—
Physical activity (units/wk)[2,5]	340.93 ± 273.9	333.6 ± 274.8	−7.56 ± 238.7[6]
Smoking status (%)			
Ever smoked within study period[1]	41.9 ± 0.008	41.3 ± 0.008	—
Never smoked[1]	58.1 ± 0.008	58.3 ± 0.008	—
Weight status			
BMI (kg/m^2)[2]	26.7 ± 6.1	27.5 ± 6.4	—
Overweight (%)[2]	30.6 ± 0.008	33.0 ± 0.008	—
Obese (%)[2]	23.3 ± 0.007	26.4 ± 0.008	—
Change	—	—	0.73 ± 2.12[7]
Subject with an increase >1 BMI unit (%)[1]	—	—	39.6 ± 0.008
Subject with a decrease >1 BMI unit (%)[1]	—	—	14.2 ± 0.006
Away-from-home eating			
Fast food[8]			
Never (%)[1]	19.0 ± 0.007	18.0 ± 0.007	—
<1 time/wk (%)[1]	28.3 ± 0.008	25.7 ± 0.008	—
1 to <2 times/wk(%)[1]	15.5 ± 0.006	18.0 ± 0.007	—
≥2 times/wk (%)[1]	37.01 ± 0.008	38.3 ± 0.008	—
Frequency (times/wk)[2]	1.89 ± 2.43[9]	1.73 ± 2.02[10]	−0.16 ± 2.41[7]
Increased (%)[1]	—	—	40.2 ± 0.008
Decreased (%)[1]	—	—	39.4 ± 0.008[11]
Restaurant[12]			
Never (%)	14.9 ± 0.006	10.2 ± 0.008	—
<1 time/wk (%)[1]	24.1 ± 0.007	28.7 ± 0.008	—
1 to <2.6 times/wk (%)[1]	26.2 ± 0.008	30.7 ± 0.008	—
≥2.6 times/wk (%)[1]	34.8 ± 0.008	30.5 ± 0.008	—
Frequency (times/wk)[2]	2.61 ± 3.11	2.07 ± 2.26	−0.84 ± 3.04[7]
Increased (%)[1]	—	—	39.5 ± 0.008
Decreased (%)[1]	—	—	46.4 ± 0.009

[1] All values are $\bar{x}$ ± SE.
[2] All values are $\bar{x}$ ± SD.
[3] Estimated from values obtained at year 7.
[4] Self-reported education; categorical by highest grade completed by year 7.
[5] Measured in exercise units/wk. This measure was derived for use with the Coronary Artery Risk Development in Young Adults data and reflects a combination of weekly participation in moderate to vigorous activities.
[6] $P = 0.0651$ (Student's t test).
[7] $P \leq 0.0001$ (Student's t test).
[8] Self-reported weekly frequency of fast food consumption. Derived from the question, "How often do you eat breakfast, lunch, or dinner in a place such as McDonald's, Burger King, Wendy's, Arby's, Pizza Hut, or Kentucky Fried Chicken?"
[9] Statistically different from times per week for eating at restaurant at year 7, $P \leq 0.0001$ (Student's t test).
[10] Statistically different from times per week for eating at restaurant at year 10, $P \leq 0.0001$ (Student's t test).
[11] Statistically different from percentage decrease in restaurant food intake, $P < 0.0001$ (two-sample test of proportion).
[12] Self-reported weekly frequency of restaurant food consumption. Derived from the question, "How many times in a week or month do you eat breakfast, lunch, or dinner at a restaurant or cafeteria?"

Longitudinal change models

Results of a comparison of change in restaurant food and fast food consumption with change in BMI are presented in **Table 3**. Once again, results are similar to those observed in the cross-sectional models. Increased consumption of fast food was associated with a positive increase in BMI change over the 3-y period (β: 0.0488; 95% CI: 0.01, 0.09; P = 0.016). Increased restaurant food consumption, however, was not associated with changes in BMI over the same time period (β:-0.001; 95% CI: −0.04, 0.03, 0.09; P = 0.960), and this estimate was not statistically different from the estimated change in BMI associated with increase fast food consumption at the 0.05 level (P = 0.081). Estimates for all covariates are included in **Appendix A**.

The estimated associations between change in BMI and categorical change in away-from-home consumption are presented

TABLE 2
Comparison of estimated associations of fast food and restaurant food consumption with BMI (dependent variable) for 3394 black and white young adults

	Cross-sectional				Year 7 exposure with year 10 outcome[3]	
	Year 7[1]		Year 10[2]			
Measure	Fast food	Restaurant food	Fast food	Restaurant food	Fast food	Restaurant food
Change in BMI (BMI unit)	0.13 ± 0.04[a]	−0.02 ± 0.03[b]	0.24 ± 0.05[a]	−0.02 ± 0.05[b]	0.16 ± 0.05[a]	−0.02 ± 0.04[b]
P	0.003	0.514	0.0001	0.756	0.0001	0.676
95% CI	0.044, 0.216	−0.089, 0.044	0.13, 0.35	−0.113, 0.082	0.065, 0.247	−0.085, 0.055

[1] Regression model with year 7 BMI predicted by fast food and restaurant food consumption at year 7 with control for race (white compared with black), sex, age (continuous), study center (IL, AL, or MN); year 7 education (continuous; in y), income (<\$12 000, \$12 000–\$24 999, or ≥\$50 000), physical activity (continuous; in units/d), total calories (continuous), family structure (married, single with children, or married with children), smoking status (ever smoked within study period compared with never smoked), and a race-by-sex interaction. Estimates by year with different superscript letters are significantly different, $P = 0.0057$ (Wald significance test).

[2] Regression model with year 10 BMI predicted by fast food and restaurant food consumption at year 10 with control for race (white compared with black), sex, age (continuous), study center (IL, AL, or MN), year 10 education (continuous; in y), income (<\$12 000, \$12 000–\$24 999, or ≥\$50 000), physical activity (continuous; in units/d), family structure (married, single with children, or married with children), smoking status (ever smoked within study period compared with never smoked), and a race-by-sex interaction. Estimates by year with different superscript letters are significantly different, $P = 0.0013$ (Wald significance test).

[3] Regression model with BMI at year 10 predicted by fast food and restaurant food consumption at year 7 with control for race (white compared with black), sex, age (continuous), study center (IL, AL, or MN), and the following baseline (exam year 7) characteristics: education (continuous; in y), income (<\$12 000, \$12 000–\$24 999, or ≥\$50 000), physical activity (continuous; in units/d), total calories (continuous), family structure (married, single with children, or married with children), smoking status (ever smoked within study period compared with never smoked), and a race-by-sex interaction. Estimates by year with different superscript letters are significantly different, $P = 0.0033$ (Wald significance test).

in **Table 4**. Increased consumption of fast food only and of both restaurant food and fast food were associated with greater mean changes in BMI over 3 y. A temporal increase in fast food consumption was associated with a 0.20 BMI unit increase over the study period (β: 0.20; 95% CI: 0.01, 0.39; $P = 0.044$). Likewise, increased consumption of both away-from-home food sources was associated with a 0.29 BMI unit increase (β: 0.29; 95% CI: 0.06, 0.51; $P = 0.012$). Increased consumption of restaurant intake of 1 time/wk, however, was not associated with change in BMI (β: −0.01; 95% CI: −0.21, 0.19; $P = 0.894$). Only the estimates for increased restaurant food consumption and increased both restaurant and fast food consumption were statistically significantly different from one another ($P = 0.0141$).

TABLE 3
Comparison of estimated associations of change in fast food and restaurant food consumption with change in BMI (dependent variable) by using continuous measures for 3394 black and white young adults

	3-y change in fast food intake	3-y change in restaurant food intake
Unadjusted for total energy[1]		
BMI (BMI unit)	0.0488 ± 0.020[2]	−0.001 ± 0.018
P	0.016	0.960
95% CI	(0.009, 0.089)	(−0.036, 0.034)
Adjusted for total energy[3]		
BMI (BMI unit)	0.0489 ± 0.020	−0.001 ± 0.018
P	0.016	0.962
95% CI	(0.009, 0.089)	(−0.036, 0.034)

[1] Linear regression model of change in fast food and change in restaurant intake on change in BMI with control for race (white compared with black), sex, age (continuous), study center (IL, AL, or MN), and the following baseline (exam year 7) characteristics: education (continuous; highest level completed), income (<\$12 000, \$12 000–\$24 999, or ≥\$50 000), family structure (married, single with children, or married with children), physical activity (continuous), fast food and restaurant food intake (continuous; in times/wk), and smoking status (ever smoked within study period compared with never smoked). Estimates in this row are not statistically significantly different , $P = 0.0807$ (Wald significance test).

[2] $\bar{x}$ ± SEM (all such values).

[3] Linear regression model of change in fast food and change in restaurant food intake on change in BMI with control for the same factors listed above plus baseline total caloric intake (continuous). Estimates in this row are not statistically significantly different, $P = 0.0812$ (Wald significance test).

DISCUSSION

We showed that fast food and restaurant consumption have differential cross-sectional effects on current BMI. Greater fast food, but not restaurant food, consumption was associated with higher BMI at year 7 (0.13 BMI unit) and year 10 (0.24 BMI unit), which translates to an increase of 0.42 kg and 0.77 kg, respectively, if converted to kilograms and scaled to a 177.8 cm height. Furthermore, a greater number of times per week of fast food consumption at year 7 was also associated with a 0.16 higher BMI at year 10. In all instances, restaurant food intake was unrelated to BMI. Thus, our results suggest that greater fast food, but not restaurant food, consumption is associated with higher BMI at the same time point.

To assess the degree to which changes in per week consumption of restaurant food compared with fast food was associated with changes in BMI over time, we used 2 model specifications. First, we estimated the associations of change in fast food and restaurant consumption with 3-y change in BMI using fully continuous measures. Although the estimate for increased fast food, but not increased restaurant, consumption was statistically significantly associated with changes in BMI over 3 y, the estimates for fast food and restaurant did not differ significantly from one another at the 0.05 level.

TABLE 4
Estimated associations of continuous change in BMI (dependent variable) with increased fast food consumption, increased restaurant food consumption, or both for 3394 black and white young adults

Measure	Increased fast food consumption only over 3 y (n = 798)	Increased restaurant food consumption only over 3 y (n = 775)	Increased both over 3 y (n = 4567)	Maintained or decreased both over 3 y (n = 1254)
Unadjusted for total energy[1]				
Change in BMI (BMI unit)	0.20 ± 0.10[2,a,b]	−0.01 ± 0.10[a]	0.29 ± 0.11[b]	Referent group
P	0.044	0.894	0.012	—
95% CI	(0.005, 0.391)	(−0.213, 0.185)	(0.063, 0.512)	—
Adjusted for total energy[3]				
Change in BMI (BMI unit)	0.20 (0.10)[a,b]	−0.01 (0.10)[a]	0.29 (0.11)[b]	Referent group
P	0.044	0.903	0.013	—
95% CI	(0.005, 0.393)	(−0.212, 0.187)	(0.060, 0.509)	—

[1] Linear regression model for increasing restaurant food consumption, fast food consumption, or both on change in BMI (continuous) with control for race (white compared with black), sex, age (continuous), study center (IL, AL, or MN), and the following baseline (exam year 7) characteristics: physical activity (continuous), family structure (married, single with children, or married with children), smoking status (ever smoked within study period compared with never smoked), and fast food and restaurant food intake (continuous; in times/wk). Estimates in a row with different superscript letters are significantly different, $P < 0.05$ (Wald significance test).

[2] $\bar{x}$ ± SEM (all such values).

[3] Linear regression model for increasing restaurant food consumption, fast food consumption, or both on change in BMI (continuous) with control for the same factors listed above plus baseline (exam year 7) total caloric intake (continuous). Estimates in a row with different superscript letters are significantly different, $P < 0.05$ (Wald significance test). For example, the coefficients for increased restaurant food consumption only and increased fast food and restaurant food consumption are significantly different from one another ($P = 0.0141$ unadjusted and $P = 0.0137$ adjusted for total energy), whereas estimates for increased fast food consumption only and increased fast food and restaurant food consumption are not significantly different ($P = 0.4797$ unadjusted and $P = 0.467$ adjusted for total energy).

It is possible that persons who change fast food but not restaurant food consumption (or vice versa) have different socioeconomic, lifestyle, or behavioral characteristics; thus, for the second model, we examined the relation between independent increases in these food sources and change in BMI. Increased consumption of fast food and of both restaurant and fast food were positively associated with a greater mean 3-y BMI change. On the other hand, increases in restaurant food consumption did not significantly affect mean changes in BMI, though the estimates for those who had a temporal increase in fast food compared with restaurant food consumption were not significantly different from one another. This lack of statistical significance could be due to the fact that the time frame, 3 y, was not long enough in duration to observe an effect. This is a point for future research.

Interestingly, further control for baseline BMI resulted in a slight increase in the effect of increased fast food consumption on change in BMI, yet the association between increased restaurant food consumption and change in BMI remained nonsignificant (results not shown). There is considerable debate about the appropriateness of controlling for baseline outcome in change models. It was shown that in certain instances such adjustment can bias effect estimates if levels of the conditioning variable are differentially associated with the outcome (22). Furthermore, as is likely the case in our situation, conditioning on baseline outcome can introduce bias due to heterogeneity; it is highly probable that the same factors (measured or unmeasured) that influence year 7 BMI, also influence BMI at year 10. Thus, we elected not to control for baseline BMI in our reported results.

At least one other study by Pereira et al (18) has reported a significant effect of change in fast food consumption (ignoring the effect of change in restaurant intake) on weight change in this same population. However, Pereira et al (18) examined the effect of change in fast food use over a 15-y period, whereas our study was limited to a 3-y period given availability of restaurant data only at exam years 7 and 10. Furthermore, use of categorical measures in Pereira et al (18), in contrast to our continuous measures, may have obscured important distinctions of the effect of increasing restaurant food, fast food, or both on increasing BMI. In fact, our preliminary analysis suggests this to be the case: a one unit increase of fast food consumption, compared with increasing neither fast food nor restaurant food intake, was significantly associated with a 30% increase in the likelihood of increasing relative to maintaining BMI over the same 3-y period (results not shown).

We cannot discount the fact that individual or neighborhood socioeconomic status, racial profile, or other unmeasured factors play a role in determining which persons patronize restaurants compared with fast food outlets. Nor can we discount the fact that such factors may be partially responsible for the differences in the associations between consumption frequency and change in BMI. Several studies have shown that access to various food sources, including fast food outlets, full-service restaurants, convenience stores and supermarkets, differs by neighborhood characteristics including mean income (23) or housing price (24) and racial profile (24, 25). Moreland et al (24) found that full-service restaurants and supermarkets were more likely found in nonminority and higher income neighborhoods, respectively. However, there were no differences in access to fast food restaurants. Similarly, Australian residents with lower (compared with higher) socioeconomic status were more likely to have access to fast food outlets (23). Increased access to fast food outlets and decreased access to supermarkets have also been linked to poorer individual dietary habits (26), increased consumption of "non-desirable" items (27), and a decrease in the likelihood of meeting dietary recommendations for certain food items (28).

The strengths of the present study include the following: use of longitudinal, prospective data with high rates of retention between study years; standardized methods and direct assessment of weight, height, and dietary data and habits; inclusion of measures of change in these dietary habits; extensive data on potential covariates and mediators; and the use of a biracial cohort from 4 cities across the country. Limitations of the present study include standardized but self-reported data on away-from-home food consumption and other lifestyle factors. Furthermore, this is an observational study, and the possibility of residual confounding or colinearities limits statements of causality. Additional limitations include the short time span, changes in questionnaires (assessment of restaurant use at just 2 time points), and the possibility for measurement error, which, if nondifferential, would lead to an underestimation of the effects.

Consumption of away-from-home food at restaurants and fast food places has increased substantially over the past 2 decades, concurrent with increases in obesity (3, 11). Away-from-home food, and particularly fast food, tends to be higher in total calories, fat, cholesterol, and refined carbohydrates, which has been shown to be associated with greater weight and weight change (8–10, 13–14, 16). Also, fast food portion sizes have increased more than have restaurant portion sizes over the past several decades (20). However, these 2 food sources, restaurants and fast food outlets, are rarely differentiated from one another in studies of away-from-home eating.

In conclusion, we showed that consumption frequency of restaurant and fast foods have directionally opposite, though not always statistically significant, associations with current BMI. Furthermore, we present evidence to suggest that changes in weekly consumption from each of these food sources may be differentially associated with weight change, although the results are not consistently statistically significant. In combination with previous research and given our short follow-up period, it may be the case that increased consumption of fast food over time leads to greater weight gain than is observed with increased restaurant food consumption. In light of recent trends relating high and increasing consumption of food away-from-home, improving our understanding of the relations of these differing food sources to health outcomes is imperative. When possible, restaurant and fast foods should be separated when away-from-home food consumption is of interest, because they may have differing associations with, in particular, changes in BMI. Furthermore, quite different program and policy options may emerge for these 2 away from home sectors, and policy makers should focus on the potentially important differences between fast food and restaurant consumption.

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APPENDIX A

Estimated associations of continuous change in away-from-home food consumption and other socioeconomic and demographic characteristics with change in BMI (dependent variable) for 3394 black and white young adults

	β estimate	SE	*P*
Exposures			
Change in fast food consumption	0.049	0.020	0.016
Change in restaurant food consumption	−0.001	0.018	0.960
Baseline covariates			
Fast food consumption (times/wk)	0.066	0.021	0.002
Restaurant food consumption (times/wk)	0.008	0.018	0.661
Black	0.185	0.083	0.026
Women	0.308	0.079	0.0001
Age at baseline, continuous	−0.027	0.011	0.011
Study center site			
Alabama	0.101	0.108	0.350
Illinois	−0.097	0.104	0.354
Minnesota	0.064	0.103	0.531
California	referent	—	—
Education, continuous (y)	0.002	0.018	0.894
Income			
<$12 000	0.080	0.127	0.529
$12 000–$24 999	0.078	0.102	0.440
$25 000–$49 000	referent	—	—
≥$50 000	0.023	0.094	0.807
Physical activity (units/wk)	0.0002	0.0001	0.152
Smoking status			
Ever smoked within study period	−0.132	0.078	0.090
Never smoked	Referent	—	—
Family structure			
Single	Referent	—	—
Married	0.098	0.097	0.310
Single, with children	−0.121	0.111	0.277
Married, with children	−0.194	0.105	0.063