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Predictors of fruit and vegetable intake in young adulthood

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Abstract

Few young adults meet national recommendations to consume at least two cups of fruit and two to three cups of vegetables daily. Effective strategies and messaging are needed to address this disparity, but research examining influences on fruit and vegetable intake during young adulthood has been limited and primarily cross-sectional. This study was conducted to identify five-year and 10-year longitudinal predictors of fruit and vegetable intake in young adulthood. The sample included 476 males and 654 females enrolled in a population-based cohort study (Projects EAT-I, II, and III). Participants completed surveys and food frequency questionnaires in Minneapolis/St. Paul, Minnesota high school classrooms in 1998–1999 (mean age=15.8, “adolescence”) and follow-up measures in 2003–2004 (mean age=20.4, “emerging adulthood”) and 2008–2009 (mean age=26.2, “young adulthood”). In young adulthood, average daily intake was 0.9 servings of fruit (excluding juice) and 1.8 servings of vegetables (excluding potatoes). Factors examined in adolescence and in emerging adulthood that were predictive of both fruit and vegetable intake in young adulthood included favorable taste preferences, fewer perceived time barriers to healthy eating, higher home availability of fruits and vegetables, and limited home availability of unhealthy foods. Analyses also identified additional factors that were specifically relevant to fruit (e.g., breakfast patterns) or vegetable intake (e.g., home food preparation) and of particular relevance during emerging adulthood (e.g., significant other’s healthy eating attitudes). Findings

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suggest individual and socio-environmental factors, particularly food preferences and home food availability, during adolescence and emerging adulthood may influence fruit and vegetable intake in young adulthood.

Keywords

Young adults; Adolescents; Fruit; Vegetables; Longitudinal

INTRODUCTION

Research indicates that consuming a nutrient-dense diet in young adulthood may protect against future chronic disease and excess weight gain (1–9). Meeting national recommendations for fruit and vegetable intake is an important component of overall dietary quality as higher intake has been related to a reduced risk of cardiovascular disease, several forms of cancer, and type 2 diabetes (10–12). Current national guidelines for young adults (19–30 years) recommend consuming at least two cups of fruit and two to three cups of vegetables daily (10).

Despite the importance of adequate fruit and vegetable intake, few young adults meet these recommendations. Over 90% of women and similarly high proportions of men aged 19–30 years do not meet recommendations (13). Effective strategies and messaging are needed to address this disparity, but research examining influences on fruit and vegetable intake during young adulthood has been limited. With few exceptions (14–17), this research has been primarily cross-sectional and little is known about the factors during adolescence or the transitional period of emerging adulthood that may influence the establishment of adult dietary patterns.

Therefore, the current study was designed to examine longitudinal predictors of fruit and vegetable intake in young adulthood. Prior research and the framework of social cognitive theory (18) were used to identify modifiable factors during adolescence (15–18 years) and emerging adulthood (19–23 years) with the potential to influence fruit and vegetable intake during the mid-to-late twenties (24–28 years). As previous research has suggested different individual and socio-environmental factors influence consumption patterns for fruits versus vegetables (19), fruit and vegetable consumption were examined as independent behaviors.

METHODS

Study Design and Population

Data for this analysis were drawn from Project EAT (Eating and Activity in Teens and Young Adults), a 10-year longitudinal study designed to examine weight-related factors among young people. The analytic sample includes 476 males and 654 females who completed a survey and food frequency questionnaire (FFQ) at EAT-I (mean age = 15.8 ± 0.8 years), EAT-II (mean age = 20.4 ± 0.8 years), and EAT-III (mean age = 26.2 ± 0.8 years). For EAT-I (Time 1), high school students at public schools in the Minneapolis/St. Paul metropolitan area of Minnesota completed assessments in classrooms during the 1998–1999 academic year (20, 21). Five years later (2003–2004), for EAT-II (Time 2), original participants were mailed surveys to examine changes in weight-related outcomes as they progressed into emerging adulthood (22, 23). EAT-III (Time 3) was designed to follow up on participants again in 2008–2009 as they progressed into their mid-to-late twenties. Although data were also collected from a younger cohort who were middle school students at EAT-I, the current study focused on the transitions from high school to emerging adulthood and into young adulthood.

At Time 3, participants were mailed survey invitation letters that provided the web address and a unique password for completing the EAT-III survey and the FFQ online (24). Nonresponders were sent up to three reminder letters and mailed paper copies of the survey and FFQ. Among those who could be contacted at Time 3, the response rate was 68% (representing 53% of the original high school sample). Statistical adjustments were made to account for attrition (see statistical analysis section). The final weighted sample was 59.8% white, 12.0% African American, 16.1% Asian, and 12.1% mixed or other race/ethnicity. Two-thirds of the sample reported completing post-secondary education (66.2%) and being married or in a committed romantic relationship (67.4%). Nearly all participants were employed part-time (30.6%) or full-time (61.5%).

The University of Minnesota's Institutional Review Board approved all protocols. Parental consent and written assent from participants was obtained at Time 1. For Time 2 and Time 3 follow-up surveys, participants were mailed a consent form with their paper survey or reviewed a consent form as part of the online survey. Completion of follow-up surveys implied written consent.

Surveys and Measures

The development of the Time 1 EAT survey was guided by adolescent focus-group discussions, in-depth literature reviews, and pilot testing (21, 25). For Time 2, 55% of survey items were retained without modification, but some revisions were made to include areas of growing research interest and to improve the relevance of items for participants in emerging adulthood based on pretesting in focus groups with young people ages 18–23 years. Theory and the results of prior research were used to inform the selection of variables from the Time 1 and Time 2 surveys for the current analysis. The survey items and response options used to define each individual (personal and behavioral) and socio-environmental predictor variable are described in Table 1. Sociodemographic characteristics were assessed on the Time 1 (gender, race/ethnicity) and Time 3 (age, educational achievement, relationship status) EAT surveys (26).

Fruit and vegetable intake was assessed using the 2007 Willett semi-quantitative FFQ at Time 3 and the youth form of this questionnaire at Time 1 and Time 2. Fruit intake (excluding juice) was estimated by summing the reported consumption of 11 items on the Time 3 FFQ and nine items on the youth form. Similarly, intake of vegetables other than potatoes was estimated by summing the reported consumption of 26 items on the Time 3 FFQ and 19 items on the youth form. The specific food items used to define daily servings are described in Table 2; one serving was defined as the equivalent of one-half cup. Prior studies have examined the reliability and validity of intake estimates based on the Willett semi-quantitative FFQ (27, 28) and the youth form (29, 30). In addition, the comparability of estimates based on the two FFQs was examined in a subsample of 91 male and 103 female participants in EAT-III who completed both questionnaires (31). Results showed the percentage of individuals classified into the same quartile rank category based on their responses on the two questionnaires was 50% for fruit and 55% for vegetable servings.

Statistical Analyses

Medians and interquartile ranges (IQR, 25th–75th percentiles) were calculated to describe daily intake of fruit and vegetables. Separate linear regression models were used to examine each potential Time 1 and Time 2 predictor of Time 3 intake for fruit and vegetable outcomes. Regressions were adjusted for sociodemographic characteristics (Model 1). In addition, the regression models used to examine Time 1 predictors of Time 3 intake were further adjusted for Time 1 intake and the regression models used to examine Time 2 predictors of Time 3 intake were further adjusted for Time 2 intake (Model 2). Model 1 was

used to examine the total association of potential predictors with *intake at Time 3*. Model 2 was used to examine the associations between predictors and *change in intake* over the five-year or 10-year period.

All variables were standardized to allow for relative comparisons of strength between observed associations. Prior to standardization, fruit and vegetable intake estimates were also energy-adjusted using the regression approach (32), because factors associated with dietary intake above and beyond any relationship with total energy consumption were of interest. The computed residuals of intake approximated normal distributions.

Because attrition from the Time 1 sample did not occur at random, the data were weighted using the response propensity method in all analyses (33). Response propensities (i.e., the probability of responding to the EAT-III survey) were estimated using a logistic regression of response at Time 3 on a large number of predictor variables from the EAT-I survey. Weights were additionally calibrated so that the weighted total sample sizes used in analyses for each gender accurately reflected the actual observed sample sizes. A 95% confidence level was used to interpret the statistical significance of probability tests, corresponding to a *P* value of <0.05. Analyses were conducted using the Statistical Analysis System (SAS, version 9.2, 2008, SAS Institute, Cary, NC).

RESULTS AND DISCUSSION

In young adulthood, average daily intake was 0.9 servings of fruit (IQR=0.4–1.6) and 1.8 servings of vegetables (IQR=1.1–3.0). These average daily intake estimates correspond to approximately one-half cup of fruit and one cup of vegetables, and confirm the existence of large discrepancies between national recommendations and the dietary patterns of young adults.

The five-year longitudinal models identified several individual and socio-environmental factors in emerging adulthood predictive of fruit and vegetable intake in young adulthood. In models adjusted for energy intake and sociodemographic characteristics, the only individual factors in emerging adulthood that predicted higher intake of both fruit and vegetables in young adulthood included greater concern about health, lower perceived time barriers to healthy eating, liking the taste, and less frequent fast-food consumption (Table 2, 5-year Model 1). Following further adjustment for intake during emerging adulthood, liking the taste and less frequent fast-food consumption continued to predict longitudinal increases in fruit and vegetable intakes (Table 2, 5-year Model 2). Vegetable preparation behaviors, perceived benefits of healthy eating, and self-efficacy for healthy eating during emerging adulthood were also found to predict higher intake of vegetables in both models (Table 2, 5-year Models 1 and 2).

In models adjusted for energy intake and sociodemographic characteristics, socio-environmental factors in emerging adulthood that predicted higher young adult intake of both fruit and vegetables included significant other's healthy eating attitudes, greater home availability of fruits and vegetables, and lower home availability of unhealthy foods (Table 2, 5-year Model 1). Following further adjustment for intake during emerging adulthood, all three factors continued to predict longitudinal increases in intake of fruit but not vegetables (Table 2, 5-year Model 2).

Comparable results were observed in 10-year longitudinal models; however, fewer associations were statistically significant. In models adjusted for energy intake and sociodemographic characteristics, factors in adolescence that predicted higher young adult intake of both fruit and vegetables included greater concern about health, lower perceived time barriers to healthy eating, liking the taste, greater home availability of fruits and

vegetables, and lower home availability of unhealthy foods (Table 2, 10-year Model 1). Following further adjustment for intake during adolescence, liking the taste of fruit or vegetables was the only factor that remained positively associated with 10-year longitudinal increases in intake of both respective outcomes (Table 2, 10-year Model 2).

To estimate the total variance in young adult intake explained by all covariates examined here, final models were examined that included individual and socio-environmental factors simultaneously (data not shown). Total variance explained by factors assessed in emerging adulthood was 17% for fruit and 19% for vegetables. The variance explained just by intake in emerging adulthood and sociodemographic characteristics was 13% for fruit and 14% for vegetables. Of the factors found to predict young adult intake of fruit and vegetables in the separate linear regression models described above, only less frequent fast-food consumption remained a statistically significant predictor of higher intake for both outcomes in the final, five-year model. Friends' and significant other's healthy eating attitudes also remained predictors of higher fruit intake in the final model, and liking the taste and buying fresh vegetables both remained predictors of higher vegetable intake.

Similarly, the total variance in young adult intake explained by factors assessed in adolescence was only 14% for fruit and 18% for vegetables. The variance explained just by intake in adolescence and sociodemographic characteristics was 12% for fruit and 16% for vegetables. Of the factors found to predict young adult intake of fruit and vegetables in the separate linear regression models described above, only favorable taste preferences remained a predictor of higher intake for both outcomes in the final, 10-year model. Greater home availability of fruits and vegetables also continued to be a predictor of higher fruit intake in the final model, and less frequent snack consumption continued to be a predictor of higher vegetable intake.

The results of this study indicate that individual and socio-environmental factors during the developmental periods of adolescence and emerging adulthood may continue to influence adult dietary patterns. Additional research focusing on young adulthood is needed to confirm these results and better understand fruit and vegetable intake. Similar to other studies (34–37), the factors during adolescence and emerging adulthood examined here explained less than 20% of the variance in fruit or vegetable intake. Further, a large proportion of the total explained variance in young adult intake was explained alone by sociodemographic characteristics and fruit and vegetable intake during earlier developmental periods. These findings suggest the importance of implementing interventions designed to improve fruit and vegetable intakes prior to adolescence and the need to explore a broader range of factors during adolescence and emerging adulthood. Extensive qualitative work and social cognitive theory were used to inform the selection of potential predictors for the current study; however, a growing body of research that addresses influences on food choices indicates it is important to consider not only the characteristics of individuals and their families, but also to examine characteristics of other environments (38).

There is a particular need for future longitudinal studies informed by ecological frameworks to include additional potential predictors specific to fruit and vegetable intake and the emerging adult years. Including measures of environments beyond the home such as physical and social aspects of work, college/university, and food retail environments as well as pricing could be important to explaining differences in intake. While limited evidence indicates that built environment features and food prices may explain some variance in intake patterns (39–41), few studies have explored the influence of social networks on young adult dietary behavior or how social and physical environments may interact to influence behavior. As perceived time barriers to healthy eating were consistently predictive of lower fruit and vegetable intake across developmental periods, it will further be important

for qualitative studies to identify what factors are the greatest contributors to this perception in adolescence and emerging adulthood.

In drawing conclusions from this study, certain strengths and limitations of the design should be considered. Strengths of this study include its 10-year longitudinal design, large and diverse sample at an understudied life stage (42), and theory-guided approach to identifying both individual and environmental predictors of intake. This study is one of the first to examine several modifiable factors at two developmental stages in relation to young adults' intake; however, some factors were measured using items not specific to fruit or vegetables. For example, participants were asked to report broadly on their significant other's healthy eating attitudes during emerging adulthood rather than attitudes specific to consuming fruit and vegetables. Although the sample was diverse and sampling weights were used to adjust for nonresponse, attrition from the original study population may have somewhat reduced its representative nature. Caution should also be used in generalizing the results to rural populations and other urban populations as it was drawn at Time 1 from a metropolitan area in one Midwestern state. Finally, even though a validated and age-appropriate food frequency questionnaire was used to assess intake at each life stage, estimates of individual energy intake likely include measurement error and residual confounding might have influenced the observed associations.

CONCLUSIONS

This study was designed to identify factors during adolescence and emerging adulthood that predict fruit and vegetable intake in young adulthood. Factors in adolescence and emerging adulthood that were predictive of both fruit and vegetable intake five and 10 years later included favorable taste preferences, fewer perceived time barriers to healthy eating, higher home availability of fruits and vegetables, and limited home availability of unhealthy foods. Analyses also identified additional factors that were specifically relevant to fruit (e.g., breakfast patterns) or vegetable intake (e.g., home food preparation) and factors of particular relevance during the emerging adulthood period (e.g., significant other's healthy eating attitudes) that may have implications for more targeted interventions.

Most young adults are not meeting recommendations to consume at least two cups of fruit and two to three cups of vegetables daily (10). Given evidence of large discrepancies between national recommendations (10) and the dietary patterns of young adults, the findings of the current study suggest it is important for nutrition interventions to address both individual and environmental factors to target improvements in fruit and vegetable intake throughout adolescence and the transition to adulthood. The results emphasize the importance of establishing favorable taste preferences for fruit and vegetables at early life stages, increasing the convenience of healthy eating, and developing strategies to address home food environments. Messages regarding the home environment and diet-related practices (e.g., fruit/vegetable purchasing) should be targeted to parents of adolescents and to emerging adults as they begin to assume increased responsibility for preparing and/or purchasing their own food. In particular, parents and emerging adults should be encouraged to keep fruit and vegetables available at home and limit the availability of other food and beverage options that are less healthful. Although manufacturers have introduced several convenient fruit and vegetable options in recent years (43, 44), there are likely additional opportunities for the food industry to help consumers in making healthier choices in the face of the many barriers encountered by young people today.

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Table 1

Description of measures used to assess hypothesized predictors of fruit and vegetable intake among participants in Project EAT (Eating and Activity in Teens and Young Adults)

Individual Factors

Personal

Concern about health	<i>How much do you care about... (1) eating healthy food? (2) being healthy?</i> Four responses ranging from <i>not at all</i> to <i>very much</i> . Three statements (e.g., <i>At this point in my life, I am not very concerned about my health.</i>). Four responses ranging from <i>strongly disagree</i> to <i>strongly agree</i> . Scoring was reversed on the last three items; Cronbach's $\alpha = 0.76^a$; range 5–20.
Perceived time barriers to healthy eating	<i>How strongly do you agree with the following statements?</i> Four statements (e.g., <i>I am too busy to eat healthy foods</i>). Four responses ranging from <i>strongly disagree</i> to <i>strongly agree</i> ; Cronbach's $\alpha = 0.77$; range 4–16.
Perceived benefits of healthy eating	<i>The types of food I eat affect... (1) my health; (2) how I look; (3) my weight.</i> Four responses ranging from <i>strongly disagree</i> to <i>strongly agree</i> ; Cronbach's $\alpha = 0.84$; range 3–12.
Self-efficacy for healthy eating	<i>If you wanted to, how sure are you that you could eat healthy foods when you are... (1) stressed out; (2) feeling down; (3) bored.</i> Six responses ranging from <i>not at all sure</i> to <i>very sure</i> ; Cronbach's $\alpha = 0.90$; range 3–18.
Perceived cooking skills ^b	<i>How adequate are your cooking skills?</i> Four responses ranging from <i>very inadequate</i> to <i>very adequate</i> ; range 1–4.
Perceived importance of shared mealtimes ^b	It is important to sit down and eat at least one meal a day with other people (family or friends). Four responses ranging from <i>strongly disagree</i> to <i>strongly agree</i> ; range 1–4.
Taste preference for fruit	<i>I like the taste of most fruits.</i> Four responses ranging from <i>strongly disagree</i> to <i>strongly agree</i> ; range 1–4.
Taste preference for vegetables	<i>Most vegetables taste bad.</i> Four responses ranging from <i>strongly disagree</i> to <i>strongly agree</i> . Scoring was reversed; range 1–4.

Behavioral

Breakfast frequency	<i>During the past week, how many days did you eat breakfast?</i> Range 0–7.
Snack frequency	<i>How many times did you snack (eat in-between meals) yesterday?</i> Range 0–6.
Fast-food frequency	<i>In the past week, how often did you eat something from a fast-food restaurant (like McDonald's, Burger King, Hardee's)?</i> Range 0–10.
Involvement in food preparation ^c	<i>In the past week, how many times did you help prepare food for dinner?</i> Range 0–7.
Eating on the run ^b	<i>I tend to "eat on the run."</i> Four responses ranging from <i>strongly disagree</i> to <i>strongly agree</i> ; range 1–4.
Buy fresh vegetables ^b	<i>During the past 12 months, about how often have you... bought fresh vegetables at the grocery store?</i> Six responses ranging from <i>never</i> to <i>daily</i> ; range 1–6.
Prepare green salad ^b	<i>During the past 12 months, about how often have you... prepared a green salad?</i> Six responses ranging from <i>never</i> to <i>daily</i> ; range 1–6.

Socio-environmental Factors

Parents' healthy eating attitudes	<i>My mother cares about eating healthy food. My mother encourages me to eat healthy food.</i> (Same statements for father.) Four responses ranging from <i>not at all</i> to <i>very much</i> ; Cronbach's $\alpha = 0.75$; range 4–16.
Friends' healthy eating attitudes	<i>Many of my friends care about eating healthy food.</i> Four responses ranging from <i>not at all</i> to <i>very much</i> ; range 1–4.
Significant other's healthy eating attitudes ^b	<i>My significant other (e.g., boyfriend/girlfriend, spouse, partner) cares about eating healthy food.</i> Four responses ranging from <i>not at all</i> to <i>very much</i> ; range 1–4.
Home fruit and vegetable availability	<i>How often are the following true?</i> Three statements (e.g., <i>Fruits and vegetables are available in my home</i>). Four responses ranging from <i>never</i> to <i>always</i> ; Cronbach's $\alpha = 0.66$; range 3–12.
Home availability of unhealthy foods	<i>How often are the following true?</i> Four statements (e.g., <i>Potato chips or other salty snacks are available in my home</i>). Four responses ranging from <i>never</i> to <i>always</i> ; Cronbach's $\alpha = 0.79$; range 4–16.

^a Cronbach's α values were calculated based on responses to the Time 2 survey and are similar to values based on responses to the Time 1 survey.

^b Assessed only during emerging adulthood (mean age = 20.4 years).

^c Assessed only during adolescence (mean age =15.8 years).

Table 2

Associations of young adults' (n=1,130) fruit and vegetable intake with factors assessed in emerging adulthood (5-year predictors) and with factors assessed in adolescence (10-year predictors)

	5-year predictors of fruit intake ^d			5-year predictors of vegetable intake ^b		10-year predictors of fruit intake ^a			10-year predictors of vegetable intake ^b	
	Model 1 $\beta^{c,d}$	Model 2 $\beta^{c,e}$		Model 1 $\beta^{c,d}$	Model 2 $\beta^{c,e}$	Model 1 $\beta^{c,d}$	Model 2 $\beta^{c,e}$		Model 1 $\beta^{c,d}$	Model 2 $\beta^{c,e}$
Individual Factors										
<i>Personal</i>										
Concern about health	0.130 ***	0.039		0.146 ***	0.072 *	0.081 **	0.024		0.063 *	0.033
Perceived time barriers to healthy eating	-0.157 ***	-0.101 ***		-0.114 ***	-0.052	-0.110 ***	-0.070 *		-0.068 *	-0.027
Perceived benefits of healthy eating	0.054	0.036		0.095 **	0.071 *	0.057	0.010		0.083 **	0.061 *
Self-efficacy for healthy eating	0.058	0.041		0.134 ***	0.089 **	0.039	0.012		0.095 **	0.057
Perceived cooking skills	0.032	0.037		0.056	0.016	-	-		-	-
Perceived importance of shared mealtimes	0.026	0.009		0.056	0.013	-	-		-	-
Taste preference for fruit or vegetables	0.154 ***	0.079 **		0.218 ***	0.122 ***	0.153 ***	0.095 ***		0.119 ***	0.065 *
<i>Behavioral</i>										
Breakfast frequency	0.097 **	0.022		0.055	-0.0004	0.116 ***	0.073 *		0.059	0.015
Snack frequency	-0.065 *	-0.065 *		-0.054	-0.018	-0.043	-0.039		-0.099 **	-0.078 **
Fast-food frequency	-0.219 ***	-0.154 ***		-0.154 ***	-0.107 ***	-0.057	-0.008		-0.027	0.013
Involvement in food preparation	-	-		-	-	0.031	0.028		-0.004	-0.032
Eating on the run	-0.062 *	-0.053		-0.050	-0.019	-	-		-	-
Buy fresh vegetables	-	-		0.228 ***	0.158 ***	-	-		-	-
Prepare green salad	-	-		0.215 ***	0.099 **	-	-		-	-
Socio-environmental Factors										
Parents' healthy eating attitudes	0.054	-0.009		0.031	-0.026	0.038	0.005		0.029	-0.007
Friends' healthy eating attitudes	0.131 ***	0.090 **		-0.004	-0.055	0.004	-0.021		0.032	0.031
Significant other's healthy eating attitudes	0.104 ***	0.078 **		0.082 **	-0.058	-	-		-	0.037

	5-year predictors of fruit intake ^a		5-year predictors of vegetable intake ^b		10-year predictors of fruit intake ^a		10-year predictors of vegetable intake ^b	
	Model 1 $\beta^{c,d}$	Model 2 $\beta^{c,e}$	Model 1 $\beta^{c,d}$	Model 2 $\beta^{c,e}$	Model 1 $\beta^{c,d}$	Model 2 $\beta^{c,e}$	Model 1 $\beta^{c,d}$	Model 2 $\beta^{c,e}$
Home fruit and vegetable availability	0.115 ***	0.064 *	0.126 ***	-0.051	0.114 ***	0.075 **	0.084 **	-0.044
Home availability of unhealthy foods	-0.117 ***	-0.065 *	-0.128 ***	-0.054	-0.094 **	-0.033	-0.108 ***	-0.032

^aFoods included within fruit servings: Young adult servings included raisins/grapes, prunes/dried plums, bananas, cantaloupe, apples/pears, oranges, grapefruit, strawberries, blueberries, peaches/plums, and apricots. Adolescent/emerging adult servings included raisins, grapes, bananas, cantaloupe/melon, apples/applesauce, pears, oranges/grapefruit, strawberries, and peaches/plums/apricots.

^bFoods included within vegetable servings: Young adult servings included tomatoes, tomato/V-8 juice, tomato sauce, string beans, beans/lentils, peas/lima beans, broccoli, cauliflower, cabbage/coleslaw, Brussels sprouts, cooked carrots, raw carrots, corn, mixed vegetables, yams/sweet potatoes, dark orange squash, zucchini/summer squash/eggplant, kale/mustard greens/chard, cooked spinach, raw spinach, iceberg/head lettuce, romaine/leaf lettuce, celery, green/yellow/red peppers, cooked onions, and raw onions. Adolescent/emerging adult servings included tomatoes, tomato/spaghetti sauce, string beans, beans/lentils/soybeans, broccoli, beets, corn, peas/lima beans, spinach, greens/kale, green/red peppers, yams/sweet potatoes, zucchini/summer squash/eggplant, cooked carrots, raw carrots, celery, lettuce/tossed salad, mixed vegetables, and coleslaw.

^c β coefficients are standardized and are interpreted as the amount of SD change in energy-adjusted fruit or vegetable intake associated with a 1 SD change in the personal, behavioral, or socio-environmental factor.

^dModel 1: Associations between each individual factor and intake were tested separately, weighted for nonresponse, and adjusted for gender, race/ethnicity, educational attainment, age, and relationship status.

^eModel 2: Associations between each individual factor and intake were tested separately, weighted for nonresponse, and adjusted for the covariates in Model 1 plus baseline fruit or vegetable intake (in adolescence or emerging adulthood) and energy intake.

* p<0.05;

**

p<0.01;

p<0.001