Variables Associated With Fruit and Vegetable Intake in Adolescents

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***Objectives*: To assess individual, social, and family environmental factors related to fruit and vegetable intake among white and black adolescents aged 11-15 years (n=736). *Methods*: Self-report questionnaire. *Results*: Preferences, availability at home, family dinner frequency, snack choice, self-efficacy, modeling, normative beliefs, and social outcome expectations were significant associates of fruit and vegetable intake. Multivariate models indicated that these associations varied by categories of intake. Availability was the most consistent associate whereas fruit preference, availability, family dinner frequency, and self-efficacy were the strongest associates. *Conclusions*: Results highlight the important influence of the family environment on fruit and vegetable intake.**

***Key words*: social cognitive theory, fruit, vegetable, adolescent**

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Healthy eating is crucial for adolescent health and optimal growth and development. Inadequate fruit and vegetable intake may predispose adolescents to future risks of morbidity and mortality associated with chronic diseases.[1-4] Fruit and vegetable intake by adolescents is low, with roughly 80% consuming less than the recommended daily intake.[5-7] Adolescence is a time of transition, with challenges of greater autonomy/independence from parents and an increasing level of peer influence.[8] Nutrition behaviors, preferences, and habits are formed and shaped during adolescence and may continue to influence adult behavior,[1,9,10] suggesting the importance of early intervention to establish, maintain, or improve healthy eating behaviors.

Compared to studies focusing on children and adults, relatively few studies have investigated determinants of adolescent fruit and vegetable intake, which tends to decline through adolescence.[11-18] Research with children and adults suggests the potential importance of several variables related to social cognitive and behavioral choice theories, including modeling, expectations and expectancies, availability, and food preferences in relation to fruit and vegetable intake.[9,11,14,16,19-27] Although there have been several studies that have examined social cognitive constructs, few have examined factors beyond the individual or social levels[28] and concurrent examination of individual, social, and environmental factors may facilitate intervention planning to address low fruit and vegetable intakes by adolescents.

Social cognitive theory (SCT)[29] seeks to provide a comprehensive understanding of health behaviors and emphasizes reciprocal determinism, or the interaction between the person and his or her envi-

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ronment that forms cognitions, modifies environments, and produces behavior.[29] A major construct of SCT considered to be one of the most important behavioral influences is self-efficacy, or the situation-specific confidence in one's ability to perform a behavior.[29] Self-efficacy beliefs related to the ability to exercise control are conceptualized to operate with goals, outcome expectations, and perceived environmental barriers and facilitators to determine behavior.[30] Self-efficacy is one of most consistently reported correlates of behavior, including fruit and vegetable intake.[25,27,31,32] Constructs from SCT selected for the study were self-efficacy, outcome expectations and expectancies, observational learning, and self-regulation.[20,21,25,31-35]

In SCT, the environment is conceptualized as a support that can impede or facilitate behavior, and thus, efforts to provide resources or reduce barriers (as well as to enhance self-efficacy to deal with environmental barriers) may help to empower an individual in such a way that enables behavior.[28] Via reciprocal determinism, individuals are able to select and to modify their environment – self-regulation is constructed from experience and is not merely environmentally triggered.[36] Adolescents likely have the ability to make choices and to exercise some control over their environments, and thus constructs such as self-efficacy and self-regulation are potentially important for dietary behaviors. It is also possible, however, that adolescents do not always have volitional control over their environment and may, therefore, be influenced by environmental barriers or facilitators to make certain choices or engage in certain behaviors.

Behavioral choice theory (BCT)[37] explicitly seeks to understand how and in what situations choices are made and posits that environmental changes can alter the reinforcing value of options and therefore shift behavior.[37] Therefore, improving access or availability to healthy options may contribute to behavior change.[38,39] Variables consistent with BCT selected for this study were behavioral cost (availability and accessibility), preferences, snack choice, and reinforcing values or the influence of food attributes on food choice (eg, taste, cost, advertising).[9,14,22,23,37,40-44]

There is a need to examine influences from multiple levels to identify which variables are most influential on behavior and to enhance effectiveness of promotion efforts.[17,45,46] Due to the need to better understand the influences upon adolescent food intake and support the development of interventions among this age-group for fruit and vegetable intake specifically, the purpose of this study was to simultaneously explore several individual, social, and environmental correlates of fruit and vegetable intake among a sample of middle school adolescents.

METHODS

Procedure

Self-report, paper-and-pencil questionnaires were administered to a convenience sample of students in 2 middle schools (grades 6-8) during regularly scheduled class periods. Teachers were trained for the administration of the questionnaire by the first author and were provided a scripted narrative to ensure uniform administration. The questionnaire took approximately 40 minutes to complete (average time to complete was roughly 25 minutes). Parents were informed of the study and had the option of removing their child from participation. Adolescents provided informed consent. The university institutional review board approved all procedures.

Participants

A total of 843 adolescents aged 11-15 years completed the questionnaire. All adolescents in each of the 2 schools were eligible to participate in the study (n=1175). The overall response rate excluding students who were absent on the day the survey was administered was 81.1% (including absences, the response rate was 71.7%). Because there were few respondents from other racial/ethnic groups (Hispanic, n=33; Asian, n=4; Native American, n=5; "other," n=27; missing, n=38), only participants who reported that they were either black or white were included in the analyses. There were no other inclusion or exclusion criteria. Therefore, the sample for this study was 736 adolescents.

Measures

The questionnaire included measures of demographic variables (race, age, sex, number of people in the household, and self-reported height and weight), fruit and

Table 1
Social Cognitive Theory and Behavioral Choice Theory Constructs and Survey Measures

Theoretical Construct	Survey Measure
Social Cognitive Theory	
Self-efficacy	
Confidence to consume fruit and vegetables in certain situations and at recommended levels	Self-efficacy for fruit and vegetable consumption: derived from Van Duyn et al;[32] 5 items; Internal consistency in adolescents for this modified scale was .81.
Self-regulation	
Permissive eating: Parents allowing adolescent to eat whatever they want. Food Self-preparation: Adolescent involvement in preparing food.	Parent-Child Food Control – Permissive Eating and Food Self-preparation Subscales: derived from Cullen et al;[20] 4 items each subscale; Internal consistencies for modified scales in adolescent sample were .77 and .74, respectively.[47]
Observational Learning	
Parent and peer modeling of fruit and vegetable intake at meals/snacks at home and restaurants	Parent and Peer Modeling: derived from Cullen et al[20]; 4 items each subscale; Internal consistency for modified scales in adolescent sample: parent = .77 and peer = .77.[47]
Outcome Expectations	
Benefits (health and social) of fruit and vegetable intake	Outcome Expectations: derived from Domel et al;[41] 4 items each subscale; Internal consistency for modified scales in an adolescent sample: health = .72 and social = .82.[47]
Outcome Expectancies	
Social expectancy – perceived value families and peers hold regarding eating fruit and vegetables	Child Normative Beliefs: from Cullen et al[20]; 6 items each subscale; Adolescent sample internal consistencies for peer beliefs = .87 and family beliefs = .88.[47]
Behavioral Choice Theory	
Preference	
Liking or preference for fruit and vegetables	Fruit and vegetable preferences: 2 items derived from Van Duyn et al;[32] modified response choices: 0 = "I don't like at all," 1 = "I like them a little bit," and 2 = "I like them a lot."
Choice/Alternatives	
Situational preferences for fruit and vegetables when choosing between favorite fruits/vegetables and favorite sweets/chips.	Snack choice: 11-item index developed by Domel et al.[41] One point is given for each clear fruit or vegetable choice (9 possible) and the items are summed to provide a total index score.
Behavioral cost	
Availability of fruit and vegetables in the home over the past week. Accessibility (convenient and ready to eat) of fruit and vegetables at home.	Availability assessed by 5 items from Kratt et al;[29] Accessibility assessed by 4 items from Davis et al;[18] the 9 items are summed for an availability index
Reinforcing value	
Importance of food-related attributes when choosing what to eat.	Food Attributes: 4 items each for 3 subscales: social influence (α = .80), avoiding weight gain (α = .73), and appeal and access (α = .65).[47]

vegetable intake, and several scales identified from the research literature derived from or consistent with SCT[29] and BCT.[37] Most measures identified from the literature were developed with child or adult samples; therefore, some of the scales were modified for this study with adolescents. A brief description of mea-

sures included in the questionnaire follows; more detailed information for many of the scales used in this study concerning items, factor structure, and construct validity for a middle-school adolescent population are reported elsewhere.[47] Please see Table 1 for a description of theory-related measures.[11,20,22,25,32,41,47]

Block Food Frequency Questionnaire Short Form.[48,49] Fruit and vegetable intake was measured by a short form of a questionnaire derived from a longer 100-item validated food frequency questionnaire.[50] Correlations between the long questionnaire and one-day dietary records were .73-.94.[50] Reduction of the longer food frequency was based upon statistical criteria, including differences and similarities in intake by demographic variables and the dietary contribution by the most important foods reported with the larger questionnaire.[49] The short form has 26 items (7 fruit and vegetable, 4 grain, and 15 fat/meat/snack) answered on a 6-point scale (scored 0-5): less than once a week, once a week, 2-3 times a week, 4-6 times a week, once a day, and 2 or more times a day.[48] The short form is less time intensive than the more comprehensive food frequency, but does not assess portion size, therefore not allowing calculation of nutrient intakes or percent of calories for macronutrients. It does provide an indication of overall diet quality by estimating the frequency of intake per week for food categories and produces reasonable estimates and rankings of food intake with validity comparable to the full-length questionnaire.[48,49] Significant Spearman correlations between the short form and the full questionnaire include fruit and vegetable servings (.71) and vitamin C (.57). The short form also has predictive value in categorizing levels of fruit and vegetable consumption (89% correctly categorized with intakes of 4 servings or fewer per day).[48]

Frequency of family dinners. One item previously used by Gillman et al[34] with children and adolescents 9-14 years of age was used to measure the frequency of family meals per week. Response choices were never (0 days), some days (1-3 days), most days (4-6 days), and every day (7 days).

Meal patterns. Two separate items assessed meal patterns. One item was developed for this study to assess whether or not the participant usually ate breakfast. Another item assessed the number of meals and snacks usually eaten each day (0, 1, 2, 3, or 4 or more).

Frequency of fast food restaurant visits. One item from Glanz et al[35] was used to assess frequency of visits to fast food restaurants. The question was slightly modified to make it more appropriate for the study population: the item was changed to ask about the frequency of visits (0 to 8 or more) over the last 7 days within 3 different restaurant categories (specific restaurants were listed in each category).

Data Analysis

Data were analyzed with SAS (version 9.1, SAS Institute, Cary, NC). The 5 servings-a-day recommendation was used in this study as a cutoff as it represents the minimum recommended level of intake. An algorithm was developed to calculate each respondent's consumption of fruit and vegetables in terms of meeting fruit and vegetable recommendations, which were categorized as follows: (1) meeting only the fruit recommendation of 2 servings per day, (2) meeting only the vegetable recommendation of 3 servings per day, (3) meeting the 5 A Day recommendation (by consuming at least 2 fruit AND at least 3 vegetable servings per day), and (4) not meeting any recommendation. Because the proportion of adolescents meeting the 5 A Day recommendation by this method was too small to analyze, this information is provided for descriptive purposes only. Fruit and vegetable intake was also calculated using an equation to derive total servings per day according to Block et al.[48] This was then used to categorize intake into one of 3 categories or levels of fruit and vegetable intake: <3 servings a day, 3-4 servings a day, and 5 or more servings a day. These categories do not make a distinction about the number of fruit or vegetable servings needed to achieve 5 servings a day (ie, indicates total servings per day regardless of whether they were fruit or vegetable servings). Chi-square tests were used to examine demographic differences in the prevalence of respondents within the fruit and vegetable intake categories.

Logistic regressions examined bivariate associations between each level of fruit and vegetable intake to demographic,

Table 2
Sample Demographic and Behavioral Characteristics (n=736)

Variable	n	%
Race		
Black	360	48.9
White	376	51.1
Sex		
Female	395	54.7
Male	327	45.3
Age		
11 years	126	17.2
12 years	260	35.5
13 years	255	34.8
14-15 years	91	12.5
BMI for Age and Sex[a]		
< 85th percentile (Normal weight)	438	66.2
85th-94.9th percentile (Overweight)	129	19.5
≥ 95th percentile (Obese)	95	14.3
Fruit and Vegetable Intake Recommendations		
Meets 5-A-Day (meets both fruit and vegetable)	37	5.0
Meets fruit recommendation only (2 a day)	79	10.7
Meets vegetable recommendation only (3 a day)	44	6.0
Doesn't meet either recommendation	576	78.3
Fruit-and-Vegetable-Intake Categories[b]		
5 or more a day	153	20.8
3-4 a day	297	40.3
< 3 a day	286	38.9

Notes.
a BMI categories were derived from the 2000 Centers for Disease Control and Prevention's growth charts for age and sex.[63]
b Based upon Block et al[48] prediction equation for total fruit and vegetable intake (represents intake as the total number of servings; no distinction made between number of servings of fruit or vegetables).

individual, social, and environmental level variables. Significant results from these bivariate associations were then used in a series of multiple binary logistic regression models comparing: <3 servings a day to 3-4 servings a day, 3-4 servings a day to 5 or more servings a day, and <3 servings a day to 5 or more servings day. So as not exclude potentially important variables from the models, variables from the bivariate associations with a P-value ≤.10 were included in the models. Three levels of multiple logistic regression models were planned: one for demographic variables only, one for individual-level variables, and one for environmental-level variables. Significant variables from each of these models were then used for a combined multiple logistic regression model for each fruit-and-vegetable-intake category comparison. All regression models were adjusted for demographic variables of race, sex, age, and BMI.

Ordinal logistic regression was explored to analyze the 3 fruit-and-vegetable-intake categories in multiple models. Ordinal regression makes use of the ordinality of the data across all levels of the outcome variable, thus producing a more powerful and efficient model than a binary logistic regression using a collapsed or dichotomized dependent variable.[51] Ordinal regression assumes that the effect of the variables is homogenous across all levels of the outcome variable. If this assumption is violated, the model is invalid and

Table 3
Means and SD for Bivariate Associates of Fruit-and-Vegetable-Intake Categories, Adjusted for Race, Sex, Age, and BMI (n=736)

	<3 a day (n = 286) Mean (SD)	3-4 a day (n = 297) Mean (SD)	> 5 a day (n = 153) Mean (SD)
Individual-Level Variables			
Self-efficacy	12.90 (3.31)	14.97 (2.94)	15.81 (3.06)
Health outcome expectations	6.47 (1.73)	6.73 (1.51)	6.62 (1.57)
Social outcome expectations	2.03 (2.24)	2.26 (2.27)	2.69 (2.44)
Fruit preference	1.35 (0.59)	1.60 (0.57)	1.64 (0.52)
Vegetable preference	0.92 (0.60)	1.14 (0.58)	1.17 (0.65)
Snack choice	3.00 (1.98)	3.74 (2.18)	4.39 (2.23)
Appeal & access food attributes	6.82 (2.62)	7.34 (2.77)	7.20 (2.77)
Social Environmental-Level Variables			
Parental modeling	9.52 (2.66)	10.74 (2.75)	11.42 (2.93)
Peer modeling	7.98 (2.67)	8.86 (2.80)	9.44 (2.79)
Family normative beliefs	6.58 (3.14)	7.43 (3.06)	8.31 (3.25)
Peer normative beliefs	3.78 (3.07)	4.71 (3.32)	5.36 (3.49)
Food Self-preparation	10.07 (3.37)	10.44 (3.34)	9.81 (3.27)
Family dinner frequency	1.61 (0.99)	1.92 (0.97)	2.08 (0.96)
Fruit and vegetable availability	4.47 (1.67)	5.21 (1.71)	5.83 (1.64)

potentially misleading.[51,52]

The score tests for the proportional odds assumption for the individual-level ordinal regression model was χ^2 = 70.31, P<.0001; and for the environmental-level model was χ^2 = 71.85, P<.0001, indicating a violation of each model's main assumption. Because the score test for proportional odds can be overly sensitive,[51,52] unadjusted ordinal regression models were also conducted; and 11 of the 19 variables used in this study violated the proportional odds assumption, indicating the effect of these 11 variables was not homogenous across fruit and vegetable intake. (These 11 variables were self-efficacy, social outcome expectations, fruit preference, vegetable preference, snack choice, parental modeling, peer modeling, family normative beliefs, peer normative beliefs, family dinner frequency, and fruit and vegetable availability.) Because the main assumption of these ordinal regression models was violated, the series of 3 binary logistic regressions comparing the 3 levels of intake were used to analyze the data, so as not to lose potentially meaningful information by merely dichotomizing fruit and vegetable intake.[51,52]

RESULTS

Demographic characteristics and fruit-and-vegetable-intake categories are presented in Table 2. There were no significant differences in fruit and vegetable intake by race, sex, age-group, or BMI group by mean number of servings, meeting recommendations, or by the 3 levels of intake. The mean number of servings for the overall sample (M = 3.62, SD = 2.06) and the proportion that met the 5 A Day recommendation (5.0%) were very similar to a national study of adolescents (M = 3.6 and 7.2%, respectively).[6]

Adjusted means (for race, sex, age, and BMI) and standard deviations for the scales are presented in Table 3. Qualitatively, means for the scales increased across levels of intake, with the exception of 2 variables (health outcome expectations and food self-preparation). The results of the bivariate logistic regressions (odds ratios and 95% confidence intervals) for each of the 3 levels of intake are shown in Table 4. In descending order, fruit and vegetable availability in the home, snack choice, self-efficacy, parent and peer modeling, and peer and family normative beliefs had significant odds ratios for each of the comparisons between categories.

Table 4
Bivariate Logistic Regression Results for Fruit-and-Vegetable-Intake Categories, Adjusted for Race, Sex, Age, and BMI (n=736)

	<3 a day vs 3-4 a day (n = 286 vs n = 297) O.R. (95% C.I.)	3-4 a day vs >5 a day (n = 297 vs n = 153) O.R. (95% C.I.)	<3 a day vs >5 a day (n = 286 vs n = 153) O.R. (95% C.I.)
Individual Level Variables			
Self-efficacy	1.24 (1.17, 1.32)*	1.10 (1.02, 1.18)*	1.34 (1.24, 1.45)*
Health outcome expectations	1.10 (0.99, 1.23)	0.95 (0.84, 1.09)	1.06 (0.94, 1.21)
Social outcome expectations	1.05 (0.97, 1.14)	1.10 (1.00, 1.20)*	1.16 (1.06, 1.27)*
Fruit preference	2.11 (1.55, 2.88)*	1.06 (0.73, 1.55)	2.48 (1.66, 3.71)*
Vegetable preference	1.96 (1.43, 2.68)*	1.01 (0.71, 1.43)	1.82 (1.27, 2.62)*
Snack choice	1.19 (1.09, 1.30)*	1.14 (1.04, 1.26)*	1.36 (1.22, 1.51)*
Appeal & access food attributes	1.08 (1.01, 1.15)*	0.98 (0.91, 1.06)	1.06 (0.98, 1.15)
Social Environmental Level Variables			
Parental modeling	1.19 (1.11, 1.27)*	1.09 (1.01, 1.17)*	1.27 (1.17, 1.38)*
Peer modeling	1.13 (1.06, 1.21)*	1.09 (1.01, 1.17)*	1.22 (1.12, 1.32)*
Family normative beliefs	1.09 (1.03, 1.16)*	1.09 (1.02, 1.17)*	1.19 (1.11, 1.27)*
Peer normative beliefs	1.10 (1.04, 1.16)*	1.09 (1.02, 1.16)*	1.20 (1.12, 1.28)*
Food self-preparation	1.04 (0.98, 1.09)	0.95 (0.89, 1.01)	0.98 (0.92, 1.04)
Family dinner frequency	1.40 (1.16, 1.68)*	1.19 (0.96, 1.48)	1.61 (1.29, 2.00)*
Fruit and vegetable availability	1.30 (1.17, 1.45)*	1.23 (1.08, 1.40)*	1.66 (1.43, 1.92)*

Notes.
Odds were predicted for the higher level of intake for comparisons between categories.
*** P≤ .05**

Fruit and vegetable preference, as well as family dinner frequency, was significantly associated with intake only when comparing the <3 servings per day with 3-4 servings per day category and when comparing the <3 servings per day with the ≥5 servings per day category. Social outcome expectations were significant only when comparing the 3-4 servings per day with the ≥5 servings per day category and when comparing the < 3 servings per day with the ≥5 servings per day category. Lastly, appeal and access food attributes were significantly associated with intake only when comparing the < 3 servings per day with the 3-4 servings per day category.

Results of the final multiple logistic regression models are shown in Table 5. Significant variables, as well as the strength of association, varied across the levels of fruit and vegetable intake. Generally, there were fewer significant variables for the 3-4 servings per day to the ≥5 servings per day comparison than for the <3 servings per day to the 3-4 servings per day comparison. Notable differences included fruit preference, family dinner frequency, self-efficacy, and parent modeling being significant when comparing the <3 servings per day to the 3-4 servings per day category whereas snack choice and social outcome expectations were significant when comparing the 3-4 servings per day to the ≥5 servings per day category. In the multivariate models, fruit and vegetable availability was the most consistent associate of fruit and vegetable intake whereas fruit preference, fruit and vegetable availability, and family dinner frequency were the strongest associates of fruit and vegetable intake.

DISCUSSION

The results from the series of multiple logistic regression models (Table 5) indicated not only different variables associated with different categories of fruit and vegetable intake, but also differential strengths of association. Analyzing fruit and vegetable intake as either a continu-

Table 5
Individual, Social Environmental, & Combined Multivariate Logistic Regression Models for Fruit-and-Vegetable-Intake Categories, Adjusted for Race, Sex, Age, and BMI

	Final Logistic Regression Models		
	<3 a day vs 3-4 a day (n = 286 vs n = 297) O.R. (95% C.I.)	3-4 a day vs >5 a day (n = 297 vs n = 153) O.R. (95% C.I.)	<3 a day vs >5 a day (n = 286 vs n = 153) O.R. (95% C.I.)
Individual Level Model			
Self-efficacy	1.20 (1.13, 1.28)	-	1.27 (1.16, 1.39)
Health outcome expectations	-	-	-
Social outcome expectations	-	1.10 (1.01, 1.21)	1.15 (1.04, 1.28)
Fruit preference	1.55 (1.11, 2.17)	-	-
Vegetable preference	-	-	-
Snack choice	-	1.15 (1.05, 1.27)	1.17 (1.04, 1.39)
Appeal & access food attributes	-	-	-
Social Environmental Model			
Parental modeling	1.12 (1.05, 1.21)	-	1.13 (1.03, 1.23)
Peer modeling	-	-	-
Family normative beliefs	-	-	-
Peer normative beliefs	1.07 (1.00, 1.13)	1.07 (1.01, 1.15)	1.15 (1.07, 1.25)
Food self-preparation	-	-	-
Family dinner frequency	1.30 (1.08, 1.58)	-	1.31 (1.02, 1.69)
Fruit and vegetable availability	1.21 (1.08, 1.36)	1.22 (1.07, 1.38)	1.53 (1.30, 1.79)
Combined Model			
Self-efficacy	1.14 (1.07, 1.23)	-	1.23 (1.13, 1.34)
Fruit preference	1.54 (1.10, 2.18)	-	-
Snack choice	-	1.11 (1.00, 1.23)	-
Parental modeling	1.10 (1.02, 1.19)	-	-
Peer normative beliefs	-	-	1.14 (1.05, 1.23)
Family dinner frequency	1.24 (1.02, 1.52)	-	-
Fruit and vegetable availability	1.15 (1.02, 1.30)	1.20 (1.05, 1.37)	1.46 (1.25, 1.72)

Notes.
Significant variables from bivariate analyses were entered into Individual or Social Environmental Models for each category. Significant variables from Individual and Social Environmental Models were entered into the Combined Model for each category. Variables were retained in the model if $P \leq .05$. Method of regression was backward elimination. Odds were predicted for the higher level of intake for comparisons between categories. All final models were significant at $P \leq .001$.

ous or dichotomous variable would have masked these results and may have been misleading. As expected, adolescents with the lowest fruit and vegetable intake reported the least amount of influencing factors upon behavior. There were fewer variables that were significantly different when comparing moderate and high levels of fruit and vegetable intake. Therefore, the effects of these factors upon fruit and vegetable intake may not be the same across levels of behavior, and interventions to increase consumption to recommended levels may be more efficient and effective if focused upon the factors that would be expected to precipitate the greatest impact. Focusing upon fruit and vegetable availability and snack choice may be of importance for increasing intake from moderate to high levels. Intervention with a different set of factors, or a different emphasis of factors, may be necessary or more effective when seeking to improve fruit and vegetable consumption by those adolescents with the lowest levels of intake. Preferences for fruit, fruit

and vegetable availability, self-efficacy, and parental modeling may be important for increasing intake among adolescents with the lowest intake of fruit and vegetables.

After controlling for demographic variables (Tables 4 and 5), availability of fruit and vegetables in the home was both a consistent and relatively strong associate with fruit and vegetable intake. Availability of fruit and vegetables, both at home and at school, has been associated with intake in children and adolescents.[11,16,20,22,26,27] Availability has been reported to be associated with knowledge, self-efficacy, and parental modeling.[7,22,26] Availability has also been positively associated with both household and community income.[7,53,54] Thus, interventions and policies may be needed to reduce the cost of produce, as well as the availability of quality produce within communities, in order to affect fruit and vegetable intake.

In terms of theory, the top 3 bivariate correlates of intake were variables from BCT (preferences, availability, and snack choice); and availability and preference remained among the strongest correlates in the multivariate models. These findings indicate potential for use of this theory with this population to modify fruit-and-vegetable-intake behaviors. Interventions to improve access, feeding practices, and the reinforcement value of healthy food options could be used to modify taste preferences[9] and food choice.[38]

More work is needed to better understand and to modify the formation of food preferences and the distal and situational influences upon food choice. The food attribute scales used in this study to measure influences on food choice were not associated with overall fruit and vegetable intake; however, it may be that the relative influence of these factors varied by more homogenous subgroups within the sample that were not identified by basing groups upon behavior. Contento et al[14] reported that influences on food choice varied among adolescents, with several attitudinal group clusters based upon food attributes: hedonistic, social/environmental control, personal health, peer-supported health, and parent-supported health. These clusters were associated with vitamin C, riboflavin, and calcium intakes; but no information about intake of more general food categories such as fruit and vegetable intake was available. Future research should continue to examine the influences on behavioral choice related to food intake.

Another variable that was relatively strongly correlated with intake was family dinner frequency. This single item assessed frequency of family dinners, but it may be more valuable in the future to assess the behaviors associated with family dinners in order to tease out important factors. For instance, family dinners may provide an opportunity to control BCT-related variables (such as preferences, availability, alternative foods) as well as an opportunity to address SCT-related variables (such as observational learning, expectations, expectancies, and self-efficacy) or other factors (such as television viewing, which has been associated with poorer food intake behaviors).[55] Family dinners may be a potential target for intervention efforts. Other studies have also found that family dinner frequency in adolescents is associated with higher fruit and vegetable intakes.[34,56] Importantly, the frequency of family dinners in one study decreased with age, which may be part of the decline in fruit and vegetable intake during adolescence.[34] Family dinners have been reported to influence adolescents' confidence in making healthier food choices.[57,58]

From SCT, self-efficacy, modeling, normative beliefs, and outcome expectations were also significantly correlated with levels of fruit and vegetable intake; however, our study found relatively weaker associations between fruit and vegetable intake and these variables. Others have reported weak associations for these variables in children as well.[20,21] Self-efficacy was a significant associate of intake only when comparing the lowest level of intake to the moderate level of intake. Self-efficacy was also an apparently weaker influence in this sample than several other factors, including fruit preferences, family dinner frequency, and fruit and vegetable availability. These results are consistent with studies among children and adolescents.[16,24,25,41] Self-efficacy among adults, however, has been reported to be a stronger predictor for total fruit and vegetable intake than were preferences.[32] Food preparation in this study was not significantly related to fruit and vegetable intake; however, one study with middle and high school adolescents did find fre-

quency of food preparation was related to higher fruit and vegetable intakes.[59]

The odds ratios found in this study were modest, which may be due to measurement error or bias or the descriptive nature of the study; or it may be that the theoretical constructs selected for the study are not individually major influencing factors on fruit and vegetable intake in this population. Although the odds ratios for the factors assessed in this study were modest and there were not large differences in magnitude between categories of intake, it is possible that tailoring based on current behavior could improve the effectiveness of interventions.[60-62] Intervention studies are needed to explicitly test the utility of these theories and the potential for tailoring based on levels of current behavior.

Limitations of this study include the use of self-reported fruit and vegetable intake as well as the uses of a cross-sectional design (which cannot address causality or temporality) and a convenience sample. The study did not assess parental perceptions regarding modeling, norms, permissive eating, food preparation, or availability and accessibility. It is possible that adults' and adolescents' perceptions of these factors could have differed; however, it may be that adolescent perceptions are more influential upon their behavior than are their parents' perceptions of these factors. The study contributes to the literature on fruit and vegetable intake by adolescents and provides information about dietary influences among black and white young adolescents. It is possible that behavior and determinants of behavior may vary in the adolescent population by age (among other potential factors), and thus, the results discussed here may not generalize to older adolescents.

Relative to the other variables measured, the study suggests the potential importance of the social, physical, and situational environment, especially the importance of the family environment (ie, fruit and vegetable availability, family dinner frequency, and the formation of food preferences) for fruit and vegetable intake in adolescents. Prospective and intervention studies of multilevel determinants of fruit and vegetable intake among adolescents of all ages and across multiple levels of behavior are needed to identify the most influential factors upon eating behavior as well as to test the utility of theory in guiding these efforts. ■

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