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ABSTRACT

Objective: To explore potential predictors of adolescents' fruit and vegetable intake by expanding on current theory and drawing from other adolescent research.

Design: This research reports on baseline and interim data from a school-based intervention study. Data were collected through surveys administered to students at the beginning and end of their 7th grade year.

Setting: The students attended 16 public schools in Minnesota.

Participants: Data were collected on 3878 students; approximately half were female and 67% were white. All students in the 7th grade cohort were invited to participate in the surveys and over 94% completed both surveys.

Variables Measured: Our dependent variable, fruit and vegetable intake, was assessed by a validated fruit and vegetable food frequency scale. Predictive factors assessed included parenting style, spirituality/religiosity, depressive symptoms, and other commonly assessed predictors.

Analysis: Generalized linear mixed model regression. Omnibus test of association using $P < .05$ is reported.

Results: Subjective norms, barriers, knowledge, usual food choice, parenting style, spirituality/religiosity, and depressive symptoms were statistically significant predictors of intake. The model explained about 31% of the variance in fruit and vegetable consumption.

Conclusions and Implications: To better understand adolescents' fruit and vegetable intake, we must explore novel predictors. Our results need to be replicated, and more exploratory research in this field is needed.

KEY WORDS: adolescents, dietary intake, fruits and vegetables

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INTRODUCTION

Increasing adolescents' intake of fruits and vegetables is a public health goal related to both proximal and distal health outcomes.[1-5] Establishing the predictive factors of adolescent fruit and vegetable intake is therefore an important step in informing intervention efforts that aim to influence these eating behaviors.

Behavioral theory is useful in suggesting possible predictors of behavior. The primary behavioral theories that have been used to study eating behaviors of youth are value-expectancy theories that focus on how attitudes and motivation influence behavior and Social Cognitive Theory (SCT), which examines how intrapersonal, environmental, and behavioral factors influence behavior.[6-9] However, these theories have limited predictive ability and, on average, explain no more than 30% of the variance in eating behavior.[10] Behavioral scientists and nutrition interventionists have called for an expansion of our current theoretical models to improve our understanding of factors that influence individual food choice.

The purpose of this research is to explore potential predictors of fruit and vegetable intake in adolescents that are not commonly examined in existing theory-based research on eating behavior. A better understanding of these factors may enhance our intervention efforts to increase fruit and vegetable consumption among adolescents. This article describes the set of predictors we examined and their association with fruit and vegetable intake in a sample of young adolescents.

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METHODS

Study Design and Population

Data for the present analyses were derived from baseline and interim surveys for the Teens Eating for Energy and Nutrition at School (TEENS) project, a randomized school-based nutrition intervention trial for middle school students and their families conducted in 16 middle schools in the Minneapolis/St. Paul, Minnesota, metropolitan area.[11] The TEENS study was designed to evaluate school-environmental, classroom, and family interventions to increase fruit and vegetable consumption and decrease fat intake in 7th and 8th graders. TEENS targeted schools with a lower-income population; thus, only school districts with a minimum of 20% of students approved for free or reduced-price meals were eligible to participate in the research.

Fourteen districts representing 33 schools were eligible for participation, and 9 districts representing 20 schools agreed to participate. The main reasons cited for not participating were time constraints, personnel changes, and lack of interest in the school food environment component of the intervention. One of the 20 schools meeting the study criteria was chosen as a pilot school based on its willingness to be a pilot for pretesting of the TEENS student survey and other evaluation and intervention materials. Three other schools were judged ineligible owing to scheduling conflicts that would have substantially limited students' exposure to the classroom intervention. The remaining 16 schools were randomly assigned from within matched pairs to intervention or comparison (delayed intervention) conditions after all baseline measures were taken. Schools were matched on the proportion of students qualifying for free or reduced-price lunch and the proportion of 7th graders expected to receive all school-based components.[12]

The evaluation design for TEENS included three components: 24-hour dietary recall interviews at baseline and postintervention with a random sample of students; classroom surveys of all students at baseline, interim, and postintervention using the same survey instrument at each time point; and school food environment assessments at baseline, interim, and postintervention. This research uses data from the baseline and interim student survey, which included a 6-item fruit and vegetable food frequency scale.

The baseline survey was self-administered in the fall of 1998 with trained survey staff present during the administration. In each of the 16 schools, the surveys were conducted in a required class (eg, math or science) to ensure that all 7th graders would be reached. Absences were recorded, and one follow-up visit was made to each school to reach as many of the missed students as possible. In the baseline survey administration, 4050 7th graders were eligible to participate. Of these, 3878 (95.8%) completed the survey, whereas 95 (2.3%) were missed owing to absence from school on 2 survey attempts, and 77 (1.9%) were not surveyed owing to parental or student refusal. Ninety-four percent of the 4033 7th graders eligible for the interim survey completed the survey in the spring of 1999. The consent procedures and survey instrument were approved by the University of Minnesota's Committee on the Use of Human Subjects in Research.

Theoretical Model Guiding the Research

SCT and the Theory of Planned Behavior (TPB) were used to inform this etiological research.[6–9] TPB focuses on intrapersonal or motivational aspects of behavior change, whereas SCT includes these intrapersonal factors in a dynamic and reciprocal relationship with environmental and behavioral factors. Our objective was to use these existing theoretical frameworks as a base and to examine potential predictors of adolescent fruit and vegetable consumption using variables that have been previously studied as predictors of dietary intake, suggested by behavioral theory, and predictive in other research on adolescent health behavior. Specifically, we evaluated the predictive effect of subjective norms (a construct from TPB), parenting style, barriers, and optimistic outlook as potentially important influences in an adolescent's social environment. Both SCT and TPB postulate that intraindividual factors also influence health behavior, and constructs frequently assessed in this domain include values, outcome expectations, and knowledge. We assessed these factors, as well as spiritual or religious beliefs and depressive symptoms, as intraindividual factors that might influence adolescent eating choices. Finally, from the behavioral domain of SCT, we evaluated the predictive power of a scale that assessed usual food choice. This scale may represent a proxy for taste preference, habit, or behavioral repertoire. We describe the outcome variable and these predictors below. Cronbach α's were derived from the baseline survey; test–retest Spearman correlations are from our pilot work conducted with 7th and 8th grade students ($n = 65$). A description of the pilot survey work and all psychometric properties of the scales is reported elsewhere.[13] Table 1 summarizes the psychometric properties of the scales.

Outcome Variable: Fruit and Vegetable Consumption

Our dependent variable, daily fruit and vegetable consumption, was measured using a modified version of a fruit and vegetable food frequency scale validated with adolescents and adapted from the Behavioral Risk Factor Surveillance System (BRFSS).[14] Respondents report the frequency of consumption of fruit, fruit juices, salad, potatoes, carrots, and other vegetables over the past year. This measure was not included in our pilot work because the validation study was published after our pilot work was complete. Therefore, test–retest Spearman correlation is not available.

Social/Environmental Domain

Students were asked to respond to questions representing 4 domains of the social environment that might influence healthful eating behavior: subjective norms, barriers to health-

Table 1. Psychometric Properties of Variables

Scale/Question (Number of Items)	Test–Retest Reliability (n ~ 65)*	Cronbach α Baseline Sample (n ~ 3878)*
Fruit and vegetable food frequency scale (6)	NA	.75
Subjective norms (6)	.49	.73
Perceived barriers (6)	.65	.66
Authoritative parenting		
Authoritative parenting: mother (6)	.61	.80
Nonauthoritative parenting: mother (3)	.62	.75
Authoritative parenting: father (6)	.56	.86
Nonauthoritative parenting: father (3)	.62	.77
Outlook for future (4)	.62	.52
Valuation of health, appearance, and achievement (7)	.51	.75
Outcome expectations (7)	.59	.82
Nutrition knowledge (11)	.43	.94
Spiritual beliefs in health behaviors (6)	.72	.80
Center for Epidemiologic Studies Depression Scale (20)	.82	.86
Usual choice score (9)	.65	.67

*Sample size varies by items but was approximately 65 for reliability testing and approximately 3878 for most items in the baseline sample.

ful eating, parenting style, and an optimistic future outlook. We developed a 6-item scale based on the TPB[7] to assess subjective norms concerning healthful eating, including questions such as "People who care about me think I should eat more vegetables." Higher scores indicate subjective norms more supportive of fruit and vegetable consumption. We also developed a barrier scale based on TPB. Barriers measured included cost, appeal, and perceived availability in the environment and higher scores indicate greater perceived barriers.

In addition, we hypothesized that parenting style might also help predict adolescents' eating behavior. From research originating in the child development literature, an authoritative parenting style is one that balances parental responsiveness and control. Authoritative parents set clear boundaries for their adolescent while remaining responsive to their adolescent's needs and rights. This parenting style has been found to foster child competence, self-esteem, and academic achievement.[15] In contrast, a nonauthoritative parent is characterized as intrusive and controlling, providing little support for the adolescent's individuation. Work by Jackson and colleagues found that a nonauthoritative parenting style was associated with adolescent initiation of smoking cigarettes[15] and alcohol use in adolescents.[16] To examine if parenting style also influences adolescent eating behaviors, we included an 18-item parenting style scale assessing mother and father's parenting style.[15] Four subscales initially reported by Jackson and colleagues emerged from factor analysis of the scale: authoritative and nonauthoritative styles for the mother and for the father.[15] In our sample, the internal consistency of each subscale ranged from .75 to .89; test–retest reliability ranged from .56 to .62. To facilitate interpretation, we transformed each subscale to a standard normal distribution, with a mean of 0 and a standard deviation of 1. Respondents who did not answer one or more items for a parent were excluded for both subscales pertaining to that parent.

We also hypothesized that adolescents' eating behavior might be predicted by their positive or negative future outlook. A 4-item scale assessing students' outlook for the future (optimism scale), based on their perceived probability of experiencing a range of socially oriented life events, was adapted from the Voice of Connecticut Youth survey.[17] Higher scores indicated greater optimism.

Individual Domain

Scales were included to assess valuation of health, appearance, and achievement (7 items) and students' outcome expectations concerning healthful eating (7 items). An 11-item nutrition knowledge scale was also included. Higher scores indicate more perceived value of health, appearance, and achievement; more positive outcome expectations; and greater knowledge.

Spirituality is 1 of the 4 domains of health (physical, social, and psychological are the others) and involves a sense of purpose or meaning to life.[18,19] It is a concept that is separate from but related to religiosity. There is some research to suggest that religiosity and/or spirituality may be related to adolescent drug use, delinquency, and other problems,[20,21] but more research on spirituality and other health behaviors of adolescents is needed.[22] We adapted a scale from the Voice of Connecticut Youth survey that asked students to evaluate how much their spiritual or religious beliefs influenced their decisions related to fighting, alcohol and drug use, selection of friends, use of free time, eating patterns, and physical activity.

Higher scores reflected higher reported levels of spiritual or religious influence.

The Center for Epidemiologic Studies Depression Scale (CES-D) was used to measure depressive symptoms. The 20-item scale was originally developed to assess the frequency of depressive symptoms in community-residing adults and has been used successfully with adolescents.[23-25] The results suggest that depressive symptoms are related to a variety of risk behaviors in youth.[26] Although the relationship between depression and poor eating habits has been documented in adults, little is known about the relationship between depression and eating behaviors in youth.

Behavioral Domain

As a measure of existing behavioral repertoire, taste, or habit, we included a 9-item usual choice scale that asked students to indicate which of 2 paired items they usually choose to eat when given the choice. The paired items represented a more and a less healthful option based on fat content, for example, "Which item would you usually choose: french fries or carrot sticks?" Higher scores indicated more lower-fat food choices.

Demographic Variables

Sex and date of birth came from school records, and date of birth was then used to compute the respondents' age on the date of the survey. Students reported race/ethnicity by self-reported response to the question, "Do you think of yourself as White; African American; Hispanic/Latino; Asian or Pacific Islander; Native American; Multi-Racial; or Other?" Students reported whether they currently participated in the free/reduced-cost meal program, the number of parents with whom they lived, the highest level of educational attainment for each parent, and the number of parents who worked full time.

Analysis

We used analytic methods that take into account the extra variation caused by sampling schools as occurs in group-randomized research involving schools.[27] We also needed an analysis that would be appropriate for the skewed distribution often associated with count-type data such as servings of fruits and vegetables. The generalized linear mixed model is appropriate when there are multiple sources of random variation and when observation-level errors cannot be assumed to be normally distributed. Schools and students were the two sources of random variation in the data. The SAS GLIMMIX macro was used for the analyses of number of servings of fruits and vegetables and was configured to provide results similar to those provided by Poisson regression, except that the standard errors, confidence bounds, chi-square tests, and *P* values reflected the extra variation attributable to schools. All analyses were conducted using Version 6.12 of SAS/STAT.[28] The dependent variable was from the interim data, and all predictors were from the baseline data.

For the dependent variable, we fit initial models containing the demographic variables, including race, gender, age, family structure, receipt of free/reduced-price lunch, parent employment status, and parent educational level. A backward elimination procedure was used, removing nonsignificant predictors one at a time until all predictors retained in the model had *P* values at the .10 level or lower. Other predictors were then evaluated separately by adding them to the final demographic model with a quadratic term to allow for nonlinearity in the relationship between the predictor and the dependent variable. When all of the potential predictor variables had been evaluated separately, variables with a *P* value of .10 or lower and those with a significant quadratic term were entered together into a model that also included the final demographic predictors from the initial model. Terms with a *P* value greater than .20 were then eliminated from the model unless a quadratic term for the same variable met the criteria for retention in the model. We used a backward elimination procedure to remove variables with *P* values above .10, re-evaluating other predictors at each step. To aid in interpretation of the coefficients for the continuous predictive variables retained in the analysis, we computed the predicted fruit and vegetable score for the median value and values at the 10th, 25th, 75th, and 90th percentiles. An event rate ratio is presented, representing the comparison in fruit and vegetable intake at varying levels of predictor variables using the median of the predictor variable as the reference standard.

RESULTS

Table 2 shows the sample characteristics. At baseline, the mean age of the sample was 12.8 years, and males and females were fairly evenly represented. The majority of the students were white (67%) and came from a two-parent household (69%). Almost one quarter of the students qualified for the free or reduced-price meal option at school. Table 3 presents the unadjusted median, possible ranges, and 10th, 25th, 75th, and 90th percentiles for the psychosocial predictors and fruit and vegetable consumption. Note that for the nutrition knowledge scale, more than 50% of the sample correctly answered all of the items.

Table 4 presents the independent variables that were retained in the final model. The columns represent 5 points on the response scale for each independent variable: the 10th percentile, the 25th percentile, the median, the 75th percentile, and the 90th percentile, with the median as the reference level. The tabled values are event rate ratios from the final model comparing servings of fruits and vegetables in each of the reported percentile groups with those of the reference group, and 95% confidence intervals are included. Event rate ratios and confidence intervals for significant terms were derived from a final model that included only significant terms.

A significant linear relationship was seen between subjective norms and the consumption of fruits and vegetables. Students who scored at the 90th percentile on the subjective

Table 2. Demographic Characteristics of Sample at Baseline

Characteristic	N	Mean	SD	%
Age, y	3878	12.8	0.38	
Gender	3878			
Female	1895			48.9
Male	1983			51.1
Ethnicity	3845			
White	2568			66.8
African American	429			11.2
Hispanic	107			2.8
Asian	269			7.0
Native American	67			1.7
Mixed	235			6.1
Other	170			4.4
Lives with two parents	3878			
Yes	2660			68.6
No	1218			31.4
Parent educational level	3878			
Both high school or less	513			13.2
One high school or less	193			5.0
One college or more	746			19.2
Both college or more	786			20.3
Other	652			16.8
Missing/don't know	988			25.5
Parent employment status	3878			
One full time	1429			36.8
Both full time	1777			45.8
Other	672			17.3
Free/reduced-price lunch				
No	2962			76.4
Yes	916			23.6

norms scale reported consuming 1.07 times the number of servings of fruit and vegetables daily as those who scored at the median (see Table 4). The event rate ratio is significant, as indicated by the fact that the confidence interval does not include 1.0. In contrast, the event rate ratio comparing those at the 10th percentile on the scale with those at the median is 0.94, suggesting that those with lower perceived social expectations to eat a healthful diet reported eating significantly fewer fruits and vegetables compared with those perceiving more normative influences toward healthful eating.

Two parenting style scales were found to relate to consumption of fruit and vegetables. For the maternal authoritative parenting style subscale, students who scored at the 75th and 90th percentiles reported consuming 1.06 and 1.17 times as many servings of fruits and vegetables as those at the median, respectively. However, students who perceived lower levels of maternal authoritativeness (10th and 25th percentiles) did not consume fewer fruits and vegetables compared with students at the median. The test for linear trend for this term was significant at $P < .05$, and a quadratic term was significant at $P < .005$. Students scoring at the 90th percentile on the paternal nonauthoritative parenting style subscale reported eating 1.09 times as many servings of fruits and vegetables as those who scored at the median, and the relationship between paternal nonauthoritative style and fruit and vegetable intake was linear.

The fourth row of Table 4 presents the results for the barriers scale and fruit and vegetable consumption. Compared with those at the median on the barriers scale, those at the 10th percentile reported eating 1.25 times as many servings of fruit and vegetables. Those scoring at the 25th percentile consumed 1.08 times as many servings of fruits and vegetables. Subjects who scored above the median (indicating above-average barriers to the consumption of fruits and vegetables) reported eating fewer servings of fruits and vegetables. A significant quadratic function was evident, reflecting the greater intake of fruits and vegetables by students reporting the lowest barriers in their social environment.

The relationship between nutritional knowledge and servings of fruit and vegetables had a quadratic component, with those scoring at the 10th, 75th, and 90th percentiles consuming as many servings of fruits and vegetables as those scoring at the median on the scale. Students who scored at the 25th percentile, representing low nutritional knowledge, consumed 1.24 times as many servings of fruits and vegetables as those scoring at the median.

Scores on the spirituality/religiosity scale were related to servings of fruits and vegetables. Students who scored at the 90th percentile on the scale reported eating 1.05 times as many servings of fruits and vegetables, whereas those scoring at the 10th percentile ate 0.94 times as many servings as those at the median. In general, reporting a stronger influence of spirituality or religion on a variety of health behaviors was positively related to fruit and vegetable consumption.

Depression was also related to fruit and vegetable intake in a linear fashion. Those who scored at the 90th percentile on the depression scale (indicating higher levels of depressive symptoms) reported eating 1.12 times as many servings of fruits and vegetables, whereas those scoring at the 10th percentile reported eating 0.95 times as many servings as those at the median.

Scores on the usual choice scale were associated with intake of fruits and vegetables; higher scores on the usual behavior scale indicate choosing more healthful foods. Students scoring at the 90th percentile reported consuming 1.22 times as many servings of fruits and vegetables as those scoring at the median. Students scoring below the median ate fewer servings of fruits and vegetables than those scoring at the median.

The only demographic variable that was a significant predictor of fruit and vegetable consumption was parents' educational level. When neither parent had any education past high school (18.2% of the sample) or when students did not know parental education levels (25% of the sample left this item blank), fruit and vegetable consumption was lower compared with that of other students whose parents had higher

Table 3. Median and Quantile Values of Psychosocial Predictors and Fruit and Vegetable Consumption*

Variable (Possible Range)	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
Subjective Norms Scale (6-30)	12.00	15.00	19.00	23.00	26.00
Maternal authoritative style†	–1.17	–0.55	0.07	0.69	1.31
Maternal nonauthoritative style†	–1.50	–0.67	–0.26	0.56	1.39
Paternal authoritative style†	–1.05	–0.54	0.22	0.72	1.23
Paternal nonauthoritative style†	–1.39	–0.57	–0.16	0.66	1.48
Perceived Barriers Scale (6-30)	17.00	20.00	24.00	26.00	29.00
Valuation Scale (7-35)	22.00	26.00	29.00	32.00	34.00
Optimism Scale (4-20)	14.00	16.00	18.00	19.00	20.00
Outcome Expectations Scale (7-35)	16.00	21.00	26.00	31.00	34.00
Nutrition Knowledge Scale (10-20)	11.00	14.00	20.00	20.00	20.00
Spirituality/Religiosity Scale (0-12)	0.00	1.00	5.00	7.00	9.00
Depressive Symptoms (CES-D) Score (0-60)	4.00	6.00	11.00	18.95	27.00
Usual Choice Scale (4-20)	9.00	11.00	13.00	15.00	17.00
Fruits and vegetables per day (0-30)	1.00	1.85	3.42	6.21	9.71

*Sample size ranged from 3351 to 3878 owing to missing data.
†Scales are standardized; therefore, range is not relevant.
CES-D indicates Center for Epidemiologic Studies Depression Scale.

levels of education. Qualitative research to understand what it means when an adolescent does not know his or her parents' education level would help us better interpret this finding. It may be that not knowing a parents' educational level represents a lower educational attainment by a parent, but we cannot know that from this research.

DISCUSSION

This research adds to the existing literature on predictors of adolescent fruit and vegetable intake by examining potential psychosocial factors that have been largely unexplored. Specifically, we examined parenting style and optimism as

Table 4. Event Rate Ratios and 95% Confidence Intervals Associated with Significant Predictors of Fruit and Vegetable Intakes (N = 3878)*

Variable	10th Percentile	25th Percentile	Median (Reference)	75th Percentile	90th Percentile
Social/environmental subjective norms*	0.94 (0.90, 0.98)	0.96 (0.94, 0.99)	1.00	1.04 (1.01, 1.06)	1.07 (1.02, 1.11)
Maternal authoritative parenting style subscale*†	1.02 (0.97, 1.06)	0.99 (0.97, 1.01)	1.00	1.06 (1.03, 1.09)	1.17 (1.09, 1.25)
Paternal nonauthoritative parenting style subscale*	0.94 (0.89, 0.99)	0.98 (0.96, 1.00)	1.00	1.04 (1.01, 1.08)	1.09 (1.02, 1.16)
Perceived barriers*†	1.25 (1.16, 1.34)	1.08 (1.06, 1.10)	1.00	0.90 (0.87, 0.93)	0.87 (0.81, 0.93)
Individual					
Nutritional knowledge*†	1.00 (0.91, 1.10)	1.24 (1.14, 1.34)	1.00	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)
Spirituality/religiosity*	0.94 (0.89, 0.99)	0.95 (0.91, 0.99)	1.00	1.03 (1.01, 1.05)	1.05 (1.01, 1.09)
Depressive symptoms*	0.95 (0.93, 0.97)	0.96 (0.95, 0.98)	1.00	1.06 (1.03, 1.09)	1.12 (1.06, 1.19)
Behavioral					
Usual choice*	0.82 (0.78, 0.85)	0.90 (0.88, 0.92)	1.00	1.11 (1.08, 1.13)	1.22 (1.17, 1.28)
Demographic		**Event Rate Ratio**		**95% Confidence Interval**	
Parent education level*					
Both high school or less		0.81		0.72-0.91	
One high school or less		0.91		0.75-1.10	
One college or more		0.91		0.83-1.00	
Missing/don't know		0.84		0.77-0.93	
Other		0.92		0.83-1.01	
Both college or more		1.00		(Reference)	

*Omnibus test of association $P < .05$ in final model.
†Significant quadratic component.

potentially important social/environmental constructs and spirituality and depressive symptoms as possible individual or psychological predictors of fruit and vegetable intake. This study also adds to the literature because it was conducted with a large sample of adolescents from a variety of ethnic backgrounds.

Our findings suggest that a variety of environmental, individual, and behavioral factors are associated with adolescents' intake of fruits and vegetables. As expected, greater intake of fruits and vegetables was evident when students reported a stronger sense of perceived normative expectations from significant others. Perceived barriers were also associated with intake of fruits and vegetables in an expected direction. The greater the barriers perceived, the fewer fruits and vegetables consumed. Barriers, both perceived and actual, are well understood as important correlates and predictors of fruit and vegetable consumption. Reducing actual and perceived barriers to healthful choices remains an important public health objective.

Findings from the parenting scales suggest that an authoritative parenting style by a mother or female figure (a style that sets clear boundaries but is also responsive to her child's needs and rights) predicted fruit and vegetable consumption by teens. For fathers or male role models, the nonauthoritative, or more autocratic, style was associated with greater consumption of fruits and vegetables by teens. We can only speculate on why the effect of parenting styles on fruit and vegetable consumption differed by the gender of parents. It may be that mothers, by virtue of their role as gatekeeper of family eating patterns, give more messages about eating. If the number of messages is greater by mothers than fathers, a less responsive parenting style (perceived as overly demanding or nagging) in combination with more messages by a mother may have negative effects. If, on the other hand, fathers give fewer messages about what their teen should or should not eat, a more directive approach might be more effective in encouraging adolescent intake of healthful foods. Additional research testing the reproducibility of our findings as well as qualitative research may help validate and explain these findings.

Among the individual/psychological factors measured, knowledge, spirituality, and depressive symptoms emerged as significant predictors of fruit and vegetable intake. Our finding that only those in the 25th percentile for the knowledge score reported significantly greater intake of fruits and vegetables than students in all other quantiles is very perplexing. The results may be attributable to the fact that most students scored very high on the knowledge questions.

Very little research has been done on the influence of spirituality or religious beliefs in the health behaviors of youth. It is easy to understand why this area is understudied. Assessing spirituality is certainly a formidable challenge, and criterion validity is impossible. Some researchers are reticent to ask students about their religious or spiritual beliefs, particularly as part of school-based research. In addition, not knowing what to do with the findings may also hinder the research in this area.[22] However, a wealth of evidence indicates that youth have spiritual beliefs and interests,[29] and other investigators have reported a positive relationship between religiosity and spirituality and engaging in health-promotive behaviors.[22,30,31] We decided to ask about spirituality in the TEENS student survey to obtain some experience in assessing and interpreting findings related to spirituality. We found that, even after controlling for many demographic and psychosocial variables (including optimism and depression), spiritual or religious belief emerged as a significant predictor of fruit and vegetable intake. Students who reported that spiritual or religious beliefs affected their decisions about a range of health behaviors, including eating habits, were more likely to report greater intakes of fruits and vegetables relative to students who did not report a spiritual influence on their health behaviors. Our findings add support for research investigating the association of spirituality and health-enhancing behavior in youth.

One of our most perplexing findings is that students who reported higher levels of depressive symptoms reported significantly greater intake of fruits and vegetables compared with students reporting fewer depressive symptoms. This finding contradicts what we expected to see because the majority of research concerning health behavior and depressive symptoms in youth indicates that youth with elevated depressive symptomatology are more likely to engage in risk behaviors than youth who have fewer symptoms. Because we know that eating disorders and overeating are related to depression, our results might suggest that students who have more depressive symptoms are eating more in general and that the high consumption of fruits and vegetables is just one part of a pattern of overconsumption. Recent research studying adolescent vegetarians showed a higher level of depressive symptomatology in vegetarian youth compared with nonvegetarians,[32] although we have no reason to suspect that vegetarian adolescents were over-represented in this sample. Future work examining depression as a predictor of fruit and vegetable intake might take into consideration total caloric intake and other consumption patterns.

Finally, our usual choice scale replicated other research findings that have shown that elements associated with eating a healthful diet are correlated.[33] Our usual choice scale primarily assessed healthful choices based on dietary fat; a low score on this scale indicated that the student chose more higher-fat than lower-fat choices. It is not surprising that students who choose a lower fat diet are also more likely to report eating more fruits and vegetables. The magnitude of the relationship is worth noting, however. Students who scored in the 90th percentile for scores on usual eating behavior reported eating 1.22 times as many daily servings of fruit and vegetables than those students at the median for usual eating behavior scores. Only barriers and nutritional knowledge, at the 10th and 25th percentiles, respectively, had event rate ratios at that magnitude.

Demographic factors, valuation of health and appearance, optimism, and outcome expectations did not emerge as significant predictors of intake. Although some of these factors

have been shown to be important correlates of other youth health behaviors, they were either not salient for this sample or age group, were poorly measured, or were correlated with other predictors.

Because we used Poisson regression, an r^2 explaining the proportion of variance attributed to the independent variables in our model was not directly available from our analysis. However, we were able to approximate an r^2 using the percentage change in the log likelihood, an indicator of how well the model fits. Using this technique, we determined that our model explains about 31% of the variance in fruit and vegetable consumption. In other research using TEENS data from control schools only, we determined that the use of variables representing only subjective norms, attitudes, and barriers from TPB explained 7% of the variance in adolescent eating behavior.[34] Therefore, the additional variance explained by parenting style, spirituality, depression, and usual choice was substantial. Still, we were able to account for only about one third of the variance in fruit and vegetable intake. Other factors, particularly environmental factors that tap access and availability, are likely important predictors to assess.[35-37]

This study had several strengths and limitations. The population sample of the TEENS study provided a large group of adolescents, and the high response rate on the survey increases the external validity of the findings. Psychometric analysis done on the survey items indicates that the scales used in the analysis had adequate to good internal consistency and reliability.[13] There are a few scales with Cronbach α levels lower than .70 (perceived barriers, outlook for the future, and the usual choice score), and two of those scales (perceived barriers and usual choice score) emerged as statistically significant predictors of fruit and vegetable intake. It is likely that developing survey items that better assessed each construct would have increased the internal consistency of the scale and added to their predictive strength. Additional theory-based psychometric work is greatly needed; improvement in validity and reliability estimates will increase the confidence that we have in our findings. The fruit and vegetable food frequency score has been validated with adolescents but still represents only a screening tool for assessing fruit and vegetable intake. Additional research using multiple 24-hour recalls or other more in-depth diet assessment tools is warranted. Our research question was informed by theory but also attempted to assess other potential predictors that have not been studied in relationship to fruit and vegetable consumption. Because our theoretical models to date have only been moderately successful in explaining adolescent health behavior, innovative etiologic work is justified.[10] Some of our findings are very difficult to interpret, especially the findings on parenting style, spirituality, and depression, and more qualitative research is needed to better understand how adolescents are interpreting the questions that we used to assess these factors, as well as how these factors might be influencing their food choices. Our findings are limited by the evaluation and measurement options available. Our data are all self-report, and only individual-level predictors were examined.

IMPLICATIONS FOR RESEARCH AND PRACTICE

A great deal of research is needed to better understand factors that influence adolescent dietary intakes. Although this research focused on intra- and interindividual factors, there is a great need for research that investigates the association between physical environmental-level factors and youth fruit and vegetable intake.[37-39] In addition, research that looks at predictors of other elements of adolescents' diets, beyond fruits and vegetables, is sorely needed. It may be that some of the predictors suggested in this research apply to other elements of the diet. Other diet assessment methodologies should be used as the dependent variables in this type of research to help determine if more sensitive dietary methods, such as multiple 24-hour recalls or more complete food frequencies, reveal other predictors of intake.

Understanding the influences of adolescent fruit and vegetable intake is a challenging but important task. A better understanding of the predictors of fruit and vegetable intake may help us design better programs and healthier environments that facilitate and encourage the consumption of fruits and vegetables by youth. It is our hope that this study spurs other investigators to conduct exploratory, etiologic work that is driven by theory, informed by research in other fields, and open to new possibilities.

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