Research Article

Parent Food and Eating Behavior Assessments Predict Targeted Healthy Eating Index Components

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ABSTRACT

Objective: To examine the ability of parent response to assessments of in-home availability of 20 fruits and vegetables (FV), self-efficacy/outcome expectancy to prepare FV that their child would eat, modeling of FV eating behavior, and eating competence to predict parents' targeted Healthy Eating Index−2010 (HEI) scores at baseline.

Design: Cross-sectional survey.

Setting: Sixty-one classrooms in 8 northern Colorado elementary schools over 4 years participating in *Fuel for Fun* (FFF), a school-based culinary and physical activity intervention.

Participants: Parents and guardians (n = 71) of fourth-grade youths from participating classrooms.

Main Outcome Measure(s): Healthy Eating Index−2010 scores as derived from 24-hour recalls administered with the Automated Self-Administered 24-hour dietary assessment tool.

Analysis: Generalized linear regression models tested the predictive validity of survey assessments for targeted HEI components. Results were considered statistically significant at $P \leq .05$.

Results: In-home FV availability predicted total fruit ($P = .01$), whole fruit ($P = .001$), and total vegetable ($P = .01$) HEI, and parent modeling of FV eating behavior predicted total fruit ($P = .01$) and whole fruit ($P = .02$) HEI. However, these survey measures were not associated with other HEI components, including total HEI. Parent self-efficacy/outcome expectancy to prepare FV that their child would eat or like was not associated with total HEI or HEI components. Eating competence did not predict total HEI but was associated with seafood and plant proteins in the anticipated direction ($P = .04$).

Conclusions and Implications: The results demonstrated construct validation of some parent *Fuel for Fun* survey assessments with targeted HEI components. Additional assessment in larger and more diverse samples is warranted so that nutrition education and behavior researchers may use these valid and reliable, brief, low-cost, and easy-to-use survey instruments as a proxy for dietary intake.

Key Words: diet assessment, dietary quality, eating competence, fruit and vegetable availability, Healthy Eating Index (*J Nutr Educ Behav.* 2019; 51:711−718.)

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INTRODUCTION

A challenge of nutrition education and behavior research is selecting survey instruments that are reliable and valid, yet feasible with minimal burden to participants and investigators. Validated survey instruments about eating attitudes and food behaviors are useful and easy to employ for both participants and researchers,[1,2] but largely have not been investigated for their association with dietary quality, such as compliance with the US Dietary Guidelines for Americans (DGA). This lack of evidence is problematic because improved dietary quality underlay the construct of many short questionnaires and was the focus of many nutrition interventions, especially those related to fruits and vegetables.[1−3] The Healthy Eating Index (HEI) is a commonly employed dietary quality measure used to assess compliance with the Dietary Guidelines for Americans.[4,5] Healthy Eating Index scores cannot be derived from dietary screeners or other brief attitude or behavior instruments.[6] Food frequency questionnaires (FFQs), 24-hour dietary recalls, and diet records can be used to calculate HEI scores, but the time and cost of administration and analysis of these methods

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limit feasibility in many nutrition education evaluation settings.

Several eating and food behavior instruments administered to parents of grade-school children were determined to be valid in terms of content, defined as "the extent to which a specific measurement reflects the specific intended domain of content."[7] These include in-home fruit and vegetable (FV) availability,[8] self-efficacy/outcome expectancy to offer FV that their child would eat or like,[9] modeling of FV consumption at mealtimes,[10,11] and eating competence.[12,13] However, the construct validity of these tools to demonstrate expected relations between the measure and other variables in the content domain[11] is limited in scope. In particular, evidence is lacking that these specific measures predict increased dietary quality for the parent respondent.

The home food environment influences children's dietary quality and weight status through both sociocultural influences (ie, parent modeling, parent feeding style and eating behaviors) and the physical environment (ie, availability of FV).[14,15] Therefore, it is important to understand how survey assessments of the home food environment predict both parent and child dietary quality. In-home food availability assessed using an instrument adapted from multiple sources[16–18] did not demonstrate a relationship between FV availability with an earlier version of HEI,[19] although participants were all female, low-income, overweight or obese, and African American. Responses to the Home Food Inventory (HFI), which is similar to the in-home FV availability survey,[8] were compared with parents' FFQ responses and found to be significantly correlated with parent MyPyramid equivalents for total number of FV servings,[20] but HEI was not examined. Moreover, observations from video-recorded family dinners at home demonstrated that the amount of FV available in the home as assessed by the HFI was positively associated with the presence of FV at dinner meals.[21] However, to the authors' knowledge, no previous research compared responses to the in-home FV availability survey[8] with total HEI and HEI components. Direct evidence supporting a relation between parents' modeling of FV eating behaviors with parent dietary quality is also lacking. Parent self-efficacy/outcome expectancy to prepare and provide FV that their child would eat or like was shown to be related to home availability of these foods and a predictor of child consumption.[9] Yet, to the authors' knowledge, no evidence is available to relate parent self-efficacy to offer FV that their child would eat or like with the parents' dietary quality.

Eating competence is an approach to eating attitudes and behaviors that is "positive, flexible and relaxed about eating with an intrinsic motivation to eat a variety of food, maintain energy balance by attending to internal cues, prioritizing and structuring meals."[22] Evidence for an association between eating competence and HEI is also limited. In a sample of low-income Pennsylvania females, competent eaters had significantly higher intakes of fiber, vitamin A, vitamin E, vitamin C, most B vitamins, magnesium, iron, zinc, and potassium compared with those who were not eating competent. Eating competence was associated with a prudent diet pattern, characterized by the intake of fruit, vegetables, and low-fat dairy, whereas not being eating competent was associated with the Western dietary pattern characterized by foods higher in fat, salt, and sugar.[22] Total HEI was higher among competent eaters relative to participants who were not eating competent, but the difference was not statistically significant ($P = .08$).

The purpose of this study was to examine the association of in-home FV availability,[8] parent self-efficacy and outcome expectancies to offer FV that their child would eat or like,[9] parent modeling of FV consumption at meal and snack times,[10] and eating competence with the construct of parent diet quality as measured by select HEI-2010 components and total HEI-2010 score.

METHODS

Study Design and Participants

This descriptive, cross-sectional survey included parents of fourth-grade children enrolled in an impact assessment of *Fuel for Fun* (FFF), a school-based culinary and physical activity intervention guided by the Social Ecologic Model,[23] Social Cognitive Theory,[24] and Experiential Learning Theory[25] delivered in 8 northern Colorado schools.[26] A total of 83 classes participated across 4 cohorts of students, but dietary assessment was not conducted in Cohort 1 (n = 22 classes). Therefore, parents from a total of 61 classes were eligible to participate in the current study. Demographics of the overall school population varied by location, with white students comprising the majority (66%–80%), followed by Hispanic/Latino (9%–30%) and low numbers of black students (<1%). Flyers were sent home by teachers to recruit parents from the school population. Recruitment materials provided a URL to a consent form and survey that included the measures under investigation. The final survey frame ascertained interest in participation in a dietary assessment. Parents expressing interest were e-mailed a link to consent to the diet assessment component. Submission of this consent triggered delivery of contact information to the Pennsylvania State University Diet Assessment Center to administer the dietary assessment. The Figure describes the flow of FFF participant participation. This study was approved by the Institutional Review Boards at Colorado State University and the Rochester Institute of Technology.

Survey Measures

The survey set included demographic items, self-reported height, weight, and food assistance program use. All measures reported in the current investigation were collected before delivery of the FFF intervention. In-home FV (fresh, canned, frozen, and 100% fruit juice) availability was assessed over the past week using a modified version from Marsh and colleagues.[8] Respondents confirmed or denied availability of 8 fruits (apples, bananas, cantaloupes or melons, grapes, mangos, oranges, strawberries, and watermelons), 9 vegetables (broccoli, carrots, corn, cucumbers, green beans, lettuce/greens, peas, potatoes (not french fries), and tomatoes), and

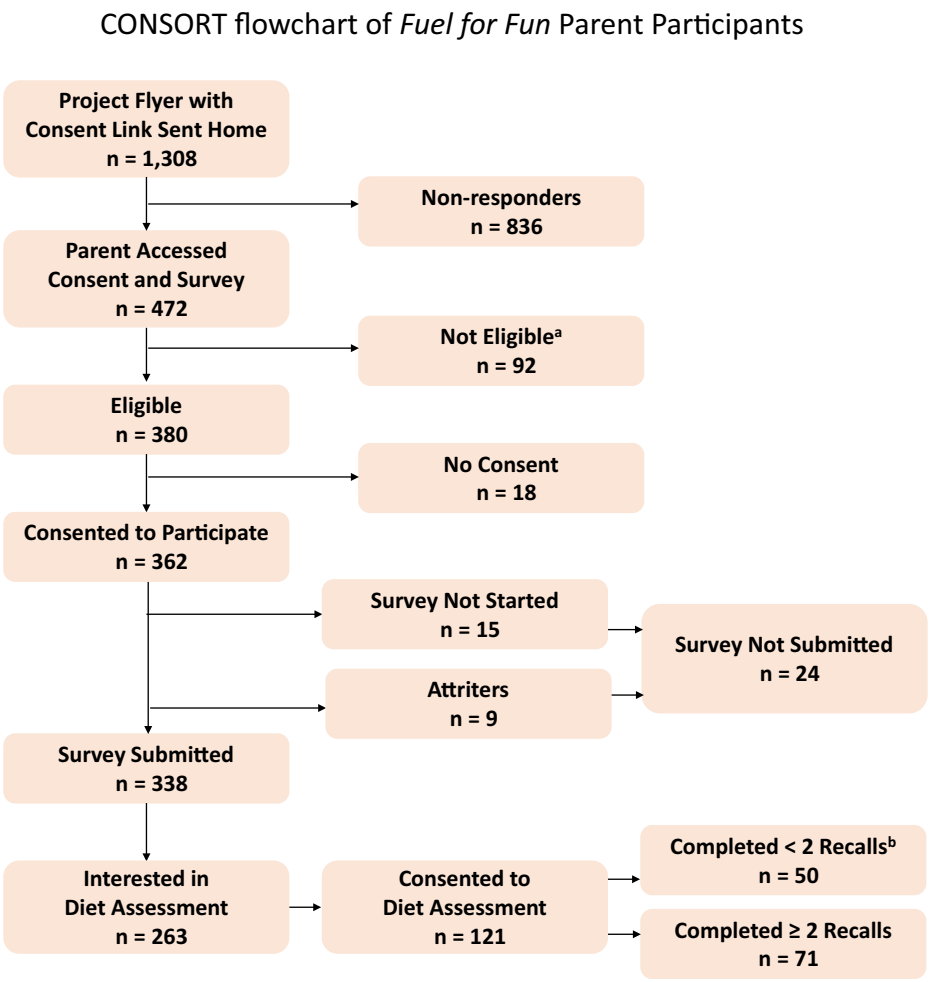

Figure. Consolidated Standards of Reporting Trials flowchart of *Fuel for Fun* parent participants. [a]Reasons for ineligibility included: not a *Fuel for Fun* parent, not English speaking, duplicate attempts, eligibility unknown, or previous participation with another child; [b]n = 44 did not complete any diet recalls and n = 6 completed 1 diet recall.

3 100% fruit juices (apple, grape, and orange). Available items were summed; possible scores ranged from 0 to 8 for fruit availability, 0 to 9 for vegetables availability, and 0 to 20 for fruit and vegetable availability (including 100% fruit juice). Parent-perceived ability to prepare and offer FV that their child would eat (ie, self-efficacy and outcome expectancies, respectively) was assessed with 12 items derived from tested measures of parent self-efficacy and expectancies modified to include only items related to FV and meals.[9] Examples of survey items included *I can prepare vegetables that my child will eat*, *I can prepare vegetables that my child will like*, and *If I prepare a meal together with my child, my child will eat the meal*. Each item had 5 response options, with possible summed scores ranging from 12 (low) to 60 (high). A modified version of Cullen et al[11] measured parent modeling of FV consumption at meals and snacks during the past week. Example questions included *How often do you eat . . . [breakfast; fruit at breakfast; lunch; vegetables at lunch; fruit at lunch, etc] with your child?* Each of the 11 items had 4 response options. After items were summed, possible scores ranged from 0 (low) to 33 (high). Eating competence was measured with the validated 16-item Satter Eating Competence Inventory Satter Eating Competence Inventory (ecSI version 2.0, Satter and Lohse, Madison, WI; 2011) to assess general eating attitudes and behaviors not specific to FV.[12,13,27] Sample eating competence items include *I feel it is okay to eat the food that I like*, and *I enjoy food and eating*. Each item had 5 response options. Possible scores ranged from 0 (low) to 48 (high); scores of ≥ 32 denoted eating competence. Design and evaluation of these measures were reported elsewhere.[10,26] Copies of the survey measures that are available for use publicly are provided as Supplementary Data

Dietary Assessment

Dietary intake data from 24-hour recalls were collected and analyzed using the Automated Self-Administered 24-hour dietary assessment tool (versions 2011 and 2014, National Cancer Institute, Bethesda, MD).[28] Participants were contacted via e-mail on randomly selected, unannounced days. E-mails to participants included training materials and contact

information for study personnel who could answer questions. Participants who were unavailable to complete online assessments were e-mailed again on a different day until up to 3 days of intake (2 weekdays and 1 weekend day) were collected for each participant or the participant declined to complete a recall. Only participants completing ≥ 2 days of recall were included in the final analysis.

Statistical Methods

Data were analyzed using SPSS Statistics for Windows (version 25.0, IBM Corp, Armonk, NY, 2017). Healthy Eating Index–2010 was calculated by averaging up to 3 days of intake for each of the 12 nutrient and food group variables needed to create the individual component scores. Healthy Eating Index–2010 variables were expressed per 1,000 kcal and algorithms were used to apply the standards for minimum and maximum component scores. The total HEI score was then calculated by summing the individual component scores.[29]

The researchers examined HEI and component scores for normality. Variables with a non-normal distribution were transformed using the square root of the reflectance to achieve normality. The HEI components for greens and beans and total protein foods could not be transformed to achieve a normal distribution and were not examined as outcome variables, but they contributed to the calculation of total HEI. Separate linear regression models determined the ability of in-home FV availability, self-efficacy/outcome expectancy, parent modeling of FV consumption, and eating competence to predict the HEI outcomes of total fruit (all forms of fruit, including juice), whole fruit (all forms of fruit, excluding juice), total vegetables, refined grains, seafood and plant proteins, dairy, fatty acids, whole grains, empty calories, sodium, and total HEI. Models were adjusted for *a priori* covariates (gender, race, education, and *Supplemental Nutrition Assistance Program* (SNAP) participation) identified on the basis of previous research.[4,30–32] Statistical significance was determined at $P \leq .05$.

RESULTS

Participant Characteristics

Dietary recall participants (n = 71) were mostly female (86%), highly educated, and predominately white, non-Hispanic. Body mass index was categorized as overweight or obese for 41% of participants. Age ranged from 25 to 58 years (mean, 37.3 [SD = 6.5] years). Approximately 10% of participants were currently enrolled in SNAP (Table 1). Sixty-eight participants (94%) completed all 3 24-hour diet recalls and 4 (6%) completed 2 recalls.

Mean scores for in-home fruit, vegetable, and combined FV availability, self-efficacy/outcome expectancy, and parent modeling are reported in Table 2. Both self-efficacy/outcome expectancy and parent modeling survey sets demonstrated internal consistency (Cronbach $\alpha = .97$ and .73, respectively). A total of 38 (54%) participants were classified as eating competent; 30 (42%) were not eating competent. Eating competence could not be determined for 3 participants (4%) who did not complete this section (Table 2). Internal consistency of the ecSI 2.0 measure was also evident (Cronbach $\alpha = .88$). Total HEI score average was 56.2 (SD = 12.1) out of a possible 100; mean HEI subcomponent scores are listed in Table 2.

In-Home FV Availability, Eating Attitudes and Behaviors, and HEI Scores

Table 3 presents the predictive validity of the survey measures with HEI and select HEI components adjusted for race/ethnicity, gender, education, and SNAP participation. Multivariate coefficient values for the regression models varied with the outcome variable (total HEI: 0.11–0.19; total fruit: 0.05–0.14; whole fruit: 0.08–0.19; total vegetables: 0.04–0.17; seafood and plant proteins: 0.05–0.17). Significant positive associations were noted for in-home combined FV availability and total fruit, whole fruit, and total vegetable HEI scores. In-home fruit

Table 1. Characteristics of *Fuel for Fun* Parent Participants With ≥ two 24-h Recalls (n = 71)

Characteristics	Participants, n (%)
Gender	
Male	10 (14)
Female	61 (86)
Race/ethnicity	
White, non-Hispanic	61 (86)
White, Hispanic	4 (6)
Native American/Alaskan Native/Asian/multiple	6 (8)
Age, y (mean [SD])[a]	37.3 (6.5)
Body mass index categories, kg/m^2	
Normal weight (18.5–24.9)	42 (59)
Overweight (25.0–29.9)	18 (25)
Obese (≥ 30.0)	11 (16)
Highest education	
High school graduate or General Educational Development	4 (4)
Some college or 2-y degree	15 (21)
4-y college graduate	29 (41)
Postgraduate college	24 (34)
SNAP participation	
Yes, currently participates in SNAP	7 (10)
Yes, participated in SNAP in past, but not now	8 (11)
No, never participated in SNAP	56 (79)

SNAP indicates *Supplemental Nutrition Assistance Program*.
[a]n = 71 participants provided age.Note: Participants were parents of fourth-grade youths.

Table 2. *Fuel for Fun* Parent Participants' Food and Eating Behaviors and Healthy Eating Index (HEI) Scores

Survey	n[a]	Reported Range	Mean (SD)
In-home fruit availability (range = 0–8)	71	1–8	4.5 (1.4)
In-home vegetable availability (range = 0–9)	71	2–9	6.7 (1.7)
In-home fruit and vegetable availability (range = 0–20)	71	5–18	12.2 (2.7)
Self-efficacy/outcome expectancy (range = 12–60)	70	12–60	52.5 (10.5)
Parental modeling (range = 0–33)	70	2–23	15.1 (3.8)
Eating competence (range = 0–48)	68	17–48	33.6 (7.3)
Healthy Eating Index (HEI), total (range = 0–100)	71	23.0–77.1	56.2 (12.1)
Total fruit HEI (range = 0–5)	71	0–5	3.0 (1.9)
Whole fruit HEI (range = 0–5)	71	0–5	3.4 (2.0)
Total vegetable HEI (range = 0–5)	71	1.4–5	4.2 (1.2)
Greens and beans HEI (range = 0–5)	71	0–5	2.6 (2.2)
Whole grains HEI (range = 0–10)	71	0–10	3.1 (3.0)
Dairy HEI (range = 0–10)	71	0.04–10	6.8 (2.8)
Total protein foods HEI (range = 0–5)	71	1.2–5	4.6 (.8)
Seafood and plant proteins HEI (range = 0–5)	71	0–5	3.6 (1.7)
Fatty acids HEI (range = 0–10)	71	0–10	3.6 (2.9)
Refined grains HEI (range = 0–10)	71	0–10	6.7 (3.0)
Sodium HEI (range = 0–10)	71	0–10	2.6 (2.6)
Empty calories HEI (range = 0–20)	71	0–20	12.4 (4.6)

[a]Values < 71 represent missing responses to specific survey items.
Note: Participants were parents of fourth-grade youths.

availability predicted higher whole fruit and total vegetable HEI scores. In-home vegetable availability was associated with increased total fruit and whole fruit HEI scores. Stronger parent modeling of FV consumption at mealtimes was associated with increased total fruit and whole fruit HEI scores (Table 3). Eating-competent participants had more favorable seafood and plant protein HEI score compared with those who were not eating competent (Table 3). No survey measures were associated with HEI components for dairy, fatty acids, empty calories, refined grains, whole grains, or sodium (results not shown).

DISCUSSION

This investigation of parents of fourth-grade children participating in a school-based culinary and physical

Table 3. Predictive Validity of In-Home Fruit and Vegetable Availability, Self-Efficacy/Outcome Expectancy, Parent Modeling, and Eating Competence With Healthy Eating Index–2010 (HEI) and Select HEI Components Among *Fuel for Fun* Parent Participants

		β (SE) *P*				
Survey	n[a]	Total HEI	Total Fruit	Whole Fruit	Total Vegetable	Seafood and Plant Proteins
In-home fruit availability[a]	71	.55 (1.06) .60	.21 (.18) .25	**.43 (.18)** **.02**	**.27 (.10)** **.01**	−.09 (.15) .57
In-home vegetable availability	71	.82 (.85) .30	**.34 (.13)** **.01**	**.32 (.13)** **.02**	.14 (.08) .08	.05 (.12) .71
In-home fruit and vegetable availability	71	.47 (.53) .38	**.23 (.09)** **.01**	**.28 (.08)** **.001**	**.13 (.05)** **.01**	.01 (.08) .90
Self-efficacy/outcome expectancy	71	.26 (.14) .06	.03 (.03) .21	.03 (.02) .16	−.01 (.01) .71	.001 (.02) .99
Parental modeling	71	.22 (.37) .56	.16 (.06) **.01**	.14 (.06) **.02**	.07 (.04) .08	−.06 (.06) .31
Eating competent (0 = no/1 = yes)	68	5.44 (2.8) .06	.59 (.49) .24	.49 (.50) .33	.10 (.30) .74	**.86 (.41)** **.04**

[a]Frequencies < 71 represent missing responses to a specific survey item.
Notes: Participants were parents of fourth-grade youths. Data were assessed by multiple linear regression adjusted for race/ethnicity, gender, education, and participation in the Supplemental Nutrition Assistance Program. Results in bold are statistically significant ($P \leq .05$).

activity intervention built on previous work[8–11] by adding a parent dietary assessment to examine the validity of survey assessments that addressed behaviors associated with parents' dietary quality. Mean total HEI score in the current study (56.2; SD = 12.1) was similar to the national average for adults aged 18–64 years (58.27; SD = 0.98).[33] In addition, mean scores in the current study for in-home FV availability, self-efficacy/outcome expectancy, parent modeling of FV eating behavior, and eating competence were similar to what was published elsewhere.[8–12,22]

Behaviors and food preferences were suggested to be mediators of behavior change.[34] For example, higher consumption of FV (a behavior change) may be mediated by in-home FV availability and lead to the outcome of improved dietary quality as measured by HEI. In the current study, higher in-home FV availability was not predictive of overall HEI ($P = .30$), but it was predictive of higher total fruit, whole fruit, and total vegetable HEI scores. Previously, eating-competent parents of fourth-grade children demonstrated greater modeling of FV intake at mealtimes and greater self-efficacy related to preparation of FV that their child would eat or like compared with parents who were not eating competent.[10] The current results demonstrate that positive parent modeling of FV consumption was associated with higher total fruit and whole fruit HEI in parents of fourth-grade children. These results provide evidence for construct validation (ie, that higher parent modeling of fruit consumption was associated with higher parental energy-adjusted fruit intake). The relation between parent modeling of FV eating behaviors and vegetable HEI was not statistically significant ($P = .08$). Intervention studies noted that increased fruit intake is generally more readily achieved than increased vegetable intake,[35,36] and overall, US residents scored more favorably on fruit HEI than vegetable HEI.[33] This may be related to why parent modeling alone was insufficient to predict vegetable HEI in the current study. Self-efficacy is a key component of the Health Belief Model[37] and previous research showed that health-related self-efficacy was positively associated with FV consumption.[38–40] Therefore, it is surprising that the current study determined that parents' self-efficacy to prepare FV that their child would eat was not associated with parents' HEI ($P = .06$) or HEI components. It is possible that if the questions focused on self-efficacy to prepare FV that the parents' themselves would eat that the association would be strengthened.

Lohse and colleagues reported a higher HEI among low-income, eating competent women compared to low-income women who were not eating competent, but the relationship was not statistically significant ($P = .08$).[22] However, the version of the ecSI used in that study was deemed not suitable for use in low-income populations.[12,41] Subsequently, the ecSI 2.0 was developed and validated in diverse income groups.[42] The current study employed ecSI 2.0 but also found a nonsignificant relation between eating competence and total HEI ($P = .06$), although a significant relation was found between eating competence and the seafood and plant proteins HEI component.

Research by Fulkerson and colleagues[20] validated an HFI with parent consumption of total fruit and total vegetable servings, as reported in a 144-item FFQ. Unlike the 24-hour recalls used in the current study, FFQs are closed-ended and do not capture detailed information about all foods and beverages.[43] The results of the current investigation extend those using FFQs by capturing total diet. The findings of the current study demonstrated that in-home fruit availability was positively associated with whole fruit HEI and total vegetable HEI. In addition, in-home vegetable availability predicted parents' total fruit and whole fruit HEI scores. These results are noteworthy given that the survey ascertained in-home availability of just 8 fruits, 9 vegetables, and 3 types of 100% fruit juice, and thus are not inclusive of the variety of fruits, vegetables, and juices captured in the 24-hour recalls used to calculate HEI. This may explain why in-home fruit availability was not associated with parents' total fruit HEI scores and why in-home vegetable availability was not associated with total vegetable HEI. Nationwide food consumption[44] and consumer survey purchase data[45] suggested that the 8 fruits, 9 vegetables, and 3 juices included in the in-home availability survey used in the current study captured most, but not all of commonly consumed fruits, vegetables, and juices. For example, pineapple, onions, garlic, bell peppers, and celery are commonly purchased and consumed items that were not captured on the survey of in-home availability.[44,45] Although the survey instructed participants to include fresh, frozen, and dried varieties, participants likely would not think to include fruits and vegetables included as part of mixed-dish convenience foods (ie, soups, sauces, frozen prepared entrées). Fruits and vegetables from these items may not be considered available in the home, but would be recorded on the recalls and thus contribute to the HEI scores. Another consideration is that the survey ascertained in-home availability of fruits and vegetables, but HEI is calculated from foods consumed both at home and away from home. Nationally representative data suggested that, depending on the respondent's age, 12.5% to 17.5% of energy is consumed at restaurants.[46] Fruit and vegetables consumed at restaurants would not be reflected in in-home availability but would be captured in the HEI calculations.

None of the survey measures were associated with HEI components for dairy, fatty acids, empty calories, refined grains, whole grains, or sodium. This lack of an association was anticipated given that the FV availability, self-efficacy/outcome expectancy, and parent modeling surveys focused heavily on FV. Because of these caveats, the ability of FV availability, self-efficacy/outcome expectancy, parent modeling, and eating competence to predict components of diet quality is compelling.

The external validity of the study is limited because the researchers used a sample with restricted geographic, racial, ethnic, and economic diversity. Respondents were all parents of grade-school children who

self-selected to participate and may have been more personally invested in nutrition than those who did not participate. Weight and height were self-reported and used to calculate body mass index to describe the study sample, although reports indicated that self-reported measures are highly correlated with actual measures.[47,48] The current study did not examine the relations of the survey measures to predict greens and beans or total protein foods given the skewed distribution of these HEI components. In addition, the sample size was limited, and a larger sample size might have strengthened some of the relations. Finally, although all of the surveys were previously validated or adapted from validated surveys,[8–13] the researchers did not assess cognitive understanding in this specific sample population.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Additional assessment in larger and more diverse samples is warranted so that nutrition education and behavior researchers may use these valid and reliable, brief, low-cost, and easy-to-use survey instruments as a proxy for dietary intake. Moreover, samples that include non-parent participants would increase the generalizability of how responses to in-home FV availability and eating competence are associated with HEI components. Parent diet quality, as measured by HEI-2010, was shown to be related to children's diet quality,[49] which supports future studies that examine the relations among in-home FV availability, parent self-efficacy/outcome expectancy, modeling of FV behaviors, and eating competence and their child's HEI.

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SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jneb.2019.02.009.

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