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Fill "half your child's plate with fruits and vegetables": Correlations with food-related practices and the home food environment

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Introduction

The diet quality of children in the US is suboptimal (Ramsay A Samantha, 2014). According to the Dietary Guidelines for Americans (DGA) children between 9–13 years of age should consume at least 4–5 servings of fruits and vegetables (FV) each day (https://www.choosemyplate.gov/MyPlate). However, national data indicate that more than 80% of 9–13 year old children do not consume the minimum recommended daily servings of fruits or vegetables (Krebs-Smith, Guenther, Subar, Kirkpatrick, & Dodd, 2010). The Healthy Eating Index (HEI) score, a measure of adherence to the U.S. DGA (Agriculture, December 2015) reflects overall diet quality (range: 0–100). Children ages 9 to 13 year have an average HEI score of 47, indicating a low-quality diet (Banfield, Liu, Davis, Chang, & Frazier-Wood, 2016).

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Author Contributions

CA: Conceptualized the study, interpreted the data, and led the writing and revisions of the manuscript.
SF: Conducted the data analysis, assisted with interpretation of data and critically edited the manuscript.
CF: Assisted with interpretation of data and critically edited the manuscript.
MS: Assisted with interpretation of data and critically edited the manuscript.
JF: Conceptualized the main study (HOME Plus), assisted with interpretation of data and critically edited the manuscript.

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The new emphasis in the 2015 DGAs is on healthy eating patterns, instead of consumption of individual foods, due to growing evidence that the combination of foods may play a synergistic role in overall health and disease reduction (Agriculture, December 2015). To disseminate the healthy eating messages of the DGA, in 2011 the *MyPlate* icon (Figure 1) was created as a new communications platform (Levine, Abbatangelo-Gray, Mobley, McLaughlin, & Herzog, 2012). The emphasis of *MyPlate* is to guide consumers, with an easy to understand icon on how to structure meals (Levine et al., 2012). As a consequence, the communication and education messages that followed *MyPlate* included "Make half of your plate fruits and vegetables". Adoption of this message by families would ideally be seen in the types of foods they purchase, serve and consume. Yet, since its inception, limited research has been conducted assessing thesse communication messages on children's and families' eating behaviors and home food environment.

The home environment is key in shaping children's eating habits. Only a few studies have examined associations between children's and adolescents' FV intake and behaviors relating to family meals and meal preparation, such as family conversations, parent self-efficacy to prepare healthy meals, parent/child cooking skills and meal planning (Boutelle, Birnbaum, Lytle, Murray, & Story, 2003; Crawford, Ball, Mishra, Salmon, & Timperio, 2007; Draxten, Fulkerson, Friend, Flattum, & Schow, 2014; Fulkerson et al., 2017; Ong, Ullah, Magarey, Miller, & Leslie, 2017). Studies among 6–12 year old children have found that the home food environment, including FV availability and accessibility, parental role modeling, children's involvement in family meal preparation (Berge, MacLehose, Larson, Laska, & Neumark-Sztainer, 2016; Chu, Storey, & Veugelers, 2014; N. I. Larson, Story, Eisenberg, & Neumark-Sztainer, 2006) and family meals are consistent predictors of children's FV intake (Ong et al., 2017). Specifically, family meal frequency has been associated with higher intake of FV (Videon & Manning, 2003), lower intake of soft drink and fast food consumption and better overall diet quality (Fink, Racine, Mueffelmann, Dean, & Herman-Smith, 2014; Ranjit, Evans, Springer, Hoelscher, & Kelder, 2015).

In 2010, as the research team of the HOME Plus study (Fulkerson et al., 2014) was finalizing the intervention of the randomized controlled trial (RCT) (see below), the new guidelines were incorporated into the intervention curriculum. However, no items were available in the literature to assess the *MyPlate* message. Therefore, a survey item was created and used in the study to represent the adoption of the *MyPlate* message. Thus, the first goal of this ancillary study was to examine the prevalence of parental report of children's adherence to USDA's *MyPlate* guidelines of 'half of plate filled with fruits and vegetables (FV)" and the second goal was to examine what food related practices were associated with frequency of serving half the plate of FV. The study results may support the use of the *MyPlate* message as an additional educational tool to promote food-related behaviors and practices among families with children.

Methods

Study Design

Data used for this study came from the baseline assessment of the Healthy Offerings via the Mealtime Environment (HOME) Plus trial (Flattum et al., 2015; Fulkerson et al., 2015;

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Fulkerson et al., 2017). HOME Plus was a two-arm RCT focusing on healthier eating, reducing sedentary behaviors, and preventing excess child weight gain through a family meals-focused, community-based program. The main meal preparer/caregiver and one 8–12 year old child were recruited through events and flyers at Minneapolis Parks and Recreation Centers. Recruitment included the recreation center staff posting flyers in the buildings and emailing the flyer to past center program participants as well as study staff attending sports and community events held at the recreation locations and setting up tables with games and sign-up sheets where they distributed flyers to interested families. The HOME Plus intervention was implemented at various community centers throughout Minneapolis. Families were excluded from the study if they did not speak English, the children had a health condition that prevented them from participating, or children had age-and gender-adjusted body mass index (BMI) below the 50th percentile. Three hundred and two families were assessed for eligibility and 160 ultimately enrolled in the study. Further study details are provided elsewhere (Flattum et al., 2015; Fulkerson et al., 2015). The study was approved by the University of Minnesota's Institutional Review Board.

Measures

At baseline, 160 parent/guardian-child dyads independently completed psychosocial surveys during the summer of 2011 and 2012 in two staggered cohorts. The adult survey, in addition to demographics, included meal-specific questions such as meal frequency, shopping and food preparation, routines and expectations. Children also completed a survey and multiple 24-hour dietary recalls. Trained study staff measured adults' and children's height using a Seca portable stadiometer and weight using a Seca scale. Two height and weight values were averaged to calculate BMI for adults and children. For children, BMI percentiles and BMI z-scores standardized for age and gender using CDC guidelines were also calculated (Centers for Disease Control and Prevention).

Child Reported Variables

Average reported daily intake of fruits and vegetables (not including juice).— Children's dietary intake was assessed via three 24-hour dietary recall interviews (two weekdays and one weekend) by trained interviewers. Of the 160 participants, 133 (83%) completed all three interviews, 22 (14%) completed two interviews, and 5 (3%) completed only one interview. The first interview occurred during a home visit and the other two by telephone within two weeks. The parents were present and helped with clarification as needed. The child-reported dietary intake data were averaged across the three interviews for analysis. The Nutrition Data System for Research (NDSR) software version 2011 and 2012 was used to collect dietary recall data and data were analyzed using 2012 version (Nutrition Coordinating Center University of Minnesota). The NDSR fruit categories included were citrus fruit and non-citrus fruit but not juice, fried fruit or fruit-based savory snacks. The NDSR vegetable categories included were dark green vegetables, deep yellow vegetables, tomatoes, white potatoes, other starchy vegetables and other vegetables but not vegetables juice, fried potatoes, legumes, fried vegetables or vegetable-based savory snacks. Children reported eating 2.31 servings of FV on average (SD=1.47, range 0–7.5).

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Healthy Eating Index-2010 (HEI-2010).—HEI-2010 total scores compare an individual's dietary quality to the 2010 Dietary Guidelines for Americans. The dietary recall data were used to calculate each child's diet quality score by summing 12 dietary component scores, including nine assessing adequate intake and three assessing intake in moderation (United States Department of Agriculture (USDA)). In this study, we focused on the total score rather than the components as the total reflects the overall quality of the child's dietary intake and is more reliable with a limited number of recall interviews and in comparisons across groups. Higher HEI-2010 scores indicate more healthful dietary intake (range: 0–100). For the present study sample, the mean HEI was 53.7 (SD=11.3, range 29.4–82.2).

Parent Reported Variables

Children had half their plate filled with fruits and vegetables (half plate FV).—The outcome variable, frequency of children's adherence to USDA's *MyPlate* guidelines of half their plate filled with fruits and vegetables was assessed using a parent survey question, "During the past seven days how many times was ½ of your child's plate filled with fruits and vegetables at dinner?" The item was created by the study team in an effort to capture adoption of the *MyPlate* message that had just been released by the DGA as the messaging was incorporated into the HOME Plus intervention program. The eight response categories ranging from 'Never' to '7 times' were dichotomized to 'never-2 times' vs. '3+' times per week.

Family meal expectations and conversations scale.—This scale was created with an additive score of responses to eight questions related to parents' expectations and practices around the main meal, usually dinner (Neumark-Sztainer, Larson, Fulkerson, Eisenberg, & Story, 2010; PD, 1988). The parents were asked to select one of four responses on a Likert scale from 'Strongly agree' to 'Strongly disagree.' Examples of questions included 'It is important that the family eat at least one meal a day together' and 'We have good conversations during dinner.' The score values ranged from 16–32 (M=27.3; SD=3.6); Cronbach's α=0.81.

Food talk at dinner scale.—The scale contained four questions describing mealtime conversations and behaviors around food that have been adapted from other studies (Lytle, 2009). Examples of questions included, 'How often does your family talk about whether the food you are eating is nutritious during a typical dinner?' and 'How often do you compliment your child on what he/she chooses to eat?' Four response categories ranged from 'Never' to 'Usually or always.' Score values ranged from 5–16 (M=12.7, SD=2.1); Cronbach's α=0.67.

Child helps to choose/prepare meals & snacks scale.—The scale contained four questions about the frequency of the child helping to decide/prepare dinner or snacks (Boutelle, Lytle, Murray, Birnbaum, & Story, 2001). Examples of questions included, 'During the past seven days, how many times has your child helped decide what foods to make for dinner' or …helped make or get snacks?' Eight response categories ranged from 'Never' to '7 times.' Scale scores range was 0–28 (M=10.8, SD=5.6); Cronbach's α=0.71.

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Parent self-efficacy to prepare a healthy meal scale.—The four-item scale described parents' self-efficacy to prepare a healthful meal despite daily stressors was adapted from Beshara and colleagues, (Beshara, Hutchinson, & Wilson, 2010). Examples of questions include, 'How likely are you to prepare a healthy meal after a tiring day?' or 'How likely are you to prepare a healthy meal when you feel stressed or tense?' Five response options ranged from 'Not at all likely' to 'Very likely." Scale scores ranged from 4–20 (M=12.0, SD=4.1); Cronbach's α=0.84.

Parent cooking skills scale.—The eight-item scale was created for the HOME Plus study using 'Yes' or 'No' response options. Parents were asked if in the past month they had engaged in behaviors such as 'picked healthy recipes to try or make' or 'reduced, substituted, or omitted ingredients in a recipe to make it healthier.' Scale scores ranged from 0–8 (M=5.5, SD=1.8); Cronbach's α=0.63.

Child cooking skills scale.—Parental perceptions of their child's cooking skills scale is a 9-item scale developed for children during the HOME pilot study (Fulkerson et al., 2010) and adapted for parents. Items were added to the scale to reflect the behavioral objectives of the HOME Plus study. Parents responded with 'Yes' or 'No.' Examples of questions included, 'In the past month, my child has followed a recipe to prepare a healthy meal or snack' or 'In the past month, my child has read a food label for key ingredients.' Scale scores ranged from 0–9 (M=4.1, SD=2.4); Cronbach's α=0.78.

Meal planning strategies scale.—The scale was created by combining questions from several surveys describing behaviors related to meal planning (Crawford et al., 2007; Cullen et al., 2004; Devine et al., 2009; Fulkerson et al., 2011). Four questions had four response options ranging from 'Never' to 'Always.' Examples of questions included, 'We try to keep our cupboards well stocked with foods that can be combined easily for a meal,' or 'We cook enough on some days/nights so that there will be leftovers for another meal.' Eight questions had four Likert-scale responses ranging from 'Strongly agree' to 'Strongly disagree.' Examples included, 'I know how to cook with low-fat cooking methods,' or 'I usually know or plan in advance what we will eat for dinner that night.' The total scale score range was 19–47 (M=32.7, SD=4.8); Cronbach's α=0.71

Frequency of family dinners.—Family dinner frequency was assessed with the question "During the past seven days, how many times did all or most of your family living in your home eat dinner together?" Eight response options ranged from 'Never' through '7 times'; range: 0–7.

Fruits and vegetables available at home—Home availability of FV was measured with the validated Home Food Inventory (Fulkerson et al., 2008). Parents completed the instrument that assesses the home availability of foods from 13 major food categories (e.g. fruits, sweetened beverages). The Home Food Inventory of Fruits and Vegetables (HFIFV) score represented a total count of the number of all types of fruits and vegetables in the home (M=20.3, SD=7.0; score range= 6–38). A higher score indicated higher home availability of FV.

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Economic Assistance.—Parents answered two questions to assess receipt of economic assistance. The first question was “Does your child receive free or reduced priced lunches at school?” The second question was “Does your family receive public assistance like food support/stamps, EBT, WIC, TANF, SSI or MFIP?” Both questions have response options of ‘Yes’ or ‘No’. If families answered ‘Yes’ to either question, they were considered to receive economic assistance.

Statistical Analysis

Multiple logistic regression models were used to test the associations between ‘half plate FV’ and child diet quality and reported intake of FV. Similar analyses were then conducted to assess associations between the ‘half plate FV’ variable and parent reported home food environmental variables, adjusted for parent reported race and receipt of public assistance (unlike other economic indicators such as education, this variable adjusts for the number of people in a household and other income sources). Odds ratios, confidence intervals and associated p-values are presented. A p-value of 0.05 or less was considered to be statistically significant. The analyses were conducted using SAS version 9.3 (Cary, NC).

Results

There were 160 parent/guardian-child dyads (adult mean age=41 years; child mean age=10 years) (Table 1.) Ninety five percent of adults and almost one half of children were female; 77% of adults and 68% children were white; 39% of families received some form of economic assistance. The average adult BMI was 28.6 (SD=7.5) (range 17.3–53.1) (1% underweight, 39% normal weight, 27% overweight, 33% obese) and child BMI percentile was 78.1 (SD=17.4) (range 30.6–99.6) (56% normal weight, 23% overweight, 21% obese). Adults reported that their children on average had half their plates filled with fruits and vegetables at dinner 2.7 times in the past week.

Table 2 shows the associations between reported consumption of daily servings of FV and children’s dietary quality with odds of having ‘half plate of FV’. With each reported intake of FV, children’s odds of having half their plates filled with FV were almost one and a half times greater (OR: 1.48, CI: 1.16 – 1.90); for each one unit increase in HEI score, there was a small but statistically significant increase in odds of having their plates filled with FV (OR: 1.05, CI: 1.02 – 1.08).

There were significant associations between the ‘half plate FV’ variable and parent-reported positive food-related practices (Table 3) Specifically, one additional weekly family meal was linked to 56% higher odds of children having half their plates filled with FV (OR: 1.56, CI: 1.28 – 1.91). Children in families who reported having higher positive meal expectations and higher positive talk about food during family dinner time had 17% (CI: 1.05 – 1.29) and 25% (CI: 1.06 – 1.48) higher odds of having half their plate filled with FV at dinner, respectively. Children who helped choose and prepare meals more frequently and had greater cooking skills had 7% (CI: 1.01 – 1.14) and 22% (CI: 1.06 – 1.41) higher odds of having half their plate filled with FV at dinner, respectively. Parents who reported having greater self-efficacy to prepare healthy meals, higher parent and child cooking skills and more strategies for meal planning had 23%, 28%, 22%, 12% higher odds of children having

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half their plate filled with FV at dinner, respectively. A higher home availability by one fruit or vegetable was associated with 11% higher odds of children adhering to 'half plate FV' message.

Discussion

The goals of the present study were to assess prevalence of parental report of children's adherence to USDA's *MyPlate* guidelines of 'half plate FV' and to explore associations with parent and child food-related behaviors and foods available in the home. Significant positive associations were observed between the 'half plate FV' and child's reported intake of fruits and vegetables and diet quality; in addition, parent and child cooking skills, home food availability of FV, family dinner frequency, and parent self-efficacy to prepare healthy meals were positively linked to children having half their plate filled with FV. Overall, the findings indicate that a positive food home environment is an important component of children's healthful dietary intake and meeting the goals of the *MyPlate* campaign.

The 'half plate FV' item created for the HOME Plus study appears to adequately measure the *MyPlate* campaign message of having half the plate filled with fruits and vegetables, even though it is a single survey question. To our knowledge, this is the first study assessing the adoption of the *MyPlate* message through a survey item. The significant positive association between 'half plate FV' and reported daily intake of FV and child's diet quality provide preliminary data to support its use in future research, particularly for studies with nutrition interventions that promote the *MyPlate* message. Additionally, the significant correlation of 'half plate FV' with child's diet quality may provide an indication of this variable's construct validity. Since the release of the *MyPlate* campaign messages in 2013 (R. C. Post, Haven, Maniscalco, & Brown, 2013), no studies have been reported that validate the 'half plate FV' question among children, possibly due to challenges requiring direct observation (Levine et al., 2012). The goal of the *MyPlate* campaign initiative is "to support Americans in building healthy diets" (R. Post, 2011) with health messages serving as a communication tool for health education initiatives in various settings and among diverse population groups. As "Make half your plate fruits and vegetables" is one of the behavior-specific messages of the *MyPlate* initiative, these findings can help nutrition interventions assess their effectiveness in promoting fruit and vegetable intake among children (Levine et al., 2012). However, larger studies are needed to confirm the observed association that was found in the present study.

Previous studies have demonstrated the role of the family in shaping children's healthful nutritional intakes and positive attitudes around food and eating (Arcan et al., 2007; Burgess-Champoux, Larson, Neumark-Sztainer, Hannan, & Story, 2009; Eisenberg et al., 2012; Fulkerson, Kubik, Story, Lytle, & Arcan, 2009). In the present study, the frequency of having family meals and home food availability of FV were the strongest correlates of children's 'half plate FV'. These findings suggest that future research promoting healthful eating through family meals and home food availability may influence the adoption of, or at least report of, adherence to the *MyPlate* message and downstream may increase the likelihood of children meeting dietary intake recommendations. Given the evidence of family meal frequency continuity over a lifetime (Friend et al., 2015; N. Larson, Fulkerson,

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Story, & Neumark-Sztainer, 2013) promotion of family meal frequency and *MyPlate* messages may have lasting impacts on children's dietary intake. Our findings also showed significant associations between 'half plate FV' and family meal routines, including meal expectations, food talk at dinner, and the availability of FV, indicating the significant positive contribution of the home environment on children's healthful dietary choices (Draxten et al., 2014; Loth, Friend, Horning, Neumark-Sztainer, & Fulkerson, 2016; Ong et al., 2017; Scaglioni, Salvioni, & Galimberti, 2008).

The present study findings of significant associations between children's 'half plate FV' and parent behaviors relating to food at home demonstrate the importance of parental food-related behaviors in the home. Parents' and children's involvement in meal preparation routines increase children's reported FV intake and can protect against unhealthy weight-related behaviors (Berge et al., 2016; Fulkerson et al., 2006; Neumark-Sztainer et al., 2010). Thus, healthful habits during childhood may promote healthful habits as adults.

The results of this study should be interpreted in light of its limitations and strengths. The cross-sectional design does not allow for causal inference of the findings. However, the significant associations of children's 'half plate FV' with a wide range of food-related behaviors and the home food environment collectively support the important role of a positive food environment in shaping children's healthful eating behaviors. Although the 'half plate FV' measures the amount of FV on the plate and not the amount consumed, its significant associations with children's reported consumption of FV and diet quality provides initial validation data for its use in assessing adoption of the *MyPlate* message. Further, since parents reported their child's plate being half full with FV, there may be a possibility of desirability bias. However, this bias maybe partially minimized as the present study used data from the baseline assessment prior to randomization and intervention parents did not have prior knowledge of the specific study characteristics. Additionally, we don't have any knowledge of the serving style used by the adults who reported that their child's plate was half filled with FV. A prior study using the same dataset found about 36% of households reported using plated meal service for their family's meals. However no significant associations were found between meal serving style and reported children's FV intake (Loth, Horning, Friend, Neumark-Sztainer, & Fulkerson, 2017). The present study excludes children with age-and gender-adjusted BMI below the 50^{th} percentile, thus the results cannot be generalized to all children; however since the study sample included children who also have normal weight status, it is likely that the study findings would apply to children in the full range of weight status. In addition, none of our assessments of food servings or dietary intake inquired about whether children ate food using a plate; the assumption of plate use may overestimate adherence to the *MyPlate* message. Lastly, parental homogeneity with respect to race/ethnicity and education level may prevent generalization of the findings, since cultural norms may differ in the manner fruits and vegetables are offered and served. Further studies with diverse population groups will illuminate the suitability of this variable for the assessment of children's FV intake.

Strengths of the study include the measurement of child reported dietary intake through 24-hour dietary recall interviews collected by trained staff with NDSR software. The use of high-quality assessment instruments, including the validated and reliable Healthy Eating

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Index-2010, adds to the strengths of the study. In addition, the inclusion of both adults' and children's responses adds to the comprehensive measure of the home food environment.

Conclusions

The goal of the present study was to assess prevalence of parental report of children's adherence to USDA's *MyPlate* guidelines of 'half plate FV' and to explore associations with parent and child food-related behaviors and foods available in the home. The associations between 'half plate FV' and a number of variables representing the home food environment, including family meal frequency, food preparation skills, and home availability of fruits and vegetables demonstrates that this campaign message can be used in nutrition interventions focusing on improving the home food environment and increasing children's FV intake and that the survey item used in the present study may be effective in capturing adherence to the *MyPlate* message. Due to the relatively small and homogenous sample of this study, future studies with larger and more racially/ethnically diverse families are needed to confirm the present study findings.

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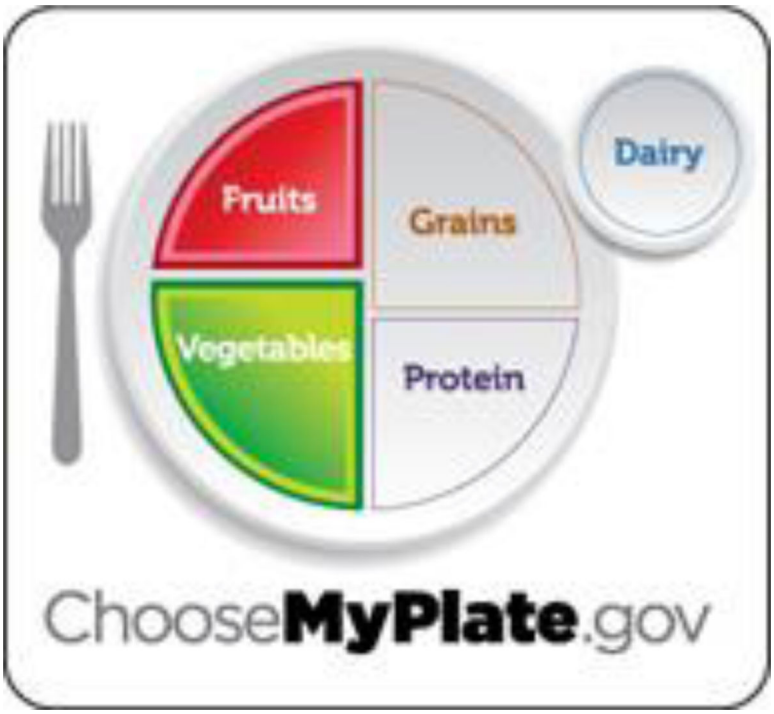

Figure 1.
MyPlate graphic

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Table 1

Sociodemographic characteristics of adults and children participating in the HOME Plus trial (N=160 parent/guardian-child dyads)

Participant Characteristics	N	%
Adult Participant Gender		
Female	152	95%
Male	8	5%
Child Participant Gender		
Female	75	47%
Male	85	53%
Adult Participant Ethnicity		
Hispanic	5	3%
Not Hispanic	155	97%
Child Participant Ethnicity		
Hispanic	15	9%
Not Hispanic	145	91%
Adult Participant Race		
African American	24	15%
American Indian	4	2%
Asian	1	1%
White	123	77%
More than one race	8	5%
Child Participant Race		
African American	28	18%
American Indian	4	2%
Asian	3	2%
White	109	68%
More than one race	16	10%
Family Receives Economic Assistance		
Yes	62	39%
No	98	61%
	Mean (SD)	**Range**
Adult Age	41.3 (7.7)	24–65
Adult BMI	28.6 (7.5)	17.3–53.1
Child Age	10.3 (1.4)	8–12
Child BMI percentile	78.1 (17.4)	30.6–99.6
Child's ½ plate was filled with FV (mean days/week)*	2.7 (2.2)	0–7

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Table 2.

Odds ratios of children having half their plate filled with fruits and vegetables (half plate FV) at dinner by children's reported dietary intake; n=160

	Odds Ratio	95% Confidence Interval	p-value
Child reported variables			
Average daily intake of fruits and vegetables (not including juice)[±]	1.48	(1.16 – 1.90)	0.002
Total diet quality (HEI-2010)	1.05	(1.02 – 1.08)	0.002

The model was adjusted for parent reported race and economic assistance

[±]Daily intake refer to reported intake through 24-hour dietary recalls

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Table 3.

Odds ratios of children having half their plate filled with fruits and vegetables (half plate FV) by parent response of food-related practices and home environment (scales); n=160 *

	Odds Ratio	95% Confidence Interval	p-value
Parent reported variables (scales)			
Family dinner frequency	1.56	(1.28 – 1.91)	<.0001
Parent cooking skills	1.28	(1.06 −1.54)	0.009
Food talk at dinner	1.25	(1.06 – 1.48)	0.009
Self-efficacy to prepare a healthy meal	1.23	(1.12 – 1.35)	<.0001
Child cooking skills	1.22	(1.06 – 1.41)	0.006
Family meal expectations & conversations	1.17	(1.05 – 1.29)	0.003
Meal planning strategies	1.12	(1.04 – 1.20)	0.003
Child help to choose/prepare meals & snacks	1.07	(1.01 – 1.14)	0.018
Home Food Environment			
Home Food Inventory of FV (HFIFV)	1.11	(1.05 – 1.17)	0.0002

* All models were adjusted for parent race and economic assistance