HHS Public Access

Author manuscript

J Acad Nutr Diet. Author manuscript; available in PMC 2018 January 01.

Published in final edited form as:

J Acad Nutr Diet. 2017 January ; 117(1): 102–109. doi:10.1016/j.jand.2016.08.006.

What's Being Served for Dinner?: An Exploratory Investigation of the Associations between the Healthfulness of Family Meals and Child Dietary Intake

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Abstract

Background—Little is known about the healthfulness of foods offered at family meals or the relationship between the food's healthfulness and child overall dietary intake.

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Objective—This exploratory study uses a newly-developed Healthfulness of Meal (HOM) index to examine the association between the healthfulness of foods served at family dinners and child dietary intake.

Design—Direct observational, cross-sectional study.

Participants/setting—Primarily low-income, minority families (n=120) video-recorded 8 days of family dinners and completed a corresponding meal screener. Dietary recalls were completed on the target child (6–12 years old). The HOM index was used to measure meal healthfulness and included component scores for whole fruit, 100% juice, vegetables, dark green vegetables, dairy, protein, added sugars, and high sodium foods.

Main outcome measures—Child dietary intake measured by three 24-hour dietary recalls.

Statistical analyses performed—Linear regression models estimated the association between the foods served at dinner meals and overall child dietary intake.

Results—The majority of coded meals included foods from protein and high sodium components; over half included foods from dairy and vegetable components. Nearly half of the meals had an added sugar component food (e.g., soda, dessert). Few meals served foods from fruit, 100% juice, or dark green vegetable components. Many components served at family dinner meals were significantly associated with child daily intake of those same foods (i.e., dark green, non-dark green vegetables, dairy, and added sugars). The HOM index total score was significantly associated with child HEI score.

Conclusions—This study represents the first report of a new methodology to collect data of foods served at family dinners. Results indicated a significant association between the majority of components served at family dinner meals and child overall dietary intake. Validation of the HOM index and video-recorded family meal methodology is needed to strengthen these research methods for use in future studies.

Keywords

family meals; direct observation; diet quality; meal screener; food availability

Introduction

Family meal research has consistently shown that frequent family meals are associated with better dietary outcomes for children,[1] such as higher intake of fruits and vegetables[2–5] and dairy, [6,7] and lower intake of sugar-sweetened beverages (SSB) in children.[5,8–10] Little is known about the types of foods children are served for dinner and whether these foods are associated with their overall dietary intake.

Existing data on foods served at family meals have generally been collected through self-report surveys[11–16] (e.g., survey questions about frequency of vegetables served at dinner), rather than direct observations. Additionally, measures used to determine the foods served at family meals are often not comprehensive.[11–16] For example, one study asked only about vegetables served at dinner,[13] another study assessed whether children were served a dessert

or a beverage,[15] while another study asked about green salad, vegetables, 100% juice, fruit, milk, SSB, and fast food at dinners.[11]

Some previous research suggested that the foods served during family meals were associated with the foods consumed by children in their daily intake.[17–19] For example, a longitudinal study found that parents' report of serving vegetables and milk at dinner was predictive of adolescents' intake of these foods at five-year follow-up.[17] While multiple tools exist to determine diet quality,[18–20] there is not an exact definition of "healthfulness" of a family meal. Additionally, there is limited data regarding the overall healthfulness of family meals and associations with child overall dietary intake. One study developed a summary score using self-report data of the presence of green salad, vegetables, 100% fruit juice, fruit, milk, SSB and fast food to assess the overall healthfulness of foods served at family dinners; however, this study did not examine the association between the healthfulness of family meals and the quality of a child's overall diet.[11]

The current study builds upon previous family meals studies[1–17,21,22] and seeks to investigate the specific foods available at family meals, the overall healthfulness of the meals, and their association with children's dietary intake. This study incrementally advances the field of family meals by developing a measurement tool that more thoroughly evaluates the foods served at family meals and the dietary healthfulness of family meals. This study employs the use of video-recorded family meals to investigate the following research questions: 1) What food components are served to children at family dinner meals, and what is the dietary quality of these meals?; 2) Is there an association between the food components served and the dietary quality of family dinner meals with children's overall dietary intake? The main hypothesis is that there will be a positive association between the food components served and overall dietary quality of family dinner meals with children's overall dietary intake and diet quality.

Materials and Methods

Family Meals LIVE!,[23] a mixed-methods cross-sectional study, recruited a sample of families (n=120) with 6–12 years old from low-income and racially/ethnically diverse households in Minneapolis/St. Paul. Children were stratified by weight status so that there were 60 non-overweight children (>5th and < 85th BMI percentile) and 60 overweight/obese children (≥85th percentile). Participants (i.e., children and their families) needed to speak and read English and have a minimum of three family dinner meals per week to be eligible for the study. Data was collected from families during two home visits, which were approximately two weeks apart. Direct observational data utilized in the current study included anthropometric measurements, video-recorded family dinner meals, meal screeners, and 24-hour dietary recalls. The University of Minnesota's Institutional Review Board Human Subjects Committee approved the study protocol. Participants over the age of 18 who were measured or participated in video-recorded meals provided written consent; children ages 8–17 provided written assent. All participating children under the age of 18 were provided written parental consent by their parent/primary guardian.

Research staff trained families on how to video-record family meals using an iPad and helped identify the best location in the home for video-recording family meals. Families were able to move the iPad if meals occurred in different rooms throughout the week; however, they were not able to take the iPad outside of the home (e.g., restaurant). After the initial home visit, families self-recorded eight days of family dinner meals, with a minimum of two weekend meals. Families were asked to complete consecutive days as much as possible.

Families were told to say into the camera what was served for dinner every night. After each meal families completed a meal screener, which is a self-report, open-ended written measure of what was served at the meal used to confirm the verbally-reported foods. To obtain authentic footage, families were asked not to alter the foods served at the meals or where meals were consumed. The first day of the video-recorded meals was not utilized in coding to allow participants to acclimate to being video recorded.[24,25]

Overall dietary intake of the target child was assessed with three 24-hour dietary recalls using Nutrition Data System for Research (NDSR) software version 2012.[26] Recalls were conducted by trained staff on two weekdays and one weekend day. The first and third recalls were conducted during home visits; the second was a telephone recall in between visits. Recalls for 6–8 years old were conducted with the child's parent/guardian with child's assistance. Recalls for 9–12 years old were conducted with the child, with parental assistance permitted for clarification. The 24-hour dietary recalls, which assess child dietary intake, were not necessarily gathered on the same days that the family video-recorded a dinner meal. All target children completed three dietary recall interviews; 100% of recalls were reviewed for accuracy and completeness by registered dietitians. Comprehensive study procedures, including demographic information, have been previously documented.[23,27]

Coding Index Development

To better understand the types of foods being offered at family meals, staff dietitians with guidance from experts in nutrition assessment created a family meal healthfulness index (Healthfulness of Meal (HOM) index) (Table 1) using the Healthy Eating Index-2010 (HEI) as a guide. The HEI was chosen as a guide because it has been shown to be both reliable and valid in assessing diet quality.[28] The HEI is broken into 12 components: 9 that assess adequacy of diet and 3 that assess components to be consumed in moderation. The HOM index is able to represent components similar to the HEI adequacy components, including Whole Fruit, Vegetables, Dark Green Vegetables, Dairy, Protein, and an overall healthfulness score. Because juice is often served to children,[29] the presence of 100% juice is evaluated as an individual component. HEI moderation components are also represented in the HOM index. The HEI's Empty Calories component is reflected in the HOM index by assessing high-fat meats and including an Added Sugars component.[30] High sodium foods were identified for the High Sodium foods component by examining the USDA National Nutrient Database for Standard Research,[31] nutrition labels of specific foods and by using NDSR as a guide. For example, if the sodium content of a food was unknown, (e.g., gravy), a serving was entered into NDSR. If the serving had greater than 140 mg of sodium, it was considered a high sodium food.[32] Given the data available through the meal screener and video-

recorded meals, we were unable to mimic some of the HEI components (e.g. Whole/Refined Grains, Fatty Acids).

The HOM index was scored using a “Present/Absent” format. For example, a meal received one point for serving whole fruit or zero points for not serving whole fruit; High Sodium Foods and Added Sugars were reverse coded. The HOM index components were summed; a maximum score of nine was possible with a higher total score being reflective of a more healthful family meal with regards to the foods served. Some families (n=22) did not complete all eight days of video-recording. Additionally, there were five meals where coders could not discern through the video or meal screener what foods were served at the meal. After removing the first day of video-recorded meals (see Methods above), the missing days, and the indiscernible videos, eight hundred meals remained for analysis.

Coding of meal screener and video-recorded data

Because the HOM index evaluates the dietary healthfulness of the entire meal, foods were coded regardless of whether they were consumed by or offered to all meal participants. The index does not quantify the amount of food served, only the presence of a food. Therefore, a meal providing one serving of dairy and a meal providing five servings of dairy would earn the same point in the Dairy component. At times, coding rules combined small amounts of vegetables or fruit into a single Vegetable or Whole Fruit point (e.g., mixed vegetables or lettuce and tomato on a sandwich). NDSR was used as a guide for mixed dishes or foods that were difficult to code. For example, if it was clear from the meal screener and video that the family was eating tacos but the ingredients were unknown, a taco with “unknown” ingredients was entered into NDSR. The food components provided by NDSR were then used as the basis of a HOM index coding rule. If the ingredients of a meal were clearly visible or written on the meal screener, the rule was not used. Protocols were also developed for coding unique food situations. For example, if a single food or beverage was listed on the meal screener and not seen on the video, that food/beverage was still coded. However, in instances where the completed meal screener did not correspond with the recorded meal, coders tried to ascertain from the video (i.e. foods present and family’s description of foods served) what was served at the family meal. A written detailed HOM index coding protocol is available from first author upon request.

Three research team members coded the meal screener and video-recorded meal data. The corresponding video was watched to corroborate information provided by the self-report meal screener and to garner additional meal information (e.g. beverages, fast foods). Videos were coded by all three coders until 95% inter-rater reliability was reached. To ensure consistent inter-rater reliability, 30% of coded meals were double-coded and coders met to reach 100% consensus. In addition, staff dietitians were consulted on unique coding situations and developed coding rules when necessary.

Measures

HOM index—As described above, the HOM index evaluates the healthfulness of foods served at family meals and ranges from zero to nine, with nine indicating a healthier meal.

24-Hour Dietary Recall Variables—The NDSR system, which was used to collect 24-hour dietary recalls, aggregates foods into food subgroups (e.g., Citrus Juice, Dark-green Vegetables). Similar food subgroups were combined to closely match the HOM index food components (e.g., NDSR "Citrus fruit" and "Fruit excluding citrus fruit" are combined to mimic HOM index's Whole Fruit component).

HEI-2010 Score—Using data from the child's 24-hour dietary recalls, a total HEI score was calculated. The maximum HEI score possible is 100, with a larger number indicating a healthier diet. Detailed descriptions of calculating HEI-2010 scores are available online.[20,33]

Covariates—Anthropometric measurements were obtained on target children in person by trained researchers.[34] Height was assessed to the nearest 0.1 cm using a Seca 217 stadiometer. Weight was measured to the nearest 0.1 kg using a calibrated Seca 869 scale. BMI percentile values were calculated for the target child using an online CDC calculator.[35] Child sex was based on parent report.

Statistical Analysis

Descriptive statistics included means and standard deviations for continuous variables and frequencies and percentages for categorical variables. To describe the HOM index component at family meals, the component's mean score based on the number of meals evaluated for each family (typically 7 days) was calculated (e.g., a family serving dairy at five of seven meals received a HOM dairy score of 0.71 (5/7)). Twenty-two families had incomplete observations over the seven-day window and mean scores were calculated for these families using the available data. Specifically, fourteen families missed one day, four families missed two days, three families missed three days, and one family missed four days. The mean HOM index and the prevalence proportion of HOM index components were calculated for these families according to the presence of component items at the number of meals for which meal data was available.

Linear regression models were fit to estimate the association between foods served at dinner meals (HOM index component scores and HOM index total score, continuous independent variables) and dietary intake (NDSR food subgroups and HEI score, continuous dependent variables). The means for the HOM index component scores and HOM index total scores were computed for each family. The independent variables were included in separate models. All models were adjusted for child sex and overweight status. Additional adjustments for parent BMI resulted in no substantial changes and are not presented. Weights were used to reflect the sampling design and the clinic-level population.[23]

Results

Characteristics of Family Dinner Meals

Foods from the protein and high sodium foods components were present at most meals (80% and 88% respectively), and added sugars component foods were present at nearly half (48%) of the meals (Table 2). Sixty percent of meals included at least one vegetable; 12% of meals offered foods from the dark green vegetable component. French fries (which were not

counted as a vegetable) were served at 13% of meals. Seventy-six percent of meals had a meat protein; 14% served seafood or plant protein. The lowest food component served was fruit; whole fruit was served at 12% of meals and 100% juice at 7% of meals.

The mean HOM Index score across all dinner meals was 3.06, with an observed range of 1.43 to 6.29. The most commonly served dishes were chicken (any preparation) (24% of meals), followed by pasta dishes (14%), macaroni and cheese (10%), pizza (10%), hot dogs and sausages (8%), and tacos (7%).

Analyses showed significant associations between HOM index components and child's dietary intake for non-dark green vegetables ($p=0.01$), dark green vegetables ($p<0.01$), any vegetables ($p=0.01$), dairy ($p=0.03$), and added sugars ($p<0.01$) (Table 3). For example, each additional family dinner that included the added sugars component (e.g., SSB, desserts) was associated with 0.18 greater servings of added sugars in the child's overall dietary intake ($p<0.01$). In addition, there was a significant association between the healthfulness of foods served at dinner meals (assessed by the HOM index total score) and child overall diet quality (assessed by the child's HEI score). Specifically, a one-unit increase on the HOM index total score was associated with a 1.8 greater child HEI score ($p=0.04$; Table 3).

Discussion

There were several main findings. The results of the current study found that the majority of family dinners contained a protein source, high sodium food(s), and dairy food(s). Few dinner meals had whole fruit, 100% juice, or dark leafy greens. Many foods served at family dinners were significantly and positively associated with the child's daily dietary intake. Overall, serving a higher quality dinner meal was associated with a child consuming a higher quality diet.

Researchers found no associations between meals serving whole fruit, total protein, high sodium foods, and 100% juice and the child consuming these same foods in their overall diet. This may indicate either that these foods are being served and not consumed by the target child, or that these foods are not being served and the child is consuming them elsewhere. This is not unexpected for components like whole fruit or 100% juice that were rarely served at video-recorded family meals (12% and 7% respectively) but are readily available at school breakfast/lunch.[36] The non-significant results may also speak to the difficulty of measuring certain components (e.g., sodium) through self-report or video data. In this study's sample protein is frequently served at family meals and children frequently consume protein; therefore, an association may not have been detectable.

One hypothesis regarding why the association between foods served at dinner meals and a child's overall dietary intake was significant may be due to a combination of children eating the foods served at family meals and/or children seeking out those same foods away from the family dinner meal. Additionally, the foods served at family meals may be related to child's preference.

Study findings also indicated that children are not meeting dietary recommendations for nutrient-rich food groups such as fruit, vegetables, and dairy,[37–40] and over-consuming

added sugars, often in the form of SSBs.[37,41] Study results may provide direction for registered dietitians, health practitioners and interventionists on how to help families improve the foods served at family meals and children's overall diet quality. The results may also be useful for counseling parents regarding improving family meal healthfulness. For example, descriptive results from this study provide key meal components to explore making changes (e.g., reducing SSB, including whole fruit.)

This study has several strengths. One goal was to obtain a comprehensive picture of the foods served at family dinners, and the study utilized multiple tools (i.e., meal screeners, family's verbal reports, video-recorded meals) to achieve this. The study was innovative in its use of direct observational video-recorded data, and the coding of video-recorded data had high inter-rater reliability. Additionally, the healthfulness of foods served at family meals was assessed in a low-income, minority population, who are at increased risk for poor nutrition and obesity.[42–44] Furthermore, the HOM index provides a promising way to quantitatively measure meal quality.

This study also has limitations to be considered. First, the meal screener and video-recorded meals are not validated tools. While 24-hour dietary recalls are frequently used to assess dietary intake, self-report data on dietary intake is subject to misrepresentation, such as the under-reporting of intake, and it can also be subject to desirability bias.[45,46] Likewise, while families were asked not to alter the foods served at the meal, it is possible that being video-recorded changed families behavior. Regarding the HOM index, food preparation details (e.g., fried or baked), mixed dish ingredients (e.g. containing cheese or not), and the source of foods (e.g., homemade or pre-packaged) were often missing. Researchers were unable to visually identify the presence of whole grains or fatty acids. Similar foods were treated the same in the HOM index regardless of differing nutrient profiles (e.g., whole milk versus skim milk). These results may also vary if breakfast or lunch meals were evaluated instead of dinner meals or if the study were done in populations of different race/ethnicities and income status. Finally, as it was not a goal of this study, discrepancies between the meal screener and video-recorded meal were not tracked. Future research may wish to explore additional methods of gaining a complete picture of the foods served at family meals, including an enhanced meal screener.

Conclusions

This study suggests that the dietary healthfulness of foods served at family dinner meals may be associated with the overall dietary quality of children. Results provide an incremental step in developing methods to assess the healthfulness of foods served at family meals. Recommendations for future research include validation of the HOM index and investigating the relationship of the HOM index with child dietary intake in a larger or more diverse sample.

Acknowledgments

Funding Sources

Research is supported by grant number R21DK091619 from the National Institute of Diabetes, Digestive and Kidney Disease (PI: Jerica Berge). Content is solely the responsibility of the authors and does not necessarily represent the official views of the National Heart, Lung and Blood Institute, the National Institute of Child Health and Human Development or the National Institutes of Health.

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Table 1

Healthfulness of Meal (HOM) component scoring standards for total score to assess the healthfulness of foods served at family meals

Component	Maximum Score	Minimum Score
Whole Fruit	1 for presence of whole fruit	0 for absence of whole fruit
Whole Fruit or 100% Juice	1 for presence of 2nd whole fruit or 100% juice	0 for neither a 2nd whole fruit or 100% fruit juice
Total Vegetables	2 for presence of non-dark green vegetables (1 point/ vegetable)[a]	0 for absence of non-dark green vegetables
Dark Green Vegetables[b]	1 for presence of dark green vegetables	0 for absence of dark green vegetables
Dairy	1 for presence of dairy products such as milk, cheese, yogurt, or soy beverage	0 for presence of dairy products such as milk, cheese, yogurt, or soy beverage
Protein	1 for presence of seafood, plant proteins (e.g., nuts, seeds, tofu, beans) or non-high fat meat (e.g., chicken, turkey, eggs)	0 for absence of seafood, plant proteins, or non-high fat meat or presence of high fat meat[c]
Sodium	1 for no fast food/take out or prepackaged dinners[d]; high sodium meats[e]; cheese; high sodium sauces; or salty snack food	0 for the presence of fast food/take out or prepackaged dinners; high sodium meats; cheese; high sodium sauces; or salty snack food
Added Sugars	1 for no SSB[f]; baked goods; candy	0 for presence of SSB; baked goods; candy
Total Score	9	0

[a]Total vegetables do not include french fries, including tater tots and hash browns. It was noted if a meal contained french fries for descriptive purposes.

[b]Dark greens include bok choy; broccoli; collard greens; kale; spinach; other greens like mustard and turnip greens; swiss chard; brussels sprouts; dark green leafy lettuce, and romaine lettuce.

[c]High fat meats include bologna, salami, summer sausage, pepperoni, bacon, breakfast sausage, hot dogs, bratwurst, and polish sausage.

[d]Examples of prepackaged dinners include frozen pizza, Hamburger Helper, ramen noodles, TV dinners, pot pies, frozen burritos, chicken nuggets, corn dogs, canned soups, and frozen french fries.

[e]High sodium meats include bologna, salami, summer sausage, ham, pepperoni, bacon, breakfast sausage, hot dogs, bratwurst, corned beef, and polish sausage.

[f]Sugar sweetened beverages

Table 2

Quality of family meals as assessed by the Healthfulness of Meal (HOM) index among participants in the Family Meals LIVE! study (n=120) families

	Family meals including food component (n=800)[c]		Proportion of families serving food component by percentage of meals (n=120)				
HOM Index Food Components[a]	**%**	**SD**	**0%**	**1–25%**	**25–50%**	**50–75%**	**75–100%**
Whole fruit	12	23	68	12	10	7	3
100% juice	7	14	72	19	5	4	0
Vegetable (non-dark green)	55	23	2	27	48	20	3
2nd Vegetable (non-dark green)	16	17	42	28	25	5	0
Dark green vegetable	12	17	59	16	22	3	0
Dairy	61	25	1	8	20	42	29
Total protein (Meat and/or Seafood & Plant)	80	16	0	0	1	27	72
Empty calories (sugar-sweetened beverages, desserts, candy)	48	31	8	13	23	33	23
High sodium foods	88	14	0	1	23	28	48
Total HOM index score[b]	3.06	0.84					

[a] HOM Index = Healthfulness of Meal index, a dietary index evaluating the healthfulness of foods served at family meals

[b] Score range: 0 – 9 with 0 lowest quality/9 highest quality

[c] Families (n=120) were instructed to video-record 8 days of family meals; the first meal for each family was not used for analysis. 22 families were missing a total of 40 video-recorded meals over the 7-day observation window (14 missing 1 day (6 meals available), 4 missing 2 days (5 meals available), 3 missing 3 days (4 meals available), 1 missing 4 days (3 meals available)); an additional 5 videos were not able to be coded; n = 800 meals were available to be coded and used in analysis.

Table 3

Associations between the foods served at family dinner meals, as assessed by the Healthfulness of Meal (HOM) index, and foods consumed by child or overall diet quality, as assessed by three 24-hour dietary recalls

	Child's mean daily dietary intake[ab]	**Crude linear regression[c]**			**Adjusted linear regression[c]**		
HOM index components		**β[d]**	**95% CI**	**p-value**	**β[d]**	**95% CI**	**p-value**
Whole fruit	0.9 servings	0.12	(−0.02 – 0.26)	0.09	0.09	(−0.04 – 0.22)	0.15
100% juice	0.8 servings	0.08	(−0.38 – 0.54)	0.73	0.06	(−0.40 – 0.53)	0.79
Non-dark green vegetables (e.g., beets, green beans, corn)	1.2 servings	0.09	(0.02 – 0.16)	0.02	0.09	(0.02 – 0.16)	0.01
Dark green vegetables (e.g., kale, spinach)	0.1 servings	0.06	(0.02 – 0.10)	<0.01	0.06	(0.03 – 0.10)	<0.01
Any vegetable (non-dark green or dark green)	1.3 servings	0.1	(0.01 – 0.19)	0.03	0.11	(0.02 – 0.20)	0.01
Dairy	2.1 servings	0.12	(0.004 – 0.24)	0.04	0.13	(0.02 – 0.24)	0.03
Total protein (meat and/or seafood & plant)	3.7 servings	−0.2	(−0.87 – 0.48)	0.56	− 0.14	(−0.69 – 0.42)	0.62
Added sugars (sugar-sweetened beverages, desserts, candy)	1.8 servings	0.19	(0.07 – 0.32)	<0.01	0.18	(0.06 – 0.31)	<0.01
High sodium foods	2947 milligrams	150[e]	(−62 – 363)	0.16	173[e]	(−34 – 380)	0.1
HOM Index Score	**Child's mean HEI[f] score**	**Crude linear regression[c]**			**Adjusted linear regression[c]**		
		β[d]	95% CI	p-value	β[d]	95% CI	p-value
	46.2 (mean) 23.1–64.9 (range)	2.1	(0.04 – 4.3)	0.046	1.8[g]	(0.1 – 3.5)	0.041

[a] Child's mean dietary intake as evaluated by three 24-hour dietary recalls.

[b] Serving size examples include: Whole Fruit: 1/2 cup raw or fresh, 1/4 cup dried; 100% juice: 4 fluid ounces; Non-dark green vegetables: 1/2 cup; Dark green vegetables: 1 cup raw; Dairy: 1 cup milk, 1.5 oz natural cheese; Protein: 1 ounce meat, 1 large egg; Added sugars: 8 fluid ounces soda, ~1 med brownie. Serving sizes taken from Nutrition Data System for Research (NDSR) 2012 User Manual. NDSR software was used to collect 24-hour dietary recalls.

[c] All regressions are probability weighted. Adjusted regressions include gender and obesity status. Bolded values indicate significance (p-value < 0.05).

[d] β: Mean difference in the outcome for a 1-day change in the index food component. For example, serving dairy at one additional meal is associated with a 0.12 greater servings of dairy in child's overall daily dietary intake.

[e] NDSR output for sodium given in milligrams, not food servings. 150 refers to 150 milligrams.

[f] HEI=Healthy Eating Index-2010 score. The HEI score is calculated from the dietary intake data collected through the three 24-hour recalls.

[g] Adjusted association of HOM index total score and child's HEI-2010 score (n=120): one point increase on the HOM index scale is associated with a 1.8 point greater HEI-2010 score.