HHS Public Access

Author manuscript

J Nutr Educ Behav. Author manuscript; available in PMC 2020 May 01.

Published in final edited form as:

J Nutr Educ Behav. 2019 May ; 51(5): 547–555.e1. doi:10.1016/j.jneb.2019.01.020.

Beyond Nutrient Intake: Use of Digital Food Photography Methodology to Examine Family Dinnertime

Morgan McCloskey, MSPH[1], **Susan L. Johnson, PhD**[2], **Traci A. Bekelman, PhD, MPH**[2], **Corby K. Martin, PhD**[3], and **Laura L. Bellows, PhD, MPH, RDN**[1]

[1]Department of Food Science and Human Nutrition, Colorado State University

[2]Department of Pediatrics, University of Colorado Anschutz Medical Campus

[3]Pennington Biomedical Research Center

Abstract

Objectives: Explore the feasibility of using an image-based food photography methodology (Remote Food Photography Method, RFPM) in a rural, low-resource audience and use the photos to examine the context of family dinner.

Design: Parents used the SmartIntake® app on study-issued tablets to take before and after photos of their and their child's dinner for ~7 nights and participated in a mini-focus group to discuss their experience with the RFPM.

Setting: Six Head Start/preschool centers in rural Colorado

Participants: Mother-child dyads (n=31)

Variables Measured: Number and quality of photos received, participant feedback, meal timing, concordance, location, preparation, quality

Analysis: Feasibility was assessed via practicality (percent photos received) and acceptability (general inductive approach used to analyze mini-focus groups transcripts for participant feedback); time-stamps, meal quality and food preparation scales were used to analyze dinner photos.

Results: The majority of photographs (738/864) were received. Participants reacted favorably to the methodology and for some; it led to greater self-reflection about mealtime. Mother-child dyads usually ate dinner at the same time and often ate the same food. Children were frequently served protein and refined grains, rarely served whole grains or fruit and many families relied on convenience foods.

Author for Correspondence: Laura Bellows, PhD, MPH, RDN, Associate Professor, Department of Food Science and Human Nutrition Colorado State University, 1571 Campus Delivery, Fort Collins, CO 80523-1571, laura.bellows@colostate.edu, Phone: 970-491-1305, Fax: 970-491-7252.

COI statement: The intellectual property surrounding the Remote Food Photography Method and SmartIntake app is owned by Louisiana State University and Pennington Biomedical and C. Martin is an inventor of the technology.

Conclusions and Implications: Digital food photography is feasible in this audience. Photos yielded a holistic picture of family dinnertime - meal timing, location, concordance in parent-child meals, level of preparation and meal quality.

Keywords

Food photography; family mealtimes; dinner; preschool; mother-child dyads

INTRODUCTION

Early childhood is a critical window for establishing healthy eating habits[1,2]. The home food environment and structure of family mealtimes are important influences on young children's eating behaviors[3]. The home food environment plays an important role in what foods are offered to and consumed by children, with home food availability being predictive of young children's dietary intake[4]. Similarly, family mealtime not only provides children with key nutrients, but also opportunities for parental role modeling of healthy eating behaviors. For example, frequent family meals, as well as positive meal environments in which parents and children are eating the same home cooked meal, are associated with increased intake of fruits and vegetables and decreased intake of fats and added sugars[5–7]. In lower-resource families where preschoolers attend a Head Start or preschool program that provides breakfast and lunch, the dinner meal is of particular interest as it is the weekday meal that families are most likely able to eat together. However, limited data exist on dinner meals among low-resource families with young children and given the importance of family mealtimes, additional exploration of this topic is warranted.

An emerging option for assessing family mealtimes is the use of digital photography. As evidenced by several recent reviews on the topic[8–10], digital photography is gaining popularity as a tool for dietary assessment, either as an image-assisted method to enhance another dietary assessment method (such as a 24-hour recall) or as the primary form of data[9]. While existing studies with children and families have primarily focused on the use of digital photography for dietary assessment[11–16], photography of food may provide insight into mealtimes beyond nutrient intake. Going back three decades, researchers have advocated for the use of a camera in qualitative inquiry, because "actions can be more accurately assessed in context[17]." Photos have been used in health research to examine school-based environments[18], document the lunchtime food environment among adolescents[19], and evaluate the built environment at the community level[20], with the ability to the highlight context of health behaviors being a key thread.

The use of digital photography at mealtime provides the opportunity to not only assess dietary quality, but to holistically assess other aspects of the mealtime, such as concordance in timing and foods served to different family members, meal preparation and plating techniques. Although some of these analyses can be done with traditional methodologies such as a food diary or 24-hour recall, photos are a rich and compelling data source and may provide a more comprehensive story. However, the systematic reviews on this topic indicate that a majority of image-based dietary assessment studies have been conducted in affluent, urban or convenience samples, illuminating a potential gap in the generalizability or

feasibility of this method for diverse samples[8–10]. For example, among studies that have been conducted with audiences with limited resources, photos have been taken by researchers rather than by the participants themselves[11], or have encountered significant challenges, including missing photos[13].

The overall aim of this study was use an image-based methodology in which the participants, families with young children in a rural, low-resource audience, photograph typical dinner meals. The two objectives were: (1) to assess the feasibility of using food photography with low-resource parent-child dyads in a rural community setting through the number and quality of photos received (practicality) as well as participant feedback (acceptability); and (2) to use food photography to examine the context of family mealtime beyond nutrient intake in families with young children, including meal timing, location, concordance in parent-child meals, level of preparation and a meal quality index.

METHODS

Study Setting and Participants

This study was conducted as one component of the formative research phase of the Healthy EnviROnments Study (HEROs), a technology-based interactive family intervention to promote healthy eating and physical activity behaviors in families with young children[21]. Participants were recruited from 6 purposefully selected preschool center/Head Start sites in rural, eastern Colorado. Interest forms for the formative phase of HEROs were sent home via children's backpacks. Parents who returned interest forms were randomly chosen to contact and schedule for the study. Out of 120 returned interest forms (15% response rate), 75 families were randomly chosen to contact and 36 agreed to participate in the study. All families who showed up to the initial training session (n=31) completed the entire photography portion of the study and 94% (n=29) completed the mini-focus group. Eligibility criteria included having a preschool child at a participating site, being an English speaker and being (one of) the primary individual(s) responsible for feeding their child. The study was approved by Colorado State University Institutional Review Board.

Food Photography

For the purposes of this study, the Remote Food Photography Method® (RFPM) and SmartIntake® app were used to capture meal photos. Digital photography has a long history of being used to accurately quantify the intake of children[12,22–25] and adults[26,27] in cafeteria and similar settings. The RFPM is a similar method but is used to capture energy and nutrient intake in free-living conditions, and it has been found to accurately estimate the intake of adults[28,29] and children[30,31]. Detailed methodology associated with the RFPM is described elsewhere[29]. Briefly, in the current study, participants used the SmartIntake mobile device application on a study-issued iPad (Apple, Inc., Cupertino, CA) to take a photo of their meal and their preschool child's meal both before and after consumption. In addition to the photos, the SmartIntake app prompted participants to send a description of the food in the photo (i.e. describing the meal or labeling milk as whole vs 1%) through the app. The photos and corresponding descriptions were wirelessly transmitted to a university server in real time, where the research team reviewed the data for quality and completeness. Because

the SmartIntake app was only available on the iOS platform at the time of the study (spring 2017), participants were given study-issued iPads for the week so as not to limit participation to those who already owned an Apple™ device.

Training

Existing RFPM training materials were adapted with an eye to cultural relevance and the potential for varying literacy and technology levels among participants. Culturally relevant meals, including commonly eaten Hispanic foods, were added as example photos. Training language was simplified, additional photos were included, and several handouts were created at a Flesch-Kincaid Grade Level score of 6.3 (MS Word 2016, Microsoft Corporation, Redmond, WA). Although previous research showed that participants in this audience are frequent users of mobile devices[32], Apple™ products were unfamiliar to most in this sample (unpublished data), and thus a component was added to the training to walk participants through common iPad features and how to use the device.

At the beginning of the 60-minute training, participants were asked to complete a food diary for the previous evening meal for themselves and their child to help them start thinking about the process of recording their meals. After this, participants learned how to use the SmartIntake app on an iPad and were trained on best practices for meal photos, such as the importance of photo angle and using a clear cup for liquids so that they were visible. Participants learned what additional details they needed to provide for each meal, such as type of bread (e.g., whole wheat or white) or milk (e.g., whole or 2%). Participants practiced taking photos and typing out meal details with real foods provided. At the conclusion of the training, participants were provided with a study iPad and handouts highlighting the main training points. The training was conducted by two members of the research team and took place at the preschool or a comfortable community location, such as a library.

Data Collection

Training and data collection were conducted in small groups with 2–7 participants per group at each of the 6 sites (n=31 families). At the training site, but prior to the start of the training, participants provided informed consent and completed a brief demographics survey. Participants were asked to take before and after photos of their meal and their child's meal at dinner for 7 consecutive nights. As the iPad was borrowed and not part of their normal routine, participants were sent a reminder text message to their personal mobile phone approximately 30 minutes before their reported dinner time each night. Throughout the evening, study staff monitored the photos for quality and completeness of data and communicated with participants via text message as necessary.

One week later, participants returned to same location to return the iPads and study staff had the opportunity to ask any clarifying questions about meal photos that had not yet been answered. At this time, participants also took part in a mini-focus group[33] to evaluate their experience with the RFPM and the feasibility of the protocol. Mini-focus groups, defined by Krueger as a small focus group often with four to six participants, is ideal for "gaining understanding of people's experiences and more in-depth insights[33]." The mini-focus group consisted of three broad, overarching questions with multiple probes; questions are provided

in Table 2. Experts in nutrition, child development, public health, medical anthropology and qualitative research reviewed the mini-focus group guide to establish content validity. Mini-focus groups were conducted by a trained member of the research team, with another trained member serving as notetaker[33,34]. The mini-focus groups lasted approximately 15–20 minutes and were audio-recorded with participants' permission. All participants were compensated $50 for their time. Figure 1 provides a timeline of data collection methodology.

Data Analysis

Feasibility—Feasibility was assessed in two ways: the practicality of the protocol in this audience was assessed by the number and quality of photos received, while acceptability of the protocol was assessed through participant feedback. Practicality was assessed by the percentage of total possible photos received from participants, as well as the percentage of quality photos. Photos were considered unusable or "not quality" if it was impossible to discern the type and quantity of food served due to the photo being extremely dark and/or blurry or due to missing details describing the food. In order to assess acceptability through participant feedback, mini-focus groups recordings were de-identified and transcribed verbatim by a HIPAA-compliant vendor, and transcripts were verified against field notes and recordings. Focus group data were analyzed and interpreted using a general inductive approach[35], which is a simple, systematic method for analyzing qualitative data collected through focused evaluation questions. Two researchers trained in qualitative data analysis[34] read each transcript multiple times and then created general categories related to the aim of understanding participants' feedback on the protocol as well as specific categories resulting from close readings of the text[35]. These categories, such as ease/difficulty of the protocol, communication with the research team and potential for future intervention use, were used as codes to code the data in NVivo (NVivo qualitative data analysis Software; QSR International Pty Ltd. Version 11, 2015) by the two researchers, who met throughout the process to achieve consensus. A summary report was generated to capture participants' feedback and experience with the RFPM.

Meal timing, concordance and location—All photos were downloaded and organized into Excel spreadsheets (MS Excel 2016, Microsoft Corporation, 2016) containing the before and after photos for each day of data, by participant. Time stamps on the photos were used to assess the time that dinner began and ended and meals were considered concordant in timing if mother and child before meal photos were taken within 10 minutes of one another. Mother and child meals were labeled as either discordant or concordant in food type if the food was either the same or from the same larger preparation, with an allowance for minor modifications, including different condiments and/or toppings, such as a mother having barbeque sauce with her hot dog, while the child has ketchup. Restaurant or takeout meals that were different menu items were considered discordant.

Meal Preparation—Based on existing literature[36,37], a scale was developed to assess the level of meal preparation. The scale ranged from 0–3, in which 0 represented a takeout or restaurant meal, 1 represented a convenience or ready to (h)eat meal (i.e., a frozen meal or cold items that required minimal effort to assemble, such as a peanut butter and jelly sandwich or cereal with milk), 2 represented a semi-convenience meal (i.e., partially

prepared items or a combination of packaged items that required preparation, such as pasta and jarred tomato sauce) and 3 represented a non-convenience meal prepared primarily from raw ingredients (Figure 2). Two research staff coded the photos for level of meal preparation and met throughout the process to achieve consensus in coding.

Meal Quality—The quality of meals served to children was assessed using the Healthy Meal Index (HMI)[38], a validated tool modeled after the Healthy Eating Index 2005 to assess the healthfulness of meals served to children in this age group. The HMI includes both Adequacy and Moderation scores, but for the purposes of this study, only the Adequacy score was used. The Adequacy score is a sum of 9 components (65 total points; Table 1). Two research staff each independently coded 33% of the child meal photos (kappa = 0.91), then each coded half of the remaining photos and checked the others' coding. Any discrepancies were resolved through meetings until consensus was achieved. Scores were recorded in REDCap[39]. T-tests were used to analyze the differences in mean weekday compared to mean weekend HMI and meal preparation scores. In order to focus on feasibility and applications of photography beyond dietary intake, nutrient data will be presented separately.

Additional Observations—Photos were analyzed for presence and type of beverage. To ascertain if a common nutrition message for low-income families was followed (e.g. stretching food dollars) photos were assessed for the inclusion of leftovers, which was defined as more than 50% of the meal consisting of a prepared component (such as pizza, burrito filling, spaghetti with sauce) from a previous night of data collection. Photos were also assessed to determine how meals were most commonly plated (i.e. standard ceramic dish, child's reusable plastic plate or single-use, disposable plate or container).

RESULTS

Participant Characteristics

All parent participants from each family (n=31) were mothers and 45% were Hispanic. Families were predominantly low-resource, as 80% had an annual household income of less than $44,955, which is 185% of the 2016 U.S. poverty line for a family of four[40]. Mothers represented a range of education levels, with 26% completing high school or less, 52% completing some college and 16% having a college degree. The average age of the child was 4.8 years and 55% of children were male.

Feasibility

All of the iPads were returned on time and in good condition. In terms of practicality of the protocol, 30 of the 31 families had the iPads for 7 nights (1 family had it for 6 nights) resulting in 864 possible photos (4 photos/night/family). Of the possible photos, 742 total photos were received, of which 4 were deemed unusable due to extremely dark and/or blurry photos. No photos were deemed unusable due to lack of written details. This resulted in 738 quality photos for analysis (85%), representing 3 or more days of usable data for 100% of participants. Communication with participants during the study period revealed a few common reasons for missing photos: simply forgetting, or an unanticipated family event or

emergency that meant they were either apart from their children or unable to take photos. In terms of acceptability of the protocol, as illustrated by the sample quotes in Table 2, participants generally reacted favorably to the data collection method and most indicated that they would participate again if asked. In particular, participants felt that it was easier to take the photos than complete a food diary, such as the one they completed in training. Participants confirmed that they appreciated the nightly text reminders and did not feel like they were intrusive. One unexpected finding was that in five out of the seven mini-focus groups, participants indicated that the project resulted in greater self-reflection, including that it made them pay closer attention to the dinnertime meal and what their child was actually eating. Participants had mixed feelings about having the iPad for uses beyond the food photography. Several really enjoyed it and downloaded both games and learning apps for their children, while others did not use it for anything besides the food photography, primarily due to concerns about the iPad breaking, siblings fighting over it or children having extra screen time beyond what was normally allowed on the families' existing devices.

Meal Timing, Concordance and Location

Mother-child dyads usually ate dinner at the same time as one another (Table 1). Among the 7.5% of meals that were eaten greater than 10 minutes apart, mothers and children ate between 13 minutes and 3 hours, 44 minutes apart, with a mean difference of 45 minutes. The average start of dinnertime was 6:09 PM for children and 6:16 PM for mothers. However, average start times for dinner ranged widely across families, from 4:29 PM to 8:10 PM. On average, dinner lasted 27 minutes for children and 24 minutes for mothers. As shown in Table 1, mother-child dyads were frequently served the same foods. Meals discordant for food type included occasions of eating out when the pair ordered different menu options (12%), eating occasions at home when the pair ate different types of pre-prepared or processed items such as two different frozen meals (5%) and eating occasions at home where the pair simply ate different meals (8%). Approximately 75% of meals consisted of food that was prepared and eaten at home, and 20% were takeout meals eaten at home, such as pizza delivery. The remaining 5% of meals were eaten away from the home, at either a fast food establishment or sit-down restaurant.

Meal Preparation

The average meal preparation score among all families was 1.7 (out of a possible 3 points; Table 1). However, there was a large range in mean scores among individual families (0.5–3.0), meaning that some families ate out almost every night, while other families always prepared meals from scratch. Figure 1 illustrates sample meals for scores 0–3. The average meal preparation score between weekdays and weekends was not significantly different (1.7 vs 1.5; $p = 0.28$).

Meal Quality

The average HMI Adequacy score was 30.3 (out of 65 possible points; Table 1), but there was a large range in average scores among families (13.3 – 41.4). Figure 3 illustrates samples meals representing the lowest, mean and highest HMI scores. As shown in Table 1, the highest scoring components of children's meals were protein, grains, and total

vegetables, while the lowest-scoring components were whole grains and fruit. HMI adequacy scores were not significantly different when comparing weekdays to weekend (29.8 vs 31.2, p=0.45). There was no significant difference in HMI adequacy score by day of data collection (p=0.68).

Additional Observations

Approximately 81% of child meal photos included a beverage, of which 19% were milk, 37% were water and 42% were a sugar-sweetened beverage, primarily sodas or juice drinks that were not 100% fruit. Families in this sample used a large amount of single-use paper and plastics, with 52% of children's meals and 47% of mother's meals being eaten from disposable plates, packaging or other single-use takeout container. Leftovers were infrequent, as only 6% of meals served to children contained noticeable leftovers from a previous night of data collection.

DISCUSSION

This study demonstrated new potential for both the breadth and depth of analytical possibilities related to digital food photography, including the Remote Food Photography Method. By collecting photos on mother-child dyads over the course of an entire week, it was possible to gain a more holistic understanding of the typical dinner meal among these low-resource, rural families. For example, time-stamps on the photos revealed that mothers and their preschool children were eating dinner at the same time most evenings. This finding stands in contrast to studies with other low-resource families, which found that only 52% of mothers consumed dinner with their preschool child[11]. Although this study did not capture actual parent-child interactions at the dinner table, if mothers are eating similar foods at the same time as their preschooler, they have a potential opportunity to role model healthy eating behaviors for their child, making role modeling a strong potential target for future intervention.

The method also could reveal rich information about the context of family meals: families ate dinner at home about three-quarters of the time. This finding is similar to reports from a national survey on food purchasing and acquisitions, which showed that rural households have a lower share of spending at restaurants and other food-away-from-home locations compared to urban households[41]. Although families ate a majority of meals at home, approximately 58% of children's meals consisted primarily of ready to h(eat) or semi-convenience foods. This indicates a high reliance on ultra-processed foods[42] such as frozen meals, packaged snacks or processed meat products like hot dogs or chicken nuggets, which tend to be higher in fat, salt or added sugars[42,43]. This is in line with other studies which have shown a high contribution of processed foods to overall energy intake and household food purchases in the US[42,43]. Specifically, data from a nationally representative sample of children and adults participating in the National Health and Nutrition Examination Survey (NHANES) 2009–2010 showed that 57.9% of average US daily energy intake comes from ultra-processed foods, while just 29.6% of energy intake comes from 'unprocessed or minimally processed foods'[42]. Further analyses have found an inverse relationship between

dietary quality and diets high in ultra-processed foods[44], indicating that promoting decreased consumption of highly processed items may be another appropriate intervention target.

Overall, food photography methods such as the RFPM and SmartIntake app, can be used to capture relative indicators of dietary quality from a meal as well as aspects of family mealtime, such as concordance in parent-child meals, which would be difficult to capture with traditional methodologies such as a food frequency questionnaire. Importantly, photography is also more objective, as it does not rely on participants' memory of the foods they consumed or the context surrounding dinnertime. Similar to other studies[8], participants in this sample found the process to be a relatively easy and preferred taking photos to completing a food diary, meaning that it is possible to obtain multiple days of data on dinnertime with a lower risk of subject attrition.

This study also demonstrated the feasibility of using an image-based dietary assessment methodology in a low-resource, rural population. All participants returned the iPads on time and in excellent condition. The high rate of quality photos returned gives credence that the training was effective. Although others have raised concerns with image-based assessments, including poor photo quality, missing photos or details about the foods[8], 85% of the total possible photos were received and of sufficient quality. This was likely due to the SmartIntake app, ample training and consistent communication with participants. Overall, participants reacted favorably to the data collection methodology and although a few participants brought up concerns about the potential for additional screen exposure, other work with this population has indicated that a study-issued device would simply replace existing screen time for young children rather than adding additional time[45].

However, the study is not without limitations. Although a majority of families supplied 5+ days of usable data, the overall sample size was small, so results may not be generalizable to a larger population. As with most dietary assessments, there was a potential for social desirability bias, if participants changed their eating habits because they were taking the photos, though this was not detected with adults in previous RFPM studies[29]. However, it is unlikely that participants could have sustained an improvement in meal quality over 7 days and there was no significant difference in HMI scores by day, indicating that participants were not trying to present a higher quality meal at the beginning of the data collection period. Additionally, photos were taken in a variety of environments (such as food on a counter without a plate, a participants' lap as they laid on the couch) that indicate most participants were not concerned with taking socially desirable photos. Another limitation of this study is that participants were only asked to take photos of what they considered to be their dinner meal. If participants or their child ate a snack before dinner or dessert after dinner and did not consider this to be a part of their evening meal, these eating occasions were not captured. Similarly, the feasibility results are associated with documenting a single meal each day. If participants were asked to take photos of every single eating occasion throughout the day, the subject burden would have been significantly higher, as was found by Nicklas et al[13].

The strengths of this study were the focus on a low-resource, rural population and showing that it is feasible to provide iPads and consistently collect 5–7 consecutive days of data on

the dinner meal. Additionally, this study highlighted the potential to expand the utility of food photography to the context of family mealtime in addition to nutrient analysis.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Overall, an image-based digital food photography methodology is feasible with a provided device in a low-resource, rural audience and photos yielded a holistic picture of dinnertime in these families. In addition to the protocol and analyses outlined in this paper, other photographic methodologies such as Photovoice[46] or photo-elicitation may be an important tool for further understanding the context of family mealtimes and untangling the mechanisms by which family meals are associated with a multitude of positive child outcomes. Beyond the richness of food photography as an assessment methodology, there is potential utility in digital food photography as an intervention strategy. Several participants in this study noted that taking the photos made them pay closer attention to the portions they were serving as well as the foods that their child was eating. If visually documenting their meals helps participants to notice behaviors that could be improved, it could be used as an intervention tool. For example, if an intervention were to ask participants to set self-monitoring goals related to meal time such as serving more vegetables or appropriate portion sizes, photos could be used as a self-monitoring tool to help motivate participants to track their own progress as well as an assessment tool for the researchers. Future studies, including larger scale community-based interventions, may be interested in continuing to explore this dual application of food photography.

ACKNOWLEDGEMENTS

This project is supported by Agriculture and Food Research Initiative Grant no. 2015-68001-23240 from the USDA National Institute of Food and Agriculture, Childhood Obesity Prevention: Integrated Research, Education, and Extension to Prevent Childhood Obesity – A2101. This work was also partially supported by NORC center grant P30 DK072476 entitled “Nutritional Programming: Environmental and Molecular Interactions” sponsored by the NIDDK, and grant **U54 GM104940 from the National Institute of General Medical Sciences of the National Institutes of Health, which funds the Louisiana Clinical and Translational Science Center.** The REDCap database is supported by NIH/NCRR Colorado CTSI Grant Number UL1 RR025780. The contents are the authors’ sole responsibility and do not necessarily represent official USDA or NIH views.

REFERENCES

1. Birch LL, Fisher JO. Development of Eating Behaviors Among Children and Adolescents. Pediatrics. 1998;101:539. [PubMed: 12224660]
2. Anzman SL, Rollins BY, Birch LL. Parental influence on children’s early eating environments and obesity risk: implications for prevention. Int J Obes. 2010;34:1116.
3. Patrick H, Nicklas TA. A review of family and social determinants of children’s eating patterns and diet quality. J Am Coll Nutr. 2005;24:83–92. [PubMed: 15798074]
4. Boles RE, Johnson SL, Burdell A, Davies PL, Gavin WJ, Bellows LL. Home food availability and child intake among rural families identified to be at-risk for health disparities. Appetite. 2019;134:135–141. [PubMed: 30553878]
5. Sweetman C, McGowan L, Croker H, Cooke L. Characteristics of family mealtimes affecting children’s vegetable consumption and liking. J Am Diet Assoc. 2011;111:269–273. [PubMed: 21272701]
6. Swanson V, Power KG, Crombie IK, et al. Maternal feeding behaviour and young children’s dietary quality: A cross-sectional study of socially disadvantaged mothers of two-year old children using the Theory of Planned Behaviour. Int J Behav Nutr Phys Act. 2011;8:65. [PubMed: 21699714]

7. Martin-Biggers J, Spaccarotella K, Berhaupt-Glickstein A, Hongu N, Worobey J, Byrd-Bredbenner C. Come and Get It! A Discussion of Family Mealtime Literature and Factors Affecting Obesity Risk. Adv Nutr. 2014;5:235–247. [PubMed: 24829470]
8. Sharp DB, Allman-Farinelli M. Feasibility and validity of mobile phones to assess dietary intake. Nutrition. 2014;30:1257–1266. [PubMed: 24976425]
9. Boushey CJ, Spoden M, Zhu FM, Delp EJ, Kerr DA. New mobile methods for dietary assessment: review of image-assisted and image-based dietary assessment methods. Proc Nutr Soc. 2017;76:283–294. [PubMed: 27938425]
10. Gemming L, Utter J, Ni Mhurchu C. Image-assisted dietary assessment: a systematic review of the evidence. J Acad Nutr Diet. 2015;115:64–77. [PubMed: 25441955]
11. Nicklas TA, O'Neil CE, Stuff JE, Hughes SO, Liu Y. Characterizing Dinner Meals Served and Consumed by Low-Income Preschool Children. Child Obes. 2012;8:561–571. [PubMed: 23181922]
12. Nicklas TA, Liu Y, Stuff JE, Fisher JO, Mendoza JA, O'Neil CE. Characterizing Lunch Meals Served and Consumed by Preschool Children in Head Start. Public Health Nutr. 2013;16:2169–2177. [PubMed: 23701867]
13. Nicklas T, Saab R, Islam NG, et al. Validity of the Remote Food Photography Method Against Doubly Labeled Water Among Minority Preschoolers. Obesity (Silver Spring). 2017;25:1633–1638. [PubMed: 28758370]
14. Nyström CD, Sandin S, Henriksson P, et al. Mobile-based intervention intended to stop obesity in preschool-aged children: the MINISTOP randomized controlled trial. Am J Clin Nutr. 2017;105:1327–1335. [PubMed: 28446496]
15. Taylor JC, Yon BA, Johnson RK. Reliability and Validity of Digital Imaging as a Measure of Schoolchildren's Fruit and Vegetable Consumption. J Acad Nutr Diet. 2014;114:1359–1366. [PubMed: 24751663]
16. Masis N, McCaffrey J, Johnson SL, Chapman-Novakofski K. Design and Evaluation of a Training Protocol for a Photographic Method of Visual Estimation of Fruit and Vegetable Intake among Kindergarten Through Second-Grade Students. J Nutr Educ Behav. 2017;49:346–351. e341. [PubMed: 28258818]
17. English FW. The utility of the camera in qualitative inquiry. Educational Researcher. 1988;17:8–16.
18. Kontak JCH, McIsaac JD, Penney TL, Kuhle S, Kirk SFL. The picture of health: examining school-based health environments through photographs. Health Promot Int. 2017;32:322–330. [PubMed: 27107022]
19. Staiano AE, Baker CM, Calvert SL. Dietary Digital Diaries: Documenting Adolescents' Obesogenic Environment. Environ Behav. 2012;44:695–712. [PubMed: 23180882]
20. Chow CK, Corsi DJ, Lock K, et al. A novel method to evaluate the community built environment using photographs--Environmental Profile of a Community Health (EPOCH) photo neighbourhood evaluation tool. PLoS One. 2014;9:e110042. [PubMed: 25369366]
21. Bellows LL, McCloskey M, Clark L, et al. HEROs: Design of a Mixed-Methods Formative Research Phase for an Ecocultural Intervention to Promote Healthy Eating and Activity Behaviors in Rural Families With Preschoolers. J Nutr Educ Behav. 2018;50:736–745. [PubMed: 29653807]
22. Martin CK, Thomson JL, LeBlanc MM, et al. Children in school cafeterias select foods containing more saturated fat and energy than the Institute of Medicine recommendations. J Nutr. 2010;140:1653–1660. [PubMed: 20668251]
23. Martin CK, Newton RL Jr., Anton SD, et al. Measurement of children's food intake with digital photography and the effects of second servings upon food intake. Eat Behav. 2007;8:148–156. [PubMed: 17336784]
24. Williamson DA, Han H, Johnson WD, Martin CK, Newton RL Jr. Modification of the school cafeteria environment can impact childhood nutrition. Results from the Wise Mind and LA Health studies. Appetite. 2013;61:77–84. [PubMed: 23154216]
25. Nicklas TA, O'Neil CE, Stuff J, Goodell LS, Liu Y, Martin CK. Validity and Feasibility of a Digital Diet Estimation Method for Use with Preschool Children: A Pilot Study. J Nutr Educ Behav. 2012;44:618–623. [PubMed: 22727939]

26. Williamson DA, Martin PD, Allen HR, et al. Changes in food intake and body weight associated with basic combat training. Mil Med. 2002;167:248–253. [PubMed: 11901576]
27. Martin CK, Nicklas T, Gunturk B, Correa JB, Allen HR, Champagne C. Measuring food intake with digital photography. J Hum Nutr Diet. 2014;27:72–81. [PubMed: 23848588]
28. Martin CK, Han H, Coulon SM, Allen HR, Champagne CM, Anton SD. A novel method to remotely measure food intake of free-living individuals in real time: the remote food photography method. Br J Nutr. 2009;101:446–456. [PubMed: 18616837]
29. Martin CK, Correa JB, Han H, et al. Validity of the Remote Food Photography Method (RFPM) for Estimating Energy and Nutrient Intake in near Real- Time. Obesity. 2012;20:891–899. [PubMed: 22134199]
30. Nicklas T, Islam NG, Saab R, et al. Validity of a Digital Diet Estimation Method for Use with Preschool Children. J Acad Nutr Diet. 2018;118:252–260. [PubMed: 28637631]
31. Nicklas T, Saab R, Islam NG, et al. Validity of the Remote Food Photography Method Against Doubly Labeled Water Among Minority Preschoolers. Obesity. 2017;25:1633–1638. [PubMed: 28758370]
32. McCloskey M, Johnson SL, Benz C, et al. Parent Perceptions of Mobile Device Use Among Preschool-Aged Children in Rural Head Start Centers. J Nutr Educ Behav. 2018;50:83–89. [PubMed: 29031581]
33. Krueger RA, Casey MA. Focus Groups: A Practical Guide for Applied Research. Thousand Oaks, CA: Sage Publications; 2014.
34. Goodell LS, Stage VC, Cooke NK. Practical Qualitative Research Strategies: Training Interviewers and Coders. J Nutr Educ Behav. 2016;48:578–585. [PubMed: 27395426]
35. Thomas DR. A general inductive approach for analyzing qualitative evaluation data. Am J Eval. 2006;27:237–246.
36. Daniels S, Glorieux I. Convenience, food and family lives. A socio-typological study of household food expenditures in 21st-century Belgium. Appetite. 2015;94:54–61. [PubMed: 25963105]
37. McLaughlin C, Tarasuk V, Kreiger N. An examination of at-home food preparation activity among low-income, food-insecure women. J Am Diet Assoc. 2003;103:1506–1512. [PubMed: 14576717]
38. Kasper N, Mandell C, Ball S, Miller AL, Lumeng J, Peterson KE. The Healthy Meal Index: A tool for measuring the healthfulness of meals served to children. Appetite. 2016;103:54–63. [PubMed: 26994739]
39. Harris PATR, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap) - A metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009;42:377–381. [PubMed: 18929686]
40. US Department of Health and Human Services. Annual Update of the HHS Poverty Guidelines 2016. https://aspe.hhs.gov/computations-2016-poverty-guidelines. Accessed August 31st, 2018.
41. Todd JE, Scharadin B Where Households Get Food in a Typical Week: Findings from USDA's FoodAPS. Washington, DC: US Department of Agriculture, Economic Research Service; July 2016 EIB–156.
42. Martinez Steele E, Baraldi LG, Louzada ML, Moubarac JC, Mozaffarian D, Monteiro CA. Ultra-processed foods and added sugars in the US diet: evidence from a nationally representative cross-sectional study. BMJ open. 2016;6:e009892.
43. Poti JM, Mendez MA, Ng SW, Popkin BM. Is the degree of food processing and convenience linked with the nutritional quality of foods purchased by US households? Am J Clin Nutr. 2015;101:1251–1262. [PubMed: 25948666]
44. Martinez Steele E, Popkin BM, Swinburn B, Monteiro CA. The share of ultra-processed foods and the overall nutritional quality of diets in the US: evidence from a nationally representative cross-sectional study. Popul Health Metr. 2017;15:6. [PubMed: 28193285]
45. McCloskey ML, Thompson DA, Chamberlin B, Clark L, Johnson SL, Bellows LL. Mobile Device Use Among Rural, Low-Income Families and the Feasibility of an App to Encourage Preschoolers' Physical Activity: Qualitative Study. JMIR Pediatrics and Parenting. 2018;1:e10858.
46. Wang C, Burris MA. Photovoice: concept, methodology, and use for participatory needs assessment. Health Educ Behav. 1997;24:369–387. [PubMed: 9158980]

CAPTIONS

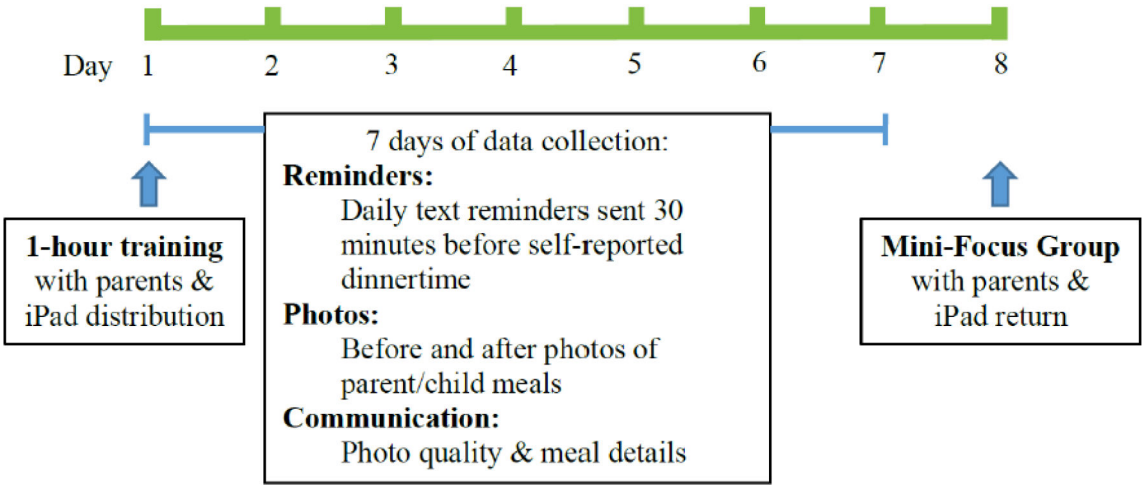

Figure 1.
Timeline of Data Collection for Remote Food Photography Method® among Parent-Child Dyads

Figure 2.
Sample child meals representing each level of meal preparation

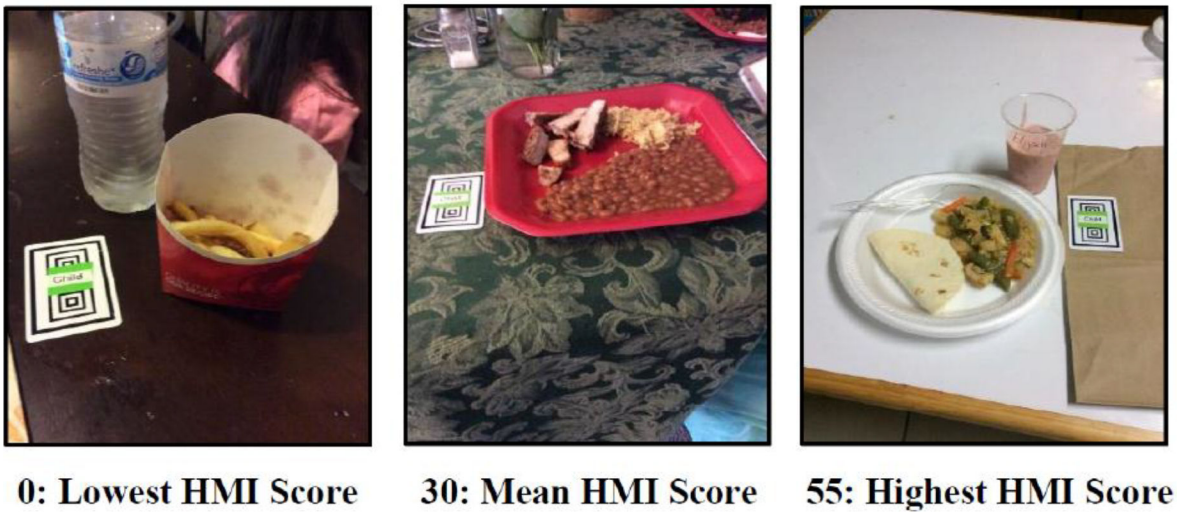

Figure 3.
Sample child meals illustrating variety of Healthy Meal Index (HMI) scores

Table 1.

Characteristics of children's meals, including meal timing, concordance, quality and level of meal preparation

	Child Meal (n=188)
Meal Timing and Concordance	
Parent and child meal from same preparation; n (%)	141 (75.0%)
Parent and child ate dinner at same time; n (%)	174 (92.5%)
Meal Preparation; n (%)	
Takeout/fast food/restaurant	47 (25.0%)
Ready to h(eat) food	72 (38.2%)
Semi-convenience (medium preparation)	38 (20.2%)
Non-convenience (high preparation)	61 (32.4%)
Meal Preparation Score (possible range 0 – 3)	
Overall cooking score	1.7
Meal Quality - Healthy Meal Index[1] **(mean (SD))**	
Total fruit (out of 10)	0.7 (2.6)
Total vegetables (out of 10)	6.4 (4.8)
Vegetable quality (out of 5)	2.3 (2.5)
Vegetable variety (out of 5)	1.6 (2.3)
Total grains (out of 5)	3.8 (2.1)
Whole grains (out of 5)	0.1 (0.6)
Dairy (out of 10)	6.1 (4.9)
Protein (out of 10)	8.8 (3.3)
Omega-3 foods (out of 5)	0.3 (0.6)
Adequacy score (out of 65)	30.2 (11.1)

[1]Higher HMI scores represent higher quality

Table 2.

Mini-Focus Group Questions and Sample Participant Quotes

Mini-Focus Group Questions	Sample Participant Quotes
Question 1: Overall, what was the experience of taking pictures at dinner like for you and your family?	"I liked it. I thought it was fun." "Yeah, the pictures were really easy." "It was better to take the pictures instead of having to write everything that we made." "I thought it was nice that you guys did the [text] reminders." "It really brought to light like how chaotic my life truly is. I never understood how I'm bouncing around. When I'm filling out the survey at the beginning, I'm like, oh, I got this. Like things are great. Then, trying to take pictures was just a highlight of how disorganized and chaotic things can be when it comes to my evening." "I noticed that portion control, I noticed that the visual, because you normally just plop it on the plate and say, "Here you go," you really don't think about it. For me, it was portions, it was really watching how much my kids were actually eating versus how much I was eating." "I just realized how much my kid really doesn't eat his vegetables."
Question 2: Sometimes people eat other foods in the evening besides dinner. What types of foods did you or your preschooler eat in the evenings that you didn't photograph?	"There were a couple nights we had dessert and I didn't take pictures of it, because it was - we were already done. I had already taken pictures, put it away and moved on."
Question 3: What was your experience like having one of our iPads for the week?	"My kids enjoyed [having the iPad] too. We don't have a tablet at home so it made me think maybe they're more mature now to where they can handle it. Because they took turns with it and they had fun." "Having the iPad was really hard because… they were all wanting to do it and then it caused a huge fight, so I had to put it up out of sight, out of mind."