Research Article

Checklist to Capture Food, Physical Activity, and Sedentary Devices in the Home Environment: The Home Inventory Describing Eating and Activity (Home-IDEA2)

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ABSTRACT

Objective: To modify and test a self-report checklist for the home food and activity environment, Home–Inventory Describing Eating and Activity (IDEA2), psychometrically with families of young children.

Design: A mixed-methods approach: (1) cognitive interviews informed instrument design (content validity), (2) parent and trained independent raters concurrently and independently completed the Home-IDEA2 during home visits (criterion validity); (3) the Home-IDEA2 was compared with a national sample via the Food Acquisition and Purchase Survey (FoodAPS) database (construct validity).

Setting: Rural communities in Colorado.

Participants: Families of preschoolers: cognitive interviews (n = 20) and home visits (n = 26).

Main Outcome Measures and Analysis: Content validity: responses to each question were analyzed using a general inductive approach. Criterion validity: Cohen's kappa (κ) coefficient was calculated for each Home-IDEA2 item. Construct validity: frequencies were calculated to determine the proportion of Home-IDEA2 food items found in FoodAPS households.

Results: Cognitive interviews identified the need for more food descriptions and the reduction of total items from 154 to 134. Testing resulted in acceptable agreement ($\kappa = 0.6–1.0$) for 82 items (58 food, 16 physical activity, and 8 electronics), moderate agreement for 36 (35 food and 1 physical activity; $\kappa = 0.4–0.5$), and poor agreement for 16 (15 food and 1 electronics; $\kappa \leq 0.3$). Overall reliability improved from 55% to 65% for Home-IDEA2 items. Comparison of Home-IDEA2 items with FoodAPS demonstrated that 60% of foods found in US homes were covered by the Home-IDEA2.

Conclusions and Implications: This study resulted in a valid, reliable, and low-burden self-report measure for food, activity, and electronic home environments by low-income, minority parents of preschoolers.

Key Words: childhood obesity, FoodAPS, home environment, physical activity, preschool, psychometrics (*J Nutr Educ Behav.* 2019; 51:589–597.)

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INTRODUCTION

Childhood obesity continues to be a major public health concern disproportionally affecting minority groups and those with limited resources.[1,2] Because 1 of every 3 preschool-aged children is considered overweight or obese,[2] the need to address this audience is warranted. Obesity prevention efforts require multilevel approaches focused on both individuals and their environments. One environment in which young children spend the majority of their time is the home.

The home environment has a critical role in the development of young children's eating and physical activity (PA) behaviors. The home largely determines children's food access via family rules, preferences, and habits.[3,4] Availability of healthful food options is the most predictive factor of children's consumption of healthy foods, including fruits and vegetables, and intake of sugar-sweetened beverages.[4–6] In a study of 6- to 11-year-olds, Couch et al[7] found that the availability of healthful foods in the home was favorably related to children's diet quality. For PA, the availability and density of PA devices (eg, bikes, jump rope, balls), as well as PA-related parent behaviors, were associated with children's PA behaviors and weight status.[8–12] The

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influence of the home availability of food and PA devices, in conjunction with parent behaviors, on children's diet and activity behaviors suggests that the home environment is a strong target for intervention.

Because of its complex, variable, and dynamic nature, it can be challenging to assess the home food and activity environment. Previously published assessment tools often were limited to a singular focus (eg, either nutrition or PA) and few offered a comprehensive instrument that addressed food, PA, and electronic or sedentary devices simultaneously, perhaps in an effort to reduce participant burden.[13] Moreover, most home food assessments included a narrow range of foods (eg, fruits and vegetables) and focused on a singular outcome (eg, cancer risk) vs a complete listing of foods representing overall dietary quality.[14] Dietary quality encompassed both the quality and variety within the whole diet rather than individual nutrients or foods, and therefore enabled an examination of associations between whole foods and health status.[15] Understanding what foods are being acquired by households, as well as where those foods are being acquired and how much consumers are paying, is an important element in shaping food and nutrition policies aimed at improving diet quality.[16] Thus, there is a need for comprehensive assessments to capture all foods at the individual household level that are sufficiently detailed for researchers and feasible for respondents to complete.

The Home Inventory for Describing Eating and Activity (Home-IDEA) is a validated self-report checklist that assesses the availability of food and activity devices in the home. In a 2014 study with diverse families of preschool-aged children, Boles et al[17] reported that criterion validity was achieved with 55% of all food, PA, and electronic device items. The number of unreliable food items (including healthy and less healthy foods) suggested that additional development, ideally consisting of both qualitative and quantitative methods, was needed to enhance the utility and validity of the Home-IDEA, particularly in health-disparate audiences. Thus, the overall goal of this study was to use a mixed-methods approach to establish the validity and reliability of a modified Home-IDEA checklist, the Home-IDEA2.

METHODS

The researchers used 3 components of this mixed-methods research to refine and test the Home-IDEA checklist psychometrically with low-income, minority parents of young children. First, they conducted cognitive testing via face-to-face interviews with participants to establish content validity by eliciting information regarding participants' understanding of the items and response options and their process for completing the Home-IDEA instrument. Second, a different sample of participants was recruited to complete the modified Home-IDEA (Home-IDEA2). To establish criterion validity, participants completed the Home-IDEA2 concurrently with and independently of a research staff member. Finally, to establish construct validity, the National Food Acquisition and Purchase Survey (FoodAPS) food-at-home data set was selected to examine the comprehensiveness of the Home-IDEA2, because the FoodAPS surveyed food purchases in a representative sample of ethnically and economically diverse households in the US, which provided an approximation of the diversity of foods likely to be found in US homes.[18] This study was approved by the Institutional Review Board at Colorado State University.

Home Food and Activity Assessment Tool

The Home-IDEA consisted of a total of 154 items: 126 food and drink items (eg, snacks, grains and cereal, drinks, meat, dairy, fruits and vegetables), 16 PA devices (eg, bike, jump rope, sports equipment), and 12 electronic devices in the child's bedroom, meant to target sedentary behaviors (eg, television, computer, video games). Preliminary psychometric evaluations showed that only 85 items from the original 154 had interrater reliability.[17] For the cognitive testing phase of this study, the original item pool of 154 items was retained to assess the impact of modifications on the reliability of previously unreliable items, with the objective of increasing the number of items that could be retained.

Cognitive Testing

Families recruited from 6 rural Colorado *Head Start* and preschool locations received recruitment interest flyers via their child's preschool and were asked to return the form to the child's teacher. Research staff contacted interested parents by telephone to explain the research process and schedule a home visit. After scheduling the home visit, a packet containing a consent form, the Home-IDEA, and a demographic survey was mailed to the participant. Parents were asked to complete the consent form and all study questionnaires before the home visit, when a face-to-face interview was conducted. Participants received $20 for participation.

Interview questions were designed to gain a further understanding of participants' completion process, comprehension of questionnaire instructions, and identification of problematic areas and items. In addition, questions probed what participants thought about food groupings and their use of nutrition labels in general and in relation to completing the Home-IDEA. The interview guide was developed by a multidisciplinary team with expertise in the fields of qualitative research methodology, nutrition, PA, and public health. Minor modifications, such as the refinement of phrasing, were made to questions; the final interview guide contained 6 open-ended questions with multiple probes. Finally, upon completion of a draft electronic version of the Home-IDEA, the second half of participants was presented with this prototype on an iPad (Apple, Inc., Cupertino, CA) to explore acceptability and comfort with use on an electronic version.

A trained researcher conducted interviews in English in participants' homes.[19,20] A second researcher audio recorded all interviews and took detailed field notes to augment information from audio recordings. A structured report of each interview was compiled by the researcher who completed the interview and included

(1) demographics, (2) item-by-item results transcribed from audio recordings and field notes, (3) observations related to the environment in which the interview took place (eg, time of day, family members present), and (4) the duration of the interview.[21] For analysis, a general inductive approach was used in which responses were analyzed by 3 researchers who independently read reports multiple times, discussed the responses until consensus was reached, and generated item-level summaries of participant responses.[22–24]

Modifications to the Home-IDEA were made based on key findings from cognitive interviews, prior psychometric testing of the Home-IDEA,[17] and representation of the food groups in the Dietary Guidelines for Americans (DGA).[25] The modified version of the questionnaire, Home-IDEA2, was then used for the criterion validation phase of this study.

Criterion Validation

Recruitment and compensation of participants for this phase of the study were similar to those in the cognitive testing phase. A new sample of participants was mailed a consent form and demographic questionnaire before the home visit. The Home-IDEA2 questionnaire was provided at the time of the home visit.

Two researchers who were reliably trained to administer the Home-IDEA2 conducted home visits.[17] Participants and research staff concurrently completed the Home-IDEA2 in English; however, steps were taken to avoid coding rooms at the same time (eg, staff coded the child's bedroom while participants coded the kitchen area). One research team member completed the Home-IDEA2 while the second research staff member took detailed field notes documenting the process in which participants completed the questionnaire (eg, seated or standing, presence or absence of visual inspection of items).

Data from the concurrent administration between parent participants and trained research staff (considered the reference standard rater) were assessed for interrater reliability and to establish criterion validity. Agreement statistics were calculated for the item level using Cohen's kappa (κ) coefficient. A κ statistic of >0.6 was considered adequate reliability.[26] Frequencies for availability of food, PA, and electronic items in the home were calculated. Analyses were conducted using SPSS software (version 21.0, IBM SPSS Statistics, Inc, Chicago, IL; 2012).

Construct Validation

The FoodAPS is a national survey of 4,826 income- and ethnically diverse households conducted between April, 2012 and January, 2013. The publicly available, deidentified food-at-home data set was examined for the presence of US Department of Agriculture Food and Nutrient Database for Dietary Studies (FNDDS) food codes.[18,27] Only foods with FNDDS food codes and matching descriptions were included in this study, which resulted in 4,325 households with an initial 2,653 FNDDS food codes matched to FoodAPS items. The number of food codes was further reduced to remove 3 food categories (infant foods, dry mixes and seasonings, and alcohol) that did not align with the purpose of the Home-IDEA2. The Home-IDEA2 was developed with the intent of measuring foods that would be consumed by children aged >2 years and adults in accordance with the DGA, thus excluding infant foods. In addition, seasonings (such as added salt or pepper) and dry mixes (ie, flour) were not included in dietary recalls *per se* as individual foods. Finally, alcohol was not included for capture in the Home-IDEA2 because it is typically not included as a component of dietary quality. Removal of food codes in the alcohol, dry mixes and seasonings, and infant foods categories resulted in the retention of 2,394 food codes.

Next, all food codes were matched to the corresponding Home-IDEA2 checklist food items. For example, 2 food codes matched the Home-IDEA2 survey item banana; these included banana, raw—food code 63107010 and ripe plantain, raw—food code 71905000. All food codes that matched a Home-IDEA2 item were assigned to the respective Home-IDEA2 item and counted only once per household regardless of the quantity of that item found in the home. Food codes that did not match a Home-IDEA2 item were assigned 0 (unmatched food codes).

After the researchers assigned food codes to the Home-IDEA2 items, they calculated the frequencies of all food codes (Microsoft Excel 2013, Microsoft Corporation, Redmond, WA), across households to determine the proportion of households that contained that item (ie, 1,332 households or 31.5% of the FoodAPS household population contained food codes representing banana). Moreover, percentages of food codes that matched a given Home-IDEA2 checklist item were calculated to describe the variety of foods that contributed to that Home-IDEA2 item (ie, 2 food codes matched banana, compared with 95 food codes that matched sweetened breakfast cereal). These food codes were then organized by Home-IDEA2 food groupings (ie, fruits, composed of a total of 74 food codes). Unmatched food codes, or foods that were not represented on the Home-IDEA2, were then assigned to food categories. For example, cookies, pies, and doughnuts all were assigned to the food category of baked goods. Unmatched food categories included baked goods, condiments, drinks, drink mixes, fruits—mixed, meats, mixed dishes, sauces, seeds, snack foods, soups, sweet foods and candied toppings, vegetables—mixed, and miscellaneous (ie, water, chewing gum).

RESULTS

Cognitive Testing

Twenty participants (41% of 48 recruited) completed interviews (25–60 min duration). All participants were mothers and 40% were Hispanic, which was representative of the *Head Start* programs and preschools included in this study.[28] One half of participants (50%) reported household incomes < 185% of the federal poverty level[29] and one third (35%) had an education level of high school or less (Table 1). Interviews were conducted until no new information arose. To determine this, the research team debriefed after every 2–3

Table 1. Participant Characteristics for Interviews and Validation of the Home Inventory Describing Eating and Activity

Characteristic	Cognitive Testing, n (%) (n = 20)	Criterion Validation, n (%) (n = 28)
Gender		
Female	20 (100)	27 (96)
Age, y		
18–29	5 (25)	7 (25)
30–49	15 (75)	20 (71)
50–64	–	1 (4)
Ethnicity		
Hispanic	8 (40)	6 (21)
Education		
Some high school	5 (25)	2 (7)
High school graduate	2 (10)	7 (25)
Some college	3 (15)	7 (25)
College graduate	10 (50)	11 (40)
Income (US dollars)		
<41,000[a]	10 (50)	15 (54)
41,001–69,000	6 (30)	3 (11)
>69,000	4 (20)	10 (36)

[a]Less than $41,000 is a proxy for <185% of poverty.[29]
Note: Percentages may not add to 100 owing to missing data.

interviews to discuss new confirmatory or contradictory findings. Because there was no set number for how many interviews were required for saturation, the number of interviews to be completed was based on the following considerations: (1) the home food and activity environment was a focused topic, (2) interviews were conducted with a relatively homogeneous group, and (3) the researchers' previous work informed several areas for modifications to the Home-IDEA.[17,19,30]

Table 2 presents key findings from cognitive testing. The interviews revealed that the majority of participants completed the Home-IDEA in the order in which the survey was constructed, from the first page to the last. Despite instructions for the participant to verify the availability of food or activity items visually, most participants remained seated for a majority of items, which suggests that memory was used to complete the assessment. Participants identified areas that were confusing or difficult to complete owing to the wording of instructions or length of sections, or where they needed to refer back to the instructions. Participants provided insight for additions, such as reminders, pictures, and more white space, to enhance the comprehension and overall acceptability of the Home-IDEA ("Can you format that [line breaks, white space] differently? It's hard to follow… I kept losing my spot" and "Could you give more examples under foods or what counts? Pictures would help."). Finally, 8 of the 9 participants who were presented with an electronic version of the Home-IDEA found it to be acceptable and preferred this version to pen-and-paper ("[Electronic version] is faster and it does all the work for you— tells if you missed one. And it's more convenient.").

Table 2. Key Findings From Participant Interviews (n = 20) for Modification of Home Inventory Describing Eating and Activity (Home-IDEA)

Question Topic	Key Findings
Process for completion	Started at first page and worked their way to the last page Relied on memory to complete the Home-IDEA
Ease/difficulty of completion	Food section proved to be most difficult, especially meats (owing to the lack of understanding about fat content) and fruits and vegetables (misunderstanding of food classification: fresh, frozen, and canned) The child's electronic bedroom environment also proved to be a difficult area owing to instructions and the layout of the form The physical activity environment was viewed as easy to complete
Use of Nutrition Facts label	Had knowledge of the nutrition label and how to use it Used nutrition label mostly in the store for sugar, fat, and calories Did not use the label to help them complete the Home-IDEA Felt that reminder(s) should be included for them to use it
Instructions	Read instructions before completing the assessment but had to refer back, specifically for the child's electronic bedroom and the fruits and vegetables sections (referring back to instructions resulted from the length of the questionnaire) Found the instructions helpful but suggested breaking them into smaller sections, bolding or underlining items, and providing reminders
Experience in completing	Found the length acceptable for everything that the researchers asked Viewed Home-IDEA as a checklist of what they had in their home and thought about their health while filling it out Electronic prototype presented on iPad was acceptable

This input resulted in several modifications to the Home-IDEA: enhanced descriptions and pictures, improved clarity of instructions, and inclusion of hints and reminders throughout the checklist positioned where the participant would need to apply the information (eg, nutrition labels). After modifications, the overall readability score of the instrument improved from a Flesch-Kincaid grade level score of 8.2 to 5.7 (Microsoft Word 2013, Microsoft Corporation, Redmond, WA). Other revisions included a reduction in the number of food items (126 to 108) and electronic devices items (12 to 9) and an increase in PA devices (16 to 17). These modifications were made based on findings from the authors' previous study[17] demonstrating low frequencies of items in households. Furthermore, because of the rapidly changing electronic environment, groupings were modified (ie, videocassette recorder was combined with DVD player), low-frequency items were deleted (i.e., cassette player), and a question was added about portable devices (ie, tablets, iPads, LeapPads [Leap Frog, Emeryville, CA], or Kindles [Amazon, Seattle, WA]). Finally, this section was expanded beyond whether the device was in the child's bedroom, to include who used the device (only the child or whether it was shared with another child or adult), recognizing that use might or might not occur solely in the child's bedroom.

Criterion Validation

A total of 28 individuals (75% of 37 recruited; 9 were not available to be scheduled) participated in the home visits (45–90 min duration; completion of the Home-IDEA2 by participants ranged from 30 to 60 min). Sample size tables for reliability testing indicated that 27–31 participants were necessary to detect a 2-tailed test for null-value κ scores (0.40) at 80% power, with 0.5 differences between κ scores (ie, 0.9 κ) and a range of proportion of positive ratings from items between 0.3 and 0.7.[31,32] Ninety percent were mothers and 21% were Hispanic. About half (57%) had at least a high school education, a third (33%) participated in the *Supplemental Nutrition Program for Women, Infants, and Children*, and 54% had incomes < 185% of the federal poverty level (Table 1).[29] Most (96%) reported a recent trip to the grocery store and 30% reported having less than the usual amount of food in their home.

Reliability testing resulted in acceptable κ statistics ($\kappa = 0.6–1.0$) for 82 items (58 food, 16 PA, and 8 electronic devices), moderate agreement ($\kappa = 0.4–0.5$) for 36 items (35 food and 1 PA), and poor agreement ($\kappa \leq 0.3$) for 16 items (15 food and 1 electronic device). Overall, 65% of items were deemed to have acceptable reliability: 54% of food, 94% of PA, and 89% of electronic items. There was high variability within food items ($\kappa = -0.12$ to 1.00). Items for the child's electronic bedroom environment and the PA devices had acceptable κ scores for all but 1 item in each section (radio [$\kappa = 0.29$] and jump rope [$\kappa = 0.48$]) (Supplementary Data). Tables 3 and 4 display items demonstrating acceptable reliability ($\kappa = 0.6–1.0$) and the percentage of homes in which items were available (based on the researchers' assessment).

Seventeen food items were highly available in the home (>60%) yet had moderate or poor reliability. Six of these items (whole-wheat bread, unsweetened and sweetened breakfast cereals, lean meat, regular fat cheese, and whole-grain crackers) required participants to use the Nutrition Facts label, ingredients list, or product description to assess accurately whether the food was present in the home. The 17 food items, including those requiring label reading, were dispersed across food groupings: whole-wheat bread ($\kappa = 0.50$), regular pasta ($\kappa = 0.35$), and unsweetened (≤6 g/serving; $\kappa = 0.4$) and sweetened breakfast cereals (≥6 g/serving; $\kappa = 0.20$) in the grains and cereals groups; corn ($\kappa = 0.49$), lettuce and other greens ($\kappa = 0.48$), tomatoes ($\kappa = 0.27$), and peas, snap peas, or edamame ($\kappa = 0.23$) in the fruits and vegetables group; deli meat ($\kappa = 0.56$), fish ($\kappa = 0.51$), lean meat ($\kappa = 0.40$), and breakfast meat ($\kappa = 0.31$) in the meat/meat alternative group; regular fat cheese ($\kappa = 0.46$) in dairy; gummy fruit snacks ($\kappa = 0.58$), chocolate and candy ($\kappa = 0.42$), whole-grain crackers ($\kappa = 0.39$), and unprepared mixes ($\kappa = 0.26$) in the snacks and sweet treats category; and french fries or tater tots ($\kappa = 0.39$) in child-friendly foods.

Construct Validation

Initial matching of the FoodAPS database resulted in 1,434 food codes being linked to the Home-IDEA2 checklist items (ie, 60% of food codes matched the FoodAPS database) (Table 5). The top 5 food categories with the greatest presence across households represented in the FoodAPS data set were baked goods (75%), condiments (65%), mixed foods (46%), snacks (41%), and vegetables (41%). The 3 food categories that contributed most to categories underrepresented in the Home-IDEA2 checklist (unmatched foods) were mixed foods (breakfast sandwiches; meat, vegetable, and sauce meals; casseroles; stews; Asian dishes; mixed and filled pasta or lasagna; pot pies; and Mexican dishes) at 13%, followed by baked goods (cookies, cakes, pies, doughnuts, muffins, waffles, and pancakes) at 9% and soups at 4%. Thus, collectively, mixed foods, baked goods, and soups represented 26% of unmatched FoodAPS food codes. All other food categories contributed ≤3% in coverage; the largest of these was condiments and snack foods, at 3% each.

DISCUSSION

This mixed-methods study resulted in a valid and reliable 134-item Home-IDEA2 checklist for low-income, minority parents of preschool-aged children to measure food, activity, and electronic home environments. Findings suggested that the comprehensiveness of the instrument provided moderate representation of foods found in US households. Collectively, the Home-IDEA2's comprehensiveness, paired with its single-respondent and self-report structure, provided a low-burden assessment for both participants and researchers, increasing the potential for large cohort studies to capture the home environment and its relationship to health outcomes such as obesity.

Table 3. Reliable Items ($\kappa > 0.6$) by Food Groupings From Home Inventory Describing Eating and Activity

Food Item	κ	n (% Availability)
Grains and beans		
Other (non-corn or flour) tortillas	1.00	3 (15.0)
Beans—canned or dried	0.84	25 (89.3)
Quinoa, barley, or couscous	0.85	13 (50.0)
Whole-wheat bagel	0.78	2 (7.4)
Refried beans	0.71	17 (60.7)
White flour bagel	0.75	5 (19.2)
White rice	0.71	24 (85.7)
Brown rice	0.71	16 (59.3)
Fruits and vegetables		
Avocado	1.00	5 (18.5)
Apple	0.89	22 (81.5)
Banana	0.85	15 (55.6)
Bell pepper	0.76	10 (40.0)
Butternut, acorn, or spaghetti squash	0.84	3 (11.1)
Raw/unpeeled potato	0.85	15 (55.6)
Watermelon, cantaloupe, or honeydew	0.78	6 (23.1)
Yellow squash or zucchini	0.76	6 (22.2)
Carrot	0.70	23 (85.2)
Cauliflower, cabbage, or brussels sprouts	0.68	11 (40.7)
Grapes	0.67	8 (29.6)
Green beans	0.66	21 (77.8)
Orange, tangerine, grapefruit, or clementine and mandarin	0.70	15 (55.6)
Pear	0.68	9 (33.3)
Beet, radish, turnip, jicama, daikon radish, or parsnip	0.60	5 (18.5)
Sweet potato	0.61	8 (30.8)
Meat/meat alternatives		
Game	0.81	7 (25.0)
Regular meat	0.63	25 (89.3)
Soy products	1.00	4 (14.3)
Egg	1.00	26 (92.9)
Dairy		
Regular cottage cheese	1.00	3 (10.7)
Reduced-fat or fat-free/light cottage cheese	1.00	1 (3.6)
Regular yogurt	0.86	14 (50.0)
Reduced-fat or fat-free/light yogurt	0.89	6 (21.4)
Skim/fat-free milk	0.62	3 (11.1)
1% milk	0.9	7 (25.0)
2% milk	0.78	15 (55.6)
Whole milk (vitamin D milk)	0.67	9 (32.1)

Note: Percent availability is based on researcher-administered Home Inventory Describing Eating and Activity.

The FoodAPS provided the first complete picture of food acquisitions in the US over an average week.[18] Findings from this study indicated that the Home-IDEA2 adequately captured 60% of foods found in US homes that were included in the FoodAPS sample. This coverage accounted for the majority of foods that contribute to nutrient adequacy, as outlined by the DGA[25] and Healthy Eating Index[33] components (ie, total fruits, total vegetables, dairy). Over 90% of whole, low-processed, or unprocessed foods were captured by the Home-IDEA2. For example, a few single vegetables (ie, artichokes, okra) were missing, as were mixed vegetables with sauce, but these accounted for only 2% of food codes. Food codes contributing to items that should be eaten in moderation, such as mixed foods, baked goods, and soups, also were not represented in the Home-IDEA2. In its current form, the comprehensiveness of foods covered by the Home-IDEA2 enhanced the ability of the researchers to assess the quality of the healthfulness of food acquisitions (HFE) by capturing both foods contributing to nutritional adequacy and those to be consumed in moderation. Furthermore, holistically detailing the HFE to capture foods at home via the Home-IDEA2 with a single respondent diminished the burden of collecting data from multiple household members, which enhanced its research utility. In contrast, information gathered by FoodAPS was collected from all members of the household (vs a single respondent) to capture food purchases for food obtained or consumed at home as well as food obtained or consumed away from home.[16] Both approaches identified the main meal planner and shopper as the primary respondent,[18] and because the Home-IDEA2 focused solely on food at home, the need for multiple household members to capture foods eaten away from home, as with the FoodAPS, was negated.

Revisions to the Home-IDEA2 resulted in improved overall reliability; 65% of items in the Home-IDEA2 were deemed reliable, compared with 55% in the original version. Considerable improvements were made in participants' ability to assess the PA and electronic environments accurately; the percentage of acceptable items increased from 69% to 94% for PA and 75% to 89% for electronic devices. Improvements for food items were more modest; the percentage of acceptable items increased 2 percentage points from the original Home-IDEA, from 52% to 54%.[17] The more complex and varied nature of the HFE appeared to be more difficult to assess accurately than the PA or electronic environments. Nevertheless, a recent systematic review[34] outlining measurements of the availability and accessibility of foods among youths found that the Home-IDEA performed

Table 4. Reliable ($\kappa > 0.6$) Food Items From Home Inventory Describing Eating and Activity: Snacks and Sweet Treats, Beverages, and Child-Friendly Foods

Food Item	κ	n (% Availability)
Cereal		
Unsweetened breakfast cereal (≤6 g/serving)	0.40	22 (78.6)
Sweetened breakfast cereal (>6 g/serving)	0.20	23 (82.1)
Snacks and sweet treats		
Rice cakes	0.76	5 (17.9)
Nuts	0.76	20 (71.4)
Frozen sweets	0.83	19 (70.4)
Dried fruit	0.69	11 (42.3)
Chips	0.62	24 (88.9)
Saltine crackers	0.64	16 (57.1)
Beverages		
Milk alternatives	1.00	9 (32.1)
Regular soda	0.71	15 (53.6)
Diet soda	0.67	5 (17.9)
Sports drinks	0.70	13 (48.1)
Bottled water	0.70	13 (48.1)
100% fruit juice	0.65	19 (67.9)
Drink mixes	0.62	19 (70.4)
Child-friendly foods		
Instant noodles	0.79	16 (57.1)
Apple sauce	0.79	17 (60.7)
Chicken nuggets, fish sticks, corn dogs, or hot dogs	0.78	15 (53.6)
Pizza	0.75	10 (35.7)
Macaroni and cheese	0.67	22 (81.5)

similar to or better than other assessments capturing food availability. Of the 20 studies included in the review, 11 measured food availability in the home via self-report questionnaire or checklists (n = 10) or observations (n = 1). Nine of the 11 studies focused on a limited set or number of foods; 1 of the 2 more comprehensive food availability assessments reported on was the Home-IDEA.[34]

Table 5. Households and Food Codes From Food Acquisitions and Purchases Survey (FoodAPS) Food-at-Home Data Set Matched to Home Inventory Describing Eating and Activity (Home-IDEA2)

Home-IDEA2 Food Groupings	Households, n (%) (n = 4,325)[a]	Food Codes, n (%) (n = 2,394)
Grains and beans	2,712 (64.0)	152 (6.3)
Fruit	2,260 (53.4)	74 (3.1)
Vegetables	2,293 (54.1)	126 (5.3)
Meat and meat alternatives	2,635 (62.2)	251 (10.5)
Dairy	2,958 (69.8)	99 (4.1)
Cereal	1,247 (29.4)	145 (6.1)
Snacks and sweets	2,553 (60.3)	215 (9.0)
Beverages	3,087 (72.9)	127 (5.3)
Child-friendly	1,809 (42.7)	145 (6.1)
Other[b]	1,682 (39.7)	100 (4.2)
Total food items matched to Home-IDEA2		1,434 (60.0)

[a]Number of households in which ≥1 food codes for each food grouping were present in FoodAPS data set; [b]Other foods include butter, salad dressings, mayonnaise, and other condiments.

Although an increase in overall reliability for the Home-IDEA2 was demonstrated, the mixed-methods approach using qualitative and quantitative data identified 2 areas that continued to be problematic for users: the use of nutrition labels and participants' reliance on memory vs visual inspection of items. The current study revealed that the majority of participants knew about the Nutrition Facts label and stated that they used it in the store, but did not use it to complete the Home-IDEA. The Home-IDEA2 limited the number of items that required use of the Nutrition Facts label; however, several foods still required label use, and low reliability was again observed for these items. For example, both unsweetened and sweetened breakfast cereals were in approximately 80% of homes, yet their κ statistics were 0.4 and 0.2, respectively. Furthermore, whole-wheat bread and whole-wheat crackers had high availability but moderate reliability: 0.5 and 0.4, respectively. These items may have performed poorly because of participants' poor comprehension of nutrition labels or terminology (eg, whole grain) or a misperception that cereals were lower in sugar than conceived of by participants.[35] Hearst et al[14] observed similar findings related to whole-wheat foods, citing that language and literacy barriers among Spanish speakers and Somali immigrant populations may have contributed to low accuracy in reporting home food availability. Two systematic reviews[36,37] reported similar findings regarding consumer struggles with the effective use of nutrition labels. Previously reported examinations[38] of the FoodAPS demonstrated a positive correlation between consumers' use of nutrition information, including foods labels, and the healthfulness of their food choices.

A second potential contributor to low-reliability items could be that participants relied imperfectly on their memory to complete the form. The instructions clearly stated, with reemphasis from researchers, that participants should visually inspect which foods were present in their home before checking them on the assessment

sheet, yet most did not. Rather, as confirmed through direct observation, participants reported that they sat at a kitchen table or in the living room and completed the form, and looked for an item only if they had a question about it. For example, corn and pasta, both of which had high availability (77%) and modest reliability ($\kappa = 0.5$), might be foods typically found in the pantry, but were miscategorized as absent because they were not visually inspected. Errors commonly made in self-report are an inherent challenge to assessing the HFE.[38] This was exemplified in this study: the researchers measured the actual food environment (ie, took inventory) whereas participants mainly provided information about typical food availability (ie, relied on memory). This discordance makes establishing reliability a continuing challenge for home food inventories.[39]

Prior reviews[13,14] noted the importance of comprehensive examinations of the home environment and called for tools to include food and PA items as well as social characteristics (eg, parent behaviors), although most limited the number and diversity of food items. Strengths of the Home-IDEA2 are that it is a comprehensive and validated self-report measure of the home environment. The coverage of food items congruent with FoodAPS, in addition to the inclusion of PA and electronic devices, underscores this point. The breadth of the Home-IDEA2 makes it a feasible, low-burden assessment of individual households for large studies. Feasibility was demonstrated by validation with a low-income, Hispanic audience of varying education levels and by a reduction in the burden of the Home-IDEA2 resulting from a single respondent reporting on 1 day vs the FoodAPS approach to multiple respondents over 7 days. Strengths of this psychometrically focused study include a mixed-methods approach that included input from a target audience about the design of the instrument, direct observation through in-home assessments to establish interrater reliability, and comparison of content with a nationally representative database. Limitations were that testing of the Home-IDEA2 was conducted with a single observation involving a small but diverse sample, a concern that might be addressed more fully in future studies.

IMPLICATIONS FOR RESEARCH AND PRACTICE

The home food and activity environment is a significant target for efforts focused on preventing obesity and chronic disease. Thus, it is critical to have valid and reliable home assessment measures that were tested with diverse audiences and that limit participant and researcher burden. Capturing the HFE accurately has the potential to drive public health interventions and policies focused on food acquisitions such as those targeting the availability and price of healthy food choices, the quality of food, and point-of-choice nutrition information.[16,39,40]

Although improvements were made to the validity and reliability of the Home-IDEA2, particularly in assessing the PA and electronic environments, additional work is warranted for the HFE. The food environment is more complex and dynamic, requiring participants actually to view the items when completing the inventory, as opposed to trying to recall them from memory. Further education about the use of nutrition labels as well as elucidation of strategies to compel participants to inspect foods visually may be needed. Future use of an electronic version of the Home-IDEA2 could employ technological strategies such as videos, images, and text reminders to highlight and/or educate participants about problematic items. For example, visual images of boxes of different sweetened breakfast cereals could be displayed for participants to determine whether they had any in the home, compared with relying on participants' ability to read nutrition labels.

In addition, to enhance the representation of foods, future HFE assessments, including a new version of the Home-IDEA, might balance the number of foods that represent nutritional adequacy with those that should be consumed in moderation, as defined by the DGA.[25] Additions of mixed foods, baked goods, and soups (food categories that represented approximately 26% of missing codes) could more fully represent foods that should be eaten in moderation. The addition of more moderate foods would allow future editions of the Home-IDEA to examine food patterns in the home via application of the Healthy Eating Index to determine the quality of the HFE.

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SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jneb.2018.12.007.

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