Published in final edited form as:
Appetite. 2014 September ; 80: 23–27. doi:10.1016/j.appet.2014.04.026.

Home food and activity assessment: Development and validation of an instrument for diverse families of young children

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Abstract

The purpose of this study was to refine and psychometrically test an instrument measuring the home food and activity environment of geographically and economically diverse families of preschool aged children. Caregivers of preschool aged children (n = 83) completed a modified self-report questionnaire. Reliably trained researchers conducted independent observations on 25 randomly selected homes. Agreement statistics were conducted at the item level (159 total items) to determine reliability. Frequency counts were calculated to identify item availability. Results showed Kappa statistics were high (0.67–1.00) between independent researchers but varied between researchers and parents resulting in 85 items achieving criterion validity (Kappa >0.60). Analyses of reliable items revealed the presence in the home of a high frequency of unhealthy snack foods, high fat milk and low frequency of availability of fruits/vegetables and low fat milk. Fifty-two percent of the homes were arranged with a television in the preschool child's bedroom. Physical Activity devices also were found to have high frequency availability. Families reporting lower education reported higher levels of sugar sweetened beverages and less low-fat dairy ($p<0.05$) compared to higher education families. Low-income families (<$27K/year) reported significantly fewer Physical Activity devices ($p<0.001$) compared to higher income families. Hispanic families reported significantly higher numbers of Sedentary Devices ($p<0.05$) compared to non-Hispanic families. There were no significant differences between demographic comparisons on available fruits/vegetables, meats, whole grains, and regular fat dairy. A modified home food and activity instrument was found to reliably identify foods and activity devices with geographically and economically diverse families.

Keywords

home environment; preschool; obesity; rural; diversity

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INTRODUCTION

The prevalence of obesity has reportedly plateaued for preschool aged children (2–5 years) according to recent epidemiological estimates (Ogden, Carroll, Kit, & Flegal, 2012). Specific socio-demographic groups of children at all ages remain consistently higher in body mass index (BMI) compared to others. For instance, preschoolers from families who identified as being Mexican American or non-Hispanic black were higher in prevalence for overweight (≥ 85thto 94.9th BMI percentile) and obesity (≥ 95th BMI percentile) compared to non-Hispanic white preschoolers (Ogden et al., 2012). In addition to race and ethnicity, low socioeconomic status (SES) has been related to an increased risk for obesity during childhood (Shrewsbury & Wardle, 2008). Socioeconomic status may impact lifestyle behaviors and environmental factors, including food access and types of physical activity (Wang & Lim, 2012). While the causal relationship between SES and childhood obesity is considered complex, children from disadvantaged backgrounds generally have greater levels of obesity than children from advantaged backgrounds (Sobal & Stunkard, 1989; Wang & Lim, 2012).

Diversity in geographical location (rural versus urban) represents an additional demographic focal point for obesity risk. Approximately 30 years ago, the prevalence of childhood obesity appeared higher in large, urban areas compared to rural areas (Dietz & Gortmaker, 1984). However, more recent data show an opposite finding in which rural children (and adults) are now more likely to be overweight or obese (Liu et al., 2012). The mechanisms of rural and urban differences in obesity prevalence are poorly understood and possibly moderated by SES factors. In particular, rural residents are more likely to be older, less educated, and have a lower income; factors known to associate with higher rates of obesity (Lantz et al., 1998; Martikainen & Marmot, 1999; Miller, Stokes, & Clifford, 1987). Structural challenges that may impact weight in rural communities include fewer services for nutrition education (e.g., access to dietitians) and physical activity (e.g., exercise facilities) as well as treatment facilities for weight management (Tai-Seale & Chandler, 2003). Thus, living in rural communities has become a health disparity (Gamm, Hutchison, Bellamy, & Dabney, 2002).

Little evidence is available, however, on validated tools identifying characteristics of the home food and activity environment among families with SES and geographical risk factors for obesity (Boles, Scharf, Filigno, Saelens, & Stark, 2013; Ostbye et al., 2013; Pinard et al., 2012). This limitation in etiological understanding can be characterized within a social-ecological theoretical view, in which obesity may result from an interactive, bidirectional influence of multiple weight-affecting factors at the individual level (e.g., temperament), within the family (e.g., feeding practices) and home environment (e.g., available foods and sedentary devices), to the community, including schools and neighborhoods (e.g., access to parks or corner stores;(see Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008 for review). While studies on the home physical environment of young children have emerged in the last decade, most have focused on white families and underrepresented families from low education and income backgrounds, the families most at risk for obesity development (Boles et al., 2013; Bryant et al., 2008; Fulkerson et al., 2008; Ostbye et al., 2013; Spurrier, Magarey, Golley, Curnow, & Sawyer, 2008). Previously published home assessments may

have been conceptually limited by the types of foods and activities included in them and may not have represented foods and activities that are available for families with socioeconomic and racial and ethnic diversity. As a result, important considerations related to methodological and psychometric testing remain largely unexplored with families of SES and geographical diversity.

Pinard and colleagues (2012) conducted a systematic review of forty home environment measures. They noted a lack of reported instrument psychometric properties and a narrow focus (food or physical activity; not combined). Additionally, few measures were inclusive of families from geographic and socioeconomic diversity, those most at-risk for development of obesity and thus, generalizability may be limited. The present study aimed to address these limitations by developing and testing a comprehensive home environment tool for families of diverse SES and geographical characteristics, known factors to be associated with increased risk for obesity.

METHODS

Participants

Families were recruited as part of the Colorado LEAP project, a longitudinal cohort study designed to test an obesity prevention program for young children (Bellows et al., 2013). Participants were recruited from four rural Colorado communities in which two areas received an intervention and were matched with two control site areas based on ethnicity, obesity prevalence, and geographic location derived from Colorado Department of Public Health and Environment (www.chd.dphe.state.co.us). Only data collected during baseline assessments are presented in the current study. Governing institutional review boards approved this study.

Measures

Demographics—Participants completed a survey of family information regarding age, race/ethnicity, family income bracket, and education level.

Anthropometrics—Parent height and weight were self-reported while child height and weight were objectively measured using a portable scale and stadiometer by trained research staff (utilizing the Harrison and colleagues method (Harrison, 1988). Adult BMI was calculated using the formula: $\mathrm{weight\ (kg)}/[\mathrm{height\ (m)}]^2$. Child BMI was determined using the CDC growth charts based on age and sex-specific references (Kuczmarski et al., 2002).

Home-Inventory Describing Eating and Activity Development (Home-IDEA)—The Home-IDEA was based on a prior validated instrument, the Home Health Environment (HHE) assessment (Boles et al., 2013; Brown et al., 2009). In order to expand the item pool to capture foods potentially purchased by families with geographical and SES diversity, new food items were taken from the Allowable Foods List from The US Special Supplemental Nutrition Program for Women, Infants, and Children (i.e., WIC Program), the Block Food Frequency Questionnaire (Block, Hartman, & Naughton, 1990), and a modified Harvard Food Frequency Questionnaire (FFQ) (Willett et al., 1983). Additional food and activity

items were created from the opinions of a panel with expertise in nutrition, physical activity, and families from diverse backgrounds. The final pool of items included 131 food and drinks, 16 physical activity devices, and 12 electronic devices. The food and drink items included foods within the following categories: snacks, cereals, drinks (e.g., milk, juice, sports drinks), fruits and vegetables, meats, dairy, breads, ready to eat meals, and others (e.g., dressings, spreads). The subscales of food groups and drinks were comprehensively developed to include all food groups and not to just high value targets (e.g., fruits and vegetables) to maximize availability measurements. Physical activity devices included a single scale of devices both children and/or adults may use (bicycles, seated cars, swing sets). Finally, the electronic devices represented screens (televisions, computers) and devices that promote sedentary behaviors (e.g., DVD players).

Procedure

Parents received study information via packets sent home with preschoolers attending preschool/Head Start centers and during parent information meetings scheduled in the evenings at preschool sites. Packets were available in both English and Spanish and Spanish-speaking study staff were available for families requiring interpretation or assistance. Once written consent had been obtained, the participating parents completed a questionnaire packet and received $40.

Independent raters called randomly selected participants to arrange a home visit to complete study surveys. During the home visit, the participant was given instructions on how to complete the Home-IDEA. In addition, the independent rater completed the Home-IDEA during this visit. Instructions were provided to each participant that stated no talking could be done while completing the form to maintain independence of responses and areas of the house were conducted at different times to avoid modeling of recording (i.e., if a parent was in the kitchen looking for specific foods, the independent rater would go to a bedroom to record electronic devices.

Analytic Plan

To first establish a gold-standard criterion, independent raters were trained and tested for inter-rater reliability. Specifically, non-study houses were selected for simultaneous coding between raters until substantial agreement was obtained based on agreement classifications (Kappa scores at or above 0.61) (Landis & Koch, 1977). Five trained coders completed home assessment training on three non-study homes. Each independent coder was compared to the referent coder (1st author), in which all items for each category were analyzed separately for three groups (food items, electronic devices, activity devices). Next, an independent rater and parent-completed report of the home environment were compared for criterion validity estimates. Unacceptable reliability for an item represented a score below our criterion (< 0.61) based on the disagreement of availability between independent coder and parent reports during the home visit. Frequency distributions of only reliable items were calculated and independent means comparisons were conducted across race and ethnicity, and for dichotomous scores for education and income across the Home-IDEA food and activity categories. Spearman's rho correlations were utilized to examine relationships between parent and child BMI and the home environment scales.

RESULTS

Sample Characteristics

Ninety-eight packets were distributed across the four recruitment sites, in which 83 (85%) were returned with complete data. Participants were primarily between the ages of 30–49 years old (57%). Twenty-two percent of caregivers identified as being as Hispanic. Nearly half of caregivers reported annual incomes below the household federal poverty level while about 89% reported having attained a high school diploma or less (See Table 1 for complete demographic data). Adult participants self-reported an average BMI of 27.4 (SD=6.07). Child participants were on average 48.1 (SD=19.2) months old with a measured BMI z-score of 0.39 (SD=1.09), ranging from −1.9 to 4.05. Twelve percent of children were considered in the overweight category, while 4.8% were considered obese, using CDC classifications (Kuczmarski et al., 2002).

Independent Raters Inter-rater Reliability

The Home-IDEA was compared across three conceptual categories of items (foods/drinks, electronic devices, physical activity devices) to establish a gold-standard criterion for participant comparisons. Independent raters were found to have Substantial to Outstanding agreement (0.67–1.00) for all categories, indicating the assessment could be reliably administered within an actual home environment (see Table 2 for within category reliability estimates).

Independent Rater and Parent Inter-rater Reliability

Twenty-five homes were randomly selected from the 83 participants to have independent assessment of the home environment measured using the Home-IDEA. In order to identify specific items within foods, drinks, activity and electronic devices that were not reliable ($k < .61$; Landis & Koch, 1977), categories were reduced to the item level for reliability analyses. For example, within the drinks subsection, each item was rated by the independent rater and the participant while the overall reliability for that item across the 25 homes was calculated to determine a single item estimate. The range of item estimates are presented for each category or subcategory for foods and were found to significantly vary (see Table 3). Within the Foods and Drinks category, 62/131 items were found to be unacceptable ($k < .61$) (Landis & Koch, 1977). Within the Electronic Activity devices, 3/12 items were considered unreliable. Finally, within the Physical Activity devices section, 3/16 items were shown to be unreliable. The final total number of retained items (85) was used in the remaining analyses of the participants' data to show only the reliably measured items.

Frequency of Reliable Food Items

Reliable food items were sorted according to frequency of items within the study homes, in which three categories were created (low [0–14.9%], medium [15.0–49.9%], and high [50.0 and above] (see Table 4 for individual item frequency scores). The majority of fruits and vegetables were in the low (39% of items) and medium (48% of items) categories, compared to the number of these items which were in the high frequency category (12%). Similarly, low fat dairy items were more likely to be in the low (5 items; e.g., fat free cheese) and

medium (2 items; e.g., skim and 1% milk) categories compared to higher fat dairy items being in the high frequency category (3 items; e.g., 2% and whole milk, regular cheese). More than half of the homes reported having sugar-sweetened soda (52%) available to drink. Lastly, full fat products (meat, dressings, butter/margarine, and snack items) were very frequently reported as being available in the homes (82–100%).

Frequency of Reliable Active and Sedentary Items

Out of 11 physical activity items reported available, only 4 were available in over half of the homes (i.e., swing sets, scooters, jump rope, and bicycles; see Table 5 for a complete list of available physical activity items). Regarding electronic media in the child's bedroom, there was an average of 2.2 (SD=2.04) devices available, of which 52% of parents reported a television being present in the child's room.

Demographic/Anthropometric Comparisons of Home Environment Characteristics

Dichotomous groups from demographic characteristics were created and independent t-tests performed across education, income, and ethnicity. Families who reported lower education (low= high school graduate or less) reported higher levels of sugar sweetened beverages ($t(67)=2.63$, $p< 0.05$) and less low-fat dairy ($t(44)=-2.08$, $p<0.05$) compared to higher education families. Low income families (<$27K per year) reported significantly fewer Physical Activity devices ($t(70)=-5.35$, $p<0.001$) compared to higher income families. Hispanic families reported significantly higher numbers of sedentary devices ($t(69)=-3.08$, $p<0.005$) compared to White families. There were no significant differences between demographic comparisons on available fruits/vegetables, meats, whole grains, and regular fat dairy.

Child measured zBMI was found to significantly negatively correlate with the total number of physical activity devices ($rs=-26$, $p<.05$) and positively with non-lean meats ($rs=.25$, $p<.05$). Parent self-reported BMI did not significantly relate to Home-IDEA food, physical activity, or electronic devices scales.

DISCUSSION

This study revealed that families from diverse backgrounds have home food and activity environments that include foods and devices that both promote and inhibit healthy eating and physically active behaviors. The results demonstrated that families at-risk for obesity (i.e., living in rural communities, high representation of minority status, and largely from low income and low education) have multiple characteristics of the home environment that have been related to obesity-related behaviors. Specifically, families generally reported lower availability of fruits and vegetables, known to relate to consumption (Hearn et al., 1998) as well as obesity status (Boles et al., 2013). Additionally, higher caloric foods and sugar-sweetened beverages were frequently available in these homes; additional factors known to promote consumption among adolescent children (Boutelle, Fulkerson, Neumark-Sztainer, Story, & French, 2007; Campbell et al., 2007). We found children with higher weight status to be from homes reportedly having fewer activity devices and more non-lean meats, though additional measures of activity level and child intake will provide important

links between environment, behavior, and health indicators. When participants were further separated into higher risk groups (i.e. according to income and education levels), additional characteristics of less healthy home environments were identified, suggesting dose-related effects may be present. That is, while our entire sample of participants was considered at-risk, separating the sample into high and low groups indicated significant home environment differences that may suggest home characteristics change with severity of risk factors.

The present investigation provided significant advancement on the development and validation of home environment assessment research. Using a rigorous method of item creation, with specific attention to items available for purchase by families from underrepresented backgrounds, an instrument was successfully created using direct observation validation methods. Because families of minority status and low SES are at greater risk for obesity compared to Asian and white families and those with higher SES, it remains critical to develop instruments that are validated from diverse populations. Additional instrument development should include additional qualitative and quantitative methods to further refine the utility of this instrument, including testing for concurrent validity with other home assessments. Specifically, families reported a number of items (ranging from healthy to less healthy) that were found to be unreliably rated by independent observation, suggesting item refinement, clarity of instruction, and item organization (e.g., ordering of items) may improve the validity of the instrument. Assessing the home environment will benefit from inclusion of measures of dietary intake, physical activity behaviors, and parenting behaviors to show how the home physical environment may relate to weight related behaviors (Ostbye et al., 2013). Finally, future studies should consider addressing psychometric properties based on participant characteristics that may impact reliability and validity, such as BMI, urban settings, and other age groups to evaluate possible biases in reporting.

While the strengths of the study include direct observation, diverse sample, and the inclusion of food and activity/sedentary items, no study is without limitations. Our preliminary results are based on a relatively small sample size, and minority families primarily from Hispanic backgrounds. Additional investigations should include larger samples that include other at-risk race and ethnicities, including African American and Native Americans. Additionally, our assessment method included a single observation of the home environment, which may underrepresent the availability of high-turn over items such as foods and drinks (Sharkey, Dean, St John, & Huber, 2010). Examinations of rural environments should expand beyond one state, particularly Colorado; the unique geographical characteristics of this state may differentially impact health related behaviors.

Conclusions

A modified home environment instrument was found to be psychometrically valid in the measurement of family homes of geographically, ethnically, and socioeconomically diverse families. Additional measurement of the homes of diverse families is needed to clarify how home environments interact with child and parent behaviors related to dietary intake, growth and risk for obesity. Future investigations may begin to then develop interventions that include identifying families benefiting from home health assessments and subsequent

modifications of the home environment focused on positively impacting child growth and development.

Acknowledgments

This project is supported by Agriculture and Food Research Initiative Competitive Grant no. 2010-85215-20648 from the USDA National Institute of Food and Agriculture. Additional support for this research was funded by a career development award from the NIH(K23DK087826) awarded to REB.

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Table 1

Participant characteristics for caregivers and their children from the Colorado LEAP Study (n=83).

	(%)	Mean (SD)
Children		
Female	50.6	
Age (months)		48.1 (19.2)
BMI z-score		0.39 (1.09)
Caregivers (female)	90.0	--
Age (y)		
18–29	40.0	--
30–49	57.5	--
50–64	2.5	--
Education level		
Some High School	22.7	--
High School Graduate	66.7	--
Some College	1.5	--
College Graduate	9.1	--
Ethnicity		
Hispanic	22.1	--
Income		
Less than $27,000	45.3	--
$27,000-$34,000	12.0	--
$34,001-$41,000	14.7	--
Greater than $41,000	28.0	--

Table 2

Kappa statistics between independent researchers.

Categories	Researcher (Kappa)
Food	(.74–.84)
Electronic Devices	(.91–1.00)
Physical Activity Devices	(.67–.87)

Table 3

Kappa range statistics between parent participants and independent researchers for ratings of food, activity, and sedentary items (n=25)

Home-IDEA Sections	Researcher and Parent (Kappa - %*)
Snacks/Treats/Nuts	(.242–92%*)
Cereal	(85.7%–96%*)
Drinks	(.119–100%*)
Meats/Poultry/Fish	(.336–100%*)
Dairy	(−.136–1.00)
Breads/Beans/Pasta/Grains	(−.038–1.00)
Ready to eat meals	(−.184–.915)
Other Foods	(.029–1.00)
Fruit and Vegetable	(−.030–1.00)
Electronic Environment: Child's Bedroom	(−.042–1.00)
Activity Environment	(.336–1.00)

Kappa Statistic range for each category on the Home IDEA reliability analysis between researcher and parent participant.

* Indicates percent agreement, which was calculated due to one reporter having been a constant.

Table 4

Availability (percentage) of reliable food items within homes of participants in the Colorado LEAP Study (n=83).

Low Frequency (0–14.9%)	Moderate Frequency (15.0–49.9%)	High Frequency (50.0% and above)
Protein	**Protein**	**Protein**
Tempeh (3.3)	Tofu (17.9)	Peanut butter (95.9)
		Regular meat (97.4)
		Eggs (98.7)
Dairy	**Dairy**	**Dairy**
Goat milk (0)	1% milk (28.2)	Whole milk (57.1)
Butter milk (0)	Skim milk (34.2)	2% milk (74.1)
Gouda cheese (6.3)		Full fat cheese (94.5)
Fat free cheese (10)		
Goat cheese (12.5)		
Grains	**Grains**	**Grains**
Crisp or was a bread (9.4)	Pita bread (19.1)	Sugar sweetened breakfast cereal (84.0)
	Quinoa (17.9)	Regular pasta (94.6)
	Couscous (25)	Unsweetened breakfast cereal (94.8)
Fruit	**Fruit**	**Fruit**
Dates (3.6)	Grapefruit (18)	Bananas (67.9)
Papaya (6.6)	Tangerines (18.2)	100% fruit juice (88.2)
Guava (6.8)	Raspberries (20)	
Currents (6.9)	Nectarines (20.9)	
Honeydew (10.6)	Mangos (21.2)	
Kiwi (14.5)	Plums (25)	
	Blueberries (27.1)	
	Watermelon (28.9)	
	Cantaloupes (29.9)	
	Avocado (41.4)	
Vegetable	**Vegetable**	**Vegetable**
Daikon radish (0)	Cabbage (21.9)	Bell peppers (56.8)
Turnips (3.4)	Edamame (27.6)	Lettuce (66.7)
Parsnip (3.5)	Squash (32.4)	
Bamboo shoots (4.9)	Zucchini (34.7)	
Jicama (5.2)	Celery (45.3)	
Radish (8.2)	Cucumber (47.2)	
Water chestnuts (9.4)		
Oils	**Oils**	**Oils**
		Butter/margarine (100)
Other	**Other**	**Other**

Low Frequency (0–14.9%)	Moderate Frequency (15.0–49.9%)	High Frequency (50.0% and above)
Kids Lunchables© (14.7)	Pizza (39)	Sugar sweetened soda (52.1)
		Unprepared mixes (67.9)
		Chocolate (77.2)
		Regular dressing (82.4)
		Potato chips (83.3)
		Jam/jelly/syrup (93)

Table 5

Frequency of physical activity devices and electronic media in the child's bedroom (n=83)

	Frequency in the home (%)
Physical Activity Items	
Hula Hoop	31.6
Trampoline	34.2
Basketball hoop	38.0
Swimming pool	39.2
Weight equipment	43.6
Yoga/exercise equipment	45.6
Seated push car	53.2
Swing set	59.5
Rollerblades/skate board, scooter	68.4
Jump Rope	69.2
Bicycle/tricycle	93.7
Electronic Media (in the child's bedroom)	
Television	51.9
Video game players	21.7
Computer	9.9