

Associations of the Home Food Environment with Eating Behaviors and Weight Status among Children and Adolescents

Martha J Nepper and Weiwen Chai*

Department of Nutrition and Health Sciences, University of Nebraska-Lincoln, Lincoln, NE 68583, USA

Abstract

Primary objective: Understanding the aspects of the home food environment of children and adolescents such as the availability, accessibility, and visibility of home healthy and unhealthy foods and the frequency and quality of family meals is necessary for developing direct interventions for weight management. This review examined the literature on associations of home food environment including availability, accessibility, and visibility of home healthy and unhealthy foods and frequency and quality of family meals with children's eating behaviors and weight status and methods to assess the availability and accessibility of foods in the home.

Main outcomes and results: Research suggests: 1) the availability and/or accessibility of home healthy or unhealthy foods were associated with children or adolescents' dietary intakes; 2) the link between home food availability and accessibility with weight status is weak; 3) the evidence on associations of frequency or nutritional quality of family meals with weight status is inconsistent; 4) the in-home assessments for food availability, accessibility and visibility appear to be necessary; however the assessment tools may need to be further improved to capture the quantity of the healthy and unhealthy foods in the home; and 5) repeated in-home assessments are needed to help determine the stability of foods routinely purchased at home.

Conclusions: The obesogenic home environment is complex. This review aims to provide valuable insights for designing direct interventions for weight management in children and adolescents by improving their home food environment.

Keywords: Food; Obesogenic; Weight; Adolescents**Introduction**

Childhood and adolescent obesity is a major public health concern. Currently, 32.4% of children and adolescents, ages 6-19 years, in all ethnicity groups are overweight, and 16.5% are obese [1]. Obese children and adolescents are more likely to become obese adults, which cause increasing rates of health complications in the future adult population [2,3]. Therefore, children and adolescent should be considered a priority population in the prevention of obesity [4].

A child or adolescent's weight can be affected by their eating behaviors, particularly increased intakes of sugar-sweetened beverages and frequency and quantity of non-nutritious foods [5]. It has been reported that approximately 40% of calories consumed by children and adolescents are foods high in calories and fat, such as sugar-sweetened beverages, fruit drinks, dairy and grain desserts, pizza, and whole milk [6]. The home environment is one of the most important settings in regard to a child's dietary intake and weight [7] since 65% to 72% of daily calories consumed are in the home [8]. Parents are seen as the nutritional gatekeeper of the home and have direct influence on the home food environment [9]. Research is beginning to explore how factors in the home food environment such as the availability and accessibility of home healthy and unhealthy foods and the frequency and quality of family meals contribute to eating behaviors of children and adolescents. For example, it is suggested that if healthy foods are available and accessible in the home, children are more likely to eat these types of foods [8]. Eating family meals may also encourage healthy eating habits and promote a healthy weight among children and adolescents [10]. Thus, understanding the home food environment of children and adolescents is particularly important for developing direct interventions for weight management and obesity prevention in this population. This review examined the literature on associations of home food environment including availability, accessibility, and

visibility of home healthy and unhealthy foods and frequency and quality of family meals with children's eating behaviors and weight status and methods to assess the availability and accessibility of foods in the home.

Description of Subject**Association of the home food availability and accessibility with eating behaviors**

Home food availability refers to the actual presence of the food in the home, which includes food on countertops or in refrigerators or cupboards [11]. Food accessibility represents foods that are retrievable, ready to eat, and in a location that facilitates their consumption [12]. Several studies have assessed whether dietary consumption of certain healthy and unhealthy foods was related to the availability and accessibility of foods in the home and the majority found that such associations exist although the food items for the observed associations varies including fruit and vegetables, snack and sweet beverages and healthy and unhealthy foods in general [8,9,11-22] (Table 1).

For example, Hanson et al. [9] examined associations between the availability of fruits, vegetables, dairy foods, and soft drinks in the

*Corresponding author: Weiwen Chai, Department of Nutrition and Health Sciences, University of Nebraska- Lincoln, Lincoln, NE 68583, USA, Tel: 402-472-7822; Fax: 402-472-1587; E-mail: wchai2@unl.edu

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Studies	Study population	Type of assessment	Results
Neumark-Sztainer et al. 2003	3957 adolescents	Self-report	Fruit and vegetable intake were strongly correlated to home availability of fruits and vegetables
Cullen et al. 2003	225 4th and 5th grade children	Self-report	Child-reported availability and parent-reported accessibility were significantly correlated with child fruit and vegetable consumption.
Hanson et al. 2004	902 adolescents (14.9±1.7 years)	Self-report	Among girls, household availability was positively associated with fruit and vegetable intakes and soft drink availability was inversely associated with dairy intake but not among the boys
Befort et al. 2006	144 adolescents (10-19 years)	Self-report	Home availability was not significantly associated with fruit, vegetable, or fat intake except for fruit intake among white adolescents only.
Young et al. 2004	366 middle school students	Self-report	Perceived fruit and vegetable availability were significant predictors of fruit and vegetable consumption.
Campbell et al. 2008	347 adolescents (12-13 years)	Self-report	Availability of unhealthy foods at home was positively associated with girls' sweet snack, girls' savory snack, boys' savory snack, and girls' high-energy fluid consumption.
Gattshall et al., 2008	219 over weight/obese children (8 – 12 years)	Self-report	Home fruit and vegetable availability is associated with children intake of vegetable and fruit.
Spurrier et al., 2008	280 preschool children	Self-report	The availability of food groups in the home was associated with children's intake of these foods (fruit and vegetables, fat in dairy, sweetened beverages, non-core foods).
Ding et al. 2012	171 adolescents (12-18 years) and 116 children (5-11 years)	Self-report	Fruit and vegetable intake was positively associated with availability of healthful food, fruit and vegetables, and was inversely associated with less-healthful foods in the home.
Luszczynska et al. 2013	2,764 adolescents (10-17 years)	Self-report	Positive associations between at-home accessibility of snacks and sweetened beverage and intakes of these food/drink items.
Wang et al. 2013	67 children (5 - 11 years)	Self-report	The availability of chips and sweets in a child's home was associated with an increased risk for consumption of fats and sweets by children.
Van Ansem et al. 2013	1501 children (8-12 years)	Self-report	Children who lived in a household where fruit or vegetable was not always available were less likely to consume the recommended amount of fruit or vegetables.
Santiago-Torres et al. 2014	187 Hispanic children (10-14 years)	Self-report	Children with lower Healthy Eating Index scores had more sugar-sweetened beverages available at home when compared with children with higher High Healthy Index scores.
Couch et al. 2014	699 children (6-11 years)	Self-report	Fruit and vegetable consumption was inversely associated with unhealthy food availability; High-calorie beverage consumptions were positively associated with unhealthy food availability; sweet/savory snack intakes were positively associated with healthful food availability (unexpected).

Table 1: Summary of studies regarding associations between home food availability/accessibility and dietary intakes among children and adolescents.

home and adolescents' intake of these foods. They found that fruit and vegetable intake increased when these foods were available in the home in the adolescent girls but not in the boys. Also, girls who had soft drinks available at home were found to consume one less serving of dairy foods compared with those who did not have soft drinks in the home [9]. Cullen et al. [12] assessed the influence of fruit, 100% fruit juice, and vegetable availability in the home on dietary intakes in 88 parents and 4th through 6th grade children. The researchers found that children's intake was positively associated with the availability of these foods in the home [12]. In a similar study examining the relationship between the home food environment, snacking, and intake of sweetened beverages among adolescents aged 10 to 17 years old, researchers found that adolescents consumed less snacks and sweetened beverages when these foods were not available in the home [18]. Spurrier et al. [16] conducted a study among preschoolers and reported that increasing the availability of fruits, vegetables, and low-fat dairy foods, and reducing the availability of fruit juice and sweetened beverages was associated with a higher intake of fruits and vegetables. In a recent study,

Santiago-Torres et al. [21] evaluated relationship between the home food environment and diet quality of Hispanic pre-adolescents (10-14 years). They reported that children with lower healthy eating index scores had more sugar-sweetened beverages available at home compared with children with higher healthy eating index scores [21].

A few studies also assessed the association of home food environment with eating behaviors among overweight or obese children and adolescents. Gattshall et al. [15] examined home food availability and accessibility and how they related to fruits and vegetables, sweetened beverages, and snack intakes among 219 overweight pre-adolescents, age 8-12 years. They found that adolescents were more

likely to eat fruits and vegetables when these foods were available at home. More recently, a study examined the home food environment among overweight and obese children, 5-11 years of age. The study results suggested that availability of chips and sweets in the home was associated with an increased intake of these foods by the children [19].

On the other hand, in a cross-sectional study examining the relationship between home food availability and food consumption, the researchers observed that even though parents reported having fruits and vegetables in the home, the degree of availability was not significantly related to the level of intakes of such foods by pre-adolescents and adolescents (10-19 years), suggesting that availability of healthy foods alone may not be adequate to influence adolescents' eating habits and healthy food choices [11].

Association of the home food availability and accessibility with weight status

A healthy weight can be difficult to maintain if a person lives in an obesogenic home environment, which is associated with a lower intake of healthy foods and a higher intake of unhealthy foods [23-25]. Studies on weight-resilience (maintaining a healthy body weight despite living in an obesogenic environment) among children and adolescents suggest that homes with healthy weight children were more likely to have healthier food options available, limit access to unhealthy foods, and live closer to a full-service grocery store [23,26]. For instance, in a qualitative study, Williams et al. [23] interviewed with the mothers of the children who were resilient to being overweight or obesity and poor nutrition. The mothers interviewed all believed that exercising control over access to unhealthy food, providing education and encouragement for consumption of healthy food and

enabling healthy food options aided their child to eat well [23]. When examining household food supplies of families with at least one child 12 years or younger, researchers found that homes with more available high calorie foods such as foods high in fat, carbohydrates and protein were associated with higher BMI values among the parents responsible for food purchasing and meal preparation. In addition, in households with overweight children, grains supplied significantly more protein and carbohydrate than in comparison households [27]. Further, when grocery store receipts were compared between families comprising mainly overweight individuals and those comprising lean family members, foods high in fat and energy were purchased more often by the overweight families as compared to healthy weight families [28]. These suggest that encouraging positive changes in the home food supply and purchasing practices may result in improvements in dietary intakes and overall weight status of both youth and adults in the family.

In an in-home observational study, Boles et al. [29] assessed the differences in the home food environment between healthy weight and obese preschoolers by examining the availability, accessibility, and readiness to eat of food items among 82 families. They found that families with obese preschoolers were less likely to have fresh vegetables available when compared to their healthier weight peers. Moreover, parents of healthy weight preschoolers provided children more access to healthier foods and made fruits and vegetables more readily to eat. Similarly, Arcan et al. [30] in a study evaluating the associations between home environmental factors and BMI among young American-Indian children reported that the availability of vegetables was marginally associated with the lower probability of being overweight and obese. In contrast, MacFarlane et al. [31] conducted a longitudinal study to assess the association between the home food environment and BMI among 293 children aged 5-6 years and 10-12 years, and found that the availability of energy-dense snack foods was not significantly associated with children's BMI values. However, in this study researchers observed that among older children, more frequent dinner consumption while watching television, less frequent breakfast consumption and more frequent fast food consumption were associated with either higher BMI z scores or odds of overweight [31]. Ihmels et al. [32] surveyed 854 parents of first grade children to determine the potential factors in the home that contribute to the predisposition of childhood obesity. The researchers found that those with higher BMI values were also characterized by higher intake of energy-dense beverages, having a TV in the bedroom, and fewer family meals [32]. Recently, Couch et al. [22] surveyed 699 child-parent dyads on multiple aspects of the home food environment, including parenting rules and feeding styles, children's dietary intake and the availability of low-calories nutrient-dense foods and high-calorie/nutrient-poor foods. The researchers found the availability of nutrient-dense and nutrient-poor food in the home was not associated with weight status among children, ages 6-11 years. However, the researchers did not conduct in-home assessments and surveys were collected from parents away from the home environment [22].

Association of Visibility of foods with eating behaviors and weight status

Food visibility refers to food that is on the countertops, top of refrigerators, or a person is able to see the food when opening the refrigerator and freezer without moving any items [33]. In addition to the availability and accessibility of home foods, understanding food visibility and storage practices may also be relevant in terms of promoting healthy eating behaviors and creating a healthier home food environment. It is suggested that food visibility may increase the

attention to food and influence the amount and type of food eaten [33]. When food storage practices were studied with 90 overweight adults in a six-month weight loss program, the participants who removed visible food from their countertops, living room tables, and kitchen tables were more likely to consume fewer calories and lose weight [34]. Wansink et al. [33] reported that although participants ate more, they tended to underestimate the amount they had consumed when foods like candies were visible and proximate. However, these very few studies were all conducted in adult population and no research on associations between food visibility and eating behaviors and weight status has been performed in children and adolescents.

Association of frequency of family meals with eating behaviors and weight status

Eating family meals may encourage healthy eating habits and promote a healthy weight among children and adolescents [10]. It is suggested that having frequent family meals is associated with an increased intakes of fruits, vegetables, and dairy products, the likelihood of eating breakfast, and drinking less sweetened beverages [35,36]. Utter et al. [37] surveyed 3,245 adolescents regarding their eating behaviors. They found that having family meals was associated with parental support of healthy eating, eating more fruits and vegetables, having more fruit in the home, eating breakfast, and bringing lunch from home. However, the adolescents who had frequent family meals were more likely to have unhealthy snacks at home (e.g., chips, candy, soft drinks) when compared to those who did not have frequent family meals. Interestingly, the study concluded that having frequent family meals had no effect on adolescents' BMI. Conversely, Taveras et al. [38] examined the effects of family meals on weight of pre-adolescents and found that eating together most days of the week decreased pre-adolescents' BMI. However, there was no association between the likelihood of becoming overweight and the frequency of family meals longitudinally. Similarly, Goldfield et al. [39] found that higher frequency of family meals was associated with lower BMI values in girls, but not in boys. In a recent systemic review, Valdes et al. [40] reported inconsistent and weak evidence of an inverse association between family meal frequency and risk of childhood overweight and obesity.

Association of nutritional quality of family meals with dietary intakes and weight status

Types of foods served at family meals may affect the dietary quality and weight status of children and adolescents. In a study of 1,923 families of adolescents, researchers examined the type of foods that were usually or always served at dinner. They found that less than a third (28%) of parents reported serving a green salad at family dinner on a regular basis, but 70% reported regularly serving vegetables (other than potatoes) and about one-fifth (21%) of families had fast food at family dinners two or more times per week [41]. In a study examining type and quality of home meals, Fulkerson et al. [42] observed 51 parents preparing an evening meal in their homes. When comparing family meals with the Food Guide Pyramid categories (e.g., meat or other protein, milk, vegetables, fruit and grains), only 18% served food from all five of the food groups, 37% from four groups; and 27% from three groups. The most frequently served food groups at the home evening meals were meat or other protein and vegetables. However, less than one-half served fruit and over one-half served desserts as part of the family meal [42].

A study examining the effect of away-from-home meal sources on weight status in 723 families found that those who purchased

weekly fast-food or take-out foods for their home evening meals had children and adolescents with higher percent body fat and weight and undesirable metabolic risk factors (e.g. elevated cholesterol, fasting blood glucose, LDL, triglycerides, and HDL) compared to those who did not eat fast-foods or take-out foods for their home evening meals regularly [43]. A similar study conducted among 902 middle-school and high-school adolescents and their families suggested that families who purchased fast-food for home meals at least 3 times per week were less likely to have vegetables and milk served with the meal, more likely to have a higher intake of salty snack foods, and have sweetened beverages and chips available in the home, as well as higher weight status among parents [44].

Interestingly, a recent cross-sectional study examined the association between adolescents' BMI and dietary intake with the structure of a family meal (e.g., length of meal, type of foods served), and interpersonal characteristics (e.g., communications, emotion/affect management) during the family meals. Researchers found that positive interpersonal dynamics during mealtime (e.g., overall family functioning) was associated with higher vegetable intake and lower adolescent weight [45]. Santiago-Torres also reported that children with lower healthy eating index scores were more likely to watch televisions while participating in family meals when compared with children with high eating index scores [21].

Assessment of availability and accessibility of home foods

Conventionally, assessing the home food environment has typically included self-reported inventory survey instruments examining the availability and/or accessibility of home foods [8,9,11-21,46]. Although validated, these instruments may be subject to various biases associated with the nature of self-report. Lately, researchers have begun to include observational methods to provide more objective measurements of the home food environment to reduce potential self-report bias and these assessments were mainly performed by trained research staff. A study by Bryant et al. conducted a telephone survey and a subsequent in-home assessment (within 14 days of the telephone interview) for the presence and quantity of healthy and unhealthy foods among 85 families with a child between the ages of 3 and 8 years. The agreement between the results from telephone interview and in-home assessment varied, but generally high (Kappa statistics 0.07-0.96) with lower scores noted for perishable foods [47]. Boles et al. [29] developed an in-home observational assessment tool to compare the differences in more than 20 home foods and drink items based on their availability, accessibility, and readiness to eat between healthy weight and obese preschoolers. The results from 82 families suggested that the assessment tool successfully discriminated between the home foods environment of preschoolers of different weight status. Among the types of foods examined, the availability and trend for accessibility of fresh vegetables best differentiated homes of healthy weight versus obese preschool children. The Home Food Inventory survey developed by Fulkerson et al. assessed home food availability of 13 major food categories and ready-access foods in the kitchen and the refrigerator [48]. In their study, the Home Food Inventory survey was completed by both research staff and study participants. The results demonstrated high kappa scores and correlations between participants' and staff's reports on foods in the home, suggesting the tool can be effectively completed by the study participants, thereby reducing the potential burden and inconvenience caused by the in-home assessment [48].

Additionally, a pilot study by Sisk et al. [49] conducted multiple household food inventories to measure the food available in the home over a 30-day time period. Specifically, the researchers visited nine

households on five separate occasions to determine the variability of foods in the home. The results found several food categories changed weekly (e.g., fresh fruits and vegetables, milk, canned vegetables and processed meats), highlighting the importance of multiple visits to one home to capture the changes in the food availability.

Although the in-home food environment assessment mitigated some of the self-report biases, there are limitations of these assessments. First, the in-home food assessments can be expensive, time-consuming and potentially intrusive. The home food observational studies to date only conducted single/one-time assessments, with the exception of one multiple household inventory study [49], which determined the stability of foods routinely purchased and available in the home. Second, most of the existing home food inventory surveys only indicated whether the food is present or not and did not assess the quantity of this particular food, which may have limited the variability in responses. In addition, there are possibilities that participants may have altered their home food environment by adding more healthy foods and eliminating unhealthy foods prior to the in-home assessment.

Conclusions

The obesogenic home environment is complex; however, understanding the aspect of the home food environment of children and adolescents such as the availability, accessibility, and visibility of home healthy and unhealthy foods and the frequency and quality of family meals is necessary for developing direct interventions for weight management. It appears that research consistently suggests that the availability and/or accessibility of home healthy or unhealthy foods were associated with children or adolescents' dietary intakes although the link between home food availability and accessibility with weight status is weak. Similarly, the evidence on associations of frequency or nutritional quality of family meals with weight status is inconsistent. The in-home assessments for food availability, accessibility and visibility appear to be necessary; however the assessment tools may need to be further improved to capture the quantity of the healthy and unhealthy foods in the home. In addition, repeated assessments are needed to help determine the stability of foods routinely purchased at home.

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