
Physical, Consumer, and Social Aspects of Measuring the Food Environment Among Diverse Low-Income Populations

Joel Gittelsohn, PhD, Sangita Sharma, PhD

Abstract: Obesity and other diet-related chronic diseases are directly related to the food environment. We describe how to better assess the food environment in specific ethnic minority settings for designing and implementing interventions, based on a review of our previous work on the food environment in American Indian reservations, Canadian First Nations reserves, the Republic of the Marshall Islands, and inner-city Baltimore. The types of food stores available within each setting and the range of healthy foods available varied greatly across these geographic regions. In all settings, proximity to food stores/supermarkets, cost, and limited availability of healthful foods were common features, which limited access to health-promoting food options. Features specific to each population should be considered in an assessment of the food environment, including physical (e.g., openness of stores, mix of types of food sources); consumer (e.g., adequacy of the food supply, seasonal factors); and social (e.g., inter-household food sharing, perceptions of food quality, language differences) aspects. The food environments common in low-income ethnic subpopulations require special focus and consideration due to the vulnerability of the populations and to specific and unique aspects of each setting.
(Am J Prev Med 2009;36(4S):S161–S165) © 2009 American Journal of Preventive Medicine

Introduction

Much recent work has focused on the relationship between the food environment, diet, and rates of chronic diseases.^{1–3} Several studies have linked the availability of food stores and fast-food restaurants to nutritional status and cardiovascular disease.^{4,5} Low-income and populations of color appear to be at particular risk of living in poor food environments and bear much of the burden of chronic disease.^{6–8}

Valid measures of food environments are needed to assess these relationships and to inform intervention strategies. Several instruments have been developed to assess the food environment, including the very comprehensive Nutrition Environment Measurement Survey in stores (NEMS-S)⁹ and Nutrition Environment Measurement Survey in restaurants (NEMS-R).¹⁰ These instruments focus on documenting the availability, price, and quality of a range of different foods at retail food stores and restaurants. What is not yet known is whether the

information provided by these instruments is sufficient to help develop interventions or to monitor the impact of existing interventions.

Food environments vary dramatically from locale to locale. As a result, instruments such as the NEMS-S require modification to be adapted to new settings. To date, most of the work on food environments has focused on urban settings, with relatively little work in rural settings. For example, to our knowledge, no work has assessed the food environment in American Indian settings.

This paper explores the food environment in four disparate low-income settings, which range dramatically in terms of geographic isolation: urban African Americans from Baltimore City (Maryland); rural American Indians (several tribes in Southwestern U.S.); semi-remote First Nations (Northwestern Ontario, Canada); and the very remote Republic of the Marshall Islands (low-lying atolls in the Pacific Ocean). Based on extensive fieldwork in these four settings over the past 2 decades, this paper presents evidence to address the following questions:

1. What are the challenges for measuring the food environment in these diverse settings?
2. What solutions make the most sense for documenting the food environment in the most meaningful, yet parsimonious manner?

Center for Human Nutrition, Department of International Health, Bloomberg School of Public Health, Johns Hopkins University (Gittelsohn), Baltimore, Maryland; Department of Nutrition, University of North Carolina at Chapel Hill, Nutrition Research Institute (Sharma), Kannapolis, North Carolina

Address correspondence and reprint requests to: Joel Gittelsohn, PhD, Room 2041, Center for Human Nutrition, Bloomberg School of Public Health, Johns Hopkins University, 615 North Wolfe Street, Baltimore MD 21205-2179. E-mail: jgittels@jhsph.edu.

Study Settings

To address these questions, we have considered our previous experience working in both domestic and international settings, which has centered on developing, implementing, and evaluating interventions to reduce the risk of chronic disease. These interventions focus on changing the food environment, primarily by working with food stores. The descriptions that follow reference formative research and intervention programs conducted on two Apache reservations in Arizona,^{11–17} the Republic of the Marshall Islands,^{18–20} eight First Nations reserves in Western Ontario,^{21–28} and in inner-city Baltimore.^{29,30} All of these settings are characterized by low-income ethnic minority populations and low food availability.

Challenges

Based on our fieldwork, we have discovered multiple factors that provide direct challenges to the adequate description of the food environment. Using a modified version of the conceptual framework developed by Glanz and colleagues,³¹ these challenges have been divided into three main aspects: the physical food environment, the consumer food environment, and social aspects of the food environment (Table 1).

Physical Aspects of the Food Environment

1. **Defining the geographic limits of the food environment:** Many American Indian reservations and First Nations reserves are within a 1- to 2-hour driving distance from cities with a range of food retailers available. In inner-city Baltimore, to compensate for a lack of adequate neighborhood grocery stores, some low-income residents will arrange transportation once a month to make use of bulk purchase stores such as Costco, which are located in suburban areas. These observations reinforce the importance of defining the food environment broadly.
2. **Accurately identifying the types of food sources:** In most low-income settings, small food stores (e.g., gas station stores, corner stores) are more available and frequently used than are supermarkets. For many vulnerable populations, such as children and the elderly with limited transportation options, they are often the primary source of purchased foods.
3. **Documenting variation in accessibility of foods within stores:** In inner-city Baltimore, great variability was found in accessibility of foods due to store configuration. Many corner stores do not permit children and nonregular customers to come inside the store, and so food selections are made based on what has been purchased before or on the small portions of the store interior that can be viewed through the plexiglass window through which transactions occur between customers and store owner.

This type of closed-store layout does not occur in the three other study settings described, with the exception of small kiosk-type stores in the Marshall Islands.

4. **Assessing use of pre-prepared food sources:** Another key facet of the food environment involves the availability of sources of ready-to-eat foods, which are commonly high-fat foods. More than half of all calories consumed by low-income African Americans in inner-city Baltimore come from carry-out or restaurant food sources. Although this characteristic is not as common in the other settings, gas station stores on the American Indian reservations are often large and offer a range of ready-to-eat foods.

Consumer-Related Aspects of the Food Environment

1. **Determining availability of fresh produce.** Most evaluations of the food environment document the availability and pricing of fresh produce. A specific challenge is how best to document this availability. Does an observer count all possible varieties? Is there some minimum number of varieties that is acceptable? In the four settings described here, availability of fresh produce in local stores is generally low, greatly limiting purchases.
2. **Documenting the adequacy of the food supply.** Adequacy of the food supply is a concern in the most remote settings, such as First Nations reserves and the Republic of the Marshall Islands. In these settings, food must be shipped, trucked, or flown in at great cost, and most stores face food shortages at key times of the year, particularly in terms of perishable foods, such as milk and produce. Documenting fluctuating availability is a key challenge for assessing the food environment.
3. **Recording the relevant aspects of pricing.** Cost is a crucial component of food accessibility in most low-income communities, including the four settings described. Deciding whether or not to record prices on all foods is a challenge, given the great diversity of foodstuffs available in stores, and the fact that prices may vary considerably from season to season. In remote First Nations reserves, prices are relatively low for perishable foods during the winter months, when the ice roads are open, but skyrocket in other months of the year when the foods must be flown in.
4. **Assessing the relevance of food-assistance program participation.** In low-income settings, availability of government food assistance programs is a key aspect of the consumer food environment. However, stores vary in their willingness to accept food stamps or benefits of the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC).
5. **Determining perceptions of food quality.** Although access (including both availability and price) to food

Table 1. Challenges/issues for measuring the food environment in diverse settings

Characteristics	American Indian reservations	First Nations reserves	Marshall Islands	Low-income Baltimore city
Physical aspects of the food environment				
Dimensions of the food environment	Much use of off-reservation stores for regular or bulk shopping	Use of off-reserve stores for regular shopping in less remote reserves	Access to foods from remote outer islands	Occasional use of large bulk-food stores beyond city limits
Types of retail food outlets	Few supermarkets, many gas station stores	Remote reserves usually have 1–2 chain supermarkets, 1–2 smaller stores	Few supermarkets, many small stores, kiosks	Great diversity of food outlets, with a preponderance of small corner stores in inner-city areas
Accessibility of food	All food stores open	All food stores open	All food stores open, except small kiosks	Extreme variation in openness of food stores; many open only for regular customers
Pre-prepared food sources	Fast food sold in gas station stores, supermarket delis	Limited availability, except in nearby towns and some supermarkets	Limited availability	Carry-outs and fast-food restaurants widely available
Consumer aspects of the food environment				
Availability of fresh produce	Moderate; depends on distance to supermarkets	Low	Low, although some local produce available	Low; limited to a few foods in smaller stores
Food supply (quantity)	Sufficient	Low levels of perishable foods and produce much of the year	Seasonal variation in the availability of produce	Sufficient
Pricing	Moderate	High for perishable foods (flown into remote reserves)	High; most foods imported and perishable foods must be flown in	Moderate; high-fat, high-sugar foods tend to be more cheaply priced
Acceptance of food stamps, WIC	High in supermarkets	Not available	Not available	High
Food quality concerns	Low	Low	Moderate	High; perception of high levels of expired, poor-quality foods in stores
Social aspects of the food environment				
Stocking of local foods in stores	Rare	Occasional	Common	Rare, little local production of food
Inter-household food sharing	Rare, except in times of community events	Common in more remote reserves for local foods	Common in extended family compounds for local foods	Rare
Language and cultural factors	Moderate; most smaller stores owned and operated locally; managers of supermarkets usually not local	Moderate; most smaller stores owned and operated locally; managers of supermarkets usually not local	Moderate; many stores owned and operated by Marshallese, but some now owned by recent Asian immigrants	High; Asian-American merchants generally service low-income African-American areas

WIC, Special Supplemental Nutrition Program for Women, Infants, and Children

is essential, selection and choice of foods is an important component. In inner-city Baltimore, perceptions of the low quality of foods (e.g., out-of-date or expired packaged foods, overripe or bruised fruit) in small stores greatly limits their appeal to local consumers and serves as a barrier to their purchase.

Social Aspects of the Food Environment

Social aspects of the food environment refer to the ways in which food retailers interact with their customers. It

can also refer to relevant social customs and behaviors relating to food.

1. **Documenting stocks of locally gathered or hunted foods in stores.** In these study settings, stores will sometimes stock locally gathered or hunted foods. In the Marshall Islands, this includes pandanus, breadfruit, and fish. On First Nations reserves, this may include fish and wild rice. As revealed in discussions with store owners in these locations, this practice reflects a desire to be in line with existing

community values, and thereby build support from the community.

2. **Determining prevalence of inter-household food sharing.** In many indigenous settings, traditional patterns of food sharing hold great appeal and are a relevant social aspect of the food environment. These patterns of food allocation are commonly tied to foods gathered or harvested from the wild, but may also include purchased foods. Large game (e.g., moose) are commonly shared by the First Nations hunter(s) with their extended family, and sometimes other needy community members.
3. **Assessing language and related cultural factors.** Cross-cultural factors, such as language differences, have been an important aspect of the social food environment in our work. In Baltimore, most small corner stores are owned and operated by Korean Americans, and serve a predominantly African-American clientele. In First Nations reserves, most of the local supermarkets are operated by non-First Nations managers, who are rotated out of the community every few years; these differences can lead to a lack of commitment to serving the needs of community members, and in some cases to an antagonistic relationship.

Recommendations

Based on the challenges and issues described above, several key recommendations have been identified:

- Systematic assessment of the food environment should be based on prior formative research in each setting to determine relevant aspects of the physical, consumer, and social environments.
- In addition to the number and types of food stores, assessment of the physical food environment should include information on access to food within stores.
- Factors relating to the consumer food environment, including seasonal variation in availability and pricing, should be considered in some settings, as well as differential acceptance of food assistance program benefits.
- Social aspects of the food environment should be considered, including consumer perceptions of food quality, cultural differences between store managers and consumers, and cultural patterns that drive food use at the household level.

Conclusion

Creating an accurate and informative assessment of the food environment in low-income ethnic communities requires attention to a broad variety of characteristics of the physical, consumer, and social food environments. Although all four settings described here are characterized by a low-income consumer base, the food environ-

ments across these settings differ dramatically. In Baltimore, residents generally live within walking distance of some food sources (although usually not supermarkets) and a high proportion of small stores have a closed configuration and do not permit customers inside the stores. Of those that do, some limit access to foods within the stores to regular customers, and do not permit children inside.²⁹ Thus, in this urban setting, retail food sources are close geographically, but access to foods within the store may be limited. This contrasts with the American Indian and First Nations settings, in which stores are generally further from where individuals live, but once one reaches those stores, access to foods is unfettered. In both settings, stores carrying a wide range of nutritious food choices are relatively distant from where people live.

This work indicates that the food environment must in many cases be broadly defined. As discovered in interviews with small store owners in Baltimore, stocking nutritious foods was related directly to their availability in wholesale stores. The assessment of the food environment should include food wholesalers and distributors as well. Use of the USDA commodity food program is common within low-income American Indian communities, but practically non-existent among African Americans in Baltimore. All of the differences mentioned suggest that to truly describe access to and use of food, investigators must expand their descriptions to include the physical settings within which foods are selected, the broad types of food sources (wholesale and retail) and suppliers, and the relationships between store managers and their clientele.

How should investigators proceed when faced with assessing a new and unique food setting? It is possible to modify existing instruments when working in diverse settings, as has been done with the NEMS-S for use in low-income urban areas.³² However, inclusion of all potential physical, consumer and social characteristics are likely beyond the means, and more importantly, the needs of individual studies of the food environment. In our own work, which is centered on changing food availability, food environment assessments have been restricted to assessing the presence of key promoted foods (more nutritious alternatives to high-fat, high-sugar foods commonly consumed, and at the same or lower price), as well as on features of local food sources that are likely to impinge or enhance access to these foods (e.g., closed food store layouts in Baltimore). The emphasis on data-gathering for the purpose of monitoring and evaluating the success of food source interventions allowed us to focus the environmental assessments. We recommend that investigators developing environmental assessment tools conduct formative research that will enable them to develop focused instruments that incorporate those physical, consumer and social characteristics of their setting that are relevant to their research purposes.

No financial disclosures were reported by the authors of this paper.

References

1. Morland K, Roux AVD, Wing S. Supermarkets, other food stores, and obesity: the Atherosclerosis Risk in Communities study. *Am J Prev Med* 2006;30:333–9.
2. Morland K, Wing S, Roux AVD. The contextual effect of the local food environment on residents' diets: the Atherosclerosis Risk in Communities study. *Am J Public Health* 2002;92:1761–7.
3. Bodor JN, Rose D, Farley TA, Swalm C, Scott SK. Neighbourhood fruit and vegetable availability and consumption: the role of small food stores in an urban environment. *Pub Health Nutr* 2007;11:413–20.
4. Satia JA, Galanko JA, Siega-Riz AM. Eating at fast-food restaurants is associated with dietary intake, demographic, psychosocial and behavioral factors among African Americans in North Carolina. *Pub Health Nutr* 2004;7:1089–96.
5. Lewis LVB, Sloane DC, Nascimento LM, Diamant AL, Guinyard JJ, Yancey AK. African Americans' access to healthy food options in South Los Angeles restaurants. *Am J Pub Health* 2005;95:668–73.
6. Booth K, Pinkston M, Poston W. Obesity and the built environment. *J Am Diet Assoc* 2005;105:S110–S117.
7. Cummins S, Macintyre S. Food environments and obesity—neighbourhood or nation? *International J Epi* 2006;35:100–4.
8. Kumanyika SK, Grier S. Targeting interventions for ethnic minority and low-income populations. *Future Child* 2006;16:187–207.
9. Glanz K, Sallis J, Saelens B, Frank L. Nutrition Environment Measures Survey in Stores (NEMS-S). *Am J Prev Med* 2007;32:282–9.
10. Saelens B, Glanz K, Sallis J, Frank L. Nutrition Environment Measures Survey in Restaurants (NEMS-R). *Am J Prev Med* 2007;32:273–81.
11. Curran S, Gittelsohn J, Anliker JA, et al. Process evaluation of a store-based environmental obesity intervention on two American Indian reservations. *Health Ed Res* 2005;20:719–29.
12. Vastine AE, Gittelsohn J, Ethelbah B, Anliker J, Caballero B. Formative research and stakeholder participation in intervention development. *Am J Health Beh* 2005;29:57–69.
13. Gittelsohn J, Toporoff EG, Evans M, et al. Food perceptions and dietary behavior of American Indian children, their caregivers and educators: formative assessment findings from pathways. *J Nutr Ed* 2000;32:2–13.
14. Gittelsohn J, Anliker JA, Sharma S, Vastine AE, Caballero B, Ethelbah B. Psychosocial determinants of food purchasing and preparation in American Indian households. *J Nutr Ed Beh* 2006;38:163–8.
15. Sharma S, Cao X, Gittelsohn J, Ethelbah B, Anliker J, Caballero B. Dietary intake and a food-frequency instrument to evaluate a nutrition intervention for the Apache in Arizona. *Pub Health Nutr* 2007;10:948–56.
16. Gittelsohn J, Davis SM, Steckler A, et al. Pathways: lessons learned and future directions for school-based interventions among American Indians. *Prev Med* 2003;37(1S):S107–12.
17. Gittelsohn J, Evans M, Helitzer-Allen D, et al. Formative research in a school-based obesity prevention program for Native American school children (Pathways). *Health Ed Res* 1998;13:251–65.
18. Cortes LM, Gittelsohn J, Alfred J, Palafox N. Formative research to inform intervention development for diabetes prevention in the Republic of the Marshall Islands. *Health Ed Beh* 2001;28:696–715.
19. Gittelsohn J, Haberle H, Vastine A, Dyckman W, Palafox N. Macro and micro-level processes affect food choice and nutritional status in the Republic of the Marshall Islands. *J Nutr* 2003;133:310S–313S.
20. Gittelsohn J, Dyckman W, Tan ML, et al. Development and implementation of a food store-based intervention to improve diet in the Republic of the Marshall Islands. *Health Prom Prac* 2006;7:396–405.
21. Gittelsohn J, Harris SB, Whitehead S, et al. Developing diabetes interventions in an Ojibwa-Cree community in Northern Ontario: linking qualitative and quantitative data. *Chron Dis Can* 1995;16:157–64.
22. Gittelsohn J, Harris S, Burris K, et al. Use of ethnographic methods for applied research on diabetes among the Ojibway-Cree in Northern Ontario. *Health Ed Q* 1996;23:365–82.
23. Gittelsohn J, Wolever TMS, Harris S, et al. Specific patterns of food consumption and preparation are associated with diabetes and obesity in a Native Canadian community. *J Nutr* 1998;128:541–7.
24. Ho LS, Gittelsohn J, Harris SB, Ford E. Development of an integrated diabetes prevention program with First Nations in Canada. *Health Prom Intern* 2006;21:88–97.
25. Ho LS, Gittelsohn J, Sharma S, et al. Food-related behavior, physical activity, and dietary intake in First Nations—a population at high risk for diabetes. *Ethnic Health* 2008;13:335–49.
26. Rosecrans AM, Gittelsohn J, Ho LS, Harris S, Nagshbandi M, Sharma S. Process evaluation of a multi-institutional community-based program for diabetes prevention among First Nations. *Health Ed Res* 2008;23:272–86.
27. Sharma S, Cao X, Gittelsohn J, et al. Dietary intake and development of a quantitative food-frequency questionnaire for a lifestyle intervention to reduce risk of chronic diseases in Canadian First Nations in north-western Ontario. *Pub Health Nutr* 2008;11:831–40.
28. Wolever TMS, Hamad S, Gittelsohn J, et al. Nutrient intake and food use in an Ojibwa-Cree community in Northern Ontario assessed by 24h dietary recall. *Nutr Res* 1997;17:603–18.
29. Gittelsohn J, Franceschini MC, Rasooly I, et al. Understanding the food environment in a low income urban setting: implications for food store interventions. *J Hunger Envir Nutr* 2007;2(2/3):33–50.
30. Gittelsohn J, Suratkar S, Song H-J, et al. Process evaluation of Baltimore healthy stores: a pilot health intervention program with supermarkets and corner stores in Baltimore City. *Health Promot Pract* 2009. In press.
31. Glanz K, Sallis JF, Saelens BE, Frank LD. Healthy nutrition environments: concepts and measures. *Am J Health Prom* 2005;9:330–3.
32. Franco M, Roux AVD, Glass TA, Caballero B, Brancati FL. Neighborhood characteristics and availability of healthy foods in Baltimore. *Am J Prev Med* 2008;35:561–7.