Concerning Limitations of Food-Environment Research: A Narrative Review and Commentary Framed around Obesity and Diet-Related Diseases in Youth

Sean C. Lucan, MD, MPH, MS

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BEFORE DESCRIBING COMMON AND CONCERNING limitations of food-environment research (and recommendations to address them), it may be useful to discuss the rationale for studying food environments in the first place. Food environments are relevant to diverse nutritional issues and health disparities. An especially compelling argument for studying food environments is the public health challenge of diet-related chronic diseases, particularly in youth.

Diet-related chronic diseases (eg, obesity, diabetes, and vascular diseases) are leading causes of disability and premature death in the United States.[1,2] Diseases that were once considered "adult-onset" now appear earlier in the life course, with preventable impairments affecting youth.[3-5] Over recent decades, young people have become more obese,[6,7] with obesity early in life linked to later-life obesity,[8,9] chronic-disease risk,[10-12] and premature death.[13]

Fortunately, if obese young people are able to transition to normal weights as adults, they might escape chronic disease risks as if they were never obese.[14] Unfortunately, such transitions rarely occur; with advancing age and passing generations, young people increasingly consume fewer healthy whole foods such as fruits, vegetables, and whole grains, and consume more unhealthy items, like refined sweets (eg, candy, sugary drinks), simple starches (eg, snacks chips), and various other refined and highly processed fare.[15-17]

There is little question that many factors influence what young people eat; individual, social, and cultural factors are undoubtedly important.[18-21] Also important are physical environments,[22,23] particularly the local environments in which individuals can obtain foods and beverages: ie, "food environments."[18,24,25] Modifying individual, social, or cultural factors may be quite difficult.[26,27] Modifying food environments—keeping individual, social, and cultural contexts in mind—could be a comparatively efficient strategy to improve nutrition and health by making healthier eating the default.[26,27]

FOOD-ENVIRONMENT CONSIDERATIONS

Food environments include settings such as homes and schools, but much of young people's unhealthy food consumption occurs away from these sites.[17,25] Thus, even well-intentioned interventions directed at home or school environments may be ineffective.[28-30] For instance, although a state ban on all sugar-sweetened beverages in middle schools reduced in-school access and purchasing of such beverages, it did not reduce overall consumption.[31] A reason, according to other research, may be that adolescents (even from low-income households) will typically spend approximately $4 per day on items such as chips, candy, and soda from outside sources.[32,33]

Outside sources of food in environments around home and school may be especially relevant for adolescents. Unfortunately, such food environments, particularly in urban, low-income, and minority communities, tend to offer mostly less-healthy fast foods and convenience items with few healthy alternatives.[34-37] This food-distribution reality is a problem because some studies suggest that the greater the density of and proximity to fast-food outlets and convenience stores, the more likely adolescents are to consume fast foods and soda,[38-40] have less healthy diets,[41] be/become overweight or obese,[39,40,42] and have features of metabolic syndrome.[43] Conversely, greater distance to convenience stores[44-46] or fast food[40] and closer proximity to supermarkets[42,47] and restaurants serving vegetables[48] are associated with higher produce consumption,[40,44,48] fewer purchases of sugary beverages,[45] less fast-food intake,[45] overall healthier diets,[46,47] and healthier weights.[42]

LIMITATIONS OF FOOD-ENVIRONMENT RESEARCH

Despite the associations noted above, some studies demonstrate no consistent relationship between access to fast-food restaurants or small stores on the one hand and dietary intake[49,50] or body weight on the other[51-54]; or between supermarket access and produce consumption on one hand

and diet quality on the other.[21,39,55] Some studies have even generated counterintuitive findings[56-61]: eg, that the odds of consuming vegetables is greater the farther an individual lives from a supermarket,[56] or that obesity rates are positively correlated with healthy food access and negatively associated with fast-food exposure.[58-61]

In a review of the literature from 2009, Larson and Story concluded that the majority of food-environment studies have "methodological limitations which limit their credibility to guide interventions and policy changes."[22] Although this review was published 5 years ago, little has changed in the landscape of food-environment research to date to suggest much progress. Indeed, several common limitations remain substantial problems for the field.

The limitations described in the review that follows involve problems of assessing physical access to food sources in an environment. The review focuses specifically on measuring food-access issues relevant to young people transitioning to adulthood, but many of the issues are cross-cutting and generally relevant to other populations and groups. For any groups, assessments of additional aspects of food environments also merit critique (eg, assessments of items available in the home and in other settings like work and school, and assessments of the placement, prices, and promotion of items within surrounding retail spaces); these additional considerations are beyond the scope of this essentially geo-spatial–focused review. What follows here are descriptions of five common limitations in food-source physical-access assessment, along with recommendations to address each.

Limitation 1: Inaccurate Datasets to Identify Food Sources

The use of pre-existing datasets, like commercial business lists, is exceedingly common in food-environment research.* Such datasets were convenient, efficient, and appropriate for early exploratory studies, and helped produce findings that called attention to possible associations between food environments, individual diet, and downstream diet-related health outcomes. Unfortunately, such datasets inadequately reflect actual food environments on the ground.[62,63] For example, a study in one dense urban area showed that one of the most commonly used business lists had a sensitivity of only 39.3% overall (only 26.2% for general grocers) and a positive predictive value of only 45.5% overall (only 32% for specialty food stores) compared to direct observation.[63] Even if performance was twice as good in other settings (which other validation studies suggest is not the case[62]), findings from research linking food environments to diet and diet-related health outcomes relying solely on such business lists would be in question.

Recommendation 1

Universally validating commercial business lists with other sources of data or otherwise using two or more pre-existing data sources for retail information (eg, telephone or Internet directories, dining or shopping guides, various government records, or multiple commercial business lists)[56,64-67] may be a strategy for researchers to use moving forward. This strategy would be appropriate when geographic areas of interest are too large and/or too dense with food sources to reasonably allow for direct observation (eg, areas like an entire US state or a large urban county). When discrepancies exist between datasets, direct ground-truthing should be done to reconcile disagreements[68,69] or, if not possible, remote assessment using web-based or other street-viewing applications[70] (but only if pilot-testing in areas of interest demonstrates acceptable concordance with direct observation). If even remote reconciliation is unfeasible (or ill-advised), at a minimum sensitivity analyses are in order, modeling and reporting best and worst-case scenarios of discrepancies to see whether conclusions change (as done in validation studies reporting results by both exact/strict and nonexact/lenient matching[63,71]). For smaller geographic areas that are less dense with food sources (eg, areas like some urban zip codes or rural counties), the gold standard should probably be "boots on the ground" direct assessments.[35,46,72-76] Data from such primary collection may not only be more complete, accurate, and applicable than that from pre-existing retail sets, it might actually be more economical as well given the considerable human and monetary investment that could otherwise be required for data purchasing/acquisition, proper data cleaning, and dataset mergers and management.

Limitation 2: Categorizations of Food Sources Based on Generalized Type

Most food-environment studies lump food sources of a certain type together[77] (eg, as if every small store were the same as every other small store in terms of varieties of foods offered when demonstrably this is not the case[78-81]). For example, supermarkets are usually considered as "healthy" food sources even though they often sell plenty of highly processed unhealthy fare.[82,83] Conversely, fast-food outlets are usually considered as "unhealthy" food sources even though they often offer whole foods like green salads, sliced fruit, and milk.

Recommendation 2

It is essential to not classify businesses based on name or generalized type (eg, Pleasantville Grocery="healthy") without knowing anything about the foods and beverages actually available. Distinctions of "healthy" and "unhealthy"—or preferably measures with greater gradation, like indexes or numerical scores accounting for inevitable product mixes—should be based on what businesses actually offer. Comprehensive audits are not necessarily required, particularly for studies at larger scales. Examining the availability (yes/no) of a few select categories (eg, sugary beverages, salty snacks, candy, fresh produce) may suffice for many purposes, with assessments of test-retest performance and inter-rater concordance to establish reliable tools and standardize methods. Studies at larger scales may benefit from remote-assessment methods, for instance using Internet menus, circulars, or other business advertisements (particularly for chain stores and restaurants that have consistent offerings across sites).[84-86] If actual assessments are not possible, studies should again include sensitivity analyses (eg,

Select list of 35 published studies available from the author upon request.