

Food and Health: Using the Foodsystem to Challenge Childhood Obesity

Final Report on the Curbing Childhood Obesity Project, Phases I and II
Including Abstract and Main Text

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Abstract

Dramatic increases in early onset of adult medical conditions associated with childhood obesity and the need to contain healthcare costs have placed obesity at the center of industry, public health, political and medical debate. These independent fields must work together if we are to implement real change.

Utilizing a unique design approach, Columbia University and MIT with the support of the United Health Foundation, joined forces to study a broad system-based view of obesity. The main conclusion – the foodsystem and health are integrally linked. To ensure that efforts to fight obesity are sustainable, we must develop a national foodsystem based on access, affordability, quality and health.

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Main Text

It has been shown that once a child has become obese it is difficult to reverse.¹ At this point it becomes a lifetime struggle challenging the individual and families, taxing the medical system, and driving healthcare costs to unsustainable limits. These pressures make it imperative that national programs to prevent the incidence of childhood obesity population-wide be developed.

In September 2007, with the support of the United Health Foundation, the Collaborative Initiatives at MIT and the Urban Design Lab at the Earth Institute at Columbia University joined together to study Childhood Obesity through a design lens. Based on an earlier systems-based study on Stroke², the goal of the project was to take a comprehensive systems-based view of obesity at multiple scales to assess potential gaps in the methods being used to combat the dramatic rise in childhood obesity and to develop new approaches to curbing the epidemic.

Design, as a discipline, considers the interdependence of diverse specialties within a system. A design-based analysis requires knowledge of the relationship between various parts of the system; an understanding of the long-range effect of changing any one part of the system; and an awareness that approaching any one part of a comprehensive system independently will have limited affect. To date, application of design research methods to broad social issues has been limited, but the potential value of such an approach, which considers a broad range of factors affecting an issue and determines where the pivotal intersections occur, is great.

What resulted was the identification of two major gaps in the effort to fight childhood obesity.

1. a lack of coordination among intervention efforts leading to an endless cycle of “start-up” programs.
2. a reluctance to take on the larger foodsystem

The team chose to target the challenge of the foodsystem as the key to mounting a sustainable national effort to change the tide of childhood obesity. Many groups around the country are working to address the issue of obesity as it affects children. From local community groups to

national foundations there is a growing momentum. However, successful programs are often limited by the larger food environment. For example, a successful school program is limited by a child's home environment or the community environment; a successful community program is limited by the surrounding retail environment. Isolated interventions are working upstream.

A strong integrated foodsystem based on access, affordability, quality and health will support the many community interventions taking place across the country and enable long-term change. Achieving this goal will require new collaborations among industry, health, agriculture, academia, non-profit, and government domains as well as the development of new business models focused on providing a healthy food supply.

Methodology:

To date the project has completed two phases. Phase I: in-depth design based research. Phase II: stakeholder assessment.

The project team was led by an architect applying design principles to the issue of childhood obesity. To augment their knowledge base the team worked with a group of advisors³. Using a combination of traditional literature review and design methods the team studied existing research on an extremely broad range of topics relating to obesity, reviewing professional journals, popular and specialized books, national and international reports, and survey data at a number of different scales; researching and visiting current intervention programs nationwide; and interviewing over 150 experts in areas related to the issue as well as behavioral economists, traditional economists, transportation experts, business leaders, and others.

The team's broad research effort involved a detailed consideration of the socio-cultural changes that have occurred that may be responsible for the sudden increase in the rates of childhood obesity around 1980.⁴ Some of the social topics researched include:

- Market trends (food consumption, food pricing, food marketing);
- Lifestyle changes (time use patterns, family structure, consumption habits);
- Policy (the Farm Bill and agricultural subsidies, food policy, and education);

- Socioeconomic factors (shift to a postindustrial economy, socioeconomic disparities, economic insecurity);
- The built environment (land use patterns, urban/suburban development, transportation, urban renewal).

To contextualize the problem and gain insight into its geographical dimension, the team researched the prevalence of obesity from a variety of spatial scales, including global, national, and municipal levels. Finally, the team examined the current literature on pharmacological, hormonal, and epigenetic factors contributing to obesity.

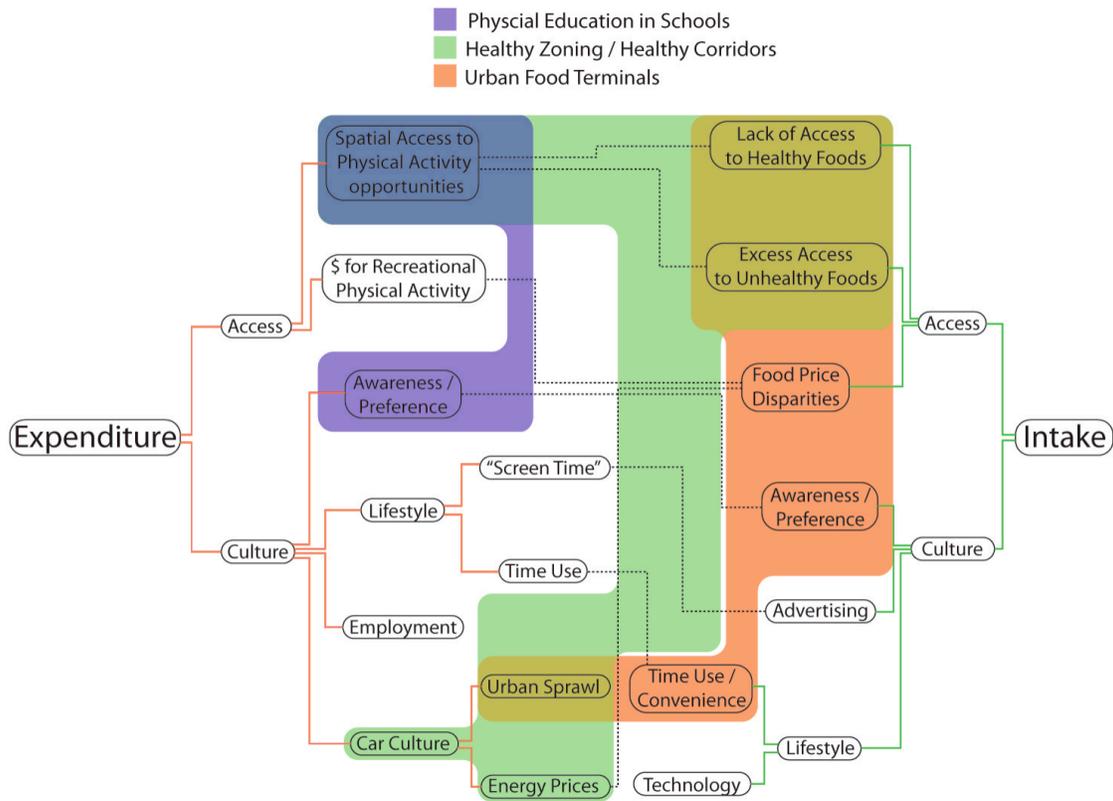
A number of design tools were used to analyze the data gathered in the early stages of the study:

Probe Presentations

“Probes” are design tools intended to provide an opportunity for the research team to explore specific topics more deeply through visualization and modeling and to assess potential intervention strategies. The team researched, analyzed, and presented findings on a specific probe topic in a brief, intensive period of time. This process challenged the team to apply early research directions to potential realistic solutions to the childhood obesity epidemic.

Selected probes conducted include:

- Childhood Obesity and the Built Environment: Strategies for Urban, Suburban, and Rural Communities
- Scenarios and Trends in Childhood Obesity and the Food System
- Physical Activity and Childhood Obesity: Evaluation of Research and Successes
- Childhood Obesity and Food Systems: The Carbon Footprint of Food
- Food Culture and Food Access: Potential Contributors to and Solutions for Childhood Obesity
- Childhood Obesity in New York City and State: Evaluation of Current Efforts



Intervention Evaluation Tools

The primary environmental factors contributing to energy expenditure and intake, the two components of the “energy equation.” Dotted lines represent strong correlations between factors on either side of the equation. The diagram can be used to begin to map the scope of various proposed interventions or combinations of interventions. Because of the complex, multi-variant nature of the problem, it is necessary to address as many of the environmental contributors as possible.

Interview Coding

An additional tool involved coding the notes from numerous interviews conducted with experts and engaged community members. The process enabled the team to extract themes that reoccurred with particular interest in interviewees’ opinions on the challenges they have faced in their work, potential future opportunities, and their perspectives on the problem of childhood obesity and efforts to address it.

Matrices

The research team compiled two matrices to facilitate data review. The first was a matrix of 115 existing obesity programs around the nation. These programs were classified according to the target age group, scale, and areas of concentration. The programs were then mapped to establish spatial concentrations and potential overlaps.

The second matrix was a searchable database outlining 600+ published articles and reports on the complex issues surrounding childhood obesity. This enabled the research team to determine the emphases of the various disciplinary fields and potential gaps in the research.

When reviewing these studies and reports, the obesity-related factors were divided in terms of energy intake, energy expenditure, medicine, and trends. These were further subdivided in the following manner:

- Energy Intake: Production (agriculture, food industry, processing), Distribution/Access (built environment distribution, market supply, school lunches, school vending, food costs) and Consumption (education, food type, food quality, lifestyle, media, marketing);
- Energy Expenditure: Built Environment, Education, and Lifestyle;
- Medicine: Biology, Treatment, Costs (economic and health);
- Trends: Children, Ethnicity, Geography, Income, Political System, and Regulation.

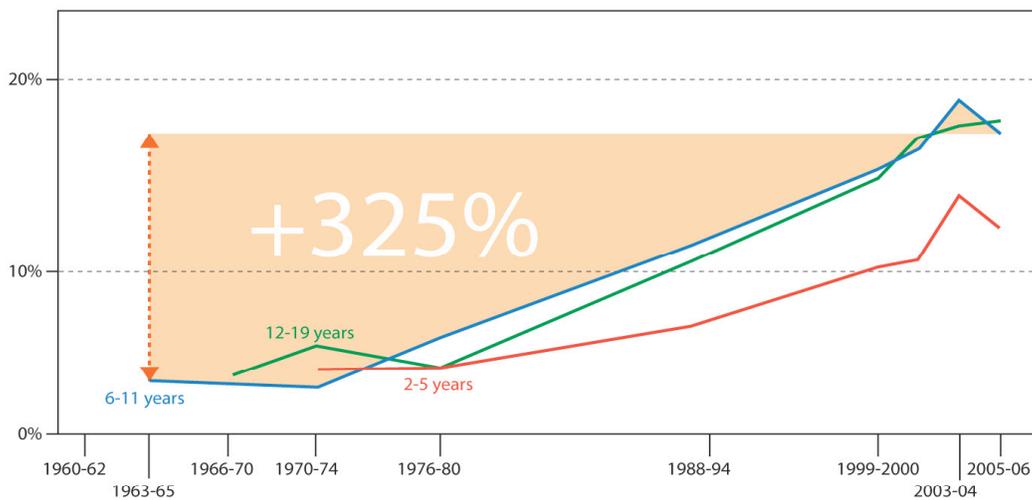
From this body of research the team built a comprehensive model of the causes of childhood obesity and current interventions and developed several recommendations for change on local, state and national levels.

Phase II involved putting the Phase I recommendations in front of various stakeholders to gain insight and to build the foundation of support needed to effect national change. The findings were presented to industry leaders, agriculture specialists, non-profit organizations, economists, farmers, marketing executives, nutritionists, doctors and government

representatives to identify real-world barriers to developing the team’s design recommendations.

Findings:

The rates of childhood obesity have increased by 325% since the early 1960s with dramatic and steady growth since 1980.⁸



The data gathered during the project both supports the intuitive understanding of obesity and challenges experts to look beyond the obvious answers. The bottom line is clear: there is an obesity epidemic because, in general, people are consuming more calories than they are using. Add to that, the fact that many of the healthy foods that are being consumed are decreasing in nutritional value and the health risks become even greater⁵.

“The 10- to 12-pound increase in median weight we observe in the past two decades requires a net caloric imbalance of about 100 to 150 calories per day. These calorie numbers are strikingly small. One hundred and fifty calories per

day is three Oreo cookies or one can of Pepsi. It is about a mile and a half of walking.”⁶

The highest level of risk is in low-income neighborhoods where the available foods tend to be high-fat, low-cost options and there are fewer opportunities for safe, accessible, physical activity.⁷ However, while increasing physical activity is a critical component of building a healthier population, it cannot affect a population-wide shift in obesity rates unless the caloric intake is addressed.¹¹

Environmental factors that are contributing to the childhood obesity crisis include:

- A steady increase in the costs of ‘healthy’ foods – defined for the purposes of the project as fresh fruits and vegetables and minimally processed food that is low in added sugar, fat, and salt

Since the 1980s, the cost of healthy foods such as fruits and vegetables has risen much more rapidly than the cost of unhealthy foods. Average absolute prices for fresh fruits and vegetables rose between five and six percent from 1987-2007 while prices for sugars, sweets, fats and oils rose between two and three percent during that same period.⁸ In a recent study published in the *American Journal of Clinical Nutrition* researchers found that \$1 could buy 1,200 calories of potato chips, 875 calories of soda, 250 calories of vegetables or 170 calories of fresh fruit.⁹

Compounding the cost of healthy food options is a consideration of the time and effort necessary to prepare them.¹⁰

- The rise of ‘fast’ foods, packaged and highly processed foods that are often high fat and low cost

The slower rise in absolute costs of processed food supplements such as sugars, fats and oils noted above has contributed to the rise in highly processed, energy-dense foods which tend to

cost much less per calorie than healthy foods. In addition, these foods are often more convenient and easily accessible providing incentives to families with limited food budgets, hectic lifestyles, or limited access to alternatives.

- Increase in government food subsidies that support production of low cost, 'fast' foods

The current foodsystem was developed with an eye to quantity not quality. Federal incentives to support the current system take the form of direct subsidies for commodity crops¹¹, and relatively inexpensive fossil fuels used for fertilizer, machinery, and processing. The result is a reduction in crop variety and a rise in low-cost processed foods.

- An increasingly widespread and complex food system, which leads to greater packaging, transportation and environmental costs – value added inputs, decreasing the profit margin, or farm share of the food dollar

In a highly globalized foodsystem it is often easier and more profitable to ship food around the world for processing and distribution than to sell fresh food grown and transported locally. This is due, in part, to a lack of regional transportation infrastructure.

- Changes in lifestyle and urban development that are lowering the rates of physical activity, particularly in lower economic populations

Activity levels in the population at large have decreased. These changes are more dramatic in low-income urban populations where the opportunities for recreational physical activity are less prevalent.¹² Changes in the built environment¹³, such as rezoning efforts, and creative use of modern gaming trends are all tools being explored to increase opportunities for physical activity.

- A rise in ‘food deserts,’ areas with limited access to grocery stores or fresh foods

In many communities across the nation, rural and urban, and at all income levels, there are no supermarkets or other healthy retail options. These communities are defined as Food Deserts¹⁴. This is of particular concern in low-income, underserved neighborhoods which are already most at risk for childhood obesity.¹⁵ In these neighborhoods, the lack of healthy retail options is often compounded by a high concentration of “fringe” retailers such as, gas stations, liquor stores, bakeries, pharmacies and convenience stores which generally sell highly processed foods with longer shelf life and easy storage options.

EAST HARLEM HEALTHY FOOD AVAILABILITY

Peaks represent high healthy food balance
Depressions represent low healthy food balance



Food Deserts are attributed to many things: business practices of grocery chains that have determined store locations based on median incomes not population levels; the costs of storing fresh healthy foods; and, in urban environments, the costs associated with retail space.

Lending weight to the argument that greater access lessens the risk of childhood obesity are

studies showing that the presence of a supermarket reduced the prevalence of overweight and obese members of the surrounding community.¹⁶

As the above illustrates, the environmental factors contributing to obesity fall into four categories: affordability, access, quality and physical activity. The first three of these are directly related to the foodsystem and are the outcomes of a system built on increasing the quantity of food without an awareness of the possible health consequences.

The Foodsystem and Health

Some of the direct health consequences of obesity include: type II diabetes, arthritis, asthma, sleep apnea, high blood pressure, high cholesterol, gallstones, fatty liver, pseudotumor cerebri, heart disease, and depression. Many of these typically adult onset diseases are now being seen in children. The cost of treating childhood obesity is approximately \$14 billion annually, diabetes \$150 billion, obesity at large \$147 billion.¹⁷

Typically, interventions to fight obesity have been done on an individual basis. Each of us must affect our own calorie intake/expenditure balance to improve our own health. However, to effect population wide change requires a larger environmental shift. The foodsystem represents that broader environmental challenge. As a system it is comprised of several parts – each acting independently but having consequences all along the line. In its simplest form the foodsystem is comprised of production, processing, transportation, retail, consumption. Changing just one piece of the puzzle will not have the power to challenge the system of obesity.

To better understand the relationship between the foodsystem and health it helps to look at the growth of the modern foodsystem. Over the course of the last century, the U.S. foodsystem has developed into an incredibly efficient machine capable of adequately feeding a growing population. Even relatively late in the 20th Century, between 1970 and 2006, the pounds of food available per capita increased by 16%.¹⁸

Over time there has been an increase in yields, labor specialization, efficiency, food choice, variety and convenience coupled with a decrease in perishability and the proportion of income Americans spend on food¹⁹. However, these gains have come with substantial negative health effects and they have created the environmental problems supporting the obesity epidemic – lack of access, affordability and quality.

- Increased yields, have led to increased caloric consumption - often with a lower nutrient content. Researchers at the Biochemical Institute at the University of Texas in Austin studied 50-year changes in U.S. Dept. of Agriculture food composition data for 13 nutrients in 43 garden crops. The team found declines in concentrations of six nutrients from the 1950s to 1999.²⁰ **Quality**
- Advances in processing, which decreased perishability, led to increased consumption of high-fat, low-cost “convenience” foods. Some sources show as much as 90% of U. S. Farm production allocated for processed foods with only 10% reaching the consumer free of processing.²¹ **Access, quality**
- Increased labor specialization and convenience decreased the general population’s connection to and understanding of food. **Access, quality**
- Increased food choice and variety, as well as corporate consolidation led to increased marketing of less healthy processed foods and broader distribution models. **Access, quality**
- Increased support of commodity crops led to a decrease in agricultural land available for other fruits and vegetables, decreasing supply and increasing costs. It also changed the farming business model forcing small farmers out of business in favor of large conglomerates. A recent TIME article notes the number of U.S. farms has decreased “from 6.8 million to fewer than 2- million” since 1935 “with the average farmer now feeding 129 Americans, compared with 19 people in 1940.”²² **Access, affordability**

“If Americans were to fully meet the recommendations from the 2005 *Dietary Guidelines* for fruits, vegetables, and whole grains, we estimate the increased demand would require U.S. agriculture to harvest a maximum of 7.4 million acres of additional cropland per year. This 1.7-percent increase is relatively small, given the total U.S. cropland of 433.5 million acres in the 2002 Census of Agriculture.²³

Just as changing only one part of the foodsystem will not have the affect of addressing the system as a whole, addressing only one part of the system failure will not be enough to effect population-wide change. Addressing the issues of access, affordability and quality individually would have some positive effect but is unlikely to stem the tide of the obesity epidemic. However, addressing them collectively by reworking the national foodsystem will build a solid food infrastructure to support a population-wide change in behavior. This in turn will provide a platform to support targeted interventions to curb childhood obesity and enable programs aimed at promoting healthy lifestyles to be sustainable.

Response and Recommendations

We believe the development of integrated, regional-scale systems nationwide, with production, transportation, processing and retail infrastructure to support them, have the potential to provide a viable alternative to the current foodsystem. These “foodsheds”²⁴ would be similar to the concept of watersheds, where the majority of food for a region would be produced within that region. Preliminary research of the Northeast Region suggests that there is the potential for the region to provide a majority of its population's basic food needs. Trade between regions would provide for more varied food demands.

Such systems would seek to optimize and maximize regional production and capacity for self-sufficiency while allowing for climatic and geographic variability that makes some areas inherently more suitable for certain types of production than others. This model would increase **access** by increasing regional supply and retail outlets, **affordability** by dramatically

2. **Mobile Markets** - these mobile units would bring goods and services directly to communities.
3. **10x10 and Lawn to Farm** – education programs aimed at teaching the value of food - economically, environmentally and practically. They also increase awareness of regional identities, production capacities and climate, and the affect of food on personal health.
4. **Healthy Food Index** – this index will serve to measure the impact of regional changes to the foodsystem in terms of access, affordability, consumption habits and health. By measuring impact regionally, the HFI will be able to quantify effective measures incentivizing replication and policy change.

In order to implement such a system it is vital that industry, government, agriculture experts, farmers, academics and health professionals work together to build viable models and measures of health outcomes. The Columbia/MIT team has spent the past several months building the foundation of such relationships. Most exciting, perhaps, is the buy-in and enthusiasm of many of the major food retail and production leaders.

Finally, the Regional Foodshed model has positive implications in other areas such as food security – ensuring that regions are self-sufficient, and the economy – recovering “farm-share” of the agricultural dollar by decreasing value-added inputs, providing jobs, reclaiming unused land and making farming a viable business opportunity.

Ultimately, however, the goal is to improve the health of children and families nationwide.

¹ Leibel RL, Rosenbaum L, Hirsch J. Changes in energy expenditure resulting from altered body weight. *New England Journal of Medicine*. 1995;332(10): 621-628.

² Stroke Pathways Project done by the Collaborative and Professor Marco Steinberg at the Harvard Graduate School of Design. strokepathways.org

³ **Paula A. Johnson, M.D.**, Executive Director, Connors Center for Women’s Health and Gender Biology and Chief of the Division of Women’s Health at Brigham and Women’s Hospital; **Rear Admiral Kenneth Moritsugu, M.D., M.P.H.** Former Acting Surgeon General; **Michael Porter**, Professor, Harvard Business School; **George Rabstejnek**, Chair of Center for Technology Commercialization, Vice Chairman of the Massachusetts Eye and Ear Infirmary; **Alfred Sommer**, Professor of Epidemiology and International Health and Dean Emeritus, Johns Hopkins University Bloomberg School of Public Health; **Roxanne Spillett**, President, Boys and Girls Club of America; **The Honorable Louis Sullivan, M.D.**, Chairman, The National Health Museum and President Emeritus, Morehouse School of Medicine; **Jim Tallon**, President of United Hospital Fund; **Marco Steinberg**, Associate Professor, Harvard University, Graduate School of Design

⁸ CDC NHANES data. Retrieved from:

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⁵ Halweil, B. *Still No Free Lunch: Nutrient levels in U.S. food supply eroded by pursuit of high yields*. The Organic Center Critical Issue Report, September 2007.

⁶ Cutler DM, Glaeser EL and Shapiro JM. Why Have Americans Become More Obese? *Journal of Economic Perspectives*: v17, No 3, Summer 2003.

⁷ French SA, Story M, and Jeffery RW. Environmental Influences on Eating and Physical Activity. *Annual Review of Public Health*, Vol. 22: 309-335, May 2001.

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⁸ Leibtag E. “Corn Prices Near Record High, But What About Food Costs?” *Amber Waves*, Vol. 6, No. 1, USDA Economic Research Service, February 2008.

⁹ Drewnowski A and Specter SE. Poverty and obesity: the role of energy density and energy costs. *American Journal of Clinical Nutrition*, Vol. 79, No. 1, 6-16, January 2004.

¹⁰ Bitler M and Haider SJ. *An Economic View of Food Deserts in the United States*. Prepared for the January 23, 2009, National Poverty Center/United States Department of Agriculture-Economic Research Service (USDA-ERS) conference “Understanding the Economic Concepts and Characteristics of Food Access.”

¹¹ There are five crops that receive direct federal commodity support (subsidies) from the USDA: corn, soybeans, cotton, rice, and wheat. The overall regulatory environment, (which includes such things as a prohibition on the production of fruits and vegetables on land that has been receiving subsidies for commodity crops) disincentivizes the production of healthy foods.

¹² I H Yen and G A Kaplan. "Poverty area residence and changes in physical activity level: evidence from the Alameda County Study." *American Journal of Public Health*, Vol. 88, Issue 11 1709-1712, 1998.

¹³ The human-made physical environment

¹⁴ Public Law 110-246, June 18, 2008, 122 Stat. pg. 2039. The Food, Conservation, and Energy Act of 2008 (2008 Farm Bill), Title VI, Sect. 7537 subsection a, pg. 2039: "DEFINITION OF FOOD DESERT. – In this section, the term "food desert" means an area in the United States with limited access to affordable and nutritious food, particularly such an area composed of predominantly lower-income neighborhoods and communities."

¹⁵ Gallagher M. *Examining the Impact of Food Deserts on Public Health in Chicago*. Mari Gallagher Research and Consulting Group 2006.

Blanchard TC, Lyson TA. Retail Concentration, Food Deserts, and Food Disadvantaged Communities in Rural America. From *Remaking the North American Food System: Strategies for Sustainability* (Hinrichs CC, Lyson TA, eds.) University of Nebraska Press, 2008.

¹⁶ Cummins C, Macintyre S. Food environments and obesity – neighborhood or nation? *International Journal of Epidemiology* 2006;35:100-104.

¹⁷ These figures are from different studies using different methodologies and are therefore not comparative.

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¹⁹ USDA, Economic Research Service. "Food CPI and Expenditures Briefing Room," www.ers.usda.gov/briefing/cpiandexpenditures/

²⁰ Includes a 6 percent decline for protein, a 16 percent decline for calcium, a 9 percent decline for phosphorus, a 15 percent decline for iron, a 38 percent decline for riboflavin, and a 20 percent decline for vitamin C. The team didn't find any nutrients that increased in the last 50 years, although thiamin and niacin barely changed.

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²¹ Martinez, Steve W. The U.S. Food Marketing System: Recent Developments, 1997-2006, ERR-42. U.S. Dept. of Agriculture, Econ. Res. Serv. May 2007.

²² Walsh B. Getting Real About the High Price of Cheap Food. *TIME in conjunction with CNN*; August 21, 2009 [Internet] www.time.com

²³ Buzby JC. *Possible implications for U.S. agriculture from adoption of select dietary guidelines*. Economic Research Report No. 31, U.S. Department of Agriculture, Economic Research Service, November 2006.

²⁴ We acknowledge Fred Kirschenmann; Distinguished Fellow, Leopold Center for Sustainable Agriculture; President, Stone Barns Center for Food and Agriculture, who brought the Foodshed concept to our attention.