that could inhibit technological development. An imaging industry that is confronting payment reductions and utilization controls is likely to pull back from critical investments in research and development. Changing the culture of medical practice to encourage more thoughtful use of imaging today will help to ensure that future patients will benefit from continued imaging innovation.

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Hunger and Socioeconomic Disparities in Chronic Disease

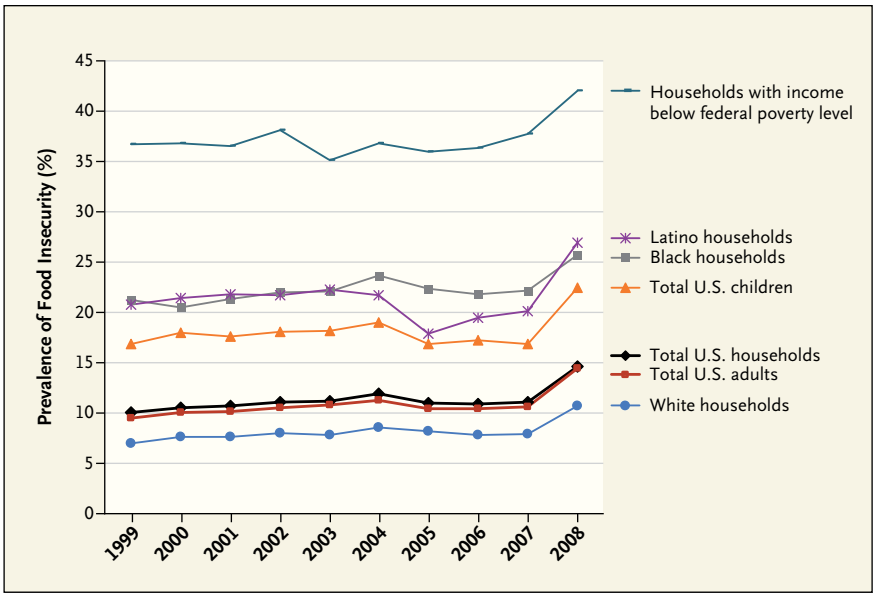
Hilary K. Seligman, M.D., and Dean Schillinger, M.D.

Each year just before Thanksgiving, the U.S. Department of Agriculture (USDA) reports the number of U.S. households that are at risk for going hungry because of an inability to afford food — a condition termed "food insecurity." After a stable prevalence for the past decade, the rate of food insecurity rose by 32% in 2008, to 14.6% of U.S. households — the highest level since the first food-security survey was conducted in 1995. About 21% of U.S. households with children are affected, as are more than a quarter of black and Hispanic households, and 42% of households with incomes below the federal poverty level (see graph).[1]

According to the Life Sciences Research Office, food insecurity exists "whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways [e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies] is limited or uncertain." The concept of food insecurity thus encompasses both the physical sensation of hunger and compensatory behaviors used to avoid hunger. These compensatory behaviors have enormous implications for the prevention and management of chronic disease. To maintain caloric intake, adults who worry that they will not have adequate money for food reduce the variety in their diet and concentrate their intake on a few low-cost, energy-dense, and (unfortunately) nutritionally poor foods. These are generally refined carbohydrates and foods with added sugars, fats, and sodium. Calorie for calorie, these foods cost less than nutritionally rich fruits, vegetables, and dairy products. For example, $1 can purchase either 1200 kcal of cookies or potato chips or 250 kcal of carrots.[2] This differential in the supermarket prices of unhealthful and healthful foods has widened over the past two decades. The USDA reports that between 1985 and 2000, the retail price of carbonated soft drinks rose by 20%, the prices of fats and oils by 35%, and those of sugars and sweets by 46%, as compared with a 118% increase in the retail price of fresh fruits and vegetables.

This widening cost differential, in combination with the global economic crisis, has profound implications in terms of increasing socioeconomic disparities in the incidence and management of obesity, hypertension, diabetes, and other diet-sensitive chronic diseases. The U.S. experience also offers a window into the emerging epidemics of obesity and diet-sensitive chronic disease in developing and newly industrialized countries.

Diabetes provides an illustrative example of the way in which food insecurity affects the incidence and management of chronic disease. Among U.S. adults 50 to 64 years of age in California, for instance, the prevalence of diabetes is 8% among whites, 16% among blacks, and 22%



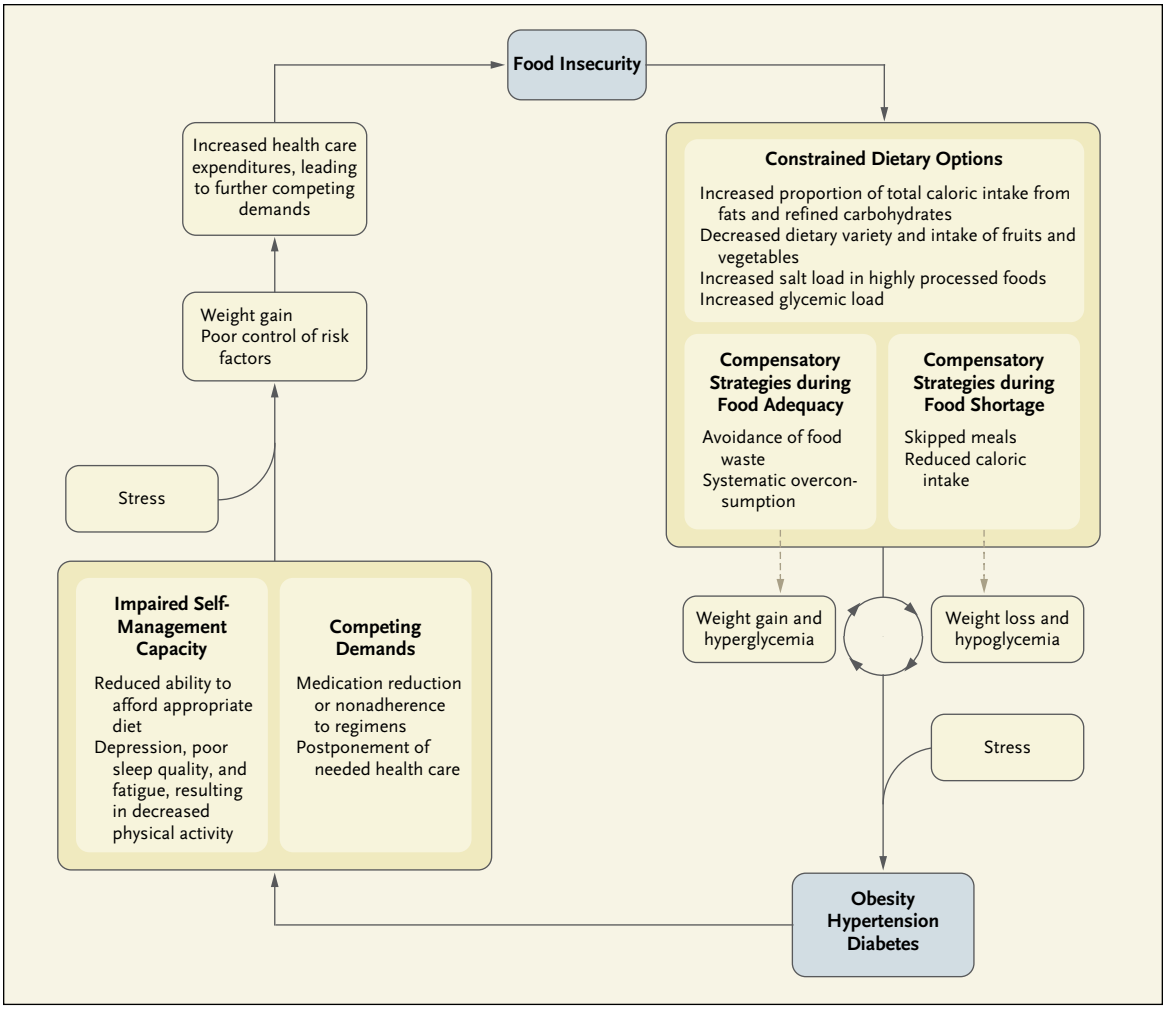
Prevalence of Food Insecurity in the United States, 1999–2008.

among Hispanics. Diabetes prevalence is twice as high among adults with less than an eighth-grade education as among those with a college education. Research conducted at the Center for Vulnerable Populations at the University of California, San Francisco, showed that even after adjustment for these sociodemographic trends, adults living with the most severe levels of food insecurity have more than twice the risk of diabetes of adults who have ready access to healthful foods.[3] Among adults who already have diabetes, food insecurity is associated with poorer glycemic control.[4] Health care providers urge patients with diabetes or prediabetes to shift their dietary intake away from inexpensive carbohydrates and fats in favor of vegetables, fruits, protein, and dairy products. The USDA reports that median weekly food spending in a household secure in its ability to afford food is about $45 per person, as compared with only $32 per person in a household that lacks such security. With $13 less to spend each week, it is difficult to shift dietary intake toward foods that are appropriate for people with or at risk for diabetes while still maintaining caloric requirements. The inability to afford such foods is one likely mechanism for the associations between food insecurity and an increased incidence of diabetes and poor glycemic control (see flow chart).

Food insecurity is a cyclic phenomenon. Most households that are at risk for going hungry because of an inability to afford food alternate many times per year between having an adequate food supply and food scarcity. Cyclic food restriction is associated with preferences for energy-dense foods, increased body fat, and decreased lean muscle mass. Adults who anticipate future food scarcity also overconsume during periods when access to food is reliable. This overconsumption can contribute not only to the development of diabetes but also to poorer glycemic control in people who already have diabetes. These behavioral adaptations appear to be hard-wired. Binge eating, efficient storage of energy (i.e., fat accumulation), and peripheral insulin resistance represent physiologic adaptations to food insecurity that have become maladaptive in an environment with an overabundance of available calories.

The association between food insecurity and diabetes has important implications for the quality, safety, and utilization of health care. Adults with diabetes are 40% more likely to have poor glycemic control if they have inadequate money for food than if they can afford a healthful diet. Their odds of having frequent and severe hypoglycemia are almost twice as high, most likely as a consequence of food inadequacy in association with medication regimens that lower blood sugar. This strikingly elevated risk of hypoglycemia almost certainly contributes to the fact that adults with diabetes who cannot afford adequate food have five more physician encounters per year than their counterparts who can afford adequate food.[5] Adults without reliable access to food also report reducing the amount of medication they take in order to have enough money for food and, conversely, going hungry in order to afford medications. Accumulating research supports the notion that food insecurity is associated not only with diabetes, but also with obesity, hypertension, and cardiovascular disease.[4]

In 2008, more than 49 million people (including 16.7 million children) in the United States lived in a household at risk for going hungry. In our view, existing efforts to increase the supply of fresh fruits and vegetables



The Cycle of Food Insecurity and Chronic Disease.

in low-income neighborhoods must be coupled with wider efforts to ensure the affordability of such foods. The United States has an existing infrastructure for reducing food insecurity: the Supplemental Nutrition Assistance Program (formerly the Food Stamp Program). Expanding eligibility criteria for this program, reaching out to eligible nonbeneficiaries, and developing and implementing new programs to encourage and provide incentives for shifting dietary intake toward more healthful foods could stem the tide of widening socioeconomic disparities in chronic disease.

In developing and newly industrialized countries worldwide, food insecurity in the context of the globalization of food markets exposes low-income populations to the same low-cost, energy-dense, and nutritionally poor foods that make low-income people in the United States particularly vulnerable to chronic diseases. Although the current economic conditions are calling attention to this problem, even at the peak of the past decade's economic growth, the prevalence of food insecurity in the United States was greater than 10% (see graph). Our ability to confront today's problem of food insecurity in a thoughtful, health-promoting, and systematic fashion will have ramifications for health inequities for decades to come.

The views expressed in this article are those of the authors and do not necessarily represent the official views of the California Department of Public Health.

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