

Will China's Nutrition Transition Overwhelm Its Health Care System And Slow Economic Growth?

The rate of change in overweight and obesity in China has accelerated during the past decade and could easily double over the next two decades.

by **Barry M. Popkin**

ABSTRACT: Rapid social and economic change is transforming China, with enormous implications for its population and economy. More than a fifth of China's adult population is overweight, related to changing dietary and physical activity patterns. Overweight and poor diets are becoming a greater burden for the poor than for the rich, with subsequent large increases in hypertension, stroke, and adult-onset diabetes. The related economic costs represent 4–8 percent of the economy. Public investments are needed to head off a huge increase in the morbidity, disability, absenteeism, and medical care costs linked with this nutritional shift. [*Health Affairs* 27, no. 4 (2008): 1064–1076; 10.1377/hlthaff.27.4.1064]

CHINA IS A TRANSFORMED COUNTRY in the new millennium. Rapid economic and social change, including an economy that has grown at an annual rate greater than 8 percent for more than two decades, has transformed urban China and much of its rural sector, although poverty, environmental, and other major problems still exist.¹ The effects of these changes are readily apparent in the rapid shift in China's nutrition transition. Obesity and noncommunicable diseases are the major causes of morbidity, disability, and mortality in China, and the health system has had to grow to care for people with these conditions.

Less apparent are effects such as shifts in the nutritional status of the Chinese population and the impact of this shift on morbidity and mortality. The proportion of the population residing in urban areas has grown rapidly.² Technological changes have reduced physical activity in work, travel, home production, and leisure. Chinese consumption patterns have been transformed by changes in food technology, importation controls, food pricing, and mass media.

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David Blumenthal and William Hsiao have traced the changes in Chinese health care—in particular, those following the privatization of the Chinese economy.³ They point out, in particular, the massive reduction in the national government's share of health care costs and the large increase in the population not covered by any health insurance or health care safety net. Recent results from the China Health and Nutrition Survey (CHNS) reveal that fewer than 25 percent of the Chinese people are effectively covered by health insurance today.⁴ National health spending has risen to well over 5.5 percent of gross domestic product (GDP) and is rapidly increasing. Blumenthal and Hsiao also note the Chinese government's attempts to respond to the challenges of providing health care to its population but do not discuss the underlying changes in the health of the population and the lack of preparation or attention to the coming epidemic of noncommunicable diseases in China.⁵

This paper provides an overview of the rapid shifts in China's dietary and physical activity patterns, and the subsequent increases in obesity and related noncommunicable diseases. It also presents data on medical costs and other data to highlight the high costs already seen in China that are linked with nutrition-related problems.

■ **Data sources.** Data in this paper are mainly from the CHNS for 1991, 2000, and 2006. These longitudinal surveys covered nine provinces that vary greatly in geography, economic development, and health indicators, thus providing a broad-based indication of the trends China is facing. Although the CHNS is not a nationally representative survey, previous CHNS findings regarding the patterns and trends in diet and body composition are almost identical with those from national surveys and the China National Bureau of Statistics.⁶

As part of the CHNS, anthropometric measurements were carried out by well-trained health workers who followed standard protocols. Weight was measured in lightweight clothing to the nearest tenth of a kilogram with a beam-balance scale. Height was measured without shoes to the nearest tenth of a centimeter, using a portable stadiometer. Dietary data consisted of three days of in-depth, twenty-four-hour recall data supplemented with household weighing and measurement at the beginning and end of each day of all inventory and all purchases.⁷

■ **Five periods of change.** China has undergone many marked shifts since 1949. These include (1) a period (1949–1957) when food production was inadequate and cereal consumption was low; (2) the famine (1957–1962), which was linked with the Great Leap Forward; (3) a strong recovery (1962–1979); (4) the subsequent reform period (1979–1985) after the liberalization of food production, when the annual economic growth rate was greater than 10 percent; and (5) the current period (since 1985), in which continued rapid economic growth and a remarkable shift in the diet structure has occurred.⁸ This paper explores the shifts since 1985 and the full implications of the obesity epidemic resulting from these changes in Chinese diet and activity patterns.

China's Nutrition Transition

■ **Major dietary changes fueled by cheap, plentiful edible oils.** Worldwide supply and demand for vegetable fats have accelerated, beginning with major technological breakthroughs in the development of high-yield oilseeds and in the refining of high-quality vegetable oils in the post-World War II period.⁹ This was fueled by concerns during 1950–1970 related to the effects on heart disease of excessive consumption of animal fats, many of which were saturated. A number of concomitant economic and political initiatives led to the development of oil crops, not only in Europe and the United States, but also in Southeast Asia (palm oils) and in Brazil and Argentina (soybean oils). There was a major delay between the time when edible oils reached higher-income countries and when they reached most of the developing world. The nutrition transition (a series of collective changes in diet, physical activity, health, and nutrition) in developing nations typically begins with major increases in the domestic production and imports of oilseeds and vegetable oils, rather than increased imports of meat and milk. While the increases in edible oil consumption were spread across all low- and middle-income countries, increased animal-source food consumption was focused on a smaller set of countries.¹⁰

Major changes in Chinese tax and import regulations during 1990 and 1991 began this rapid increase in the dietary intake of oils. One of the most common oils consumed in China is soybean oil. Chinese soybean oil importation skyrocketed from a minuscule level in 1989 to more than fourteen million metric tons per annum (seventy-eight kilocalories per person per day) by 2006. Domestic production also skyrocketed, and large amounts of vegetable oils—many containing highly pathogenic products—were consumed.¹¹

The shift in China led to the excessive use of edible oils by all social classes; the price and income elasticities indicate that the most rapid increases in edible oil consumption are now occurring among the poor. Intake of edible oil almost doubled between 1989 and 1991, as per capita intake increased from 23.2 to 41.6 grams per day (209 to 374 kilocalories) among adults.¹²

■ **The revolution in animal-source foods.** Long-term global declines in the prices of beef, other animal-source foods, and feed grains have led to a second major set of dietary shifts around the world. For example, Chris Delgado and others have shown that worldwide beef prices have declined in real terms by more than 400 percent over the past four decades. The worldwide livestock revolution continues, with increasingly open trade and large global subsidies helping fuel the changes.¹³

Consumption of eggs, poultry, beef, and pork has increased rapidly in China, and milk intake has recently begun to rise. The average Chinese adult now consumes more than 300 kilocalories per day of pork, poultry, beef, mutton, fish, eggs, and dairy foods. As my colleagues and I have shown elsewhere, the structure of consumption shifts in China is such that for each additional increase in income, adults proportionally increase their intake of animal-source foods.¹⁴

“China is experiencing the world’s fastest growth in supermarkets, with sales growing by as much as 40 percent annually.”

■ **The shift toward energy-dense diets.** The increase in intake of animal-source foods and edible oils, along with declines in cereal intake and minimal changes in vegetable intake, has led to large increases in the energy density of the diet and equally large increases in fat intake. Accurate data on the total increase in saturated and hydrogenated fats in the Chinese diet are not available; however, the proportion of energy from fat and animal-source foods has certainly increased greatly. The classical Chinese diet—rich in vegetables and carbohydrates with minimal animal-source food—no longer exists. In 2006, fewer than 1 percent of all Chinese adults consumed a diet with less than 10 percent of energy derived from fat. In contrast, in 2006, slightly more than 44 percent of adults consumed a higher-fat diet, with more than 30 percent of energy derived from fat, and close to two-thirds of adults consumed a diet with more than 10 percent of energy derived from animal-source food fats—primarily saturated fats (Exhibit 1).

■ **Westernization of the food supply and eating patterns.** *Changes in food marketing.* Many scholars have suggested that the consumption patterns, featuring fast-food chains and soft drink consumption, that are dominant in the United States will become a global issue.¹⁵ However, this does not appear to be the pattern of change in China.¹⁶ The major changes one sees in China are in the food marketing landscape. Throughout Asia as in Latin America, the food marketing landscape is becoming dominated by supermarkets, particularly large superstores.¹⁷ In China, Carrefour and Wal-Mart supermarkets are not only expanding rapidly but are also being matched by domestic clones.¹⁸ China is now experiencing the world’s fastest growth in supermarkets, with sales of these stores growing by as much as 40 percent annually.¹⁹ By 2003, more than \$55 billion had been spent on construction of supermar-

EXHIBIT 1
Shifts In Energy Sources In The Chinese Diet, For Adults Ages 20–45, Selected Years 1989–2006

	More than 30 percent of energy from fat					More than 10 percent of energy from animal-source foods				
	1989	1993	1997	2000	2006	1989	1993	1997	2000	2006
Urban	19.8%	44.0%	52.0%	56.9%	57.9%	49.8%	59.8%	57.2%	62.0%	81.9%
Rural	12.1	18.8	26.5	38.3	38.7	33.3	37.6	37.6	44.0	61.1
Low-income	9.3	11.6	15.8	27.1	33.5	26.2	28.7	27.1	35.4	53.8
Middle-income	16.2	23.7	30.9	44.6	39.4	42.8	45.3	42.4	51.3	60.6
High-income	18.5	43.9	51.3	56.3	53.4	47.8	61.5	61.6	60.7	79.5
Total	14.7	26.0	34.2	43.9	44.1	38.8	43.9	43.5	49.4	67.0

SOURCE: China Health and Nutrition Surveys for 1989, 1993, 1997, 2000, and 2006.

kets, and urban, let alone rural, areas have only begun to be reached by this construction boom. These supermarkets are spreading to secondary cities and towns and starting to reach into higher-income rural areas.

Consumption of sugars. One might also expect that with all of these changes, the Chinese would have followed the U.S. model featuring excessive consumption of caloric sweeteners and large amounts of soft drinks and fruit drinks; however, this is not the case. The Chinese, although starting to consume limited amounts of soft drinks and other sweetened beverages and foods, still derive only a small proportion of their energy from these sources. Moreover, they consume very little take-out food and Western-style fast foods. Among Chinese children ages 2–18, for example, in 2000, less than 10 percent of calories were derived from food purchased away from home, while comparative data from a neighboring country—the Philippines—found that in 2002, almost 40 percent of children’s calories were derived from such foods.²⁰ This same study showed that less than 0.1 percent of Chinese children’s energy was obtained from fast foods and soft drinks, compared with about 3 percent of Philippine children’s energy. Western and Chinese variants of pizza, hamburgers, fried chicken, and related fast-food chains are rapidly expanding in Chinese cities, but the total reach of these chains into the broader population is still limited.

Changes In Physical Activity

■ **Work activity patterns.** Several linked changes in physical activity are occurring jointly. One is a shift away from high-energy activities such as farming, mining, and forestry toward the service sector.²¹ Reduced energy expended in the same occupation are a second dimension of the shift in the energy expended for economic work.²² For instance, the proportion of Chinese urban adults (male and female) working in occupations requiring moderate and high activity levels has decreased, but participation in low-activity occupations has increased (Exhibit 2). In rural areas, however, a shift for some (in high-activity occupations) toward decreased physical activity has occurred to a lesser extent than in urban areas, linked to holding multiple jobs and more intensive effort, but participation in moderate-effort occupations is declining for many. Although some initial research between 1989 and 1991 found an increase in adult underweight status in rural China, most people with increased heavy activity at work are those with higher incomes who combine work in the agricultural and modern sectors. Thus, most of our research on occupational energy expended has not found increased high-activity work linked with reduced weight.²³ There is also a clear overall income gradient among those involved in occupations with high and low expenditure of energy.

■ **Transportation and leisure activity.** Other major changes relate to modes of transportation and activity patterns during leisure hours. In China, 14 percent of households acquired a motor vehicle between 1989 and 1997. In one study, we showed that the odds of being obese were 80 percent higher ($p < 0.05$) for men and

EXHIBIT 2**Shifts In The Distribution Of Physical Activity Requirements Of Adults' Primary Occupation, China, 1989 And 2006**

	Activity requirements, 1989			Activity requirements, 2006		
	Low	Moderate	High	Low	Moderate	High
Urban	44.8%	46.1%	9.1%	66.7%	29.3%	4.0%
Rural	21.8	39.1	39.1	33.2	28.2	38.6
Low-income	21.5	36.0	42.5	32.9	30.2	36.9
Middle-income	28.0	44.5	27.5	37.2	27.6	35.2
High-income	37.6	44.2	18.2	52.4	27.7	19.9
Total	28.6	41.3	30.1	42.4	28.3	29.3

SOURCE: China Health and Nutrition Surveys for 1989 and 2006.

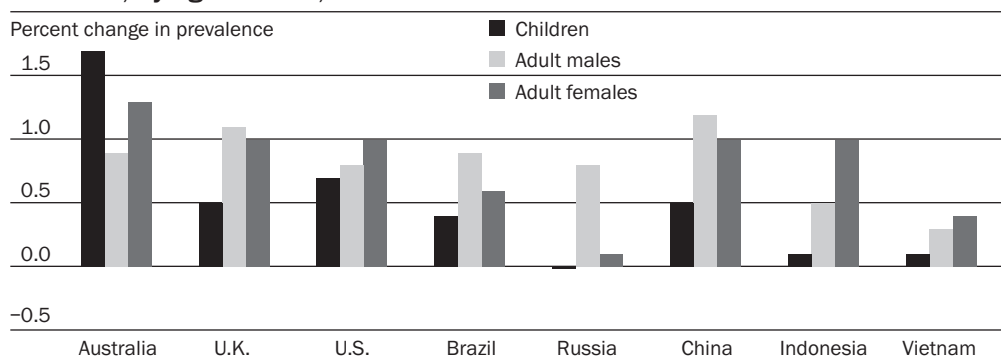
NOTE: Adults are those ages 20–45.

women in households that owned a motor vehicle than for those in households that did not.²⁴ Also, television ownership has skyrocketed in China, leading to greater inactivity during leisure time.²⁵ In 1989, only 63 percent of households owned a television set, whereas by 2004 more than 95 percent of all households owned one set, and two-thirds of households owned a color television set.²⁶

Changes In Weight Among Chinese Adults

■ **Overweight in China.** As one might expect, the combination of all of these forces has resulted in a rapid increase in the distribution of the body mass index (BMI) of the Chinese population, particularly adults. Overweight status among adult males tripled and among adult females, doubled, between 1989 and 2000. By 2004, nearly a quarter of all Chinese adults were overweight. Moreover, the rate of change of Chinese overweight status, in particular among adults, is one of the most rapid in the world and far larger than that in the United States.²⁷

■ **Global context.** To put the level of overweight and obesity into a broader context, we examined data from studies that are nationally representative, are weighted, and contain direct measurements of weight and height. The most standard measure of adult obesity is BMI. BMI greater than 30 is considered obese, and BMI of 25–29.9 is considered overweight. Age-sex standards equivalent to adult overweight and obesity standards exist and are used for children and adolescents.²⁸ More than 25 percent of Chinese adults are now overweight or obese, compared with about two-thirds in countries as diverse as the lower-income countries of Egypt, Mexico, and South Africa and the higher-income countries of Australia, the United Kingdom, and the United States. More than 1.2 percent of the Chinese adult male population became overweight or obese each year during the past decade, while the annual rate of increase was slightly less among adult men in Australia, the United Kingdom, and the United States (Exhibit 3).

EXHIBIT 3**Annual Absolute Change In The Prevalence Of Overweight And Obesity In Eight Countries, By Age And Sex, From 1985–1995 To 1995–2004**

SOURCE: B.M. Popkin, "Understanding Global Nutrition Dynamics as a Step toward Controlling Cancer Morbidity and Mortality," *Nature Reviews Cancer* 7, no. 1 (2007): 61–67. (Reprinted with permission from Macmillan Publishers Ltd.)

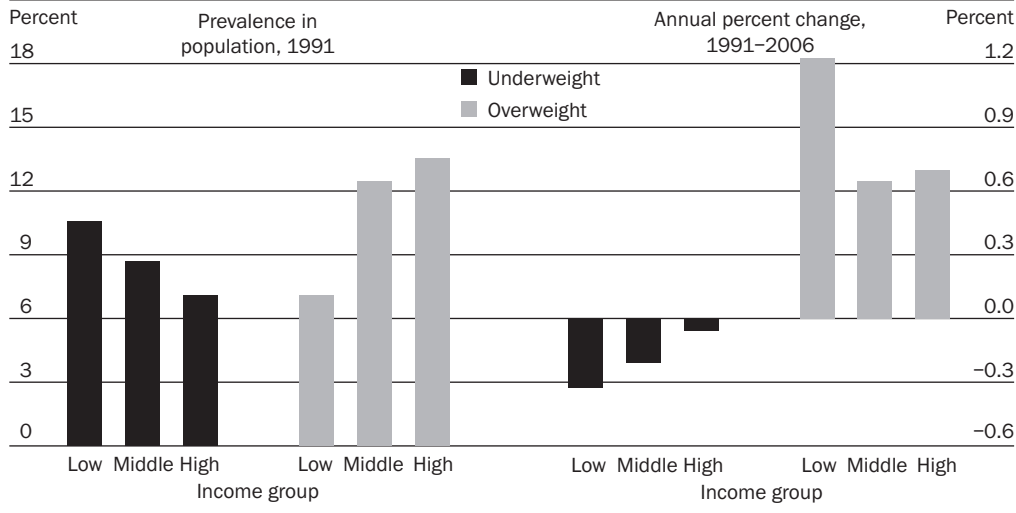
NOTE: For adults, body mass index (BMI) of 25.0 or greater; for children, International Obesity Taskforce equivalent.

■ **Underweight in China.** The proportion of underweight adults (ages 20–45) dropped during this time period. The largest decline in change per year is found among the low-income tertiles for underweight and among both the low- and high-income tertiles for overweight status (Exhibit 4).

■ **Overweight: a problem of the poor.** There is a shift in transitional and lower-income countries toward more overweight among people in lower socioeconomic groups. In a study of women from thirty-eight countries, we found that when countries achieved a GDP of \$2,500 (in 1995 dollars), they had more overweight among less educated women than among more educated women.²⁹ China, with its much lower GDP, also has greater overweight and obesity among less educated than among more educated women.³⁰ The income differentials are not dramatic, yet they do show a decline in underweight across all income tertiles (Exhibit 4). In fact, the proportion of underweight adults dropped to 6.5 percent in this time period (data not shown). The shift in China toward more overweight among the poor is also seen in more complex longitudinal research on dietary change. This work, published in both social science and economics journals, shows that increased income among the poor is associated with a greater increase in the income elasticity and a greater income elasticity overall than among higher-income adults.³¹

■ **Pace of changes.** Rates of change in overweight and dietary pattern shifts are accelerating. The prevalence rate of change in overweight accelerated from less than 0.5 percent during 1980–1990 to 1.9 percent for men and 0.9 percent for women during 1997–2000. Preliminary data for 2004 indicate that these changes are accelerating.³² In the dietary area, we have documented longitudinally that income elasticity, or the proportion of food purchases with a 1 percent increase in income, has accelerated at an increasing rate over the past fifteen years.³³

EXHIBIT 4
Prevalence Of Underweight And Overweight Among Chinese Adults, By Income Group, 1991–2006



SOURCE: China Health and Nutrition Survey, 1991 and 2006.

NOTE: The prevalence of under- and overweight in 1991 relates to the left-hand y axis; the percentage change from 1991 to 2006 relates to the right-hand y axis.

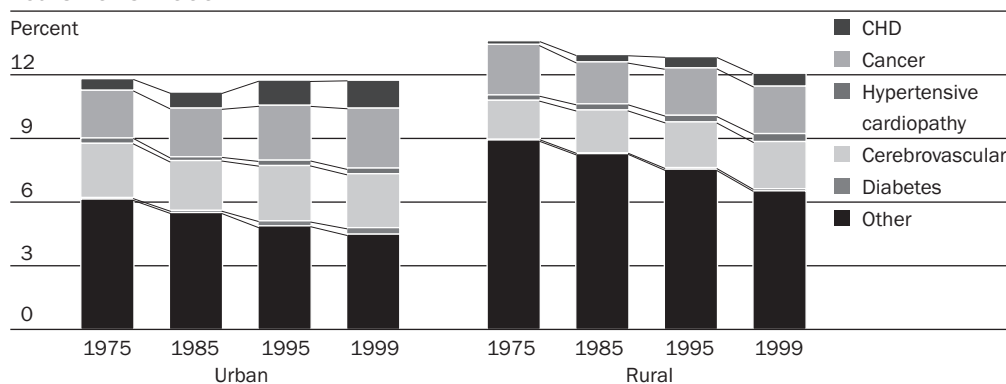
Implications Of The Changes

■ **Implications for health status.** While mortality rates from coronary heart disease (CHD) are dropping in higher-income countries, China—along with many other developing countries—is seeing a large increase in nutrition-related causes of death, such as cancer and CHD.³⁴ The causes are directly linked to diet, activity, and obesity (Exhibit 5).³⁵

In both urban and rural areas there have been large absolute and relative declines in non-nutrition-related deaths—deaths from infectious and parasitic infections, hunger, and accidents. In contrast, in urban areas there was an increase in the overall death rate between 1985 and 1995. Moreover, since 1985, deaths from nutrition-related noncommunicable diseases have increased from 48 percent to 61.8 percent of all deaths in urban areas and from 34.5 percent to 45.9 percent in rural areas.

■ **Implications for the health system.** Since 1985, China has accelerated the decentralization of its public health and medical care systems. A major reduction in central government funding, coupled with an increased focus on local funding from private economic activities, has resulted in serious neglect of public health activities. At the same time, health care spending is burgeoning: during 1978–2002, it rose fortyfold, and, more importantly, national health care spending nearly doubled, with a major element being the increased cost of prescription drugs.³⁶

This shift in health and nutritional status has resulted not only in high direct medical care and drug costs but also in increased disability, mortality, and sick-

EXHIBIT 5**Trends In The Causes Of Mortality In China, By Urban And Rural Location, Selected Years 1975–1999**

SOURCE: China Ministry of Health, *Annual Statistical Reports of Death, Injuries, and Causes of Death in China*, selected years 1975–1999.

NOTE: CHD is coronary heart disease.

ness during the period of active labor-force participation prior to retirement (indirect costs). Elsewhere, we have developed some of the linkages and relationships that lead to these economic costs in greater detail.³⁷ The range of pathways linking the nutrition transition in China to health and economic costs must include the effects of diet and activity indirectly through obesity, as well as directly for a range of noncommunicable diseases.

Using current prevalence data for most of China's key nutritional, physical activity, and mortality patterns—as well as retirement age and medical care costs—the economic costs are predicted to be very large. The rate of change in overweight and obesity in China has accelerated over the past decade, and even the most conservative assumptions have it doubling over the next two decades. Conservative estimates predict that lost work time will increase as the prevalence of diabetes, osteoarthritis, and many other debilitating conditions rises. Based on fairly conservative assumptions, the total impact of these nutrition-related components of poor diet, inactivity, and obesity on medical costs to treat noncommunicable diseases, labor productivity, and national production are very large. In the case of China, the indirect effect of obesity and obesity-related dietary and physical activity patterns was 3.58 percent of GDP in 2000 and was projected to reach 8.73 percent in 2025.³⁸ These estimates do not account for much of the recent rapid increase in the use of and spending for pharmaceutical products, which would make the total costs even higher.³⁹

Discussion

China is not unique, but its importance in the global economy is great. Clearly, its transition in diet, activity, and obesity and related health care and other costs is already affecting the Middle East and many other Southeast Asian and Latin

“China’s transition in diet, activity, and obesity and related health care and other costs is already affecting other countries.”

American countries.⁴⁰ Moreover, these changes appear to be penetrating most countries in the developing world.⁴¹ In general, rates of change, worsening dietary and physical activity patterns, and increased obesity are greater in many developing and transitional countries than in higher-income ones.⁴²

■ **Future health care costs.** There is no clear way to fully forecast the health care costs of China’s transition toward a lifestyle linked with nutrition-related non-communicable diseases. The current trajectory cannot measure the role that prescription drugs might play—both in economic costs and in impact on the overall economy—because the available data do not measure pharmaceutical usage.⁴³ Treatment of hypertension and many other treatable diseases is low but expected to increase.⁴⁴ Nonetheless, the costs of treating diseases such as diabetes are enormous; a more aggressive system of treatment would most certainly raise health care costs.

■ **A note of caution.** There are no data from China that would allow us to understand the exact impact of obesity on productivity, absenteeism, and retirement there. Without such data, one must rely on studies undertaken in other countries, but results should be interpreted with caution. This brief layout can certainly provide a strong case for public investment to improve dietary, activity, and body composition patterns in China and other developing countries. However, it is clear that from the individual perspective, having a tastier higher-fat and sweetened diet is desirable. A reduction in stressful activity in market and home production is also desired. The critical issue is finding effective social investments and regulations to encourage people to develop lifestyles that will reduce these problems and result in a healthier population.

■ **Food system issues.** Issues to be addressed in the food sector include increasing the intake of fruit, vegetables, and high-fiber foods, and reducing the intake of fat and caloric sweeteners. There is great controversy about the need to reduce total fat intake versus the intake of certain kinds of fats (trans fatty acids, erucic acid, and saturated fats).⁴⁵ There is also some debate about the role of caloric sweeteners. For instance, the World Health Organization has recommended a maximum of 10 percent of energy from caloric sweeteners—a level below that of caloric sweeteners consumed in diets in a number of high-, low-, and moderate-income countries (for example, the United States, Russia, Mexico, and Brazil).⁴⁶ In contrast, the U.S. Institute of Medicine conducted the same review and concluded that 25 percent of energy from caloric sweeteners was acceptable.⁴⁷

■ **Physical environment issues.** The physical environment can be changed in ways that enhance physical activity. A growing body of knowledge points to the role of environmental factors ranging from connectivity of streets to availability of walking options, and from street safety to the organization and layout of buildings.⁴⁸ In-

creased opportunities for physical activity, such as recreation facilities and transportation options, will raise physical activity levels and lower the prevalence of overweight. Conversely, constraints to physical activity such as crime and air pollution will have the opposite effect.

THERE ARE MANY OPTIONS AVAILABLE TO ACHIEVE each of the desired changes in the food supply and the physical environment. A few countries are already beginning to take some steps to address these issues, but much remains to be done.⁴⁹ This paper provides some sense of how overweight and obesity have affected one country and will continue to do so if the country does not take radical corrective action.

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