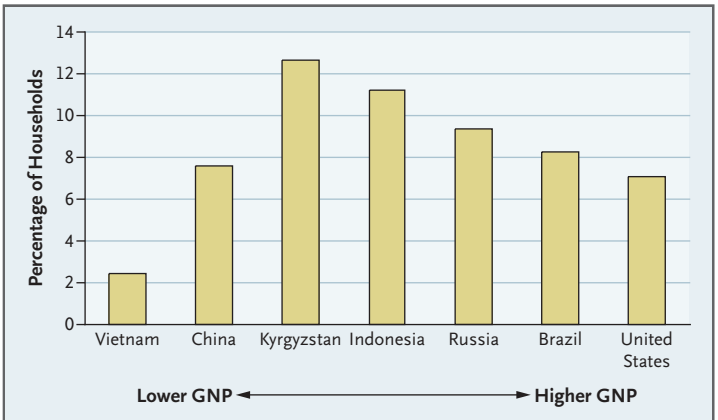
GLOBAL HEALTH

A Nutrition Paradox — Underweight and Obesity in Developing Countries

Benjamin Caballero, M.D., Ph.D.

A few years ago, I was visiting a primary care clinic in the slums of São Paulo. The waiting room was full of mothers with thin, stunted young children, exhibiting the typical signs of chronic undernutrition. Their appearance, sadly, would surprise few who visit poor urban areas in the developing world. What might come as a surprise is that many of the mothers holding those undernourished infants were themselves overweight.

The combination of underweight in children and overweight in adults, frequently coexisting in the same family, is a relatively new phenomenon in developing countries undergoing the nutrition transition — the changes in diet, food availability, and lifestyle that occur in countries experiencing a socioeconomic and demographic transition. In such countries, as many as 60 percent of households with an underweight family member also have an overweight one, a situation that has been dubbed the "dual burden household"[1] (see graph). Among countries at an intermediate level of development (middle-income countries, with a per capita gross national product [GNP] of about $3,000 per year), overweight ranks fifth among the top 10 causes of disease burden — right below underweight.[2] This is the same position held by overweight as a cause of disease burden in the developed world.



Percentage of Households Having Both Underweight and Overweight Members in Seven Countries.

The countries are arranged according to their per capita gross national product (GNP), with data adjusted for household size, from the lowest average on the left (Vietnam, $1,100) to the highest average on the right (United States, $26,250). Data are from Doak et al.[1]

Traditionally, obesity has been linked with abundance, and it was anticipated that as developing countries improved their economic status and their GNP, undernutrition would decrease and obesity would begin to appear among members of the upper socioeconomic classes. But the relationship between GNP and overweight is complex. Although being poor in the poorest countries (those with a per capita GNP of less than $800 per year) indeed "protects against" obesity, being poor in a middle-income country is actually associated with a higher risk of obesity than being richer in the same country.[3]

The reasons are not completely clear, but it is obvious that in poor countries, the dietary energy intake of the poorest people may be limited by the scarcity of food, and the high energy demands of manual labor and daily-survival activities make it difficult for people to achieve a net positive energy balance and therefore to gain weight. In more urbanized developing countries with a higher GNP, food scarcity may no longer be the driving factor behind energy intake. Instead, the availability of cheap, energy-dense foods (including those from street vendors and fast-food restaurants) may facilitate the consumption of more calories. Widespread access to television would favor an indoor, sedentary lifestyle, further reducing the average daily energy expenditure. In the wealthier segments of a given population, these influences may be counterbalanced by access to better education about health and nutrition, sufficient income to purchase healthier foods (which are usually more expensive), greater quantities of leisure time for physical activity, and better access to health care that would help to address problems of excess weight. The contribution of the urban environment to the underweight–overweight para-

Dr. Caballero is director of the Center for Human Nutrition and a professor of international health at the Bloomberg School of Public Health, Johns Hopkins University, Baltimore.

dox will probably continue to increase, since it is predicted that most of the population growth in the next 30 years will occur in urban areas, and almost all these new urban areas will be located in developing countries.

These factors explain the development of obesity among people who are marginally poor. But what about the persistence of underweight? It seems evident that the improvement in per capita GNP in countries undergoing a socioeconomic transition does not benefit all citizens equally. Data from the World Bank show that the rates of poverty and underweight have actually increased among children younger than five years of age in urban areas of countries in socioeconomic transition.[4] People who move from rural to urban areas usually lose the ability to grow their own food and become dependent for their calories on a cash market. It is also more likely that women who move to the city will join the labor force and therefore become less available to prepare food at home, relying more heavily on commercially prepared foods for themselves and their families. For people with sufficient money, such a reliance may improve food choices and permit a more stable, if not better-quality, supply of dietary energy. But for those with an inadequate income, the urban environment may not offer the safety net of extended family and subsistence agriculture that is common in rural areas. These factors may explain why in Brazil women with incomes in the lowest quartile of the income distribution have a higher prevalence of underweight as well as a higher prevalence of overweight than do women with incomes in the top quartile.[5]

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Food Seller, Gambia.

Because food costs consume a much larger proportion of family income in developing countries than in developed countries — more than 50 percent, in many cases — prices have a strong effect on the selection of particular foods. The globalization of food markets has resulted in the introduction of mass-produced, low-cost foods to the domestic food supply of many developing countries. This change, along with advertising campaigns, may have a powerful effect on the food choices and dietary patterns of low-income families. For example, the introduction of low-cost vegetable oils from industrialized countries greatly increased the proportion of fat calories in the average diet in countries undergoing the nutrition transition. Although many of these low-cost commercial foods are energy-dense, they may be nutrient-poor. And nutrient density is particularly important for growing children. For example, on a per-calorie basis, a five-year-old boy needs five times as much iron in his diet as a man. Cheap, energy-dense, nutrient-poor foods may adversely affect the growth of the child but may provide sufficient calories for the adult to gain excess weight.

Factors other than diet and lifestyle also link early undernutrition with overweight in adulthood. The hypothesis of "fetal origins of disease," which is supported by a number of observational epidemiologic studies, postulates that early (intrauterine or early postnatal) undernutrition causes an irreversible differentiation of metabolic systems, which may, in turn, increase the risks of certain chronic diseases in adulthood. For example, a fetus of an undernourished mother will respond to a reduced energy supply by switching on genes that optimize energy conservation. This survival strategy causes a permanent differentiation of regulatory systems that result in an excess accumulation of energy (and consequently of body fat) when the adult is exposed to an unrestricted dietary energy supply. Because intrauterine growth retardation and low birth weight are common in developing countries, this mechanism may result in the establishment of a population in which many adults are particularly susceptible to becoming obese.

The coexistence of underweight and overweight poses a challenge to public health programs, since the aims of programs to reduce undernutrition are obviously in conflict with those for obesity preven-

tion. As pointed out by Doak et al.,[1] these programs will have to identify and consider the magnitude and demographic composition of dual-burden households at the local and regional levels and then develop more targeted interventions. It will be essential to educate health care workers about the underweight–overweight phenomenon. Fortunately, some important interventions for reducing the rate of undernutrition may also be beneficial in terms of reducing the burden of obesity: promoting breast-feeding, improving the nutritional status of women of reproductive age, and reducing the rates of fetal growth retardation and low birth weight.

Improving the "obesogenic" environment in urban areas of the developing world may be more challenging. Governments and nongovernmental organizations must play an active role in promoting and protecting an environment that supports the growth and development of infants and children, monitoring the food market, and facilitating community-based initiatives that aim to promote healthy eating and physical activity. The World Health Organization's Global Strategy on Diet, Physical Activity, and Health, endorsed by all member countries in May 2004, outlines a program and process for achieving these goals. But the other major challenge for countries in transition is to reduce socioeconomic and health disparities in urban areas. Until we close these gaps, we will continue to find malnourished children in the arms of overweight mothers.

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Marathon Maladies

Benjamin D. Levine, M.D., and Paul D. Thompson, M.D.

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Patriots' Day, a Massachusetts holiday commemorating the Revolutionary War Battles of Lexington and Concord, is also the date of the annual Boston Marathon, a 42-km footrace. It was first run in 1897, one year after members of the Boston Athletic Association returned from the reincarnation of the Olympic Games in Greece.

As traditional as the marathon itself is the use of the event for research and of its runners as research subjects. In the second year of its existence, two physicians, Harold Williams and Horace D. Arnold, examined urine specimens from some of the runners and noted urinary casts and proteinuria — findings that would later be known as "athletic pseudonephritis."[1] Clarence DeMar, a legendary Boston runner, won the marathon an incredible seven times. His total would probably have been higher had he not been advised against competing by a physician who detected what was undoubtedly an innocent flow murmur produced by DeMar's augmented cardiac stroke volume. DeMar was also a subject in studies performed by the noted Boston cardiologist Paul Dudley White, who had a lifelong interest in the marathon and had studied the heart rate of Boston participants in the 1915 and 1916 races. When DeMar died of colon cancer in 1958, White arranged for an autopsy on the already embalmed body. A report in 1961[2] presented results from both White's earlier studies of DeMar and the autopsy, which showed that the diameter of DeMar's coronary arteries was approximately two to three times that in normal adults. White, a great advocate of exercise who often rode his bicycle to

Dr. Levine is a professor of cardiology and the director of the Institute for Exercise and Environmental Medicine, Presbyterian Hospital of Dallas, University of Texas Southwestern Medical Center at Dallas. Dr. Thompson is the director of the preventive cardiology program, Division of Preventive Cardiology, Hartford Hospital, Hartford, Conn.