Chronic diseases are increasing in global prevalence and seriously threaten developing nations' ability to improve the health of their populations. Although often associated with developed nations, the presence of chronic disease has become the dominant health burden in many developing countries. Chronic diseases were responsible for 50% of the disease burden in 23 high-burden developing countries in 2005 and will cost those countries $84 billion by 2015 if nothing is done to slow their growth. The rise of lifestyle-related chronic disease in poor countries is the result of a complex constellation of social, economic, and behavioral factors. Variability in the prevalence of chronic disease is found both at the country level and within countries as differences in risk factors are observed. This upward trend is forecast to continue as epidemiologic profiles and age structures of developing countries further shift. More research is needed to identify a full range of prevention-focused, cost-effective interventions against chronic diseases in the developing world.

Key words: chronic diseases; obesity; developing country; poor; economics

Overview of Disease Burden

Chronic Diseases Compared to Infectious Diseases

Chronic diseases are a serious threat to health and longevity in developing countries. In all but the poorest countries, the death and disability from chronic diseases now exceeds that from communicable diseases—comprising 49%, compared with about 40% for communicable disease and 11% for injuries.¹ The dominance of chronic disease in developing countries is not well recognized among health experts and nonexperts alike because these ailments are often less visible than communicable diseases, progress slowly, and are under-diagnosed. Further, the presence of chronic disease has overtaken the communicable disease burden in part because of success in reducing the latter—but tragically, also because poor countries are increasingly adopting the unhealthy lifestyles of the developed world.

This chapter is primarily about lifestyle-related chronic diseases—those that derive from personal decisions about diet, exercise, and tobacco consumption—driven largely by changing environments and rising incomes. The most prominent of these diseases are coronary artery disease, ischemic stroke, diabetes, and some cancers. Overweight and obesity are common precursors caused by the some of the same risk factors.¹ Thus, this chapter addresses a new and emerging aspect of health in developing countries—one that poses a serious and growing burden on individuals, health systems, and economies of poor countries but is also largely preventable.

Trends Show Growing Effect

Trends in chronic disease can be viewed in two ways: through projections from WHO data in the Global Burden of Disease and Risk Factors report² and from individual and cross-country observational survey data obtained from official country statistics and private researchers. Lacking adequate disease prevalence data, country surveys usually present data on specific risk factors. Both methods tell the same story but with different metrics and periods.

The WHO projects increases in deaths and illness due to chronic diseases in low- and middle-income countries up to 2030. The increasing prevalence of chronic disease in developing countries can be decomposed into two main trends: rising average age of the population and changing epidemiologic profile of the

¹ Other diseases designated by the World Health Organization (WHO) as Type II include the following: Noncommunicable conditions are neuropsychiatric conditions, some respiratory and digestive diseases, and congenital anomalies. Communicable diseases are categorized as Type I and injuries as Type III by the WHO.
population. Figure 1 shows that expected improvements in age-specific death rates from chronic diseases in developing countries will not outweigh the mortality increase caused by having an older population.

The survey data show increases over time in the proportion of the population that is overweight or obese, a major risk factor associated with chronic diseases. These increases appear across a wide range of developing countries, but with substantial variation among those countries in the prevalence levels and rates of increase (Fig. 2). These trends illustrate two important realities about the global increase in chronic diseases.
First, because of the variability in experiences across countries, a better understanding of the underlying conditions is needed. Second, we can expect the burden of chronic disease to continue rising as the drivers spread across and within countries.

**Regional Burden**

A longstanding assumption has been that chronic diseases exist primarily in rich countries and that communicable diseases exist primarily in poor countries. This simple division is no longer true. Finland, Taiwan, and South Korea are examples of relatively rich countries with low prevalence of the major chronic diseases. Canada and the United Kingdom have higher death rates from chronic diseases than from communicable diseases; however, the chronic disease toll in those countries is still much lower than those prevailing in many poor countries. Conversely, even very poor countries, such as India and Pakistan, and moderately poor countries, such as Russia and China, show higher death rates from chronic disease than communicable disease.\(^3\) Figure 3 shows current and projected country-level prevalence of overweight. Sub-Saharan Africa, South Asia, and some portions of Southeast Asia are the only world regions with fewer than half of the people facing a serious risk of chronic disease soon.

A more nuanced understanding of who is affected by chronic diseases is gained by examining the presence of various risk factors for chronic disease at different income levels—not just at the country level but within countries as well. On this, the evidence is mixed.

In rich countries, the poor have a higher burden of both communicable and chronic diseases than the wealthy.\(^3\) In the low- and middle-income countries, the distribution of chronic disease risk factors varies. As in rich countries, the prevalence of smoking is higher among the poor in low- and middle-income countries, whereas levels of physical inactivity and type 2 diabetes are also higher among the poor in some low- and middle-income countries but are higher among the wealthy in others. Figure 4 shows smoking prevalence among the poor and rich in selected developing countries.

On the other hand, obesity is increasing for all income categories in low- and middle-income countries, with an emerging tendency to shift toward the poor. These patterns are based on scattered empirical data from a cross-section of developing countries, so strong conclusions are not warranted. Some have found that countries with an average per capita income level above $2500 show a greater likelihood of obesity among lower-income women in their populations (and a lower likelihood or no connection between income and obesity among men) than those countries below that income level.\(^4\) In a review of national data from 37 developing countries gathered between 1992 and 2000, Monteiro et al.\(^3\) confirm that “obesity starts to fuel health inequities in the developing world when the [gross domestic product] reaches a value of about $2500 per capita” (p. 1183). The data are limited to adult women, and education is used as a proxy for socioeconomic status.

Other have found a lack of clear evidence about economic status and various risk factors. Suhrcke et al. examined the relationship between average income and average body mass index (BMI) across countries.\(^3\) They found that average BMI appears to increase at a decreasing rate as gross domestic product (GDP) per capita rises—a positive relationship between BMI and income up to a relatively high level of income per capita ($22,000 per year in 2002). Beyond about $22,000 annual income, BMI drops with increasing income. They find wide variation around the mean. For example, at similar per capita income levels, Micronesia has an average BMI level of 32.6 among its male adult population, whereas Namibia has an average BMI of 21.5 in the same population. However, for other chronic disease risk factors, such as alcohol consumption or high blood pressure, a weak or no apparent relationship to income level can be found.

The conclusion is that conditions have changed in developing countries in recent years such that unhealthy behaviors that lead to chronic diseases are common among people of all income levels. Such behaviors are increasingly more likely among lower-income people in countries above a certain income threshold.

The demographic influence on the rise in chronic diseases across the world was mentioned earlier. Some believe that there is an unstoppable aspect to the rise of chronic diseases simply due to population aging.\(^6\) Although this may be true, the economic effect of chronic diseases will be different if the diseases affect people primarily during their productive working years versus after retirement and if the disease is treated versus left undetected or untreated. Again, there is a difference in the burden imposed by chronic diseases in rich versus poor countries. More morbidity and mortality from chronic diseases occurs before age 60 in low- and middle-income countries than in high-income countries. About one-third of deaths in low-income countries attributable to chronic disease occur before age 60.\(^3\)

This overview should make clear that the growing presence of chronic diseases among the populations of
FIGURE 3. Prevalence of overweight by country, 2005 and 2015. Reprinted with permission from WHO.² (In color in Annals online.)

the world is complex—with some common factors and important differences. The next section will expand on the particular implications of chronic diseases for the poor in developing countries.

**Causes of Chronic Disease among the Poor**

A complex constellation of social, economic, and behavioral factors is behind the rise in chronic diseases. With the luxury of hindsight, we can apply some of the lessons learned in developed countries to developing countries, but only to a limited extent. The three main risk factors for chronic diseases—overnutrition, lack of physical activity, and tobacco use—are increasing generally in developing countries, just as in developed countries. The alarming aspect in regard to the public health and economic agendas of these countries is the speed with which unhealthy habits have taken hold in developing countries, with little indication of slowing.²
Personal Lifestyle Changes

The chronic diseases addressed in this chapter are often called lifestyle diseases. That terminology suggests that people adopt unhealthy habits—such as energy-dense diets, smoking, and reduced activity level—from personal preference. The extent to which unhealthy behaviors and harmful exposures are voluntary is a complex issue still being explored by researchers. Exposures to secondhand smoke and marketing of junk food and sugared beverages to children are two areas of enhanced disease risk where personal freedom is limited. Less clear is how much choice is involved in other unhealthy behaviors and environmental conditions.

Survey research shows that the primary chronic disease risk factors are becoming increasingly common in developing countries and are gravitating toward the poor and urban. The appropriateness of public policy in attempting to stop this trend relies on understanding why this is happening. A significant body of literature around poor health and its relationship to inequity dating from 30 years ago is relevant here, although studies in developing countries have not yet been performed to measure the role of socioeconomic status and health. More recent work has confirmed that a strong inverse relationship between income and cardiovascular health in developed countries can be almost completely explained by adverse risk factors, suggesting that a great savings to society would occur if socioeconomic gradients were reduced. That conclusion applies most strongly where society bears some burden of ill health through health system costs or loss of productive lifetime. In poor countries, the immediate costs of chronic ill health rests with the ill individual and his family, but longer-term health and economic consequences may increasingly affect health systems and other units in society, such as workplaces.

Diet

The dramatic changes occurring in people’s diets around the world have been referred to as the nutrition transition. The model suggests that countries pass through a continuum of dietary, economic, and health stages (among other categories) as they modernize and urbanize. At a late (but not the final) stage of the
transition, people consume more fats, more animal-based products, and more sugar, as well as more processed foods and less fiber. Each factor can be, but does not have to be, a precursor to overweight and obesity, leading to chronic diseases.

A combination of economic and social factors is contributing to these dietary changes. One factor is relative food prices: The 20-year trend in global prices of edible oils, animal-based products, and sweeteners has been downward, contributing along with increased incomes to greater consumption of those foods in developing countries. Recent research in the United States suggests that nutrient-deficient obesogenic diets may be more common among the poor because they are more affordable than diets of high quality. As-faw shows that government subsidies in Egypt lower developing-country regions but have been less well documented.

Obesity, leading to chronic diseases, does not have to be, a precursor to overweight and risk of obesity, as driven by the relative cost of different types of foods. Drewnowski concludes that price is an obesogenic factor, rather than any specific food ingredient.

Social factors are also responsible for changes in diet in developing-country populations. Increasing urbanization and the trends that accompany it (higher incomes, exposure to mass media and marketing campaigns, greater female employment, and less leisure time) contribute to the nutrition transition described earlier. Although these trends are global, they are proceeding at various rates across regions, and the effect on food and eating patterns is not uniform. Latin Americans rely heavily on supermarkets for their food purchases—a reliance that rose fourfold between 1990 and 2000. This trend is occurring in other developing-country regions but has been less well documented. The most obvious effect of supermarket sales is greater availability of processed foods, which are higher in fat, salt, and sugar than foods from more traditional retail food outlets. Similarly, fast-food outlets and other away-from-home food purveyors can be found anywhere in the world, but their effect on diets is not well understood.

In Africa, urbanization has greatly influenced how people eat. New habits are arising that include snacking on foods that are higher in fat and starch as Western food becomes increasingly available. The rise in untraditional diets has been linked to diseases previously seen in regions of greater affluence.

The presence of concurrent over- and undernutrition has significance for chronic disease trends. Some research has suggested that micronutrient malnutrition and early childhood growth stunting may contribute to a greater disposition for chronic disease in later life. The developing world bears a simultaneous dual burden of under- and overnutrition and thus may be strongly predisposed to suffer from chronic disease and accompanying health and economic burdens later in life. A similar trend is seen in countries undergoing epidemiologic and economic transition, where obese adults live in the same household with stunted children.

The National Family Health Survey of India showed that 36% of women had a BMI characteristic of undernutrition, whereas 11% had a BMI characteristic of obesity. In Indonesia, 10% of households experience simultaneous obesity and undernutrition among family members.

**Physical Activity**

The level of physical activity is another important risk factor for chronic diseases that is undergoing profound change in developing countries. Caused by some of the same sweeping trends that have led to dietary changes—urbanization, modernization, and changes in occupational behaviors—physical activity in general appears to be declining. Reports from the United States estimate that the population-attributable risk of physical inactivity is responsible for 12% of type 2 diabetes and 22% of coronary heart disease, as well as significant shares of other poor health conditions. Such attributable risk studies are not yet available from developing countries; nonetheless, evidence about the epidemiologic transition points to declining physical activity as a cause of greater chronic disease prevalence.

The data on physical inactivity are scarce and fragmented, so at this stage it is not feasible to attribute health outcomes to specific behavioral shifts. Self-reported data on physical activity are subject to bias, and the use of pedometers and other monitoring technologies is not yet widespread, even in developed countries. Limited research suggests the importance of changes taking place in workplace technology (more mechanization, less manual labor) and behavior within

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4There is a strong correlation between obesity and overweight and chronic diseases, with a relative risk of 2.1 or greater for obese people to develop diabetes and a 15%–20% greater frequency of heart problems than nonobese people (Pena and Bacallao).
the home (more television viewing, greater use of automobiles). Much more information is needed to get a full picture of what factors determine people’s physical activity, but declining prices for more passive leisure and transportation alternatives and greater affordability of cars and other mechanized equipment, along with competitive forces driving workplace changes, are not expected to reverse course. Thus, there may be a permanent downward shift in people’s energy expenditure.

Poor Health Care

Poor health care is an important risk factor for the development of chronic diseases. In poor developing countries, lack of access and affordability of preventive care is the general rule facing people. Also, primary care systems are weak and often ill-equipped to respond to emerging disease symptoms. Treatments that are extremely cost-effective in developed countries, such as antihypertensive and cholesterol-lowering drugs, are unaffordable to most affected people in developing countries. More than 80% of diabetes care is provided in the rich countries where only 20% of diabetics live.26

Those least likely to get regular preventive care or to afford primary treatment are the low-income population. When the poor can afford and access some medical care for diabetes, for example, it is for control of high blood sugar rather than preventive care against heart disease and other complications. But more often, even blood sugar control through insulin is not available. In the poorest countries, however, the poor are still far more likely to be suffering from a communicable disease burden, whereas the wealthy have access to reasonable health care. It is therefore the middle-income quintiles that may be most vulnerable to the effects of chronic disease. Their access to health care depends on where they live, their occupations, and whether the public health system functions well.

To illustrate the point about how chronic diseases burden a health system, recent statistics show the demands placed on the UK Health System from chronic disease patients.27

- Around 80% of general practitioner consultations relate to chronic disease.
- Patients with a chronic disease or complications use more than 60% of hospital bed days.
- Two-thirds of patients admitted as medical emergencies have exacerbation of chronic disease or have chronic disease.
- For patients with more than one condition, costs are six times higher than those with only one.
- Evidence from the United States shows that the care of people with chronic conditions consumes about 78% of all healthcare spending.

People in developing countries make far different use of health care than people in the United Kingdom, so the comparison should not be overstressed. Nonetheless, with chronic diseases soon to exceed 50% of the disease burden in developing countries, it is clear that the demand from even a small proportion of the people in need of care would overwhelm most health systems. To keep costs as low as possible, and the sacrifice of normal living to a minimum, it is desirable to treat those with chronic diseases in the least intensive care setting possible. Early diagnosis and disease management is key to slowing disease progression and maintaining an ability to function in everyday life—something most critical for the poor.

Cost-effective Interventions for Chronic Disease

Cost-effectiveness analysis assists decision makers and healthcare providers to select among interventions in responding to the growing problem of chronic disease, as well as in establishing appropriate expectations about the costs of changes in health outcomes through both targeted and population-wide interventions. It is especially important in resource-limited countries that health interventions not rely heavily on healthcare systems that are already overburdened by communicable disease demands. Therefore, population-based approaches are especially appealing, but the evidence base for such interventions is particularly weak.

Only a few studies have described interventions for lifestyle diseases in developing countries, about half of which include cost data and provide conclusions about cost-effectiveness. The limited literature is probably related to the newness of chronic diseases in developing countries, the multitude of possible health endpoints and interventions, the multisectoral sources of the problem, and the limited knowledge of means of changing individual and population behavior. The results of studies from developed countries cannot be assumed to apply well to developing-country settings, where population-attributable risk for individual risk factors, as well as effectiveness of interventions, can vary widely.28 Efforts are under way to improve the evidence base for cost-effective chronic disease interventions that are designed for developing-country settings.29

Two major chronic disease primary prevention strategies and one secondary prevention strategy are cost-effective across a broad range of developing
countries. Other prevention and treatment approaches may be cost-effective but have not been adequately implemented and evaluated at this time. The two primary prevention strategies are tobacco control and salt reduction. The combined cost of these two population interventions would be about $0.36 per person affected per year in the 25 high–chronic disease burden countries studied. Costs would be slightly higher in middle- and upper-income countries and lower in low- and low-to-middle-income countries. The highly cost-effective secondary prevention measure is a multidrug regimen for high-risk cardiovascular patients. Such patients can be effectively treated to avert adverse events for about $300 per life-year saved across the group of countries, whereas primary prevention for high-risk individuals (a larger but less targeted group) can be achieved for $825–$900 per life-year saved in low- and low-to-middle-income countries. The overall cost of the multidrug regimen for both groups would be about $1.10 per person in those countries.

Other feasible interventions that appear to be cost-effective in developing countries include reducing saturated fat in manufactured products and removing trans fats from the food supply and replacing them with polyunsaturated fat. Cost-effectiveness ratios for these interventions are based on various modeling efforts that do not yield a clear result because of different assumptions about the costs of the interventions. Although there is a clear need—and movement toward—improved information on the cost-effectiveness of chronic disease interventions in developing-country settings, a strong case can be made that the existing evidence is sufficient for immediate action on several fronts. Poor country health systems can scarcely keep up with the basic healthcare needs of their citizens and often do not do an adequate job. The added burden of screening, diagnosing, and treating the growing numbers of people with or at high risk of chronic disease threatens to cause a complete breakdown of public health services and so is generally neglected. In the realm of private health delivery, the ability to provide appropriate-quality care will grow with demand, but only for the well-off. The middle classes and poor will not be served.

**Economic Implications**

Public health experts and policy makers began to recognize a close link between health and macroeconomic outcomes during the 1990s, after the publication of the World Bank’s *World Development Report 1993* that focused on the economic returns to investments in health. This Report was followed in 2001 by the Report of the Commission on Macroeconomics and Health to the WHO and other studies. The consensus has been that both macroeconomic and microeconomic arguments can be made for improving health and preventing chronic diseases.

Estimates of the nationwide costs of chronic disease range from 0.02% up to 6.77% of GDP in a country. Most of these results come from studies in developed countries. In the United States, for example, the nationwide cost of treatment for seven major chronic diseases was $277 billion in 2003—roughly $100 per year for every person in the country—or 5% of GDP. Another study estimates global treatment costs for diabetes alone at between $232 billion and $421 billion in 2007, about 52% of it in the United States. The treatment costs for diabetes in developing countries are estimated to be 9% of the global total, with India accounting for the largest amount at $2 billion in 2007.

A fuller economic measure combines those direct treatment costs with the indirect costs of chronic illness, such as lost work and earning ability and the costs of caregivers. The indirect costs of those seven chronic diseases in the United States amounted to five times the direct costs. The WHO projected the lost economic output from diabetes, stroke, and cardiovascular disease in developing countries at $1.25 trillion by 2015 in five major developing countries. This figure includes $557 billion in China, $300 billion in the Russian Federation, and $336 billion in India. This analysis incorporates some measure of reduced savings and investment because of lost work but does not include adverse effects on children’s education or the loss of well-being from morbidity or social value of losing a human life beyond labor value of that life. Such aspects should be included in a comprehensive measure of how chronic disease affects the macroeconomy; but such studies have not been carried out. Each method has weaknesses, and the continuing tendency of researchers to use different methods means that the results have different interpretations.

A middle-ground approach was recently used in *The Lancet* analysis of lost economic output across 23 high-burden developing countries. The cost of doing nothing about the growth of three major chronic diseases is estimated at $84 billion. This estimate was obtained by projecting the numbers of premature deaths in those countries from three major chronic
diseases (coronary heart disease, stroke, and diabetes) and then calculating the loss in economic output that occurs because those deaths reduce the amount of productive labor available to the country. The difference in economic output between a scenario of no chronic disease deaths and continuing current trends is the estimated lost GDP from chronic diseases. The method used conservatively excludes household effects mentioned earlier, as well as increased morbidity.

In developed countries, the measured direct costs of chronic disease tend to be much higher than in developing countries, primarily because of different access to treatment. In developing countries much chronic illness goes untreated, particularly among the poor and middle class. Therefore, it is important to measure indirect costs of chronic disease in a developing-country setting—a challenge that cannot be met with current prevalence information. The indirect costs include functional loss and/or death that results in reduction or loss in wages, reduced savings, inability to care for the family, and significant pain and suffering. Other consequences at the household level may include children’s dropping out of school to care for a parent, reduced food available to the family, and permanent loss of well-being. In the early stage, perhaps even before a disease is diagnosed, the indirect economic effects may be minor, but if treatment is not available, they are likely to mount over a longer period. This long-term economic drain contrasts with communicable diseases that may bring about a short-term crisis and could even result in death but is more likely to resolve without a continuing care burden on the other family members. Exceptions to the extended cost burden may be cases of untreated diabetes, where the patient often does not survive acute hyperglycemia, and acute myocardial infarctions. In both cases, death may quickly follow diagnosis.

In all the economic approaches used to estimate the effects of chronic diseases, some measure of lost productivity is calculated, either based on lost workdays at various wages or based on modeling economic relationships more fully. The preceding figures incorporated these losses into macroeconomic effects from chronic disease mortality. The effect of chronic disease on work and workers can also be viewed from a microeconomic level: Chronic diseases reduce the economic productivity of those affected and may affect their wages or income. Both direct and econometric efforts exist to measure that effect.

The evidence from developed countries again points to significant effects on wages, earnings, workforce effort, and retirement. Direct measurements taken in developing countries of changes in productivity are relatively small, but econometric evidence suggest that workers in Central Asia may reduce their labor effort by 7%–30% because of limitations put on their activity by chronic diseases. Some evidence from Russia shows that people in good health are paid substantially more (22% for women and 18% for men) than people in poor health. For those specifically burdened with chronic illness, per capita income is expected to be 5.6% lower.

The combined effect of high costs of illness and potentially significant productivity losses from having chronic diseases suggest large overall economic effects in a population with a high chronic disease burden. At the macroeconomic level, this effect can have long-term implications for future growth. The economic methodology is not yet sufficiently robust to calculate effects on long-term growth from the microdata available; in fact, there often appear to be large gaps in measured microeffects and measured macroeffects that are unexplained. Only one study has tried to estimate the macroeconomic effects of chronic diseases across countries, and it found a small estimated effect (0.1% in high-income countries and insignificant in low- and middle-income countries). However, as populations age and the prevalence of chronic diseases rise as expected, it may become more apparent what the long-term economic costs will be.

Conflicts of Interest

The author declares no conflicts of interest.

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