

Behavioral Risk Factors • TOBACCO Over 1.3 billion people use tobacco worldwide, a number that is projected to increase to 1.6 billion by 2030. Tobacco use currently causes about 5 million deaths annually (9% of all deaths), approximately 1.6 million of which are CVD-related. If current smoking patterns continue, the global burden of disease attributable to tobacco will reach 10 million deaths by 2030. Although tobacco use has been greatest in HICs historically, consumption has shifted dramatically to LMICs in recent decades. Some of the highest tobacco use now occurs in the East Asia and Pacific region. A unique feature of LMICs is easy access to smoking during the early stages of the epidemiologic transition due to the availability of relatively inexpensive tobacco products. In South Asia, the prominence of other locally produced forms of tobacco besides manufactured cigarettes makes control of consumption more challenging. Secondhand smoke is another well-established cause of CHD, responsible for 600,000 deaths of nonsmokers in 2011. Although smoking bans have both immediate and long-term benefits, implementation varies greatly between countries.

DIET Total caloric intake per capita increases as countries develop. With regard to CVD, a key element of dietary change is an increase in intake of saturated animal fats and hydrogenated vegetable fats, which contain atherogenic *trans* fatty acids, along with a decrease in intake of plant-based foods and an increase in simple carbohydrates. Fat contributes less than 20% of calories in rural China and India, less than 30% in Japan, and well above 30% in the United States. Caloric contributions from fat appear to be falling in the HICs. In the United States, between 1971 and 2010, the percentage of calories derived from saturated fat decreased from 13% to 11%.

PHYSICAL INACTIVITY The increased mechanization that accompanies the economic transition leads to a shift from physically demanding, agriculture-based work to largely sedentary industry- and office-based work. In the United States, approximately one-quarter of the population does not participate in any leisure-time physical activity, and only 51.6% of adults report engaging in physical activity three or more times a week. Physical inactivity is similarly high in other regions of the world and is increasing in countries that are rapidly urbanizing as part of their economic transition. In urban China, for example, the proportion of adults who participate in moderate- or high-level activity has decreased significantly, whereas those who participate in low-level activity has increased.

METABOLIC RISK FACTORS

Examination of trends in metabolic risk factors provides insight into changes in the CVD burden globally. Here we describe four metabolic risk factors—lipid levels, hypertension, obesity, and diabetes mellitus—using data from the Global Burden of Disease, Injuries, and Risk Factors Study (GBD 2010). The GBD project identified and compiled mortality and morbidity data from 187 countries from 1980 to 2010.

Lipid Levels Worldwide, high cholesterol levels are estimated to play a role in 56% of ischemic heart disease events and 18% of strokes, amounting to 4.4 million deaths annually. Although mean population plasma cholesterol levels tend to rise as countries move through the epidemiologic transition, mean serum total cholesterol levels have decreased globally between 1980 and 2008 by 0.08 mmol/L per decade in men and 0.07 mmol/L per decade in women. In 2008, age-standardized mean total cholesterol was 4.64 mmol/L (179.4 mg/dL) in men and 4.76 mmol/L (184.2 mg/dL) in women. Large declines occurred in Australasia, North America, and Western Europe (0.19–0.21 mmol/L). Countries in the East Asia and Pacific region experienced increases of greater than 0.08 mmol/L in both men and women. Social and individual changes that accompany urbanization clearly play a role because plasma cholesterol levels tend to be higher among urban residents than among rural residents. This shift is largely driven by greater consumption of dietary fats—primarily from animal products and processed vegetable oils—and decreased physical activ-

ity. In HICs, in general, mean population cholesterol levels are falling, whereas wide variation is seen in the LMICs.

Hypertension Elevated blood pressure is an early indicator of the epidemiologic transition. Worldwide, approximately 62% of strokes and 49% of CHD are attributable to suboptimal (>115 mmHg systolic) blood pressure, which is believed to account for more than 7 million deaths annually. Remarkably, nearly half of this burden occurs among those with systolic blood pressure less than 140 mmHg, even as this level is used at the arbitrary threshold for defining hypertension in many national guidelines. Between 1980 and 2008, the age-standardized prevalence of uncontrolled prevalence has decreased even as the number of people with uncontrolled hypertension has increased. This trend results largely from population growth and aging. Rising mean population blood pressure also occurs as populations industrialize and move from rural to urban settings. For example, the prevalence of hypertension in urban India is 25%, but varies between 10% and 15% in rural communities. One major concern in LMICs is the high rate of undetected, and therefore untreated, hypertension. This may explain, at least in part, the higher stroke rates in these countries in relation to CHD rates during the early stages of the transition. The high rates of hypertension throughout Asia, especially undiagnosed hypertension, likely contribute to the high prevalence of hemorrhagic stroke in the region. Globally, however, mean systolic blood pressure has decreased among both genders (0.8 mmHg per decade among men; 1.0 mmHg per decade among women).

Obesity Although clearly associated with increased risk of CHD, much of the risk posed by obesity may be mediated by other CVD risk factors, including hypertension, diabetes mellitus, and lipid profile imbalances. According to the latest GBD data, nearly 1.46 billion adults were overweight (body mass index ≥ 25 kg/m²) in 2008, and approximately 508 million were obese (BMI ≥ 30 kg/m²). Obesity is increasing throughout the world, particularly in developing countries, where the trajectories are steeper than those experienced by the developed countries. In many of the LMICs, obesity appears to coexist with undernutrition and malnutrition. Adolescents are at particular risk. Currently, 1 in 10 children are estimated to be overweight, a number that is increasing worldwide. Women are also more affected than men, with the number of overweight women generally exceeding underweight women based on data from 36 LMICs.

Diabetes Mellitus As a consequence of, or in addition to, increasing body mass index and decreasing levels of physical activity, worldwide rates of diabetes—predominantly type 2 diabetes—are on the rise. According to the most recent data from the GBD project, mean fasting plasma glucose levels have increased globally between 1980 and 2008. An estimated 346 million people worldwide have diabetes. The International Diabetes Foundation predicts that this number will reach 522 million by 2030, a yearly rate of growth that is higher than that of the world's adult population. Nearly 50% of people with diabetes are undiagnosed, and 80% live in LMICs. The highest regional prevalence for diabetes occurs in the Middle East and North Africa, where an estimated 12.5% of the adult population has diabetes. Future growth will also largely occur in this region, along with other LMICs in South Asia and sub-Saharan Africa. There appear to be clear genetic susceptibilities to diabetes mellitus of various racial and ethnic groups. For example, migration studies suggest that South Asians and Indians tend to be at higher risk than those of European extraction.

SUMMARY

Although CVD rates are declining in the HICs, they are increasing in virtually every other region of the world. The consequences of this preventable epidemic will be substantial on many levels, including individual mortality and morbidity, family suffering, and staggering economic costs.

Three complementary strategies can be used to lessen the impact. First, the overall burden of CVD risk factors can be lowered through population-wide public health measures, such as national campaigns