Chapter 5

Cost-Effective Strategies for Noncommunicable Diseases, Risk Factors, and Behaviors

Public health specialists concerned with low- and middle-income countries have devoted considerable attention to communicable diseases and maternal and child health for some time. Recently, however, their attention has turned to noncommunicable diseases such as cardiovascular disease (CVD), diabetes, and various cancers and intentional and unintentional injuries. This shift is due to the recognition that the burden of noncommunicable disease in low- and middle-income countries not only is growing rapidly but is already astoundingly large. Indeed, by 2001, CVD had become the leading cause of death worldwide in both developing and developed countries. Noncommunicable diseases are now dominant sources of morbidity and mortality around the globe.

The profile of some noncommunicable diseases in low- and middle-income countries is similar to that in high-income countries. In all regions of the world, for example, at least 80 percent of the burden of CVD comes from ischemic heart disease, congestive heart failure, and stroke. These conditions share many risk factors—obesity, high blood pressure, physical inactivity, and salt intake—and hence are susceptible to the same interventions.

Other noncommunicable diseases exhibit different profiles in developing and developed countries. Cancer, for example, displays considerable geographic variation. The types of cancers that predominate in the high-income countries—lung, colorectal, breast, and prostate cancer—can be traced to such factors as the earlier beginnings of the tobacco epidemic, earlier exposure to carcinogens, and diet and lifestyle. By contrast, the cancers that predominate in low- and middle-income countries—cervical, liver, and stomach cancer—are associated with chronic infections with human papillomavirus, hepatitis B, and *Helicobacter pylori*. Cancer causes a large and increasing disease burden

worldwide, but its epidemiology, and consequently the relevant interventions, differ significantly in low- and middle-income countries and high-income countries.

The burden of noncommunicable disease is growing, but many low- and middle-income countries have not yet experienced the full demands that these conditions will place on their health systems. Ironically, part of that burden will result from successes in preventing or treating communicable diseases and reducing childhood mortality: with improved public health, individuals who would have died in childhood will now survive and become susceptible to noncommunicable disease.

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Some of the burden of noncommunicable disease and injury is avoidable. By adopting policies that promote healthy eating and discourage smoking, for example, low- and middle-income countries may escape the risk profiles that wealthier countries acquired as they developed. Implementing proper road safety measures would also permit low- and middle-income countries to avoid a substantial burden of road traffic injuries, which increase as motorized traffic increases. As loss of life from communicable disease is reduced, it need not be replaced by an equal loss of life from noncommunicable disease.

CARDIOVASCULAR DISEASE, DIABETES, HIGH BLOOD PRESSURE, CHOLESTEROL, AND BODYWEIGHT

The disease burdens from CVD, diabetes, and related conditions of high blood pressure, high cholesterol, and excessive bodyweight are increasing worldwide.[1] Once considered diseases of industrialized countries or of the affluent in developing countries, they are now recognized as global problems.

In 2001, CVD became the world's leading cause of death and now accounts for 28 percent of all deaths worldwide, with 80 percent of the burden in low- and middle-income countries. Most of that burden falls in Asia and Eastern Europe because of the large populations in these regions and the high incidence of coronary artery disease in Eastern Europe and Central Asia. Diabetes is also on the rise around the world, reaching a prevalence of 5.1 percent in 2003. The prevalence of diabetes is greatest in high-income countries at 7.8 percent, and in developing

[1] This section is based on *DCP2,* chapters 30, 33, 44, and 45.

regions ranges from a low of 2.4 percent in Sub-Saharan Africa to a high of 7.6 percent in Eastern Europe and Central Asia. Despite the higher prevalence of diabetes in high-income countries, the majority of the disease burden from diabetes, more than 70 percent, is in the developing regions because of their larger populations.[2]

Another way of looking at the burden of CVD, diabetes, and related conditions is to classify them by risk factor. The *World Health Report 2002* (WHO 2002) estimated that globally, 7.1 million deaths could be attributed to high blood pressure, 4.4 million deaths to high cholesterol, and 2.6 million deaths to excessive weight. Excessive weight is a growing problem in almost every country, even the poorest. It is increasing so rapidly that in middle-income countries the disease burden associated with having a body mass index greater than 25 is now equal to or greater than the disease burden resulting from undernutrition.

These diseases are not inevitable consequences of modern life. Low rates can be achieved with moderate changes in lifestyles that are fully compatible with life in the 21st century. Nevertheless, the requisite changes in smoking habits, physical activity, and diet may not be easy and will require support and encouragement through investments in education, changes in food policies, and sometimes even changes in urban infrastructure. Whereas the required behavioral changes are the same everywhere, the ways to achieve them will necessarily vary across countries and regions, with different approaches corresponding to cultural, social, and economic features.

"Despite the higher prevalence of diabetes in high-income countries, the majority of the disease burden from diabetes, more than 70 percent, is in the developing regions because of their larger populations."

Lifestyle Interventions

The key risk factors for CVD and diabetes—obesity, physical inactivity, and unhealthy diets—require interventions to change unhealthy lifestyles. These changes are most likely to occur with implementation of a coordinated range of interventions to encourage individuals to maintain a healthy weight, participate in daily physical activity, and consume a healthy diet. A healthy diet replaces saturated and trans fat with unsaturated fat; increases consumption of fruits, vegetables, and

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[2] Diabetes data combine both type 1 (an autoimmune disease that results from destruction of the pancreatic cells, leading to an absolute insulin deficiency) and type 2 (characterized by insulin resistance, in which target tissues do not use insulin properly, and inadequate insulin secretion from the pancreas), plus gestational diabetes. Type 2 diabetes, which has some of the same risk factors as CVD, now accounts for approximately 85 to 95 percent of all diagnosed cases of diabetes.

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whole grains; and limits sodium intake and excessive calories from any source, but especially from sugar-based beverages.

Education is key to implementing such changes. It appears to be more effective when provided through multiple methods and sites, such as schools, workplaces, mass media, and health centers. Educational messages are also more effective if they are reinforced by action. Schools, for example, should provide not only curricula on good nutrition but also healthy meals; worksites should not only inform workers about the role of physical activity but facilitate the use of nonmotorized transportation.

Urban design and transportation policy are other key elements of lifestyle interventions. People can be encouraged to increase their physical activity by using public and nonmotorized transport, especially walking and bicycling. Although not normally considered an instrument for improving health, national transportation policies can strongly influence automobile use and dependency. Low taxes on gasoline, free parking, and wide street design encourage the use of automobiles (as in the United States), while narrow streets, limited parking, and high gasoline costs discourage their use (as in Western Europe). Because using an automobile is twice as costly in Europe as in the United States, Europeans walk or bicycle more and use their cars approximately 50 percent less than Americans. The same trends in public policy are played out in low- and middle-income countries. Singapore has been a leader in discouraging private automobile use and encouraging use of public transport, walking, or bicycling. By contrast, China has explicitly encouraged families to buy automobiles by lowering taxes, simplifying registration procedures, and allowing foreign financing.

"... the Netherlands reduced the trans fat content of the food supply from about 6 percent of the energy content to approximately 1 percent in a single decade."

Food policy is another important area for encouraging lifestyle change. Policy tools include how food is processed by fortifying foods with micronutrients and limiting advertising for unhealthy foods. One of the most effective ways to improve diets is to regulate or provide incentives for food manufacturers to replace unhealthy ingredients or products with healthier ones. Changes in types of fats, for example, can be almost imperceptible to consumers and relatively inexpensive. Many European manufacturers have greatly reduced foods' trans-fatty acid content by changing production methods. In this way, the Netherlands reduced the trans fat content of the food supply from about 6 percent of the energy content to approximately 1 percent in a single decade. In Mauritius, government policies replaced commonly used palm oils for cooking with soybean oil, which reduced the intake of fatty acids and

lowered serum cholesterol levels. Other easily targeted changes in food processing include reducing salt and fortifying foods with micronutrients such as vitamin A, vitamin B12, iodine, iron, and folic acid.

Experience has provided some lessons for implementing successful lifestyle interventions across populations:

- Interventions should be long term with multiyear time frames.
- Credible agencies should be responsible for such interventions.
- Collaboration between the health sector, other government agencies, schools, workplaces, and the voluntary sector is important.
- Cooperation with the food industry is essential to ensure the availability of reasonably priced healthier food options with food labeling that presents relevant information in a clear, reliable, and standardized way.

Several lines of evidence indicate that most coronary artery disease, stroke, and diabetes and some cancers can be prevented or delayed by realistic changes in diet and lifestyle. One line of evidence is based on declines in coronary artery disease in countries that have implemented preventive programs. A dramatic example is that of Finland, which had the highest rates of CVD in the world, and where a comprehensive program focused on diet and lifestyle modification reduced the mortality rate by approximately 75 percent between 1972 and 1992 (box 5.1).

Box 5.1 Community Response to CVD in Finland

In 1972, Finland had the world's highest mortality rate from CVD. Planners examined policy and environmental factors contributing to CVD and sought appropriate changes, such as increased availability of low-fat dairy products, antismoking legislation, and improved school meals. They used the media, schools, worksites, and spokespersons from sports, education, and agriculture to educate residents. After five years, significant improvements were documented in smoking, cholesterol, and blood pressure. By 1992, CVD mortality rates for men age 35 to 64 had dropped by 57 percent. The program was so successful that it was expanded to include other lifestyle-related diseases and was used as a model for public health planners throughout the country and elsewhere. Twenty years later, major reductions in CVD risk factor levels, morbidity, and mortality were attributed to the project. Recent data show a 75 percent decrease in CVD mortality (Puska and others 1998).

Source: DCP2, chapter 44, p. 837.

DCP2 estimates the cost-effectiveness of several of these interventions. Replacing saturated fat with monounsaturated fat in manufactured products, accompanied by a community media campaign, can reduce coronary artery disease events by 4 percent. The total cost of these changes would range from US$1.80 to US$4.50 per person per year depending on the region. The incremental cost-effectiveness ratio would range from US$1,865 per DALY averted in South Asia to US$4,012 per DALY averted in the Middle East and North Africa.

Replacing the 2 percent of energy that comes from trans fat with polyunsaturated fat would reduce CVD by 7 to 40 percent and would also reduce type 2 diabetes. The effect would vary by region. Trans fat consumption is already low in China, so replacing it with polyunsaturated fat would not avert as much disease as in South Asia, where commonly used cooking fats have an extremely high trans fat content. Because partially hydrogenated fat could be eliminated or significantly reduced by voluntary industry action as done in the Netherlands or regulation as in Denmark, this intervention requires no consumer education, and the cost amounts to no more than US$0.50 per person per year. The cost-effectiveness ratio for this intervention ranges from US$25 to US$73 per DALY averted depending on the region. The intervention is cost saving in all regions.

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Legislation that mandates reducing the salt content of manufactured foods, accompanied by an educational campaign, can reduce blood pressure and would cost US$6 per person per year. This intervention would cost US$1,325 per DALY averted in South Asia and US$3,056 per DALY averted in the Middle East and North Africa.

Medical Interventions

When lifestyle changes are insufficient to avert CVD or diabetes, a variety of medical interventions exist. Many of these are sophisticated and expensive, such as grafting new arteries around the heart or opening a blockage with angioplasty, but relatively inexpensive treatments for chronic CVD are also available. For individuals who have suffered heart attacks, medications such as beta-blockers and aspirin can reduce the chance of a recurrence. The essential treatment for averting death from type 1 diabetes is insulin injections to maintain proper blood glucose levels. For type 2 diabetes, treatment requires changes in diet and physical activity, which are also needed for type 1 disease, and oral glucose-lowering agents, with insulin required only in severe cases. Blood pressure and lipids can

also be controlled with pharmaceuticals. Other effective interventions for diabetes include early detection and screening followed by treatment for retinopathy, microalbuminuria, and foot disease.

Glucose levels of those with both type 1 and type 2 diabetes are currently poorly controlled in low- and middle-income countries. A 1997 survey by the International Diabetes Federation showed that no country in Africa had universal access to insulin for those who needed it. In the Democratic Republic of Congo, those with type 1 diabetes had access to insulin less than 25 percent of the time, implying a high mortality rate. Even in middle-income countries, such as El Salvador and Peru, diabetics requiring glycemic control had access to insulin only 26 to 49 percent of the time.

"Even in middle-income countries . . . diabetics requiring glycemic control had access to insulin only 26 to 49 percent of the time."

Most of the evidence regarding the cost-effectiveness of medical treatments for CVD and diabetes is from high-income countries. Medical interventions for CVD that are likely to be cost-effective in low- and middle-income countries include the following:

- anticlotting agents such as aspirin and heparin to prevent venous thromboembolism
- benzathine penicillin injections as secondary prevention, usually for five years, for those whose who have had rheumatic fever
- angiotensin-converting enzyme inhibitors for congestive heart failure
- anticoagulants for mitral stenosis and atrial fibrillation
- various drugs, including beta-blockers and off-patent statins, for long-term care of postmyocardial infarction.

Having defibrillators in emergency vehicles is highly cost-effective in high-income countries but is unlikely to be cost-effective in most lower-income countries. Nevertheless, having them available in hospitals may be cost-effective.

Medical researchers are pinning great hopes on the development of a so-called polypill to prevent CVD. The hypothetical polypill would combine several medications, including generic aspirin, a beta-blocker, a thiazide diuretic, an angiotensin-converting enzyme inhibitor, and a statin. When taken by a population with a 35 percent risk of CVD, the incremental cost-effectiveness ratio of such a polypill ranges from US$721 per DALY averted in the Middle East and North Africa to US$1,065 per DALY averted in East Asia and the Pacific. The cost-effectiveness is understandably lower in populations where the prevalence of CVD is lower.

"Medical researchers are pinning great hopes on the development of a so-called polypill to prevent CVD . . ."

"... for diabetes ... glycemic control, blood pressure control, and foot care are all cost-effective and feasible."

The cost-effectiveness of medical interventions for diabetes varies greatly. Some are cost saving; others can cost more than US$73,000 per quality-adjusted life year gained. *DCP2* estimates of the cost-effectiveness of these interventions explicitly incorporate differences in implementation, including the ease of reaching the targeted population and interventions' technical complexity, capital intensity, and cultural acceptability. Using this framework, glycemic control, blood pressure control, and foot care are all cost-effective and feasible.

Glycemic control costs less than managing the complications that arise in its absence. Ensuring adequate access to insulin is an important, cost-effective approach for people with type 1 diabetes, for whom insulin is essential. Blood pressure control for those with hypertension is also cost-effective and cost saving. Because many of the medications that control blood pressure are generic drugs, the drug cost in low- and middle-income countries is quite low. Furthermore, many people with diabetes in these countries also have poor control of their blood pressure. The combination makes these medications highly cost-effective.

Thus the cost-effectiveness of medical interventions varies considerably across contexts, depending on the availability of skilled personnel, the prices of drug, and the prevalence of risks. By contrast, lifestyle interventions are often cost saving because they avert conditions that can be costly to treat.

"By 2020, unless cancer prevention and screening interventions effectively reduce ... incidence ... the number of new cancer cases will increase from ... 10 million cases in 2000 to an estimated 15 million ..."

CANCER

Cancer is another noncommunicable disease long considered a health threat primarily for high-income countries, but now imposing a considerable disease burden worldwide.[3] In 2001, cancer caused more than 7 million deaths, of which 5 million were in low- and middle-income countries. That year, cancer resulted in the loss of more than 100 million DALYs, with nearly 75 million lost in low- and middle-income countries. By 2020, unless cancer prevention and screening interventions effectively reduce the incidence of cancer, the number of new cancer cases will increase from an estimated 10 million cases in 2000 to an estimated 15 million per year, and 9 million of them will occur in developing countries.

While cancer is a problem everywhere, it is not manifested in the same way worldwide. A substantial portion of cancers in developing

[3] This section is based on *DCP2*, chapter 29.

countries, up to 25 percent, are associated with chronic infection. Liver cancer is causally associated with hepatitis B infection, cervical cancer with infection by certain types of human papillomavirus, and stomach cancer with *Helicobacter pylori* infection. The incidence of these cancers is also related to the absence of a well-developed public health infrastructure for the control of cancer-causing infectious agents.

In 2000, seven types of cancer accounted for approximately 60 percent of all newly diagnosed cancer cases and cancer deaths in developing countries: cervical, liver, stomach, esophageal, lung, colorectal, and breast. The first four exhibit elevated incidence and mortality rates in developing countries. The last three have a lower but increasing incidence because of demographic and industrial transitions. Developing regions also exhibit considerable variation in their cancer burdens. Deaths from liver cancer are relatively high in East Asia and Africa because of the high prevalence of chronic hepatitis B infection and inadequate food storage and preservation in those regions. Deaths from colorectal and breast cancer are relatively high in Eastern Europe as people in those regions have adopted less healthy, high-fat diets and more sedentary lifestyles. Deaths from oral cancer are particularly high in South Asia, where chewing betel quid is common. These different types of cancer call for different intervention strategies.

Interventions fall into several categories. Primary prevention eliminates exposure to cancer-causing agents; secondary prevention involves detecting and treating precancerous lesions; treatment includes surgery, chemotherapy, and radiotherapy; and palliative care addresses patients' physical and psychological comfort from diagnosis through death.

Primary prevention for the types of cancer that are of greatest concern in developing countries include immunizing against and treating infectious agents, implementing dietary interventions, introducing tobacco control programs, reducing excessive alcohol consumption, and using chemoprophylaxis. Cost-effectiveness studies of these interventions are relatively rare and are concentrated in high-income countries. For example, studies in the United Kingdom and the United States find that the costs of screening and treating individuals for *helicobacter* infections to reduce the risk of stomach cancer run between US$25,000 and US$50,000 per life year saved, but another study found that this intervention would be much more cost-effective in Colombia, where health care costs are lower and the prevalence of stomach cancer is higher.

"Treatment cost-effectiveness for cervical, breast, oral, and colorectal cancer ranges from US$1,300 to US$6,200 per year of life saved. For . . . liver, lung, stomach, and esophageal cancer, the cost-effectiveness is much worse . . ."

Secondary prevention consists of screening programs to detect and treat precursors of cancer, which can prevent or reduce the incidence of highly invasive cancers, such as cervical or colorectal cancers. Effective screening can also detect invasive cancers, such as breast and lung cancers, at an earlier stage than would otherwise be possible and thus improve the likelihood that treatments will be successful. The cost-effectiveness of secondary prevention depends on many factors, including the costs of diagnostic tests, the prevalence of the disease, and the availability of effective treatments.

Cancer treatment includes surgical removal of tumors, chemotherapy, and radiation therapy. Treatment cost-effectiveness for cervical, breast, oral, and colorectal cancer ranges from US$1,300 to US$6,200 per year of life saved. For cancers that are more difficult to treat, such as liver, lung, stomach, and esophageal cancer, the cost-effectiveness is much worse, ranging from US$53,000 to US$163,000 per year of life saved.

The availability of cost-effective methods of prevention and treatment for cancers in low- and middle-income countries varies significantly depending on the type of cancer, with a consequent substantial effect on the equity of outcomes. In the case of cancers for which effective detection and treatment are not available, that is, esophageal, liver, lung, and pancreatic cancer, survival rates are similar in rich and poor countries. For cancers with proven methods of treatment, such as large bowel, breast, ovarian, and cervical cancer, a substantial gap is apparent between the better survival rates in high-income countries and the worse survival rates in low- and middle-income countries. A third group of cancers requires treatments that are complex and multimodal, including testicular cancer, leukemia, and lymphoma. The challenges to providing appropriate care for these cancers are particularly large in settings without specialized medical staff and good health care infrastructure.

CONGENITAL AND DEVELOPMENTAL DISORDERS

Another component of the burden of noncommunicable disease comes from congenital and developmental disorders.[4] As low- and middle-income countries make progress in controlling the major childhood illnesses, a number of congenital and developmental disorders are likely to be revealed.

[4] This section is based on *DCP2,* chapter 34.

Figure 5.1 Global Distribution of Hemoglobinopathies

Source: DCP2, chapter 34, p. 665.

Note: Structural hemoglobin variants: Hb E (innocuous unless interacting with α or β thalassemia) and Hb S (causing sickle-cell disease in the homozygous state).

Hb = hemoglobin

In Africa, 2 percent of infants have sickle cell disease, one of the inherited conditions, or hemoglobinopathies, that affects the normal functioning of hemoglobin in the red blood cells (figure 5.1). The condition is largely absent among adolescents and adults because of the high mortality rates among children. As countries control malaria and improve the diagnosis and treatment of infections with antibiotics, more infants with this condition will survive into adulthood.

"In Africa, 2 percent of infants have sickle cell disease . . ."

The prevalence of learning and developmental disabilities (functional limitations that result from damage to the nervous system) is at

least 10 to 20 percent in high-income countries. Infants and children with these disabilities are less likely to survive and come to the attention of the health system until countries are better able to control common infectious diseases and the coverage of their health systems becomes more complete.

Congenital and developmental disorders arise from a variety of conditions. Many of these disorders are strictly genetic: sickle cell anemia occurs in one out of four children whose parents carry the recessive gene for this condition, and Down syndrome is caused by the presence of a third chromosome. Other disorders arise when fetal development is harmed, as occurs with fetal alcohol syndrome, iodine deficiency, and congenital rubella. A third class of disorders arises from adverse environmental exposure, for example, neurological damage caused by cerebral malaria, bacterial meningitis, or lead poisoning.

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These disorders account for a significant share of the world's disease burden. Some 7 percent of the world's population carries genes that can cause hemoglobin disorders, and each year between 300,000 and 500,000 babies are born with severe forms of these disorders. Mild mental retardation from lead ingestion accounts for 1 percent of the global disease burden, about 9.8 million DALYs, and lead ingestion is only one of many causes of mental retardation.

The consequences of these disorders vary widely and depend both on the severity of the condition and on the context. When a health system can assure proper diagnosis and penicillin prophylaxis, many children can live normal lives despite carrying sickle cell. Hyperactivity disorders and dyslexia are problematic in school settings that do not have resources to address them. Stigmatization may prevent individuals from participating in social activities even when their functional limitations are not a constraint. In places where public policy promotes the construction of ramps for wheel chairs or Braille signs, functional limitations are less restrictive.

Some health interventions address congenital and developmental disorders by preventing them. These include measures like offering genetic screening and counseling for couples when serious congenital disorders are detected, vaccinating against Hib and meningitis to avert neurological damage, implementing behavioral interventions to stop alcohol use during pregnancy to avert fetal alcohol syndrome, eliminating environmental exposure to toxins such as lead that cause mental retardation, and redressing nutritional deficiencies among pregnant women.

Other interventions are available to prevent disorders from progressing to disability:

- Screening for metabolic disorders identifies individuals who will develop neurological damage after ingesting certain foods. Children at risk for such disorders and their parents can be counseled to restrict the identified children's diets accordingly.
- Screening for sickle cell anemia can be followed by penicillin prophylaxis to reduce the risk of death and morbidity from infections.
- Screening and treatment for congenital hypothyroidism can avert developmental damage that results in severe cognitive disabilities.
- Prompt treatment for cerebral malaria can avert long-term neurological damage.

When disorders cannot be prevented, in some cases treatments are available to mitigate their impact on an individual's health. People with conditions caused by severe thalassemias, genetic disorders involving defective hemoglobin production in the blood, may require blood transfusions with washed red blood cells adequately screened for blood-borne diseases; individuals with sickle cell disease can be hospitalized and treated with analgesics when they develop severe bone pain; and nutritional fortification, surgery, rehabilitation, or special education may be able to reduce the severity of impairments.

Finally, when disorders cannot be prevented or treated, mitigating the impact of the disability on a person's quality of life might be possible. Many interventions are directed at associated health conditions; for example, people born with Down syndrome are likely to require treatment or therapy for poor hearing and vision, congenital heart defects, and low mental capacities. Other interventions address environmental constraints on an individual's participation in family and social life, whether by improving physical mobility through appropriate investments in public infrastructure, such as wheelchair accessible mass transit, buildings, and restrooms; building social support networks; or addressing social stigma and educating the public to be more inclusive of people with disabilities.

DCP2 finds that many interventions for addressing congenital and developmental disorders are cost-effective. Chapter 34 highlights penicillin prophylaxis for newborns with sickle cell anemia, which costs between US$7,000 and US$12,000 per death averted and US$250 to US$600 per DALY averted. It also notes that screening for sickle cell

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"Better nourishment for pregnant women . . . not only would be beneficial to women's own health and reduce the risk of maternal mortality, but would also reduce the chances of their children being born with a congenital disorder."

anemia among people of African descent costs about US$6,700 per death averted, but that universal screening in other populations with low prevalence is not cost-effective. Chapter 49 finds that folic acid fortification of grains to prevent birth defects is cost-effective, costing an average of US$36 per DALY averted in Latin America and the Caribbean, US$40 per DALY averted in Sub-Saharan Africa, US$58 per DALY averted in South Asia, and US$160 per DALY averted in East Asia and the Pacific. Prenatal screening and selective pregnancy termination to prevent Down syndrome, spina bifida, and other frequently fatal congenital disorders can be highly cost-effective, but raise ethical, social, and cultural concerns that have to be addressed in ways that respect the gravity of such decisions and assure the protection of human rights.

In addressing congenital and developmental disorders, the evidence in *DCP2* demonstrates the strong relationships between diseases. Immunization programs aimed at preventing rubella reduce the likelihood of congenital deformities in newborns, and better control of malaria would reduce the prevalence of neurological disorders resulting from cerebral malaria. Better nourishment for pregnant women, with particular attention to micronutrients such as vitamin A, folic acid, and iodine, not only would be beneficial to women's own health and reduce the risk of maternal mortality, but would also reduce the chances of their children being born with a congenital disorder.

UNINTENTIONAL INJURIES

"Worldwide, unintentional injuries accounted for 3.5 million deaths in 2001, of which more than 90 percent occurred in low- and middle-income countries . . ."

Unintentional injuries, particularly road traffic injuries, are another component of the burden of noncommunicable disease.[5] Worldwide, unintentional injuries accounted for 3.5 million deaths in 2001, of which more than 90 percent occurred in low- and middle-income countries and accounted for about 7 percent of all deaths in these countries. Of these, road traffic injuries accounted for about 34 percent of deaths from unintentional injuries. While men account for 66 percent of all deaths from unintentional injuries, they account for 73 percent of road and traffic injuries.

Road traffic injuries increase when the volume of travel and the use of motorized vehicles, especially two-wheeled vehicles, increase. They also occur more frequently with increasing speed and in places where

[5] This section is based on *DCP2,* chapter 39.

roads cannot handle the increasing volume and speed of traffic. Injuries also result when pedestrians must share roadways with motorized and nonmotorized vehicles.

Road traffic injuries tend to increase as countries industrialize and grow economically. Later, as wealth increases and public institutions strengthen, countries invest in safety measures, but waiting for incomes to rise before implementing preventive measures results in the needless loss of millions of lives. Awareness of this historical pattern of rising traffic accidents may help low- and middle-income countries recognize the need to incorporate safer designs when building roads and highways and to promote safe driving.

Many effective interventions are available to reduce the risk of road traffic injuries. The first set of interventions manages exposure to risk. Examples include substituting safer modes of transportation for more dangerous ones and minimizing high-risk scenarios, for example, by raising the legal minimum age for driving a motorcycle. A second set of interventions involves constructing safer roads. This can include placing speed bumps to slow traffic, separating vehicular lanes from paths used by pedestrians and bicycles, constructing median barriers, providing passing lanes, and improving street lighting. A third set of interventions focuses on encouraging people to adopt safer behaviors. These include introducing legislation and enforcing it with respect to speed limits, blood alcohol levels, driving hours for commercial drivers, provision and use of seatbelts, and use of bicycle and motorcycle helmets along with providing education for pedestrians.

DCP2 assesses the cost-effectiveness of several different interventions aimed at reducing traffic accidents, including increased penalties for violating road safety regulations paired with enforcement, speed bumps, and requirements for using bicycle and motorcycle helmets along with enforcement.

Evidence for the effectiveness of stronger road safety laws is available from Brazil, where a package of three interventions that included legislative changes to increase penalties, broadcast of messages in the media to inform the public about the changes, and better enforcement achieved a 25 percent reduction in traffic fatalities between 1997 and 1998. Even though education about road safety alone can have an impact, studies in Malaysia and Thailand demonstrated that education has a much greater impact when it is part of a package that includes strong legislation and increased enforcement because the interventions reinforce one another.

"Brazil . . . achieved a 25 percent reduction in traffic fatalities between 1997 and 1998 . . ."

". . . education has a much greater impact when it is part of a package that includes strong legislation and increased enforcement because the interventions reinforce one another."

Speed bumps installed at dangerous intersections or near pedestrian crossings are a simple way to reduce speed and the risk of accidents. Prior surveillance and data collection are required, because to be effective, speed bumps must be installed at the most dangerous locations. Ghana introduced speed bumps in hazardous places and reduced road traffic fatalities at these locations by more than 50 percent.

Bicycle helmets are extremely effective at preventing head injuries; motorcycle helmets are somewhat less so. In China, bicycle-related deaths kill 22 people per million inhabitants each year, while motorcycle accidents kill 16 people per million inhabitants. Case-control studies indicate that bicycle helmets can reduce injuries by 85 percent.

In modeling the cost-effectiveness of these interventions, *DCP2* finds that all of them cost less than US$1,000 per DALY averted. For traffic safety legislation and enforcement, cost-effectiveness ranged from US$14 per DALY averted in South Asia to US$584 per DALY averted in Eastern Europe and Central Asia. Putting speed bumps in the 10 percent of intersections that are the most lethal in a city of 1 million would cost only US$2 per DALY averted in Latin America and the Caribbean to US$9 per DALY averted in East Asia and the Pacific. Increasing bicycle helmet use in China would cost US$107 per DALY averted, while increasing motorcycle helmet use would cost US$467 per DALY averted (table 5.1).

"Putting speed bumps in the 10 percent of intersections that are the most lethal in a city of 1 million would cost only US$2 per DALY averted in Latin America and the Caribbean to US$9 per DALY averted in East Asia and the Pacific."

Thus interventions to reduce the risk of traffic injuries are reasonably simple and cost-effective. Nonetheless, investments in such interventions are low. In 1998, Uganda spent only US$0.09 per capita and Pakistan US$0.07 per capita on road safety, or less than 1 percent of public spending on health in each country. Reviews of road safety initiatives found similar underinvestment in road safety in Benin, Côte d'Ivoire, Kenya, Tanzania, and Zimbabwe.

Implementing road safety measures does not require new knowledge: the risk factors are well known. Implementation often fails, however, because of conflicts between government ministries, inefficient civil services, and corruption. While the costs are not negligible, the interventions are cost-effective.

TOBACCO USE

While some diseases—HIV/AIDS, TB, cancer—seem to stalk people, some behaviors seem to seek out disease.[6] Addictive behaviors put people into the latter category.

[6] This section is based on *DCP2*, chapters 44 and 46.

Table 5.1 Key Findings: Cost-Effective Interventions to Prevent Unintentional Injuries in Low- and Middle-Income Countries

Injury	Promising interventions	Interventions shown to be effective in low- and middle-income countries (references)
Road traffic injuries (RTIs)	Reducing motor vehicle traffic: efficient fuel taxes, changes in land-use policy, safety impact assessment of transportation and land-use plans, provision of shorter and safer routes, trip reduction measures	Increasing the legal age of motorcyclists from 16 to 18 years (Norghani and others 1998)
	Making greater use of safer modes of transport	
	Minimizing exposure to high-risk scenarios: restricting access to different parts of the road network, giving priority to higher occupancy vehicles or to vulnerable road users, restricting the speed and engine performance of motorized two-wheelers, increasing the legal age for operating a motorcycle, using graduated driver's licensing systems	
	Safer roads	
	Safety awareness in planning road networks, safety features in road design, and remedial action in high-risk crash sites: making provisions for slow-moving traffic and vulnerable road users; providing passing lanes, median barriers, and street lighting	
	Traffic calming measures, such as speed bumps	
	Speed cameras	Speed bumps in reducing pedestrian injuries (Afukaar, Antwi, and Ofusu-Amah 2003)
	Safer vehicles	
	Improving the visibility of vehicles, including requiring automatic daytime running lights	Daytime running lights on motorcycles (Radin Umar, Mackay, and Hills 1996; Yuan 2000)
	Incorporating crash protective design into vehicles, including installing seat belts	
	Mandating vehicle licensing and inspection	Increases in fines and suspension of driver's licenses (Poli de Figueiredo and others 2001)
	Safer people	
	Legislating strategies and increasing enforcement of, for example, speed limits, alcohol-related limits, hours of driving for commercial drivers, seat belt use, bicycle and motorcycle helmet use	Legislation and enforcement of motorcycle helmets (Ichikawa, Chadbunchachai, and Marui 2003; Supramaniam, Belle, and Sung 1984).
Poisonings	Better storage, including positioning and nature of storage vessels	Free distribution of child-resistant containers (Krug and others 1994)
	Use of child-resistant containers	
	Warning labels	
	First-aid education	
	Poison control centers	
Fall-related injuries	*Older people*	
	Muscle strengthening and balance retraining, individually prescribed	
	Tai chi group exercise	
	Home hazard assessment and modification for high-risk individuals	
	Multidisciplinary, multifactorial screening for health and environmental risk factors	
	Younger people	
	Multifaceted community programs of the Children Can't Fly type	

(Continued on the following page.)

Table 5.1 (*Continued*)

Injury	Promising interventions	Interventions shown to be effective in low- and middle-income countries (references)
Burn-related injuries	*Fire-related injuries*	
	Introducing programs to install smoke alarms	
	Separating cooking areas from living areas	
	Locating cooking surfaces at heights	
	Reducing the storage of flammable substances in households	
	Supervising children more effectively	
	Introducing, monitoring, and enforcing standards and codes for fire-resistant garments	
	Scald-related injuries	
	Separating cooking areas from play areas	
	Improving the design of cooking vessels	
	Fire- and scald-related injuries	
	Increasing awareness of burns prevention	
	Providing first-aid education	
Drowning	Limiting exposure to bodies of water close to dwellings, such as by fencing	
	Providing learn-to-swim programs	
	Providing education about risks for drowning	
	Increasing supervision and providing lifeguards at recreational facilities	
	Equipping boats with flotation devices and ensuring their use	
	Legislating and enforcing rules about the numbers of individuals carried on boats	
	Having trained and responsive coast guard services	

Source: DCP2, chapter 39, table 39.3.

"Worldwide, tobacco use accounts for 1 of every 5 deaths among men and 1 of every 20 deaths among women over the age of 30."

Worldwide, tobacco use accounts for 1 of every 5 deaths among men and 1 of every 20 deaths among women over the age of 30. In 2000, 4.8 million premature deaths could be attributed to diseases caused by tobacco, including CVD, lung cancer, and chronic obstructive pulmonary disease. In low- and middle-income countries, smoking is also associated with respiratory illnesses such as asthma and TB. Among men in China, smoking was responsible for an estimated 12 percent of deaths from TB. In India, TB was four times more likely in smokers than nonsmokers, suggesting that smoking is a contributory factor in about half of all TB deaths among men. The eventual risk of death from smoking is high: about one-half to two-thirds of long-term

smokers will die from diseases caused by their addiction. Smokers also impose health risks on others, with passive smoking being a significant risk factor for children in developing asthma, throat inflammations, and respiratory illnesses.

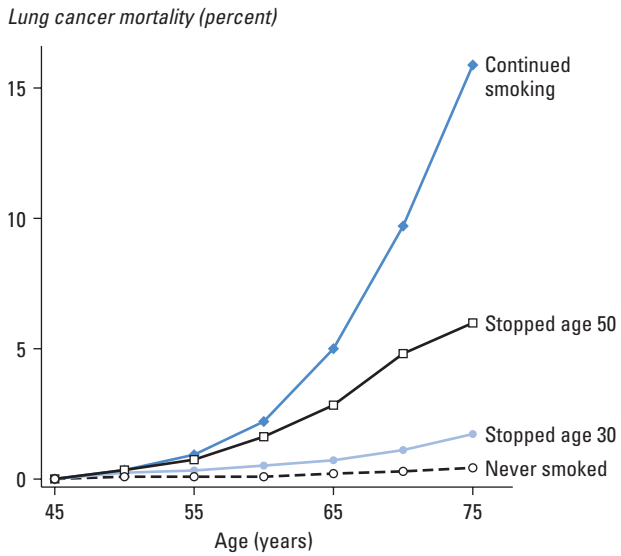
An estimated 1.1 billion people currently smoke, and four-fifths of these smokers reside in low- and middle-income countries. Smoking prevalence is highest in Eastern Europe and Central Asia, where 35 percent of all adults smoke. However, East Asia and the Pacific currently accounts for most tobacco-related deaths, about 40 percent. Men smoke more than women, although the gap is smaller in high-income countries.

The global trends in smoking are worrisome. If the proportion of young people taking up smoking continues its current pattern—about half of men and 1 in 10 women—each year will see some 30 million new long-term smokers. As a result, by 2030 the number of tobacco-related premature deaths will rise to 10 million per year (figure 5.2).

Yet these deaths are avoidable, as demonstrated by experiences in countries where quitting has become common. Serious tobacco control efforts first began in the United Kingdom and the United States in the 1960s. Their sustained impact has discouraged young people from smoking and helped millions of smokers to quit. As a direct result,

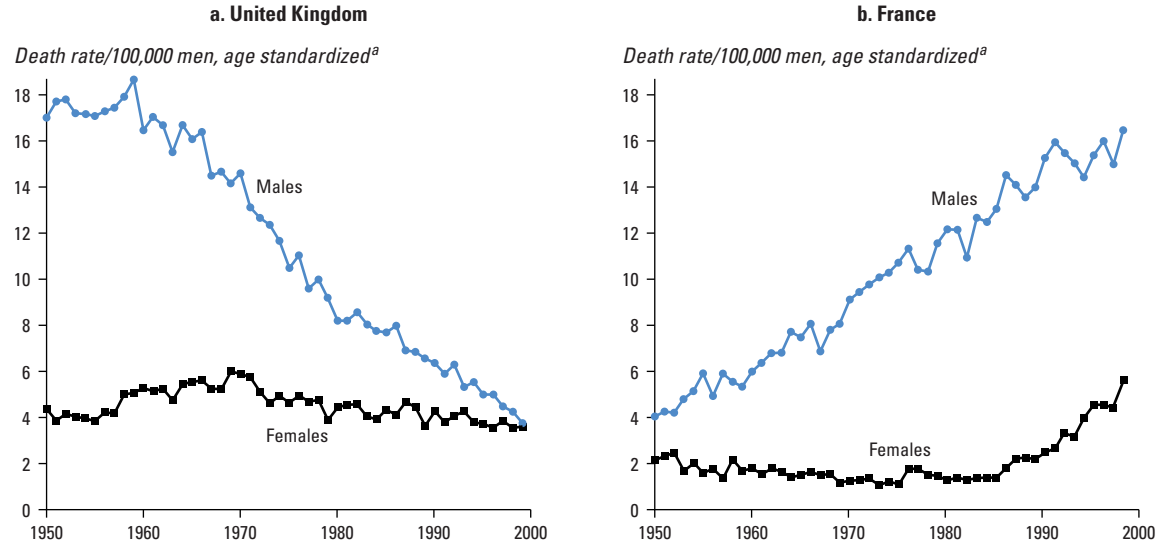
"... one-half to two-thirds of long-term smokers will die from diseases caused by their addiction."

Figure 5.2 Projected Rise in Tobacco-Related Deaths of Smokers Who Fail to Quit



Source: DCP2, chapter 46, p. 5.

Figure 5.3 Trends in Deaths Attributed to Smoking



Source: DCP2, chapter 46, p. 4.

a. Mean of annual rates in component five-year age groups.

"In the United Kingdom . . . , the incidence of lung cancer among men age 35 to 44 fell from 18 cases per 100,000 people in 1950 to 4 cases per 100,000 in 2000."

lung cancer rates in the United Kingdom and the United States have dropped rapidly. In the United Kingdom, where the main increase in smoking began before World War II, the incidence of lung cancer among men age 35 to 44 fell from 18 cases per 100,000 people in 1950 to 4 cases per 100,000 in 2000 (figure 5.3a). By contrast, smoking became common in France much later, efforts to discourage smoking did not have an impact until the 1990s, and the incidence of lung cancer among French men has continued to climb (figure 5.3b).

The addictive substance in tobacco is nicotine, a psychoactive drug. Inhalation is the most effective way of getting nicotine to receptors in the brain. Nicotine creates positive sensations when it is administered and leads to unpleasant sensations when it is withdrawn. In this regard, it is on a par with such other powerfully addictive drugs as heroin and cocaine.

Behavioral influences strengthen the biochemically addictive nature of tobacco. Unlike illicit drugs that entail risks of incarceration and social disapproval, social mores and licit commercial interests have favored tobacco. Tobacco companies and governments have encouraged

smoking through advertising and other forms of promotion. Mass marketing also presents smokers with many opportunities and frequent cues to both purchase and use tobacco, making cessation that much more difficult.

Prevention is the best way to address diseases caused by tobacco. Anything that reduces smoking, whether reducing the number of people who start smoking, increasing the number who quit, reducing the number who relapse, or decreasing smoking among those who continue, will ultimately reduce the burden from tobacco-related illnesses such as CVD, cancer, and TB. The addictive nature of tobacco has implications for discouraging its use. Educating consumers that tobacco is an addiction and causes health problems is insufficient, because people regularly underestimate their future health risks and because young people are more prone to adopting risky behaviors. Once people are addicted, cessation is difficult. Interventions proven effective at reducing smoking include increasing tobacco taxes, disseminating information about tobacco's health risks, restricting smoking in public places and workplaces, banning advertising, and increasing access to cessation therapies.

Nearly all governments tax tobacco to generate revenue, but as awareness of the dangers of smoking has grown, governments are increasingly using tobacco tax policy to raise the cost of the habit and discourage the use of tobacco. In some cases, countries have even earmarked tobacco taxes to finance health programs aimed at reducing exposure to tobacco.

"... governments are increasingly using tobacco tax policy to raise the cost of the habit and discourage the use of tobacco."

Tobacco taxes have a greater effect on reducing consumption among lower-income groups, youths, and those who are less educated. Taxes are also more effective in the long run than in the short run, because addicted consumers change their habits slowly. Higher tobacco prices appear to be particularly effective in preventing young smokers from moving beyond experimentation to becoming regular smokers. Studies have estimated that the effect of raising tobacco prices may be twice as high in low- and middle-income countries than in higher-income countries, implying that significant increases in tobacco taxes in the former would be effective in reducing tobacco use. Taxes account for more than two-thirds of the retail price in most high-income countries but less than one-half in low- and middle-income countries.

In addition to raising the price of tobacco, many countries have effectively discouraged smoking by restricting it in public areas. The

justification for such measures is to protect nonsmokers from harm caused by inhaling secondhand smoke, but such measures also create a hindrance to smokers, forcing them to change their habits and seek out special smoking areas. This can help raise barriers to smoking and also stigmatize the practice, thereby inducing changes in social norms. To have an impact, such regulations require enforcement, particularly when they are first introduced.

Interventions that affect people's attitudes toward and knowledge about the dangers of smoking can also be extremely helpful. Cigarettes are among the most heavily advertised and promoted products in the world. Information and education campaigns can counter the impact of this marketing by publicizing reports about the dangers of smoking, putting warning labels on packages, and broadcasting antismoking messages in the media. Comprehensive bans on advertising and promoting tobacco may reduce smoking and make public awareness campaigns more effective.

While the dangers of smoking have become widely known in most high-income countries, awareness of the risks of mortality and disease posed by smoking is still not widespread in low- and middle-income countries. The key messages that need to be transmitted are that addiction will eventually kill one-half to two-thirds of all smokers; that, on average, smokers will lose 20 to 25 years of life and will die between the ages of 35 and 69; and that quitting raises the chances of survival no matter how long an individual has smoked.

"... quitting raises the chances of survival no matter how long an individual has smoked."

The recent development of drugs that counter the effects of nicotine improve the chances that smokers who would like to quit can succeed. Ironically, nicotine-containing tobacco products are often cheaper and easier to purchase than nicotine replacement therapies. Policies that redress this imbalance by decreasing the costs of nicotine replacement therapies and increasing their availability can help smokers quit. These therapies become more effective when coupled with counseling and peer support. Promoting cessation is particularly important, because the bulk of tobacco-related deaths between now and 2050 will be among current smokers. By contrast, policies aimed at preventing young people from taking up smoking will have their main impact after 2050.

Interventions aimed at reducing the supply of tobacco do not seem to be particularly effective. Some of these programs, such as prohibiting the sale of tobacco products to young people, are difficult

and costly to enforce. Restrictions on the importation of tobacco products might raise domestic prices, but also violate international trade agreements. Programs aimed at encouraging farmers to stop growing tobacco are ineffective because other farmers can expand their production to fill the gap. Hence, low- and middle-income countries would be well advised to concentrate their efforts on reducing demand.

Fortunately, most demand-side interventions are cost-effective, and even cost saving. Tobacco taxes aimed at raising the cost of smoking are the most cost-effective way to reduce smoking. A 70 percent increase in the price of tobacco could avert 10 to 26 percent of all smoking-related deaths worldwide. The effect would be particularly strong in low- and middle-income countries, among young people, and for men. Using a base-case scenario of a 33 percent price increase yields a cost-effectiveness ratio of US$3 to US$42 per DALY averted in low- and middle-income countries and US$85 to US$1,773 per DALY averted in high-income countries. Successful interventions in Poland and South Africa went well beyond such a modest price increase, almost doubling cigarette prices over a short time (*DCP2,* chapter 8; Levine and others 2004). Despite price increases being the most cost-effective approach to controlling tobacco consumption, this public health measure is grossly underutilized. Indeed, when adjusted for purchasing power, the price of tobacco products actually fell in most developing countries between 1990 and 2000.

Increasing access to nicotine replacement therapies to assist smokers who want to quit is more expensive, costing between US$75 and US$1,250 per DALY averted, but is still relatively cost-effective, especially where the direct cost of therapies is low. Other nonprice interventions could be implemented for between US$233 and US$2,916 per DALY averted. The cost-effectiveness of nonprice measures is extremely sensitive to context. In countries where the public readily absorbs public health messages, the costs could be low.

Tobacco-related deaths are the fastest growing cause of death in low- and middle-income countries, on par with the HIV/AIDS epidemic. The availability of cost-effective control measures eliminates any excuse for inaction. The obstacles to forestalling a rapid increase in tobacco-related deaths, which requires strong and skillful responses to those who market tobacco products and lobby against reform, lie squarely in the political realm.

"A 70 percent increase in the price of tobacco could avert 10 to 26 percent of all smoking-related deaths worldwide."

". . . when adjusted for purchasing power, the price of tobacco products actually fell in most developing countries between 1990 and 2000."

"Tobacco-related deaths are the fastest growing cause of death in low- and middle-income countries, on a par with the HIV/AIDS epidemic."

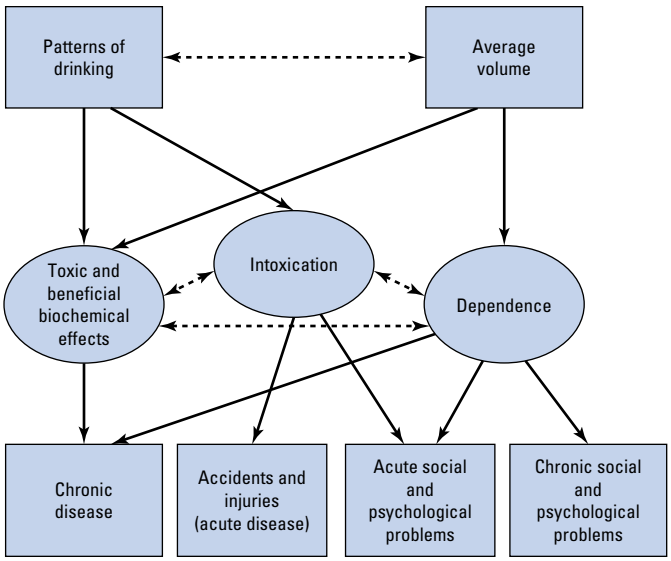
"Alcohol-related diseases account for about 4 percent of global DALYs each year . . . from a low of 0.5 percent in the Middle East and North Africa . . . to . . . 10.7 percent in Eastern Europe and Central Asia."

ALCOHOL ABUSE

High-risk alcohol use[7] is a serious public health problem.[8] It directly harms the health of those who drink excessively and contributes to risky behaviors that cause injury and impairment to themselves and others. Alcohol consumption is linked to long-term health and social consequences through three intermediate mechanisms: intoxication, dependence, and direct biological effects (figure 5.4).

Alcohol-related diseases account for about 4 percent of global DALYs each year and range from a low of 0.5 percent in the Middle East and North Africa, where alcohol consumption is low, to between 1.5 and 2.0 percent in South Asia and Sub-Saharan Africa, 4.3 percent in East Asia and the Pacific, 8.8 percent in Latin America and the Caribbean, and 10.7 percent in Eastern Europe and Central Asia. About 75 percent of this disease burden is manifested in chronic illnesses such as alcohol

Figure 5.4 Model of Alcohol Consumption, Intermediate Outcomes, and Long-term Consequences



Source: DCP2, chapter 47, figure 47.1.

[7] High-risk alcohol use is defined differently for men and women. For men it is defined as consuming an average of more than 40 grams per day of pure alcohol, and for women the figure is more than 20 grams per day. This gender-specific difference reflects biological differences in metabolizing alcohol.

[8] This section is based on *DCP2,* chapter 47.

dependence, vascular disease, cirrhosis of the liver, and cancer, with unintentional and intentional injuries (particularly road traffic accidents) accounting for the remaining 25 percent.

High-risk drinking is particularly problematic in Europe and Central Asia, where as many as 1 in 5 men and 1 in 10 women between the ages of 15 and 29 engage in high-risk drinking. Even though high-risk drinking in Europe and Central Asia is only marginally more prevalent than in high-income countries, it accounts for double the disease burden because more of that drinking is in the hazardous, higher volume part of the high-risk range.

Interventions may be designed to prevent high-risk drinking or to mitigate its effects. Some of these interventions operate at the population level, such as legislative measures and taxes, improved law enforcement, and mass media campaigns. Other measures aim specifically at high-risk drinkers to encourage behavior modifications.

As in the case of tobacco, public policy can have a substantial effect on alcohol abuse. Taxing alcohol raises the price and thereby reduces consumption. Estimates indicate that a 10 percent increase in the price of alcohol reduces consumption of beer by about 3 percent, wine by 10 percent, and distilled spirits by as much as 15 percent. Restricting sales to a limited number of licensed retail outlets or restricting the hours when alcohol can be sold can make obtaining alcohol more difficult. Strict drunk driving laws also discourage excessive consumption, prevent traffic accidents, and can reduce traffic fatalities by 7 percent. When enforcement through random breath testing is included, fatalities and nonfatal injuries from accidents may fall an additional 15 percent. Making these kinds of public policy measures effective requires enforcing regulations and laws, whether by means of additional policing to reduce smuggling and tax evasion or by mounting random breath testing of drivers to discourage drunk driving (box 5.2).

When they are effective, bans or restrictions on advertising alcoholic products remove cues that encourage alcohol consumption; however, manufacturers often substitute other methods of marketing, such as sponsoring sporting events. Consequently, restricting advertising may only reduce high-risk drinking by 1 to 3 percent.

Many countries engage in mass media campaigns and school-based education about the risks of drinking. Studies show that such efforts do increase knowledge about and attitudes toward alcohol and its risks to health, but they have not shown sustained reductions in the rate of alcohol consumption or reductions in alcohol-related harm.

". . . a 10 percent increase in the price of alcohol reduces consumption of beer by about 3 percent, wine by 10 percent, and distilled spirits by as much as 15 percent."

"Strict drunk driving laws . . . can reduce traffic fatalities by 7 percent."

Box 5.2 Tax Rate Reduction and the Resulting Disease Burden in Mauritius

Mauritius, an island nation in the Indian Ocean, has a population of about 1 million. Tourism is the third-ranked industry in terms of hard currency earnings. In June 1994, the government drastically lowered customs duties on imported alcoholic beverages to 80 percent from rates that had ranged from 200 percent for wine to 600 percent for whisky and other spirits (Abdool 1998). The government made the change under pressure from the hotel industry, which claimed that tourists were not purchasing enough alcohol because of its high prices (Lee 2001). Other reasons given for the change were to reduce unofficial imports from abroad and to make better, more refined alcoholic beverages available to the local population. Despite little evidence to support the view, there were claims in the public discussion that better-quality alcohol would result in fewer health problems.

The effects of the change were felt mainly by Mauritians rather than tourists, as follows:

- Arrests for driving with blood alcohol over the legal limit made primarily in connection with traffic crashes increased by 23 percent between 1993 and 1997.
- Admissions of alcoholism cases to the island's psychiatric hospital shot up in 1994. The 1995 rate was more than twice the 1993 rate, and the rate rose again slightly in 1996 and 1997. Medical specialists in Mauritius agree that patients with alcohol problems account for an increasing portion of admissions in general medical wards and now represent between 40 and 50 percent of bed occupancy (Abdool 1998).
- Age-adjusted death rates per 100,000 population for chronic liver disease and cirrhosis rose from 32.8 for males and 4.0 for females in 1993 to 42.7 for males and 5.3 for females in 1996 (WHO 1999, 2000).

Even though available statistics are limited, the reduction in alcohol import taxes clearly had a substantial negative effect on the health of Mauritians. Thus, the government's 1997 call for control measures for alcohol—specifically, new permits for licensed premises, increased excise duties on alcohol, and limitations on bars' opening hours—was not surprising. Alcohol taxes were increased somewhat in the 1999/2000 budget (U.S. Department of State 1999). However, an analysis by World Bank staff that did not take health effects into account called for further reductions in maximum tariff rates, identifying Mauritius as having an antitrade bias on the basis of the structure of its alcohol and tobacco taxes (Hinkle and Herrou-Aragon 2001).

Source: Adapted from *DCP2,* chapter 47, p. 900.

Brief interventions to reduce high-risk drinking at the personal level through educational sessions and psychosocial counseling in primary health care settings reduce alcohol consumption among high-risk drinkers by 13 to 34 percent, but poor adherence and low coverage can offset these gains substantially.

In the three regions where high-risk alcohol use is found among more than 5 percent of the population—Europe and Central Asia, Latin America and the Caribbean, and Sub-Saharan Africa—the most effective interventions are taxation and brief interventions, averting more than 500 DALYs per 1 million total population per year. The remaining control strategies, random breath testing, reduced hours of sale at the weekend, and a comprehensive advertising ban, produced effects in the range of 200 to 400 DALYs averted per 1 million population per year. In the two remaining regions with lower rates of high-risk drinking, particularly among the female population, the burden that is avertable via taxation is significantly reduced: 10 to 100 DALYs averted per 1 million population per year. In South Asia, the most effective intervention appears to be enforcement of drinking and driving laws given the combination of the higher prevalence of traffic-related injuries and lower levels of high-risk drinking.

"... where high-risk alcohol use is found among more than 5 percent of the population .... the most effective interventions are taxation and brief interventions ..."

The cost-effectiveness of interventions also varies substantially between regions. Whereas taxation, limitations on retail sales, and advertising bans are the most cost-effective interventions in the three regions with a higher prevalence of high-risk drinking, these same interventions are among the least cost-effective in the other two developing regions.

In Europe and Central Asia, Latin America and the Caribbean, and Sub-Saharan Africa, raising excise taxes by 25 percent costs between US$100 and US$200 per DALY averted, reducing access to retail outlets costs between US$152 and US$340 per DALY averted, and enforcing advertising bans cost between US$134 and US$380 per DALY averted. Random breath testing of drivers is much more costly, ranging from US$973 per DALY averted in Sub-Saharan Africa to US$1,856 per DALY averted in Europe and Central Asia. By contrast, in South Asia, the cost-effectiveness ranking of these interventions is inverted: enforcing a 25 percent increase in taxes on alcoholic beverages costs US$3,654 per DALY averted, whereas random breath testing of drivers costs US$531 per DALY averted.

"High-risk alcohol use, along with tobacco use ... demonstrate[s] that ... public policy measures can be substantially more cost-effective than individualized medical treatment."

In general, countries with a high prevalence of high-risk drinking should begin with taxation because in such contexts it appears to have the largest effect for the fewest resources. In places where high-risk drinking is less of a public health burden, other intervention strategies that restrict the supply or promotion of alcoholic beverages appear to be promising and relatively cost-effective.

High-risk alcohol use, along with tobacco use, accounts for a sizable and growing portion of the disease burden in low- and middle-income countries. They both demonstrate that for some risk factors and conditions public policy measures can be substantially more cost-effective than individualized medical treatment. They also show that good health policies may also be good tax policies. The value of such multisectoral interventions is a common theme in *DCP2* chapters dealing with addictions and recurs in discussion of interventions to reduce CVD, diabetes, and road traffic injuries.

MENTAL HEALTH

"About 13 percent of all DALYs are due to neurological and psychiatric disorders."

By looking beyond mortality figures to consider the burden of disability in developing countries, the first edition of *Disease Control Priorities in Developing Countries* (Jamison and others 1993) revealed that mental health accounts for a substantial amount of the disease burden in these countries.[9] Depression, schizophrenia, bipolar disorder, anxiety disorders, dementias, and epilepsy are conditions that do not appear as significant causes of mortality, but they seriously reduce the quality of life for individuals and their families. Disease burden estimates in *DCP2* confirm that mental health contributes significantly to the global burden of disease. *DCP2* also presents what is known about cost-effective interventions while emphasizing the need for further research to develop better ways to address the mental health burden.

About 13 percent of all DALYs are due to neurological and psychiatric disorders. Alzheimer's disease and other dementias account for 17.1 million DALYs and are twice as common among women as men, while epilepsy accounts for another 6.2 million DALYs and Parkinson's disease for 2.3 million DALYs. Depression is the most common psychiatric disorder, accounting for 51.9 million DALYs or 3.4 percent of the global burden of disease. It is ranked fourth among all causes of DALYs and is the leading nonfatal condition globally. It is also more common among women than among men. Schizophrenia, bipolar disorder, and panic disorder account for another 11.6 million DALYs, 9.7 million DALYs, and 4.5 million DALYs, respectively. Mental health conditions are common in developing countries, but are less frequently recognized, diagnosed, and treated than in developed countries.

"Depression is the most common psychiatric disorder, . . . ranked fourth among all causes of DALYs and . . . the leading nonfatal condition globally."

[9] This section is based on *DCP2*, chapters 31 and 32.

The interventions available for preventing and treating mental health problems in developing countries are relatively limited. Many neurological conditions, such as Alzheimer's disease and Parkinson's disease, have no cure, and preventive measures are also lacking. The major exception is stroke, for which preventive measures were discussed earlier. For other mental health problems, large advances have been made in both pharmacological treatments and psychosocial therapies, but many interventions are still focused on mitigating symptoms or easing the burden on families caring for members with mental health problems.

Some pharmacological treatments are available for Alzheimer's disease and other dementias, but most interventions for this disease aim to reduce stress and depression among patients' caregivers. For example, training caregivers about proper diet or establishing bowel and bladder routines can make caring for someone with Alzheimer's less stressful. For Parkinson's disease, treatments aim at symptomatic relief by means of pharmaceuticals, physical therapy, and traditional medicines. For schizophrenia, depression, bipolar disorder, and panic disorders, a variety of pharmacological treatments are available, including older mood stabilizers, for instance, lithium; antipsychotics, for example, haloperidol; and antidepressants such as tricyclic medications, which are also used to treat anxiety disorders. Psychosocial treatments, which consist largely of cognitive-behavioral approaches, have also proven to be effective.

"For schizophrenia, depression, bipolar disorder, and panic disorders, a variety of pharmacological treatments are available . . ."

While it is necessary to generate a wider range of interventions to address mental health problems, the quality of life for a large number of people in low- and middle-income countries could be substantially enhanced by applying interventions already demonstrated to be cost-effective. For people suffering from epilepsy, administering phenobarbitol helps avert seizures at a cost of US$89 per DALY averted. For Parkinson's disease, two interventions are reasonably cost-effective: l-dopa and carbidopa at US$1,500 per DALY averted and ayurvedic treatments at US$750 per DALY averted. Treatment of acute stroke because of vascular occlusion using aspirin costs only US$150 per DALY averted. Interventions to prevent the recurrence of stroke are cost-effective in part because they are easily targeted to a population that is known to face higher risks, costing US$70 per DALY averted for aspirin treatment, US$932 per DALY averted for dipyridamole and aspirin, and US$1,458 per DALY averted for carotid endarterectomy.

"Treatment of acute stroke because of vascular occlusion using aspirin costs only US$150 per DALY averted."

The variations in labor, transportation, and service delivery costs across regions generate significant differences in the cost-effectiveness of these treatments. For example, aspirin is the most cost-effective

"For psychiatric disorders, combining drugs with psychosocial treatment is generally the most cost-effective intervention."

intervention for acute stroke in South Asia and Sub-Saharan Africa, whereas aspirin plus dipyridamole treatment is more cost-effective in the other developing regions.

For psychiatric disorders, combining drugs with psychosocial treatment is generally the most cost-effective intervention (table 5.2). For example, treating schizophrenia with older antipsychotic medications such as haloperidol along with family psycho-education is the most cost-effective intervention available, ranging between US$5,000 and US$8,000 per DALY averted in the Middle East and North Africa, South Asia, and Sub-Saharan Africa and between US$10,000 and US$17,000 per DALY averted in the other regions. Treating depression with new antidepressants such as Fluoxetine and group psychotherapy costs between US$2,000 and US$3,000 per DALY averted in all the regions. Treating panic disorders with newer antidepressant drugs such as Fluoxetine costs between US$1,000 and US$1,500 per DALY averted.

Addressing the burden of mental health in developing countries requires closing a treatment gap between what can be done for people with neurological and psychiatric disorders compared with what is currently being done. *DCP2* identifies the available cost-effective measures, but closing this gap also relies heavily on general improvements in health systems. Cost-effective treatment largely involves outpatient care, but depends significantly on the ability of health professionals at the primary level to recognize symptoms and refer patients to appropriate care. It also requires better management of drug supplies to assure the availability and potency of drugs, along with counseling for patients and their families to encourage adherence. Research is needed to widen the range of available interventions, reduce the cost of current interventions, discover more cost-effective treatments, and, if possible, find ways to prevent or cure these debilitating conditions.

"Addressing noncommunicable diseases and injuries is not something that low- and middle-income countries can leave to the future."

CONCLUSION

Addressing noncommunicable diseases and injuries is not something that low- and middle-income countries can leave to the future. These conditions already account for a substantial share of the disease burden in most countries and are likely to increase further as these countries make progress in controlling infectious diseases and reducing the high rates of mortality and morbidity associated with childbearing and infancy.

Table 5.2 Costs and Effects of a Specified Mental Health Care Package

	World Bank region					
	Sub-Saharan Africa	Latin America and the Caribbean	Middle East and North Africa	Europe and Central Asia	South Asia	East Asia and the Pacific
Total effect (DALYs averted per year per 1 million population)						
Schizophrenia: older antipsychotic drug plus psychosocial treatment	254	373	364	353	300	392
Bipolar disorder: older mood-stabilizing drug plus psychosocial treatment	312	365	322	413	346	422
Depression: proactive care with newer antidepressant drug (SSRI; generic)	1,174	1,953	1,806	1,789	1,937	1,747
Panic disorder: newer antidepressant drug (SSRI; generic)	245	307	287	307	284	330
Total effect of interventions	1,985	2,998	2,779	2,862	2,867	2,891
Total cost (US$ million per year per 1 million population)						
Schizophrenia: older antipsychotic drug plus psychosocial treatment	0.47	1.81	1.61	1.32	0.52	0.75
Bipolar disorder: older mood-stabilizing drug plus psychosocial treatment	0.48	1.80	1.23	1.39	0.62	0.95
Depression: proactive care with newer antidepressant drug (SSRI; generic)	1.80	4.80	3.99	3.56	2.81	2.59
Panic disorder: newer antidepressant drug (SSRI; generic)	0.15	0.27	0.21	0.23	0.16	0.20
Total cost of interventions	2.9	8.7	7.0	6.5	4.1	4.5
Cost-effectiveness (DALYs averted per US$1 million expenditure)						
Schizophrenia: older antipsychotic drug plus psychosocial treatment	544	206	226	267	574	522
Bipolar disorder: older mood-stabilizing drug plus psychosocial treatment	647	203	262	298	560	446
Depression: proactive care with newer antidepressant drug (SSRI; generic)	652	407	452	502	690	675
Panic disorder: newer antidepressant drug (SSRI; generic)	1,588	1,155	1,339	1,350	1,765	1,649

Source: DCP2, chapter 31, p. 622.

Note: SSRI = selective serotonin reuptake inhibitor.

Prevention, often through multisectoral public policies, is key, whether it involves educational efforts to promote healthier lifestyles, food regulations that discourage the use of unhealthy fats and oils by food manufacturers, urban transportation policies that encourage bicycling and wearing helmets, fiscal policies that tax tobacco and

alcohol products, or cultural activities aimed at reducing social stigma attached to developmental disabilities. For the burden that remains, many cost-effective interventions are available and should be promoted. Where treatments are unavailable or not cost-effective, research is needed.

Prevention, care and treatment, and research are all activities that are facilitated by the presence of a strong and functioning health care system. If countries can successfully strengthen their health systems to improve the coverage of interventions that reduce infectious disease and maternal and neonatal conditions, building further capacity to address the demands that noncommunicable diseases will impose should be possible. The next two chapters address the range of policies available to build and strengthen health care systems so that they can meet these challenges.