the declining TFR. Countries with low TFR and high wealth, such as Italy, France, and Sweden, fit into this pyramid model.

HOW DOES THE GEOGRAPHY OF HEALTH INFLUENCE POPULATION DYNAMICS?

The condition of a country's population requires much more than simply knowing the total population or the growth rate. Also of significance is the welfare of the country's people, across regions, ethnicities, or social classes. Among the most important influences on population dynamics are geographical differences in sanitation, the prevalence of diseases, and the availability of health care.

Infant Mortality

One of the leading measures of the condition of a country's population is the **infant mortality rate** (IMR). Infant mortality is recorded as a baby's death during the first year following its birth (unlike child mortality, which records death between ages 1 and 5). Infant mortality is normally given as the number of cases per thousand, that is, per thousand live births.

Infant and child mortality reflect the overall health of a society. High infant mortality has a variety of causes, the physical health of the mother being a key factor. In societies where most women bear a large number of babies, the women also tend to be inadequately nourished, exhausted from overwork, suffering from disease, and poorly educated. Often, infants die because they are improperly weaned. Demographers report that many children die because their parents do not know how to cope with the routine childhood problem of diarrhea. This condition, together with malnutrition, is the leading killer of children throughout the world. Poor sanitation is yet another threat to infants and children. Estimates are that more than one-fifth of the world's population lacks ready access to clean drinking water or hygienic human waste-disposal facilities.

The map showing the world distribution of infant mortality (Fig. 2.16) reveals high rates in many poorer countries. The map shows infant mortality patterns at five levels ranging from 100 or more per thousand (one death for every eight live births) to fewer than 15. Compare this map to that of overall crude death rate (CDR) in Figure 2.12, and the role of infant mortality in societies with high death rates is evident.

The lowest infant mortality rate among larger populations has long been reported by Japan, with 3.0 deaths per 1000 live births in a country of over 128 million people. Some less populated countries show even lower IMRs. Singapore has over 4.5 million people and an incredibly low IMR of just under 3, and Sweden's nearly 9 million people record an IMR of 2.8.

In 2008, 22 countries still reported an IMR of 100 or more, and several had rates of 125 or higher—that is, one death or more among every eight newborns. Sierra Leone and Afghanistan had the highest IMR: 165. Dreadful as these figures are, they are a substantial improvement over the situation 20 years ago (although they are not much improved since 1997). Globally, infant mortality has been declining, even in the poverty-stricken regions of the world.

Each of these observations about infant mortality rates considers what is happening within an entire country. The IMR varies within countries and gives us a lens into variations in access to health care and health education within a country. A statistic typically varies by region, ethnicity, social class, or other criteria. The IMR of South Africa is 48 per thousand, an average of all the people within the country's borders. The IMR for South African whites is near the European average; for black Africans it is nearer the African average; and for the Coloured and Asian population sectors it lies between these two figures. The reported average for South Africa does not tell ethnic and class differences within South Africa.

In the United States, in 2004, the IMR for African Americans was 13.6, above the countrywide average of 6.8 and the IMR of 5.7 for non-Hispanic whites. The risk factors that lead to a high IMR afflict African Americans at a much higher rate than non-Hispanic whites in the United States. According to the Centers for Disease Control, 88.9 percent of non-Hispanic whites and 76.5 percent of African Americans received prenatal care starting in the first trimester of their pregnancy. Lower education levels for African American women also contributed to the higher IMR. One risk factor that contributes to high IMR, smoking during pregnancy, was higher for non-Hispanic whites. The centers for disease control found that 13.8 percent of non-Hispanic whites smoked cigarettes during pregnancy in 2004, and 8.4 percent of African American women smoked during pregnancy.

The IMR in the United States also varies by region, with the highest IMR in the South and the lowest in the Northeast (Fig. 2.17). Race, ethnicity, social class, education levels, and access to health care also vary by region in the United States, and these correlations are found for many health problems from diabetes to heart disease.

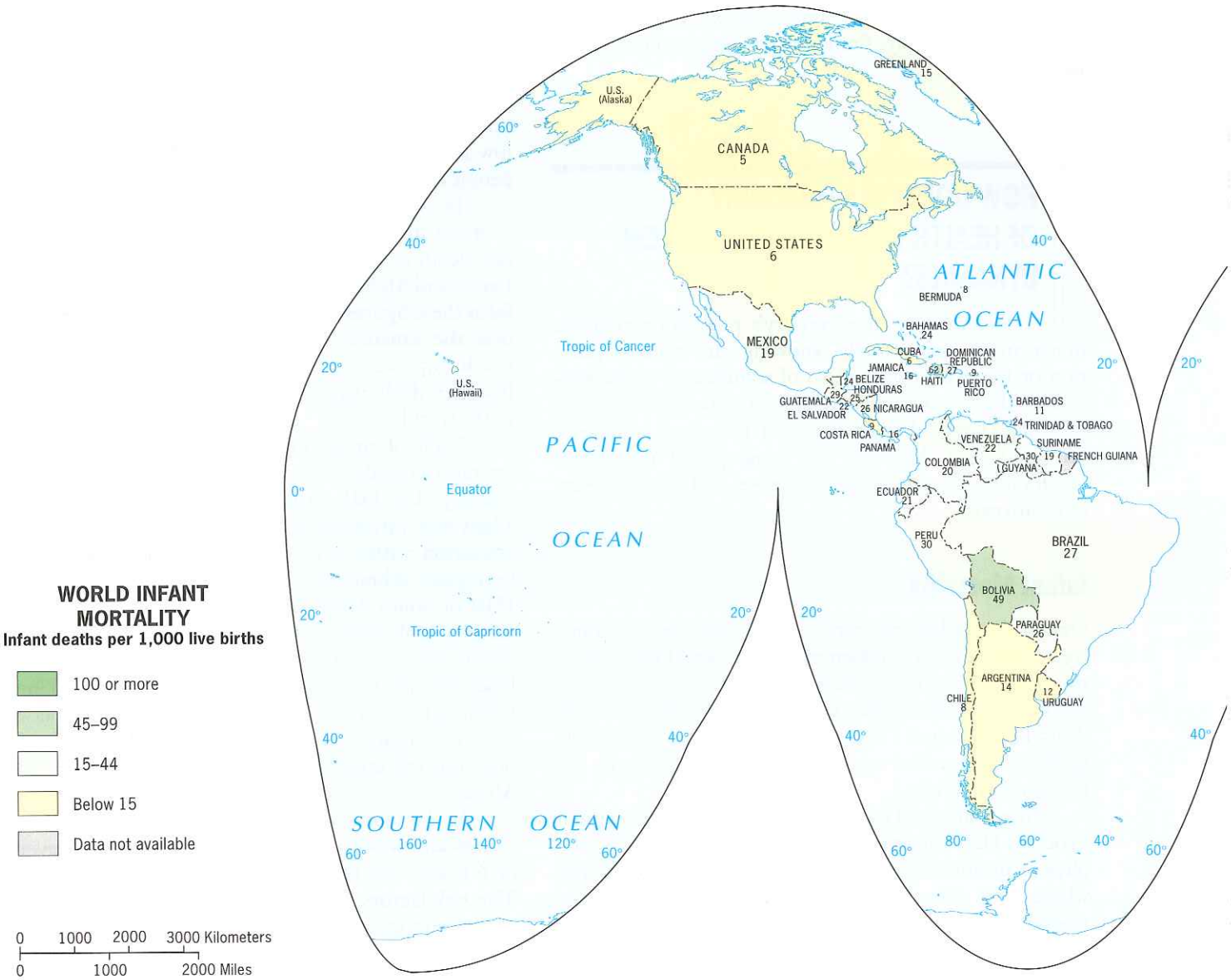
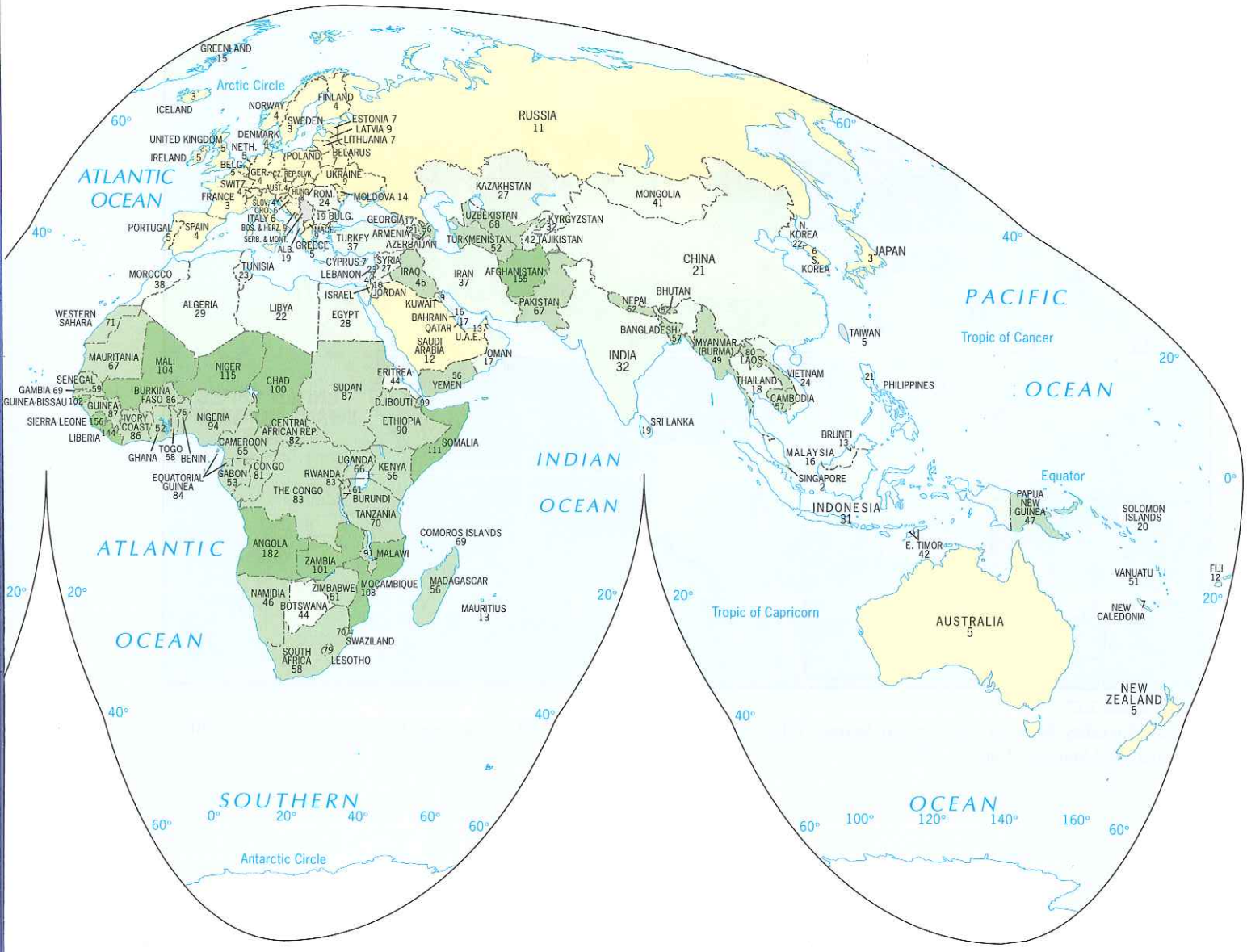


Figure 2.16
Infant Mortality Rate, 2008. *Data from*: CIA World Fact book, 2008 estimate.

According to the Office of Minority Health and Health Disparities at the Centers for Disease Control in the United States, "The leading causes of infant death include congenital abnormalities, preterm/low birth weight, Sudden Infant Death Syndrome (SIDS), problems related to complications of pregnancy, and respiratory distress syndrome. SIDS deaths among American Indian and Alaska Natives is 2.3 times the rate for non-Hispanic white mothers."



Another measurement of the health of children early in life is the newborn death rate, a measurement of the number of children who die in the first month of life out of every 1000 live births. Surprisingly, the United States has the *second highest newborn death rate* in the world. The annual State of the World's Mothers report explains that the high newborn death rate in the United States and in other wealthy countries is typically from premature births and low-birth-rate babies. In the poorer countries

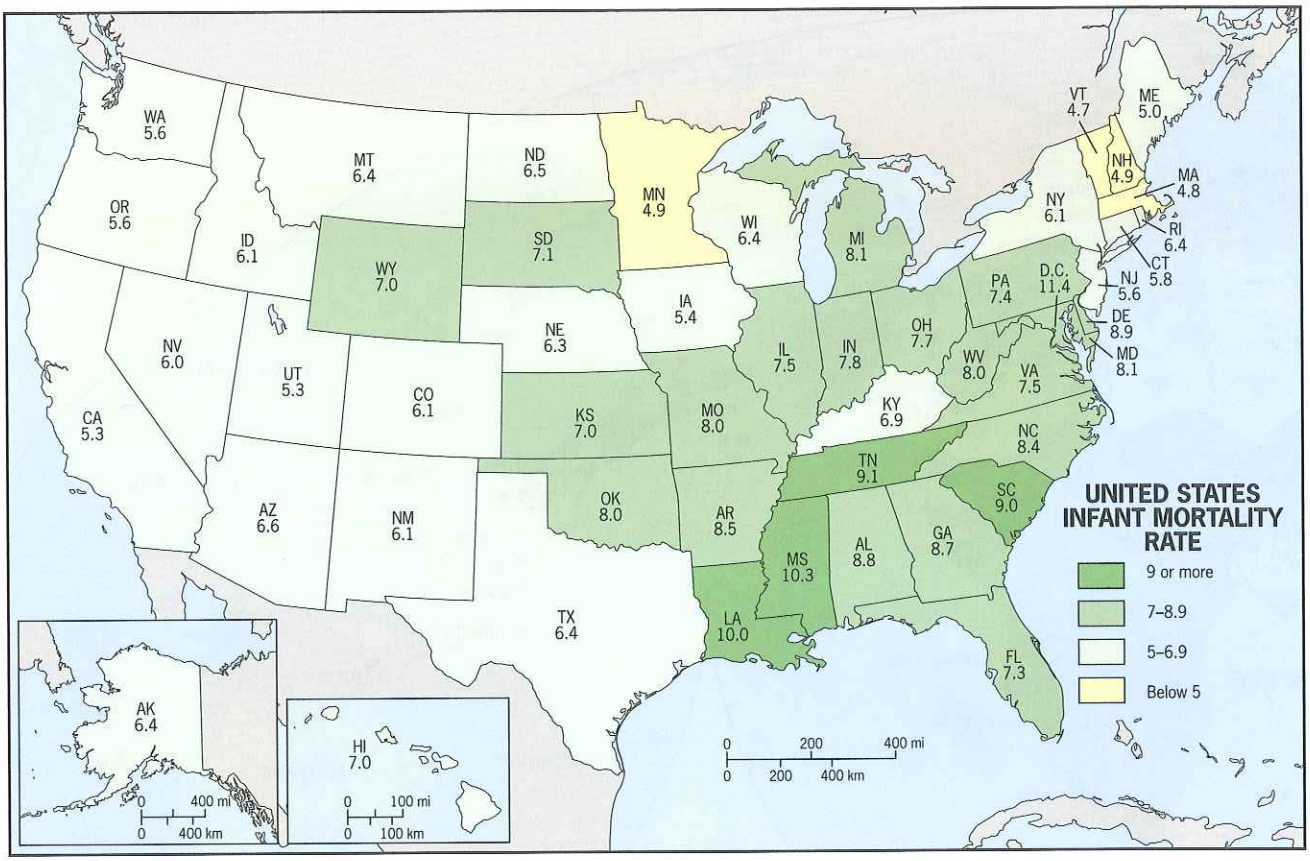


Figure 2.17

Infant Mortality Rate in the United States. Infant deaths per 1,000 live births. *Data from*: Centers for Disease Control, National Vital Statistics Reports, 2007.

of the world, diarrhea and infections cause half of newborn deaths.

Figure 2.18 maps the Mother's Index from the State of the World's Mothers report. The Mother's Index measures 10 barometers of well-being for mothers and children. Although the United States has a high newborn death rate, its position on the Mother's Index is high. The overwhelmingly low measurements for Subsaharan Africa on the Mother's Index confirms that poverty is a huge factor in the health of women and children. Specifically, 99 percent of newborn deaths and 98 percent of maternal deaths (deaths from giving birth) occur in the poorer countries of the world.

In the countries in the world experiencing violent conflict, the Mother's Index plunges, and the chances of newborn survival fall. Examine Figure 2.18 again and note the position of countries that have violent conflict or a recent history of conflict: Iraq, Afghanistan, Liberia, Sierra Leone, and Angola.

Child Mortality

Infants who survive their first year of life still do not have a long life expectancy in the poorer areas of the world. The **child mortality rate** (CMR), recording the deaths of children between the ages of 1 and 5, remains staggeringly high in much of Africa and Asia, notably in the protein-deficient tropical and subtropical zones. *Kwashiorkor* (also known as protein malnutrition), a malady resulting from a lack of protein early in life, afflicts millions of children; *marasmus*, a condition that results from inadequate protein and insufficient calories, causes the deaths of millions more. In some countries, more

than one in five children still die between their first and fifth birthdays, a terrible record in this twenty-first century.

Life Expectancy

Another indicator of a society's well-being lies in the **life expectancy** of its members at birth, the number of years, on average, someone may expect to remain alive. Figure 2.19 shows the average life expectancies of populations by country and thus does not take into account gender differences. Women outlive men by about four years in Europe and East Asia, three years in Subsaharan Africa, six years in North America, and seven years in South America. In Russia today, the difference is approximately 14 years.

The map does reveal huge regional contrasts. At the start of the century, world average life expectancy was 68 for women and 64 for men. Not only are these levels exceeded in the wealthy countries of the Western world, but great progress has also been made in East Asia, where Japan's life expectancies are the highest in the world. With its low infant and child mortality rates and low fertility rates, Japan's life expectancy is predicted to rise to 106 by the year 2300. By contrast, tropical Subsaharan African countries have the lowest life expectancies. In Subsaharan Africa, the spread of AIDS over the past two decades has lowered life expectancies in some countries below 40, a level not seen for centuries.

Life expectancies can change in relatively short order. In the former Soviet Union, and especially in Russia, the life expectancies of males dropped quite precipitously following the collapse of communism, from 68 to 62 years. Today, Russia's life expectancy is only 58 for males; female life expectancy also declined, but only slightly, from 74 to 72.

Life expectancy figures do not mean everyone lives to a certain age. The figure is an average that takes account of the children who die young and the people who survive well beyond the average. The dramatically lower figures for the world's poorer countries primarily reflect high infant mortality. A person who has survived beyond childhood can survive well beyond the recorded life expectancy. The low life expectancy figures for the malnourished countries remind us again how hard hit children are in poorer parts of the world.

Influence on Health and Well-Being

Health and well-being are closely related to location and environment. People who live in Iceland (where mosquitoes are rare) do not need to worry about contracting malaria, unless they travel to parts of the tropics where malaria prevails. People who live in close proximity to animals, including livestock, run a greater risk of catching certain diseases than do people who live in cities. When an outbreak of a particular disease occurs (for example "bird flu" in East Asia), its source and diffusion are studied by specialists in medical geography.

Medical geographers study diseases, and they also use locational analysis to predict diffusion and prescribe prevention strategies. A medical geographer can answer questions such as: Where is the bird flu most likely to diffuse and under what time line if an outbreak occurs in New York City? If a country receives enough funding to build 25 clinics for people in rural areas, where should these clinics be located so as to allow a maximum of patients to be able to reach them?

Diseases can be grouped into categories to make it easier to understand the risks they pose. About 65 percent of all diseases are known as **infectious diseases**, resulting from an invasion of parasites and their multiplication in the body. Malaria is an infectious disease. The remainder can be divided into the **chronic** or **degenerative diseases**, the maladies of longevity and old age such as heart disease, and the **genetic** or **inherited diseases** we can trace to our ancestry, that is, the chromosomes and genes that define our makeup. Sickle-cell anemia, hemophilia, and lactose intolerance are among these genetic diseases. These can be of special geographic interest because they tend to appear in certain areas and in particular populations, suggesting the need for special, local treatment.

Three geographic terms are used to describe the spatial extent of a disease. A disease is **endemic** when it prevails over a small area. A disease is epidemic when it spreads over a large region. A pandemic disease is global in scope.

Infectious Diseases

Infectious diseases continue to sicken and kill millions of people annually. Malaria, an old tropical disease, alone still takes more than a million lives annually and infects about 300 million people today. HIV/AIDS, an affliction that erupted in Africa only about 30 years ago, has killed about 25 million people since that time. These two maladies illustrate two kinds of infectious disease: *vectored* and *nonvectored*.

A vectored infectious disease such as malaria is transmitted by a intermediary *vector*, in malaria's case a mosquito. What happens is that the mosquito stings an already-infected person or animal, called a *host*, and sucks up some blood carrying the parasites. These then

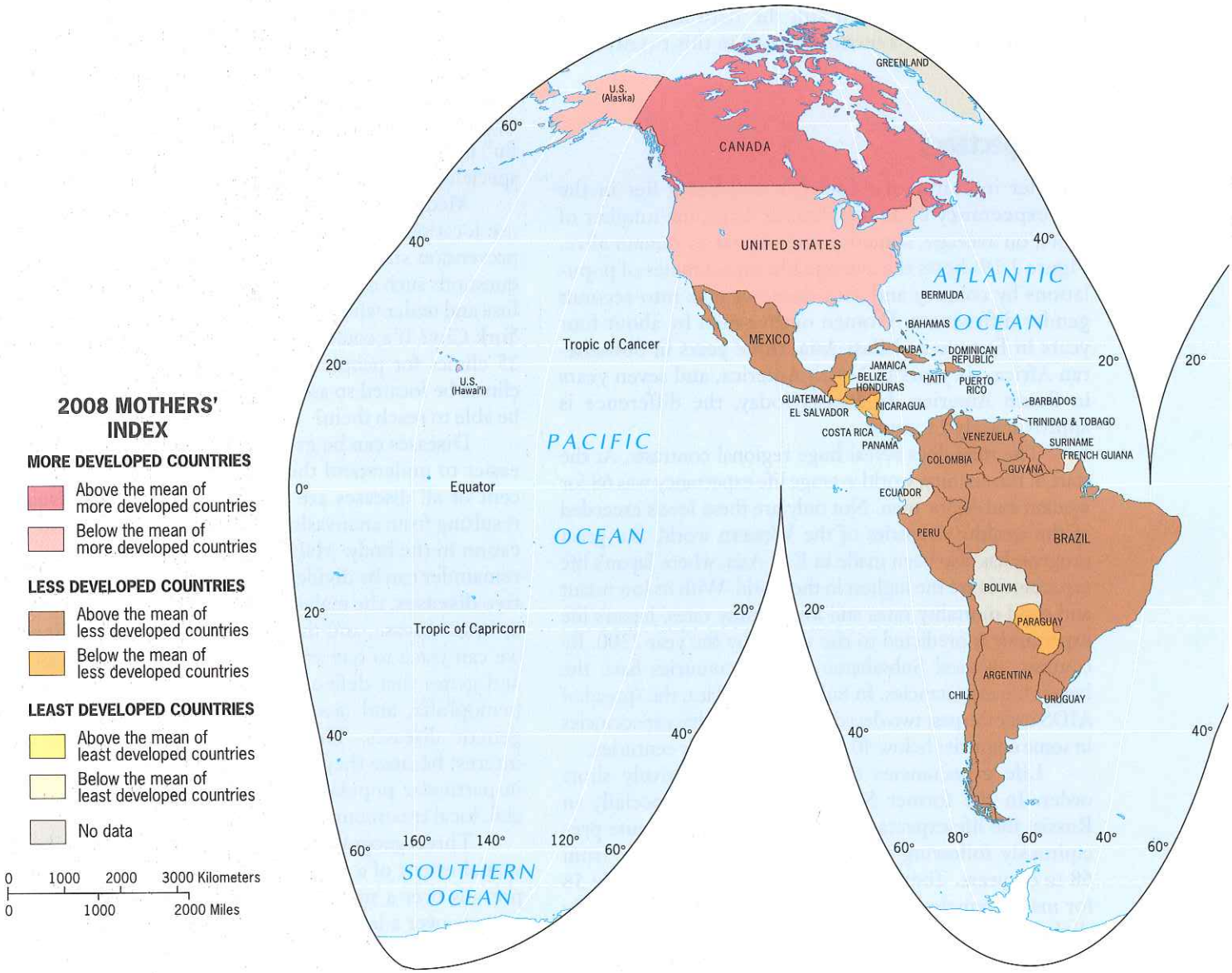
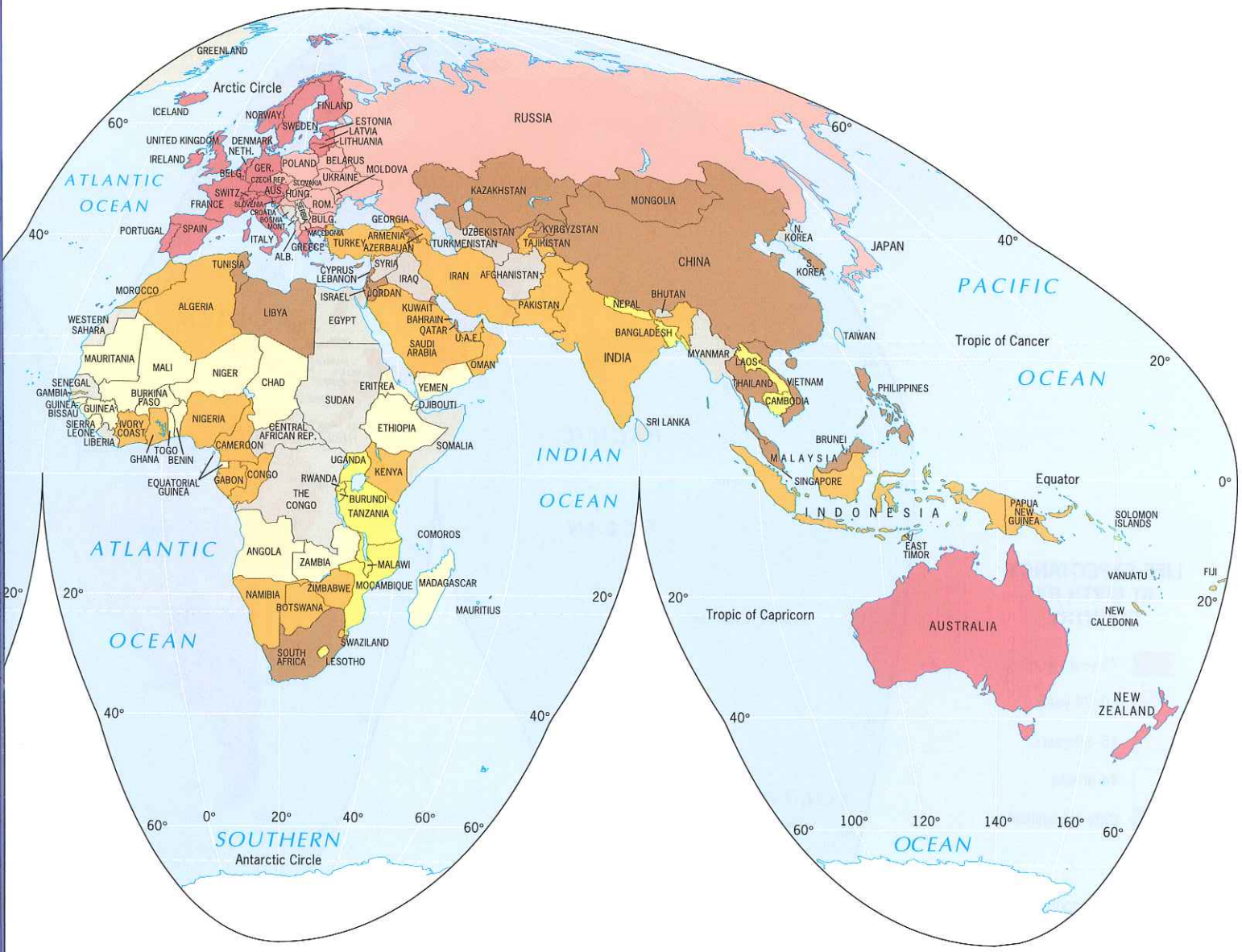


Figure 2.18

The Mothers' Index, 2008. Save the children calculates the mothers' index annually, based on 13 indicators, to guage the overall well-being of mothers and their children by country. *Data from*: Save the Children.

reproduce and multiply in the mosquito's body and reach its saliva. The next time that mosquito stings someone, some of the parasites are injected into that person's blood stream. Now that person develops malaria as the parasites multiply in his or her body, and he or she is a host.

Mosquitoes are especially effective vectors of infectious diseases ranging from yellow fever (another historic illness) to dengue fever (a newer disease that is fast spreading—see Chapter 1). But mosquitoes are only one kind of vector. Fleas, flies, worms, snails, and other vectors



transmit such terrible diseases as sleeping sickness, river blindness, guinea worm, elephantiasis, and numerous others. Tropical climates, where biological activity is most intense, are the worst-afflicted areas of the world, but infectious diseases are a global phenomenon.

No disease in human history has taken more lives than malaria, and the battle against this scourge still is not won. On the day you read this, about 3000 people will die from malaria, the great majority of them in Africa and most of them children. What these numbers do not tell you is that an esti-

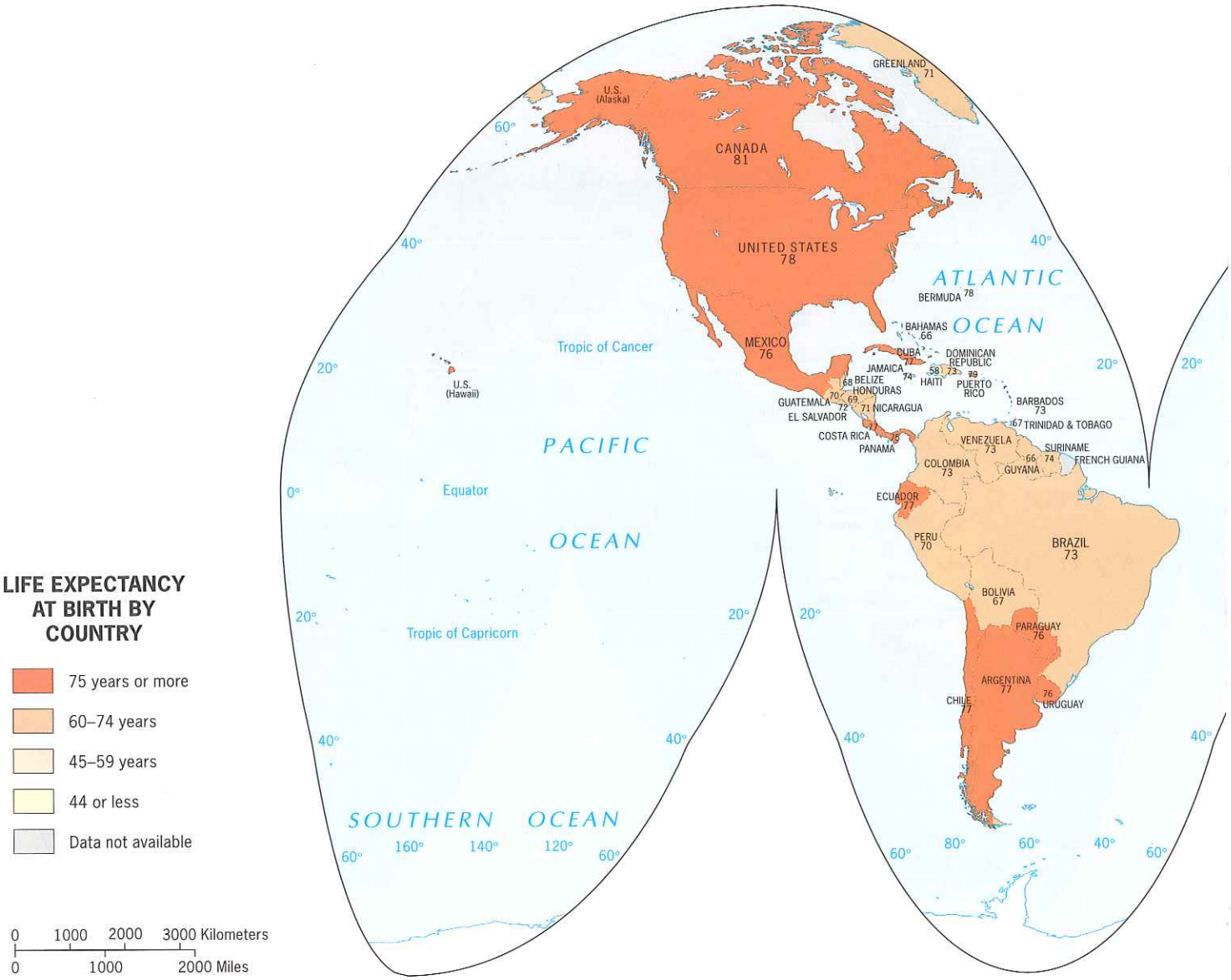
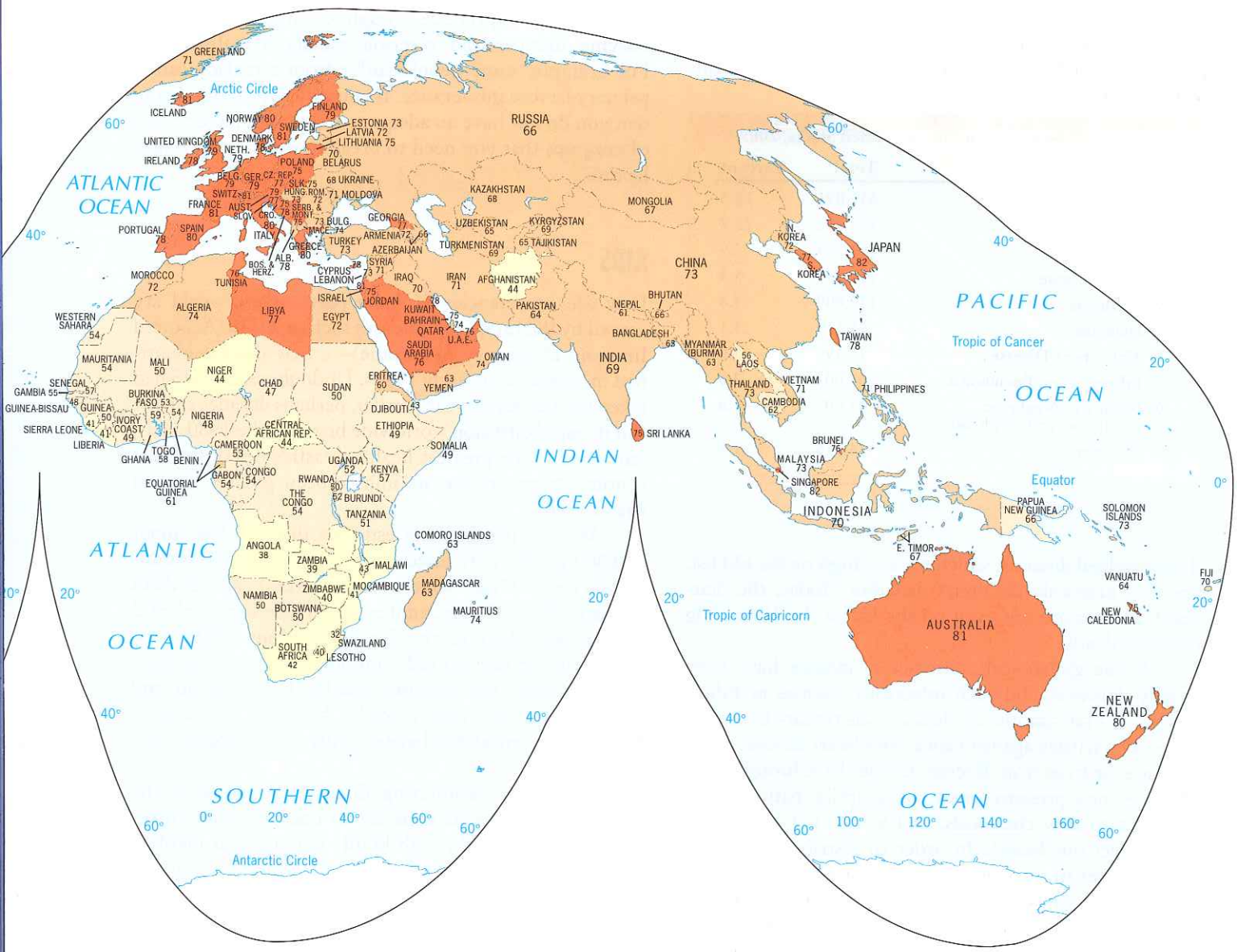


Figure 2.19
Life Expectancy at Birth in Years, 2008. *Data from:* CIA World Factbook, 2008 estimate.

mated 3 to 5 million people live lives that are shortened and weakened by malaria infection. If you do not die from malaria as a youngster, you are likely to be incapacitated or struggle in exhaustion with chronically severe anemia throughout your life (see Chapter 10 for a longer discussion of malaria).

Nonvectored infectious diseases, such as influenza, are transmitted by direct contact between host and victim. A kiss, a handshake, or even the slightest brush can transmit influenza, a cold, or some other familiar malady. Even standing close to another person so that tiny moisture particles in exhaled air can transmit the disease to you. HIV/AIDS (discussed below) is a nonvectored infectious disease that is transmitted primarily through sexual contact and secondarily through needle sharing in intraveneous drug use.



Chronic and Genetic Diseases

Chronic diseases (also called degenerative diseases) are the afflictions of middle and old age, reflecting higher life expectancies. Among the chronic diseases heart disease, cancers, and strokes rank as the leading diseases in this category, but pneumonia, diabetes, and liver diseases also take their toll. In the United States 100 years ago, tuberculosis, pneumonia, diarrheal diseases, and heart diseases (in that order) were the chief killers. Today, heart disease and cancer head the list, with cerebral hemorrhage (stroke) next and accidents also high on the list (Table 2.1). In the early 1900s, tuberculosis and pneumonia caused 20 percent of all deaths; today, they cause fewer than 5 percent.

TABLE 2.1
Leading Causes of Death in the United States, 2005. *Data from*: Center for Disease Control, National Center for Health Statistics, 2008.

Leading Causes of Death in the United States, 2005

Cause	Total	Percent
1. Heart Disease	652,091	26.6
2. Cancer	559,312	22.8
3. Stroke	143,579	5.9
4. Lung Diseases	130,933	5.3
5. Accidents	117,809	4.8
6. Diabetes	75,119	3.1
7. Alzheimer's Disease	71,599	2.9
8. Influenza and Pneumonia	63,001	2.6
9. Nephritis, Nephritic Syndrome, and Nephrosis	43,901	1.8
10. Septicemia	34,136	1.4

The diarrheal diseases, which were so high on the old list, are now primarily children's maladies. Today, the diarrheal diseases are not even on the list of the 10 leading causes of death.

At the global scale, diseases of infancy have been largely defeated, and such infectious diseases as tuberculosis and pneumonia are less serious threats than they were. The battles against cancer and heart disease, however, are far from won. Recent decades have brought new lifestyles, new pressures, new consumption patterns, and exposure to new chemicals, and we do not know how these affect our health. In order to distribute adequate food supplies to populations in huge urban areas, we add various kinds of preservatives to foods without knowing exactly how they will affect our health in the long run. We substitute artificial flavoring for sugar and other calorie-rich substances, but some of those substitutes have been proven to be dangerous. Despite all the sugar substitutes, obesity plagues a significant percentage of the U.S. population, bringing with it heart disease and diabetes. Even the treatment of drinking water with chemicals is rather recent in the scheme of global population change, and we do not know its long-term effects. Future chronic diseases may come from practices we take for granted as normal now.

Genetic diseases are of particular interest to medical geographers because they are disorders that tend to be transferred from one generation to the next and display clustering that raises questions about environment and long-term adaptation. Prominent among these are metabolic diseases—the body's inability to process all elements of the diet—in which enzymes play a key role. If the body fails to produce enough (or any) of a particular enzyme, that can lead to serious metabolic malfunction. For example, some people suffer from a malady called primary lactose intolerance. If you suffer from this disorder, you do not have an adequate supply of one (or a set) of enzymes that you need to break down the milk sugar lactose.

AIDS

Low life expectancies in some parts of the world are caused by the ravages of diseases such as **AIDS** (Acquired Immune Deficiency Syndrome)—a new disease identified in Africa in the early 1980s. Undoubtedly, AIDS had taken hold in Africa years earlier, perhaps decades earlier. But its rapid diffusion worldwide began in the 1980s, creating one of the greatest health catastrophes of the past century. Nowhere has its impact been greater than in Africa itself.

Medical geographers estimate that in 1980 about 200,000 people were infected with HIV (Human Immunodeficiency Virus, which causes AIDS), all of them Africans. By 2007, the number worldwide exceeded 33.2 million according to the United Nations AIDS Program, with 68 percent (22.5 million) of all cases in Subsaharan Africa! The infection rate has been slowing, and some regions have experienced a downturn, but eastern Europe and central Asia have recently seen a surge in HIV infection.

AIDS is a debilitating disease that weakens the body and reduces its capacity to combat other infections. It is spread through bodily contact that involves the exchange of bodily fluids such as blood or semen. Sexual activity and shared needles among drug users can transmit it but so can blood transfusions. Over a period of years, a person's immune system is impaired, weight loss and weakness set in, and other afflictions, such as cancer or pneumonia, may hasten an infected person's demise.

Over the past two decades, the AIDS pandemic has reached virtually all parts of the world, but its full dimensions are unknown. People infected by HIV do not immediately display visible symptoms of the disease; they can carry the virus for years without being aware of it, and during that period they can unwittingly transmit it to others. In its earliest stages a blood test is needed to confirm HIV's presence, but millions go untested. Add to this the social stigma many people attach to this malady, and it is evident that official statistics on AIDS lag far behind the real numbers.

That is true not only in Africa but in other parts of the world as well; both India and China, for example, long

denied that AIDS presents a serious health threat to their populations. Now China is reporting at least 650,000 infected, and the number in India may well exceed 5 million. Estimates of the number of cases in the United States surpass 1 million; in Middle and South America, nearly 2 million are infected. But after Africa, the worst-afflicted geographic realm is Southeast Asia, with as many as 6 million cases.

Nowhere is AIDS having the impact it has had on Subsaharan Africa, however. In 2006, some 24 percent of people aged 15 to 49 were infected in Botswana, 20 percent in Zimbabwe, almost 19 percent in South Africa, and 17 percent in Zambia. These are the official data; medical geographers estimate that 20 to 25 percent of the entire population of several tropical African countries is infected. The United Nations AIDS program reports that more than 1.6 million people died of AIDS in Subsaharan Africa in 2007 alone. Geographer Peter Gould, in his book *The Slow Plague* (1993), calls Africa a "continent in catastrophe," and the demographic statistics support his viewpoint. Life expectancy in Botswana and Swaziland has declined to 34 (and is projected to fall farther), and in Zimbabwe it is 36. In a continent already ravaged by other diseases, AIDS is the leading cause of death.

AIDS is reshaping the population structure of the countries hardest hit by the disease. Demographers look at the projected population pyramids for countries with high rates of infection and no longer see population pyramids—they see population chimneys. The shape of the projected population pyramid is altered to look more like a chimney than a pyramid, reflecting the major impact AIDS plays on the younger population in the country and its future generations (Fig. 2.20). The United States Census Bureau projects that AIDS will cause higher rates of death among young women than young men. In countries with population chimneys, men will take younger and younger brides, thus increasing the rate of AIDS in younger females.

Geographers are engaging in fieldwork to understand the human toll of AIDS locally and within families. Geographer Elsbeth Robson studied the impact of AIDS in hard-hit Zimbabwe. Robson found that global processes like the diffusion of AIDS and reductions in spending on health care (often mandated by structural adjustment programs) "shape young people's home lives and structure their wider experiences." In Subsaharan Africa, the number of children orphaned when parents die from AIDS is growing rapidly (Fig. 2.21). In 2004, UNICEF reported that in just two years, between 2001 and 2003, the number of global AIDS orphans (children who have lost a parent to AIDS) rose from 11.5 million to 15 million. Robson found that in addition to the rising

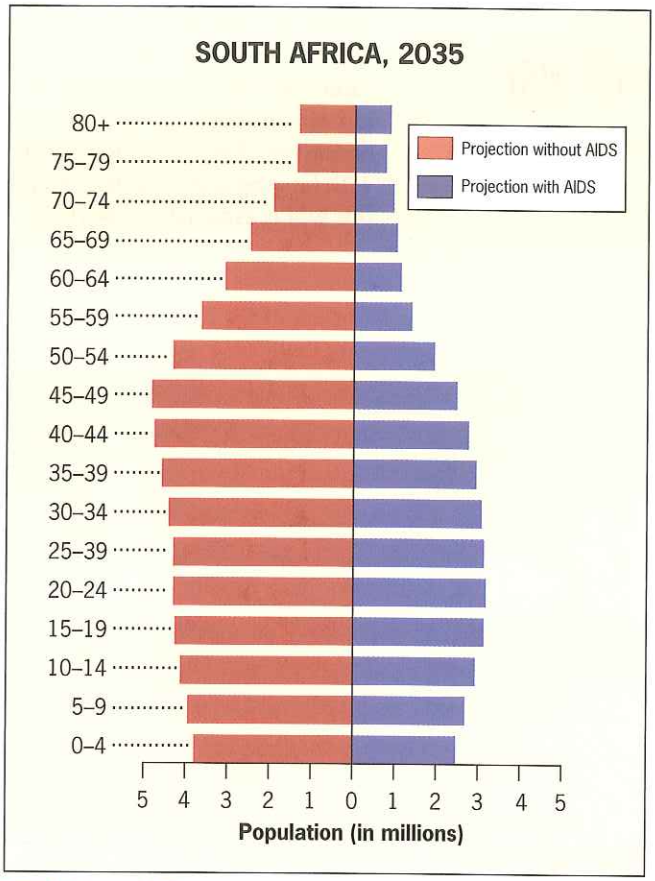


Figure 2.20
Affect of AIDS on the Population Pyramid for South Africa, predicted 2035. Estimated population, male and female, with AIDS and without AIDS. *Data from*: United States Census Bureau, 2005.

number of AIDS orphans, many young children, especially girls, are taken out of school to serve as caregivers for their relatives with AIDS (Figure 2.22). Robson found in her interviews with young caregivers that "more children are becoming young carers as households struggle to cope with income and labor losses through illness and mortality."

There are few positives to report. Uganda, once Africa's worst afflicted country, has slowed the growth of AIDS through an intensive, government-sponsored campaign of propaganda and action—notably the distribution of condoms in even the remotest part of the country. In the world's wealthier countries, remedies have been developed that can stave off the effects of AIDS for many years. But African countries cannot afford such luxuries. United Nations calculations suggest that globally upwards of $50 billion needs to be spent to slow AIDS and treat the infected by 2015; in 2007, only about 10 billion was

Guest Field Note

Marich Village, Kenya

This drawing was done by a Pokot boy in a remote primary school in North Western Kenya. He agreed to take part in my fieldwork some years after I had started researching young carers in Subsaharan Africa. Since those early interviews in Zimbabwe I have been acutely aware of young carers' invisibility—you can't tell who is a young carer just by looking at them. Indeed, invisibility is a characteristic of many aspects of the social impacts of HIV/AIDS. This young person drew himself working in the fields and taking care of cattle. The reasons why African young people help with farming and herding are many, but for young caregivers assisting their sick family members in this way is especially important.

Credit: Elsbeth Robson, Keele University

Figure 2.22

available. The impact of AIDS will be felt in African economies and in African demographics for generations to come. HIV/AIDS will constrain African economic development (see Chapter 10) and require world intervention to overcome.

thinking geographically

Study Figure 2.17, the infant mortality rate (IMR) by state in the United States. Hypothesize why the IMR is low in some regions of the country and high in others. Shift scales in your mind, and take one state and choose one state to consider—how do you think IMR varies within this state—what other factors are involved at this scale and this level of generalization to explain the pattern of IMRs? Use the population Internet sites listed at the end of this chapter to determine whether your hypotheses are correct.

HOW DO GOVERNMENTS AFFECT POPULATION CHANGE?

Over the past century, many of the world's governments have instituted policies designed to influence the overall growth rate or ethnic ratios within the population. Certain policies directly affect the birth rate via laws ranging from subsidized abortions to forced sterilization. Others influence family size through taxation or subvention. These policies fall into three groups: expansive, eugenic, and restrictive.

The former Soviet Union and China under Mao Zedong led other communist societies in **expansive population policies**, which encourage large families and raise the rate of natural increase. Ideological, anticapitalist motives drove those policies, now abandoned. Today, some countries are again pursuing expansive population policies—because their populations are aging and declining. The aging population in Europe has encouraged some countries to embark on policies to encourage