CHAPTER 2

Population and Health

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FIGURE 2.1 Shanghai, China. The Shanghai tower is over 2000 feet (600 m) tall. The view from the observation deck is dramatic, but murky at best.

I have been coming to Shanghai for years and have seen the rapid transformation of the city on the ground. Small houses have been leveled by the thousands and replaced with thousands of apartment buildings, each a dozen or more stories tall. The opening of the observation deck atop the recently built 128-story Shanghai Tower gave me the chance to get a bird's eye view of the city. It's a sunny day, but the view is obscured by air pollution (**Fig. 2.1**). The explosive growth of Shanghai and other Chinese cities has come with costs, and one of them is significant air pollution.

China's population of 1.4 billion people has been migrating to cities in droves. China has more than 100 cities with more than 1 million people. Shanghai is the largest, with an estimated 22 million people. Rapid urbanization, stemming from a combination of rapid economic and population growth, has taken its toll on the environment and people's health. Coal is the biggest source of fuel in China. Burning coal emits PM-2.5, a small (fine particle) air pollutant that is particularly dangerous to human health because when it is inhaled, it damages the lungs. Unlike larger particles that may simply irritate your eyes or throat, PM-2.5 particles are so fine they can even get into the bloodstream. One study found that Chinese life expectancies in the north, where air pollution rates are higher, are 5.5 years shorter than life expectancies in the south. To reduce air pollution, China limited coal burning, banned imports on plastics for incineration (see Chapter 13), and restricted the number of cars on roads in major cities.

In this chapter, we examine population trends across the world and at different scales. We also look at how population growth is tied to global health because health, well-being, and population growth are closely related, in China and around the world.

CHAPTER OUTLINE

2.1 Describe the Patterns of Population Distribution.

Geographers examine patterns of population distribution. We ask why population densities are higher in some places than in others, and why population growth rates differ from place to place. **Demography** is the study of general population trends. Population geographers work together with demographers, seeking answers to how and why population trends vary across space (**Fig. 2.2**). Scale (see Chapter 1) is crucial to studies of population because population dynamics that are evident at small scales (local or state) cannot necessarily be seen when one looks at the country, region, or global scales. For example, people may migrate from the central city to the suburbs in one city, but that trend is not evident globally.

Population Density

Population density is a measure of total population relative to land area. Population density assumes an even distribution of people over an area. The United States, for example, with a territory of 5,692,815 sq miles or 9,161,966 sq km,[1] has a population of 326 million. This yields an average population density for the United States of just over 86 people per sq mile (33 per sq km). This density figure is also known as the country's **arithmetic population density**, and in a very general way it emphasizes the contrasts between the United States and much more densely populated countries, including Bangladesh at 2962 people per sq mile (1144 per sq km), the Netherlands with 1068 people per sq mile (412 per sq km), or Japan at 869 people per sq mile (335 per sq km).

No country has an evenly distributed population. Arithmetic population densities do not reflect the emptiness of parts of Alaska or the sparseness of population in much of the West. Arithmetic population figures can actually be quite misleading. Egypt, with a population of 97.6 million, has a seemingly moderate arithmetic population density of 252 people per sq mile (97 per sq km). Egypt's territory of 384,345 sq miles (995,450 sq km), however, is mostly desert, and the vast majority of people are crowded into the valley and delta of the Nile River. Nearly 98 percent of all Egyptians live on just 3 percent of the country's land; so, the arithmetic population density figure is meaningless in this case (**Fig. 2.3A and B**).

Physiologic Population Density

Physiologic population density relates the total population of a country to the area of arable (farmable) land. Like arithmetic population density, physiologic population density is expressed in number of people per sq mile (sq km), but the only land counted in the area is agriculturally productive land. Take Egypt as an example again. The population density of Egypt is 252 people per sq mile, but if we only count arable land in the calculation, the population density is much higher. Egypt's physiologic density is 6995 people per sq mile (2701 per sq km). The higher density expressed in the physiological population density better reflects Egypt's population pressure, and it continues to rise rapidly despite Egypt's efforts to expand its irrigated farmlands.

[1]Territory excludes the surfaces of lakes and ponds and coastal waters up to three nautical miles from shore.

Author Field Note Taking in the Busy Streets of Yangon, Myanmar

"An overpass across one of Yangon's busy streets provided a good perspective on the press of humanity in Southeast Asia. Whether in urban areas or on small back roads in the countryside, people are everywhere – young and old, fit and infirm. When population densities are high in areas of poverty and unsophisticated infrastructure, vulnerabilities to natural hazards can be particularly great. This phenomenon became stunningly evident in 2008 when a tropical cyclone devastated a significant swath of the Irrawaddy delta south of Yangon, killing some 100,000 people and leaving millions homeless."

– A. B. Murphy

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FIGURE 2.2 **Yangon, Myanmar (Burma).**

Author Field Note Traveling from Lush Fields to Desert Sands in Luxor, Egypt

"The contrasting character of the Egyptian landscape could not be more striking. Along the Nile River, the landscape is one of green fields, scattered trees, and modest houses, like along this stretch of the river's west bank near Luxor (**Fig. 2.3A**). But anytime I wander away from the river, brown, wind-sculpted sand dominates the scene as far as the eye can see (**Fig. 2.3B**). Where people live and what they do is not just a product of culture; it is shaped by the physical environment as well."

– A. B. Murphy

FIGURE 2.3A AND B **Luxor, Egypt.**

Appendix B provides complete data on both arithmetic and physiologic population densities, and some of the data are striking. Mountainous Switzerland's physiologic density is 10 times as high as its arithmetic density because only 1 out of every 10 acres in Switzerland is arable. Ukraine's population is 44,800,000, and its arithmetic population density is 192 per sq mile (74 per sq km). Ukraine has vast farmlands, which make its physiologic density 281 people per sq mile of arable land (109 per sq km). The difference in arithmetic density and physiologic density for a single country reveals the proportion of arable land to all land. In the case of Ukraine, the physiologic density is 1.46 times as high as the arithmetic density because 1 out of every 1.46 acres of land in Ukraine is arable.

In Appendix B, the countries and territories of Middle America and the Caribbean stand out as having high physiologic densities compared to the moderate physiologic densities for South America. India's physiologic density is the lowest in South Asia despite its huge population. Both China and India have populations well over 1 billion, but according to the physiologic density, India has much more arable land per person than China.

Population Distribution

Globally, people are not distributed evenly, and within world regions or countries, people are not distributed evenly, either. One-third of the world's population lives in China and India. Yet each country has large expanses of land (the Himalayas in India and a vast interior desert in China) where people are very sparsely distributed. In addition to studying population densities, geographers study population distribution. A **population distribution** is the description of the pattern in the spatial arrangement of people, including where large numbers of people live closely together (*clustering*) and where few people live (*dispersed*).

Historically, people lived in places where they could grow food—making for a high correlation between arable land and population density. Cities generally began in agricultural areas, and for most of history, people lived closest to the most agriculturally productive areas. In recent times, advances in agricultural technology and in the transportation of agricultural goods have begun to change this pattern. Population distribution maps reflect this change, as people cluster more closely together in urban areas and are more dispersed across rural areas.

Geographers represent population distributions on thematic maps using **dot maps**, with each dot representing a certain number of people. At the local scale, a dot map of population can show each individual farm in a sparsely populated rural area. At the global scale, the data are much more generalized (**Fig. 2.4**).

At the global scale, where one dot on a map represents 100,000 people, three major clusters of population stand out. The three largest clusters are East Asia, South Asia, and Europe. North America is fourth.

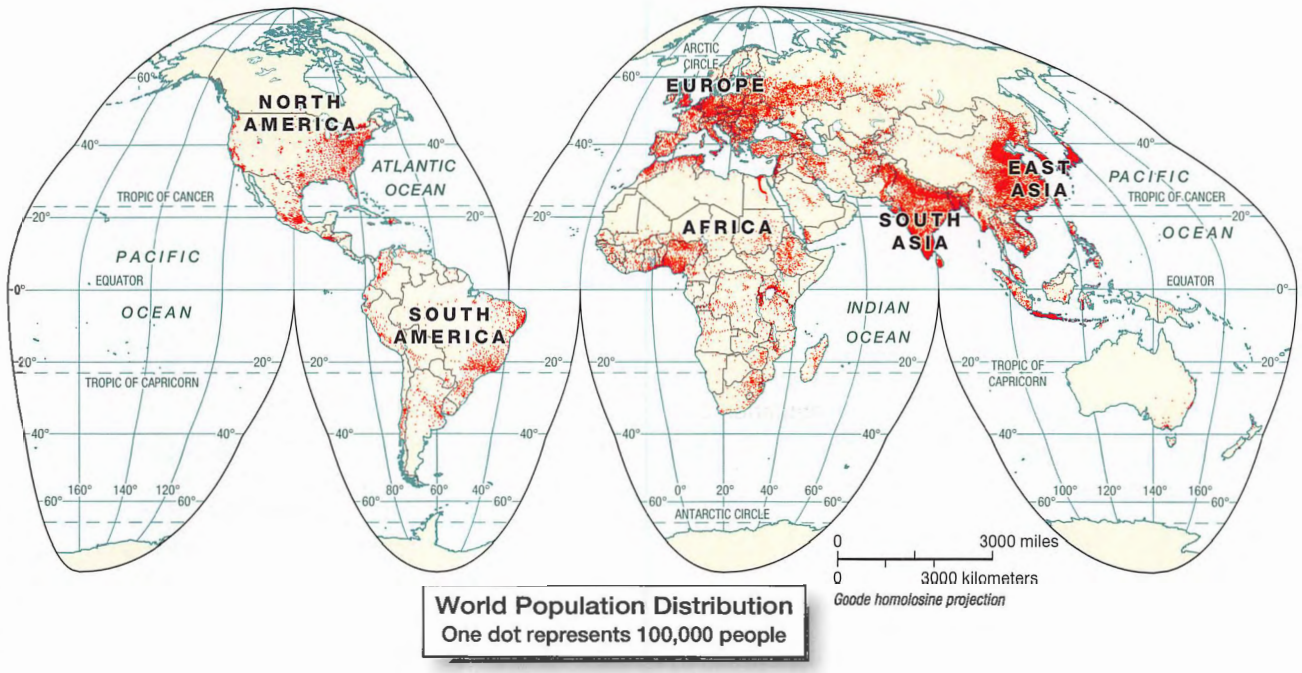


FIGURE 2.4 World Population Distribution. The largest clusters of people globally are in East Asia, South Asia, and Europe. Throughout the world, people are concentrated along coastlines, near major rivers, and in cities. Extreme climates, including polar regions and deserts, are sparsely populated as are mountainous areas.

East Asia

Figure 2.5 is a dasymetric map of population. It takes into account underlying landscape and topography to better estimate where people are clustered and where they are sparsely distributed. The largest population concentration lies in East Asia, primarily in China but also in Korea and Japan. Almost one-quarter of the world's population is clustered here—1.4 billion people in China alone. In addition to high population density in China's large cities, ribbons of high population density extend into the interior along the Huang He and Yangtze valleys. Farmers along China's major river valleys produce crops of wheat and rice to feed not only themselves but also the population of major Chinese cities such as Shanghai and Beijing.

South Asia

The second major population cluster also lies in Asia. At the heart of the South Asian cluster of 1.5 billion people is India, and the cluster extends into Pakistan and Bangladesh and onto the island of Sri Lanka. On the map, the South Asian cluster looks more concentrated than the East Asian cluster because the region is surrounded by physical barriers where population density abruptly declines. South Asia is surrounded physically by the Himalaya Mountains to the north, mountain chains in Afghanistan and Pakistan on the west, and the Indian Ocean around the south and east.

As in East Asia, people in South Asia cluster in major cities, on the coasts, and in major river basins, including the Ganges, Indus, and Brahmaputra. The South Asian population cluster is growing more rapidly than East Asia because India's growth rate of 1.17 is higher than China's at 0.56. Demographers predict that by 2030, India will be the most populated country in the world, and 1 out of 6 people in the world will live in India.

Population density is so high in South Asia that even rural areas of the region have high population densities. In Bangladesh, over 156 million people, almost all of them small farmers, are crowded into an area about the size of Iowa. Over large parts of Bangladesh, the rural population density is between 3000 and 5000 people per sq mile. By comparison, in 2017 the population of Iowa was just about 3.15 million people, and the rural population density was 55 people per sq mile.

Europe

The European population cluster contains over 725 million inhabitants, less than half the population of the South Asia cluster. A comparison of the population and physical maps indicates that in Europe, terrain and environment are not as closely related to population distribution as they are in East and South Asia. In Asia, high population densities follow coastlines and rivers more clearly than in Europe. Europe is densely populated even in mountainous, rugged country.

Europe was the hearth of the Industrial Revolution and the second urban revolution. That means Europe industrialized

and had a second urban revolution (see Chapters 9 and 12) before Asia. European cities and towns grew through the 1800s and 1900s, especially in industrial areas, including northern France, western Germany, northern Italy, and east into Russia. In Germany, 77 percent of the people live in urban places; in the United Kingdom, 83 percent; and in France, 80 percent. With so many people concentrated in the cities, the rural countryside is more open and sparsely populated than in East and South Asia.

The three major population concentrations we have discussed—East Asia, South Asia, and Europe—account for approximately 4 billion of the world population of 7.7 billion people. Nowhere else on the globe is there a population cluster even half as great as any of these. The populations of South America and Africa combined barely exceed the population of India alone.

North America The fourth largest population cluster is North America, and we describe it here for a reference point for students living in or familiar with the U.S. and Canada. North America has one quite densely populated region, stretching along the urban areas of the east coast, from Boston in the north to Washington, D.C. in the U.S. and from Quebec City to Montreal, Ottawa, Toronto, and Windsor in Canada. Areas of dense population extend from one city in the region to the next, as shown in **Figure 2.6**. Urban geographers use the term **megalopolis** to refer to a huge urban agglomeration like this one. The cities of this megalopolis are home to more than 70 million people. Half of Canada's population lives in the Quebec City to Windsor corridor, and about 20 percent of Americans live in the Boston to Washington, D.C. corridor.

The combined North American megalopolises in the northeast U.S. and southeast Canada create a population cluster that is about one-quarter the size of Europe's population cluster. If you have lived or traveled in this megalopolis, you can think about traffic and comprehend what dense population means. However, the total population of this megalopolis is small in comparison with the East Asian population cluster, and the 28,717 people per sq mile density of New York City (11,000 per sq km) does not rival the density in world cities such as Mumbai, India, with a population density of 68,400 per sq mile (26,400 per sq km), or Dhaka, Bangladesh, with a population density of 122,700 per sq mile (47,400 per sq km).

Reliability of Population Data

When the United States plans and conducts its **census** every 10 years, the government runs a marketing campaign encouraging every person in the country to be counted. Because much federal government funding depends on population data, state and city governments also recognize the importance of having their citizens counted in order to gain more federal dollars per capita. If the population is undercounted, that translates into a loss of dollars for city governments.

Research confirms that migrants, racial minorities, families who double up in rentals or do not have homes, and low-income families are less likely to complete a census form. Advocates for disadvantaged groups encourage people to fill out their census forms. They are concerned that the people in disadvantaged groups suffer further from lack of additional funding for services when they are undercounted in the census. Being undercounted also translates into less government representation because the number of congressional seats allotted to each state is based on the census counts.

For recent censuses, advocacy groups have urged the Census Bureau to sample the population and derive population statistics from the samples. They argue that this approach would more accurately reflect the number of people in the United States. However, the United States Census Bureau has continued to conduct its census as it always has, trying to count each individual in its borders. Controversies have also arisen over asking citizenship questions on the census. Advocates of such questions point to the importance of drawing distinctions between citizens and unauthorized or undocumented immigrants. Opponents argue that a citizenship question will discourage anyone with any legal concerns about citizenship from filling out census forms, which will produce an inaccurate count of the population in the U.S.

The debates over how to conduct a census and the cost involved in counting every person in a country make getting accurate counts difficult. Nonetheless, several agencies collect data on population by country. The United Nations assembles and reports official statistics from governments of countries. The World Bank and the Population Reference Bureau also gather and generate data and report on the population of the world and of individual countries. If you compare the population data reported by each of these sources, you will find inconsistencies in the data. Data on population, growth rates, food availability, health conditions, and incomes are often informed estimates rather than actual counts.

TC Thinking Geographically

How does reading about the 3 largest population clusters in the world (East Asia, South Asia, and Europe) and studying Figures 2.4 and 2.5 change your **mental map** of where people live in the world and why people are clustered in certain regions? Compare Figures 2.4 and 2.5 with Figure 9.41. Explain the role **world cities** play in the distribution of people.

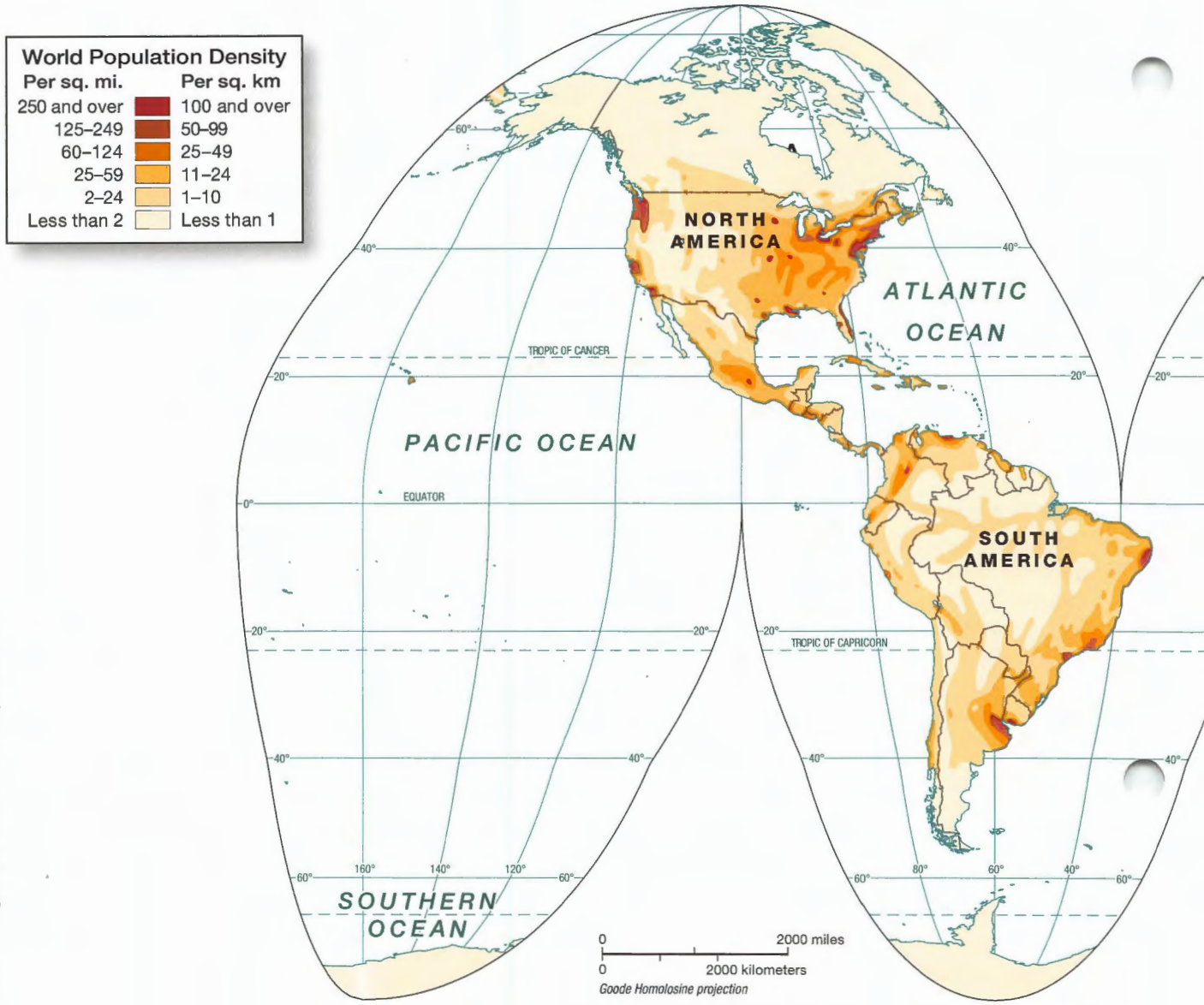


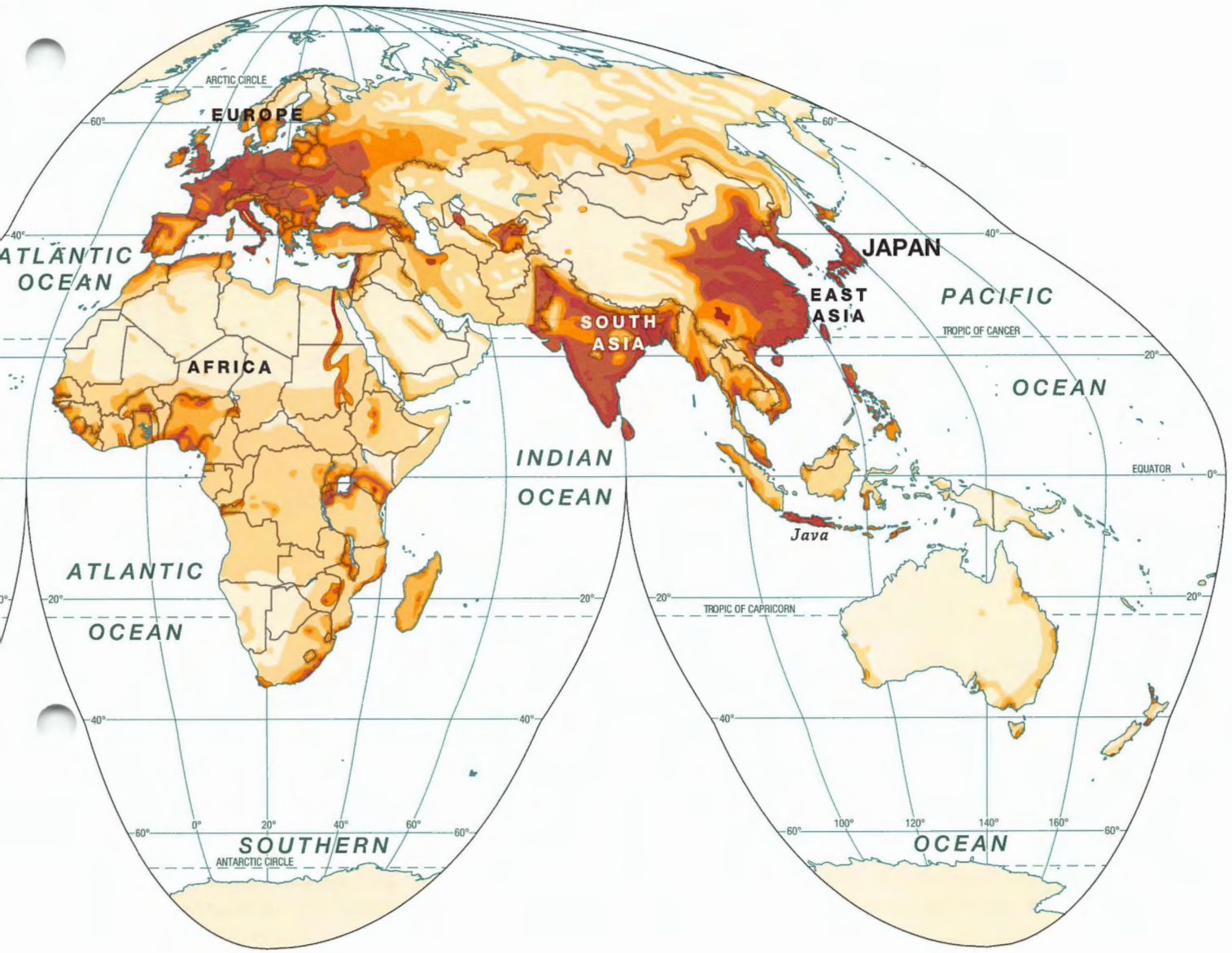
FIGURE 2.5 World Population Density. This dasymetric map of population takes the underlying landscape, land cover, and topography into account when distributing people on the map. You can see where people cluster and which areas are sparsely populated. The common color among East Asia, South Asia, and Europe shows that these regions have similar population densities.

2.2 Identify and Explain Influences on Population Growth over Time.

In the late 1960s, alarms sounded throughout the world with the publication of Paul Ehrlich's *The Population Bomb*. Ehrlich and others warned that the world's population was outpacing food production. We can trace alarms over the rapidly increasing world population back to 1798, when a British economist published an essay warning that the world's population was growing at a rate faster than food supplies and that famine and war would be the result.

Malthus

The British economist Thomas Malthus published *An Essay on the Principles of Population* in 1798. He warned that the world's population was increasing faster than the food supplies needed to sustain it. Malthus reasoned that food supplies grow linearly, adding acreage and crops incrementally by year, but population grows exponentially, compounding on the year

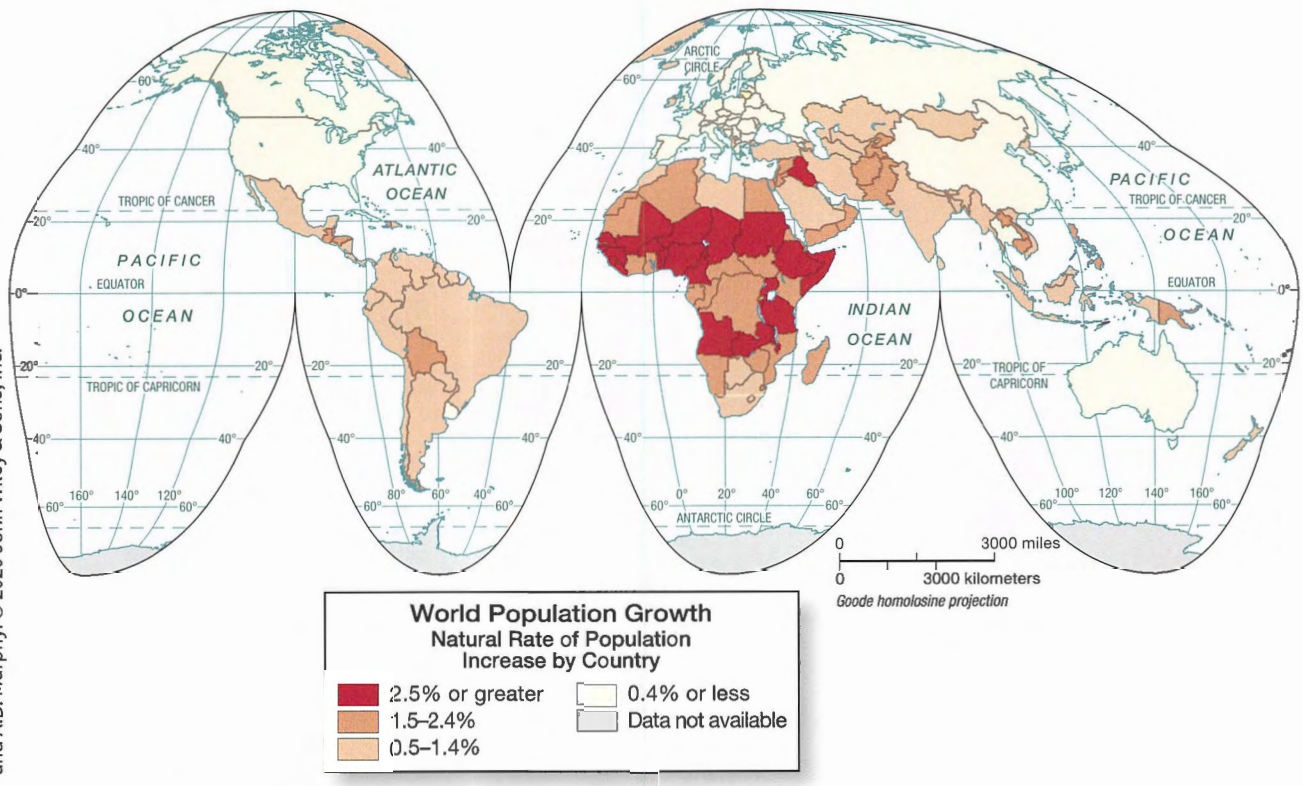


before. From 1803 to 1826, Malthus issued revised editions of his essay and responded vigorously to criticism. Malthus's predictions assumed that what people can eat within a country depends on what is grown in the country.

We now know his assumption that countries depend completely on what is grown inside their borders does not hold true. Countries are not closed systems. Malthus did not foresee how agricultural goods would be exchanged across the world through globalization. Mercantilism, colonialism, and capitalism brought global interaction among the Americas, Europe, Africa, Asia, and the Pacific. Through global interaction, new agricultural methods developed, and commodities and livestock diffused across oceans. Crops well suited for certain climates and soils arrived in new locations. For example, while the potato is associated with Ireland, Irish farmers did not grow potatoes until the 1700s, when the crop arrived from South America. Countries with little arable land were increasingly able to import a wide variety of crops. Only 2 percent of the land in Norway is arable, but they can import the majority of their food, circumventing the limitations on food production there.

In recent decades, food production has grown rapidly because the amount of cultivated land has expanded. Improved seed strains, pesticides, fertilizers, irrigation systems, and constant innovation have remarkably increased yields per acre (see Chapter 11). In the twenty-first century, bioengineering continues to bring new hybrids, genetically modified organisms, and new fertilizers that have continually expanded food production.

The environmental costs of modern farming techniques raise serious questions about future limitations on the exponential expansion of agriculture. Neo-Malthusians who are



Data from: Population Reference Bureau, 2018. Visualization by E.H. Fouberg and A.B. Murphy. © 2020 John Wiley & Sons, Inc.

FIGURE 2.6 Natural Increase Rate. The natural increase rate subtracts crude death rates from crude birth rates and does not include immigration or emigration. Natural increase rates are high in Africa and low in North America, Europe, Russia, China, Japan, and Australia.

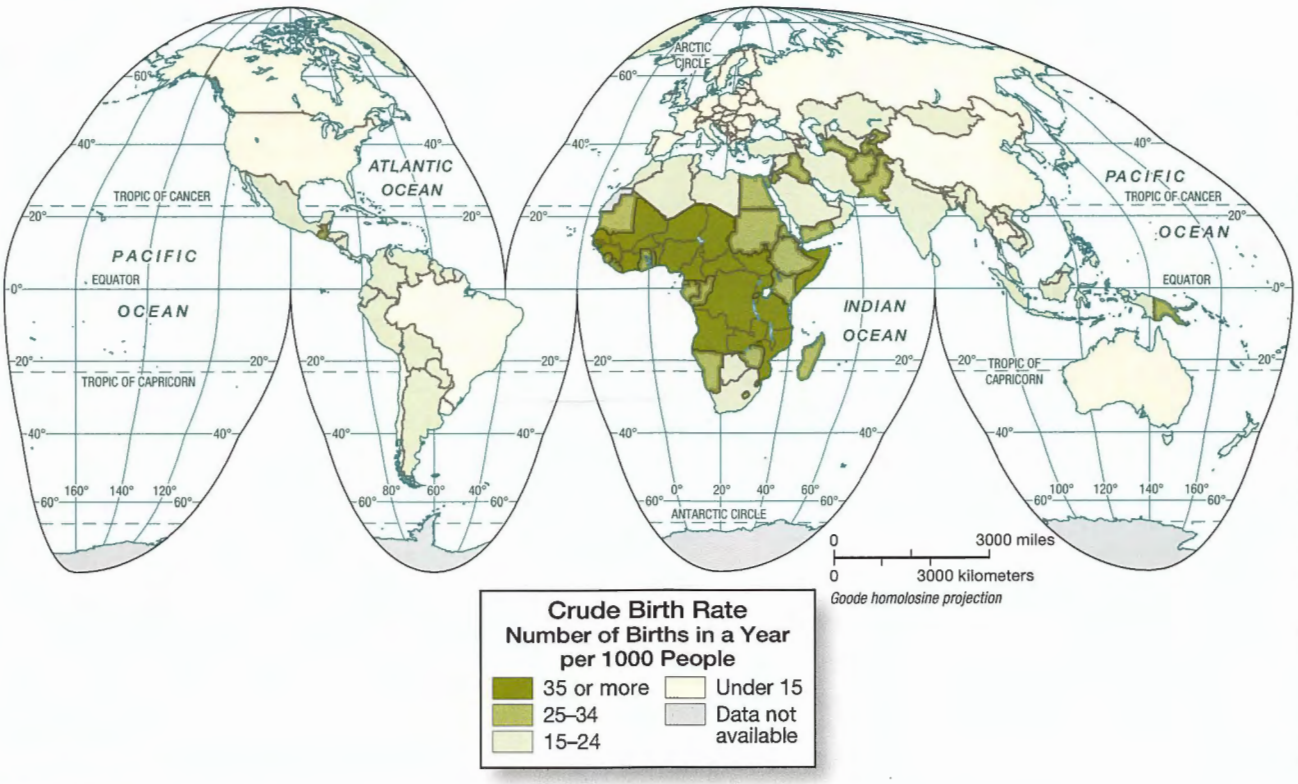
reviving Malthus's ideas focus much more on the growing population of the world than on food production. Although many demographers predict that the world's population will stabilize later in the twenty-first century, neo-Malthusians argue that overpopulation is a real problem and will cause human suffering. Neo-Malthusians are pessimistic that Earth can sustain a larger population and believe population will be checked when we reach the limits of resources including not just food, but also energy and water.

Natural Increase Rate

Geographers and demographers measure population change and composition to compare relative differences among countries, study outcomes of population change, and make predictions. Two statistics are used to calculate the **natural increase rate** of a population: the crude birth rate and the crude death rate (Fig. 2.6). The **crude birth rate** (CBR) is the number of live births per year per thousand people (**Fig. 2.7**). The **crude death rate** (CDR) is the number of deaths per year per thousand people (**Fig. 2.8**). Subtracting the crude death rate from the crude birth rate gives us the rate of natural increase. The natural increase rate shows how a country's population is changing without migration, because immigration (in) and emigration (out) are not included in the natural increase rate. Europe and Russia have negative natural increase rates, meaning that without immigration, their populations are declining.

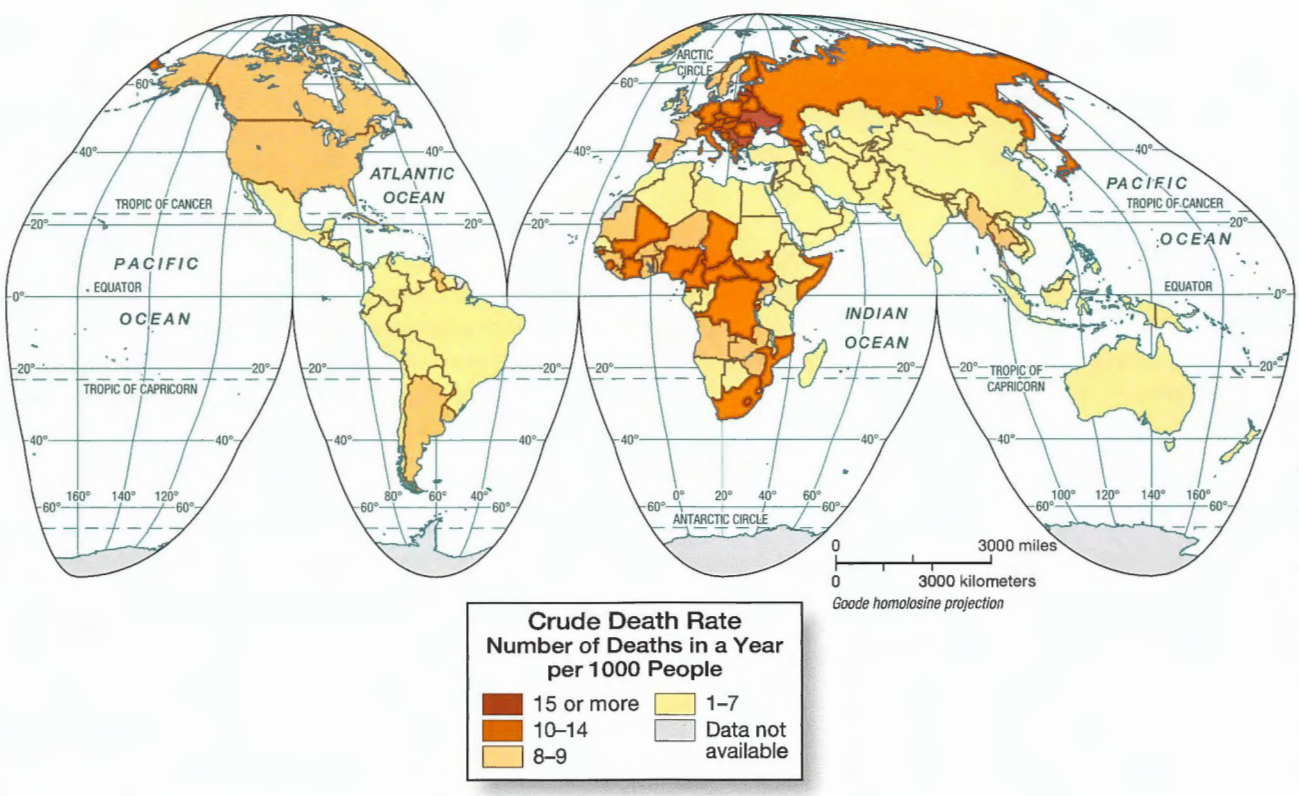
The world map (Fig. 2.6) shows a wide range of natural increase rates across world regions. Countries and regions go through stages of expansion and decline. In the mid-twentieth century, the population of the former Soviet Union was growing vigorously, but the country's growth rates fell quickly when the Soviet Union dissolved in 1991. Thirty years ago, India's population was growing at nearly 3 percent, more than most African countries; then India's growth rate fell below Africa's. Today, Africa's rate of natural increase still is higher than India's (2.43 percent to 1.17 percent), but parts of sub-Saharan Africa are still being impacted by the HIV/AIDS epidemic, which killed millions, produced orphaned children, reduced life expectancies, and curtailed growth rates.

The map also reveals continuing high growth rates in Muslim countries of North Africa and Southwest Asia, including Sudan (2.55 percent), Yemen (2.52 percent), Afghanistan (2.65 percent) and the Palestinian territories (2.83 percent). For much of the second half of the twentieth century, countries in this region saw their growth rates increase even as



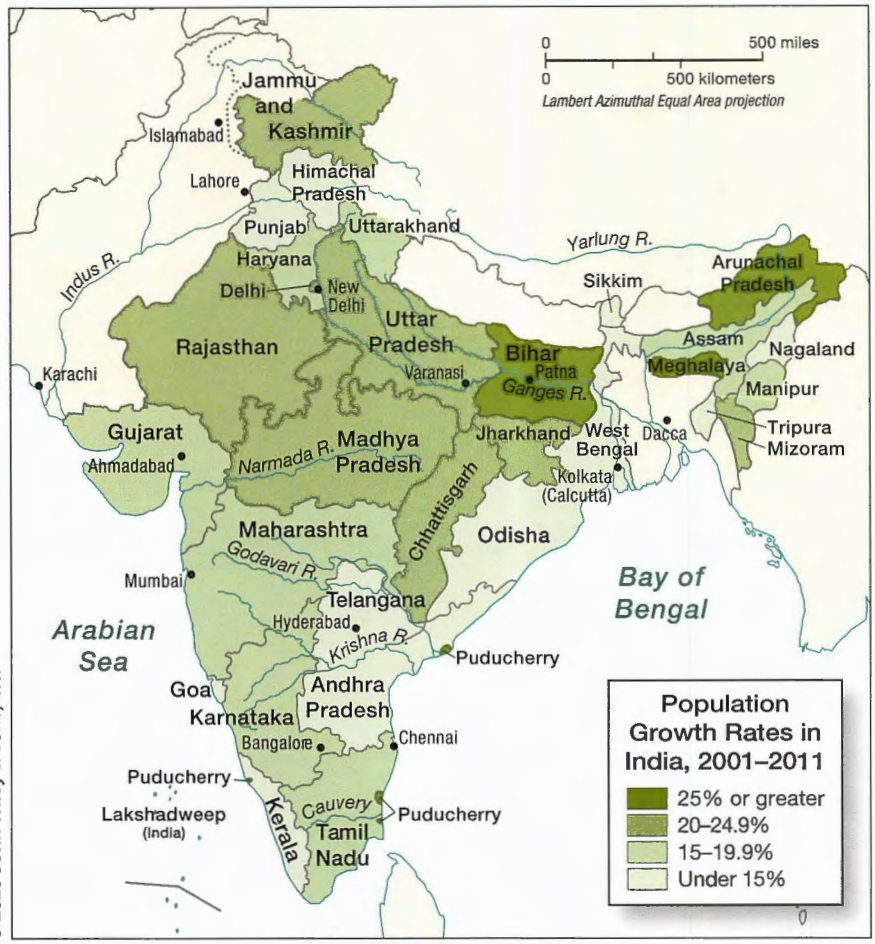
Data from: World Bank, 2019. Visualization by E.H. Fouberg and A.B. Murphy.

FIGURE 2.7 Crude Birth Rate. Number of Births in a Year per 1000 People. A fairly distinct north–south pattern is evident, as northern countries have lower crude birth rates than southern countries. Africa has higher crude birth rates than South America, South Asia, and Southeast Asia.



Data from: World Bank, 2019. Visualization by E.H. Fouberg and A.B. Murphy.

FIGURE 2.8 Crude Death Rate: Number of Deaths in a Year per 1000 People. The death rate has declined globally as countries have transitioned into the third stage of the demographic transition and beyond. A few countries in the global north have relatively high death rates, including Russia and a number of eastern European countries.



Data from: India Census Bureau, 2011. Visualization by E.H. Fouberg and A.B. Murphy.

FIGURE 2.9 Population Growth Rates in India, 2001–2011. Northern India continues to have the highest growth rates. Population growth rates are lower in southern India, where women have higher literacy rates, better access to health care and birth control, and higher land ownership rates than in northern India.

those in most of the rest of the world were declining. But more recently several countries with fast-growing populations, such as Iran, Oman, and Morocco, have shown significant declines. Demographers point to the correlation between high growth rates and opportunities for women. Where cultural traditions restrict educational and professional prospects for women, and men dominate family dynamics as a matter of custom, rates of natural increase tend to be high.

South Asia is a particularly important geographic region in the population growth rate picture. The region includes India. India's growth rate has slowed significantly in recent years—even falling a little below the global average, but it remains higher than China's. The situation in East Asia, the world's most populous region, is different. China's official rate of natural growth has fallen well below the global average, and Japan's population is shrinking. Southeast Asia's natural growth rates remain higher, but this region's total population is much lower than that of either East or South Asia. Moreover, key countries, such as Indonesia and Vietnam, have declining growth rates, and in Thailand's case, the growth rate is negative.

South America, whose natural population growth rates were quite high just a generation ago, is experiencing significant reductions in growth rates. The region as a whole is still growing at a little over 1 percent, but Brazil's population growth rate, for example, has declined from 2.9 percent in the mid-1960s to 0.8 percent today. And the populations of Argentina, Chile, and Uruguay are growing at rates well below the world average.

As **Figure 2.6** shows, the countries with the lowest growth rates—including those with declining rates of natural population increase—lie in the global economic core, extending from the United States and Canada across Europe to Japan. Australia and Uruguay are in this category. Wealth is not the only reason for negative population growth rates. After the Soviet Union dissolved in 1991, deteriorating health conditions, high rates of alcoholism and drug use, a rise in male suicide rates, and economic problems led to negative population growth in Russia and several of the other countries that were once part of the Soviet Union. In recent years, Russia's economy has improved, but its birth rate has remained low. The same is true in Ukraine (also once part of the Soviet Union), which shows negative growth.

Between 1900 and 2000, the world's population rose from 1.6 billion people to 6.1 billion, and in 2019, it rose above 7.7 billion. Population growth is not simply a result of women having more children. It is also a result of expanded life expectancies. In 1900, global life expectancy was 30 years; by 2016, it was 72 years. Demographers now predict that world population may well level off at 10 to 11 billion people somewhere between 2050 and 2100. The global composition of younger to older people in 2050 will be markedly different than the global composition in 1900 because of declining birth rates and rising life expectancies.

India The world map of growth rates is a good overview, but it does not show us differences within countries. India is a federation of 29 states and 7 union territories, and the individual states differ greatly both culturally and politically. In India, states in the north record population growth rates far above the national average (**Fig. 2.9**). In southern and western India, populations are growing much more slowly. Women in southern and western India have higher literacy rates (**Fig. 2.10**), greater

land ownership rates, better access to health care, and more access to birth control methods. All of these factors keep growth rates lower in southern and western India than in northern and eastern India.

In 1952, India became the first country in the world to institute a population planning program. The goals were to lower fertility rates and slow the population growth rate. In 1976, the Indian government led a mass sterilization drive. The government focus was forced sterilization of any man with three or more children. Zealous government agents, some working under quotas, brought men without children into clinics to be sterilized. One doctor reported that he let men without children out the back door of the clinic without sterilizing them during the 1976 sterilization campaign. In 1976, the state of Maharashtra sterilized 3.7 million men and women before public opposition led to rioting, and the government abandoned the program (**Fig. 2.11**). Other states also engaged in compulsory sterilization programs, with heavy social and political costs. The 1976 program sterilized 6 million men.

India shifted its family planning focus from sterilizing men to distributing birth control to women. The Indian government makes injectable contraceptives available to women across the country. Most Indian state governments are using advertising and persuasion to encourage families to have fewer children. Posters urging people to have small families are everywhere, and the government supports a network of family planning clinics even in the remotest villages.

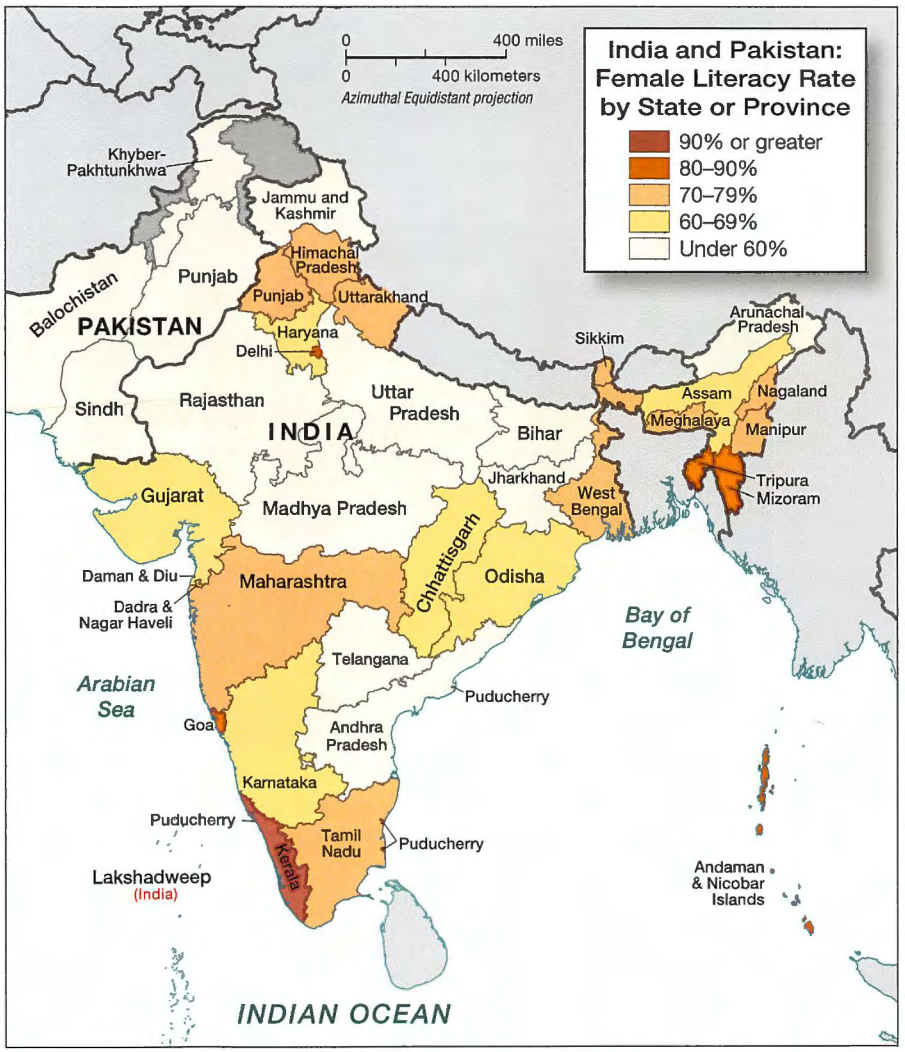


FIGURE 2.10 **Literacy Rates by State in South Asia.** The lowest literacy rates are in Pakistan, and the highest literacy rates are generally in southern India.

An increasing number of women, especially in southern and western India, are using modern contraceptives. The **contraceptive prevalence rate** is the percentage of women ages 15 to 49 who are currently using or whose partner is currently using at least one contraceptive method. In India, the contraceptive prevalence rate for the country is 55.1 percent. Southern states like Andhra Pradesh (69.8 percent) and Maharashtra (63.5 percent) have higher rates of contraceptive prevalence than northern states, including Bihar (26.0 percent) and Meghalaya (21.1 percent) (**Fig. 2.12**).

A world map of growth rates is a global overview, a mere introduction to the complexities of the geography of population. The India example demonstrates that what we see at the scale of a world map does not give us the complete story of what is happening within each country or world region.

Doubling Time

One way to explain the growth rate in world population is to compare the population's rate of growth to its **doubling time**. Every rate of growth has a doubling time. For example, if you invested $100 at 10 percent, compounded annually (exponentially), it would take about seven years to double to $200. It would take another seven years to become $400, and then another seven years to become $800. A growth rate of 10 percent has a doubling time of around seven years.

Two thousand years ago, the world's population was an estimated 250 million. More than 16 centuries passed before this total doubled to 500 million, the estimated population in 1650. Just 170 years later, in 1820 (when Malthus was still writing), the population doubled again, to 1 billion (**Fig. 2.13**). And barely more than a century after this, in 1930, it reached 2 billion. The doubling time was down to 100 years and dropping fast. The population explosion was in full gear. Only 45 years elapsed for the next doubling to take place, to 4 billion (1975). In the mid-1980s, doubling time was only 39 years. Since then,

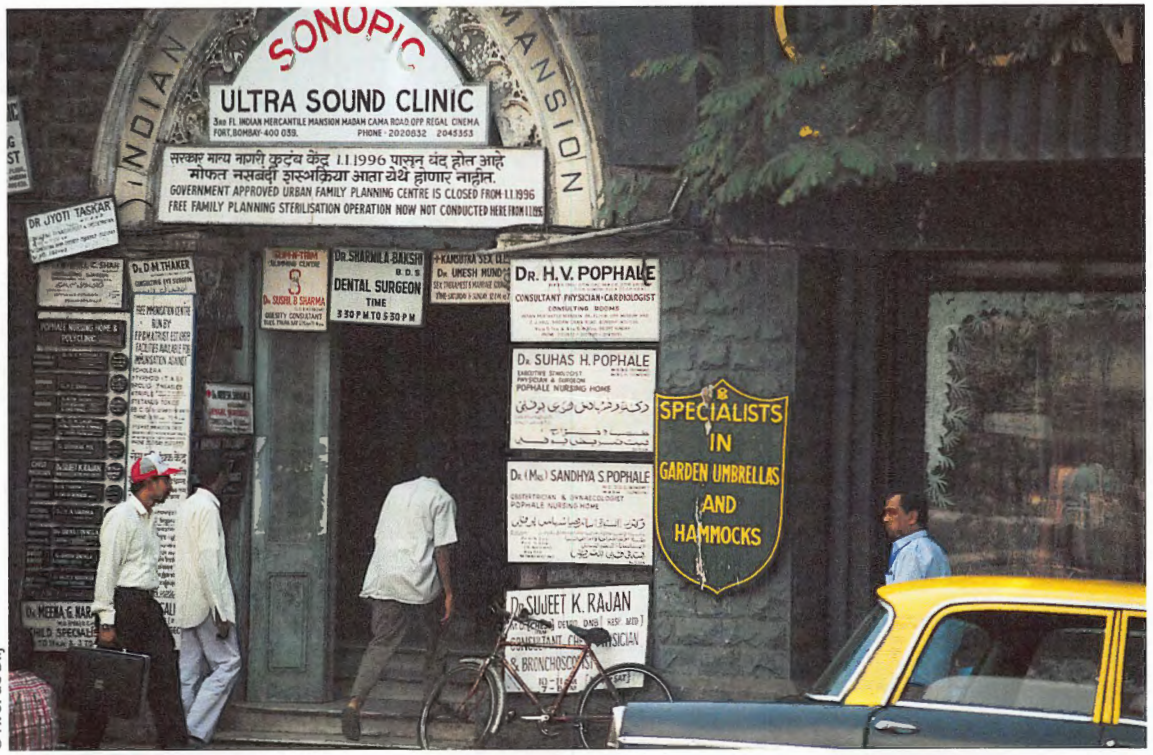


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FIGURE 2.11 **Maharashtra, India.** Above the entrance to a suite of medical offices is a sign announcing that the "free family planning sterilization operation" closed in 1996. The Indian government ended forced sterilization programs after protests and now simply sets goals of lowering birth rates. States in India are at liberty to create their own population control policies. For example, the state of Maharashtra has a policy of paying cash to newly married couples who delay having their first child until two years after marriage.

population policies designed to slow growth, including China's one-child policy, have lengthened the world population's doubling time to 54 years.

For demographers and population geographers who study global population growth today, the concept of doubling time is losing much of its punch. With populations falling in many places, fears of global population doubling quickly are subsiding. Many indicators, such as the slowing of the doubling time, suggest that the explosive population growth of the twentieth century will be followed by a slowdown during the twenty-first century.

No single factor can explain the variations shown in Figure 2.6. Economic prosperity as well as social dislocation reduce natural population growth rates. Economic well-being, which is associated with urbanization, higher levels of education, later marriage, and family planning, lowers population growth. In the table presented in Appendix B, compare the indices for natural population increase and the percentage of the population that is urbanized. In general, the higher the population's level of urbanization, the lower its natural increase.

Total Fertility Rates

Demographers who predict growth in world population will eventually taper off and stabilize base their predictions on a combination of longer life expectancies coupled with lower total fertility rates. Demographers measure whether a population can replace its deaths with births by looking at total fertility rates. The **total fertility rate** (TFR) is the average number of children born to women of childbearing age (between 15 and 49). To stay at replacement levels and keep a population stable over time without immigration, a country needs a TFR of 2.1. More than 95 countries, containing 41 percent of the world's population, have fallen below replacement level (**Fig. 2.14**).

Demographers at the United Nations predict that the TFR of the combined world will fall to less than 2.2 by 2050. The world TFR combines regions including Europe, where TFRs are low, and regions including Africa, where TFRs are high. In 2016, the worldwide TFR was 2.4, ranging from 1.2 in South Korea to 7.2 in Niger.

Predicting population growth is difficult because so much depends on the decisions made by women of childbearing age. In wealthier countries, more women are choosing to continue education, develop careers, and marry later, delaying childbirth. This results in an aging population, which in turn affects the **old-age dependency ratio**—the relationship between the number of people over the age of 65 and the working-age population between 15 and 64. Europe has 29.9 old-age dependents for every 100 working-age people, and that figure is expected to rise to 47 by 2050. The old-age dependency ratio for sub-Saharan Africa, by contrast, is 5.7. For Africa, the challenge is a high **child dependency ratio** (74 compared to just 23 in Europe).

An aging population requires substantial social adjustments. Older people retire and eventually suffer health

problems, so they need pensions and medical care. Younger workers in the population provide tax revenues that enable governments to pay for services for older people. As the proportion of older people in a country increases, the proportion of younger people decreases. Aging countries have relatively fewer young workers to provide tax revenues and support programs for a growing number of retired people.

To change the age distribution of an aging country and provide more taxpayers, a country can either increase its TFR or enable immigration. Immigration yields an influx of younger workers who pay taxes on their wages, homes, and purchases. What happens if a country resists immigration despite an aging population? Japan is an interesting case study. Japan's population is no longer growing, and demographers project the Japanese population will continue to decline. The population fell from a peak of 128.06 million in 2008 to 126.8 million in 2017. Japan predicts that its population will fall to around 100 million by 2050, a loss of 20 percent of its current population. However, Japan was a closed society for hundreds of years, and even today the Japanese government discourages immigration. More than 98 percent of the country's population is Japanese, according to government statistics.

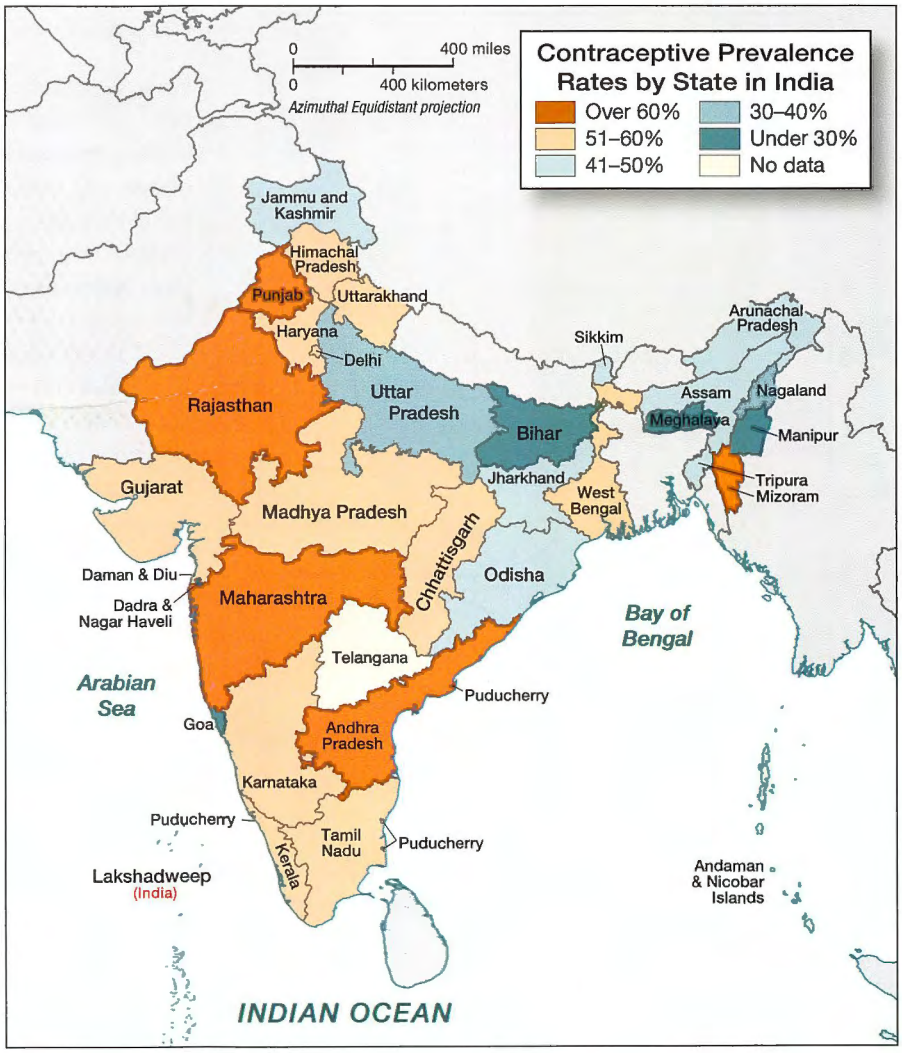


FIGURE 2.12 Contraceptive Prevalence Rates by State in India. The lowest contraceptive prevalence rates are in northern India, and the highest contraceptive prevalence rates are generally in southern India.

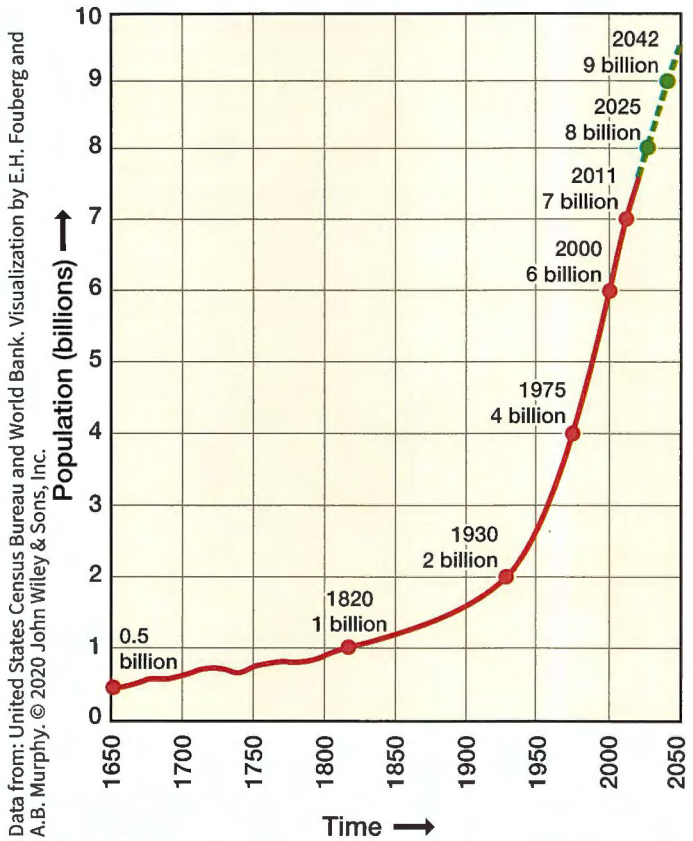
Data from: New et al., "Levels and trends in contraceptive prevalence, unmet need, and demand for family planning for 29 states and union territories in India: a modelling study using the Family Planning Estimation Tool", Lancet Glob Health. 2017 Mar;5(3):e350-e358. Visualization by E.H. Fouberg and A.B. Murphy. © 2020 John Wiley & Sons, Inc.

Today, TFRs are falling in almost every country, in large part because of family planning. In some lower income countries, a combination of government and nongovernment organizational programs encourage women to have fewer children. Some women are also choosing to have fewer children because of economic and social uncertainty. In some countries, TFRs are declining dramatically. Kenya's TFR was down to 3.85 in 2016; China's fell from 6.1 to 1.75 in just 35 years and in 2010 dropped to 1.5, though it hit 1.62 in 2016. Once the government of Iran began to allow family planning, the TFR fell from 6.8 in 1980 to 1.7 in 2016.

At one time a low TFR was a goal that demographers generally agreed all governments would surely want. However, long-term economic implications and demographic projections have given many governments pause. Countries need a young, vigorous, working-age population to work and pay taxes to grow a country's economy and support the long-term needs of an aging population.

In the face of declining population growth rates, some governments have taken countermeasures. Sweden, Russia, and other European countries provide financial incentives such as long maternity leaves and state-paid daycare to prospective mothers. Japan has public service campaigns encouraging men to do more housework. Such programs and debates have had only limited success in encouraging sustained population growth.

How can the worldwide population continue to increase when so many countries are experiencing low TFRs and population decline? Despite declining population growth rates and even negative growth rates in a number of the world's countries, the global population continues to rise. The worldwide TFR was 2.43 in 2016, above the replacement level of 2.1. Although the population bomb Ehrlich warned of is no longer ticking at the same rapid pace, the worldwide population continues to grow. The low TFRs and low population growth rates described in this chapter continue to be offset to a degree by additions to the population in countries where growth rates are still relatively high, including India, Indonesia, Bangladesh, Pakistan, and Nigeria.



Data from: United States Census Bureau and World Bank. Visualization by E.H. Fouberg and A.B. Murphy. © 2020 John Wiley & Sons, Inc.

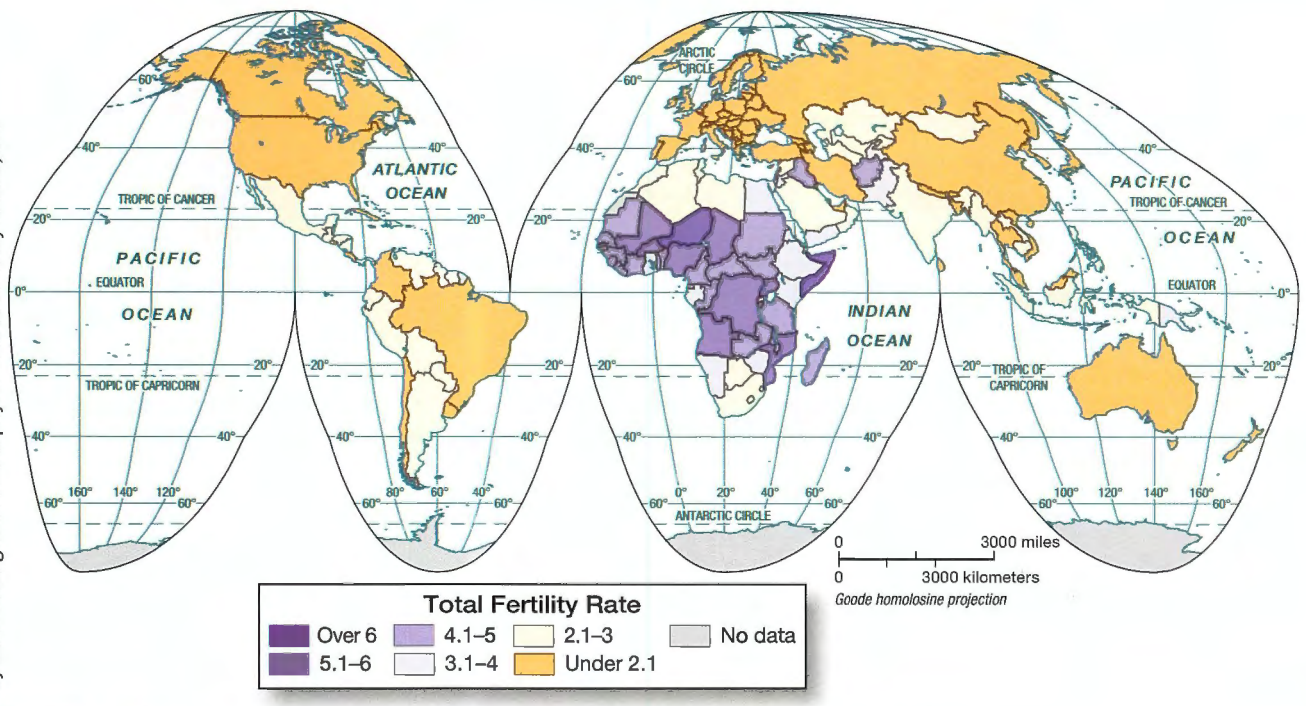
FIGURE 2.13 **Population Growth, 1650–2050.** The dashed line indicates one estimate of global population growth until 2050.

Population Pyramids

When geographers study populations, they are concerned not only with distribution and growth rates, but also with **population composition**: the structure of a population in terms of age, sex, and other properties such as marital status and education. Age and sex are particularly key indicators of population composition, and demographers and geographers use **population pyramids**, which are graphic representations of the age and sex composition of a population (**Fig. 2.15**).

To read a population pyramid, start by looking at the horizontal axis and notice males are on the left side of the pyramid and females are on the right side. Then, look at the vertical axis and note that the age composition of the country is broken into age groups, normally five-year increments. The youngest age groups, starting at birth (age 0) are at the bottom and the oldest age groups are at the top. All population pyramids start at age 0, but not all end at the same age at the top. Countries with higher life expectancies have higher numbers in their top age bracket than countries with lower life expectancies. So, it's always a good idea to look at the numbers in the top age bracket on a population pyramid.

A population pyramid can instantly convey the demographic situation in a country. In lower income countries, where birth and death rates generally remain high, the population pyramid looks like a pyramid or an evergreen tree, with wide branches at the base and short ones near the top. The youngest age groups have the largest share of the population. In the pyramid for most lower income countries, the three groups up



Data from: World Bank, World Development Indicators, 2017. Visualization by E.H. Fouberg and A.B. Murphy. © 2020 John Wiley & Sons, Inc.

FIGURE 2.14 **Total Fertility Rate (TFR).** TFRs are lowest in Europe, North America, Japan, Australia and New Zealand. TFRs remain relatively high in Africa and Southwest Asia.

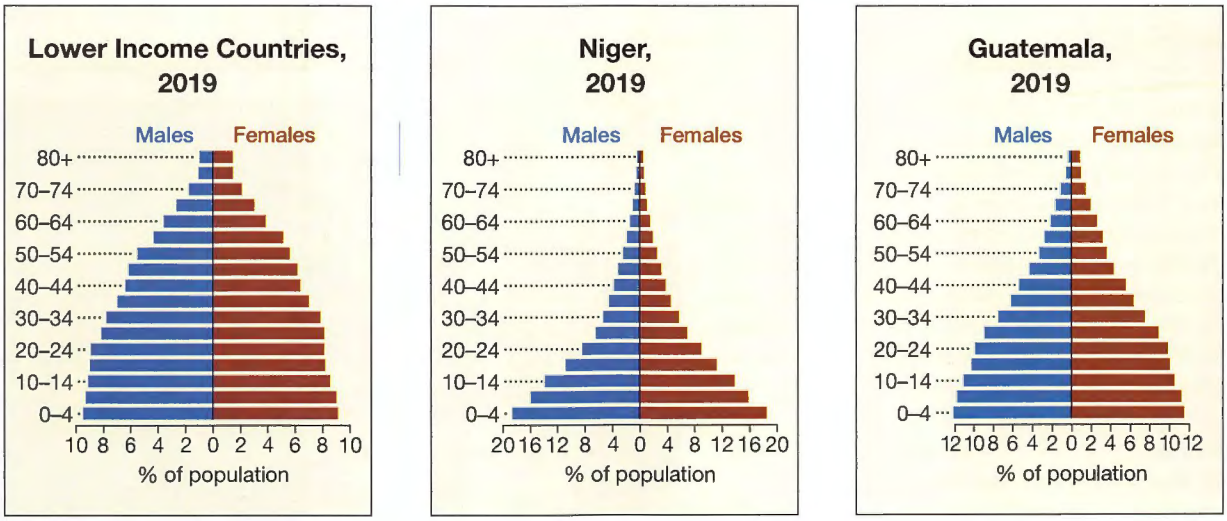


FIGURE 2.15 Age-Sex Population Pyramids for Countries with High Population Growth Rates. Countries with high total fertility rates, high infant mortality rates, and low life expectancies will have population pyramids with wide bases and narrow tops.

to age 14 account for more than 40 percent of the population. From age group 15 to 19 upward, each group is smaller than the one below it. Older people, in the three highest age groups, represent less than 10 percent of the total. Slight variations on this pyramid mark the population structures of such countries as Pakistan, Yemen, Guatemala, Cameroon, and Laos.

Higher income countries have population pyramids that do not look like pyramids at all. Families become smaller, children fewer. The "pyramid" looks like a slightly lopsided chimney, with the largest components of the population not at the bottom but in the middle. The middle-age bulge moves upward, reflecting the aging of the population (**Fig. 2.16**) and the declining TFR. Countries with low TFR and high wealth, such as Italy, France, and Sweden, fit into this pyramid model.

The religious composition of a population can influence growth rates, and by extension the look of the pyramid. The Roman Catholic Church does not support contraception, and some conservative branches of Islam frown on the use of contraceptives as well. In countries such as Nigeria, for example, conservative Islam is practiced in the north, and northern Nigeria has notably higher population growth rates than southern Nigeria.

There are, however, many places where dominant religious traditions do not tell us much about population trends. Some areas of the world with low population growth rates are in the very heart of the Roman Catholic world, even though Roman Catholic doctrine opposes birth control and abortion (**Fig. 2.17**). Curiously, adherence to this doctrine appears to be

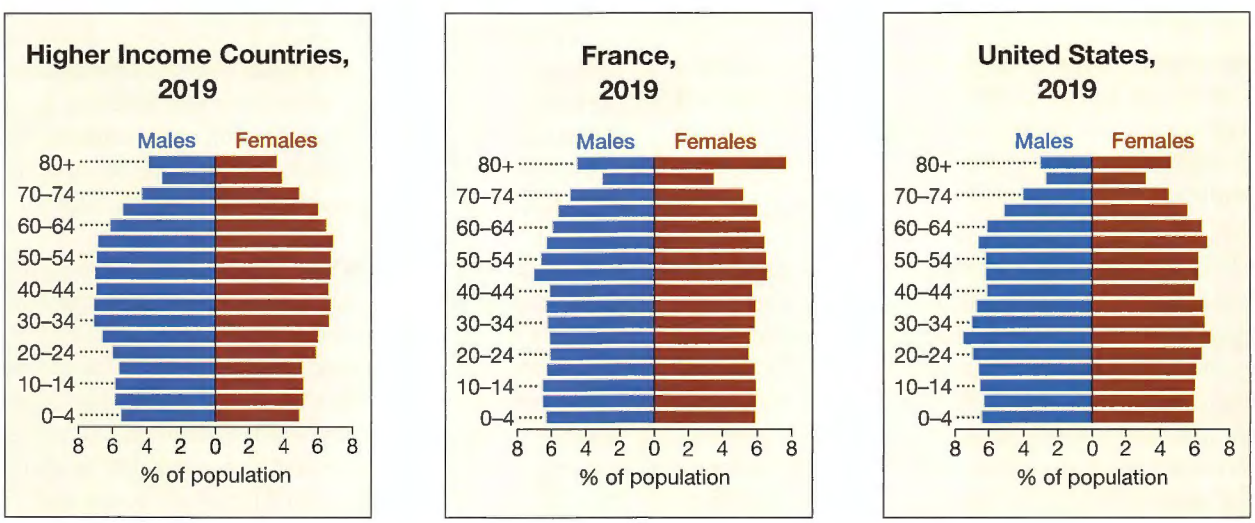


FIGURE 2.16 Age-Sex Population Pyramids for Countries with Low Population Growth Rates. Countries with lower total fertility rates and longer life expectancies have population pyramids shaped more uniformly throughout.

Author Field Note Looking for Children in Bordeaux, France

"My mind was on wine. I was in Bordeaux, France, walking down the street to the Bordeaux Wine Museum (Musee des Vins de Bordeaux) with a friend from the city. Having just flown from Dakar, Senegal, after spending several weeks in sub-Saharan Africa, I found my current surroundings strikingly different. Observing the buildings and the people around me, I noticed that after having been among so many young children in sub-Saharan Africa, the majority of the inhabitants I encountered in Bordeaux were adults. I turned to my friend and asked, 'Where are all the children?' He looked around, pointed, and replied, 'There goes one now!' In Bordeaux, in Paris, in all of France and the rest of Europe, there are fewer children and populations are aging."

– H. J. de Blij

© H. J. de Blij

FIGURE 2.17 **Bordeaux, France.**

stronger in areas farther from the Vatican (headquarters of the Catholic Church). The Philippines, for example, has a relatively high population growth rate.

The situation is different in the case of Islam. Saudi Arabia, home to Mecca (the hearth of Islam), has a relatively high population growth rate, with the population increasing at 2 percent each year. Yet in Indonesia, thousands of miles from Mecca, the government began a nationwide family planning program in 1970 when the population growth rate was high. Conservative Muslim leaders objected, but the government used a combination of coercion and inducement to continue its program. By 2000, Indonesia's family planning program had lowered the growth rate to 1.6 percent, and in 2016 it stood at 1.1 percent.

The Demographic Transition

The **demographic transition** is a model suggesting that a country's birth rate and death rate change in predictable ways over stages of economic development (**Fig. 2.18**). The model is based on population change in western Europe after the Industrial Revolution.

Stage 1: Low Growth The world population rose from 250 million people 2000 years ago to 500 million people in 1650. Charts may show that growth as a line sloping upward gently. However, in reality, population did not trend steadily upward. Populations rose and fell with fluctuating birth rates and death rates, reflecting the impacts of disease, crop failures, and wars. Stage 1 is the initial low-growth phase, where all places stayed for most of human history. This stage is marked by uncertainty, including high birth rates and equally high death rates. In this phase, epidemics and plagues keep the death rates high. At times, death rates exceeded birth rates.

For Great Britain and western Europe, death rates exceeded birth rates during the bubonic plague (the Black Death) of the 1300s, which hit in waves. The bubonic plague began in Crimea on the Black Sea, diffused through trade to Sicily and other Mediterranean islands, and moved through contagious diffusion and the travel of rats (which hosted the flea, the insect responsible for spreading the plague) north from the Mediterranean.

Once the plague hit a region, it was likely to return within a few years, creating another wave of human suffering. Estimates of plague deaths vary between one-quarter and one-half of the population, with the highest death rates recorded in western Europe (where trade among regions was the greatest) and the lowest in the east (where cooler climates and less connected populations delayed diffusion). Across Europe, cities and towns were left decimated. Historians estimate that the population of Great Britain fell from nearly 4 million when the plague began to just over 2 million when it ended.

Famines also limited population growth. A famine in Europe just prior to the plague likely facilitated the diffusion of the disease by weakening people's immune systems. Famines in India and China during the eighteenth and nineteenth centuries resulted in the deaths of millions of people. At other times, destructive wars have largely wiped out population gains.

Stage 2: High Growth Stage 2 of the demographic transition had high birth rates, rapidly declining death rates, and very high natural increase rates. Stage 2 came after the Industrial Revolution (around 1750) in Europe when access to food, sanitation, and health care improved, resulting in much lower death rates. Improvements in agriculture that preceded the Industrial Revolution created a more stable food supply (see Chapter 11). Sanitation facilities made towns and cities safer from epidemics, soap became more widely used, and modern medical practices began to take hold.

Data from church records in Great Britain (the hearth of the Industrial Revolution) reveals that after industrialization began, death rates in Great Britain began to fall. Before 1750, death

rates in Europe may well have averaged 35 per 1000 (birth rates averaged under 40), but by 1850 the death rate was down to about 16 per 1000. With a rapidly falling death rate and a birth rate that remained high, Britain's population explosion took place.

Countries in stage 2 today are much lower income countries with relatively high birth rates and natural increase rates, along with slowly falling death rates. Lower income countries that already went through stage 2, as well as countries like Palestine and Afghanistan that are going through stage 2 now, have been helped by the diffusion of western medicine, including vaccinations against common childhood diseases.

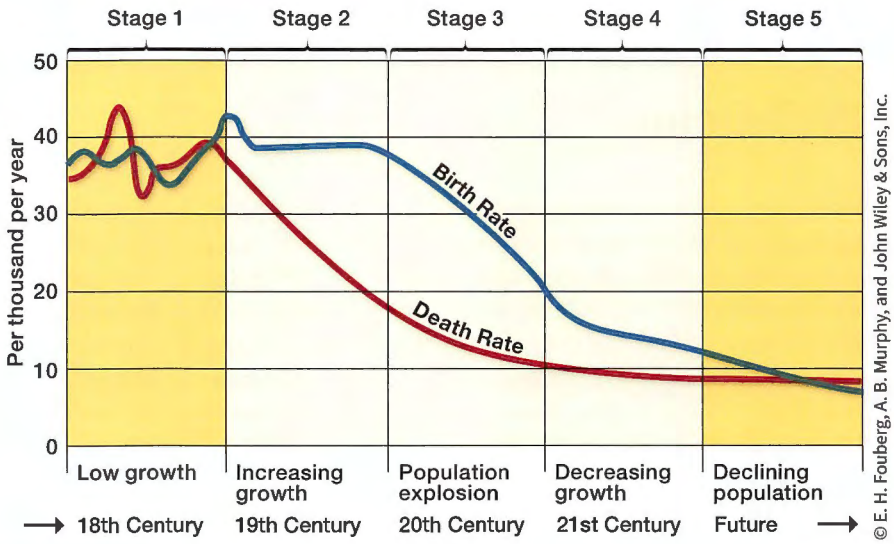


FIGURE 2.18 The Demographic Transition Model. Population growth is particularly high between the middle of stage 2 and the middle of stage 4, when death rates have declined due to better food supply and access to medicine, but birth rates have stayed relatively high before later declining.

Stage 3: Moderate Growth

Stage 3 of the demographic transition has rapidly declining birth rates, continually declining death rates, and a low natural increase rate. In stage 3, death rates continued to decline and birth rates began to fall but stayed higher than death rates, resulting in continued growth in natural increase rate, but at a slower pace. For Great Britain, this was after the Industrial Revolution, from around 1870 through two world wars in the 1900s. New opportunities—especially for women— were not always compatible with large families. Women delayed marriage and childbearing. Medical advances lowered infant and child mortality rates, lessening the sense that multiple children were necessary to sustain a family. Young adults began marrying at later ages, leading to a natural decrease in TFR and crude birth rates.

Stage 3 of the demographic transition happens when a country's birth rate begins to fall. Countries in stage 3 today include middle-income countries like Brazil. Brazil's lower birth rates came about through increasing access to modern contraceptives, rather than a change in the age of marriage.

Improving educational opportunities for women correlates with declining birth rates. Studies in Mali have shown that girls who go to school end up having just over half as many children as women with no access to education. Expanding educational opportunities for girls and women in countries such as Mali, then, will likely have a significant impact on future population growth.

Stage 4: Low Growth

Stage 4 of the demographic transition has low birth rates, low death rates, and stable or slowing rates of natural increase. In Great Britain after 1950, both the birth rate and death rates declined to low levels, resulting in slow or stabilized population growth. Advances in modern contraceptives and access to legal abortion expanded after the 1950s, which also helped keep birth rates quite low in Great Britain and other higher income countries.

Countries in stage 4 today include higher income countries like the United States and the United Kingdom. The diffusion of contraceptives, access to abortion, and conscious decisions by many women to have fewer or no children, or to start having children at a later age, have lowered birth rates.

Stage 5: Negative Growth

Stage 5 of the demographic transition has very low birth rates, increasing death rates, and declining natural increase rates. Countries in stage 5 include Japan and Russia. The global growth rate is now down to 1.2 percent, perhaps slightly lower, even though the increase in world population still exceeds 80 million annually. With women having fewer children, many demographers are predicting that as more countries reach stage 5 of the demographic transition, the world will reach **zero population growth** in the next 50 years. The result would be a planet that has achieved what is called a *stationary population level* (SPL).

Predictions about future population growth require frequent revision, and anticipated dates for population stabilization are often moved back. In the late 1980s, for example, the World Bank predicted that the United States would reach SPL in 2035 with 276 million inhabitants. Brazil's population would stabilize at 353 million in 2070, Mexico's at 254 million in 2075, and China's at 1.4 billion in 2090. India, destined to become the world's most populous country, would reach SPL at 1.6 billion in 2150. These figures have proven unrealistic. China's population passed the 1.2 billion mark in 1994, and India's reached 1 billion in 1998. Recent reports predict that China's population will "stabilize" at 1.45 billion in 2030 and India's at 1.7 billion in 2060.

TC Thinking Geographically

Pick two countries with high growth rates. Determine the state of the demographic transition for each country. Sketch what you imagine their **population pyramids** look like. Hypothesize what may lead them to the next stage of the demographic transition.

2.3 Explain How Health and Disease Affect Peoples' Well-Being.

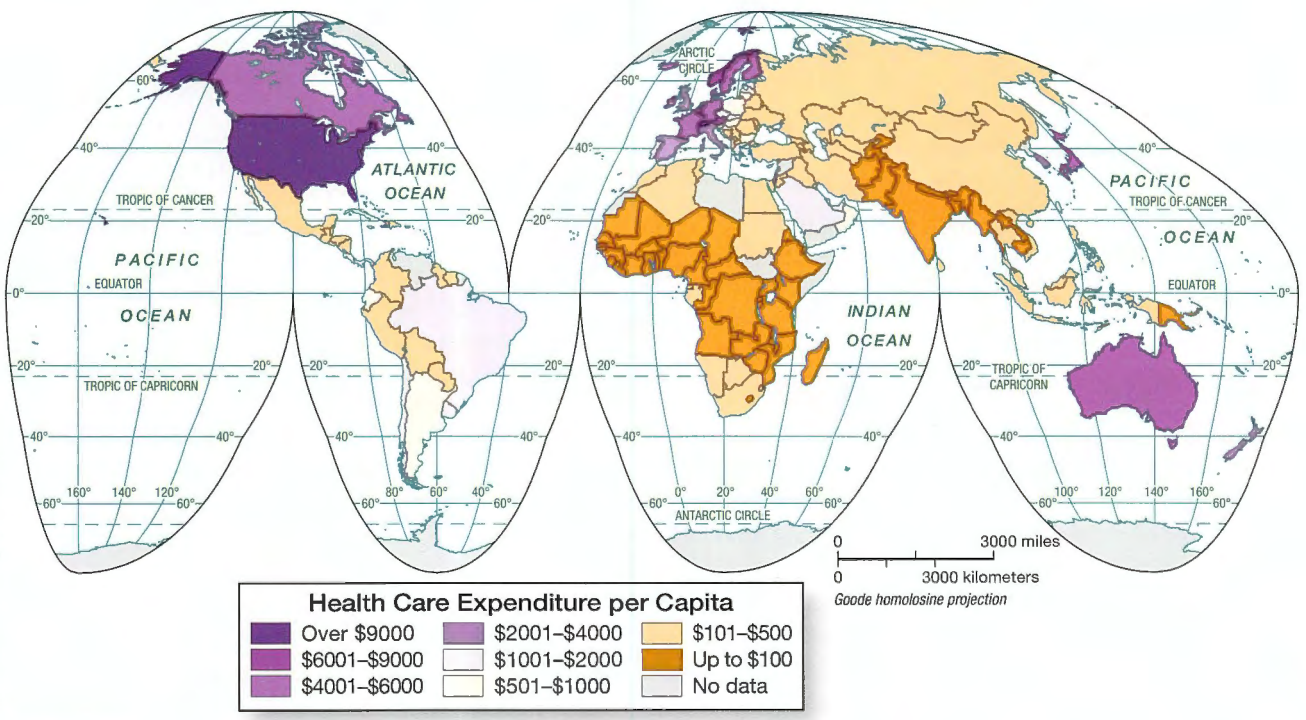
Medical geographers increasingly study not just disease patterns, but issues such as access to medical care and the ways in which inequalities and place-based social norms affect disease transmission. How healthy a population is depends on geographical differences in sanitation and access to health care. For many people, access to medical care is fundamentally a geographic matter, because access is a function of *absolute distance* to medical facilities and the available transportation infrastructure. Infrastructure can impede or facilitate access to health care.

Access to medical clinics and hospitals, fully certified medical staff, and prescription medicines is greater in higher income countries. Europe, North America, Japan, and Australia and New Zealand spend much more money on health care per person than other world regions (**Fig. 2.19**). Patients with greater access to health care have lower infant mortality rates and longer life expectancies. Higher rates of health expenditures per capita occur in countries where medical hospitals put forth great effort in terms of procedures, technologies, medicines, and care to the most vulnerable populations, including premature babies and frail elderly (defined as those over age 85).Social norms and circumstances matter as well. The transmission of HIV/AIDS is partly a product of attitudes toward the use of condoms, mobility patterns, socioeconomic status, and other place-specific social variables. Social context also matters in chronic obesity, which is associated with higher rates of heart disease and diabetes. In places where heavily processed foods become popular or are the cheapest and most available food options, chronic obesity is reaching epidemic levels. As these examples illustrate, understanding global health requires taking into account the geographic context within which diseases are embedded.

Health of Women and Children

Figure 2.20 maps the Mothers' Index from the *State of the World's Mothers* report. The Mothers' Index measures barometers of well-being for mothers and children. The Mothers' Index confirms that income and access to medical care are major factors 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 lower income countries globally.

For the countries in the world experiencing violent conflict, the Mothers' Index plunges and the chances of newborn survival fall. Examine Figure 2.19 again and note the position of countries that have violent conflict or a recent history of conflict: Iraq, Afghanistan, Syria, and Sierra Leone.



Data from: World Bank. Visualization by E.H. Fouberg and A.B. Murphy.

FIGURE 2.19 Health Care Expenditures per Capita. Health care expenditures per capita are highest in North America, Europe, Japan, and Australia.

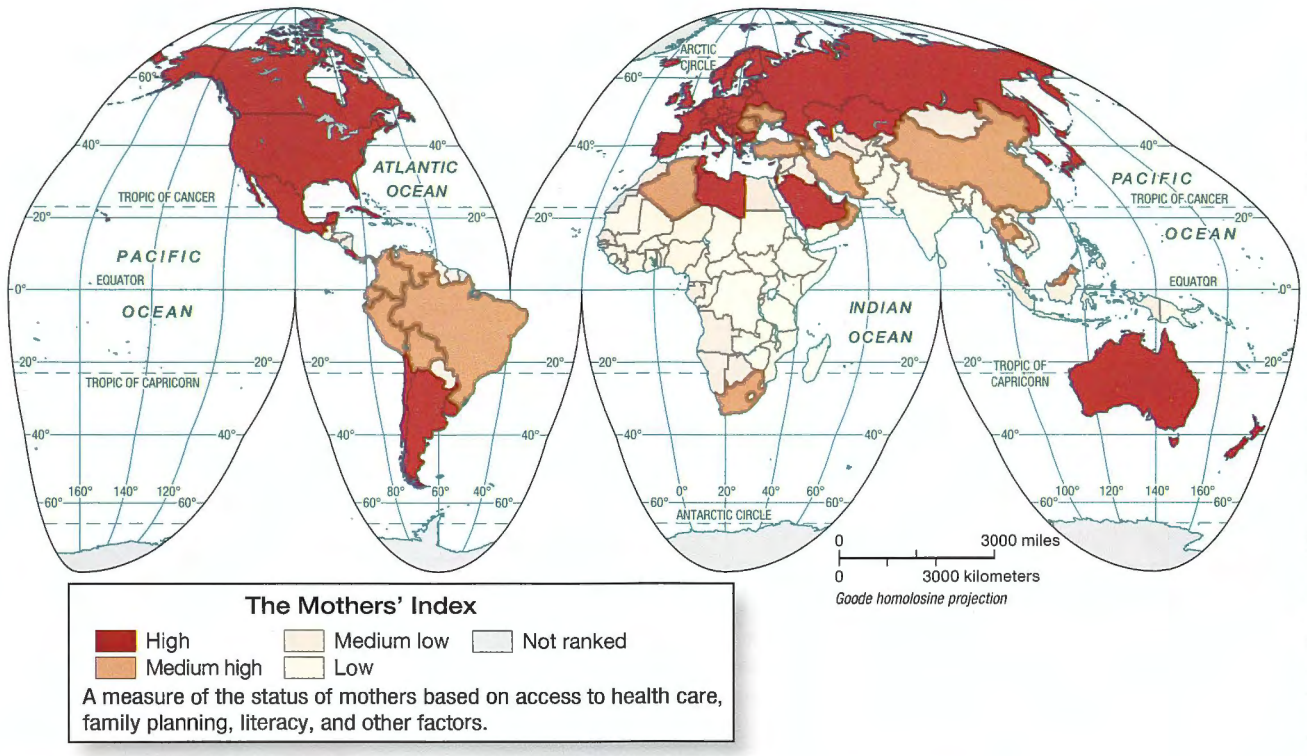


FIGURE 2.20 The Mothers' Index. Save the Children annually calculates the Mothers' Index, based on 13 indicators, to gauge the overall well-being of mothers and their children by country.

Infant Mortality

Whether a baby lives to its first birthday is one measurement of mortality. Differences in infant mortality rates vary depending on access to health care, sanitation, and education. **Infant mortality rate** (IMR) is the probability that a child will die before reaching the age of 1 year. The child mortality rate (CMR) records the probability a child will die before reaching the age of 5 years. Both infant mortality and child mortality rates are given as the number of cases per 1000 live births.

Another measurement of children's health 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. Save the Children's annual *State of the World's Mothers* report explains that the high newborn death rate in the United States and in other higher income countries is typically from premature births and low-birthweight babies. In lower income countries, diarrhea and infections cause half of newborn deaths.

Infant and child mortality reflect the overall health of a society. High infant mortality rates have a variety of causes. The physical health of the mother, which includes access to prenatal care and access to sanitation and hygiene, are major factors. In societies where most women bear a large number of babies, women also tend to be inadequately nourished and poorly educated. Diarrhea and malnutrition are the leading killers of infants and children throughout the world. Save the Children's annual *State of the World's Mothers* reports that in lower income countries, diarrhea and infections cause half of newborn deaths (mortality under age 1 month).

In lower income countries, women, even pregnant women, often feed themselves last by family tradition. This means the mother may not consume enough calories during pregnancy for the baby to grow to a healthy weight or during nursing to produce nutritious breast milk. Pregnant women with low education may have health-care providers who explain the importance of sanitation and hand washing to avoid diarrheal disease, but they may ignore the advice of medical staff over the advice given at home by their mothers-in-law. Roughly 30 percent of the world lacks ready access to clean drinking water, 6 out of 10 lack access to hygienic human waste-disposal facilities, and as many as 4 billion people live without basic sanitation (including toilets).

Figure 2.21 shows the variability of the infant mortality rate by country and world region. The lowest infant mortality rate among larger populations has long been reported by Japan, with 1.9 deaths per 1000 live births in a country of over 126 million people. Singapore has over 5.4 million people and a low IMR of 2.2, and Sweden's 9.6 million people record an IMR of 2.3.

In 2017, five countries still reported an IMR of 70 or more—the Central African Republic, Sierra Leone, Somalia, Chad, and the Democratic Republic of the Congo. The Central African Republic's IMR of 87.6, the highest in the world, reflects one death or more among every eight newborns. Dreadful as these figures are, they are a substantial improvement over the situation in 2012, when 11 countries reported IMRs of 70 or more. Globally, infant mortality has been declining, even in low income world regions.

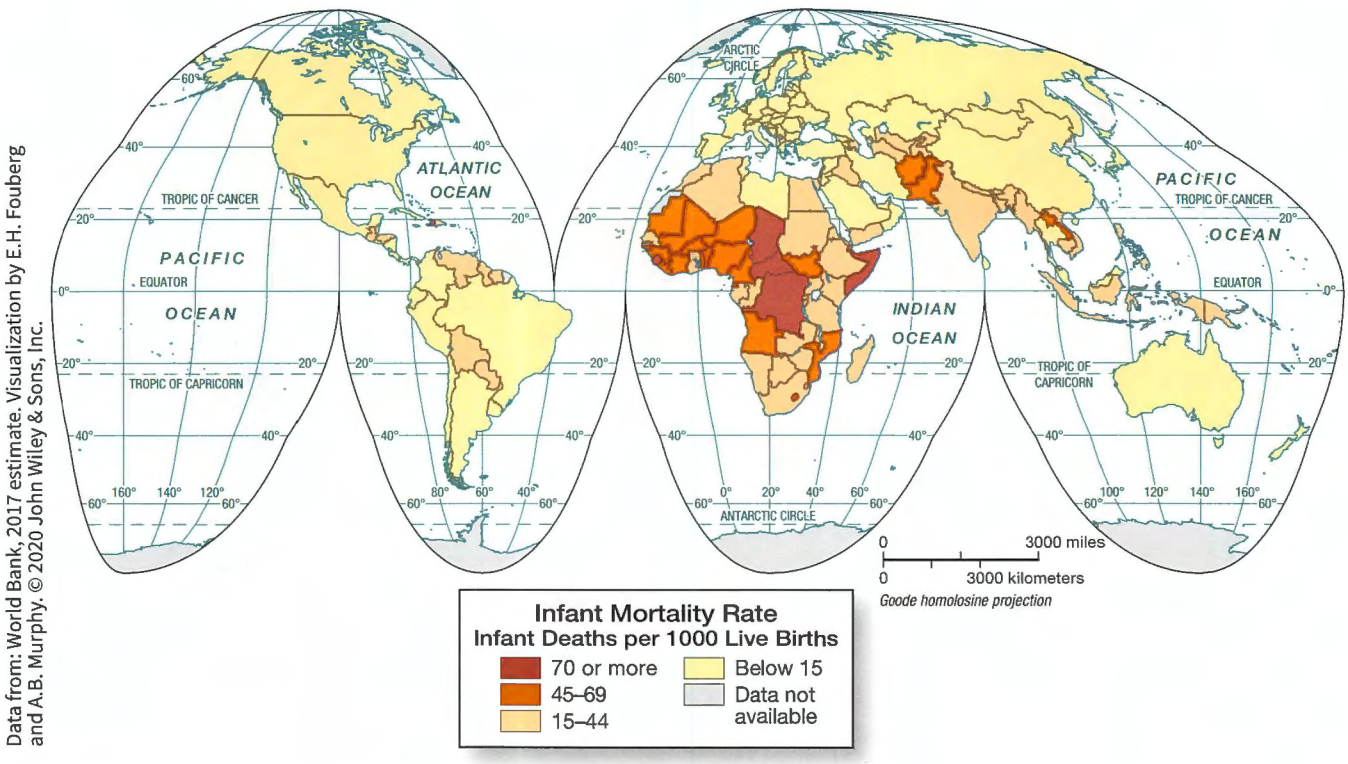


FIGURE 2.21 Infant Mortality Rate. The map shows infant mortality patterns at five levels ranging from 70 or more per 1000 to fewer than 15. Compare this map to that of the overall crude birth rate (CBR) in Figure 2.7, and the correlation between high infant mortality rates and high birth rates is evident.

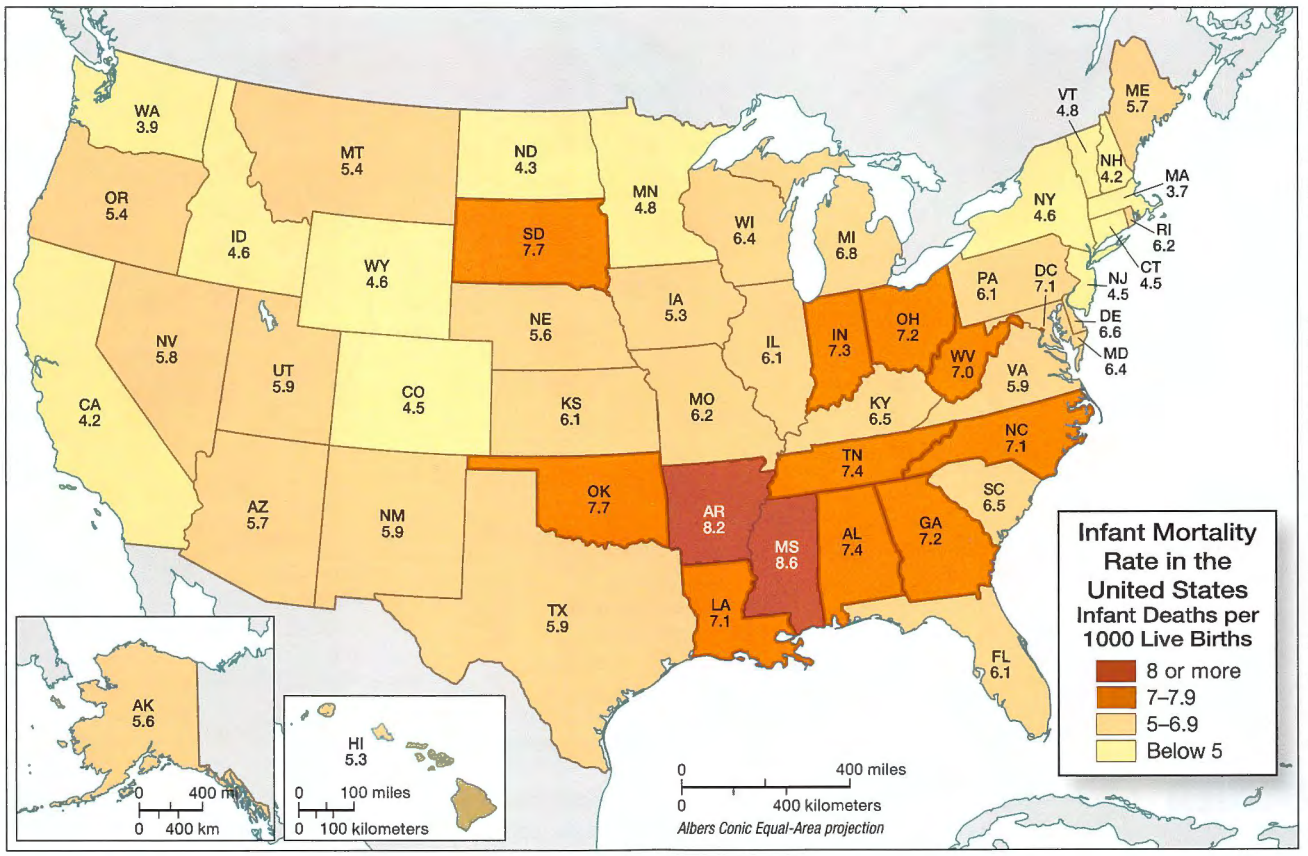
Each of these observations about infant mortality rates considers what is happening, on average, in a country. IMR varies within countries and gives us insight into variations in access to health care and health education depending on region, ethnicity, social class, or other criteria. The IMR of South Africa is 48 per 1000, 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 "coloured" (multiracial) and Asian population sectors it lies between these two figures.

IMR in the United States The IMR in the United States varies by region, with the highest IMR in the South and the lowest in the Northeast (**Fig. 2.22**). Race, ethnicity, social class, education levels, and access to health care also vary by region in the United States. In 2015 the IMR for African Americans was 11.7 in the United States, above the country-wide average of 6. The IMR for non-Hispanic whites was 4.8, below the U.S. average. According to the Centers for Disease Control, in 2016, 82.3 percent of non-Hispanic whites, but only 66.5 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. However, one risk factor that contributes to high IMR, smoking during pregnancy, was higher for non-Hispanic whites than for African Americans. The Centers for Disease Control found that 10.5 percent of non-Hispanic whites smoked cigarettes during pregnancy in 2016, and 6 percent of African American women smoked during pregnancy.

According to the Department of Health and Human Services, "the leading causes of infant death include congenital abnormalities, pre-term/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."

Child Mortality

Infants who survive their first year of life have lower life expectancies in lower income world regions. The child mortality rate, which records the deaths of children between the ages of 1 and 5, remains disturbingly high in significant parts of Africa and Asia, notably in protein-deficient regions. *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 the twenty-first century.



Data from: Centers for Disease Control, National Vital Statistics Reports, 2017. Visualization by E.H. Fouberg and A.B. Murphy. © 2020 John Wiley & Sons, Inc.

FIGURE 2.22 Infant Mortality Rate in the United States. This map shows infant deaths per 1000 live births. In Figure 2.21, the entire United States is in the lowest class on the map. Shifting scales to states within the United States, the infant mortality rate shows variation, with high infant mortality rates in the South and low infant mortality rates in the states of Washington and Massachusetts.

Life Expectancy

Life expectancy is the average number of years a person is expected to live. **Figure 2.23** shows life expectancies by country. 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 may rise to 106 by the year 2300. African countries have the lowest life expectancies. The spread of HIV/AIDS over the past four decades has lowered life expectancies in some countries below age 40. Lowest life expectancies in Africa are now just over 50 due to improved access to antiretroviral treatments and programs to prevent mother-to-child transmission of HIV/AIDS.

Life expectancies of men and women are grouped together into one statistic by country in Figure 2.23. At the start of the twenty-first century, world average life expectancy was 68 for women and 64 for men. You can get a sense of differences in life expectancy between men and women by looking at population pyramids. If the oldest generation on a country's population pyramid has much wider bands for women than for men, it indicates women have longer life expectancies than men in that country. Women commonly outlive men. Women outlive men by about four years in Europe and East Asia, by three years in sub-Saharan Africa, by six years in North America, and by seven years in South America. In Russia, women are expected to outlive men by 11 years.

The map reveals significant regional contrasts. In the former Soviet Union, and especially in Russia, the life expectancies of men dropped quickly following the collapse of communism, from 68 to 60 in 2008. Life expectancies for men in Russia remain lower than for women. In 2014, the BBC, citing an article in a medical journal, reported that 25 percent of Russian men die before they reach the age of 55. Russia's men experience much higher rates of alcoholism and suicide than women.

Life expectancy figures do not mean that 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 lower income countries primarily reflect high infant mortality rates. The low life expectancy figures for countries where malnourishment is a challenge remind us again how hard hit children are in parts of the world.

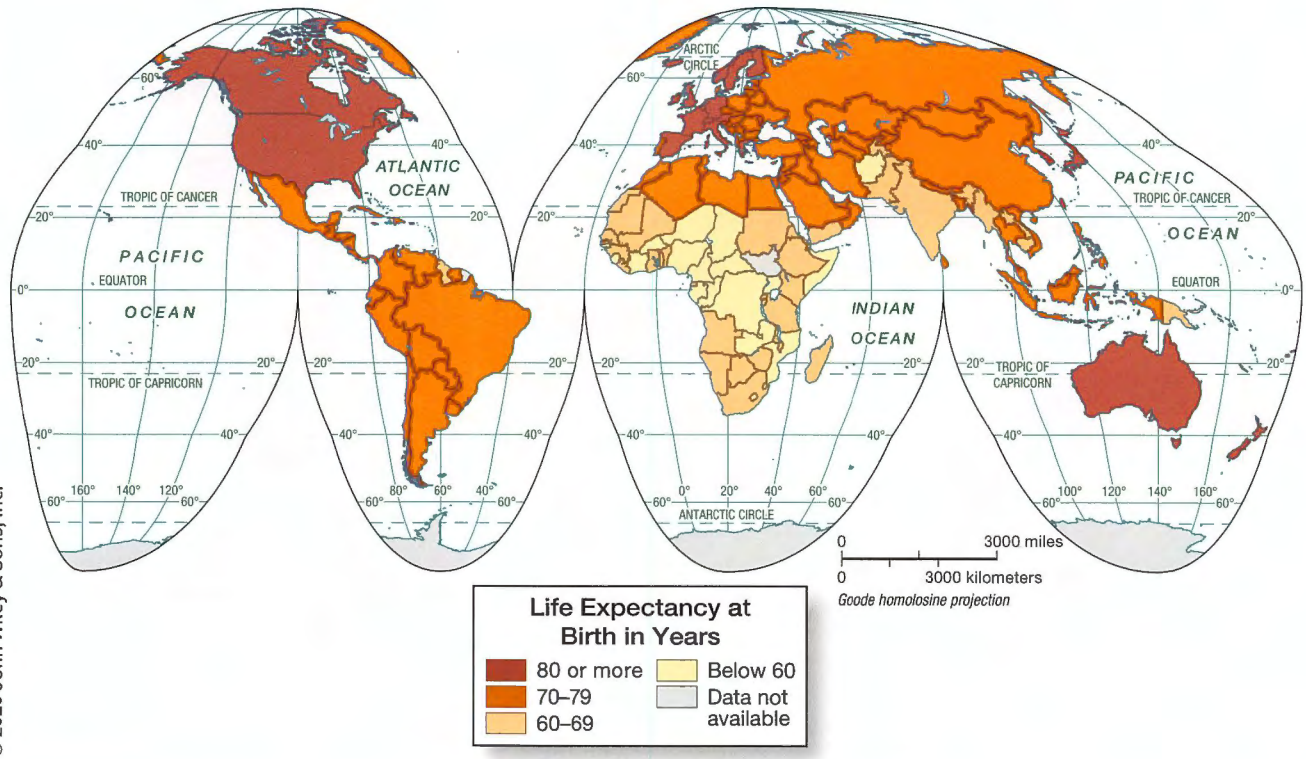


FIGURE 2.23 Life Expectancy at Birth in Years. This map highlights global inequalities in life expectancies. Someone born in Japan has a life expectancy that is three decades longer than someone born in Afghanistan or Nigeria.

Infectious Disease vs. Chronic Disease

Most of the world maps in this chapter show differences in population and health between higher income world regions and lower income world regions. Whether we look at population growth rates, TFR, infant mortality, or life expectancy, we see North America, Europe, Japan, Australia and New Zealand in one camp, and Latin America, Africa, and much of Asia in another camp. Demographers report that differences in income also impact the types of disease to which people are susceptible. The **epidemiological transition** holds that as a country moves from high population growth rates to stable population growth rates, the causes of death and the age at which people are afflicted by disease change. Countries with high birth rates and high population growth rates tend to have more infectious diseases that afflict younger populations. Countries with stable growth rates, including low birth rates and low death rates, tend to have more chronic diseases that afflict older populations.

Scientists estimate 65 percent of all diseases are **infectious diseases**, resulting from an invasion of parasites and their multiplication in the body. The remainder can be divided into the **chronic** or **degenerative diseases** that come with old age, such as heart disease, prostate cancer, and diabetes, and **genetic** or **inherited diseases** we can trace to our genetic makeup. Genetic diseases, including sickle-cell anemia, hemophilia, and cystic fibrosis, are of interest to medical geographers because they tend to appear in specific places and in particular populations.

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

Battling infectious disease is far from a thing of the past. In early 2019, Washington and Oregon struggled to contain a measles outbreak that infected more than 50 children. Although measles was fully eradicated in the United States decades ago, anti-vaccination campaigns in the Pacific Northwest led to particularly low vaccination rates in the region. Nearly a quarter of kindergartners in Washington are not vaccinated against measles, making the outbreak especially difficult to manage. The challenge of such a case is place specific. The outbreak was made possible and exacerbated by the fact that vaccinations are seen with suspicion in Washington and Oregon.

Infectious diseases continue to sicken and kill millions of people annually. Malaria, a tropical disease, still takes more than a million lives annually and infects between 300 and 600 million people today. HIV/AIDS, an virus that erupted in Africa four decades ago, has killed about 35 million people globally. These two maladies illustrate two kinds of infectious disease: *vectored* and *nonvectored*.

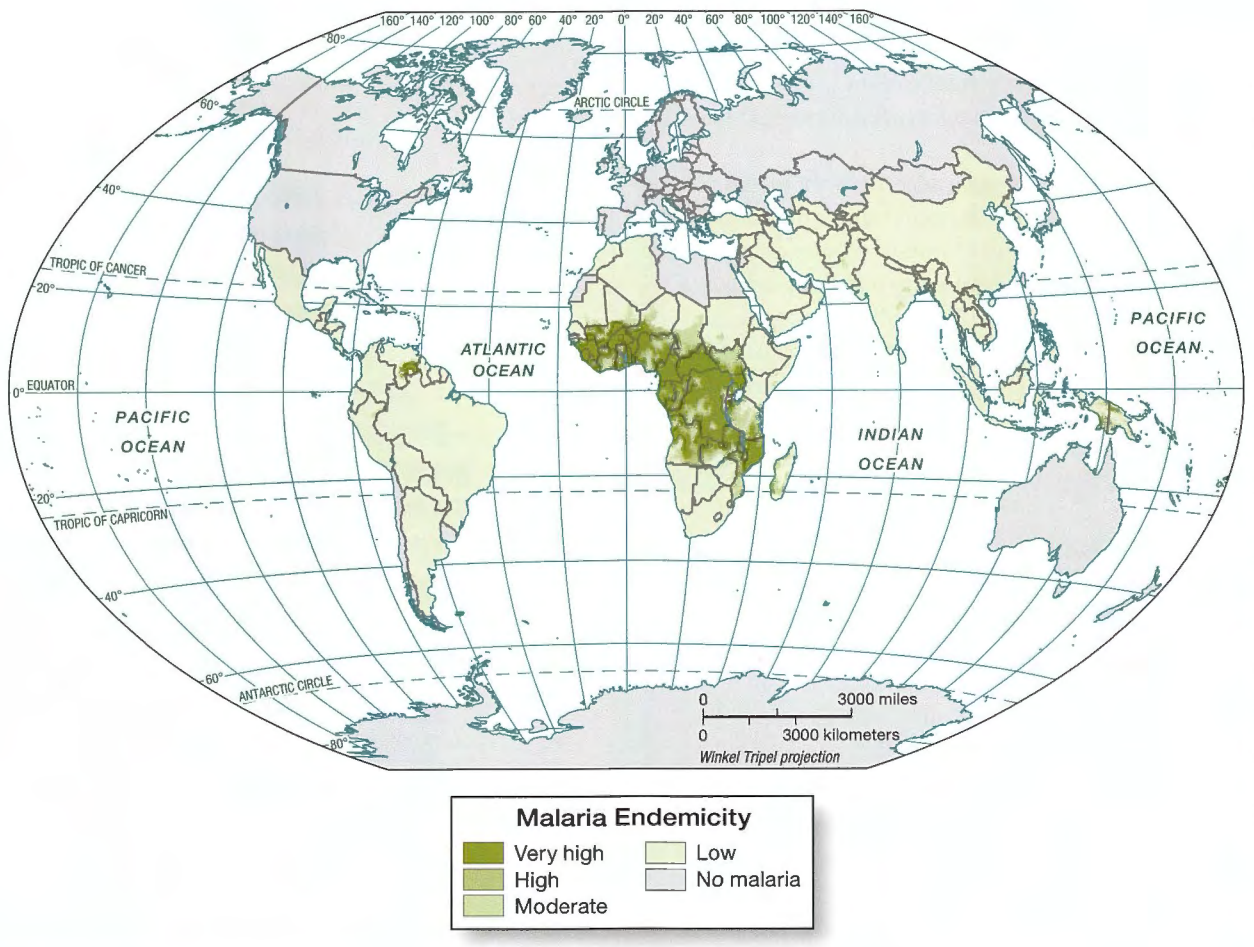
Malaria and Other Vectored Infectious Diseases A vectored infectious disease such as **malaria** is transmitted by an intermediary vector—in malaria's case, a mosquito. What happens is that the mosquito stings an already infected person or animal, called a host, and sucks up some blood carrying the parasites. These parasites then 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 bloodstream. Now that person develops malaria as the parasites multiply in his or her body, and the infected person becomes a host.

Malaria manifests itself through recurrent fever and chills, with associated symptoms such as anemia and an enlarged spleen. Malaria is a major factor in infant and child mortality, as most of the victims are children age 5 or younger. If a person survives the disease, he or she will develop a certain degree of immunity. However, many infected by malaria are weak, lack energy, and face an increased risk of other diseases taking hold.

Malaria occurs throughout the world, except in higher latitudes and elevations and in drier environments. Although people in the tropical portions of Africa suffer most from the disease, malaria is also prevalent in parts of India, Southeast Asia, and the tropical Americas (**Fig. 2.24**). No disease in human history has taken more lives than malaria, and the battle against this scourge is not yet won.

There are signs of progress, however. Infection rates have been falling in sub-Saharan Africa because of the increasingly wide distribution of insecticide-laden mosquito nets that are used to surround sleeping quarters and protect people from malaria-carrying mosquitoes, which are most active at night. Efforts are also under way to introduce genetically engineered mosquitoes that do not have the capacity to transmit the malaria parasite. The hope is that the genetic mutation of these mosquitoes will diffuse through the offspring of the current mosquito population.

Mosquitoes are especially effective vectors of several other infectious diseases, ranging from yellow fever to dengue. Yellow fever killed vast numbers of people in the past. It is being driven back by a vaccine, which can provide immunity for 10 years, but it is still prevalent in tropical Africa and South America, where it has long been endemic.



Source: Adapted from World Health Organization, Roll Back Malaria Department and United Nations Children's Fund. World Malaria Report, 2005.

FIGURE 2.24 Global Distribution of Malaria Transmission Risk. Malaria was once more widespread, but it is now concentrated primarily in the tropics, where moisture allows higher breeding rates for mosquitoes.

In addition to mosquitoes, other vectors, including fleas, flies, worms, and snails, transmit infectious diseases including river blindness, guinea worm, and elephantiasis. Sleeping sickness, which is transmitted by the tsetse fly, is a particular menace. The fly sucks the blood from an infected animal or individual and then infects others with its bite. Sleeping sickness began around 1400 in West Africa, but it spread throughout much of sub-Saharan Africa in the succeeding centuries. Both people and animals infected by the disease come down with a fever, followed by the swelling of lymph nodes and inflammation of the brain. Death is not uncommon. Progress has been made in combating the disease through tsetse fly eradication campaigns, but much of sub-Saharan Africa is still affected. Tropical climates, where warm, moist conditions allow vectors to thrive, are the worst afflicted areas of the world, but vectored infectious diseases are a global phenomenon.

HIV/AIDS and Other Nonvectored Diseases

Nonvectored infectious diseases are transmitted by direct contact between host and victim. A kiss, a handshake, or even contact with someone's breath can transmit influenza, a cold, or some other nonvectored diseases. HIV/AIDS is a nonvectored infectious disease that is transmitted primarily through sexual contact and secondarily through needle sharing. The hearth of the HIV/AIDS pandemic is in Africa. After four decades of rapid diffusion, HIV/AIDS has created one of the greatest health catastrophes in modern history. Nowhere has its impact been greater than in Africa itself.

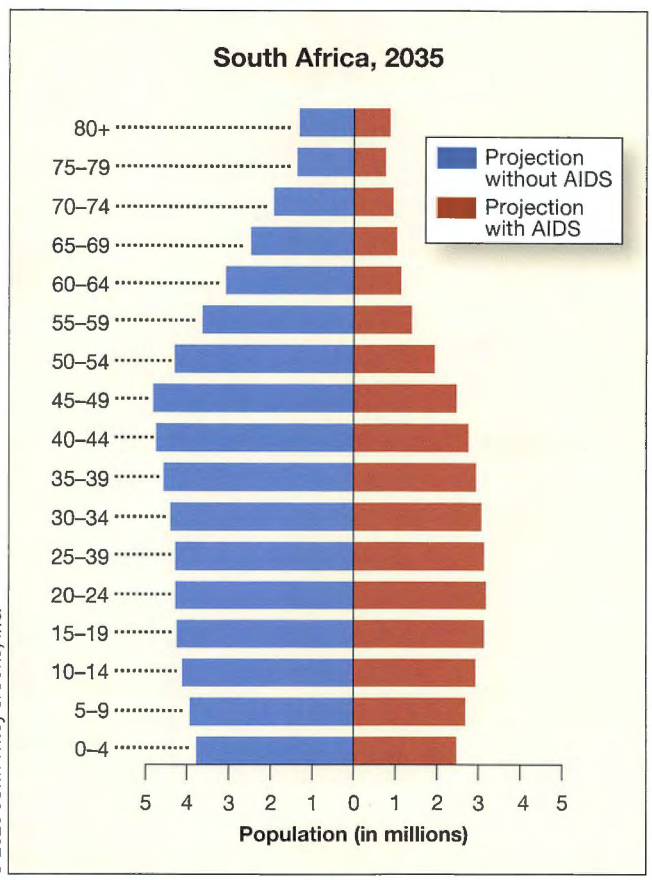
Medical geographers estimate that in 1980 about 200,000 people were infected with HIV (Human Immunodeficiency Virus, which causes AIDS, Acquired Immune Deficiency Syndrome), all of them Africans. By 2018, the number worldwide exceeded 36.9 million and totaled 77.3 million since the start of the epidemic, according to the United Nations AIDS Program. The majority of all cases of HIV/AIDS are concentrated in sub-Saharan Africa. The infection rate worldwide has fallen dramatically since 2001 and is continuing to slow, but eastern Europe and Central Asia have recently seen a surge in HIV/AIDS.

The impact of HIV/AIDS on sub-Saharan Africa is striking. In 2017, 27 percent of people aged 15 to 49 were infected in Eswanti, 23.8 percent in Lesotho, almost 23 percent in Botswana, and 18.8 percent in South Africa. These are the official data; medical geographers estimate that as much as 20 percent of the entire population of several African countries may be infected. The United Nations AIDS program reports that nearly a million people died of AIDS in 2017 alone. Geographer Peter Gould, in his book *The Slow Plague* (1993), said HIV/AIDS had made Africa a "continent in catastrophe," and the demographic statistics support his viewpoint. In a continent already ravaged by tropical diseases (see discussion above), AIDS is still the leading cause of death for adults. It has reshaped 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—reflecting the major impact of AIDS on the younger population in the country (**Fig. 2.25**).

Over the past four decades, the AIDS pandemic has reached virtually all parts of the world. China reported at least 820,000 infected in 2018, with 40,000 new cases in a single quarter of 2018 alone, and the number in India may well exceed 2 million living with HIV. Estimates of the number of cases in the United States surpass 1 million; in Middle and South America, nearly 2 million are infected. Southeast Asia now has as many as 5.2 million cases.

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. Add to this the social stigma many people attach to the disease, and it is evident that official statistics on AIDS do not give a full picture of the toll the disease takes.

Fieldwork conducted by geographers is shedding light on the human toll of HIV/AIDS locally and within families. Geographer Elsbeth Robson has studied the impact of HIV/AIDS in hard-hit Zimbabwe. She found that the diffusion of HIV/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 sub-Saharan Africa,



Data from: United States Census Bureau, 2005. Visualization by E.H. Fouberg and A.B. Murphy.

FIGURE 2.25 Effect of AIDS on the Total Population Pyramid for South Africa, Predicted 2035. This graph shows the estimated population, male and female, with AIDS and without AIDS.

the number of children orphaned when parents die from AIDS is growing rapidly (**Fig. 2.26**). 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. As of 2015, 13.4 million children had lost one or both parents to AIDS, and 80 percent of those were found in sub-Saharan Africa. Robson found that in addition to the rising number of AIDS orphans, many young children, especially girls, are taken out of school to serve as caregivers for their relatives with AIDS (**Fig. 2.27**). In her words, "more children are becoming young carers as households struggle to cope with income and labor losses through illness and mortality."

Despite the magnitude of the HIV/AIDS pandemic, enormous strides have been made in the past decade in the fight against the disease. Medical advancements have allowed people infected with HIV to live longer with antiretroviral treatments, which work to suppress the virus and halt the progression of the disease. In 2016, 17 million people living with HIV had access to antiretrovirals, and AIDS-related deaths had decreased more than 50 percent from their peak in 2005. Uganda, once Africa's worst-afflicted country, has slowed the growth of HIV/AIDS through an intensive, government-sponsored campaign of propaganda and action—notably the distribution of condoms in even the remotest part of the country. Life expectancy in Botswana and Swaziland, at 34 during the worst of the epidemic, has risen to 67. In Zimbabwe, life expectancy rose from 36 in 2007 to 61 in 2016. In addition to treatment, reproductive education programs have helped stem the transmission of the virus. Since 2010, the number of children with HIV/AIDS worldwide dropped 47 percent, largely as a result of programs aimed at preventing mother-to-child transmission.

Turning to other nonvectored infectious diseases, ebola is a serious disease that starts when humans come into contact with the bodily fluids of infected monkeys or fruit bats, and it is then spread from person to person through bodily fluids. Outbreaks in sub-Saharan Africa are deadly; the outbreak in West Africa in 2014 killed more than 11,000 people. Although the international health community mobilized to help stop the spread of ebola in West Africa, outbreaks continue. Almost every year, another outbreak occurs in the Democratic Republic of the Congo.

The origin of Middle East respiratory syndrome (MERS) is suggested by the name. A more recent disease, and less deadly than ebola, MERS has spread well beyond its source region, with cases appearing as far away as the United States by 2014. A particularly large outbreak took place in the Republic of Korea in 2015.

The most common nonvectored infectious disease is influenza, or the flu, which affects millions of people every year. Most infected individuals recover, but hundreds of thousands do not. Influenza epidemics often start when humans come into contact with infected pigs, which in turn contract the virus from birds and waterfowl. Southeastern China is a particularly common source region. In some years the spread of the virus reaches pandemic proportions. The most famous pandemic occurred in 1918–1919, leading to some 50 to 100 million deaths around the world. More recent pandemics have been less serious, but approximately 500,000 people succumbed to one strain of influenza in 2009–2010 (the so-called swine flu pandemic). Vaccines have slowed the spread of influenza, but staying ahead of virus mutations is an ongoing challenge.

Chronic and Genetic Diseases

Chronic diseases (also called degenerative diseases) are primarily afflictions of middle and old age. Among the chronic diseases, heart disease, cancer, and stroke 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

Author Field Note Visiting an AIDS Hospice Village in Johannesburg, South Africa

"The day was so beautiful, and the children's faces so expressive I could hardly believe I was visiting an AIDS hospice village set up for children. The Sparrow Rainbow Village on the edges of Johannesburg, South Africa, is the product of an internationally funded effort to provide children with HIV/AIDS the opportunity to live in a clean, safe environment. Playing with the children brought home the fragility of human life and the extraordinary impacts of a modern plague that has spread relentlessly across significant parts of sub-Saharan Africa."

– A. B. Murphy

Photo by A.B. Murphy. © 2020 John Wiley & Sons, Inc.

FIGURE 2.26 **Johannesburg, South Africa.**

TABLE 2.1 **Leading Causes of Death in the United States, 2017**

Cause	Percent of Total Deaths
1. Heart Disease	23.0
2. Cancer	21.3
3. Accidents	6.0
4. Chronic Lower Respiratory Disease	5.7
5. Stroke	5.2
6. Alzheimer's Disease	4.3
7. Diabetes	3.0
8. Influenza and Pneumonia	2.0

Source: "Deaths: Leading Causes for 2017", National Vital Statistics Report, Vol. 68, No. 6, 2019.

accidents next (**Table 2.1**). In the early 1900s, tuberculosis and pneumonia caused 20 percent of all deaths; today, they cause around 2 percent of all deaths. Diarrheal diseases, which were so high on the old list, are now primarily children's maladies. Today, diarrheal diseases are not even on the list of the leading causes of death in the United States.

At the global scale, cancer and heart disease take a high toll. Recent decades have brought new lifestyles, new pressures, new consumption patterns, and exposure to new chemicals, and we do not yet know how these are affecting our health. The health impacts of the preservatives that are added to many foods are not fully understood. We substitute artificial flavoring for sugar and other calorie-rich substances, but some of those substitutes have been proven to be dangerous. 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 now take for granted.

Diseases of Addiction Alcohol and drug addiction are also chronic diseases that are hazards of the modern world. The World Health Organization estimates that well over 200 million people worldwide are addicted to alcohol, with the highest rates of addiction found in eastern Europe and Russia. The disease is also prevalent in other parts of Europe, North America, and East Asia, with serious negative consequences for mental health and life expectancy. In contrast, the Middle East and sub-Saharan Africa exhibit some of the lowest rates of alcohol addiction.

As for drugs, the addiction pattern depends in part on the particular drug in question. Cocaine addiction is highest in parts of the United Kingdom, Spain, and the United States, whereas amphetamine-based stimulants are particularly prevalent in the Philippines, El Salvador, and Australia. What is clear is that

Guest Field Note Learning the Perspectives of Young AIDS Caregivers in Marich Village, Kenya

Elsbeth Robson
Keele University

This drawing was done by a Pokot boy in a remote primary school in northwestern Kenya. He agreed to take part in my fieldwork some years after I had started researching young carers (caregivers) in sub-Saharan Africa. Since those early interviews in Zimbabwe, I have been acutely aware of young carers' invisibility – you can't tell who are young carers 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. African young people help with farming and herding for many reasons, but for young caregivers, assisting their sick family members in this way is especially important.

FIGURE 2.27 **Marich Village, Kenya.**

the region where drugs are produced does not necessarily correspond with the region of the greatest consumption. Europe and North America lead the world in the consumption of many drugs, but the vast majority of them come from elsewhere.

Opioid addiction is a growing epidemic impacting every socio economic class within primarily higher income countries. Pharmaceutical companies pitched prescription opioids to medical doctors, claiming the drugs had low addiction rates. Doctors wrote prescriptions for high-dose pills and recommended patients take them for long periods after surgeries and injuries. Observant doctors, nurses, and community members recognized the addictive properties of opioids, while pharmaceutical companies continued to deny it. The opioid epidemic took root **(Fig. 2.28)**.

Both prescription and nonprescription opioids flooded the market, leading to medical complications and death for tens of thousands of people in the United States alone. In 2016, opioid overdoses accounted for more than 42,000 deaths, and in 2017 the U.S. Department of Health and Human Services declared the opioid problem to be a public health emergency. Some states began limiting the length of opioid prescriptions, and the medical community is moving to adopt alternative approaches to pain management. The opioid crisis includes prescription pain relievers, heroin, and synthetic opioids such as fentanyl. Addicts who cannot access or afford prescription opioids turn to the equally addictive but less expensive heroin. The National Institute on Drug Abuse reports that "about 80 percent of people who use heroin first misused prescription opioids." Most deaths are from overdose or tainted fentanyl, and non-Hispanic whites have the highest rates of overdose death in the U.S.

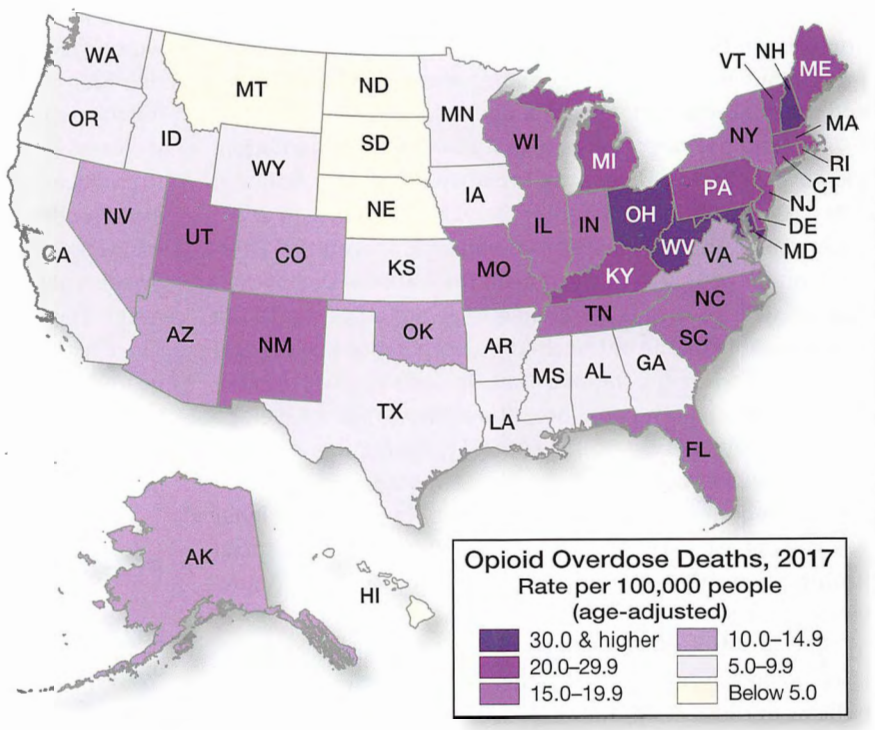


FIGURE 2.28 Opioid Deaths. The hearth of the opioid epidemic in the United States is West Virginia and the surrounding states. The crisis is spreading across the country at an alarming rate.

TC Thinking Geographically

Study Figure 2.22, the infant mortality rate (IMR) by state in the United States. Hypothesize reasons that would explain why the IMR is low in some **regions** of the country and high in others. Shift **scales** in your mind, and choose one state to consider: How do you think IMR varies within this state? At the scale of the state, what other factors might explain the pattern of IMR?

2.4 Identify Why and How Governments Influence Population Growth.

Governments have enacted policies to influence population growth rates or the ethnic composition of their countries. Government policies may lower birth rates through subsidized abortions or forced sterilization. Policies may also work to promote higher birth rates through tax incentives and marketing campaigns. Government population policies fall into three categories: expansive, eugenic, and restrictive.

Expansive

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. Although such policies have been abandoned in China, countries in stages 4 and 5 of the demographic transition are pursuing expansive population policies because their

populations are aging and their growth rates are declining. Countries in the former Soviet Union and Europe are encouraging families to have more children through tax incentives and the expansion of family-friendly social services.

In response to concerns over Russia's aging population, the government of Ulyanovsk Province has held a National Day of Conception each September 12 since 2005. In 2007, government and businesses in Ulyanovsk offered the afternoon off for people to participate in the National Day of Conception. The government planned to award a free car to the proud parents of one of the children born 9 months later, on June 12— the Russian National Day. On June 12, 2008, 87 children were born in the province, about four times its average daily birth rate. Between 2005 and 2011, the number of births in the province rose by 19.5 percent. Although Russia's birth rate has rebounded somewhat, its ability to sustain a higher TFR will depend on many factors, including alleviating social problems, stabilizing incomes, and having continued government support.

In the 1980s, the governments of several European countries, including France and Sweden, adopted family-friendly policies designed to promote gender equality and boost fertility rates. The programs focused on alleviating much of the cost of having and raising children. In Sweden, couples who work and have small children receive cash payments, tax incentives, job leaves, and work flexibility that lasts up to eight years after the birth of a child. The policies led to a mini-birth-rate boom by the beginning of the 1990s.When the Swedish economy slowed in the early 1990s, so did the birth rate. The children born in 1991 made up a class of 130,000 students in the Swedish education system. But the children born three years later, in 1994, made up a class of only 75,000 students. The birth rate fell to 1.5 children by the end of the 1990s, and the country had to think anew about how to support families and promote fertility.

One imaginative approach was suggested by a spokeswoman for the Christian Democrat Party, who urged Swedish television to show racier programming at night in hopes of returning the population to a higher birth rate! Over the last 20 years, increases in child allowances and parental benefits have helped to produce a natural rate of increase that is a little higher than that in many other European countries and a TFR of 1.9, the third highest in Europe behind Iceland and the United Kingdom. In 2015 the Swedish population saw its largest annual increase in 70 years, a result of family-friendly policies but also record-high immigration.

Even China is realizing the low birth rates that came from nearly four decades of the one-child policy are problematic for the country's continued growth. The Chinese government is now offering incentives for highly educated Chinese women to have more children.

Eugenic

Eugenic population policies are designed to favor one racial or cultural group by discouraging ostracized groups from having children. Nazi Germany was a drastic case in point, but other countries also have pursued eugenic strategies, though in more subtle ways. Until the time of the civil rights movement in the 1960s, some observers accused the United States of pursuing social policies tinged with eugenics that worked against the interests of African Americans.

Many countries have a history of forced sterilization of lesbian, gay, transgender, and bisexual individuals; some even maintain those policies today. In January 2019, Japan's Supreme Court upheld a lower-court ruling that anyone officially registering a change in gender has to be sterilized. In other places eugenic population policies are practiced covertly through discriminatory taxation, biased allocation of resources, and other forms of racial favoritism.

Restrictive

Restrictive population policies are designed to reduce a population's natural increase rate. Policies range from tolerating unapproved means of birth control to outright prohibition of large families. One of the most famous restrictive population policies was China's one-child policy. Instituted in 1979, the **one-child policy** financially penalized families (other than minorities) who had more than one child and kept educational opportunities and housing privileges from families who broke the one-child mandate.

The one-child policy drastically reduced China's growth rate from one of the world's fastest to one of the world's slowest (**Fig. 2.29**). In the 1970s, China's growth rate was 3 percent; in the mid-1980s it was 1.2 percent; and today it is 0.5 percent (**Fig. 2.30**).

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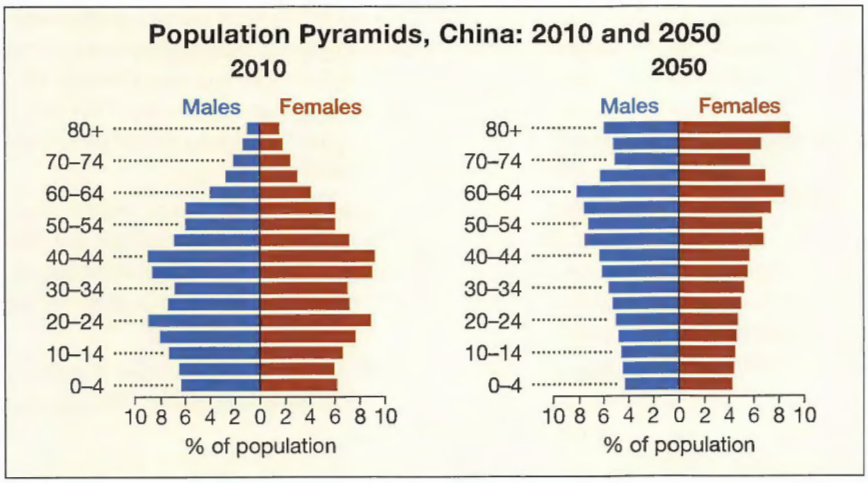
FIGURE 2.29 **Chengdu, China.** A large billboard from the 1990s warned readers to follow China's one-child policy.



Data from: Population Reference Bureau, 2010. Visualization by E.H. Fouberg and A.B. Murphy. © 2020 John Wiley & Sons, Inc.

FIGURE 2.30 Population Pyramids, China: 2010 and 2050. The 2050 pyramid assumes that present growth rates continue into the future.

The main goal of the one-child policy was achieved, but the policy had several unintended consequences, including an increased abortion rate, an increase in female infanticide, and a high rate of abandoned girls (many of whom were adopted in the United States and Canada).

During the 1990s, under pressure to improve its human rights records and also with the realization that the population was quickly becoming gender and age imbalanced, China relaxed its one-child policy. Several exemptions allowed families to have more than one child. Rural families whose first child was a girl could have a second child. If both parents of the child are only children, they could have a second child.

In late 2013, China officially amended the one-child policy to allow all couples to have two children provided one parent is an only child. Despite the changes in policy, China's birth rate has not rebounded as much as the government anticipated. The Chinese government is realizing the impacts of its one-child policy could last for decades to come.

TC Thinking Geographically

Recognizing that China's one-child policy left a significant impact on its **population pyramid** (Fig. 2.30), and thinking about China's expansion into Southeast Asia and Central Asia through the Belt and Road Initiative (Chapters 8 and 10), imagine how the Chinese government may use **migration** as a strategy to remedy its low birth rates and provide the population growth they want. Consider how **gender** was impacted through the one-child policy and how it could be impacted through your hypothetical, new migration policy.

Summary

2.1 Describe the Patterns of Population Distribution.

1. There are two common ways of calculating population density: arithmetic population density (average density in a unit area) and physiologic population density (average density in relation to the amount of arable land in a unit area).
2. Population distribution across Earth's surface is highly uneven. The areas of highest density correspond with places where the growing and harvesting of food are easiest. The largest population concentrations are found in the most agriculturally productive parts of East and South Asia, Europe, and North America.

2.2 Identify and Explain Influences on Population Growth over Time.

1. In the late 1700s, Thomas Malthus warned that Britain faced massive famine because of rapid population growth. A great famine did not happen, but the rapidly growing worldwide population of more recent times has led many to embrace Malthusian ideas. A stronger case can be made for these ideas at the global scale than at smaller scales because the interconnections among places undermine the significance of the population–food production ratio in any one place. Even at the global scale, increases in agricultural production complicate the relationship Malthus emphasized.
2. Total fertility rates (TFRs—the average number of children born to a woman of childbearing age) tell us how fast populations are growing. Places with TFRs below 2.1 are not growing. More and more countries, particularly high-income countries, are not growing, making it challenging for the working-age population to support children and the elderly.
3. Population pyramids show the age and sex structure of a population. They are called pyramids because, when first developed, most countries had a population structure in which children represented the highest proportion of the population, followed by young adults, followed by older adults, followed by the elderly. The result was a diagram that looked like a pyramid. The population pyramids of more prosperous countries today do not look like pyramids because the largest components of the population are not children, but middle-aged people.

4. The overall size of the human population has grown dramatically over the past few centuries. The demographic transition model shows that this happens when death rates decline but birth rates remain high. Population growth slows when birth rates also decline. Birth rates declined first in countries with greater urbanization and wealth. Birth rates are now declining in most places, but they still remain relatively high in poorer, less urbanized parts of the world.
5. There is a strong correlation between areas with improving educational opportunities for women and declining rates of natural population increase. The educational and economic opportunities afforded to women will play a central role in the population picture in the decades to come.

2.3 Explain how Health and Disease Affect Peoples' Well-Being.

1. Rates of infant mortality, child mortality, and life expectancy reflect the overall health of a society. The lowest rates of infant and child mortality are found in countries such as Sweden, Japan, and Singapore.
2. There are three basic types of diseases studied by geographers and others: infectious diseases, chronic or degenerative diseases, and genetic or inherited diseases. An infectious disease is epidemic when it spreads over a large region. A pandemic disease is global in scope.
3. Malaria and HIV/AIDS are two of the most deadly infectious diseases plaguing the planet over the past half-century. Some progress is being made in combating both diseases through education, the development of new drugs (in the case of HIV/AIDS), and the distribution of nets plus the introduction of genetically engineered mosquitoes (in the case of malaria).
4. Chronic diseases such as heart disease and cancer are afflictions of middle and old age. Recent decades have brought new lifestyles, new pressures, new consumption patterns, and exposure to new chemicals. We do not yet know how these are affecting our health.
5. Mapping diseases and the access of communities to medical facilities can tell us much about the health issues and challenges facing different populations.

2.4 Identify Why and How Governments Influence Population Growth.

1. Governments sometimes adopt policies that are designed to increase or reduce population growth rates. A number of states with low TFRs have adopted expansive population policies (e.g., tax incentives for having more children and generous maternal leave policies).
2. The most influential restrictive population policy of the last few decades is China's one-child policy. That policy has now been relaxed out of concern that China's population is aging.

Self-Test

2.1 Describe the patterns of population distribution.

1. In the study of demography, an advantage of looking at physiologic population density as opposed to arithmetic population density is that:
   a. you learn more about the health of a population.
   b. you learn more about the wealth of a population.
   c. you learn more about the agricultural base that can support a population.
   d. you learn more about the industrial base that can support a population.
2. Throughout most of human history, population density has been highest:
   a. in areas where food can be grown.
   b. in areas where average temperatures are high.
   c. in areas with high levels of biodiversity.
   d. in areas where few or no dangerous animals can be found.
3. Which world regions have the highest population densities?
   a. East Asia, sub-Saharan Africa, and Europe
   b. East Asia, Europe, and North America
   c. East Asia, South Asia, and Europe
   d. East Asia, South Asia, and sub-Saharan Africa

2.2 Identify and explain influences on population growth over time.

4. Thomas Malthus is famous for arguing that:
   a. population growth would have serious environmental consequences.
   b. population growth would outstrip food supply.
   c. population growth would lead to industrialization.
   d. population growth would slow with greater urbanization.
5. If immigration is not a factor, a population needs a total fertility rate of _____ to reach replacement level.
   a. 1.5 c. 2.5
   b. 2.1 d. 3.1
6. In which of the following countries is the old-age dependency ratio a significant concern?
   a. Nigeria c. Indonesia
   b. Mexico d. Japan
7. A population pyramid for which of the following countries would most likely have the shape of an actual pyramid (a broad base that then tapers upward to a point)?
   a. France c. Bangladesh
   b. Russia d. Canada

8. The demographic transition model charts the relationship over time between:

a. birth rates and death rates.

b. death rates and disease.

c. birth rates and average family size.

d. death rates and the child dependency ratio.

2.3 Explain how health and disease affect peoples' well-being.

9. Life expectancy at birth in the United States is the highest in the world.

a. true b. false

10. Malaria is an example of:

a. a chronic disease.

b. a genetic disease.

c. a vectored infectious disease.

d. a nonvectored infectious disease.

11. Which of the following terms describes a disease that spreads around the globe?

a. vectored c. epidemic

b. endemic d. pandemic

12. Which of the following statements about HIV/AIDS is correct?

a. The disease started in North America and then spread around the world from there.

b. The disease started in Europe and then spread to North America, but not elsewhere.

c. The disease started in sub-Saharan Africa and then spread around the world from there.

d. The disease started in East Asia and then spread to sub-Saharan Africa and North America.

2.4 Identify why and how governments influence population growth.

13. China's one-child policy, which has now been relaxed, is an example of:

a. an expansive population policy.

b. a restrictive population policy.

c. a eugenic population policy.

d. an anti-infant-mortality population policy.

14. Each of the following countries has made efforts to increase population growth rates except:

a. Russia. c. India.

b. Denmark. d. France.

15. Government initiatives designed to boost the population growth rate in Sweden have produced a modest uptick in the growth rate.

a. true b. false