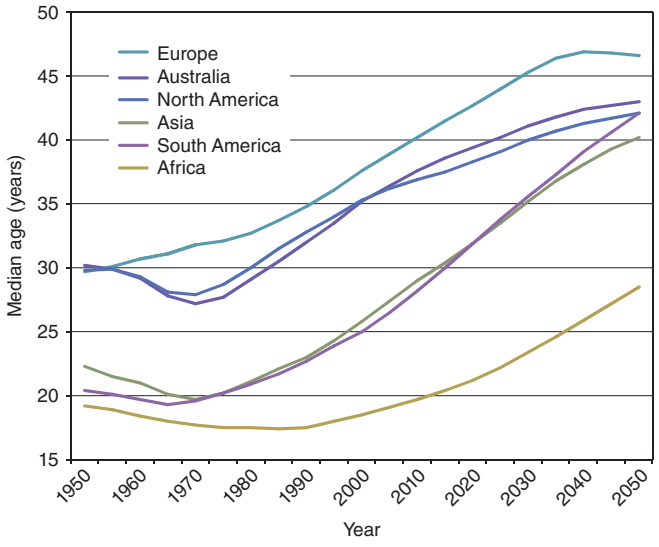

FIGURE 11-2 Population aging in different geographic regions. *(From United Nations World Population Prospects: The 2008 Revision, http://www.un.org/esa/population/publications/wpp2008/wpp2008_highlights.pdf.)*

The overall number of children has remained relatively stable, but explosive growth has occurred among older populations. The percentage of growth is particularly dramatic among the oldest of the old. For example, the number of persons aged 80–89 years more than tripled between 1960 and 2010 and will increase over tenfold between 1960 and 2050. Women already outlive men by many years, and the sex discrepancy in longevity is projected to increase further in the future.

Population aging occurs at different rates in varying geographic regions of the world. Over the past century, Europe, Australia, and North America have had the populations with the greatest proportions of older persons, but the populations of Asia and South America are aging rapidly, and the population structure on these continents will resemble that of "older" countries by around 2050 (Fig. 11-2). Among older persons, the oldest old (those >80 years of age) are the fastest-growing segment of the population (Fig. 11-3), and the pace of population aging is projected to accelerate in most countries over the next 50 years. There is no evidence that the rate of population aging is decreasing.

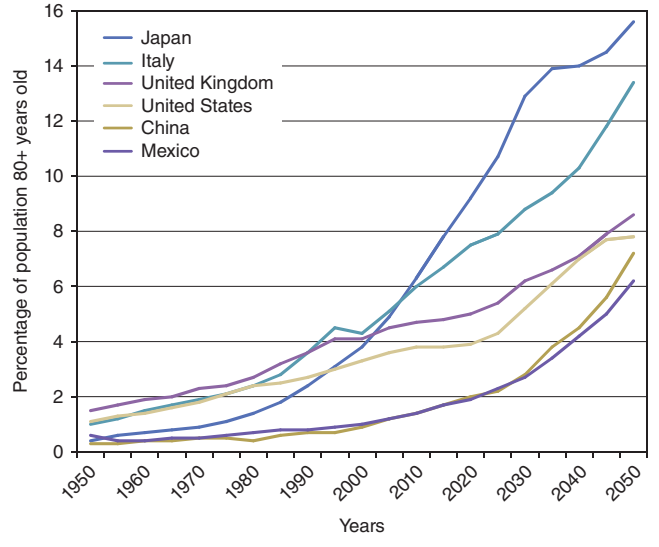

FIGURE 11-3 Percentage of the population age >80 years from 1950 to 2050 in representative nations. The pace of population aging will accelerate. *(From United Nations World Population Prospects: The 2008 Revision, http://www.un.org/esa/population/publications/wpp2008/wpp2008_highlights.pdf.)*

POPULATION AGING AND HEALTH

Many chronic diseases increase in prevalence with age. It is not unusual for older persons to have multiple chronic diseases (Fig. 11-4), although some seem more susceptible than others to co-occurring problems. Functional problems that pose difficulties or require help in performing basic activities of daily living (ADLs) (Table 11-1) increase with age and are more common among women than among men. In recent decades, the age-specific prevalence of disability has declined, especially in the oldest old. Estimated rates are shown in Fig. 11-5 as the percentage of persons who reported severe difficulty or needed help in bathing, and data on other basic ADLs show similar trends. Although the age-specific prevalence of disability is decreasing, the magnitude of this decline is small compared to the overwhelming effect of population aging. Thus, the number of people with disability in the United States and other countries is rapidly expanding. Rates of cognitive impairments, such as memory problems, also increase with aging (Fig. 11-6). Chronic disease and disability lead to increased use of health care resources. Health care expenditures increase with age, increase more with disability, and are highest in the last year of life. However, new medical technologies and expensive medications are greater influences on health care costs than population aging itself. General practitioners and internists with little specific training in geriatric medicine provide the bulk of care for older persons.

SYSTEMIC EFFECTS OF AGING

Systemic consequences of aging are widespread but can be clustered into four main domains or processes (Fig. 11-7): (1) body composition; (2) balance between energy availability and energy demand; (3) signaling networks that maintain homeostasis; and (4) neurodegeneration. Each domain can be assessed with routine clinical tests, although more detailed research techniques are also available (Table 11-2).

Body Composition Profound changes in body composition may be the most evident and inescapable effect of aging (Fig. 11-8). Over the life span, body weight tends to increase through childhood, puberty, and adulthood until late middle age. Weight tends to decline in men between ages 65 and 70 years and in women somewhat later. Lean body mass, composed predominantly of muscle and visceral organs, decreases steadily after the third decade. In muscle, this atrophy is greater in fast-twitch than in slow-twitch fibers. The origin of this change is unknown, but several lines of evidence suggest that progressive loss of motor neurons probably plays an important role. Fat mass tends to increase in middle age and then declines in late life, reflecting the trajectory of weight change. Waist circumference continues to increase across the life span, a pattern suggesting that visceral fat, which is responsible for most of the pathologic consequences of obesity, continues to accumulate. In some individuals, fat also accumulates inside muscle, affecting muscle quality and function. With age, fibroconnective tissue tends to increase in many organ systems. In muscle, fibroconnective tissue buildup also affects muscle quality and function. In combination, the loss of muscle mass and quality result in reduced muscle strength, which ultimately affects functional capacity and mobility. Muscle strength declines with aging; this decrease not only affects functional status but also is a strong independent predictor of mortality (Fig. 11-9). Progressive demineralization and architectural modification occur in bone, resulting in a decline of bone strength. Loss of bone strength increases the risk of fracture. Sex differences in the effects of aging on bone mass are due to differences in peak bone mass and the effects of gonadal hormones on bone. Overall, compared with men, women tend to lose bone mass at a younger age and more quickly reach the threshold of low bone strength that increases fracture risk.

All of these changes in body composition can be attributed to disruptions in the links between synthesis, degradation, and repair that normally serve to remodel tissues. Such changes in body composition are influenced not only by aging and illness but also by lifestyle factors such as physical activity and diet. Body composition can be approximated in clinical practice on the basis of weight, height, body mass index (BMI; weight in kilograms divided by height in meters squared), and waist circumference or, more precisely, with dual-energy x-ray