The Aging of Human Populations: The Significance of an Epidemiologic Perspective

INTRODUCTION

Today, older people constitute a larger segment of the population than at any other time in history. For example, in the United States in 1900, only 4% of the population was aged 65 and older. One hundred years later, people in that age group represent nearly 13% of the population, and by 2030, when the last wave of people born between 1946 and 1964 (the baby boom generation) reaches the age of 65, they are expected to constitute just over 20% of the country’s population. This historic, demographic transformation has had, and will continue to have, dramatic and far-reaching social, political, and economic consequences for all segments of the society. This transformation can be demonstrated graphically by reviewing the age structure of the nation from 1905 to 2030. Figure 1–1 displays the number of males and females in each age group, from the youngest ages at the base upward to the oldest groups, for the years 1905, 1975, 2010, and 2030. In addition to a general increase in the size of the population, these figures indicate that there has been over the four periods a more even distribution in the number of people across the age groups...
CHAPTER 1  THE AGING OF HUMAN POPULATIONS

Population by Age and Sex: 1905

Projected Population by Age and Sex: 2010


Population by Age and Sex: 1975


Projected Population by Age and Sex: 2030

for both males and females. It is clear that what was once labeled a “population pyramid” (in fact, still the generic name for this type of demographic display), will, in the future, more closely resemble a “population dome.”

The aging of human populations represents one of the most significant public policy issues facing society. Not only has the increase in the sheer number of the older population focused the public’s attention, but the current and future levels of that population’s health and vitality are also of widespread concern. The fundamental question is whether an increase in the proportion of older people will result in an increase in the prevalence of chronic disease and disability. That simple question is the basis of public debate about anticipated increases in health-care costs, federal spending for entitlement programs, and in particular, the future viability of the Social Security and Medicare programs in the United States (Rice & Fineman, 2004). Although the Medicare population (in other words, people 65 and older) represents approximately 13% of the population, they accounted for 31% of national health care spending in 1999 (Rice & Fineman, 2004). The enrollment in the Medicare program will increase significantly after 2010. It is anticipated that the enrollment will grow by 2.4% a year between 2010 and 2030. This is in contrast to a projected, average annual growth rate of 1.4% between the late 1990s and 2007. During the same period, the number of workers in the United States, that is, those people whose payroll deductions sustain the program, will decline. The ratio of workers to Medicare beneficiaries, coupled with an anticipated decrease in the absolute number of workers, has stimulated intense debate about policy options for the Medicare programs, including slowing the growth of provider payments, increasing beneficiary cost-sharing requirements, placing the cost of monthly premiums on a graduated scale to better reflect differences in household income, advancing the age of eligibility, increasing Medicare revenues, and introducing guidelines that will “privatize” elements of the programs. Further compounding the issue is a growing increase in calls for expanding Medicare coverage to include increased pharmaceutical benefits and long-term care beyond current coverage for rehabilitative care following hospitalization. In February 2004, the chairman of the U.S. Federal Reserve questioned in public testimony to the Congress whether current Medicare benefits could be maintained for future generations of older retirees in light of current and projected federal deficits. Following the reelection of President Bush in
November 2004, both Social Security and Medicare became the focus of extensive political debate. Not surprisingly, the specter of generational conflict has been raised as public debate addresses the question of what proportion of the society’s resources should be allocated to support its growing senior population. This debate has led to fundamental questions about the need for what James Madison, in a letter to Thomas Jefferson in 1790, called a “web of obligatory connections between past and present generations,” something Madison saw as being “essential for continuation of civilized society” (Ellis, 1998, p. 132). Of course, the aging of the population is not confined to the United States, nor is public discussion and debate about the implications of that aging population or increases in the prevalence of chronic disease, disability, and their associated social and economic costs.

In this chapter, we will examine aging as a global phenomenon; consider the Epidemiologic Transition Theory as one framework for understanding regional differences in aging populations; describe the development of the epidemiology of aging as a viable field of study and practice; and finally, outline the core epidemiological questions that serve to frame the study of aging, health, and functioning in populations. The main purpose is to highlight the special significance and contribution of the epidemiology of aging for addressing these important issues and, it is hoped, make the case for the importance of a text in this field.

HUMAN AGING AS A GLOBAL PROCESS

The aging of the population is a global issue. Table 1–1 displays the current and future projections for the size of the senior population by region of the world between the years 2000 and 2050 (National Research Council, 2001). Two points are clear. First, there is considerable variation among regions. In 2000, the percentage of the population aged 65 and older ranged from 14% in Europe to 2.9% in sub-Saharan Africa. Second, in 2050, although Europe is expected to continue to lead the world in the percentage of older people in its population (nearly 30%), seniors in a number of other regions, most notably, Asia, Latin America and the Caribbean, and the Near (or Middle) East and North Africa, are expected to constitute a much higher percentage of the total populations of those areas than they do today, in some cases, approximating the percentages that are expected for North America and Oceania.
Although regional comparisons of this kind are very useful, it should be kept in mind that there are variations in the percentage of older people within each region. For example, in 2000, the percentage of people aged 65 and older in Europe ranged from a high of 18.1% in Italy to 12.3% in Poland. Even more dramatically, in Asia, the percentage of seniors ranged from 17.1% in Japan to 3.3% in Bangladesh.
It is clear that there is a difference in the percentage of people aged 65 and older between the so-called developed and developing worlds. Between 1950 and 2030, we can see again the transformation from a population pyramid to a population dome. In this case, the greater absolute size of the population in the developing world contributes significantly to the shape of that dome. Without the population from the developing
world, the global age structure would more closely resemble an elongated tower, with very little difference in the size and distribution of the population across age groups for both males and females.

The elderly support ratio also provides a useful summary of the age distribution of the population. This ratio represents the number of people aged 65 and over per 100 aged 20 to 64. In the United States, the ratio is anticipated to increase from 21 in 2000 to 37 in 2030. While this increase is noteworthy, it is even more dramatic in other developing nations. For example, the ratio in Italy is expected to increase from 29 to 49 between 2000 and 2030, and in Japan, from 27 to 52 over the same time period. Although less pronounced, the elderly support ratio is also expected to increase among developing nations. For example, in Asia the ratio is expected to increase from 12 to 26 in China between 2000 and 2030, in India from 9 to 15, and in Thailand from 11 to 27. In Latin America and the Caribbean, the ratio ranges from 13 to 28 in Chile and from 8 to 11 in Guatemala (Kinsella & Velkoff, 2001).

In addition to summarizing the age distribution of the population, the elderly support ratio is also useful for estimating the proportion of the population (those aged 20 to 64 years) theoretically available to contribute to the overall economic productivity of the country in general and to the economic support for seniors aged 65 and older in particular (In the United States, this support comes in the form of such transfer programs as Social Security and Medicare). The significance of the ratio will vary with each country’s economic transfer programs and the perceived need demonstrated by the country’s elderly, as reflected by their level of health and functioning. With recent attempts to reduce trade and immigration barriers among countries, there are also incentives for developed countries to reduce their elderly support ratio by encouraging migration of younger workers from other countries, most notably developing countries. No doubt, this will be an important area of future research and policy, especially regarding the effect of this migration on the elderly support ratio of the migratory workers’ home countries.

Global patterns of aging, migration, and travel also will have implications for the development and transmission of infectious and chronic health conditions. For example, the recent epidemic of sudden acute respiratory syndrome (SARS) in China and Canada in 2002 and 2003 focused attention on exposure and transmission patterns associated with travel among countries. Although younger people are most likely to contact the condi-
tion, reduced age-related resistance to infection and the presence of other, comorbid health conditions make the condition especially lethal for elderly people (Leung et al., 2004; Liang et al., 2004; Xu et al., 2004).

In general, global patterns of aging have important implications for current and future incidence and prevalence of health conditions and disability. The specific patterns of disease and disability, of course, will depend on a variety of factors that include specific environmental and behavioral risk factors as well as the resources devoted to preventive and health care services. This will be addressed in more detail in subsequent sections. At this point, however, it is important to consider the reasons why there are regional variations in older populations and the effect the health status of these populations have had on those patterns.

**Epidemiologic Transitions and Changes in Life Expectancy**

What accounts for differences in age distribution of the population around the world? The Epidemiologic Transition Theory, as first published by Omran in 1971, was originally presented as an attempt to both describe and explain these global patterns. In this section, we will review the original formulation of this theory as well as its critiques and proposed modifications.

The reasons for the improvements in life expectancy represent an important area of investigation. The basic proposition of the Epidemiologic Transition Theory (Omran, 1971) is that the increases in life expectancy have been caused in part by a substitution in late-onset degenerative causes of death, such as heart disease and cancer, replacing deaths caused by early-onset infectious and parasitic diseases. This epidemiologic transition was due to a variety of factors that were associated with socio-economic factors and, more specifically, forces of modernization. These factors include improvements in public hygiene, sanitation, and housing; improvements in nutrition, food production, and processing; and later, immunization and other medical innovations. Improved access to formal education by females also has been identified as an important factor (Aviles, 2001). Because infants and children of both genders and adolescent and young adult women were at greatest risk of early death from infectious and parasitic conditions, reduction in the incidence of these conditions results in an improvement in life expectancy. Initial improve-
ments in life expectancy, therefore, were due to early reduction of infant and maternal mortality. People typically survived their early years to develop degenerative, chronic conditions later in life.

The epidemiologic transition, as originally proposed, took place in three stages:

- The age of pestilence and famine
- The age of receding pandemics and
- The age of degenerative and man-made diseases

High fertility and high mortality characterized the age of pestilence and famine. Although the mortality rates were high, there were also periodic fluctuations in those rates due to epidemics that regularly affected the population. Influenza, pneumonia, diarrhea, smallpox, tuberculosis, as well as trauma and infections associated with childbirth, were conditions that most commonly affected the population during this period. During the age of receding pandemics, basic improvements in living standards, public sanitation, housing, and nutrition reduced the incidence of the pandemics of infectious and parasitic disease, especially among infants and young women. The development and dissemination of medical and public health measures, such as new immunization and community screening programs, sustained this transition. Following a reduction in mortality rates, a reduction in birth rates occurred. Finally, as the risk of early death from infectious and parasitic diseases declined, more people survived to their later years. Life expectancy improved. During this third period, the age of degenerative and man-made diseases, the major causes of disease are the late-onset conditions of heart disease, cancer, and stroke. Relatively low and stable birth and death rates characterize this period. Overall, the transition from the first to the third stage has resulted in a progressive aging of the population. Regions of the world are currently in different stages of development. Some regions of the world are presently in the third stage of development; others are not. As noted previously, the age distribution of the world population is quite variable. Indeed, Omran proposed that the nature and timing of the transition depends on the time period, country, the stage of modernization, and, it may be hypothesized, the degree of contact a country has with regions in different stages of transition. This is important. While each region may proceed through a similar demographic and epidemiologic transition, each region is characterized by a different pattern, pace, determinants, and consequences.
Three models were identified. The Classic or Western Model is characterized by a gradual, progressive transition from high mortality and high fertility to low mortality and low fertility. This transition, as experienced by Western Europe and the United States, was stimulated in large part by socioeconomic factors. Specific factors included the sanitary revolution of the late 1800s, coupled with the development and dissemination of medical and public health innovations during the early period of the 1900s. In the second and third decades of the 1900s, chronic and degenerative disease replaced infectious diseases as the primary causes of death. In contrast, the Accelerated Epidemiologic Transition Model occurred in countries such as Japan. Although the factors that stimulated the transition were similar to the factors that affected the transition in the Classic Model, Omran contends that the process occurred more quickly. The epidemiologic transition that occurred at this time and region of the world was affected by interaction with regions—the United States and Western Europe—that had made that same transition decades before. Finally, the Contemporary (or Delayed) Epidemiologic Transition Model characterizes the ongoing transition that is taking place today in many of the developing nations. Mortality rates in a number of these nations began to decline at the end of the 1800s, but accelerated after World War II. Many of these nations are still characterized by high fertility rates. Although socioeconomic factors contributed significantly to this transition, as was the case with the first two models, public health and medical interventions played, and continue to play, a more significant role.

There is evidence to support the premise that the aging of the populations in the developing countries is occurring more rapidly than it did in developed countries. One measure used by the U.S. Census Bureau is the time it takes for the percentage of people aged 65 and older in a country’s population to increase from 7% to 14% of its total population. For example, in the developed world, it took over 115 years (1865–1980) for the senior population in France to increase from 7% to 14%, compared to only 26 years (1970–1996) in Japan. In contrast, among developing countries, it is estimated that the time will range from 30 years for Chile (2000–2030) to only 15 years in Tunisia (2020–2035) (National Research Council, 2001).

The Epidemiologic Transition Theory provides a parsimonious framework for considering the interrelationship of life expectancy, morbidity, and mortality within a global-historical context. In addition, the model under-
scores the significance of socioeconomic and environmental factors in this transition. That is not to say, of course, that aspects of the theory have not been questioned or that the theory itself has not been modified over time. Indeed, Omran (1971) concluded his original paper by acknowledging that there are inherent difficulties in attempting to formulate such a comprehensive theory, especially when it attempts to incorporate such a vast array of social, economic, demographic, and epidemiologic factors. He called on other researchers to assist in expanding or refining the theory.

Three types of modifications or critiques have been proposed. First, there have been proposals to extend the number of stages from three to four and, in some cases five, to better account for recent events. Second, there are critiques that question some of the theory’s fundamental assumptions. Finally, there have been proposals to include additional variables, for example, regional differences in natural resources and climatic patterns.

NEW STAGES

Fifteen years after the publication of Omran’s paper, Olshansky and Ault (1986) proposed that the final stage of the theory (the age of man-made diseases) no longer accurately characterized many of the developed nations. Instead, they proposed that many of these countries could be better specified by a fourth stage—the age of delayed degenerative diseases.

At the time the original paper was published in 1971, Olshansky and Ault argued that Omran and others did not fully appreciate the long-term significance of the decline in coronary heart disease that began in 1967 and 1968. The general consensus at the time was that life expectancy, approximately 70 years at that time, had reached its biologic limit and it was very unlikely that there would be any meaningful improvement in life expectancy beyond that point. This proved not to be the case. While the death rates declined initially among middle-aged people, later declines occurred among older age groups. The development of new drugs and antibiotics and improved methods of diagnosing and treating degenerative diseases and their complications served to postpone deaths from these diseases by slowing the rate of chronic disease progression and by reducing case-fatality rates. In addition to advances in medical technology, there were lifestyle changes, such as reductions in smoking and improved exercise and dietary behavior. Improved access to health services in the United States also was provided to the elderly through the introduction of
the Medicare program in the 1960s. In contrast to improvements in life expectancy that were driven by reductions in infant and maternal mortality at the turn of the century, current and future gains in life expectancy are reducing mortality among older age groups. Just as the initial epidemiologic transitions resulted in infectious and parasitic diseases being replaced by chronic diseases, the most recent transition has resulted in the age at death changing from the young old to the old old.

Olshansky and Ault (1986) argued that this period of increased age at onset of degenerative conditions is important regarding two factors: (1) the size, age, and gender distribution of the older population, and (2) the health and vitality of the older population. Indeed, the relationship between increased age at onset and associated levels of health and vitality has been the topic of some debate, especially in the United States.

**Epidemiologic Transitions and the Compression of Morbidity**

It is fair to say that this debate was first joined in 1980 with the publication of a paper in *The New England Journal of Medicine* by James Fries on “the compression of morbidity.” According to Fries, his paper challenged the “common anticipation” that there would be in the future “an ever older, ever more feeble, and ever more expensive-to-care-for populace” (Fries, 1980). Instead, Fries predicted a future in which morbidity and disability would be “compressed” into the final years or even months of life. This “compression of morbidity” hypothesis, which was dismissed by some commentators at the time as “dangerous optimism” (Schneider and Brody, 1983), is based on the following propositions:

- There is a fixed life span. Fries argued that although there has been an improvement in life expectancy, all species have, at some point, a fixed life span, in other words, the maximum expected number of years of life. Based on his projections, most humans can expect to live to approximately 85 years.
- There is a common course for most chronic conditions. The onset of disease is followed by a period or morbidity or disability, which, in turn, is followed by death.
- The onset of chronic disease is occurring later in life. This is the result of the improvements in preventive health behavior (such as,
exercise and nutritional improvements) and medical innovations.
(Less attention is given to socioeconomic factors.)

• With a fixed life span, a delay in the onset of disease should be followed by a “compression” of morbidity. This process, in turn, would result in a “rectangularization” of the survival curve (Figure 1–3). People will survive for a longer period of life before developing chronic disease. Moreover, the late onset of chronic diseases would be followed by a relatively short period of disability, which, in turn, would be followed by, to use Fries’s term, a more “natural death.”

Fries also proposed a new research agenda. This research would first assess the variability of one or more markers of aging, such as, oxygen uptake or cognitive function. This would be followed by examinations of the associations between differences in those markers and differences in health behavior. This would determine whether differential aging in these outcomes is associated with differences in health behavior. Finally, prospective intervention studies would be designed to determine

![Figure 1–3 Rectangularization of the Survival Curve](image)


FIGURE 1–3 Rectangularization of the Survival Curve
whether there is a causal relationship between particular types of health behavior, such as, exercise and dietary practices, and differences in the markers of aging.

Not surprisingly, the compression of morbidity hypothesis proved to be quite controversial. Concerns were expressed about whether the hypothesis was based on sound research, whether it was testable, and finally, whether it unwittingly served to justify reduced support for gerontological research and reduced support for programs assisting disabled older populations (Schneider & Brody, 1983). First, it was somewhat unclear whether Fries was using the term “life span” to mean a fixed end point or something that was more akin to “life expectancy” when he proposed that the human life span was age 85 years. Second, it was questioned whether there was a generic relationship between disease, disability, and death, that is, disease leads to disability, which, in turn, leads to death. Some commentators argued instead that it was impossible to think in terms of a generic, linear process, given that the severity, timing, and course of functional limitations and disability were so variable across conditions (Rice, Haan, Selby, & Satariano, 1991). In fact, some very common conditions, such as osteoarthritis and cataracts, often lead to disabilities, but are not necessarily lethal. It was argued that older people were increasingly avoiding or surviving chronic conditions, only to develop nonlethal, disabling conditions (Gruenberg, 1977). Living longer is often associated with living more years with functional limitations and disability. It also was argued that Fries’s formulation of diseases, disability, and death seemed to ignore the presence of multiple, concurrent health conditions, so common in older populations (Rice et al., 1991). The compression of morbidity hypothesis also seemed to ignore, some charged, that the severity of disability may vary over the disease course, increasing in the years just prior to death, especially for those aged 85 and older (Guralnik, 1991). Instead of being compressed, the years of disability may be extended by initiating an early predisability period. The feasibility of testing the hypothesis also was questioned, as the age of the onset of a chronic condition, such as heart disease and cancer, is difficult to establish (Kaplan, 1991). Finally, there was concern about the political implications of the hypothesis. Schneider and Brody (1983) concluded a critical assessment of the compression of morbidity hypothesis with the hope that political leaders and policy makers would not be “seduced” by Fries’s statements and assume that resources should not be
committed to meet the needs of an aging population. Unfortunately, much of the debate during those early years focused on the political and ideological implications of the hypothesis, resulting in what Fries later characterized as producing “more heat than light” (Fries, 2003).

In 1990, the National Institute on Aging convened a conference in Pacific Grove, California, to establish a research agenda for the compression of morbidity hypothesis, an agenda that would be designed to provide some light on this critical issue (Haan, Rice, Satariano, & Selby, 1991). The conference concluded with a number of recommendations (Rice et al., 1991). First, it was concluded that predictions about the effects of aging on health would require a comparison of the incidence and survival time in different time periods. Longitudinal studies of well-characterized cohorts were needed, therefore, to determine the onset and duration of disease, to compare how different cohorts of people age, and to assess differences in disease patterns. This included the recommendation that each cohort should be characterized by age, gender, race, ethnicity, and socioeconomic status, so that the diversity of the population should be presented. Second, based on the position that the aging process does not necessarily involve an immutable progression toward deterioration, disability, and death, it was proposed that health transitions associated with single and multiple health conditions should be studied in more detail. Third, biologic, behavioral, medical, social, economic, and environmental risk factors for disease and disability should be identified, especially in terms of how chronological age affects the strength and direction of those risk factors. Fourth, it was recommended that better measures of comorbidity (or multiple occurrence of health conditions) and quality of life should be developed and tested. Fifth, more attention should be given to strategies to promoting health and preventing disease, including research on assistive devices and low-cost aids to improve mobility, sight, and hearing for older persons. Sixth, research was recommended to examine long-term care services, medical care, alternatives to institutionalization, housing, financial support, retirement patterns, and barriers to service and care. Seventh, methodological research and data needs were identified. It was argued that refined statistical models, as well as new measures of “active life expectancy,” were required to characterize the relationship between age changes and the onset of single and comorbid conditions, disability, and mortality. Active life expectancy is an estimate of the remaining years of life that are spent in independence and
mobility (See Chapter 4 for a more complete description). Finally, a strong recommendation was made that national and local longitudinal surveys were needed to develop more refined forecasts of life expectancy, health, and vitality.

DEVELOPMENT OF A LONGITUDINAL RESEARCH BASE

Progress has been made. Since 1995, a series of papers have been published, based on a number of different longitudinal data sets. Most important, these studies have provided an opportunity to examine levels of health and functioning among different cohorts or generations of older people. While there have been eight surveys to address the trends in functioning and disability among older populations, only the National Long-Term Survey and the National Health Interview Survey were judged in a recent review (Freedman & Martin, 1998) to be of sufficient quality (rated “good”) to address a number of the key issues. This means that each of the two surveys met most of the following criteria:

- Independent repeated cross-sectional assessments
- A national sample that included institutionalized residents
- A time frame of eight years or more
- Five or more annual assessments
- Identical interview methods
- Detailed self-reported outcomes
- Low loss to follow-up, less than 5%
- Fewer than 10% proxy respondents
- Low missing data of less than 5%
- A sample size that is large enough to detect 1–2% change per year.

Three examinations by Manton and colleagues were based on data from the National Long-Term Survey. This survey, judged in the evaluation to be “one of the best designed surveys for analyzing national disability trends,” consisted of a series of cross-sectional surveys of representative samples of older people aged 65 and older, including people who were institutionalized, that were administered through the 1980s and 1990s. Each survey was based on consistent field methods with relatively high follow-up rates. Based on data from 1982, 1984, 1989, a consistent
decline was reported in the prevalence of 16 medical conditions. In subsequent examinations, Manton and colleagues reported a consistent decline in the prevalence of chronic disability, as measured by activities of daily living (ADL) and instrumental activities of daily living (IADL) first between 1989 and 1994 (Manton, Corder, & Stallard, 1997) and later in a subsequent analysis from 1992 to 1999 (Manton & Gu, 2001). Manton argued that while there was an increase in the prevalence of chronic conditions, the severity of those conditions, as measured by limitations and disabilities, was less.

In a series of papers based on the data in the National Health Interview Survey, there was a consistent decline in reports of “any disability” from 1982 to 1993 and in a later paper from 1982 to 1996. Although declines were noted for IADL, there was no consistent decline in ADL. The National Health Interview Survey consisted of annual assessments of samples of national residents aged 70 and older.

Although judged as only of “fair” quality, consistent declines in “any disability,” IADL disability, and in selected physical functional and sensory limitations were reported for studies based on the Supplements on Aging and the Survey of Income and Program Participation. As will be addressed in more detail in Chapter 4, Freedman and Martin report that generic measures of functioning, such as, reported difficulty seeing words in a newspaper, lifting and carrying 10 pounds, climbing a flight of stairs, and walking a quarter of a mile, may represent assessments of function that are less dependent on social and technological resources, as would be the case with ADL and IADL measures.

Although there seems to be consistent evidence of a decline in general measures of disability among the best national surveys, there is no clear explanation for why this is the case. Without consistent findings regarding differences by age, gender, race, and education, it is difficult to develop explanatory hypotheses. As Freedman and colleagues (2002, p. 3145) report, “Future work would do well to focus on rigorously examining trends in important disparities. A thorough understanding of trends in disparities is critical not only for identifying groups that might benefit from various health-related interventions but also for projecting the future course of population-level health trends.” Possible explanations that have been offered for the decline include the role of medical care and, in particular, technological devices for detecting disease at an early stage, for determining best treatment strategies, and devices to improve the
prospects of rehabilitation. Other reasons include an increase in the prevalence of healthful behaviors and the higher years of education among later cohorts of older people, although, as noted, research to date shows no consistent pattern between the prevalence of education and declines in the prevalence of disability.

In a recent paper, Fries (2003) claims that recent reports based on data from the National Long-Term Survey and the National Health Interview Survey support the original compression of morbidity hypothesis. He also notes, however, that more definitive assessments can be obtained only by tracking age-specific disability and age-specific mortality, although he makes no mention about the importance of tracking age of onset of conditions. If age-specific disability declines more quickly than age-specific mortality, then there is evidence of a compression of morbidity, especially if this is shown serially across successive cohorts of older people. Other evidence, he indicates, could be obtained by examining whether disability could be postponed by specific interventions (such as exercise, weight control, total joint replacement, influenza vaccination, or smoking cessation) by more than projected increases in the length of life from these interventions.

Two additional sources of information are necessary to provide a more definitive test of the compression of morbidity hypothesis. First, it is necessary to determine whether there is a difference in the prevalence of generic functional limitations and measures of disability. As Freedman and Martin (1998) indicate, the generic measures, such as report of level of difficulty in the performance of such generic tasks as lifting items less than 10 pounds, provide a “cleaner” measure of morbidity that is less influenced by social expectations, as is the case of ADL and IADL. Second, it is necessary to develop more sophisticated assessments that include measures of the severity of functional limitations and disability. As noted at the Pacific Grove Conference, the severity of limitations and disability is not uniform and the severity of such limitations and disability, in fact, may be more pronounced in the later years. Clearly, more sophisticated surveys need to be introduced to capture this more detailed information, information that is necessary to test the compression of morbidity hypothesis and, more generally, to assess the nature of the proposed stage of epidemiologic transition, “age of delayed degenerative disease,” as suggested by Olshansky and Ault.

In a recent review of the research on trends in health among the elderly, Crimmins (2004) concludes with two observations: First, health as mea-
sured in most ways has improved during the past 20 years. Second, although the prevalence of most conditions has increased, any particular condition may be less disabling. Again, while the reasons for this improvement is not completely clear, there are some tentative explanations. It may be that there has been an improvement in diagnosis, treatment, and rehabilitation for older people with specific conditions. If recent cohorts of elderly are in better health and adhere to better health practices, they are less likely to be diagnosed with severe disease and less likely to experience functional limitations.

**CRITIQUE OF BASIC ASSUMPTIONS**

Progressive and sustained improvements in life expectancy and the resultant aging of the population are fundamental propositions of the Epidemiologic Transition Theory. It is assumed that all societies and regions of the world will experience improvements in life expectancy, admittedly in their own time and in their own way. Thus, improvements in life expectancy are presented as a positive force of nature. However, recent events in Russia and other states in the former Soviet Union indicate that life expectancy can be quite fragile and gains can be lost in a relatively short period of time (Notzon, Komarov, Ermakov, Sempos, Marks, & Sempos, 1998; Shkolnikov, McKee, & Leon, 2001). Specifically, between 1990 and 1994, life expectancy for Russian men and women declined dramatically from 63.8 and 74.4 years to 57.7 and 71.2 years respectively, while in the United States, life expectancy increased for both men and women from 71.8 to 78.8 years to 72.4 and 79.0 years respectively. Closer inspection revealed that more than 75% of the decline in Russian life expectancy was due to increased mortality rates for ages 25 to 64 years. Leading causes of death included cardiovascular diseases, injuries, pneumonia, influenza, chronic liver diseases, and cirrhosis and other alcohol-related causes. Researchers conclude that the dramatic decline in life expectancy was due to a variety of actors, including economic and social instability, high rates of tobacco and alcohol consumption, poor nutrition, depression, and deterioration of the health care system (Leon et al., 1997). Interestingly, some of the most dramatic declines occurred in the wealthiest regions. Recent data indicate that life expectancy is beginning to rebound, attributed by some to reduction in the social and economic trauma occurring following the collapse of the Soviet Union. It is interesting to consider whether the events in Russia suggest that epidemiologic
transition is not always progressive, moving from stages 1 to 3 (and perhaps 4). Moreover, it is unknown whether events could be so dramatic to reverse the transition, moving from stages 3 to 1.

There are also criticisms of the presumption that the Epidemiologic Transition Model is uniform within countries (Mackenbach, 1994; Gaylin & Kates, 1997; Heuveline, Guillot, & Guatkin, 2002). For example, the United States is included with other developed nations in the third or fourth stages of transition. This presumption neglects, some charge, the heterogeneity that exists within both developed and developing countries. It may be, for example, that the epidemiologic profile of some residents of developed countries may be more akin to stage 2 than stages 3 and 4. This is reflected, in turn, in the health disparities that exist in countries such as the United States and other developed countries, disparities that are often associated with differences in race, ethnicity, and socioeconomic status. Rather than one epidemiologic transition, there may be multiple transitions occurring within single countries, reflected as well in the heterogeneity of multiple health conditions. Developed and developing countries are characterized by a variety of conditions, including both chronic and infectious diseases.

Robine and Michel (2004) argue that a general theory of population aging must take these multiple patterns into account. In a commentary that accompanied the Robine–Michel paper, Guralnik (2004, p. 606) summarizes their position as follows:

There may be a circling back, where, first, sicker people survive into old age and disability rises, then the number of years lived with disability decreases as new cohorts of healthier people enter old age, but, finally, the number of years lived with disability rises again when the average age of death goes so high that many people spend their last years at advanced old age burdened by multiple chronic diseases and frailty. And as if all of this were not complex enough, Robine and Michel proposed that it is happening at different times in different countries and perhaps even at different times in the same country within different population subgroups. Particularly provocative and worthy of serious consideration is their proposal that all these changes, both expansion and compression of morbidity, are part of a single unifying process, a “general theory on population aging,” and are simply different stages of a single transition.

**Additional Determinants**

One of the significant features of Omran’s Epidemiological Transition Theory is the role of socioeconomic context and the so-called historic...
forces of modernization. Improvements in life expectancy, the aging of the population, and changes in the causes of death are due to these factors. Recent work, although not presented in the context of the Epidemiologic Transition Theory, suggests that other factors may have affected this transition. For example, Jared Diamond’s recent book, Guns, Germs, and Steel (1999, p. 16), is based on a question that is very similar to the basic questions that led to the Epidemiologic Transition Theory: “Why did human development proceed at such different rates on different continents?” Diamond contends that differences in human development and demography, such as the aging of populations, may have been affected by differences in land topography and natural resources. Specifically, differences in topography may have affected both the opportunities for the production and accumulation of food through the availability and domestication of wild plant and animal species as well as the likelihood for contact among populations and resultant opportunities for the diffusion of technology and social, political, and economic organization. According to Diamond, Eurasia had a greater variety of wild plant and animal species available for domestication. Moreover, sustained contact with domesticated animal species led to the establishment of immunities to particular types of infectious and bacterial diseases. In addition, contact and diffusion of innovations among populations was more likely in Eurasia, because of its east–west major axis and the relative absence of such geographic barriers as major north–south mountain ranges. In contrast, interhemispheric diffusion made no contribution to Native America’s complex societies, isolated from Eurasia at low latitudes by broad oceans, and at high latitudes by geographic barriers and a climate suitable only for hunting and gathering. Together these factors helped to support the development of a larger, more diverse, and more organized population in Eurasia. Work similar to Diamond’s can serve as a model to broaden the scope of the Epidemiologic Transition Theory.

THE EPIDEMIOLOGIC TRANSITION THEORY: SOME SUGGESTED MODIFICATIONS

The Epidemiologic Transition Theory has contributed to our understanding of the global patterns of aging and longevity among developed and
developing nations. The strengths of this theory can be summarized as follows: First, the theory casts the study of aging, health, and longevity into a broad historical and global context. The causes and consequences of aging and longevity are not restricted to one country, in one period of history. Second, the theory emphasizes the effects of social, economic, and political forces on changes in patterns of longevity and the age profile of nations. Together, these characteristics set the stage for the development of global and regional strategies to understand and enhance the health and functioning of older populations.

Thirty years ago, Omran (1971) acknowledged that this theory must be refined over time. In that spirit, we propose the following modifications, taking into account recent commentaries and research in this area.

- Following from Diamond and others, it is reasonable to consider a broader array of factors that affect the epidemiologic transition. While Diamond considers the role of topography, land use, and the diffusion of innovation to explain the past and current state of development in nations, it is reasonable to also consider the significance of such factors for future development, especially as we continue to think of aging, health, and longevity within an interconnected, global context.
- Along those lines, one of the most significant issues to address in more detail is the relationships among nations, in particular, the relationships among developed and developing nations to explain patterns and timing of aging and longevity. As noted previously, the traditional Epidemiologic Transition Theory indicates that the time required for nations to advance from one stage to another depends on the historical context and the relationship that nation has with nations at a more “advanced” stage. Omran points to the diffusion of technology and other markers of modernization as contributing significantly to the improvement of longevity in developing nations. This, of course, is the fundamental issue of contemporary globalization. Following the observation made by at least one commentator (Aviles, 2001), relationships among nations can be multifaceted and may not always contribute positively to the improvement of longevity among residents of developing countries. From the perspective of this theory, future researchers should be cognizant of this possibility and consider a variety of outcomes associated with contact among nations.
• The nature and timing of transitions from one stage to another also can be variable, as evidenced by reductions in life expectancy among segments of the Russian population, a point underscored by Robine and Michel in their discussion of a new theory of population aging. There may be times in which improvements in life expectancy are delayed or even reversed by social, political, and economic events. The Epidemiologic Transition Theory should be modified to allow for these occurrences. It is reasonable to speculate, for example, that the current epidemic of obesity among children and adolescents in the United States may have a negative effect on future life expectancy when that generation reaches its middle years.

• Perhaps the most significant concern is that little attention has been given to the heterogeneity of life chances within countries and regions. As noted previously, the theory should be expanded to consider and assess the number and type of transitions within countries that will assist in accounting for differences in aging, longevity, and, in general, health disparities.

• It is reasonable to expand the number of stages from three to four, allowing for what Olshanksy and Ault (1986) refer to as the age of delayed degenerative diseases (Rogers & Hackenberg, 1987). Some commentators also have proposed a fifth stage that reflects the reemergence of infectious diseases in developed nations (the age of emergent and re-emergent infections) (Smallman-Raynor & Phillips, 1999). Although this, in fact, represents a fifth stage, it also may reflect recognition that chronic and infectious diseases can occur concurrently. Moreover, the presence of concurrent infectious and chronic diseases may characterize the heterogeneity of the nations or, as noted previously, the fact that there may be concurrent epidemiologic transitions within nations.

Despite these suggested modifications, it is important to realize that, at the very least, the Epidemiologic Transition Theory has served as a typology for the description of global aging and longevity by geographic area and historical period. At best, the theory holds the promise for also explaining patterns of aging, health, functioning, and longevity. To do so, the theory must be expanded conceptually to account for the heterogeneity that exists among and within nations. As we will see, it is precisely in this area that the epidemiology of aging may make its most significant contribution.
TOWARD AN EPIDEMIOLOGY OF AGING

Chronological age historically has been a key variable in epidemiological studies of disease and disability. Indeed, age is so closely aligned with the incidence of disease and disability that it has been necessary to adjust or “hold constant” the effects of age, so that the significance of other variables could be noted. It is ironic, therefore, that while chronological age has figured so prominently in the study of epidemiology, the epidemiology of aging, as a separate field, is of relatively recent origin.

It is useful to consider in what ways the field of epidemiology compares to other fields that focus on aging, such as demography, gerontology, and geriatrics. Recently, the *Annals of the New York Academy of Science* devoted a special issue in 2001 to articles that compared the two fields of epidemiology and demography and addressed the likelihood of a collaboration or synthesis of methods between the two fields to provide a more comprehensive view of aging, health, and function in populations (Weinstein, Hermalin, & Stoto, 2001). Robert Wallace (2001), one of the contributors to that special issue, reports that both demography and epidemiology are applied disciplines that address the issue of population health as well as issues of social and economic well-being. In addition, however, Wallace notes that demography, being more closely connected to the social sciences, typically does not include biologic factors in descriptive and analytic reports, as is done in epidemiologic studies. Moreover, demography is more likely to examine global patterns of aging and longevity than is the case in epidemiology. Epidemiology, on the other hand, is more likely to examine the causes and consequences of disease with specific populations. In addition, epidemiology, as noted by Wallace (2001, p. 64), is “more willing to engage in randomized population experiments and quasi-experiments in order to scientifically validate its hypotheses and suppositions, as well as to test potentially health-enhancing interventions.” Gerontology is a multidisciplinary field that focuses on the biology, psychology, and sociology of aging. Unlike epidemiology, gerontology is not restricted to the study of the causes and consequences of aging, health, and functioning. Moreover, gerontology addresses subjects at both the individual, familial, and community levels. Finally, geriatrics is a branch of medicine that focuses on age-related factors associated with the causes and consequences of disease, limitations, and disability, typically at the individual or patient levels. In addition, geriatrics focuses on the
development of age-related protocols that enhance the diagnosis, treatment, and rehabilitation of the older patient.

In 1972, the National Institutes of Health (NIH) convened the first conference on the epidemiology of aging in Washington, DC. The epidemiology of aging was presented (in many ways, introduced) at this conference as a field that should address the underlying physiological factors that characterized aging, in fact, factors that served as markers of aging. The markers were considered to be distinct from individual chronic conditions, but perhaps represented the physiological foundation that affected relative host susceptibility to all health conditions and disabilities. As Adrian Ostfeld, chairperson of the NIH conference, indicated in his opening remarks (Ostfeld & Gibson, 1975, p. 1):

The epidemiologic method has been traditionally used in the study of specific diseases, first the communicable and later the chronic disorders. Some of us think that the time has come to apply these fruitful methods to a phenomenon broader and more complex than any illness, the condition of aging itself.

Ostfeld went on to describe the challenges faced by researchers in this new field (Ostfeld & Gibson, 1976, p. 1):

But the challenge of applying epidemiologic methods to the study of aging is a far more difficult one than applying them to a disease. A clear, valid, and reliable definition of aging remains to be formulated. The units of aging capable of study range from intracellular enzyme activity to overall mortality rates, with subcellular particles, cells, hormones, immune processes, tissues, organs, and neural and endocrine biofeedback mechanisms in between. This conference represents a small beginning in considering how we may use epidemiologic methods in partnership with other disciplines in attempting to improve our understanding of aging at all levels of living organisms.

Fourteen questions were raised at the 1972 conference:

1. Is there a valid and reliable definition of aging independent of the common chronic diseases?
2. What does the remarkably high prevalence of carbohydrate intolerance in the elderly mean in terms of morbidity and mortality? What is the mechanism and should it be treated?
3. What are the precursors of Alzheimer’s disease and chronic brain syndrome in the elderly?
4. In elderly cohorts, how do endocrine and immune functions decline over time, and how is the decline correlated with morbidity and mortality?
5. What is the value of intervention studies on blood pressure in older populations in reducing the incidence of stroke and senile dementia?
6. Why is life span so extraordinarily short after the onset of senile dementia?
7. What living arrangements for the elderly will produce the lowest morbidity and mortality and the highest indices of life satisfaction?
8. What aspects of socioeconomic status make it so important a determinant of longevity?
9. What can we learn from studying the effects of retirement, relocation, bereavement, and economic loss in cohorts of elderly persons?
10. Why are mortality rates lower in the Midwestern United States than in the Southeast and Northeast?
11. What are the differential effects on aging of sex?
12. Do dietary habits adversely or favorably affect morbidity and mortality experience in populations?
13. Can Comfort’s measures provide a useful index of aging? (Alex Comfort was the author of a popular book at the time on sexuality and aging. Although aging and sexuality remains an important area of study, today, the Comfort book receives less attention.)
14. Can studies of aging be grafted on to existing cohorts, for instance, the Framingham, Albany, Evans County, and Tecumseh studies?

In 1977, a second conference was convened, in part, to take stock of the progress that may have been made in the intervening five years (Haynes & Feinleib, 1980). The consensus was that some progress had been made, but more governmental support was required to support the methods and sources of longitudinal data that were necessary to develop this field.

In 1974, the National Institute on Aging was established, as part of the Research on Aging Act, as one of the institutes of the National Institutes
of Health. One of the branches of this new institute was dedicated to epidemiology, demography, and biometry. One of the primary objectives of this branch was to describe and explain patterns of aging, health, and functioning in human populations. This, of course, helped to provide additional focus to the emerging field of the epidemiology of aging. The epidemiology, demography, and biometry branch stimulated the development of new national population surveys on aging, such as the National Health and Nutrition Examination Survey I (NHANES I). This survey, together with other collaborative studies, provided a picture of the aging population. In addition, a series of analytical studies were undertaken nationally and in collaboration with other countries to better understand the causes and consequences of aging populations. A consideration of economic factors figured prominently in these investigations. Finally, the branch and institute gave special attention to the development of new methods, especially related to the meaning of impaired functional status.

Since the second NIH conference, two edited volumes in the epidemiology of aging have been published—one by Jacob Brody and George Maddox in 1988 and the second by Robert Wallace and Robert Woodson in 1992. The Brody–Maddox volume includes the proceedings of a series of symposia on epidemiology and aging at the International Association of Gerontology in 1985. The volume consists of four parts: Epidemiology and the Challenge of Aging; Epidemiology and Aging in International Perspective; The Epidemiology of Psychiatric Disorders in the Elderly; and Uses of Epidemiological and Social Survey Research in Program Planning and Evaluation and in Policy Analysis. In contrast, the Wallace–Woodson volume consists of individually invited pieces on a variety of topics, organized in four parts: Interdisciplinary Contributions to the Epidemiologic Study of the Elderly; Issues in Surveying Older Persons; Important Measurement Themes in the Elderly; and Analytic Issues in the Epidemiologic Study of the Elderly. In addition to highlighting recent research in the epidemiology of aging, these volumes helped to advance the field by identifying the important topics and describing the methodological approaches needed to address those topics.

There also has been an increase in the number of studies worldwide in the epidemiology of aging, most notably, longitudinal studies that provide an opportunity to examine health, functioning, and longevity in aging populations. Many of these studies will be described in the subsequent chapters. The studies can be summarized as follows:
Clinic/Laboratory-Based Populations for Epidemiologic Studies of the Elderly

These are early studies based on selected samples of relatively homogeneous populations that include detailed assessments of physiological markers of aging as well as behavioral and social factors. The exemplar for studies in this area is the Baltimore Longitudinal Study (BLSA). The BLSA was established in 1958 and consisted of male subjects aged 20 and older. Male subjects consisted primarily of employees at the Department of Agriculture, the George Washington University, or the University of Maryland. Subjects were invited to the laboratory in Baltimore, Maryland, for two and a half days to be assessed in terms of over 100 tests. The test interval has varied across age groups and over time. The BLSA provided some of the most detailed assessments of the physiologic markers of aging populations.

Adapted Populations for Epidemiologic Studies of the Elderly

These are population-based studies that developed into epidemiologic studies of aging as the original cohorts of those studies aged. Exemplars for this type of study include the Framingham Heart Study, the Honolulu Heart Study, and the Alameda County Study. This was the type of study called for by Ostfeld and others at the first NIH meeting on the epidemiology of aging: aging studies that reflected an efficient and effective use of current resources. The advantage of this type of study is that information has been collected for extended periods of time, often following the cohort from the middle to senior years. Unlike the Baltimore Longitudinal Study, these studies are more representative of the larger population of older residents.

Established Populations for Epidemiologic Studies of the Elderly

The more recent epidemiologic studies have been based on longitudinal studies that were designed specifically for the purpose of research on aging. Reflecting the global significance of aging, there have been a variety of emergent studies of this kind throughout the world. The National Institute on Aging initiated a collaborative study in 1984 that serves an exemplar for many studies of this kind. The study, the Established Populations for Epidemiologic Studies of the Elderly (EPESE), was the first
collaborative, community-based study devoted specifically to the study of the epidemiology of aging, health, and functioning. It was based on three population-based samples: East Boston, MA; New Haven, CN; and selected countries in Iowa. Later, the collaboration was expanded to include selected counties in North Carolina. The study is important for a variety of reasons. First, although not representative of the nation, the collaboration was perhaps the largest and most representative study in the United States. The samples from New Haven and North Carolina included valuable information about African-Americans. Second, the study protocol consisted of a home interview that included the respondents’ reports of health and functioning as well as direct assessments of physical performance. Respondents were asked to perform specific tasks that were designed to assess upper- and lower-body function, walking speed, balance, and fine dexterity. The inclusion of these items was a major innovation to population-based studies and supported an observation made by Robert Wallace that many of the research methods used in community studies were first developed in laboratory and clinical settings. Third, the EPESE protocol arguably has become the standard protocol for epidemiological studies of this kind, providing the bases for comparisons of aging populations throughout the world. For example, the protocol or key components of the protocol have been used as part of longitudinal studies in Amsterdam, Berlin, and Beijing. In the United States, there are notable examples, such as the Hispanic EPESE, which includes a comprehensive examination of Mexican-American seniors in Texas, Arizona, New Mexico, and California. Other community studies that have included core elements of the protocol have been conducted in Marin County and the City of Sonoma in California. The study in Sonoma (the Study of Physical Performance and Age-Related Changes, or SPPARCS) also includes a laboratory component, with assessments of pulmonary function, cardiovascular fitness, and vision.

Special Populations of Epidemiologic Studies of the Elderly

There are also longitudinal studies that focus on important subgroups of older populations. For example, the MacArthur Study on Successful Aging is designed to examine those older subjects who perform at the highest levels and are most able to preserve their health and functioning. Subjects for this study were recruited from the EPESE cohort aged 70 and older who scored in the top 20% of selected performance measures. On the other hand, the Women’s Health and Aging Study consisted of female
residents of Baltimore aged 65 and older who scored in the lowest one third on a number of selected items. Other studies included the NIA ABC study and also the Centenarian study, which consisted of respondents aged 100 and older.

Special Populations of Epidemiologic Studies of Elderly with Selected Chronic Conditions

These longitudinal studies consist of older people diagnosed with specific chronic conditions. Their purpose is to examine the causes and consequences of older people diagnosed with those specific conditions. Representative collaborative studies include the Cardiovascular Health Study, the NCI/NIA Comorbidity and Cancer Study, and the Osteoporotic Fracture Study. In some cases, studies of this kind have included control groups of older people of the same age without the diagnosed condition. The Health and Functioning in Older Women with Breast Cancer (HFW) study included a sample of female residents in the Detroit metropolitan area aged 40 to 84 years newly diagnosed with invasive breast cancer. In addition, female residents of the Detroit metropolitan area of the same age without a past or current diagnosis of invasive breast cancer were recruited through telephone random-digit dialing. The cases were interviewed at 3 and 12 months after diagnosis to assess, in part, patterns of functional limitations and disability. The controls were interviewed twice over the same period. This represented an attempt to identify the number and types of functional limitations and disability that may be likely to occur among women with breast cancer from those limitations and to identify any disability that may be found among women of the same age without the disease.

Although this list does not represent by any means the number and diversity of studies in the epidemiology of aging, it does identify five common categories of studies in this area. In addition to characterizing the etiology and course of chronic disease in older populations, epidemiological studies of this kind also have focused on geriatric syndromes, such as frailty, falls and injury, incontinence, vision and hearing difficulties, dizziness, postural instability, and delirium. Geriatric syndromes are conditions caused by a variety of different pathological processes. Finally, studies in the epidemiology of aging have focused on functioning and disability, identified by the Institute of Medicine in 1991 as the first priority in studies of older populations.
Finally, nearly 30 years after the first NIH conference on the epidemiology of aging, Linda P. Fried, a leading geriatrician and epidemiologist of aging, published a review article for Epidemiologic Reviews in 2000 that evaluated the accomplishments in the field and included a new research agenda for this century. Using the study of falls and injuries as an exemplar, Fried (2000) reports that six findings related to this area have generic implications for the epidemiology of aging in general:

• The level of risk for a fall or injury increases steadily with each risk factor.
• Nearly 50% of falls are due to an interplay of host susceptibility and environmental risks, an important connection that is the basis of an ecological approach, a point to which we will return in Chapter 2.
• The effectiveness of interventions in this area depends in part on the underlying functional status of the aging population.
• Both primary and secondary prevention are effective in reducing the incidence of falls.
• The goal of an intervention should be based on the type of falls. For example, in the general population, the objective may be to reduce the likelihood of a fall, whereas in a more frail population, the objective may be to reduce the number of falls.
• The risk factors for falls may be associated with the likelihood of other geriatric syndromes associated with frailty.

These six points, then, represent the tenets of the epidemiology of aging. These tenets also underscore a point that was made by Adrian Ostfeld 30 years earlier at the first NIH conference on the epidemiology of aging: “This field will require a new set of sophisticated methods and research designs.” As Fried (2000, p. 102) goes on to write:

This [the need for new methodological strategies] is due to the heterogeneity of health and functional status among the aged; the prevalence of subclinical disease or disability, which alters risk for future outcomes; and the fact that risk associated with a characteristic may change because of survivorship characteristics, such that an increased proportion of persons still living with a risk characteristic at age 80, for example, may be resistant to the risk factor. In addition, the study of trajectories in health status over time has to account for improvement as well as decline—in physical function, for example. In order to develop the most effective scientific bases for prevention and health promotion for an aging population in the 21st century, we must take these issues into account.
THE EPIDEMIOLOGY OF AGING: THE CORE QUESTIONS

Epidemiology, both as a perspective and as a set of analytic methods, is especially well suited to examine patterns of health and functioning in an aging population. Epidemiology is based on the premise that health outcomes are not distributed randomly in the population. Rather, the incidence and prevalence of health outcomes, as well as the duration and quality of life, follow specific patterns. The purpose of epidemiology is to describe and explain those patterns in the population. This information, in turn, will establish the foundation for future public health interventions. The important questions are how best to prevent and postpone disease and disability and to maintain the health, independence, and mobility of an aging population:

1. What is the overall distribution of the health outcome in the population, such as number and types of subclinical conditions, diseases, levels of functioning, limitations, disability, and survival? How does the health outcome vary among age groups? How does it change as people age? To what extent does the health outcome vary within age groups?

2. To what extent do differences among and within age groups vary by gender, race, ethnicity, socioeconomic status, and geographic region? One example is the difference among groups in the age of the onset of a particular condition.

3. To what extent do differences among and within age groups vary by other factors associated with health, functioning, behavior, social factors, and the physical environment? Although these factors are important in their own right, they also serve to explain the associations between health outcomes and age, gender, race, ethnicity, socioeconomic status, and geographic region.

4. To what extent are differences among and within age groups associated with age differences in:
   a. The prevalence of the same risk factors
   b. The salience or strength of the same risk factors
   c. The frequency and timing of exposure over the life course to the same risk factors
   d. Exposure to a different set of risk factors?
How does the timing of these factors across the life course, coupled with developmental physiological factors, affect the subsequent risk of disease, disability, and death in the middle and senior years?

5. What are the biologic, behavioral, social, and environmental factors associated with maintenance of health and functioning among older people, or so-called healthy aging? Special attention should be given to those older people that maintain health and functioning, in spite of a risk-factor profile that should elevate their risk for disease, disability, and death.

Finally, epidemiology provides an opportunity to distinguish between “sick” individuals” and “sick populations” (Rose, 1985). The study of “sick individuals” is designed to understand the reasons why some people are at risk for health problems, while other people are not. In contrast, the study of “sick populations” focuses on an understanding of differences in the incidence of disease and other disorders among populations. At first glance, the difference between sick individuals and sick populations may seem trivial, a largely semantic distinction. It is not. The study of sick individuals depends on the overall distribution of risk factors in a specific population. For example, the risk of disease associated with a particular factor, such as a high-fat diet, would appear to be modest or even non-existent in a population in which most of the people consume a high-fat diet. In that population, the risk of disease among sick individuals would be found to be associated with one or more other factors, whose prevalence is sufficiently variable in the population. This group of high-risk individuals would be relatively small. The true significance of a high-fat diet would only become apparent by comparing the incidence of the disease in a country with high-dietary fat consumption to a country with low-dietary fat consumption. In addition to contributing to our understanding the etiology of disease, this distinction has important implications for prevention. Although people at high risk should receive attention, a more substantial impact may be achieved by changing the entire population distribution to reduce exposure to particular factors. For example, more may be achieved by reducing the fat consumption by a small amount for a large number of people than may be achieved by reducing the risk of a small number of high-risk individuals. With regard
to the epidemiology of aging, this underscores the significance of global studies that include comparative studies among nations. In the next chapter, we will focus on the utility of an ecological model for examining the intersection of biologic, behavioral, and environmental factors over the life course to organize and conduct studies in the epidemiology of aging.

**CONCLUSION**

The aging of population is a global issue. It is not just the sheer number of older people in the population, but the implications of that aging population for patterns of health, functioning, and longevity, as well as the number and types of resources that will be needed to address the needs of this aging population. The Epidemiologic Transition Theory was presented as one common framework for describing and explaining the patterns of health and functioning in the population. Moreover, the epidemiological perspective is presented as being ideally suited to understanding the causes and consequences of an aging population. In the next chapter, we will argue that an ecological model should serve as a multidisciplinary foundation for future research and practice in the epidemiology of aging.

**REFERENCES**


