Gender Gap in Longevity and Disability in Older Persons

Anne B. Newman1,2 and Jennifer S. Brach2,3

INTRODUCTION

Women live longer than men, but older men have fewer disabilities than do older women. The purpose of this review is to examine the magnitude of the difference in longevity and disability that exists between older men and older women. Possible explanations for the differences in longevity and disability will be presented.

THE LONGEVITY GAP

Today, a woman has an excellent chance of surviving well into her 80s and, for those who survive to age 85 years, the remaining average life expectancy is an additional 6 years. Therefore, most women who reach age 85 can expect to pass age 90 (1). Life expectancy varies throughout the lifespan. The gap between men and women is actually largest at younger ages and gets smaller with increasing age (figure 1). Nevertheless, at all ages, women have a better survival than do men. At birth, the gap is about 6 years; at age 65, it decreases to about 3 years; and at age 75, it is even lower, at about 2 years (1).

The gender gap in longevity has changed over time and varies across countries. Stages have been described that relate gender differences in longevity to societal development (2). In developing societies (stage 1), life expectancy in women is limited by high maternal mortality, so that the gender gap between men and women tends to be smaller. Stage 2 societies have had improvements in maternal and infant mortality, resulting in an increase in the gender gap that substantially favors women. Currently, the developed countries are entering a third stage, in which the life expectancy for women is so high that it may be near its maximum, and now the continued improvements in life expectancy are relatively greater for men than for women.

Thus, in developed countries such as the United States, Canada, and the countries of Western Europe, the gender gap in longevity is now decreasing between men and women. However, the larger number of women surviving at every age has resulted in a much larger number of older women than of men. In the United States, there are about 20 million women over age 65 years compared with 14 million men. The ratio of women to men at age 65 is about 120 women for every 100 men, and by age 85, it is 250 women to 100 men (1). Because of these trends, the majority of older patients in the health care system are women. Of those over age 65 years, about 60 percent are women, and more than 70 percent of those over 85 years are women.

For most major causes of death, rates of mortality throughout life are higher in men than in women (1, 3). Heart disease deaths show the greatest difference in mortality rates between men and women (table 1). Men are about twice as likely to die from heart disease as are women (173.1 per 100,000 vs. 95.4 per 100,000, respectively). For stroke, the rate is only about 20 percent higher in men than in women. The higher cancer mortality in men is almost entirely due to higher rates of lung cancer. Although the rate of lung cancer has been increasing in women, it is still much higher in men. Men are also more likely to die in motor vehicle accidents and from chronic lung disease.

The basis for this gender difference in longevity between men and women is thought to be a complex interaction of environmental, behavioral, and biologic factors. For example, over the past century, the increase in lung cancer and heart disease in men has been largely attributed to cigarette smoking. Most older men living today were smokers at some time in the past or currently, while only about half of the women ever smoked cigarettes. Although the higher rates of smoking in men may have increased the gap between men and women in the past, the increasing rates of smoking in women over the past 20 years may now be limiting the gains in life expectancy for women (4, 5). Lung cancer is now the leading cause of cancer death in women, surpassing breast cancer about 10 years ago (6).

Body weight and weight gain have been increasing in both men and women in recent years. There are differences in patterns of weight and weight gain between men and women. Men have an earlier peak in their weight than do women, a factor that could increase the gap in favor of women (7). However, men report more physical activity than women do. It does not appear that this difference would have a major impact on mortality because inactivity predominates in both men and women in our society (8). Other differences in health behaviors may be important. For example, men are known to have more accidents, to be homicide...
At birth, Women

At birth, Men

At age 65, Women

At age 65, Men

At age 75, Women

At age 75, Men

FIGURE 1. Life expectancy at birth, at age 65 years, and at age 75 years, by sex, United States, 1950–1997. (Source: National Center for Health Statistics, 1999 (1)).

TABLE 1. Age-adjusted death rates per 100,000 population, United States, 1997*

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart disease</td>
<td>173.1</td>
<td>95.4</td>
</tr>
<tr>
<td>Cerebral vascular accident</td>
<td>27.9</td>
<td>24.2</td>
</tr>
<tr>
<td>Neoplasms</td>
<td>150.4</td>
<td>107.3</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>52.8</td>
<td>27.5</td>
</tr>
<tr>
<td>Chronic obstructive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pulmonary disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor vehicle accident</td>
<td>21.7</td>
<td>10.2</td>
</tr>
<tr>
<td>Suicide</td>
<td>17.4</td>
<td>4.1</td>
</tr>
<tr>
<td>Homicide</td>
<td>12.5</td>
<td>3.3</td>
</tr>
</tbody>
</table>

* Source: National Center for Health Statistics, 1999 (1).

Most investigations of the biologic basis of longevity in women have focused on hormonal differences. Gender-specific hormones are thought to be a major factor in the difference in longevity, primarily because of effects on lipids and the vasculature (11, 12). Testosterone raises low density lipoproteins and lowers high density lipoproteins, while estrogen does just the opposite. Estrogen also protects the vascular endothelium, and these effects may persist well after the menopause. After menopause, there is a shift in lipid levels that parallels the increase in cardiovascular disease risk postmenopausally. Although the mortality risk for a woman comes closer to that of a man, it never catches up (13). Older women always remain somewhat more protected from heart disease. The risk of death from heart disease for women aged 75 years lags about 10 years behind that of men, but even at advanced age, the risk remains lower than the risk for older men. Since most of these women never took postmenopausal estrogen, estrogen cannot be the only factor in protecting women from mortality.

Variations in mortality are reflected in known differences in noninvasive markers of vascular disease. In a large population study of the risk factors for cardiovascular disease in older adults, the extent of atherosclerosis by noninvasive testing was found to be much lower in women than in men. Using carotid artery ultrasound, electrocardiogram, echocardiography, and other measures to image the vascular system, we found that the proportion of those with no evidence of either clinical or subclinical cardiovascular disease was about 40 percent in women compared with 20 percent in men over age 65 years (14). Surprisingly, even when men and women without atherosclerosis were compared, women had a much lower risk of mortality than did men. The extent of subclinical cardiovascular disease was a strong predictor of mortality in both men and women. However, after adjustment for the extent of subclinical disease, as well as for age and other factors, men had twice the rate of mortality of women (15). This is evidence that the gender difference in cardiovascular disease does not fully explain the gender difference in mortality.

As mentioned above, the difference in cancer mortality between men and women appears to be largely due to smoking. Rates of gender-specific cancers in men and women, such as prostate, breast, and ovarian cancer, are quite balanced between men and women (6). Thus, the gender difference in cancer mortality appears to be unrelated to hormonal factors or other biologic differences between men and women.
Finally, there are very likely to be genetic factors that relate to the difference in longevity. The genetic differences are expressed in the hormonal, immunologic, and other physiologic differences in men and women (16). One of the most interesting facts about genetics and gender is that, at conception, the ratio between males and females is about 160 males per 100 females. Owing to a higher rate of early fetal loss in males, at the time of birth, the ratio is almost even, although there is still a slight excess in male births (105 male births per 100 female births) (17). Therefore, women have a more favorable survival rate, even throughout the prenatal period. Although there has not been much work in this area, it may be fruitful to examine the genetics of this large difference in prenatal survival for new clues to the survival gap between men and women.

In summary, the gender gap in longevity favors women, but is currently decreasing in developed countries. Gains in life expectancy in men are now relatively greater than those in women. Nevertheless, women have had an advantage, resulting in many more older women than men for many years to come. Although the rate of cardiovascular disease death is higher in men than in women, cardiovascular disease remains the leading cause of death in older women, and the absolute number of cardiovascular deaths in older women exceeds the number in older men. This will have a major impact on the practice of medicine. The majority of geriatric patients are and will continue to be women.

THE DISABILITY GAP

In spite of the fact that women seem to be hardier and to have a better survival rate than do men, the prevalence of disability is greater in older women. Studies of disability and disease in older adults can be examined for differences between men and women that may explain this paradox. The World Health Organization defines disability as “a restriction or lack of ability to perform an activity in a normal manner” (18). Acquired disability in late life is of major concern, especially because it is related to quality of life, the ability to remain independent in the community, health service utilization, and the burden on family and caregivers (19-23).

Disability can be explained by using either a medical or social model (18, 24). In this review, we use the medical model to define disability since this is the more common approach taken in epidemiologic studies. Using a “medical model,” disability is often defined as the person’s ability to perform activities of daily living (ADL) needed for self care, instrumental activities of daily living (IADL) needed to maintain independent living in the community, and basic mobility tasks such as the ability to climb stairs or walk several blocks (25, 26). In addition to the different types of tasks evaluated, the degree of disability is often assessed. The degree of disability can be determined by ascertaining the ability to perform a task, the amount of assistance needed to perform a task, and/or the amount of difficulty experienced performing a task. A standard and universal method of assessing disability is lacking, and therefore, the prevalence of disability often differs across studies (27).

Although the prevalence of disability differs across studies, two findings are consistent. The first is that disability increases with increasing age, and the second is that a greater percentage of women are disabled compared with men (table 2) (25, 28, 29). Recently, the 1994 National Health Interview Survey disability supplement was used to estimate activity limitation (disability) in the population aged 55 years or older (28). Limitation of activity was assessed in three major areas: 1) functional activities (i.e., lifting, climbing stairs, walking, sustained standing, bending, reaching, and grasping); 2) ADL (i.e., bathing, dressing, walking in the home, transfers, eating, and toileting; and 3) IADL (i.e., shopping, managing money, using the telephone, performing household chores, and preparing meals). Disability increased with increasing age, with 28 percent of the people aged 65-74 years reporting difficulty with functional activities and greater than 60 percent of those aged 85 years and older reporting difficulty with functional activities. Similar patterns were observed for ADL (5 and 27 percent) and IADL (16 and 53 percent) disability, respectively. For all activities (functional activities, ADL, and IADL) and across all age groups, the prevalence of disability was greater for women than for men. For example, 24 percent of the men and 31 percent of the women aged 65-74 years reported difficulty with functional activities, 5 percent of the men and 6 percent of the women reported difficulty with ADL, and 12 percent of the men and 18 percent of the women reported difficulty with IADL. Census data from the Survey of Income and Program Participation support these findings (29).

Another way to illustrate differences in disability is to examine differences in active-life expectancy, a term related

<table>
<thead>
<tr>
<th>TABLE 2. Percentage of men and women with limitations in functional activities, activities of daily living, and Instrumental activities of daily living, United States, 1997*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age group (years)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Functional activities</td>
</tr>
<tr>
<td>ADL†</td>
</tr>
<tr>
<td>IADL†</td>
</tr>
</tbody>
</table>

* Source: 1994 National Health Interview Survey disability supplement (28).
† ADL, activity of daily living; IADL, instrumental activity of daily living.
to disability. Active-life expectancy is defined as the proportion of years spent without disability. Active-, disabled-, and total life expectancies are about 50 percent higher for women than for men (table 3). Because women live longer than men, the period of disabled-life expectancy for women is about twice as long as it is for men (30). For both Black and White men and women, disabled-life expectancy is about 1 and a half years for men and closer to 3 years for women. Therefore, for those over age 85 years, there is, on average, an additional 6 years of survival (3), but about half of that will be spent with disability.

The method of measuring disability has several limitations. First, many of the studies describing the prevalence of disability include only older persons living in the community and, thus, exclude older persons living in personal care homes or nursing homes. If those living in personal care homes or nursing homes were included in the estimates, the prevalence of disability would be expected to be higher. Since a greater percentage of women than of men over age 65 years are in nursing homes (6 vs. 3 percent) (31), we would expect the gender gap in disability to be greater if institutionalized older adults were included in the disability estimates.

The majority of studies rely on self-report as a measure of disability. Often, older adults fail to report slight declines in function or mild disability (32). By failing to capture all disability, the prevalence of disability may be underestimated. However, it appears that there are no gender differences in the reporting of disability (33), so its underestimation should not influence the gender gap.

The reliability and validity of questions used to assess disability should be considered when measuring disability. One important issue is the reliability of disability measures that often use proxy respondents, such as the United States Census, which queries only one respondent per household. Recently, Andersen et al. (34) examined the proxy reliability of the Census 2000 disability questions. Proxies tended to report more disability than was reported by the person with the disability, thus overestimating the prevalence of disability. However, there is no evidence that a gender bias exists in the overreporting of disability by proxy respondents. To establish validity of the measure, the responses to the Census 2000 disability questions were compared with the responses to the Center for Disease Control’s Behavioral Risk Factor Surveillance System disability surveillance and ADL instrument (34). The agreement between the questions from the two measures varied considerably. The poor agreement between certain components of the two questionnaires is most likely due to the difference in the phrasing of the questions and not to a gender bias.

Finally, disability is often assessed by using a limited list of activities or tasks. It is impossible to query the older adult about all activities or tasks with which they could possibly have difficulty. Once again, however, there is no indication of a gender bias in the basic tasks that are used to assess disability.

Several theories of why women have more disability than men do have been explored. Some of the explanations have included such ideas as reporting bias, higher rates of disabling disease, possible physiologic differences, and behavioral factors that could leave women more susceptible to disability than men are.

First of all, there has been concern that disability questionnaires are biased against women because of the inclusion of household tasks such as shopping and cooking that men do less often. Perhaps men report less disability because they have less need to do these tasks. However, when self-report of disability is compared with actual observed performance, women demonstrate as much disability as reported (33). Women tend to have less social support and assistance because they are more often widowed. The vast majority of older women who are independent in the community are living alone (1). However, when examined, this relative lack of support does not appear to explain the difference in disability between men and women (35).

A more likely explanation for the disability gap is that women have more comorbidity or chronic health problems than do men. Comorbidity refers to the presence of multiple medical conditions simultaneously. Women are more likely than men to report having two, three, or even four or more diagnoses. Both men and women with higher comorbidity have greater disability, but at every level of comorbidity, women have somewhat greater disability (36). In several large surveys, the prevalence of specific conditions causing disability differs between men and women, suggesting that comorbidity counts do not adequately reflect differences in health status. In a study of older adults reporting disability, women were much more likely to report heart disease as a reason for disability, whereas men were more likely to report stroke and chronic obstructive pulmonary disease as the reason for disability. Mental conditions, including depression and dementia, were cited more often by women as the cause of disability, as were injuries (37).

<table>
<thead>
<tr>
<th>TABLE 3. Total life expectancy, active-life expectancy, and disabled-life expectancy at ages 65, 75, and 85 years, according to sex, United States, 1997*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total life expectancy (years)</td>
</tr>
<tr>
<td>At age 65 years</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Men</td>
</tr>
<tr>
<td>Women</td>
</tr>
</tbody>
</table>

* Source: Guralnik et al. (30).

Epidemiol Rev Vol. 23, No. 2, 2001
Arthritis is the major cause of disability in the older adult population (38). Nearly 50 percent of older adults aged 65 years and more report that they have arthritis, and approximately 25 percent of these persons state that their arthritis limits some of their everyday activities (27, 39). When disease-specific causes of disability are examined, arthritis emerges as the most significant disabling condition for women (1). Osteoarthritis of the knee, which is more common in women than in men (40 percent prevalence in women vs. 30 percent prevalence in men) accounts for a large part of the gender difference in disability (39). Generalized osteoarthritis, which includes hand osteoarthritis, is also more common in women than in men (40).

Alzheimer’s disease and dementia are a major cause of both mental and physical disability. Even though a large proportion of people with Alzheimer’s disease are women, it does not appear that differences in the rates of the disease explain the gender gap in disability. Recent evidence suggests that the excess number of women with Alzheimer’s disease is due to a longer life expectancy rather than to sex-specific factors for the disease (41). In addition, vascular dementia is more common in men, so that the overall rates of dementia are fairly equal in men and women.

Often underreported in population studies, depression is another important cause of disability. Most community surveys of mental illness show that depression and depressive symptoms actually decrease with age (42). However, in those who are ill (which often includes older persons), rates of depression are increased. In addition, at every age, depression is more common in women than in men. In medical patients, the prevalence of depression is about 15-20 percent higher in women than in men (43). While depression itself is quite disabling, when combined with other illnesses, it is thought to cause an excess of disability beyond that of either condition alone.

Although cardiovascular disease is the leading cause of death and hospitalization of adults over age 65 years, it is the second or third leading cause of disability. Cardiovascular disease may not explain the gender differences in disability since it is more common in men than in women. However, the differences in the rates of disease between men and women narrow with increasing age (1, 15). Because cardiovascular disease is so common, it accounts for a large proportion of the disability that occurs in older women. Additionally, when paired with another condition such as arthritis, cardiovascular disease seems to multiply the disability (44). This may be due to the increased energy expenditure required when there is a mechanical disadvantage in mobility.

More common in men than in women, stroke is another cause of disability (45). The amount of disability suffered from a stroke depends on several factors such as size of the lesion, the location of the lesion, and the natural history of recovery. There is a much smaller gender difference in stroke than in heart disease, and the rates of stroke are much lower than for other conditions. Thus, stroke, while an important cause of disability in both men and women, does not account for the gender difference in disability and accounts for only a small portion of disability overall.

Falls and, specifically, injurious falls may partially explain the gender differences in disability. In both men and women, falls are a major risk factor for functional decline and nursing home admission (46). However, older women are 50 percent more likely to fall than are older men (47-50), and they are more likely to be injured when they fall than are men (48, 51). The most common serious injury in older women is hip fracture. Hip fracture is important in men who are much older, but there are fewer men at risk, resulting in a much higher number of women with hip fracture at every age (52) (figure 2).

Loss of muscle mass is also thought to contribute to disability and mobility impairment in old age. This loss of muscle mass that occurs with aging is termed sarcopenia. There is a 30-40 percent loss of skeletal muscle from young adulthood to old age. These changes in body composition have been well described in smaller groups, but only recently has it been possible to measure it precisely in population studies. Risk factors for this loss of muscle mass are not well defined. Gender differences in hormones are potential factors. Figure 3 shows the difference between muscle mass in the thigh of a young and an old person. The cross-sectional area of the thigh is similar, but much of the muscle area in the older person is replaced by fat. Women have a higher percentage of body fat than do men. However, at every level of percentage of body fat, older women appear to be more disabled than do older men (figure 3) (53). The highest level of percent body fat in men is similar to the lowest level of percent fat for women, so that women carry a relatively higher proportion of their body.

**FIGURE 2.** Age-specific incidence rates of hip fracture by sex, United States, 1950–1997. (Source: Lauritzen et al., 1993 (52)).

*Epidemiol Rev* Vol. 23, No. 2, 2001
weight as fat than men do. This relative difference in body composition may be a major contributor to the relatively greater disability in older women.

The prevalence of total disability in older women is approximately 50 percent higher than that for men. The higher rates of nonfatal diseases and conditions such as arthritis, depression, dementia, and falls and the differences in body composition may explain the gender gap differences in disability in older persons. Additionally, these nonfatal conditions are more often present in combination in women than in men, which often magnifies the disability. When the number of chronic conditions are adjusted for, men and women have more similar levels of disability, although women still report greater amounts of disability. The higher number of chronic conditions and the high number of comorbidities in combination with the greater number of older women results in the great disparity in the absolute number of disabled women compared with men.

Disability in older adults translated to a huge burden on the health care system. Those who are disabled have a two- to threefold increased rate of hospitalization and increased use of physician services and of home health care. About 60 percent of disabled older adults will be admitted to nursing homes, but the vast majority of people with disability are living in the communities and are being seen in primary care practices (25). Primary health care needs can be expected to increase in proportion to the increase in numbers of older adults. Because most of these older adults are women, health care in old age is becoming a major issue in women’s health.

**Implications for preventive health practice**

Prevention of premature mortality remains an important goal for preventive health practices. Many interventions that reduce mortality should also decrease disability. However, most women will have multiple chronic conditions affecting both mortality and disability.

There is much interest in the potential for trophic factors, such as growth hormone, estrogen, testosterone, and adrenal androgens, to prevent involutinal changes in old age (54). Growth hormone has been shown to decrease fat mass and weight, but effects on function are not well established (55). In men, androgens have effects on body composition similar to those of growth hormone. Adrenal androgens have been given to women as well as to men. Dihydroepiandrosterone is converted to estrogen or androgen, depending on the amount of peripheral fat. It can be virilizing in women, and its effects on strength and body composition are small (56).

Estrogen has the potential to be important in several of the disabling conditions in older women. Estrogen replacement therapy has known positive effects on bone. The effects on neuromuscular function are inconsistent and much less studied (57, 58). Estrogen replacement therapy has become increasingly controversial. In observational studies, estrogen appears to be protective for cardiovascular disease (59–62). However, a secondary prevention trial showed that hormone replacement therapy in women with established cardiovascular disease resulted in a 50 percent increase in cardiovascular events in the first year (63). In addition, somewhat paradoxically, higher bone mass is a risk factor for osteoarthritis, but postmenopausally, even after adjustment for bone mass, women who take estrogen appear to have slower progression of osteoarthritis. There is also much interest in the potential for estrogen to prevent dementia. Results to date are mixed, with a recent clinical trial in patients with dementia showing no benefit of estrogen replacement (64). It may still have a role in primary prevention, but since incidence increases so late, very long-term follow-up is needed.

Physical activity is an important factor in preventing disability in older adults. Several observational studies have shown that adults who participate in a moderate physical activity program on most days of the week are less likely to be disabled in later years (65–67). In addition, intervention studies of strength and endurance programs have had positive results, with both older men and older women achieving improvements in strength, mobility, and function (68–70). Older men and women should be encouraged to...
participate in moderate physical activity on most days of the week to prevent disability.

In addition to the measures discussed above, efforts should be made to put proven preventive measures into practice. Stroke and heart failure are prevented by treating systolic hypertension. Those with atrial fibrillation should be treated with effective anticoagulation. Much is known about preventing osteoporotic fractures by preventing falls and treating the osteoporosis.

Therefore, prevention and research in older women’s health must simultaneously include an examination of multiple common chronic conditions. Many observational studies and clinical trials have added secondary outcomes to address this need. For example, the Study of Osteoporotic Fractures (71) added secondary outcomes of breast cancer and cognitive function. The Hormone Estrogen Replacement Study (72), a study of coronary artery disease, has now added knee osteoarthritis as an outcome. The Women’s Health Initiative (73) was designed from the beginning to include outcomes of mortality, breast cancer, cardiovascular disease, and osteoporotic fracture and subsequently added dementia as an outcome. The Cardiovascular Health Study (74) has added a dementia study as well. The Study of Health, Aging, and Body Composition (75) includes all common causes of disability, as well as disability itself, as an outcome.

In summary, the survival advantage in women has resulted in a much larger number of women than men living to old age. The higher prevalence of disabling conditions and the tendency to carry multiple comorbid conditions contribute to higher rates of disability in older women compared with older men. Older women should plan for about 3 years of disability at the end of life. The high life expectancy of women is a major achievement, but more must be done to prevent disability and improve the quality of life in the later years.

REFERENCES

33. Merrill SS, Soeman TE, Kasl SV, et al. Gender differences in


Epidemiol Rev Vol. 23, No. 2, 2001