Chapter 4: Key Messages

- The biggest problem created by bone disease, especially osteoporosis, is fractures, which may be the first visible sign of disease in patients. Each year an estimated 1.5 million individuals suffer a fracture due to bone disease.
- The risk of a fracture increases with age and is greatest in women. Roughly 4 in 10 White women age 50 or older in the United States will experience a hip, spine, or wrist fracture sometime during the remainder of their lives. Looking ahead, the lifetime risk of fractures will increase for all ethnic groups as people live longer.
- Osteoporosis is the most common cause of fractures. Roughly 10 million individuals over age 50 in the United States have osteoporosis of the hip. An additional 33.6 million individuals over age 50 have low bone mass or "osteopenia" of the hip and thus are at risk of osteoporosis and its potential complications later in life.
- Due primarily to the aging of the population, the prevalence of osteoporosis and low bone mass is expected to increase. By 2020, one in two Americans over age 50 is expected to have or be at risk of developing osteoporosis of the hip; even more will be at risk of developing osteoporosis at any site in the skeleton.
- Osteoporosis does not affect everyone to the same degree. Women, especially older women, are more likely to get the disease than are men. An estimated 35 percent of postmenopausal White women have osteoporosis of the hip, spine, or distal forearm. That said, men, especially elderly men, can and do get osteoporosis.
- The age-adjusted prevalence of osteoporosis and the rate of hip fracture are lower in Black women than in White women in the United States. The prevalence of osteoporosis in Hispanic and Asian women is similar to that found in White women, and the incidence of hip fractures among Hispanic women in California appears to be on the rise. However, it is important to remember that osteoporosis is a real risk for *any* aging man or woman.
- Much less is known about the frequency of most other skeletal diseases, due in part to underdiagnosis and underreporting. Some data, however, are available. An estimated one million individuals in the United States have Paget's disease, while roughly 20,000 to 50,000 Americans may have OI.

Chapter 4

THE FREQUENCY OF BONE DISEASE

While they may not get as much attention as heart disease, cancer, and other major diseases, bone diseases are common in the United States, especially among the elderly, and they take a large toll on the Nation's overall health status. Fractures are the biggest problem associated with bone disease; they are common, costly, and become a chronic burden on both individuals and society. Osteoporosis is a leading underlying cause of fractures, especially among the elderly. It affects both sexes and all races, although to varying degrees. The reason for the disease's high prevalence is relatively simple—almost everyone loses bone as they grow older. Other bone disorders, such as Paget's disease of bone, hyperparathyroidism, osteogenesis imperfecta, rickets, and osteomalacia are much less common. Like osteoporosis, these diseases also have adverse effects on bone strength and fracture risk by affecting bone density, bone turnover, or bone structure. Although some bone diseases lead to pain and deformity, most adverse effects relate to fractures.

This chapter reviews the most recent evidence related to the occurrence of fractures and bone diseases in the community. The following chapter deals with the burden caused by these fractures and diseases, including the most common complications that may ensue, such as physical disability, depression, a reduced quality of life, and potentially death. The following chapter also discusses the large costs associated with fractures and bone disease.

Fractures Caused by Bone Disease

Fractures are by far the biggest problem caused by bone disease. They are common and can be quite debilitating. In many cases they are the first sign of the disease in patients.

Incidence of Fractures

An estimated 1.5 million individuals suffer a fracture caused by bone disease annually (Riggs and Melton 1995, Chrischilles et al. 1991). In fact, fractures are the most common musculoskeletal condition requiring hospitalization among Medicare enrollees (who are age 65 and older). Approximately one-third (500,000) of fracture patients are hospitalized (see Table 5-1 in Chapter 5 for more details), while many more suffer fractures that do not require or result in hospitalization.

The risk of fracture increases dramatically with age in both sexes, both because bones become more fragile and the risk of falling increases. Roughly one in four (24 percent) women age 50 or older fall each year, compared to nearly half (48 percent) of women age 85 or older; comparable figures for men are 16 percent and 35 percent (Winner et al. 1989). These falls can result in fractures, and when they do the fracture is almost always caused by low bone

mass or osteoporosis. (See next section for more on osteoporosis and low bone mass.)

Another way to examine the frequency of fractures is to consider the chances of experiencing one or more of them during a lifetime of average length. What is clear from this analysis is that a substantial portion of the population faces a serious risk. As illustrated in Table 4-1, roughly 4 in 10 White women age 50 or older in the United States will experience a hip, spine, or wrist fracture sometime during the remainder of their lives; 13 percent of White men in this country will suffer a similar fate (Cummings and Melton 2002). Figures for men are lower due to their shorter life expectancy and lower fracture incidence rates. However, these data do not include other fractures (e.g., of the upper arm, pelvis, lower leg, ribs); if all fractures are included, the overall lifetime risk of fracture is even greater. Hip fractures are the most serious threat, as 17 percent of White women and 6 percent of White men age 50 and older will suffer a hip fracture sometime during the remainder of their life. The lifetime risks of clinically diagnosed spine fractures in these populations are 16 percent and 5 percent, respectively, and 16 percent and 2 percent for wrist fractures (Cummings and Melton 2002). The lifetime risk for nonwhites is less across all of these fracture types.

Looking ahead, the lifetime risk of fractures will increase for all groups as people live longer. An analysis in Sweden, for example, found that increasing life expectancy significantly increased the lifetime risk of hip fracture, from 14 percent to 23 percent in women and from 5 percent to 11 percent in men (Oden et al. 1998). If incidence rates were to rise by just 1 percent annually in Sweden, the lifetime risk of hip fracture could increase still further, to 35 percent in women and 17 percent in men. Of course, most hip fractures occur in the elderly and thus affect individuals only late in life. Other types of fractures are more likely to strike younger. For example, wrist and other limb fractures are ten times more common than are hip fractures among women who have just gone through menopause (Cooper and Melton 1992).

Although fractures of the upper arm, pelvis, and some other sites are more common in the elderly, the fractures most closely associated with bone disease are those of the hip (proximal femur), spine (vertebrae), and wrist (distal forearm). The annual incidence of hip fractures increases dramatically with age, from just 2 fractures per 100,000 among White women

Table 4–1. Lifetime Risk of Fracture at Age 50 Years

Type of fracture	White women	White men
Hip (%)	17.5	6.0
Vertebra(%)	15.6	5.0
Forearm (%)	16.0	2.5
Any of the three (%)	39.7	13.1

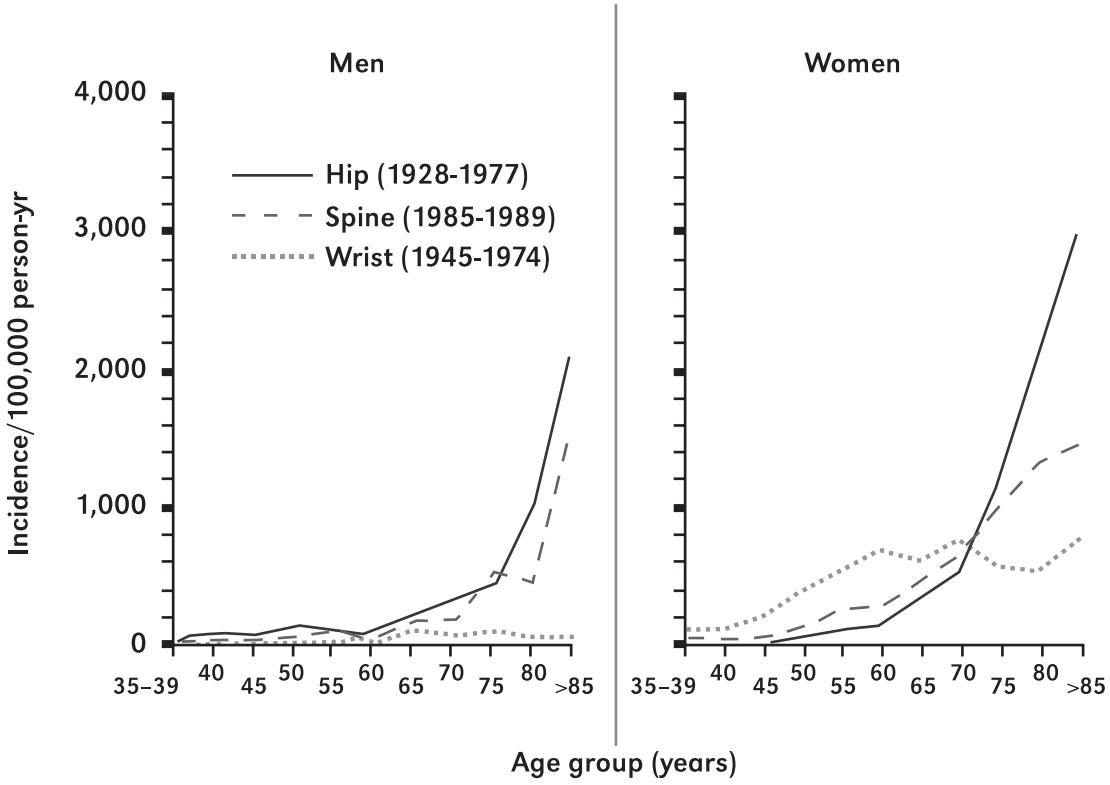
Source: Cummings and Melton 2002.

under age 35 to over 3,000 fractures per 100,000 among White women age 85 and older (Figure 4-1). Hospital discharge rates for hip fractures per 1,000 Medicare enrollees increased by 9.2 percent between 1992 and 1999, and then fell by 5.5 percent from 1999 to 2001 (Dartmouth 2004). Although achieved over a short time interval, this recent decline in hip fracture incidence is consistent with falling hip fracture rates that have been observed among White women in California (Zingmond et al. 2004). While the reasons for this decline are not entirely clear, it could potentially be due to the use of new therapies, e.g., pharmaceuticals, as discussed in Chapter 9. Nevertheless, even with modest reductions in the incidence rate of fractures (i.e., the number of fractures per 1,000 Medicare enrollees), the total number of hip fractures will likely increase significantly over the next 20–50 years due to the aging of the population. In other words, a modest decline in fracture rates per 1,000 Medicare enrollees will be overwhelmed by the growth in (and aging of) the overall Medicare population. The only way to realize meaningful reductions in the absolute number of hip fractures is to significantly reduce hip fracture rates, as outlined in the *Healthy People 2010* goals. These goals call for more than a 50 percent reduction in the hip fracture rates for females and a 20 percent decrease for males (see Table 1-1 for more details). Hip fracture incidence in men is about half that in women at any given age. Since there are fewer elderly men than there are women (due to shorter life expectancy), women account for 80 percent of all hip fractures (Cooper and Melton 2002). The greater risk of hip fractures in elderly women has been attributed both to their lower bone density compared to men as well as to their high risk of falling.

There is no generally accepted definition of a spine fracture (Genant and Jergas 2003), and estimates of the overall prevalence of spine fractures in postmenopausal women vary widely depending on the definition used (Black et al. 1991). Although experts do not always agree with the morphometric classification of specific patients, x-ray readings suggest that an estimated 20–25 percent of postmenopausal White women have at least one moderately deformed vertebra (Grados et al. 2004), while about 10 percent have the more severe spine fractures that are most likely to produce symptoms (see below). Most studies also show that the prevalence of spine fractures is similar in middle-aged women and men, but some of those in men may not be due to osteoporosis but rather to job-related injuries or trauma (O'Neill et al. 1996). It is important to remember, however, that the incidence of clinically diagnosed spine fractures (i.e., those diagnosed by a physician after a patient complains of symptoms) is much less than the incidence rates suggested by vertebral morphometry. In a recent study from Sweden, only 23 percent of vertebral deformities in women were diagnosed clinically (Kanis et al. 2004). In other words, there are many "silent" spine fractures that produce no obvious symptoms to the patient. These silent fractures may involve compression (or flattening or crushing) of the vertebrae, can result in kyphosis (curvature of the spine) and chronic back pain, and may be associated with an increase in morbidity.

Falls account for about one-fourth of the spine fractures that come to clinical attention (Cooper et al. 1992a); the majority of clinically diagnosed spine fractures result from excess stresses on the spine caused by everyday activities (Myers and Wilson 1997). The incidence of clinically recognized spine fractures increases rapidly with age in both sexes (Figure 4-1). Since rates are higher among women, who

Figure 4–1. Age Specific Incidence Rates for Proximal Femur (Hip), Vertebral (Spine), and Distal Forearm (Wrist) Fractures in Rochester, Minnesota, Men and Women



Source: Cooper and Melton 1992.

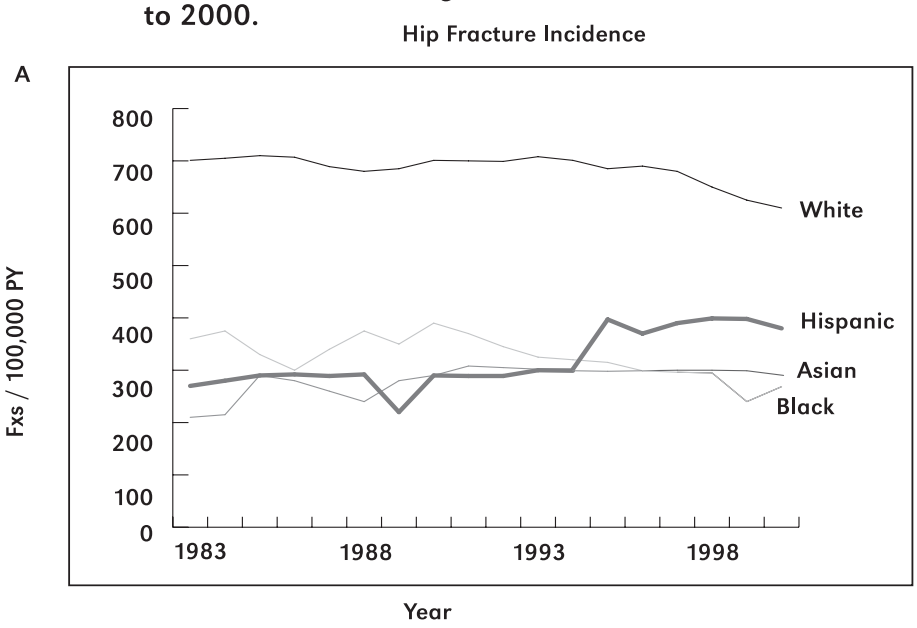
also live longer, three-fourths of all spine fractures are diagnosed in women (Cooper et al. 1992a).

Finally, wrist fractures tend to occur among younger individuals with osteoporosis, but these patients are at increased risk of a hip fracture later in life (Klotzbuecher et al. 2000). The incidence of wrist fracture rises little with age among men (Figure 4-1), so most distal forearm fractures are in women.

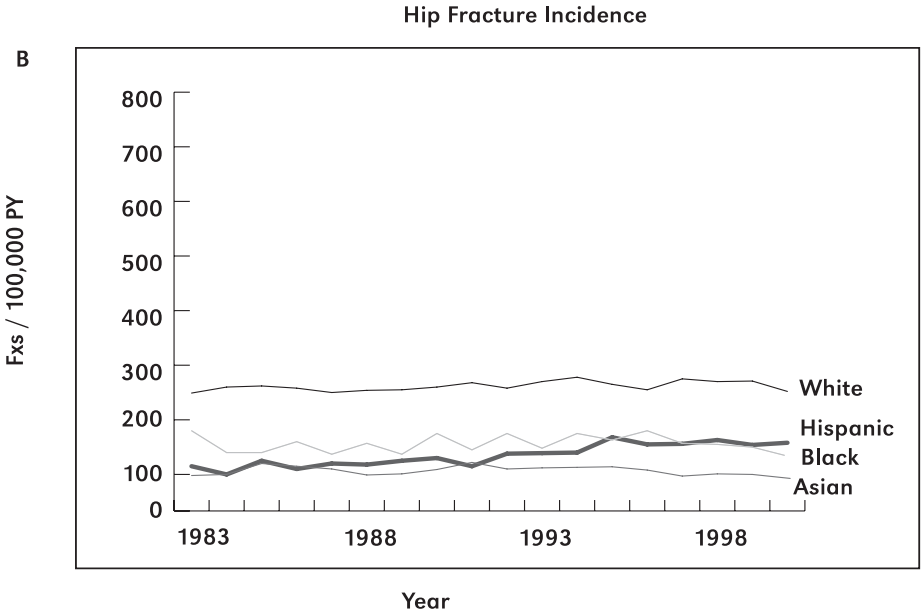
Variations Across Ethnic Groups and Geographic Regions

Fracture incidence in the United States is usually highest for Whites and lower for other ethnic groups (Melton and Cooper 2001, Lauderdale et al. 1997). The lower incidence of fractures among Blacks has generally been explained by their greater bone mass. But differences in bone mass fail to explain the lower hip fracture rates observed in Hispanics and

Figure 4–2. A - Hip Fracture Incidence by Race/Ethnicity Among Women 55 Years of Age and Older in California, 1983 to 2000.

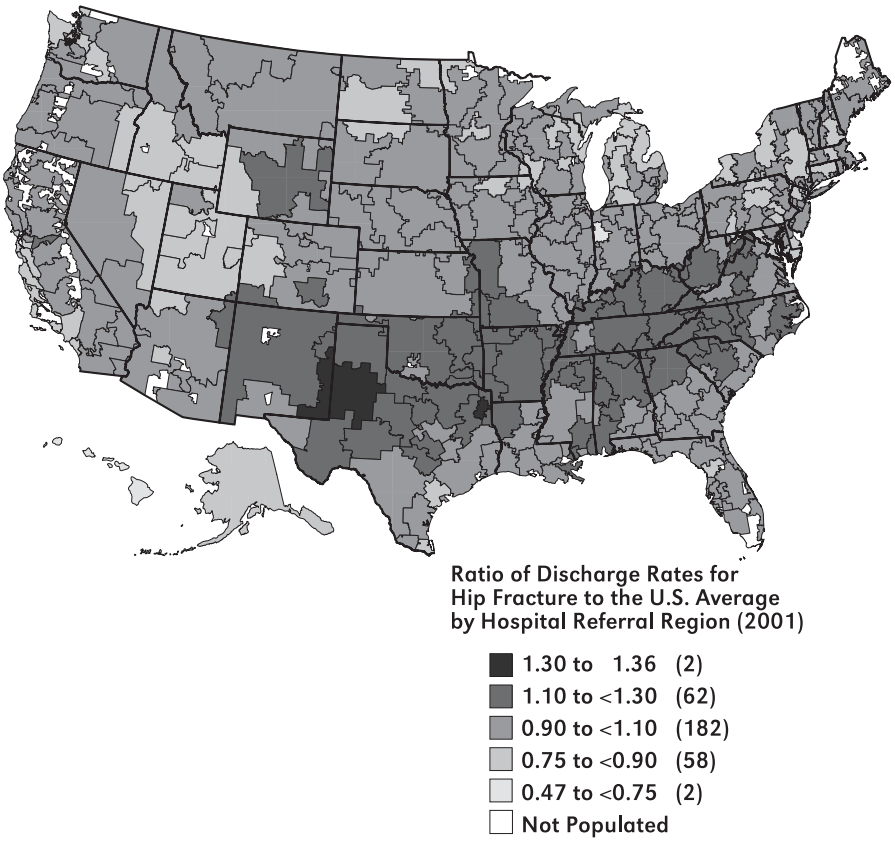


B - Hip Fracture Incidence by Race/Ethnicity Among Men 55 Years of Age and Older in California, 1983 to 2000.



Source: Zingmond et al. 2004.

Figure 4–3. Ratio of Hip Fracture Rates to the U.S. Average (2001)



Note: The actual variation for hip fractures is 0.47 to 1.36 per 1000 Medicare recipients, a three fold difference from the lowest to the highest rate per 1000. The numbers in parentheses indicate the number of Hospital Referral Regions (HRR's) with the specified ratio. Only two of the HRR's were 30% or more above the national average, and only two regions were 25% or more below the national average.

Source: Dartmouth 2004.

Asians. One hypothesis for these lower fracture rates is that Asians are less likely to fall (Davis et al. 1999). Hip fracture hospitalization rates for male and female non-Hispanic Whites, Blacks, Hispanics, and Asians over age 50 were tracked in New York City from 1988 to 2002. Females were more likely to fracture than males across all ethnic and racial minorities, and the risk of a hip fracture in these minority groups was one-third to one-half that of their White counterparts (Fang et al. 2004). This finding is consistent with recent data from California, which also shows a lower risk of fractures in minorities and men (see Figure 4-2). However, in California, the State with the largest population of Hispanic residents in the United States, hip fracture incidence increased among Hispanic women and men from 1983 to 2000, while it fell among non-Hispanic White women during the same time period. The magnitude of the decrease—almost 1 percent per

year—is similar to rates observed in White women in Rochester, MN (Zingmond et al. 2004). As a consequence of these trends, although the majority of hip fracture patients continue to be non-Hispanic Whites, ethnic minorities are an increasing proportion of all cases encountered in California.

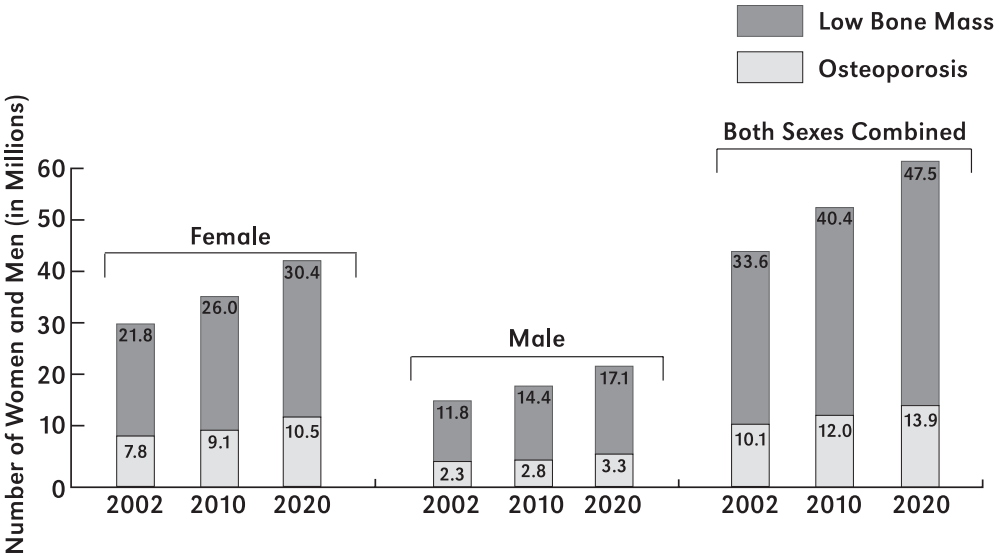
Spine fractures among Asians are about as frequent as they are in Whites (Ross et al. 1995). Few data are available for other ethnic groups. Hospital admissions for spine fractures in the United States are about four times greater for elderly Whites than for Blacks (Jacobsen et al. 1992). Hospital admissions, however, may not be a very accurate marker of spine fractures, as few patients are actually admitted for spine fractures. Also, African Americans and other underserved groups may not have ready access to hospital care. Likewise, spine fractures are less frequent among Mexican-Americans as compared to non-Hispanic White women (Bauer and Deyo 1987). Forearm fractures are also less common in Black and Asian populations (Chung and Spilson 2001). Lower rates for Blacks than Whites have also been reported for most other types of fractures. Finally, although limited data are available on the prevalence of osteoporosis in the American Indian and Alaska Native (AIAN) population, one study suggests that fracture risk in AIAN women is similar to that in White women (Siris et al. 2001).

Fracture rates tend to vary across countries and regions within countries (Cummings and Melton 2002). For example, wrist and hip fracture rates in the United Kingdom are around 30 percent lower than in the United States. However, hip fracture rates vary more than sevenfold from one country to another within Europe (Melton and Cooper 2001), and similar variation has been observed for spine fractures (O'Neill et al. 1996). Differences in the frequency of falls in different parts of Europe may explain in part the difference in limb fractures (Roy et al. 2002). Likewise, hip fracture incidence differs among various Asian countries (Lauderdale et al. 1997). Marked variation in fracture incidence is seen even within specific countries. As shown in Figure 4-3, hip fractures in the United States are most prevalent in the South (where hip bone density is lowest [Looker et al. 1998]), with two areas of Texas having the highest rates of fracture (Dartmouth 2004). However, the incidence of arm fractures is higher in the East and lower in the West (Karagas et al. 1996).

Osteoporosis

Osteoporosis and osteopenia (see box) are by far the most common causes of the fractures discussed in the previous section (although other bone diseases can cause fractures as well). In fact, decreased bone density is an important risk factor for fractures both in postmenopausal women (Stone et al. 2003) and older men (Nguyen et al. 1996). A panel of experts judged that skeletal fragility might be responsible for 80–95 percent of hip and spine fractures in White women, depending on age, along with 70–80 percent of distal forearm fractures and 45–60 percent of fractures at other skeletal sites (Melton et al. 1997). The comparable figures were less for women of other races and for men. While the risk of fracture is highest in those who have osteoporosis, many more individuals with osteopenia (low bone mass) are at increased risk as well. In fact, an analysis of peripheral bone mineral density (BMD) and fractures in over 200,000 women (The National Osteoporosis Risk Assessment, or NORA, study) suggests that at least half of all fragility fractures occur in this low bone mass group (Siris et al. 2001).

Figure 4–4. Projected Prevalence of Osteoporosis and/or Low Bone Mass of the Hip in Women, Men, and Both Sexes, 50 Years of Age or Older



Note: The National Health and Nutrition Examination Survey (NHANES) is conducted by the National Center for Health Statistics, a part of the Centers for Disease Control and Prevention. This survey is conducted on a nationally representative sample of Americans. As a part of NHANES, bone mineral density of the hip was measured in 14,646 men and women over 20 years of age throughout the United States from 1988 until 1994. These values were compared with the WHO definitions to derive the percentage of individuals over the age of 50 who have osteoporosis and low bone mass. These percentages were then applied to the total population of men and women over the age of 50 to estimate the absolute number of males and females in the United States with osteoporosis and low bone mass. Projections for 2010 and 2020 are based on population forecasts for these years; they are significantly higher than current figures due to both the expected growth in the overall population and the expected aging of the population.

Source: NOF 2002.

Prevalence

As noted in the previous chapter, the World Health Organization has defined osteoporosis, for practical purposes, as a bone mineral density(BMD) value more than 2.5 standard deviations below the mean for normal young White women. Based on this definition, it has been estimated that roughly 10 million individuals over age 50 in the United States have osteoporosis of the hip, as shown in Figure 4-4 (NOF 2002, Looker 1997, Looker 1998). (The precise number suffering from the disease is difficult to determine, since bone loss varies in the different parts of the skeleton where bone mass is measured and definitions of osteoporosis have not been developed for all subpopulations.) An additional 33.6 million individuals over age 50 have low bone mass or "osteopenia" of the hip and they are at risk of osteoporosis and its potential complications later in life (NOF 2002, Looker 1997, Looker 1998).

Due primarily to the aging of the population, the prevalence of osteoporosis and low bone mass is expected to increase to 12 million cases of osteoporosis and 40 million cases of low bone mass among individuals over the age of 50 by 2010, and to nearly 14 million cases of osteoporosis and over 47 million cases of low bone mass in individuals over that age by 2020 (NOF 2002). In other words, **by 2020 one in two Americans over age 50 is expected to have or to be at risk of developing osteoporosis of the hip**; even more will be at risk of developing osteoporosis at any site in the skeleton.

One problem in estimating the frequency of osteoporosis is that many individuals may have the disease but not know it. The National Health and Nutrition Examination Survey (NHANES) revealed that only 1 percent of men and 11 percent of women age 65 and older reported that they had osteoporosis; testing at the hip showed that four times as many men (4 percent) and 2.5 times as many women (26 percent) actually had the disease (Table 4-2). In fact, more men (2 percent) reported a history of hip fracture than reported a prior diagnosis of osteoporosis (1 percent); for women the figures were reversed, 6.1 percent and 11.1 percent, respectively. These data for both men and women reveal not only the underdiagnosis of osteoporosis but also the failure to recognize that most hip fractures are due, at least in part, to osteoporosis. The likelihood of experiencing most other bone diseases is lower. In fact, only about 1 percent of the population age 45 and older has evidence of Paget's disease of bone and probably less than 1 percent has hyperparathyroidism (see below).

Variations Across Gender, Race, and Ethnicity

Osteoporosis does not affect everyone to the same degree. Women, especially older women, are much more likely to get the disease than are

What Is Osteopenia?

The term "osteopenia" is used to define individuals who have low bone mass and some increased risk of fracture. Their bone mass is not so low that they are deemed to have osteoporosis. This classification is similar to that used for people with high levels of LDL (or so-called "bad") cholesterol, where individuals with values over 160 mg/dl are deemed "high risk" and those between 130 and 160 mg/dl are deemed "moderate risk." The range defining osteopenia or low bone mass is quite large, ranging from -1 to -2.5 T-scores (that is, bone density levels that are 1 to 2.5 standard deviations below the average for young adults who have achieved normal peak bone mass), which translates into bone mass that is 10–30 percent below this average level. Thus, osteopenia is not a disease but rather a way of describing the results of a measurement. Obviously, given the wide range in this measurement, not everyone with osteopenia is at the same risk of fracture. Since individuals who are told they have osteopenia may become excessively concerned, providers should be sure to frame the bone health issue in terms of fracture risk. As emphasized elsewhere in this report (see Chapter 8), BMD T-scores are only one component of that risk, and fracture risk may actually be quite low for many people with osteopenia, particularly younger individuals. To avoid causing unnecessary alarm among patients, many health care professionals prefer to avoid the term "osteopenia," instead telling patients that they have "somewhat low bone mass" and then explaining what that means in terms of fracture risk and how the problem can best be dealt with to minimize that risk.

Table 4–2. Prevalence (per 100 persons) of Osteoporosis and Hip Fracture in Persons 65 Years of Age and Older, by Gender and Age: United States, 1988-1994

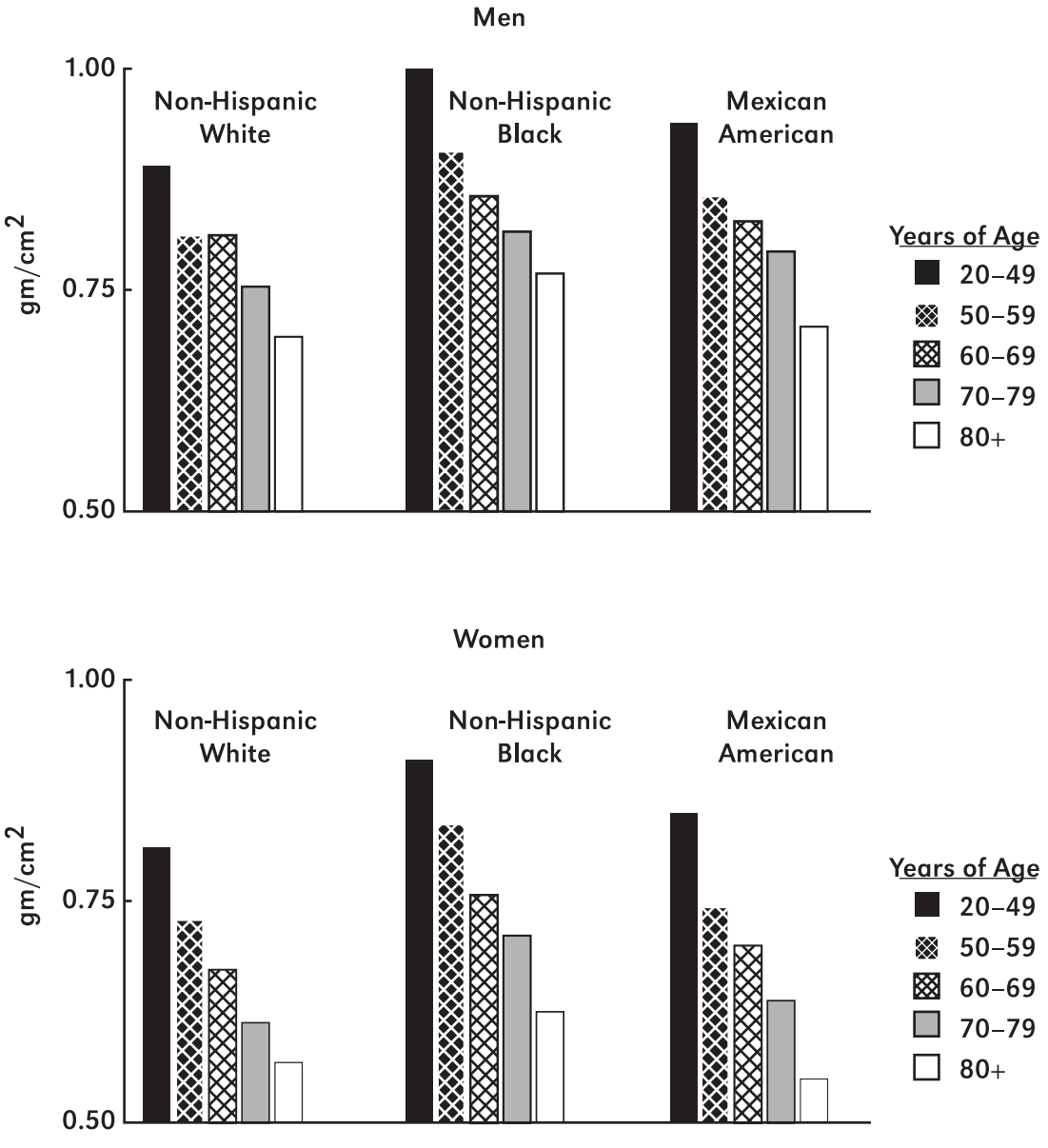
	Self-reported		Tested
Gender and age	Hip fracture %	Osteoporosis %	Osteoporosis %
Male	2.3	1.3	3.8
65–74 years	2.1	1.3	2.0
75–84 years	2.4	1.3	6.4
85 years and over	4.1	1.6	13.7
Female	6.1	11.1	26.1
65–74 years	4.5	10.9	19.0
75–84 years	7.3	12.1	32.5
85 years and over	11.8	9.7	50.5

Source: Praemer et al. 1999. Published with permission from the American Academy of Orthopaedic Surgeons.

men. In fact, women over age 50 accounted for over 75 percent (7.8 million) of the total cases of osteoporosis at the hip in 2002 (NOF 2002). Women are more susceptible than men to osteoporosis because they begin with less bone mass and lose it at a somewhat faster rate. As shown in Figure 4-5 (Looker et al. 1998), White women lose one-third of their hip BMD between the ages of 20 and 80, while White men lose only a quarter during this time. These data on hip BMD are from NHANES III, where a large representative sample of the U.S. population was assessed at a single point in time (cross-sectional data). Bone loss in other parts of the body, however, does not necessarily follow the same pattern. For example, while bone loss from the hip is approximately linear across adult life, bone loss in other parts of the skeleton begins around the time of menopause in women and at a comparable age or later in men (Melton et al. 2000).

Using the World Health Organization's definition, an estimated 35 percent of postmenopausal White women have osteoporosis of the hip, spine, or distal forearm (Melton et al. 1998) and are at increased risk of future fractures. Since bone mass decreases slowly over time, it is no surprise that the prevalence of osteoporosis (the proportion of the population within a certain age range affected at any given time) increases with age. NHANES data show that the prevalence of osteoporosis at the hip increases over tenfold among postmenopausal White women, from 4 percent in those between the ages of 50 and 59 to 52

Figure 4–5. Mean Bone Mineral Density of the Femoral Neck by Age for U.S. Men and Women of Different Racial/Ethnic Groups



Source: Looker et al. 1998.

percent among those age 80 and older (Looker et al 1997). The overall prevalence of osteoporosis of the hip among postmenopausal White women is 17 percent in NHANES, compared to 21 percent in Sweden (Kanis et al. 2000) and only 8 percent in Canada (Tenenhouse et al. 2000). These variations may explain the differences in hip fractures among women in these various countries, with Swedish women being the most likely to suffer fractures and Canadian women the least (Melton and Cooper 2001).

While NHANES did not assess bone density at the spine or wrist (and consequently more such data are needed), other studies suggest that the prevalence of osteoporosis at these sites follows a somewhat similar pattern. For example, the prevalence of osteoporosis at the wrist increases thirteenfold, from 6 percent among women age 50–59 to 78 percent among those age 80 and older, yielding an overall prevalence of osteoporosis of the wrist among postmenopausal White women of 33 percent (Melton et al. 2000). Due to increasing difficulty in accurately assessing bone loss from the spine as individuals age (because of artifacts that mask bone loss; see Chapter 8 for more details), the diagnosed prevalence of osteoporosis in White women age 80 and older is only twice that among those between the ages of 50 and 59 (Melton et al. 2000). Thus, just 8 percent of postmenopausal women appear to have osteoporosis of the spine. The comparable figure in Canadian women is 12 percent (Tenenhouse et al. 2000).

There is some lack of agreement about how osteoporosis should be defined in men and non-Whites. Since aging men of all races also lose bone from the hip (Figure 4-1), one would expect the prevalence of osteoporosis to increase with age in men as it does in women. However, due to the limited data available at the time, the World Health Organization did not propose a specific definition of osteoporosis for men. Based on the same absolute cut-off value for men as for women (0.56 g/cm2 for femoral neck BMD), the prevalence of osteoporosis among White, Mexican-American, and Black men age 50 and older is 4 percent, 2 percent, and 3 percent, respectively, according to NHANES III (Looker et al. 1997). When the normal values for a young adult male are used as the cut-off point, the estimated prevalence of osteoporosis in these men increases substantially to 7 percent, 3 percent, and 5 percent, respectively. The comparable figure for Canadian men is about 4 percent (Tenenhouse et al. 2000). The fact that many fewer men than women develop very low levels of bone density, where fracture risk is greatest, helps explain the lower incidence of hip fractures in men.

With respect to non-White women, comparisons of BMD to normal values for non-Hispanic White women suggest that the age-adjusted prevalence of osteoporosis at the hip among Black women in the United States is 6 percent, compared to 17 percent for postmenopausal White women. This is consistent with the much lower fracture rates observed in Blacks (Melton and Cooper 2001). Mexican-American women in the United States have an estimated prevalence of hip osteoporosis of 14 percent (Looker et al. 1997), which is consistent with the somewhat lower risk of hip fractures in most populations of Spanish heritage compared to those of Northern European extraction. It has generally been presumed that Asians have a prevalence of osteoporosis similar to that in Whites. Japanese data indicate that the prevalence of osteoporosis at the lumbar spine is as high or higher than in White women while the prevalence of osteoporosis at the hip (12 percent) is lower (Iki et al. 2001). This goes along with the fact that

spine fractures are almost as common among Asian women as they are in White women, while hip fractures are considerably less common (Melton and Cooper 2001).

Other Metabolic Bone Diseases

Much less is known about the frequency of most other skeletal diseases. This is because many of them, such as Paget's disease of bone and primary hyperparathyroidism, appear to be underdiagnosed. Others, such as osteomalacia and renal osteodystrophy, may in some cases be complications of some other condition and thus they are not counted separately. For example, the U.S. Renal Data System reports that almost 325,000 Americans are being treated for chronic renal failure by dialysis or renal transplantation (USRDS 2000). Over a third of those are Black, and their dialysis rate is five times greater than that of Whites. Although fracture rates are increased in these individuals (Alem et al. 2000), there appear to be no estimates of the actual prevalence of renal bone disease (see Chapter 3). By contrast, Black Americans are at a lower risk of primary hyperparathyroidism than are White Americans (Melton 2002). The condition is more common in women than men, and its prevalence increases with age in both sexes. Although there are indications that up to 1 percent of the population may be affected at any given time (Melton 2002), the annual incidence of diagnosed primary hyperparathyroidism has been estimated at only 21 per 100,000 (Wermers et al. 1997). However, the frequency of diagnosis of primary hyperparathyroidism is affected by how often blood calcium levels are measured and acted upon in clinical practice.

Paget's Disease of Bone

Based on an x-ray survey of the hip, pelvis, and spine by the first National Health and Nutritional Examination Survey, the prevalence of Paget's disease of bone has been estimated at 1.3 per 100 women and men age 45–74 (Siris 1999). This would represent over one million affected individuals in this country today. However, just as for spine fractures, many Pagetic bone lesions are asymptomatic and consequently undetected by health care professionals, meaning that the prevalence of clinically diagnosed cases of Paget's disease is much less. The incidence of the disease rises with age but is generally less than one per 1,000 per year, even among elderly individuals. The incidence is about twice as great in men as it is in women, and most patients are of Northern European heritage. Indeed, Paget's disease is most common in North America and Western Europe, except Scandinavia (Siris 1999). There is some evidence that the incidence of Paget's disease may be falling, but this may be the result of a decrease in the frequency of routine screening procedures (Tiegs et al. 2000).

Developmental Skeletal Disorders

There are many congenital disorders of the skeleton, but most are quite rare. Two of the more common conditions are osteopetrosis and the various forms of osteogenesis imperfecta (see Chapter 3). Altogether, 20,000 to 50,000 Americans may have osteogenesis imperfecta according to the Osteogenesis Imperfecta Foundation. The Paget's Foundation estimates that about 14,000 people in the United States (equivalent to one out of every 20,000 individuals) have osteopetrosis.

Acquired Skeletal Disorders

There are no estimates of the incidence of aseptic necrosis, despite its being a not uncommon complication of hip fracture and glucocorticoid therapy (see Chapter 3). Primary bone neoplasms, such as osteosarcoma, are less

common. The most frequent malignancy arising in bone is multiple myeloma, which was described in Chapter 3. This malignancy affects men more than women and Blacks more than Whites. Altogether, there are about 2,400 new cases and 1,300 deaths each year in this country from cancer of the bones and joints, compared to 14,600 new cases and 10,900 deaths annually from multiple myeloma (ACS 2001). Of the more than 560,000 people who die of cancer each year, most will have had skeletal complications of their malignancy (bone metastases) at some point during their illness. Bone metastases most commonly occur in individuals with breast, prostate, kidney, lung, pancreatic, colorectal, stomach, thyroid, and ovarian cancers. People dying of breast and prostate cancer almost always experience bone metastases, causing a great deal of the pain in the last days of life. Bone metastases most commonly occur in the spine; other common sites include the pelvis, hip, upper leg bones, and the skull (ACS 2004).

Prospects for the Future

The prevalence of bone diseases is going to increase significantly as the population ages. In the United States, the number of people age 65 and older is expected to rise from 35 to 86 million between 2000 and 2050, while the number age 85 and older will increase from 4 to 20 million (US Census Bureau 2004). Much of this increase will occur in the next 25 years as the "baby boomers" reach their 70s and 80s. Unless prevention activities are greatly enhanced, this demographic change alone will cause a substantial increase in the number of people with bone diseases. For example, based on data from NHANES, it is estimated that 7.8 million women and 2.3 million men in the United States already have osteoporosis at the hip. These figures could rise to 10.5 million women and 3.3 million men (an increase of 35 percent in women and 43 percent in men, respectively) by 2020 (Figure 4-4) (NOF 2002). These trends make reaching the *Healthy People 2010* goal (which is to reduce the overall prevalence of osteoporosis at the hip among adults from 10 percent to 8 percent) all the more difficult (USDHHS 2000).

In fact, these demographic changes could cause the number of hip fractures in the United States to double or triple by 2040 (Schneider and Guralnik 1990). Any such increase will also make it very difficult to achieve another *Healthy People 2010* goal of reducing the annual incidence of hip fractures by 60 percent (from 1,056 to 416 per 100,000) among women age 65 or older, and by 20 percent (from 593 to 474 per 100,000) among elderly men (USDHHS 2000). History does not offer much optimism that these goals will be reached, either. In fact, *Healthy People 2000* called for a nearly 15 percent reduction in the overall incidence of hip fractures among men and women age 65 and older (from 714 per 100,000 in 1988 to 607 per 100,000 by 2000) (USDHHS 1991). The annual incidence among this population actually increased by over 17 percent, to 840 per 100,000, in 2000.

The aging phenomenon and its potential impact on bone disease are not unique to the United States. Across the globe, the number of individuals age 65 and older is expected to increase nearly fivefold between 1990 and 2050, from 323 million to 1.55 billion. This trend alone could result in a 3.7-fold increase in the number of hip fractures worldwide, from an estimated 1.7 million in 1990 to a projected 6.3 million in 2050 (Cooper et al. 1992b). Even this figure may prove conservative, as it assumes that the incidence of hip fractures among individuals of a given age remains constant. If, instead, incidence rates remain constant in Europe and North America (they have stabilized in these areas recently) but increase by 3 percent annually elsewhere (as is occurring in some parts

of the world), the total worldwide number of hip fractures each year could exceed 21 million by 2050 (Gullberg et al. 1997).

Key Questions for Future Research

Research questions for Chapter 4 have been merged with those for Chapter 5 because of the close relationship between frequency and burden of disease issues. (See Chapter 5, page 103.)

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