Update on the Epidemiology of Osteoporosis

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Introduction
Osteoporosis is a major public health problem that affects the entire aging population. This report provides an update on the epidemiology of osteoporosis and its associated fractures. Published studies from 1997 to the present are highlighted. The current US prevalence estimates for osteoporosis, trends in fracture incidence rates, and latest reports on the morbidity, mortality, and costs attributable to osteoporotic fractures are discussed. Recent advances in our understanding of risk factors associated with osteoporosis and related fractures are reviewed. Special attention is paid to the rapid progress being made in the field of genetics, the growing importance of nutrition, and the new questions being raised as to the influence of hormonal factors on bone mineral density and fracture risk. New studies linking osteoporosis to several other important diseases in women including breast cancer, osteoarthritis, and stroke are also reviewed.

Prevalence of Osteoporosis
Looker et al. [4•] recently reported the prevalence of low femoral bone density in 14,646 US men and women from the Third National Health and Nutrition Examination Survey (NHANES III) using the WHO criteria for osteopenia and osteoporosis. According to the WHO criteria, 13% to 18% of women aged 50 years or more had osteoporosis and another 37% to 50% had osteopenia. Applying the most recent US census data, this translates to 4 to 6 million women with osteoporosis and 13 to 17 million with osteopenia. For men, 1% to 4% (280,000 – 1 million) are estimated to have osteoporosis and another 15% to 33% (4–9 million) have osteopenia when based on female cutoffs. When based on male cutoffs, 3% to 6% (1–2 million) men have osteoporosis and 28% to 47% (8–13 million) have osteopenia. The breakdown of prevalence estimates by each state is available in the 1997 National Osteoporosis Foundation (NOF) report [5]. Age-adjusted prevalences were higher in nonhispanic whites (NHWs) than in nonhispanic blacks (NHBs); prevalences in Mexican-Americans (MAs) were similar or slightly lower than NHWs. Data specific to Asian-Americans is sparse, although it appears that Chinese-Americans and Japanese-Americans have similar bone density to whites after adjustments for covariates that vary by ethnicity [6]. Prevalence estimates are often limited because gender and ethnic differences in bone size are not completely controlled for by dual energy x-ray absorptiometry (DXA) measurements of areal (g/cm2) BMD. In addition, the prevalence of osteoporosis may be underestimated when only a single BMD site (eg, hip) is used. Because an individual with...
normal BMD at one site (eg, hip) may have low BMD at another site (eg, spine, wrist), the prevalence of osteoporosis is expected to be higher if a number of skeletal sites are assessed simultaneously [7].

The US Food and Drug Administration’s (FDA) Radiological Devices Panel met on May 17, 1999 to discuss the use of gender and race-specific databases in assessing fracture risk. Current recommendations are to use a white female reference population for all groups [8]. The panel recommended that a young normal human database should be established in place of the current young white normal female database.

Hip Fracture Incidence and Prevalence
In the United States, 250,000 individuals more than 65 years of age fracture their hip each year [9,10]. Hip fractures increase exponentially with age: the incidence of hip fractures in white women (per 1000 person years) is 2.2, age 65 to 69 years; 4.4, age 70 to 74 years; 9.5, age 75-79 years; 16.9, age 80 to 84 years; 27.9, age 85 to 90 years; and 34.2, age 90 years and older [11]. This incidence of hip fractures is higher for white than African-American, Asian and Hispanic women. In a California hospital discharge study of hip fracture, the age-adjusted incidence (per 1000 person years) of hip fracture was 6.2 among white women, 3.8 among Asian women, 2.4 among African-American women, and 2.2 among Hispanic women [12].

The rate of hip fractures may be declining in white women and men [13]. For example, age-adjusted hip fracture incidence rates in Rochester women increased almost sixfold between 1928 and 1950, but fell by about 20% between 1950 and 1992. Reasons for the reported decline in fracture incidence are currently unknown. More data are needed to determine if these trends are widespread or limited to the small, predominately white and highly educated community of Rochester, Minnesota. Yet even if the incidence is declining, there will be an exponential increase in the number of hip fractures worldwide because of the dramatic demographic shifts in age structure of the population [14]. The impact of this marked increase in hip fracture will be greatest in Asia and developing countries. In 1990, about one fourth of all hip fractures occurred in Asia; by 2050, almost half of all hip fractures worldwide will occur in Asia [15].

The current estimates of the lifetime risk (ie, probability of having a fracture prior to death) of sustaining a hip fracture have recently been challenged. In the United States, it is currently estimated that the lifetime risk by age 50 of having a hip fracture is about 16% to 17.5% for women and 5% to 6% for men [16,17]. For African Americans, the lifetime risk is estimated to be 5.6% and 2.8% for women and men, respectively [13]. Oden et al. [18] argues that lifetime risk estimates have not taken into account the declines in mortality rates. Thus, estimates have been considerably underestimated.

Costs
Complications of osteoporosis, namely fractures, create a heavy economic burden on the health care system estimated at $13.8 billion in the United States in 1995 [19•]. The majority of health care expenditures are attributable to inpatient care ($8.6 billion) followed by nursing home care ($3.9 billion) and outpatient services ($1.3 billion). Although most costs were spent on white women (75.1%), one fourth was spent on men and minorities. Even the group least susceptible to fracture, nonwhite men, required $174 million in osteoporosis care in 1995. Treatment of hip fractures incurs the greatest amount of health care expenditures (63.1%); however, 36.9% of costs went to treatment of fractures in white women.

Mortality
Excess mortality occurring after a hip fracture compared with that expected in the population is estimated to range from 12% to 35% [20]. New evidence is accumulating that age, race [21], gender [21–23], health and functional status [24,25] all contribute to the survival outcome following hip fracture. The greatest excess mortality typically occurs within the first year [21]; however, some studies show a sustained effect [25]. In one recent report, the greatest excess mortality occurred within the first 6 months following a fracture in those with the poorest health; however, there was a continuing trend of increased mortality, with an excess of 14 deaths per 100 cases by 5 years for patients who had little functional impairment and few comorbidities before the fracture [25]. Men appear to have a poorer prognosis than women [23]. A large prospective study showed that men had consistently higher standardized mortality ratios (2.2–3.2) than women (1.7–2.2) for hip, vertebra, and other major (eg, pelvic, rib) and minor (eg, distal arm and leg) fractures [23]. African Americans have a poorer outcome following a hip fracture than whites, although reasons for this racial difference are unclear [21].

New reports demonstrate that vertebral fractures, both those that come to clinical attention and those that do not, are associated with increased mortality. Ismail et al. [22] reported a modest excess mortality in those with, compared with those without, radiographic vertebral deformity (RR=1.9, CI 1.0,3.4). Adjustments for smoking, alcohol consumption, previous hip fracture, general health, body mass index (BMI) and steroid use reduced the excess risk (RR=1.6, CI 0.9,3.0). The authors speculate that the excess mortality associated with radiographic vertebral deformity (the majority of which are not clinically apparent) may in part be due to comorbid conditions. Results from the Study of Osteoporotic Fractures (SOF) also found women with radiographic evidence of vertebral fractures to have increased mortality rates. Women with vertebral fractures were more