APPENDIX A

BEHAVIORAL RISK FACTOR SURVEILLANCE SYSTEM

DESCRIPTION AND METHODOLOGY

The Behavioral Risk Factor Surveillance System (BRFSS) was established in 1984 by the U.S. Centers for Disease Control and Prevention (CDC) in order to allow states to determine the prevalence of selected health risk factors among their adult populations. The West Virginia Bureau for Public Health was one of the 15 initial participants in the BRFSS, which now includes all 50 states, the District of Columbia, Puerto Rico, Guam, and the Virgin Islands. The system allows states to monitor trends in health behaviors, as well as compare data with other states. The survey technique used, that of interviewing a random sample of state residents by telephone, is a faster and more cost-effective way of obtaining this information than in-person interviews.

The BRFSS survey represents a collaborative effort between the Bureau and the CDC. The Bureau provides telephones, office space, interviewers, and supervision of the data collection; financial assistance, a standardized set of core questions, computer-assisted telephone interviewing software, computers, data processing services, and analytic consultation are provided by CDC. Questions of topical interest may be added by individual states. West Virginia's survey included additional questions on osteoporosis in 1997 through 1999 and will do so in 2004.

CDC provides banks of telephone numbers that are presumed to contain either more household numbers (high density stratum) or fewer household numbers (low density stratum). The high density stratum is sampled at a higher rate than the low density stratum. The data ultimately are weighted to account for differences in selection probability. Calls are made until each number results in a completed interview or a refusal or is disqualified. A number is disqualified if it is non-residential or non-working, if there is no eligible respondent available during the survey, if the selected respondent is unable to communicate, or if the number has been called at least 15 times without success (encompassing a minimum of three attempts each during afternoon, evening, and weekend). Since 2002, approximately 275 interviews have been completed each month, yielding an annual sample size of about 3,300 interviews.

Within each household, the actual respondent is chosen randomly to avoid possible biases related to the time of day and household telephone answering preferences. Since the number of adults and the number of telephone lines may differ from household to household, resulting in their having different probabilities of being selected, data are weighted to compensate for this bias. Survey responses are weighted to an estimate of the state population's age and sex distribution, obtained from CDC, to more accurately reflect the prevalence of behavioral risk factors among the state's residents.

For additional information on the BRFSS, contact Fred King, BRFSS Coordinator, Office of Epidemiology and Health Promotion, 350 Capitol Street, Charleston, WV 25301, (304) 558-1755/FAX (304) 558-1787.

APPENDIX B

NATIONAL OSTEOPOROSIS FOUNDATION
America's Bone Health:
The State of Osteoporosis and Low Bone Mass in Our Nation

METHODOLOGY

Prevalence data extrapolations used in the NOF report were derived from research summaries provided by the National Health and Nutrition Examination Survey III (NHANES III) conducted from October 1988 through October 1994 in two phases (12). Each phase of the survey comprised a national probability sample. Phase I took place from October 18, 1988, through October 24, 1991, at 44 different locations; Phase II was conducted from September 20, 1991, through October 15, 1994, at 45 locations. A total of 33,994 persons were interviewed in their homes over the six-year period. The interviews included a physical examination in a mobile examination center (MEC); 30,818 such examinations were conducted.

In the MEC, bone densitometry of the proximal femur was conducted on all men and women aged 20+. (Examinees who were or possibly could be pregnant, as well as those who had previously broken both hips and those with hip pins or artificial hips were excluded.) Using dual energy x-ray absorptiometry (DXA), five bone density measurements were made: the femur neck, trochanter, intertrochanter, Ward's Triangle, and total region. Rigorous quality control was maintained throughout the survey, including the monitoring of each DXA instrument and the review of each individual scan by the Mayo Clinic before its inclusion in the NHANES III database.

Because the bone density tests were conducted in the MEC, the sample was biased in favor of those able to participate in such an examination. The sample was therefore weighted before data analysis was performed. For more information on the NHANES III sample weights, the reader is referred to the NHANES III Analytic and Reporting Guidelines (U.S. DHHS, 1996b).

The NHANES III measurements derived for the femoral neck, trochanter, and intertrochanter were used by the NOF to calculate the following percentages of women with osteoporosis and low bone mass by race:

- 20% of non-Hispanic white and Asian women age 50 and older were estimated to have osteoporosis.
- 10% of Hispanic women age 50 and older were estimated to have osteoporosis
- 5% of non-Hispanic women age 50 and older were estimated to have low bone mass
- 52% of non-Hispanic white and Asian women age 50 and older were estimated to have low bone mass.

- 49% of Hispanic women age 50 and older were estimated to have low bone mass.
- 35% of non-Hispanic black women age 50 and older were estimated to have low bone mass.

Estimated rates of osteoporosis and low bone mass among men were based on the observations of leading researchers and were calculated as followed:

- 7% of non-Hispanic white and Asian men age 50 and older were estimated to have osteoporosis.
- 4% of non-Hispanic black men age 50 and older were estimated to have osteoporosis.
- 3% of Hispanic men age 50 and older were estimated to have osteoporosis.
- 35% of non-Hispanic white and Asian men age 50 and older were estimated to have low bone mass.
- 19% of non-Hispanic black men age 50 and over were estimated to have low bone mass.
- 23% of Hispanic men age 50 and over were estimated to have low bone mass.

A young female reference group was used to estimate low bone mass in men, resulting in a conservative estimate.

These percentages were then applied to state-specific population estimates obtained from the Census Bureau for 2002 and 2020 (extrapolated from 2000 census data) to obtain the estimated number of men and women in each state with osteoporosis and low bone mass.

APPENDIX C

THE STATE BURDEN OF FRACTURE MODEL

METHODOLOGY

The state burden of illness model was developed by Merck and Company and presented at the 1996 annual meeting of the American Society of Bone and Mineral Research. The model combined estimates of fracture risk with Census Bureau projections for the female populations of each state to project hip, wrist, and vertebral fractures for 1995-2015.

Two sources were used to calculate estimated fracture risks: (1) epidemiological studies conducted in Rochester, Minnesota, and reported upon in the 1980s and (2) a 5% sampling of Medicare patients compiled between 1986 and 1990. The Rochester data involved hip, vertebral, and wrist fractures among white women only and are reported in five-year age intervals. The Medicare data are reported in five-year intervals starting with age 65 and by race (white, black, and other/unknown) and do not include estimates for vertebral fractures.

The Census Bureau population projections were made for 1993 and five-year intervals beginning with 1995. The numbers used for intervening years were derived through extrapolation of the projections. Only women aged 45 and older were included in the model; five age groups were therefore extracted from the Census estimates: 45-54, 55-64, 65-74, 75-84, and 85+.

For each state, the projected fracture numbers and rates were calculated by multiplying the population within a specific age group by the corresponding fracture rates from the sources described above. The additional projections of hip fracture mortality were derived using mortality data from the same sources. Total hip fracture mortality rates represent all those women who are expected to die within one year following their hip fracture. It would be expected that some of these women would have died during that year of other causes; “excess” deaths represent the additional deaths that are directly related to the hip fracture.

The state burden of fracture model also contains projections of fracture costs over the same time period. The model assumes the cost of a hip fracture to be $24,677, which includes hospital costs, rehabilitation costs, and nursing home stays up to one year following the fracture. The model also assumes the cost of a wrist fracture to be $350 and that of a vertebral fracture to be $50. The projections assumed an annual 5% rate of inflation in medical care costs. Because our estimates for hospital costs alone for the treatment of wrist and vertebral fractures far exceeded the model’s assumptions, we chose not to include this segment of the model in our analysis.

APPENDIX D

NATIONAL OSTEOPOROSIS FOUNDATION OSTEOPOROSIS ATTRIBUTION PROBABILITIES

METHODOLOGY

It has been very difficult to assess the extent of the burden of osteoporosis among different segments of the population because the diagnosis of osteoporosis is rarely listed in conjunction with its resulting fractures. In a study of 1992 hospital discharge records for hip fractures in the United States, for example, only 6% included an associated diagnosis of osteoporosis, although it is widely recognized that the majority of such fractures among the elderly occur because of low bone mass. To address this problem, the National Osteoporosis Foundation convened a panel of six expert clinicians with extensive experience in the treatment of patients with osteoporosis to assess the contribution of this disease to four types of fractures (13). Probabilities were calculated for hip, vertebral, forearm, and all other site fractures among three age groups (45-64; 65-84; 85+), three racial groups (white, black, all others), and both genders. Seventy-two categories resulted from these groupings.

The Delphi method was used to attain a group judgment on fracture probabilities for all 72 different age, gender, and race categories. The process used by the expert panel comprised three stages, or rounds. Round I was conducted by mail prior to the meeting of the panel and involved an initial estimation of osteoporosis attribution probabilities for each category by each panel member, recorded on an *Osteoporosis Attribution Probability Response Form.* On a separate form, each participant outlined his or her key assumptions used in determining the probabilities. Before Round II, the panelists were provided the modal probabilities and confidence intervals for each category as well as a summary of the assumptions involved. They were also provided with available published data on osteoporosis incidence by age, gender, and ethnicity. At this point, the panel convened and discussed the preliminary estimates. Each panelist then developed a second set of attribution probabilities, again recorded on the *Osteoporosis Attribution Probability Form.* Modal probabilities and ranges were again determined for each category and distributed to the panel members. Round III involved further discussion on the areas of continued disagreement. The process was completed when each participant assigned a final probability to each of the 72 categories. Median attribution probabilities were calculated and then ranked by the panelists according to a numeric validity scale reflecting the degree of certainty associated with the final probability.

The final attribution probabilities are presented by race for each gender, age group, and fracture site in the following three tables. In addition, the initial assumptions considered by the expert panelists are listed. Because West Virginia has such a small minority population, and because data on race are not included on all hospital discharge records, this study utilized only the probabilities calculated for the white population.

Table 1
FINAL OSTEOPOROSIS ATTRIBUTION PROBABILITIES BY FRACTURE TYPE, GENDER, AND AGE
White Population

Site	Age Group					
	45-64 Years		65-84 Years		≥85 Years	
	Median Attribution Probability (Range)*	Validity Rank**	Median Attribution Probability (Range)*	Validity Rank**	Median Attribution Probability (Range)*	Validity Rank**
Women						
hip	0.80 (0.25-0.80)	2.0	0.90 (0.80-0.95)	1.2	0.95 (0.90-1.0)	1.0
spine	0.80 (0.50-0.85)	1.8	0.90 (0.70-0.95)	1.3	0.95 (0.80-1.0)	1.3
forearm	0.70 (0.10-0.70)	2.0	0.70 (0.50-0.80)	1.8	0.80 (0.70-0.95)	1.8
other sites	0.45 (0.05-0.55)	2.3	0.50 (0.25-0.65)	2.5	0.60 (0.45-0.80)	2.3
Men						
hip	0.60 (0.10-0.70)	2.2	0.80 (0.60-0.95)	1.8	0.85 (0.80-0.95)	1.7
spine	0.70 (0.50-0.90)	2.2	0.90 (0.50-0.95)	1.8	0.90 (0.60-0.95)	1.8
forearm	0.40 (0.05-0.50)	2.5	0.45 (0.15-0.60)	2.3	0.45 (0.30-0.60)	2.2
other sites	0.15 (0.05-0.30)	2.7	0.30 (0.20-0.40)	2.7	0.45 (0.30-0.50)	2.7

*Probability can range from 0.00 (no attribution) to 1.00 (100% attribution).
**Validity scores can range from 1 (±5% error) to 4 (more than ±20% error).

Table 2
FINAL OSTEOPOROSIS ATTRIBUTION PROBABILITIES BY FRACTURE TYPE, GENDER, AND AGE
Black Population

Site	Age Group					
	45-64 Years		65-84 Years		≥85 Years	
	Median Attribution Probability (Range)*	Validity Rank**	Median Attribution Probability (Range)*	Validity Rank**	Median Attribution Probability (Range)*	Validity Rank**
Women						
hip	0.65 (0.15-0.75)	2.2	0.80 (0.50-0.95)	1.8	0.95 (0.60-0.95)	1.8
spine	0.65 (0.40-0.75)	2.5	0.80 (0.50-0.90)	2.3	0.90 (0.60-0.95)	2.2
forearm	0.55 (0.05-0.60)	2.0	0.60 (0.30-0.75)	2.2	0.70 (0.40-0.85)	2.2
other sites	0.35 (0.05-0.40)	3.0	0.40 (0.15-0.50)	2.8	0.45 (0.20-0.70)	2.7
Men						
hip	0.30 (0.05-0.65)	2.8	0.65 (0.10-0.85)	2.3	0.75 (0.25-0.90)	2.3
spine	0.55 (0.30-0.80)	3.0	0.75 (0.30-0.90)	2.5	0.85 (0.30-0.95)	2.3
forearm	0.20 (0.05-0.40)	2.7	0.30 (0.10-0.50)	2.8	0.35 (0.20-0.50)	2.8
other sites	0.15 (0.05-0.20)	3.5	0.15 (0.05-0.30)	3.5	0.25 (0.15-0.40)	3.5

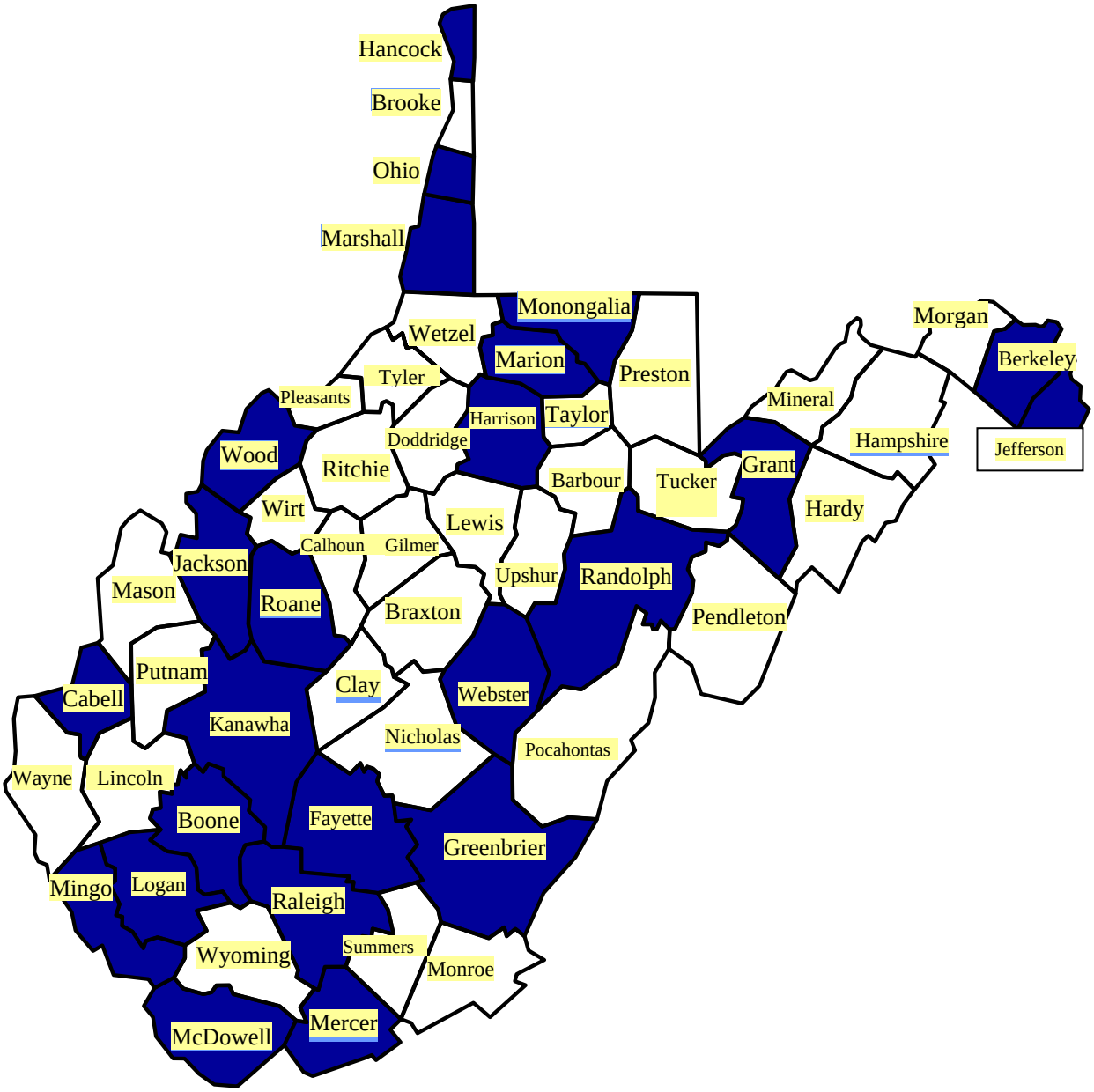
*Probability can range from 0.00 (no attribution) to 1.00 (100% attribution).
**Validity scores can range from 1 (±5% error) to 4 (more than ±20% error).

Table 3
FINAL OSTEOPOROSIS ATTRIBUTION PROBABILITIES BY FRACTURE TYPE, GENDER, AND AGE
Other Race*** Population

Site	Age Group					
	45-64 Years		65-84 Years		≥85 Years	
	Median Attribution Probability (Range)*	Validity Rank**	Median Attribution Probability (Range)*	Validity Rank**	Median Attribution Probability (Range)**	Validity Rank**
Women						
hip	0.75 (0.20-0.85)	2.7	0.85 (0.50-0.95)	2.5	0.95 (0.60-0.95)	2.5
spine	0.75 (0.40-0.80)	2.8	0.85 (0.50-0.90)	2.7	0.95 (0.60-0.95)	2.7
forearm	0.60 (0.10-0.70)	2.7	0.70 (0.35-0.80)	2.7	0.70 (0.55-0.90)	2.7
other sites	0.35 (0.10-0.50)	2.7	0.40 (0.20-0.65)	2.7	0.45 (0.30-0.80)	2.7
Men						
hip	0.55 (0.10-0.65)	3.2	0.75 (0.15-0.90)	3.0	0.85 (0.30-0.95)	3.0
spine	0.60 (0.30-0.80)	3.2	0.75 (0.40-0.90)	3.0	0.85 (0.50-0.95)	3.0
forearm	0.30 (0.30-0.55)	3.0	0.35 (0.15-0.50)	3.0	0.40 (0.30-0.50)	3.0
other sites	0.15 (0.10-0.30)	3.3	0.20 (0.10-0.40)	3.3	0.30 (0.20-0.50)	3.3

*Probability can range from 0.00 (no attribution to 1.00 (100% attribution).
**Validity scores can range from 1 (±5% error) to 4 (more than ±20% error).
***Includes Asian/Pacific Islanders, American Indians, and other races.

Bone Mineral Density Measurement Sites in West Virginia
(In dark blue)



INITIAL ASSUMPTIONS CONSIDERED IN THE DETERMINATION OF OSTEOPOROSIS ATTRIBUTION PROBABILITIES

Gender
Females have a greater number of osteoporotic fractures than males.

Age
Approximately 10% of the population will have had a fracture by age 45. Increases above this are associated with osteoporosis.

Wrist fractures increase to age 65, then plateau.

Vertebral fractures and hip fractures increase exponentially with age.

Falls are more frequent in the elderly ($\geq$65), increasing the chance for hip fracture in this group.

Forearm fractures increase at age 50, spine at age 60, and hip at age 70. All other fractures increase at age 65.

Older patients (all genders and races) have more osteoporotic fractures than younger patients.

Race
Fracture rates are greater in Caucasians than blacks, with others in between.

Caucasians and Asians have lower bone mass and an increased risk of fracture than do blacks.

Little information is available for bone mass in Native Americans and Pacific Islanders.

The "other" racial category is intermediate between white and black.

Fractures of "other sites" in blacks and other races are approximately 50% of whites.

Insufficient data exist to suggest that there are significant differences of rates in other races than in whites.

Gender & Age
Most hip, spine, and wrist fractures in elderly women (>65) are associated with low bone mass.

Young males (<50) have more fractures due to severe trauma.

In men under 65, the rate of radial bone loss is slightly greater than half that of women.

Seventy percent of white women over age 50 will have a decrease in bone mass sufficient to warrant the diagnosis of osteoporosis. Therefore, the overall proportion of fractures at certain sites (hip, wrist, spine) due to osteoporosis will be at least 70% in the oldest group.

By age 80, three-fourths of white women have a decreased fracture threshold.

Gender & Race
The rate of hip fracture in black, Hispanic, and Asian females is about 40% that of whites. The rate of hip fracture in black males is 70% that of whites. The rate of hip fractures in Hispanic males is 50% that of whites. The rate of hip fractures in Asian males is 33% that of whites.

Percent due to osteoporosis is the same for males and females, blacks and whites although the number of fractures is less.

White males and black females will have about half the proportion of osteoporotic fractures as white females. Black males will have about one-fourth. However, secondary osteoporosis will contribute in all of these groups.

Osteoporotic hip fractures in white women are 3-4 times more common than in black women, and "others" are approximately three- fourths as common as whites.

Both male and female blacks have substantially greater bone mass at any age than whites.

Fracture Type
Fractures of the hip and wrist involve trauma; therefore their proportion attributable to osteoporosis will be lower than for the spine. Wrist fractures are usually not osteoporotic in men.

Traumatic vertebral fractures are relatively uncommon; therefore a higher proportion will be osteoporotic.

Other fractures are less likely to be osteoporotic. An average of 20% are associated with osteoporosis.

Fractures of the ankle, elbow, finger, and face are not associated with low bone mass.

An exponential relationship exists between decreasing bone mass and risk of fracture.

"Spine" refers to vertebral body and not posterior elements or transverse processes.

"Forearm" refers to all forearm fractures including distal radius.