THE BURDEN OF OSTEOPOROSIS IN WEST VIRGINIA

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EXECUTIVE SUMMARY

Osteoporosis is a devastating disease that is affecting millions of lives. The costs of osteoporosis are enormous, both to the individual who is afflicted with the disease and to society in general. It has been estimated by the National Osteoporosis Foundation (NOF) that in 2000 approximately 44 million people aged 50 and over in the United States either had osteoporosis or were at risk of developing the disease; this number is expected to rise to over 61 million by the year 2020 (1). The burden of osteoporosis on the health care system is estimated to be approximately $17 billion annually, accounting for about $40,000 in total medical costs for each hip fracture (1). The cost is expected to rise as high as $140 billion by the year 2040 (2). Osteoporosis-related fractures cost the state of West Virginia an estimated $41.5 million in 2001.

Osteoporosis is characterized by decreased bone tissue and increased susceptibility to fractures. It has been called the "silent disease" because its progression is so insidious; most individuals are not aware they have osteoporosis until they actually fracture a bone (usually the hip, spine, or wrist). Approximately 1.5 million fractures per year are osteoporosis related: 300,000 hip fractures, 700,000 vertebral fractures, 250,000 distal forearm fractures, and 250,000 fractures at other sites (1).

Because osteoporosis primarily affects our older citizens, it is of particular concern to health professionals in West Virginia. In 2000, West Virginia had the oldest population in the nation according to population estimates published by the U.S. Census Bureau (3). The state's median age was 38.9, higher even than that of Florida (37.7). As the population continues to age, the public health burden of osteoporosis in West Virginia will increase accordingly.

According to the NOF, one in every two women and one in four men will suffer an osteoporosis-related fracture at some time in their lives. A woman's risk of a hip fracture is equal to her combined risk of having breast, uterine, or ovarian cancer. Sufferers of hip fractures have a 5% to 20% greater risk of dying within the first year after their injury compared to others in the same age group. One-half (50%) of persons who have a hip fracture will be unable to walk without assistance during their remaining lifetime; 25% will require long-term care (1).

PROGRAM DESCRIPTION

Mission

Raise public awareness of the nature, prevention, diagnosis and treatment of osteoporosis in West Virginia. Develop strategies for raising public awareness including educating health professionals, obtain and deliver information regarding osteoporosis to general public, and provide a resource network to disseminate information on osteoporosis.

Legislative Act

In 1996, the West Virginia Legislature created the Osteoporosis Prevention Education Act. This act provided for the establishment of the West Virginia Osteoporosis Prevention and Education Program (WV OPEP), which was designed to address the problem of osteoporosis in West Virginia. The act outlined the duties and responsibilities of the WV OPEP, which included:

- Development of strategies to raise public awareness
- Development of strategies to educate consumers, physicians, and health professionals on the risk factors, diet and exercise, diagnostic procedures, drug therapies, injury prevention, and treatment of osteoporosis
- Needs assessment
- Use and replication of other successful osteoporosis programs
- Development of an Interagency council on osteoporosis in order to coordinate programs conducted by the Bureau for Public Health
- Development of an advisory panel to provide nongovernmental input regarding the program

WV OPEP is a part of the Bureau for Public Health and is located in the Office of Epidemiology and Health Promotion – Division of Health Promotion and Chronic Disease. It addresses the problem of osteoporosis through various methods. It provides education on osteoporosis prevention, detection and treatment to physicians, health professionals, senior citizen centers, county health departments, community organizations, state employees and the general public to raise the awareness of the disease among all individuals. It provides this information in the form of brochures, newsletters, manuals, and audiovisual materials by request. Media, such as newspapers, radio, and television are also utilized to disseminate information throughout West Virginia.

In 1996, the West Virginia Legislature established the West Virginia Osteoporosis Prevention and Education Program.

Healthy People 2010 Objectives

OBJECTIVE 2.1.

Increase to 35% the proportion of youth aged 13-18 years who are aware of good bone health and osteoporosis prevention. (Baseline: 13% males, 16% females in 2003)

Data Source: West Virginia Eating, Activity, Teen Survey

OBJECTIVE 2.2.

Increase to 35% the proportion of persons aged 18 and over who have received counseling from their health care provider concerning osteoporosis and/or osteoporosis prevention. (Baseline: 22.5% in 1999)

Data Source: West Virginia Bureau for Public Health (WVBPH), Office of Epidemiology and Health Promotion (OEHP), Behavioral Risk Factor Surveillance System (BRFSS)

OBJECTIVE 2.3.

Reduce the prevalence of osteoporosis, as defined by low bone mineral density (BMD), in West Virginia to no more than 50% among people aged 50 and older. (Baseline: 68.2% in 2002)

Data Source: National Osteoporosis Foundation

OBJECTIVE 2.4.

Reduce hospitalizations due to osteoporosis-related fractures among persons aged 45 or older to 50%. (Baseline: 65.4% in 2001)

Data Sources: National Osteoporosis Foundation Prevalence Estimates

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WHAT IS OSTEOPOROSIS?

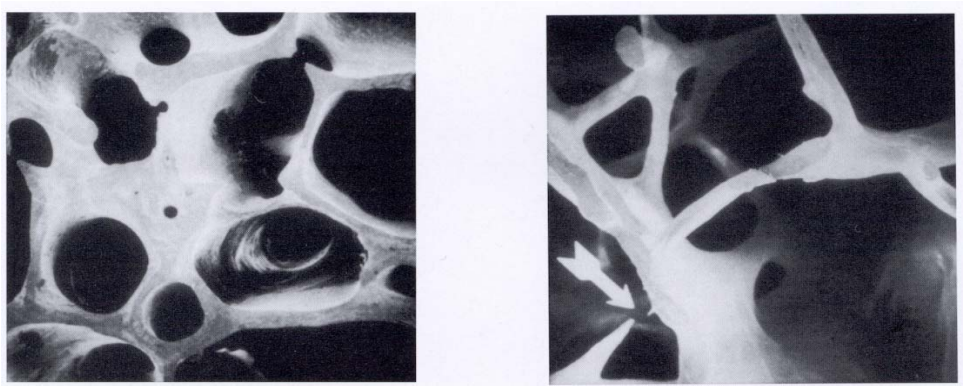
Bone is composed of protein (collagen) and minerals, primarily calcium salts and phosphate. The first stage of osteoporosis is a condition known as **osteopenia**, i.e., a decrease in the volume of mineralized bone. When osteopenia advances to the point where there is a reduction in total bone (protein and minerals), the disease stage of **osteoporosis** has been reached. Compared with normal bone, osteopenia carries a 2-fold increased risk of fracture, while osteoporosis carries a 4- to 5-fold increased risk of fracture (4).

Normal bone consists of two layers: cortical bone and trabecular bone. Cortical bone forms the outer layer and is dense and compact, while trabecular bone has a honeycomb structure and is much more porous. Cortical bone provides one-third of total skeletal surface and three-fourths of skeletal mass; trabecular bone, on the other hand, provides two-thirds of total skeletal surface but only one-fourth of skeletal mass. Most cortical bone is found in the shafts of the long bones of the appendicular skeleton (upper and lower limbs). Trabecular bone is found in axial skeletal bones (cranium, vertebrae, ribs, and sternum) and the ends of the long bones.

Bone is a living tissue that undergoes constant remodeling, or turnover, during its lifetime. Large cells called osteoclasts absorb bone tissue, leaving microscopic cavities. Other cells, known as osteoblasts, produce new bone to fill the cavities. Bone mass refers to the amount of mineralized tissue in the bone; the higher the bone mass, the stronger the bone. Bone mass is accumulated during childhood and young adulthood, reaching a peak between the ages of 25 and 35. (Trabecular bone forms earlier than cortical bone.) Peak bone mass is determined by such factors as genetics, diet, exercise, and an individual's overall health. Men have a higher bone mass than women, while African Americans have greater bone mass than white or Asian Americans. Adequate calcium and Vitamin D intake and regular physical activity during the skeleton's formative years can increase bone mass, while cigarette smoking and immoderate alcohol use can decrease mass.

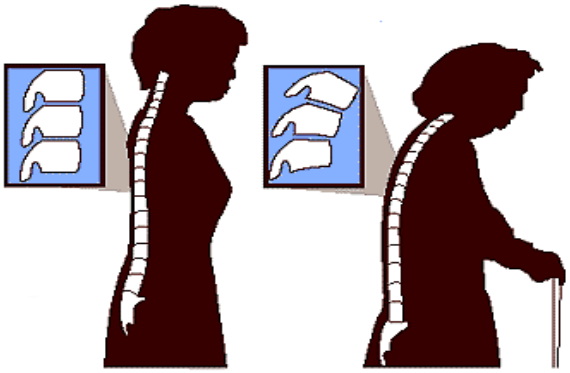
After age 35, both men and women begin to lose bone mass (0.3% to 0.5% yearly) as a normal part of aging, through an imbalance of the remodeling process. During the years following menopause, a woman's bone loss, especially of trabecular bone, accelerates due to her decreased estrogen levels. The rate of bone loss during menopause is six times more than bone loss in a man. It has been estimated that women can lose from 2% to 4% of their trabecular bone

mass per year for five to ten years after menopause, adding up to 25% to 30% of their total trabecular bone (4).



Normal Bone Osteoporotic Bone

If nothing is done to prevent bone loss during menopause, five years following menopause, a woman can lose the amount of bone that was gained during adolescence (5). Because the spine is composed primarily of trabecular bone, often the first fractures that occur as a result of postmenopausal osteoporosis are compression fractures of the vertebrae. Compression fractures can be painless and thus undetected until there is a noticeable loss of height. Curvature of the spine, called kyphosis, can also occur, leading to chronic back pain. Spinal fractures distort the skeletal anatomy, causing reduction of the thoracic and abdominal cavities and in time affecting the functioning of the heart, lungs, stomach, and bladder. The postural disfigurement, reduced mobility, pain, and psychological distress that can accompany compression fractures have a profound effect on an individual's quality of life.



With osteoporosis, the spine is subject to compression fractures that cause the vertebrae to collapse. This may lead to forward curvature of the spine (as seen in the figure on the right).

TYPES OF OSTEOPOROSIS

Type I (postmenopausal) osteoporosis occurs when there is a decline in ovarian function and lack of estrogen and progesterone production. This results in an increase of bone resorption and decrease in bone formation. The increased resorption leads to a greater loss of trabecular bone, resulting in typically vertebral and hip fractures (6).

In Type II (senile) osteoporosis the elderly experience hip fractures more often than spinal fractures, with a more even sex distribution. Weak, osteoporotic bone is slow to heal after surgical repair of the fracture and acute complications can follow, including pneumonia, pulmonary embolism, and depression. Aggressive physical therapy, often difficult for an elderly patient, may be necessary to overcome the consequences of prolonged bed rest. As a result, most patients fail to recover their full range of activity. While other fractures, such as that of the distal forearm bone, may be less traumatic, they still result in the loss of the use of the extremity for a certain period of time, limiting the individual's ability to function normally (6).

Certain medications and diseases cause Secondary osteoporosis. They may increase bone resportion, decrease bone formation, or increase calcium secretion. Some of the medications include: glucocorticoids, anticonvulsants, diuretics, and heparin while some diseases are: stroke, hyperthyroidism, hypogonadism, and early oophorectomy (6).

Osteoporosis for which there is no known cause is known as idiopathic osteoporosis. This condition is typically found in children and young adults. It is determined by a loss of bone density however, with normal hormone and vitamin levels.

There are different types of osteoporosis:
Postmenopausal, Senile, Secondary, and Idiopathic

DETECTION OF OSTEOPOROSIS

Routine X-rays can detect osteoporotic bones only when at least 30% of their bone mass has been lost. At this stage of the disease, the affected bones have a much lighter and thinner appearance than normal bones. An earlier and more accurate assessment of bone loss is accomplished through the use of bone densitometry. Bone densitometers measure the absorption of radiation by the skeleton (skeletal calcium) in order to determine bone mass. Measurements of bone mass are generally considered the most valid estimator of an individual's fracture risk.

Bone density can be measured in several different locations, with different techniques used for different sites. The two most common techniques used in the 1980s were single-photon absorptiometry (SPA), used to measure appendicular sites such as the wrist, and dual-photon absorptiometry (DPA), capable of two-dimensional scanning and used to measure the spine or femur. Both SPA and DPA use radioisotopes for bone imaging. While still available and widely used, SPA and DPA are being replaced by dual energy x-ray absorptiometry (DXA) and quantitated computer tomography (QCT), both of which have more precision and can assess bone mass at any site. These techniques use x-ray sources to image bones, as does radiographic absorptiometry (RA), primarily used to measure the small bones of the hand. Of all the techniques, only QCT has the ability to separate cortical from trabecular bone by providing a three-dimensional image; however, it is more difficult to perform and delivers much more radiation (100 times that of DXA) than the other methods of measurement.

No agreement yet exists on which method is the most effective for diagnosing individual patients and monitoring the progress of their disease. In fact, even the value of densitometry itself in assessing an individual's risk of osteoporosis has been questioned. Many physicians support the use of densitometry in screening high-risk patients to identify those with osteopenia or osteoporosis. Others, however, question the cost effectiveness of large-scale screening, arguing that no studies exist to date showing that the use of bone densitometry in high-risk groups actually results in a reduced incidence of fractures. The usefulness of bone densitometry in research on osteopenia and osteoporosis and for individual clinical decision making, i.e., measuring therapeutic response through interval monitoring, is generally more accepted.

A definitive diagnosis of osteoporosis is made only after performing a diagnostic test and meeting certain specifications. The World Health Organization (WHO) developed a method, known as the T score, by which one's bone density is measured. An individual's T score is determined by comparing theirs to that of a healthy thirty-year-old. A standard deviation of -1.0

indicates that the individual's bone mass is 10% less than normal. The following table displays the standard deviations for bone density measurements (5):

Standard Deviation	Diagnostic Category
0 to –1.0	**Normal**
-1.1 to –2.5	**Osteopenia**
More than –2.5	**Osteoporosis**

Bone density can be measured in several different locations, with different techniques used for different sites.

RISK FACTORS

The etiology of osteoporosis is multifactorial. Age, sex, race, lifestyle, and overall health are all factors:

Age — The risk of osteoporosis increases with age, however it can develop in young people.

Gender — Women are more likely to develop osteoporosis than men. Women have less bone mass than men and lose bone mass earlier and more rapidly because of hormonal changes during menopause. This does not mean, however, that osteoporosis is not a threat to men. It is estimated that up to one-third of all hip fractures occur in men, while compression fractures affect perhaps one-half as many men as women. Osteoporosis among men is becoming an increasingly serious public health problem as the population ages.

Race — Caucasian and Asian individuals have a greater risk of developing osteoporosis than people of other races, with Northern Europeans and North Americans at greatest risk. However, African Americans and Hispanics are also at significant risk from the disease. The National Osteoporosis Risk Assessment (NORA) study found that while African Americans had a lower prevalence of low bone density (32%), they still exhibited a substantial absolute risk of fracture (7).

Heredity — Family history is also a factor in the development of osteoporosis. Studies have shown that young women whose mothers have suffered vertebral fractures often have reduced bone mass themselves however, a family history of the disease is also considered a risk factor for men.

Menopause/Menstrual History — Early menopause (either natural or surgically induced) increases a woman's risk of osteoporosis. These conditions result in the lack of estrogen production, a hormone that is helps maintain the normal rate of bone remodeling. As estrogen levels fall, bone resorption becomes greater than bone formation, leading to a loss in bone mass. In addition, amenorrhea, loss of a female's menstrual cycle due to anorexia, bulimia, or excessive physical exercise, may cause bone mass loss.

Bone Structure/Body Weight — Small-boned, thin women have a lower bone mass than other women and thus are at greater risk from the disease.

Low Testosterone Levels — Men with testosterone deficiency are at greater risk.

Endocrine Disorders — Hyperthyroidism (having an overactive thyroid gland, such as in Grave's disease), hyperparathyroidism (excessive parathyroid hormone production), as well as decreased production of estrogen and testosterone can call cause osteoporosis.

Medications — Common medications that can cause osteoporosis when administered over a prolonged period of time include corticosteroids (such as Prednisone), heparin, anti-seizure medications such as Dilantin and phenobarbital, immunosuppressive drugs, and even antacids that contain aluminum. Steroids are the second most common cause of osteoporosis (next to decreased estrogen levels), and the American College of Rheumatology estimates that 35% of persons who get steroid-induced osteoporosis are men.

Immobility — Prolonged periods of immobility substantially increase an individual's risk of developing osteoporosis. Prolonged bed rest has been shown to reduce bone mineral density by about 0.5% per month. In bedridden patients, lumbar spine mineral density decreases by about 0.9% per week, or approximately 45% loss per year. However, bone remineralization begins once the individual is able to walk again (8).

Inadequate Calcium Intake — Calcium consumption in childhood, adolescence, and early adulthood appears to affect peak bone mass. Findings are mixed on the effectiveness of calcium supplements among menopausal and older women in preventing osteoporosis.

Age	Amount of Calcium
Birth – 6 months	200 mg
6 months – 1 year	270 mg
1 – 3 years	500 mg
4 – 8 years	800 mg
9 – 18 years	1,300 mg
19 – 50 years	1,000 mg
50+	1,200 mg
Pregnant or lactating Women	
18 years or younger	1,300 mg
19 – 50 years	1,000 mg

Inadequate Physical Activity — Although vigorous exercise early in life has been shown to increase bone mass, it is yet unknown whether this advantage produces lifelong protection from menopausal or senile osteoporosis. It is clear, however, that prolonged weight-bearing exercise does reduce bone loss and the risk of falling (and thus the fractures that can result from falls). A study done in West Virginia, by Gordon et al., reported that 86% of study participants viewed physical activity as a form of prevention for osteoporosis however, only 28%

of these individuals met the adequate physical activity recommendations. These statistics show the importance of not only increasing awareness of the benefits of physical activity but also of facilitating behavior changes in order to increase physical activity levels (9).

Cigarette Smoking — Studies have shown that cigarette smokers have lower bone density than nonsmokers. Smoking has also been associated with an increased risk of hip and wrist fractures. Over one-fourth (28%) of West Virginia adults smoke, thereby increasing the risk of osteoporosis (10).

Excessive Alcohol Intake — Alcohol has a direct toxic effect on osteoblasts, the cells responsible for bone formation, leading to a decrease in replacement bone. Heavy drinkers also have high levels of corticosteroids in their blood. These hormones are produced by the adrenal glands and are an additional risk factor for osteoporosis.

Excessive Caffeine Intake — Studies have indicated that heavy caffeine consumption can have a deleterious effect on bone mass by increasing calcium excretion.

Depression — New studies have indicated that women who are suffering from depression have lower bone density than nondepressed women, perhaps resulting from higher levels of corticosteroids in their blood.

The etiology of osteoporosis is multifactorial.
Age, sex, race, lifestyle, and overall health are all factors.

PREVENTION AND TREATMENT

The development and progression of osteoporosis is dependent on two separate processes: the formation of bone mass during childhood and young adulthood and the rate of bone loss in later life. The activity of the cells involved in the formation and regeneration of bone tissue is regulated by many factors, including hormonal levels and balances, diet, the metabolic effects of caffeine intake and cigarette and alcohol use, and external physical forces such as body weight and exercise. Because of the complex nature of osteoporosis, its prevention and treatment must be comprehensive, emphasizing diet, exercise, drug and hormonal therapies, and behavioral changes.

Primary Prevention. The best defense against osteoporosis is the accrual of maximum bone mass in childhood, adolescence, and young adulthood. Primary prevention includes educating youth on the dangers of bone disease in later life, with an emphasis on the importance of diet and exercise in earlier years.

- Children and adolescents should be encouraged to participate in various forms of physical exercise, ranging from organized sports to family-centered activities. Parents need to ensure that their children are physically active and find ways to incorporate exercise into their daily schedule.

- Parents need to be made aware of the important role of calcium in their children's diets in building and maintaining bone. The National Institutes of Health recommends that children aged 1 through 10 years receive from 800 to 1,200 mg of calcium every day, while adolescents and young adults aged 11 through 24 years need from 1,200 to 1,500 mg daily (11). Families should be counseled on the benefits of drinking skim or 1% milk to lower their fat intake while still getting their necessary calcium. Diets low in calcium should include a calcium supplement.

- Optimal calcium absorption requires adequate levels of vitamin D, which are normally obtained from exposure to sunlight (as little as 10 minutes per day). Unless they are home bound, children and young adults rarely need a vitamin D supplement.

- The roles played by cigarette smoking and immoderate alcohol use and caffeine consumption in the development of osteoporosis need to be emphasized in the health education of young people.

- Physicians play an important role in the prevention of osteoporosis by discussing the problem with their patients. A study done by Gallagher et al. reported that only 49% of study participants stated that a physician had discussed osteoporosis with them, and most of the discussions came only after a diagnosis of osteopenia/osteoporosis (12).

Secondary Prevention. Secondary prevention activities should be promoted among middle-aged and older adults who are at risk for osteopenia and osteoporosis. Hormonal therapy, weight-bearing exercise, and calcium supplementation are the major forms of prevention among these ages. Bone mass screening through bone densitometry is often recommended for high-risk individuals.

- Hormone replacement therapy (HRT) has shown to be very beneficial in the prevention and treatment of many health conditions. Recently, scientific evidence has prompted health professionals to no longer prescribe it as a form of treatment or prevention for osteoporosis. There are certain contraindications to HRT, including breast cancer or a strong family history of breast cancer, active liver disease, unexplained vaginal bleeding, and active vascular thrombosis; however, studies are currently under way on a low-dose, plant-based estrogen that appears to have fewer risks and side effects. Each woman needs to weigh the risks and benefits of HRT individually with her physician.

- At any age, physical activity positively affects bone mass. Exercise programs in middle life need to be aimed at increasing strength, coordination, balance, and flexibility. A regular regimen of weight-bearing exercises in which bones and muscles work against gravity is recommended. Such exercises include walking, tennis, stair climbing, and weightlifting.

- The NIH recommends an intake of 1,000 mg of calcium among adult women aged 25-49 who are premenopausal and those aged 50-64 who are postmenopausal but taking estrogen therapy (10). Women aged 50-64 who are not taking estrogen and all women aged 65 and older need 1,500 mg. The recommended intake is 1,000 mg for adult men aged 25-64 and 1,500 mg for men aged 65 and older.

- Most physicians now recommend bone density measurement for individuals at high risk for osteoporosis. These include postmenopausal women who are not on hormone replacement therapy; women with a family history of osteoporosis who have early onset menopause, amenorrhea, or a low body weight; persons with x-ray evidence of osteopenia; persons on long-term glucocorticoid therapy, or individuals with hyperthyroidism or hyperparathyroidism.

The NOF has established guidelines regarding individuals that should consider bone density testing:

- All postmenopausal women under age 65 who have one or more additional risk factors for osteoporotic fracture (besides menopause)
- All women age 65 and older regardless of additional risk factors
- Postmenopausal women who present with fractures (to confirm diagnosis and determine disease severity)
- Women who are considering therapy for osteoporosis if bone density testing would facilitate the decision
- Women who have been on hormone replacement therapy for prolonged periods (longer than five years)
- Men who present with fractures
- Men with prostate cancer being treated with a gonadotropic releasing hormone agonist
- Individuals who have primary hyperparathyroidism
- Individuals who are on a long-term glucocorticoid treatment (1)

Tertiary Prevention. Tertiary prevention activities involve middle-aged and elderly individuals who have been diagnosed with osteoporosis or have already suffered an osteoporotic fracture. These activities are aimed at limiting future disability and aiding rehabilitation. Exercise programs, better nutrition, and drug therapy are all components of a comprehensive regimen designed to treat established osteoporosis.

- Fall prevention education and management is vitally important among the elderly. Nearly nine out of every ten fractures (87%) among older persons (aged 65+) are caused by falls. By 2050, it is estimated that there will be 650,000 hip fractures annually, or nearly 1,800 hip fractures per day (13). The National Osteoporosis Risk Assessment (NORA) study reported that individuals with osteoporosis were four times more likely to suffer a fracture. Despite these facts, only 5% of individuals with osteoporotic fractures are referred for further evaluation and treatment of osteoporosis (14). According to the National Center for Injury Prevention and Control, falls are the second leading cause of injury death among persons aged 65-84 and the leading cause among persons aged 85+ (15). Fall prevention programs

targeted at persons with osteoporosis stress exercises that improve balance and coordination. As inactivity increases the risk of falling also increases, even physically deconditioned persons with osteoporosis need a moderate exercise program tailored to their individual abilities and limitations. The Journal of the American Medical Association reported in 1994 that a one-year trial of high-intensity strength training by postmenopausal women had a positive effect on their bone density, muscle mass, muscle strength, dynamic balance, and overall physical activity level (16). Even frail nursing home residents were found to be capable of performing the recommended twice-weekly strength-training exercises and experienced improvements in mobility, thus reducing their risk of a fall. Improved physical fitness in an elderly patient also can result in less pain in the performance of daily activities.

- Calcium absorption is often a greater problem among the elderly, especially those who are home bound or in nursing homes. These individuals are at risk of vitamin D deficiency because they are not exposed to sunlight on a frequent basis and may need a vitamin D supplement to meet their daily requirement.

- Biphosphonates are a new class of drugs that increase bone mass by inhibiting bone resorption. They offer an alternative to HRT in postmenopausal women and may be useful in men and patients undergoing long-term glucocorticoid therapy. Two biphosphonates, etidronate and alendronate, are presently being used to treat established osteoporosis, and others are undergoing clinical trials. (While not yet FDA approved for the treatment of osteoporosis, etidronate has been approved for other bone diseases and is prescribed extensively for osteoporosis as well.) Approximately 80% to 85% of patients have been shown to maintain or increase bone mass with biphosphonate therapy (4).

- Calcitonin is another drug therapy that has been approved by the FDA for the treatment of osteoporosis. Calcitonin is a natural hormone that increases bone density by slowing the rate of bone loss and also relieves bone pain in some patients. It is administered either as an every-other-day injection or as a once-a-day nasal spray.

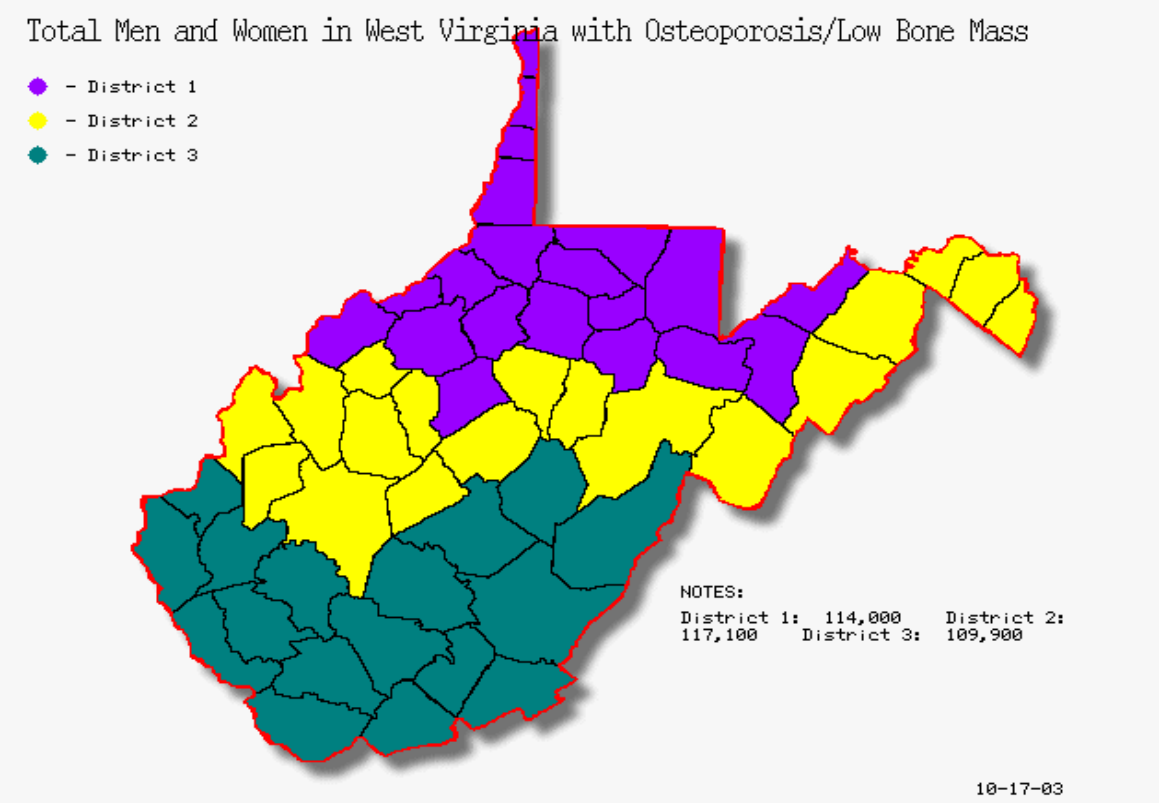
- A new class of drugs known as selective estrogen receptor modulators, or SERMs, are being clinically tested as an alternative to HRT. These drugs act as estrogen in the skeleton and cardiovascular system, while blocking estrogen's effects in the breast and uterus. One type of SERM, raloxifene, was approved by the FDA in 1997 for the treatment of osteoporosis in both men and women (17).

OSTEOPOROSIS IN WEST VIRGINIA

Risk Factors for Osteoporosis Among West Virginians

Age, sex, and race all play a major role in the development of osteoporosis, with older white women the group at greatest risk for the disease. According to the U.S. Census Bureau, West Virginia's population has the highest median age in the nation, 38.9, exceeding even that of Florida (38.7) (3). West Virginia ranks third in the country in the percentage of its population (15.3%) that is 65 and older, 275,550 people, and this number is expected to increase to 460,000 by the year 2025 (18,19). Women compose a larger percentage of the population in West Virginia than in the nation as a whole: the state's population is 51.4% female, compared to 50.9% in the total U.S. The Mountain State has a small minority population, with 95.0% of the population classified as white, 3.2% as African American, and 1.8% as another race (18).

The NOF reports that a total of 369,900 West Virginia men and women had osteoporosis or low bone mass and is expected to increase to 466,300 by the year 2020. The map below illustrates these numbers according to Congressional districts (1).

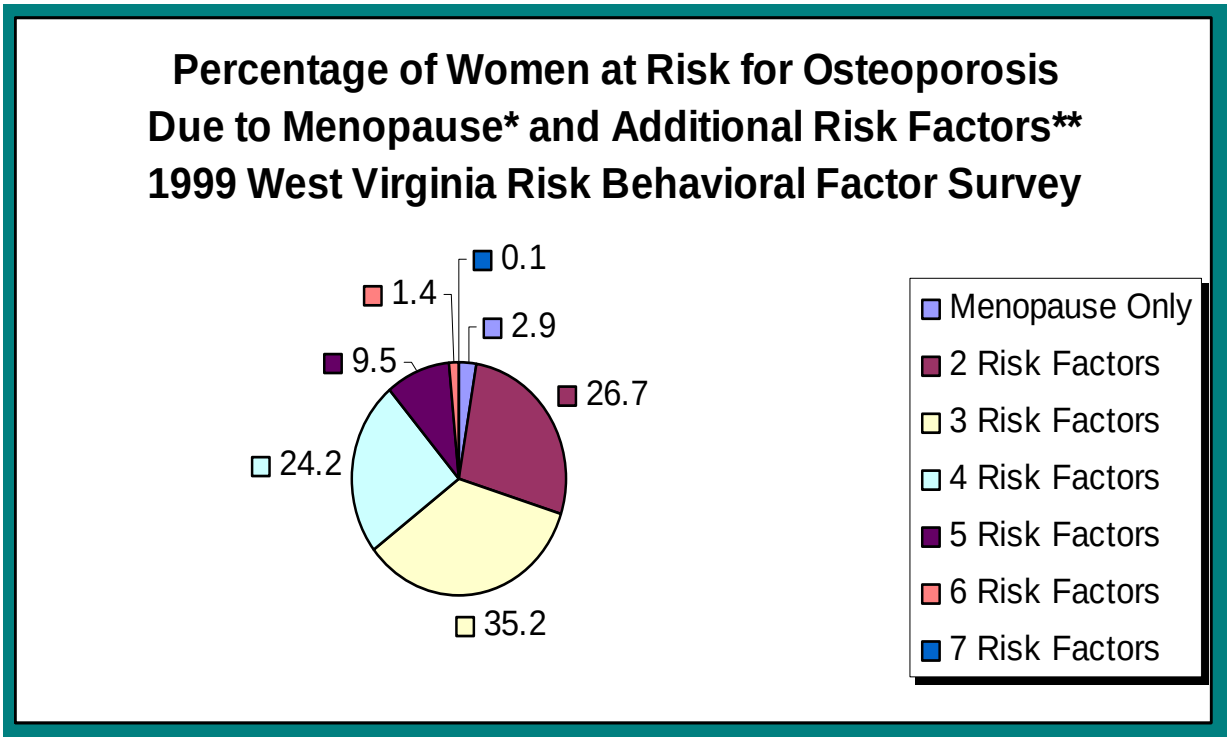


Data from the Behavioral Risk Factor Surveillance System (BRFSS), a telephone survey of West Virginians aged 18 and older that monitors health behaviors, provided information on the prevalence of eight additional risk factors for osteoporosis: bone structure/body weight, menopause, heredity, thyroid or cortisone-like medications, consumption of dairy products, cigarette smoking, physical inactivity, and alcohol misuse. The table below presents these findings (10).

PREVALENCE OF SELECTED OSTEOPOROSIS RISK FACTORS, BY GENDER
West Virginia Behavioral Risk Factor Surveillance System,* 1999

Risk Factor	Male (%)	Female (%)	Total (%)
Small, thin body frame	17.1	33.4	25.7
Family history of osteoporosis	6.6	18.5	12.9
Menopause (decreased estrogen levels		47.8	47.8
Thyroid medication, steroids, or treatment for cancer	16.1	29.5	23.2
Consumption of fewer than three servings of dairy products per day	83.3	85.7	84.5
Current cigarette smoking **	28.9	27.6	28.2
No leisure-time exercise**	28.2	34.8	31.7
Heavier drinking**	4.1	2.1	3.0
Broken bone in hip, wrist, or back since age 45	6.1	8.7	7.5
Take calcium supplement	7.5	29.2	19.0
Have received counseling about osteoporosis	9.5	35.1	23.0

*See Appendix A for BRFSS description and methodology. **2001 data



*Women who have gone through menopause

**Additional risk factors include broken bones, smoking, certain medications, <3 dairy daily, family history of osteoporosis, and having a small, thin frame

The chart above depicts the percentage of women in West Virginia who have gone through menopause (the leading cause of osteoporosis) and have reported other risk factors as well. As shown, 7 out of every 10 women (70.4%) in this group reported having three or more risk factors for osteoporosis. The table on the following two pages lists the combinations of multiple risk factors reported by these women during the 1999 BRFSS survey.

WOMEN AT RISK FOR OSTEOPOROSIS DUE TO MENOPAUSE AND OTHER RISK FACTORS, BY PERCENTAGE
West Virginia Behavioral Risk Factor Survey, weighted 1999
(Includes only women who have experienced menopause)

Risk Factor(s) Contributing to Osteoporosis	%
Menopause only	2.9
Two Risk factors	26.7
Menopause, fewer than 3 servings of dairy products per day (<3)	23.5
Menopause, small or thin body frame (STF)	1.7
Menopause, current cigarette smoking (smoking)	0.6
Menopause, family history of osteoporosis (FH)	0.4
Menopause, thyroid medication, steroids, chemotherapy (medications)	0.5
Three Risk Factors	35.2
Menopause, <3 dairy, medication	13.0
Menopause, <3 dairy, STF	10.3
Menopause, <3 dairy, FH	4.1
Menopause, <3 dairy, smoking	3.9
Menopause, <3 dairy, broken bone in hip, wrist, or back (broken bone)	1.6
Menopause, STF, medication	0.7
Menopause, FH, medication	0.5
Menopause, smoking, STF	0.4
Menopause, smoking, FH	0.4
Menopause, smoking, medication	0.2
Menopause, STF, FH	0.1
Four Risk Factors	24.2
Menopause, < dairy, STF, medication	6.9
Menopause, <3 dairy, FH, medication	3.6
Menopause, <3 dairy, smoking, STF	3.6
Menopause, <3 dairy, STF, FH	3.1
Menopause, <3 dairy, smoking, medication	2.3
Menopause, <3 dairy, medication, broken bone	1.8
Menopause, <3 dairy, STF, broken bone	1.3
Menopause, <3 dairy, smoking, FH	0.5
Menopause, <3 dairy;, FH, broken bone	0.4
Menopause, STF, medications, broken bone	0.2
Menopause, <3 dairy, smoking, broken bone	0.1
Menopause, smoking, STF, medication	0.1
Menopause, smoking, FH, medication	0.1
Menopause, STF, FH, medication	0.1
Menopause, STF, FH, broken bone	0.1
Menopause, FH, medications, broken bone	0.1

Five Risk Factors	9.5
Menopause, <3 dairy, smoking, STF, FH	0.5
Menopause, <3 dairy, smoking, STF, medication	1.4
Menopause, <3 dairy, smoking, STF, broken bone	0.2
Menopause, <3 dairy, smoking, FH, medication	1.4
Menopause, <3 dairy, smoking, FH, broken bone	0.4
Menopause, <3 dairy, smoking, medication, broken bone	0.2
Menopause, <3 dairy, STF, FH, medication	2.9
Menopause, <3 dairy, STF, FH, broken bone	0.5
Menopause, <3 dairy, STF, medication, broken bone	1.1
Menopause, <3 dairy, FH, medication, broken bone	0.8
Menopause, < dairy, smoking, STF, medication, broken bone	0.1
Menopause, STF, FH, medications, broken bone	0.1
Six Risk Factors	1.4
Menopause, <3 dairy, smoking, STF, FH, medication	0.9
Menopause, <3 dairy, smoking, STF, FH, broken bone	0.1
Menopause, <3 dairy, smoking, STF, medication, broken bone	0.1
Menopause, <3 dairy, STF, FH, medication, broken bone	0.2
Seven Risk Factors	0.1
Menopause, <3 dairy, smoking, STF, FH, medication, broken bone	0.1

NOF PREVALENCE ESTIMATES

The National Osteoporosis Foundation recently released *America's Bone Health: The State of Osteoporosis and Low Bone Mass in Our Nation.* The report included the estimated prevalence of osteoporosis in the United States from 2002-2020 (1). Prevalence figures were based on research summaries from the National Health and Nutrition Examination Survey III (NHANES III) conducted from 1988 through 1994, during which time approximately 34,000 respondents were interviewed in their homes. As part of the survey, bone densitometry was performed on all men and non-pregnant women aged 20 and above. Prevalence estimates for osteoporosis and low bone density were then calculated for persons aged 50 and older using state-specific population estimates extrapolated from 1993 census data. Osteoporosis was defined as bone density values greater than 2.5 standard deviations below a non-Hispanic white female reference group mean aged 20-29 years old; low bone mass (osteopenia) was defined as bone density values between 1 and 2.5 standard deviations below the same mean. A more detailed discussion of the NHANES methodology is found in Appendix B.

The NOF study estimated that a total of 251,300 women in West Virginia suffered from either osteoporosis (69,100) or low bone mass (182,200); among men in the state, 19,700 had osteoporosis and 98,900 had low bone mass.

The table below compares the 1996 and 2002 estimates in terms of age-specific rates per 1,000 population. Perhaps even more vividly than number estimates, the rates indicate how widespread the burden of osteoporosis is among West Virginia's older population and how it continues to increase.

Osteoporosis Prevalence Rates (1996 and2002)
West Virginia Residents Aged 50+

Characteristic	Number (1996)	Rate per 1,000 Population (1996*)	Number (2002)	Rate per 1,000 Population (2002**)
Women with osteoporosis	63,683	210.2	69,100	213.3
Women with low bone mass	119,279	393.7	182,200	562.3
Women with osteoporosis or low bone mass	182,962	604.0	251,300	775.6
Men with osteoporosis	15,878	68.2	19,700	73.8
Men with low bone mass	23,818	102.3	98,900	370.5
Men with osteoporosis or low bone mass	39,696	170.5	118,600	444.3
Total with osteoporosis	79,561	148.5	88,800	150.3
Total with low bone mass	143,097	267.1	281,100	475.7
Total with osteoporosis and low bone mass	222,658	415.6	369,900	620.0

*Rates calculated using 1990 U.S. Census Data. Total Female population: 302,940 Total Male population: 232,791
**Rates calculated using 2000 U.S. Census Data. Total Female population: 324,006 Total Male Population: 266,942

In 2002, 775.6 out of every 1,000 people aged 50 and older, or over three-fourths of all women in this age group, in our state either already had osteoporosis or were at risk due to low bone density, an increase from 604 in 1996. There was a dramatic increase in the prevalence of osteoporosis or low bone mass in men from 267.1 in 1996 to 444.3 in 2002. This results in a total increase from 415.6 per 1000 population in 1996 to 620 per 1000 population in 2002 for the number of men and women with osteoporosis or low bone mass. These are alarming statistics, and the situation will only worsen if nothing is done. By 2020, the NOF predicts that a total of 311,600 women and 154,700 men in the state will have osteoporosis or low bone mass.

MEN AND OSTEOPOROSIS

Many believe osteoporosis is a disease that affects only women however, this is not true. As previously mentioned, 118,600 men age 50 and older currently have osteoporosis or low bone mass in West Virginia. The NOF reports that the occurrence of osteoporosis in men has been greatly underestimated. It was previously thought that one in eight men would suffer an osteoporotic fracture in their lifetime however; new studies report that the risk has risen to one in four men (1). This underestimation could be due to the fact that men have greater bone mass and present with osteoporotic fractures up to ten years later than women (20).

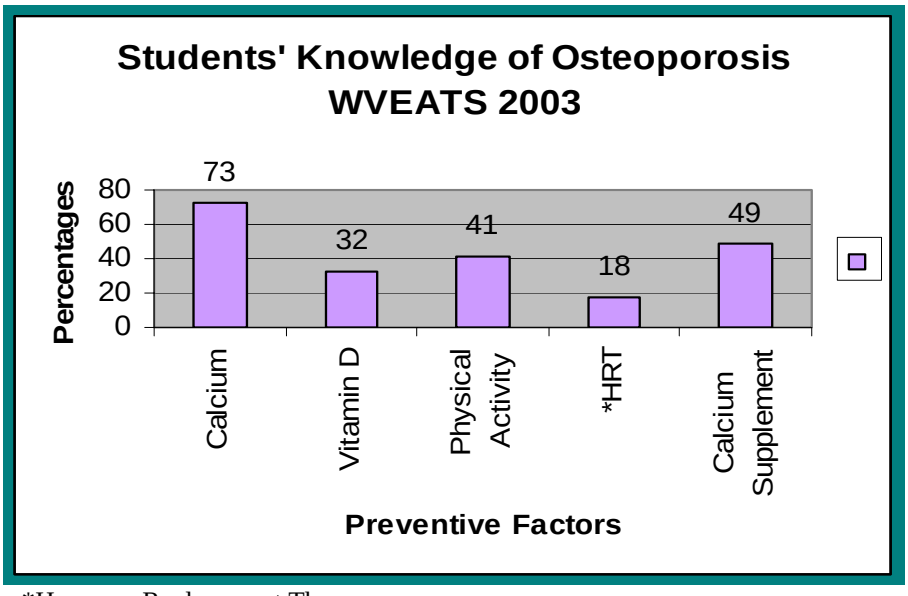
A study done by Kiebzak et al. reported that only 7% of male subjects suffering from a hip fracture were previously diagnosed with osteoporosis and less than 5% were being treated for osteoporosis upon discharge (21). This is alarming due to the fact that nearly 30% of hip fractures occur in males and they are twice as likely to die after a hip fracture (20). These numbers emphasize the importance of the need for increased education and awareness regarding the risk of osteoporosis in men.

Many believe osteoporosis is a disease that affects only women however, this is not true.

CHILDREN AND OSTEOPOROSIS

Contrary to popular belief, osteoporosis is not a disease caused by old age. Many refer to it as "a pediatric disease with geriatric consequences" due to the importance of good bone health, proper diet and regular physical activity in adolescents and teenagers. The NIH states that "sub-optimal bone growth in childhood and adolescence is as important as bone loss to the development of osteoporosis" (14). By the age of twenty, the average young person has developed approximately 98% of his/her bone mass and a diet high in calcium and regular physical activity are major components of them achieving their optimal mass (22). Despite the importance of these two factors few young people meet the recommended requirements.

The West Virginia Eating, Activity, and Teen Survey (WVEATS) found that 11% of males and 9% of females (grades 9-12) did not know what osteoporosis was and 13% of males and 16% of females did not know what affected it. It also found that over half of students that reported drinking milk one or more times per day actually drank less than one serving of milk per day when comparing self-reporting to interview-based questions (23). The following table shows the percentages of students that were aware of preventive factors for osteoporosis.

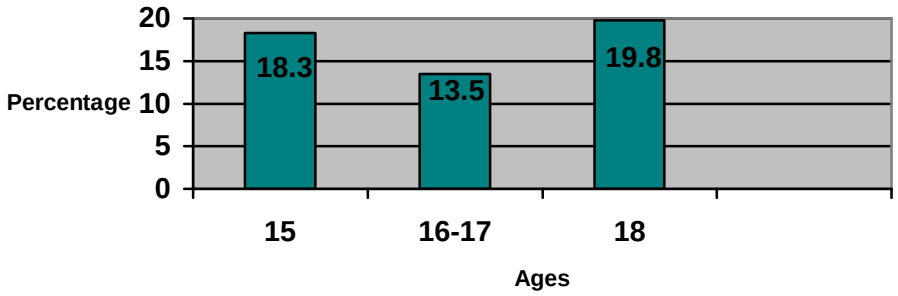


*Hormone Replacement Therapy

The National Dairy Council reports that about 30% of children between the ages of one and five do not get the recommend daily amount of calcium in their diets and that 70% of preteen girls (ages 6-11) and 60% of preteen boys do not meet calcium recommendations. They also state that nearly 9 out of 10 teen girls (12-19) and 7 out of 10 teenage boys do not meet daily calcium recommendations and that on average, teen girls drink twice as much soda as milk (22). The 2001 West Virginia Youth Risk Behavioral Survey (YRBS) reported only 18.3% of West Virginia children age fifteen drank three or more glasses of milk per day. The YRBS also reported that only 24.2% of children age fifteen participated in moderate physical activities for at least 30 minutes on five or more days per week (24).

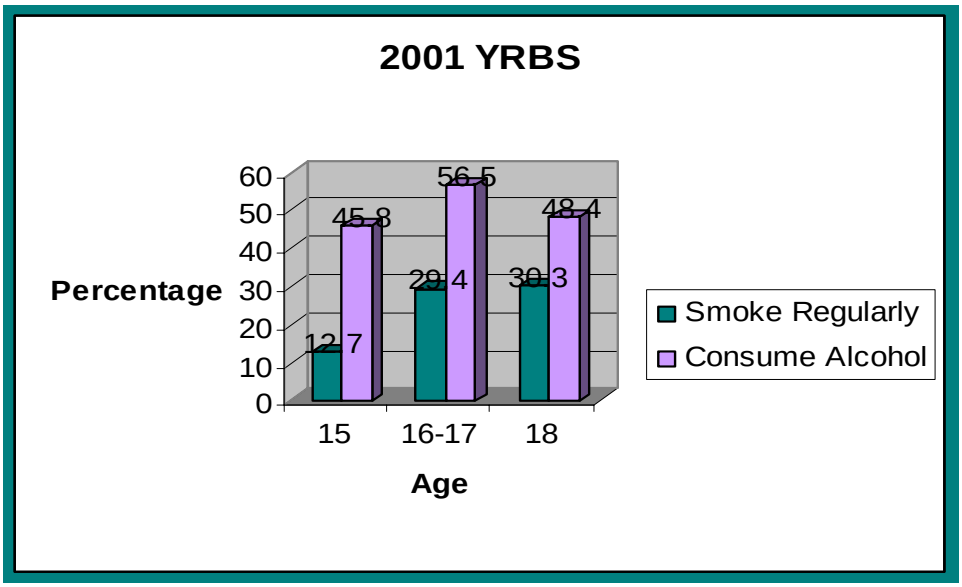
*Moderate physical activity defined as students who exercised or participated in physical activities that did not make them sweat or breathe hard for at least 30 minutes on five days or more of the past seven days.

Percentage of Students Who Drank 3 or More Glasses of Milk Per Day (2001 YRBS)



Cigarette smoking and alcohol consumption also plays an important role in the development of osteoporosis. The 2001 YRBS reports that 12.7% of children age fifteen smoke on a regular basis while 29.4% age 16-17 report doing so. It also states that 45.8% of children age fifteen and 56.5% age 16-17 have had at least one drink of alcohol on one or more of the past thirty days (24). Medical conditions such as anorexia and juvenile arthritis and medications may also affect peak bone mass.

**Regular cigarette smoking defined as smoking at least one cigarette every day for 30 days.



These figures illustrate the importance of educating our youth on beginning the prevention of osteoporosis at an early age. Increased efforts are needed in providing educators with the information necessary to give students the proper tools to ensure a lifetime of strong and healthy bones.

Many refer to osteoporosis as
"a pediatric disease with geriatric consequences"
due to the importance of good bone health, proper diet
and regular physical activity in adolescents and teenagers.

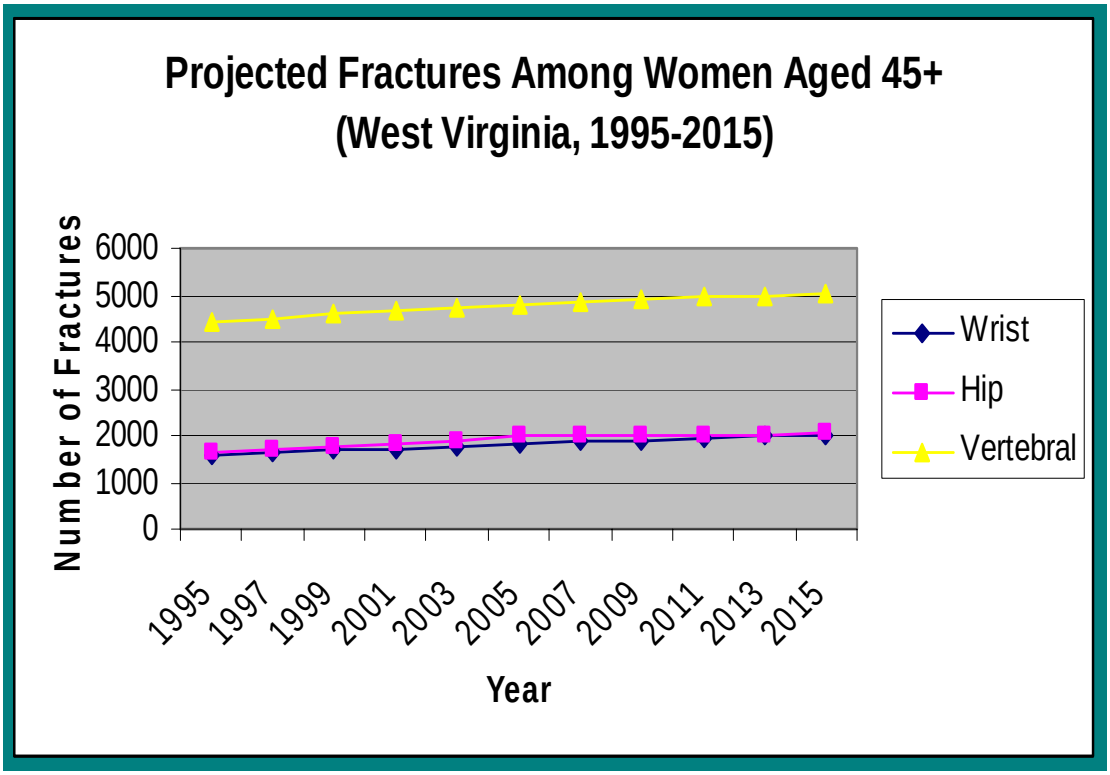
STATE BURDEN OF FRACTURES MODEL

Another method of estimating the extent of osteoporosis and osteopenia in West Virginia is through the use of the state burden of fractures model first presented by Merck and Company at the 1996 annual meeting of the American Society of Bone and Mineral Research (23). This model predicts the number of fractures that will be suffered by women aged 45 and older in each of the 50 states and the District of Columbia annually from 1995 through the year 2015. The model uses 1993 U.S. Census Bureau population data and estimates of fracture risk from (1) an epidemiological study conducted in Rochester, Minnesota, of white women, collected in five-year age groups, and (2) a 5% sampling of Medicare patients compiled between 1986 and 1990 and reported by race and five-year age intervals. A more detailed presentation of the state burden of fractures model methodology is found in Appendix C.

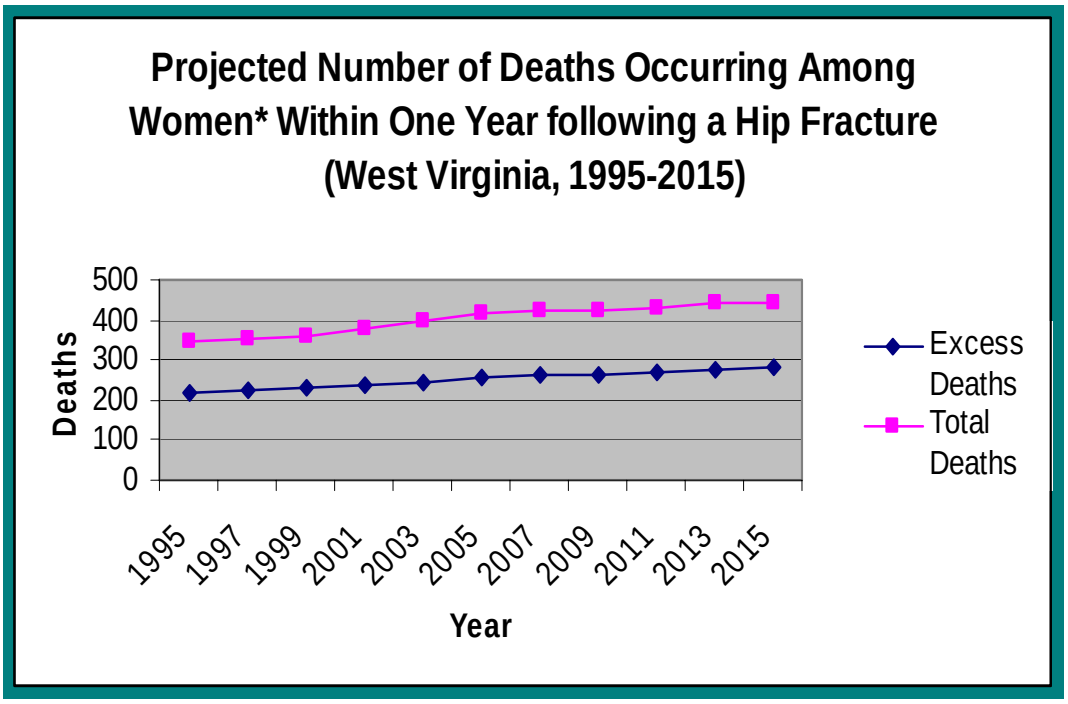
The following projections resulted from applying the model to West Virginia population data:

- The incidence of all fractures will increase by 19% during the twenty-year span.
- More than 41,000 women in the state will experience hip fractures during this period.
- Approximately 38,500 women will suffer a wrist fracture between 1995 and 2015, while nearly 100,000 women will experience vertebral fractures.

The graph below shows the projected number of hip, wrist, and vertebral fractures among women aged 45+ in West Virginia for the years 1995 through 2015.



In addition to predicting the number of hip, wrist, and vertebral fractures, the model estimates hip fracture mortality (i.e., deaths occurring within one year of a hip fracture). The top line on the graph below, labeled "total deaths," represents the total number of women aged 50 and older expected to die within one year of a hip fracture. Since some of these women would have died of other causes during that year, not all the deaths can be attributed to the fracture. The line labeled "excess deaths" represents only those deaths that are directly related to the hip fracture. As depicted on the graph, the model predicts that from 1995-2015 approximately 8,400 West Virginia women aged 50 and older will die within a year following a hip fracture; of these, 5,200 deaths will be attributable to the fracture itself.



Approximately 8,400 West Virginia women aged 50 and older will die within a year following a hip fracture; of these, 5,200 deaths will be attributable to the fracture itself.

OSTEOPOROSIS - RELATED HOSPITALIZATIONS

Hospitalization discharge data provide valuable insight into the burden of osteoporosis in West Virginia. Data from the West Virginia Health Care Authority's (HCA's) database were used to estimate osteoporosis-related hospitalizations among West Virginia residents in 2001. HCA collects inpatient discharge data from all nonfederal licensed hospitals in the state and Medicare data on West Virginia residents hospitalized in out-of-state hospitals, including information on patient age, sex, and length of stay. Discharges are coded according to the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM). This study presents data on hospitalizations of West Virginia residents aged 45 and older with a primary diagnosis of a fracture of the hip, spine, forearm, or other site. The proportion of each fracture category attributed to osteoporosis was determined using a method developed by an expert panel convened by the National Osteoporosis Foundation, the details of which are found in Appendix D.

The table on the following page summarizes 2001 HCA data on the number of discharges, total inpatient charges per discharge, and the average length of stay per discharge by type of fracture. Of the 23,394 hospitalizations due to fractures among persons aged 45+, 65.4% (3,044) were estimated to have been osteoporosis related (73.2% in women and 46.3% in men). The majority (60.3%) of these fractures involved the hip, while 8.2% involved vertebrae, 3.0% the forearm, and 28.3% other sites. Among osteoporotic fractures, women accounted for 78.9% of hip fractures, 73.4% of vertebral fractures, 85.8% of forearm fractures, and 82.1% of other fractures. More than three-fourths of the hospitalizations (85.4%) involved persons aged 65 through 84, with nearly one-third (31.1%) of the patients aged 85 and older.

An estimated $41.5 million was billed in 2001 for hospitalizations due to osteoporotic fractures; this represented 14.9% of total charges for all fractures among persons aged 45+ ($276.9 million). Two-thirds (66.3%) of osteoporosis-related charges were for patients with hip fractures. Eight percent (8.1%) of total osteoporotic charges involved vertebral fractures, 1.5% involved forearm fractures, and 24.0% involved fractures of other sites.

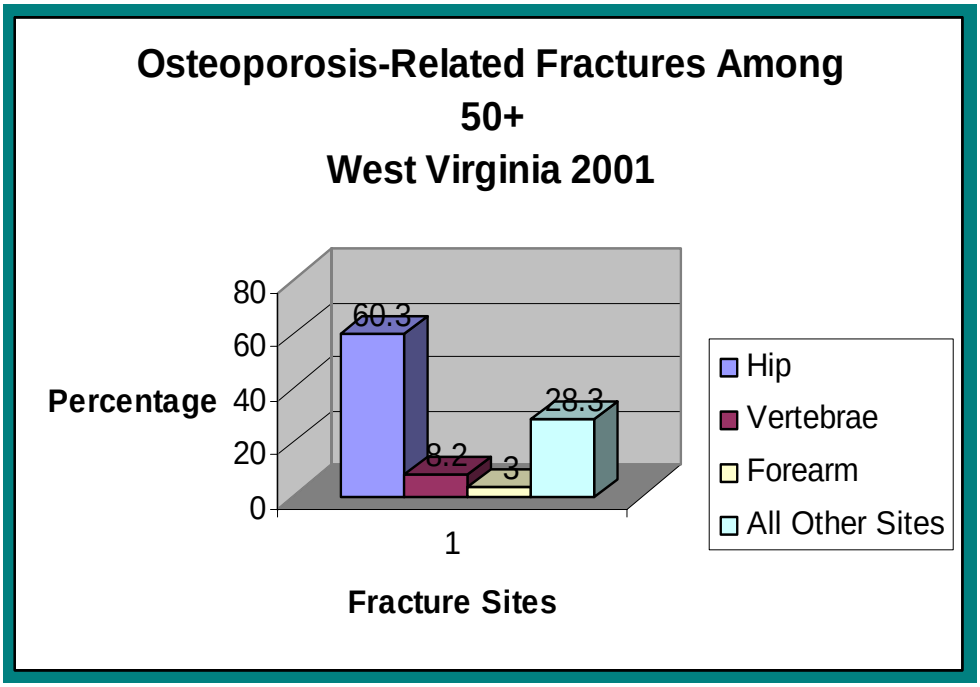
The average length of stay for osteoporotic fractures was 7.1 days for men and 5.8 days for women. Hip fractures required the longest stay for women, an average of 7.4 days while vertebral fractures required the longest stay for men, an average of 9.1 days. Not surprisingly, forearm fractures resulted in the shortest average stays: 4.0 days for men and 4.4 days for women. Men had longer average stays for vertebral fractures, while women had slightly longer stays for forearm fractures.

Estimated Hospitalization Data for Osteoporosis-Attributable Fractures, By Gender and Age West Virginia Residents Aged 45 and Older, 2001

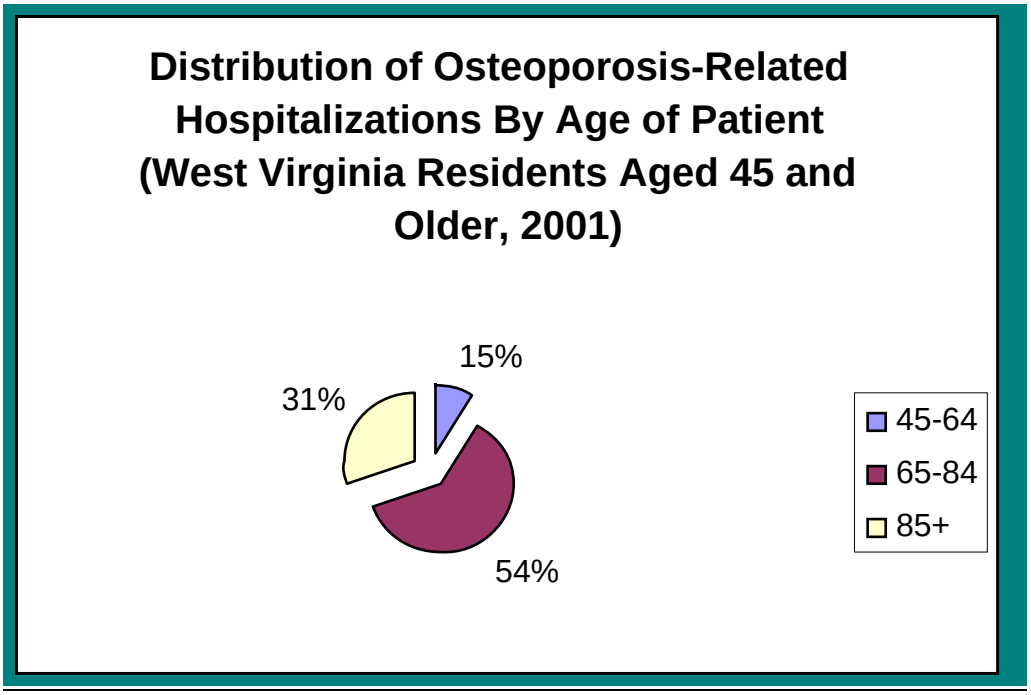
Age	Male			Female		
	Number of Discharges	Total Charges ($)	Average Length of Stay (Days)	Number of Discharges	Total Charges ($)	Average Length of Stay (Days)
Hip (ICD 820)						
45-64	52	838,512.60	6.8	79	1,216,759.20	7.0
65-84	218	3,364,042.40	8.0	809	12,337,418.70	8.3
85+	117	1,792,648.30	7.6	562	7,981,277.80	7.6
Total	387	5,995,203.30	7.5	1450	21,535,455.70	7.4
Vertebral (ICD 805)						
45-64	9	419,658.40	14.4	29	430,679.20	4.9
65-84	47	498,992.40	4.8	103	867,499.20	5.6
85+	11	841,059.00	8.0	53	334,761.00	5.8
Total	67	1,759,709.80	9.1	185	1,632,939.40	5.4
Forearm (ICD 813.4 – 813.5)						
45-64	6	47,857.20	2.2	18	198,594.90	3.8
65-84	5	52,700.80	4.5	42	346,630.90	3.9
85+	2	14,320.80	5.2	19	143,349.60	5.6
Total	13	114,878.80	4.0	79	509,835.40	4.4
All Other Sites (ICD 800-829)						
45-64	65	1,136,852.30	5.2	188	2,413,779.80	4.5
65-84	67	919,833.90	6.8	360	3,994064.00	6.5
85+	22	226,476.50	5.8	161	1,275,114.00	6.3
Total	154	2,283,162.70	5.9	709	7,682,957.80	5.8
TOTAL	621	10,152,954.60	6.6	2423	31,361,188.30	5.8

Estimates derived using National Osteoporosis Foundation Methodology

Overall, women accounted for the overwhelming majority of estimated osteoporotic fracture hospitalizations (92%), while men accounted for approximately 8%. However, the average hospital charge per fracture was lower for women regardless of fracture site. Combining all osteoporotic fractures, the average charge among female patients was $11,560.21; the average charge among male patients was $14,559.37, for a total of $41.5 million. .



*Estimates derived using National Osteoporosis Foundation Methodology



Combining all osteoporotic fractures,
the average charge among female patients was $11,560.21;
the average charge among male patients was $14,559.37,
for a sum total of $41.5 million.

COMPARISON OF OSTEOPOROSIS-RELATED HOSPITALIZATIONS, WV AND US

The report by Ray et al cited previously entitled “Medical Expenditures for the Treatment of Osteoporotic Fractures in the United States in 1995" examined the economic consequences of osteoporosis on the national level (26). The same NOF methodology was used in that report to determine osteoporosis attribution probabilities as was applied in the present study (detailed in Appendix D), allowing a comparison between selected West Virginia and United States osteoporosis-related hospitalization data. Osteoporosis-attributable hip fractures accounted for a higher percentage of total osteoporotic fractures and related hospitalization charges in West Virginia than in the U.S. as a whole, reflecting the state’s older population. For the same reason, women represented a slightly higher proportion of patients with osteoporotic fractures in the state than in the nation. The average length of stay nationally was somewhat longer than that estimated for the state (9.6 days versus 8.9 days). The greatest difference in osteoporosis-related hospitalizations between West Virginia and the United States was the estimated average in-patient charge per hospitalization: $19,873 in the U.S. as a whole, compared to $10,801 in West Virginia. These data are presented on the following page.

SELECTED DATA ON OSTEOPOROSIS-RELATED HOSPITALIZATIONS*
West Virginia (1996) vs. United States (1995)

	West Virginia	United States
Total Number (Est.)	3,944	432,448
% Fractures by Site		
% Hip	60.5%	57.0%
% Vertebral	6.5%	6.8%
% Forearm	2.2%	3.1%
% All Other Sites	30.8%	33.0%
Gender		
Female	80.5%	78.9%
Male	19.5%	21.1%
Average Length of Stay	8.9 days	9.6 days
Total In-Patient Charges	$42,600,000	$8,594,000,000
% In-Patient Charges by Site		
% Hip	66.3%	64.9%
% Vertebral	4.3%	6.7%
% Forearm	1.4%	2.1%
% All Other Sites	28.1%	26.3%

*Estimates derived using National Osteoporosis Foundation methodology.

OSTEOPOROSIS COSTS AND MEDICARE

The costs to Medicare from osteoporosis are enormous. A report by Baron et al published in the *Morbidity and Mortality Weekly Report* analyzed excess costs to Medicare for 10 fracture sites (27). The study examined claims data for a 5% systematic sample (n=1,288,618) of Medicare beneficiaries aged 65 and older. Among those beneficiaries, a total of 26,785 fractures were identified. Costs incurred by each patient were calculated for a six-month period before the fracture, a 12-week period of care following the fracture, and a 40-week follow-up period. Expenses included in-patient hospitalization, physicians' fees, out-patient care facilities, skilled nursing facilities, home health agencies, and hospice care. Excess costs were calculated by comparing costs during the care and follow-up periods to the baseline period before the fracture. The findings showed that excess costs to Medicare ranged from $2564 following a wrist fracture to $15,294 following a hip fracture. For 1992, the total excess cost to Medicare was estimated at $4.2 billion, $2.9 (or 69%) of which was associated with hip fractures. This represented 3% of all Medicare costs for that year.

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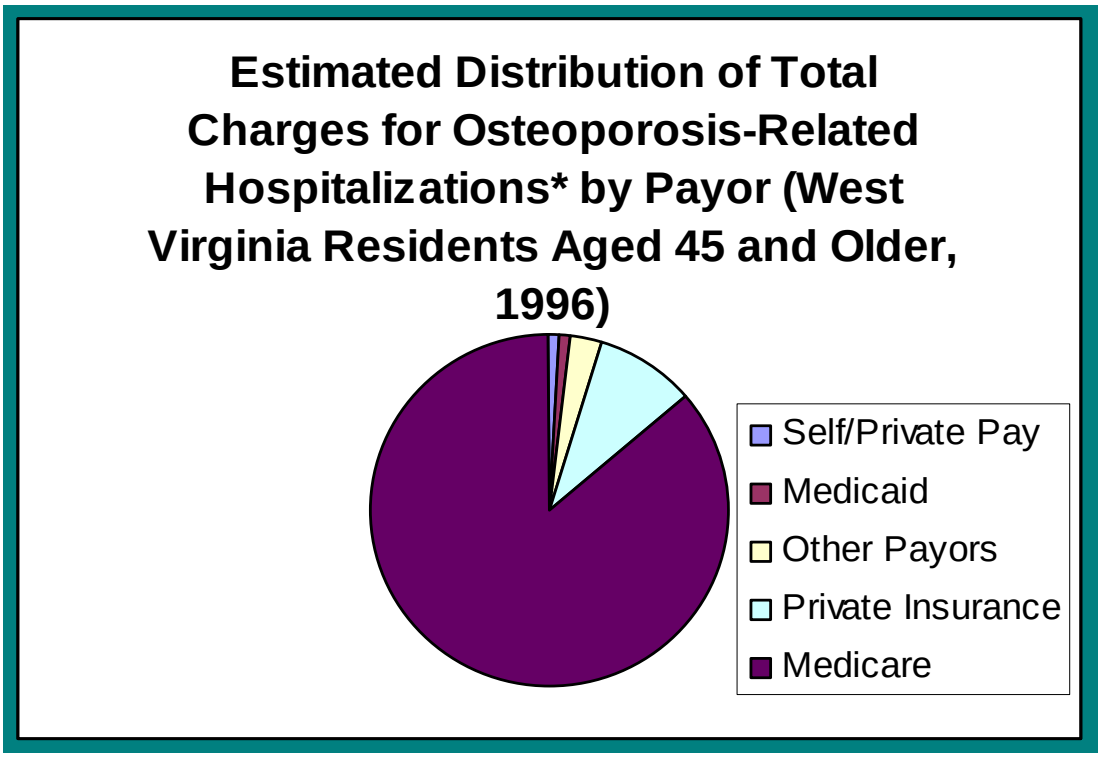
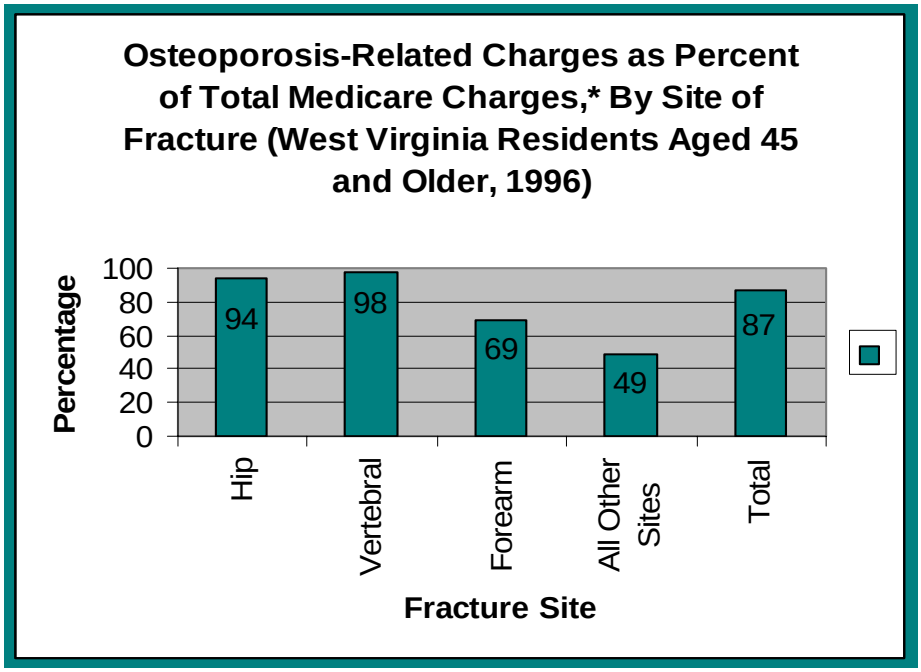
OSTEOPOROSIS-RELATED HOSPITALIZATION CHARGES IN WEST VIRGINIA

Estimated osteoporosis-related hospitalization costs in West Virginia in 1996 exceeded $42 million, nearly two-thirds (65%) of the total $66 million in hospital costs for all fractures among persons aged 45 and older. The bulk of the osteoporotic charges, or approximately 86%, was billed to Medicare, reflecting the age of the majority of osteoporosis sufferers. The pie chart below illustrates the approximate breakdown of charges for osteoporosis-attributable hospitalizations by payor: the remaining charges were billed to private insurance companies (9%), other payors (3%), Medicaid (1%), and self or private pay (1%).



Of the $42 million in osteoporosis-related hospitalization costs in 1996, an estimated $36 million were billed to Medicare. Hip fractures are more likely to occur among persons over the age of 65; therefore, while charges for hip fractures constituted two-thirds (66%) of total hospitalization charges, they represented nearly three-fourths (73%) of Medicare billings for osteoporotic fractures. The graph on the following page shows the osteoporosis-related percentage of Medicare charges for each type of fracture.



Approximately $47 million was billed to Medicare in 1996 for hospitalizations due to fractures among persons aged 45 and older. Of this, nearly $37 million (79%) was estimated to be osteoporosis related. As shown above, almost all (98%) of Medicare charges for vertebral fracture hospitalizations were attributable to osteoporosis, as were 94% of hip fracture charges, 69% of forearm fracture charges, and 49% of charges for other fractures. As the incidence of osteoporosis increases, so will the burden on the already stressed Medicare system.

It is vital to emphasize modification of the behaviors that lead to an increased risk of osteopenia and osteoporosis, as well as to improve interventions for fracture prevention. The disturbing projections given earlier in this report underscore the fact that the physical suffering, disability, tremendous health care costs, functional impairment, and mortality that result from osteoporosis will continue to increase steadily if action is not taken now to address the problem.

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

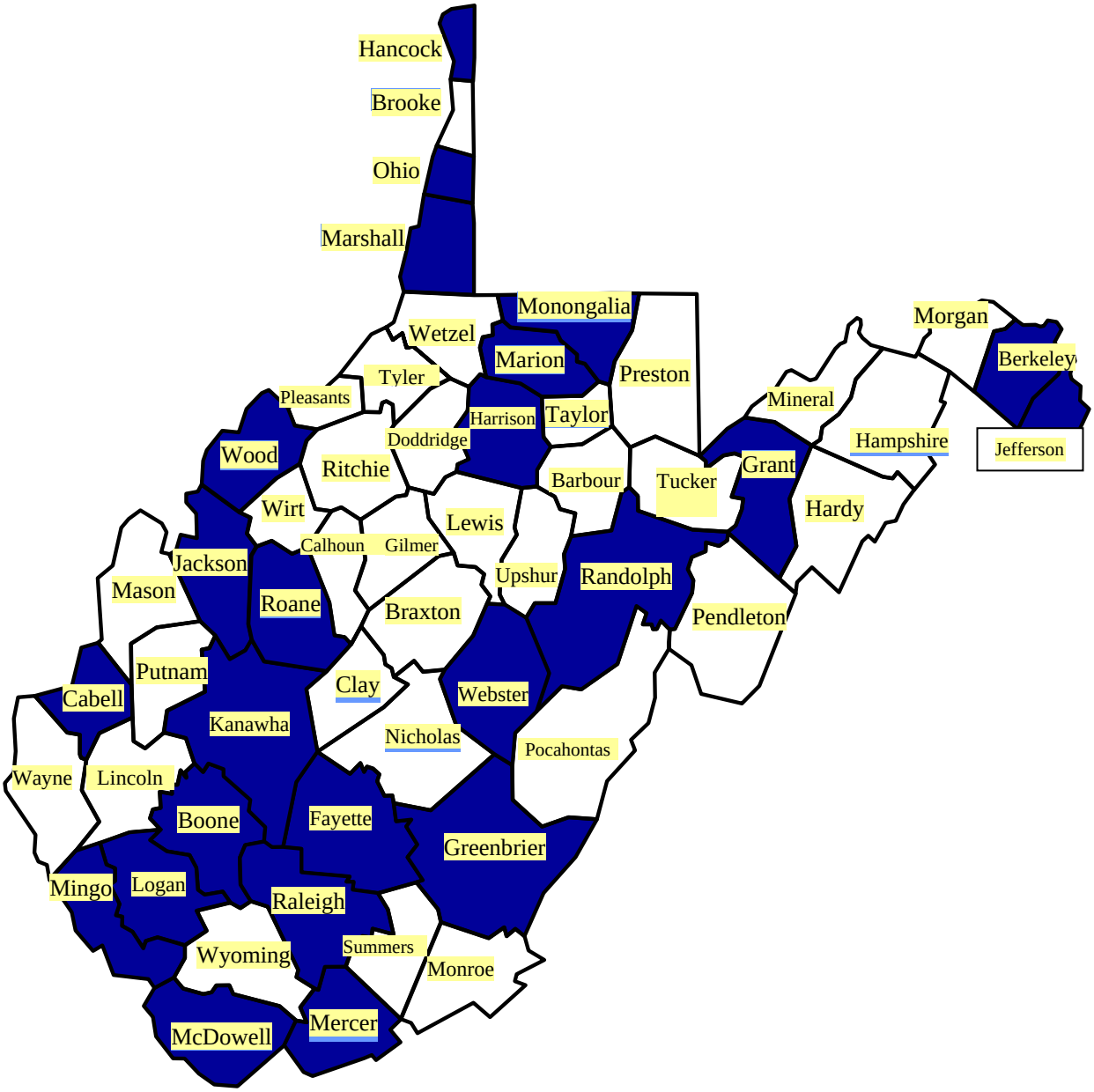
*Probability can range from 0.00 (no attribution) to 1.00 (100% attribution).
**Validity scores can range from 1 (±5% error) to 4 (more than ±20% error).

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.

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