

Osteoporosis: Beyond Bone Mineral Density

A special report on the state of osteoporosis research

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for



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Osteoporosis History

Osteoporosis was first defined in 1940 as a disease of low bone mineral density (BMD). This definition was based on research conducted by Fuller Albright at Massachusetts General Hospital. Dr. Albright took pigeons, removed their ovaries, and noticed that their bones lost density and became weaker. In 1994 the World Health Organization codified this paradigm by creating the official diagnosis of osteoporosis as having low bone mineral density as defined by a “T” score. A T-score is a number of standard deviations from peak bone mass of healthy women aged 20-29. A T-score of -2.5 or less was diagnostic of osteoporosis, while a T-score of -1 to -2.5 is diagnostic of osteopenia.

Q: How accurate is a bone density test at predicting fractures?

A: Not very accurate at all. It only predicts 44% of women who will fracture and 21% of men.

However, the most dangerous aspect of osteoporosis is not a T-score (a number on a test). **The most dangerous thing about osteoporosis is breaking a bone.** If you have osteoporosis and fracture a hip, there is a 20% chance of dying within the year. After a hip fracture only 50% of people regain the same level of independence they had before the injury.¹ And of those who survive the first year, 20% require nursing home care.²

BREAK A HIP WITH OSTEOPOROSIS AND YOU HAVE A 20% CHANCE OF DYING WITHIN THE YEAR, AND A 20% CHANCE OF ENDING UP IN NURSING HOME CARE WITH CHRONIC PAIN.

Thus, a bone density test is only as useful as it can predict whether you will get a fracture. The problem is that since the mid-1990s, research shows that that a bone density test predicts less than half of all people who will fracture. In fact, it only predicts 44% of women and 21% of men who will fracture a bone. Every major healthcare organization that has published position

statements on osteoporosis, including the American College of Obstetricians and Gynecologists (ACOG) and the World Health Organization have concluded that fracture risk depends primarily on factors other than bone density.

This osteoporosis report provides you with the tools you need to take better care of yourself and to help you make the best choices for your healthcare. In it you will learn how through diet, lifestyle and dietary supplements global research has shown that you can reduce your fracture risk up to 87%. You also will learn both the potential benefits and risk of osteoporosis medications, and how your current medications, lifestyle and diet may actually be causing your disease.

How Common are Osteoporosis and Fractures

Since it was first defined, osteoporosis has been recognized as a major health concern in the United States and globally. By 2004, more than 10 million people in the U.S. had been diagnosed with osteoporosis,³ a number that is projected to increase to 14 million diagnosed cases by 2020.⁴ It's currently estimated that more than 39 million Americans have osteoporosis or pre-osteoporosis (osteopenia).⁵ In 2005 alone, there were more than 2 million osteoporotic fractures treated at a cost of \$16.9 billion.⁴

Debilitating pain in the elderly is often attributed to fractures from osteoporosis, and can lead to further disability and early death.^{6,7} It's estimated that 40% of women 50 years or older will suffer a hip fracture.⁸

THOSE WHO SURVIVE THE FIRST YEAR HAVE A 20% CHANCE OF ENDING UP IN NURSING HOME CARE WITH CHRONIC PAIN.

Risk Factors for Osteoporosis and Fractures

Osteoporosis is a common disease and there are many risk factors for osteoporosis and osteoporotic fractures. Other diseases and medications cause osteoporosis (see Table 1 and Table 2). Although much research, and billions of dollars, has been spent over the last 30 years to elucidate the role genetics plays in the development of diseases, no causative link has been made between genetics and osteoporosis.

Diet, lifestyle, comorbidities (other diseases a person has), and medications all seem to play a more important role than genetics in determining someone's osteoporosis risk. And the nice thing is that people can change the majority of the most important risk factors. As such, they are called "**modifiable risk factors.**" In the next section, Decreasing Risk Factors for Osteoporosis and Fractures, we help you understand how you can modify your risk factors to stack the deck in your favor, improve your bone health and decrease fracture risk.

Table 1. Drugs that Cause Osteoporosis and Fractures (Partial List)

Drugs
Acid-blocking medications (Prilosec, Protonix, Zantac)
Aluminum-containing antacids
Anticonvulsants (phenytoin, phernobarbital)
Immunosuppressants
Lithium
Prednisone
Tamoxifen (pre-menopausal use)

Table 2. Diseases that Cause Osteoporosis (Partial List)

Disease
AIDS or HIV
COPD
Cushing's Disease
Eating Disorders (anorexia)
Female athlete triad (disordered eating, amenorrhea, osteoporosis)
Gastrectomy
Hypogonadism (primary and secondary)

**ACID-BLOCKING DRUGS (PROTONIX, PRILOSEC, ZANTAC)
INCREASE THE RISK OF HIP FRACTURES NEARLY 60%.**

Oral prednisone taken for 6 months or longer increases fractures up to 200%.⁹

While that risk has been known for more than a dozen years, the risk from acid-blocking medications is more recent. A 2006 study published in the *Journal of the American Medical Association* concluded that acid-blocking medications, which include Prilosec, Protonix, Aciphex, and Zantac, increase the risk of hip fractures by nearly 60% after four years.¹⁰ **Acid-blocking medications were never approved by the FDA for longer than two weeks of use. Nevertheless, doctors are prescribing them in record numbers and people are taking them indefinitely with deadly consequences.**

Decreasing Risk Factors for Osteoporosis and Fractures

Medications

Medications are used to prevent and treat osteoporosis. The most commonly prescribed medications are the bisphosphonate category of

FOSAMAX AND ACTONEL DO NOT REDUCE HIP FRACTURE RISK IN PEOPLE WITHOUT PREVIOUS HIP FRACTURES.

drugs. They are available as oral and intravenous formulations. Oral bisphosphonates include Actonel (risedronate), Didronel (etidronate), Skelid (tiludronate), Fosamax (alendronate) and Boniva (ibandronate). In 2006 Fosamax was the most widely prescribed oral bisphosphonate, generating \$2 billion in sales in the United States alone.¹¹ The most potent bisphosphonates are delivered intravenously and include Aredia (pamidronate) and Zometa (Reclast, zoledronate). Other lesser prescribed medications include Forteo (recombinant parathyroid hormone), Evista (raloxifene) and Prolia (Denosumab).

While these medications do build bone density, the question that should always be asked is how effective are they at reducing fractures? The bisphosphonate medications appear to reduce vertebral fractures an average of about 49%. However, while vertebral fractures may cause pain they don't kill you like a hip fracture will. Unfortunately, the medications are even less effective at reducing hip fractures. A series of 2008 articles that reviewed the published studies that included more than 27,000 patients concluded that **taking alendronate (Fosamax) risedronate (Actonel) or etidronate (Didronel) does not reduce hip fracture risk in people who had not previously suffered a hip fracture.**¹²⁻¹⁴ And in the cases of Actonel and Didronel, they did not prevent a first vertebral fracture either.^{13,14}

FOSAMAX, ACTONEL AND BONIVA INCREASE FRACTURE RISK AND OSTEONECROSIS OF THE JAW (ONJ)

The other concern with the bisphosphonate medications is their side effects. Paradoxically, these medications actually increase the risk of fracture after as little as just three years of taking them.^{15,16} They also cause osteonecrosis of the

jaw (ONJ), which is where the jaw bones literally just start to disintegrate with something as seemingly innocuous as getting a tooth pulled. Bisphosphonate-related ONJ (BRONJ) used to be considered quite rare. However, a 2008 study concluded that 8% of patients taking oral bisphosphonates (Fosamax, Actonel, Boniva) could be at risk for BRONJ, nearly double what had previously been estimated.¹⁷

Parathyroid hormone (Forteo) provides the best fracture reduction (65-69% vertebral fracture reduction), but is unfortunately only available as an injection.¹⁸

Diet

Diet provides the raw materials for our bodies to function. Drs. Neustadt and Pieczenik wrote extensively about this in their book, *A Revolution in Health Through Nutritional Biochemistry*. A Mediterranean dietary pattern, which is rich in whole foods, including vegetables, fruits and legumes; rich in lean proteins such as fish and chicken; and low in processed packaged foods and red meats has been associated with maintaining bone density and preventing osteoporosis.¹⁹

Exercise

Studies have confirmed the beneficial effects of exercise on bone health. Weight-bearing exercise causes muscles and bones to work against gravity and stimulates bone production. Exercise can increase muscle

FEMALE ATHLETE TRIAD: DISORDERED EATING, AMENORRHEA (LOSS OF A GIRL'S PERIOD), AND OSTEOPOROSIS CAUSED BY TRAINING AND COMPETING IN MARATHONS, TRIATHLONS, BIKE-A-THONS

mass, strength, and balance, thereby decreasing the risk for falling and suffering an osteoporotic fracture. Muscle strengthening and balance exercises (eg, Chi Gong) have been shown to decrease risk for fall and fall-related injuries by 75% among women aged 75 years and older. In another study, one year of weight-bearing exercise training in community-living women (ages 66 to 87 years) improved hip bone mineral density by 8.4% compared to controls.

One of the big myths with osteoporosis is that people believe the more you exercise the better it is. The fact is that there is a diminishing return on exercise, and you can get too much exercise.

Competitive athletes are actually at increased risk for osteoporosis. In women this is called the “Female athlete triad.” What happens is they exercise so frequently and vigorously that their percent body fat drops too low, they stop menstruating and they start losing bone. Many also have eating disorders which compounds the problems.

Research shows that even moderate exercise can build stronger bones and significantly lower your risk for fractures. In one study, one year of weight-bearing exercise training in community-living women (ages 66 to 87 years) improved triangle BMD by 8.4% compared to controls.²⁰

Environment

One of the most important risk factors for a fracture is falling. Reducing falls is an important strategy in decreasing fracture risk. This includes ensuring that loose steps are fixed, throw rugs that people can trip over are removed and pathways through walkways are cleared of furniture people can trip over.

Dietary Supplements

Many companies produce dietary supplements for bone health. Many people buy calcium and other bone health supplements thinking that they might promote bone growth or reduce osteoporosis risk. By definition, dietary supplements are not approved by the FDA to diagnose, treat or prevent a disease; however, manufacturers of some dietary supplements can make certain claims, as approved by the FDA. For example, labels for calcium supplements can state that calcium “reduces osteoporosis risk.”

Other ingredients you might find are boron, strontium, magnesium, soy isoflavones, vitamin K2 (as MK4TM or MK7), horsetail (*Equisetum arvense*) and omega-3 fatty acids. So what’s the evidence for their effectiveness in promoting bone health?

Calcium and Vitamin D

**CALCIUM AND VITAMIN D3 ONLY
DECREASE FRACTURES ABOUT 16%.
ADDING MK4 DECREASED FRACTURES
87% IN CLINICAL TRIALS**

When most people think about a dietary supplement for bone health and bone building they automatically think of calcium and vitamin D. The FDA has approved calcium and vitamin D to

“reduce osteoporosis risk.”

But does calcium reduce fractures? Several studies have looked at this question with mixed results. In one study of 5292 volunteers, 85% female, different doses of calcium were administered to see if they could reduce the risk of a subsequent fracture once the participants had already had a fracture.²¹ No fracture reducing benefit with calcium was found in this study.

However, another study noted a modest 16% reduction in fracture risk over 3 years in 2532 community-dwelling residents (average age, 73 years; 59.8% female) who supplemented with 400 IU vitamin D3 and 1000 mg calcium as calcium carbonate daily.²²

The bottom line for these research studies is that calcium supplements and vitamin D3 may reduce fractures by about 16%.

Vitamin K2 (MK4 and MK7)

MK4 and MK7 are two types of vitamin K2 that are commercially available in dietary supplements. However, MK7 has never been shown to reduce fractures. In contrast MK4 has

**MK7 HAS NEVER BEEN SHOWN TO REDUCE
FRACTURES IN CLINICAL TRIALS.
MULTIPLE CLINICAL TRIALS CONCLUDED
MK4 REDUCES FRACTURES UP TO 87%.**

been shown to decrease fractures, and has even been approved by the Ministry of Health in Japan since 1995.²³ Multiple clinical trials using 45 mg per day of MK4 show that this amount, and only this amount, of MK4 taken daily may decrease fractures by 87% independent of the number of falls experienced by volunteers.²⁴⁻²⁶ Even at extremely high doses in humans of 135 mg/day of MK4, and 250 mg/kg body weight per day in rats showed that MK4 does not increase the risk for blood clots.^{27,28} As documented in published studies, more than 6000 patients in Japan have

taken MK4 for up to six years without any dangerous side effects reported. MK4 is understood to be safe and effective at promoting bone health and building strong bones when 45 mg/day are taken with calcium and vitamin D.

In clinical trials MK4 (45 mg daily) prevented bone loss and/or fractures caused by corticosteroids (eg, prednisone, dexamethasone, prednisolone),²⁹⁻³³ anorexia nervosa,³⁴ cirrhosis of the liver,³⁵ postmenopausal osteoporosis,^{23,25-27,36,37} disuse from stroke,³⁸ Alzheimer's disease,²⁴ Parkinson's disease,³⁹ primary biliary cirrhosis,⁴⁰ and leuprolide treatment (for prostate cancer).⁴¹ Pathological fractures are a serious problem resulting from skeletal unloading in handicapped children. Sugiyama et al⁴² published a case report of an institutionalized, bedridden 8-year-old girl with Arnold-Chiari deformity with low BMD whose BMD increased with MK4 treatment. MK4 also inhibited phenytoin-induced bone loss in rats;⁴³ prevented and increased bone formation in neurectomized rats,^{44,45} an animal model for immobilization osteoporosis; prevented and increased bone formation in orchidectomized rats,⁴⁵ an animal model for secondary osteoporosis caused by testosterone deficiency; and improved healing time and bone quality in experimentally induced osteotomy in rats alone and in the presence of glucocorticoids.⁴⁶ MK4 therapy also has been cited⁴³ as a potential strategy for drug-induced bone loss.

Boron

Boron, a trace mineral needed in only tiny amounts, was first discovered in 1910 as being required for plant development and health. In 1985 researchers discovered that humans also require boron. Some foods are good sources of boron, including pears, prunes, apples, raisins, and tomatoes. Studies have shown that 3 milligrams (mg) of boron daily reduces urinary excretion of calcium and magnesium, especially when dietary magnesium is low. Boron supplementation elevates the serum concentrations of 17 beta estradiol and testosterone, again only when dietary magnesium is low. This suggests that boron may promote bone health. However, there is no evidence that boron in bone health supplements improves bone mineral density, decreases bone loss or decreases fractures.

Strontium

Several rigorous clinical trials have evaluated strontium for its bone building effects. Strontium ranelate (SR) is a form of strontium salt from ranelic acid patented by a French company. SR is the only form of strontium that has ever been studied in clinical trials, and is not available in the US. Strontium citrate is the form of strontium available in osteoporosis supplements in the US and has never been studied in clinical trials for its bone building effects.

SR is approved for osteoporosis treatment in most of Europe but not in the US. Studies in rats concluded that SR does have an affinity for bone, decreases bone loss and can build bones.⁴⁷ A laboratory study determined that SR can promote osteoblast production.⁴⁸ Clinical trials in have shown that taking 500-2000 mg per day of SR can decrease vertebral fractures by 23% to 49%, as well as increase bone mineral density.^{49,50}

STRONTIUM MAY INTERFERE WITH CALCIUM ABSORPTION AND GIVES FALSE BONE DENSITY SCAN RESULTS.

People may want to think twice before taking strontium for several reasons. First, strontium is not approved by the US FDA. Second, strontium is heavier than calcium. As such X-rays from a bone density scan bounce off the strontium to a greater degree than calcium, and change what's called the "refractive index."⁴⁹ Unless the radiologist understands this and uses a mathematical calculation to correct for this, the bone density scan will be inaccurate.⁴⁹ Since radiologists are not taught this in medical school or residency, even if you tell them that you are taking strontium most probably the radiologist will have no idea how to correct for it and provide an accurate result.

Magnesium

Magnesium may play a role in promoting bone health. However, only one small clinical trial, conducted in 1993, has been published

MAGNESIUM HAS NEVER BEEN SHOWN TO REDUCE FRACTURES.

on the effectiveness of magnesium for building bone.⁵¹ This study concluded that taking a few hundred milligrams daily of magnesium (as magnesium hydroxide, one of the least absorbable forms of magnesium) may increase bone mineral density by one to eight percent. This evidence

is quite weak. While about 56% of adults do not consume even the minimum recommended daily allowance of magnesium,⁵² a good multiple vitamin should contain at least 100 mg of magnesium as an amino acid chelate, the most absorbable form of magnesium. Additionally, food rich in magnesium includes bran cereal, shredded wheat, brown rice, almonds (also an excellent source of calcium) and Swiss chard. So following a healthy eating plan and taking a high quality multiple vitamin should provide all the magnesium you need.

**MAGNESIUM WAS NOT REQUIRED FOR THE 87%
FRACTURE REDUCTION SHOWN WITH MK4.**

Soy Isoflavones

Soy isoflavones refers to multiple naturally-occurring chemicals called phytoestrogens. As the name implies, these molecules have estrogenic activity. Since estrogen supplementation has been approved by the FDA as an osteoporosis treatment approach, soy isoflavones have been studied for their bone building effects. Observational studies and clinical trials have not shown any consistent evidence that soy isoflavones can build stronger bones.

Horsetail (*Equisetum arvense*)

Occasionally you may encounter horsetail (*Equisetum arvense*) in bone health supplements. This botanical is high in silicon and believed by some to promote bone health. However, there are no clinical trials showing that horsetail improves bone mineral density or decreases fractures.

Omega-3 Fatty Acids

Omega-3 fatty acids are polyunsaturated fatty acids that have anti-inflammatory actions and lots of research showing cardiovascular disease benefits. In fact, the American Heart Association (AHA) now recommends people consume 2000 mg daily of combined EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) for heart health. There are some bone building supplements that contain omega-3 fatty acids, but in much lower doses than those recommended for heart health. However, while theoretically plausible, there are no studies showing that omega-3 fatty acids build bone or reduce fractures.

Osteoporosis: Myths and Facts

1. **Myth:** The most important thing about osteoporosis is what my bone density scan result shows.

Fact: The most important thing about this disease is not what a number on a test shows, but rather how accurately it predicts fracture risk. **Fractures are the most dangerous aspect of osteoporosis and the only thing healthcare providers should be trying to predict or prevent.**

2. **Myth:** A bone density test accurately predicts my fracture risk.

Fact: A bone density test only predicts 44% of women and 21% of men who will fracture.

3. **Myth:** Calcium and vitamin D are enough to protect my bone.

Fact: Calcium and vitamin D only reduce fractures about 16%.

4. **Myth:** Osteoporosis is just a disease of the elderly.

Fact: Osteoporosis can occur at any age, and is caused by many diseases. With the increase in aging baby boomers osteoporosis is increasing to the level of a national health emergency. But since many diseases cause osteoporosis, including Celiac disease and anorexia, osteoporosis can occur at any age.

5. **Myth:** Men don't get osteoporosis.

Fact: About 1 of every 5 of osteoporosis patients is a man. Osteoporosis due to

secondary risk factors is evidenced at roughly 50 to 60 years of age, while primary osteoporosis occurs after about the age of 70.

**ONE OF EVERY FIVE (20%)
OSTEOPOROSIS PATIENTS IS MALE.**

6. **Myth:** Fosamax and Actonel protect against a first hip fracture and reduce overall fracture risk.

Fact: Fosamax and Actonel do not prevent a first hip fracture and actually increase fracture risk after three years of taking them.

**BISPHOSPHONATE MEDICATIONS (FOSAMAX, ACTONEL, BONIVA) INCREASE
FRACTURE RISK AFTER TAKING THEM FOR THREE YEARS.**

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