



Understanding How Nutrition Affects Bone Health

Osteoporosis and low bone mass are major health problems affecting over 44 million Americans, primarily women. Osteoporosis is characterized by a thinning of the bones in the skeleton that leads to an increased risk for fractures of the hip, spine and wrist which can occur with little or no trauma. This bone thinning disease is a silent epidemic that affects individuals across all racial and ethnic groups. However, osteoporosis should not be considered an inevitable consequence of aging. Nutrition is emerging as a way to help optimize bone health, no matter what our age. This pamphlet is designed to help you understand how nutrition (in particular calcium, vitamin D and protein) affects bone health.

Calcium

There is little doubt that calcium (be it from food or supplemental sources) is a critical nutrient for bone health. During adolescence and adulthood, overwhelming scientific evidence indicates that the amount of calcium in our diet does, indeed, make a difference in our bones. Between the ages of 9 and 11, a great deal of bone building occurs. During this time, adequate calcium nutrition is critical. Consuming enough dietary calcium during the first 2 to 3 decades of life will help maximize our peak bone mass (PBM). PBM is the highest bone mass (or the thickest bones) one will have during his or her lifetime. For most individuals, PBM is reached in early adulthood. The higher our PBM, the more bone we have to 'spend' during later adulthood, thus protecting us from osteoporotic fractures. In this way, PBM is like money in the bank from which we make withdrawals later in life.

It is never too late for dietary calcium to improve bone health. Studies conducted in middle and late adulthood have clearly shown that adequate dietary calcium will help slow the bone loss that occurs with aging. By itself, dietary calcium is not a cure for bone loss, because bone loss is not entirely due to a calcium deficiency. Yet, calcium is clearly of vital importance when it comes to maintaining bone.

How much calcium is enough?

The current Recommended Dietary Allowance for calcium is 1,000 mg for adults between 19 and 50 years of age. This increases to 1,200 mg for those over 50 years. How do we know how much calcium is in our diet? Here is a simple yet relatively accurate method. Each serving of a dairy food averages about 300 mg of calcium. A serving

of dairy is equal to a cup of milk (regardless of the type), or yogurt, or 1.5 oz. of cheese. Calcium fortified soy products and fruit juices are excellent sources of calcium and also contain about 300 mg of calcium per serving. In addition, a balanced diet provides roughly 200 mg of calcium. Therefore, in order to reach 1200 mg of calcium a day, one would need to consume a healthy diet with at least 3 servings of calcium rich foods. If dairy products and calcium fortified products are not part of your diet, then calcium supplements should be considered. Most calcium supplements are well absorbed if taken with meals. Calcium citrate may be somewhat better than calcium carbonate but is generally more expensive. For reasons of cost, we generally recommend calcium carbonate preparations.

Vitamin D is also essential

Vitamin D is needed for the absorption of calcium, and it also plays a major role in bone metabolism. Without vitamin D, we absorb less calcium, and the result is soft, poorly mineralized bones leading to an increased risk of fractures, particularly hip fractures. Vitamin D is both a hormone and a nutrient; it can be derived from compounds found in the skin upon exposure to sunlight or it can be obtained through our diet. In general, we need about 15 minutes of sunlight exposure to our hands and face a few times a week to meet vitamin D requirements. For those who have limited sun exposure, the main dietary source of vitamin D is fortified milk. Surprisingly, other dairy products (cheese, ice cream, yogurt) are low in vitamin D. For those who limit sun exposure and don't drink milk, vitamin D supplements should be used. For adults, the current recommendations are a total daily vitamin D intake of 400-600 IU (international units) per day.

The forgotten nutrient: Protein

Based on recent clinical studies, our research team has found that dietary protein is a very important regulator of calcium metabolism. In the long run, dietary protein is important for bone health.

Since 1920, scientists have known that high-protein diets increase urinary calcium. The source of the extra urine calcium was thought to be bone. It has been widely suggested that a high-protein diet generates an acid load that leaches calcium from bone. Most scientists assumed that a high protein diet was harmful to bone and that a lower protein diet would be beneficial. Despite years of research, there is very little direct scientific evidence that a high protein diet is harmful to bone. The question "How does protein affect bone?" is controversial in the medical field and very confusing to the consumer.

In search of the source of the high urine calcium observed during a high protein diet, our research team has conducted several nutrition studies providing diets containing various levels of protein to healthy women.

We found the reason that urinary calcium increases during a high protein diet was not because calcium was coming from bone, as most scientists hypothesized. Rather the urinary calcium was elevated because the intestinal tract was absorbing more calcium. For example, in 20 healthy women consuming a low protein diet, urinary calcium averaged 137 mg per day (relatively low) and their intestinal calcium absorption was only 18% (very low). When these same women consumed the high

protein diet, their urine calcium significantly increased to 214 mg per day (a high value) primarily because their intestinal calcium absorption also significantly increased to 26% (quite a surprise). We now know the intestinal tract is mediating the effect of dietary protein on urinary calcium.

The inevitable question: So what?

The change in intestinal calcium absorption in response to dietary protein may not make the headlines of the *New York Times*, but it may mean that a low protein diet is not healthy for your skeleton. We found that in short term studies, the body acted as if it were trying to compensate for the poor calcium absorption by changing body hormones in a way that might be harmful to bone. The low protein diet caused levels of certain hormones to rise which act to stimulate bone breakdown. The body does this to compensate for the calcium it was not getting from the diet. If these changes are chronic, that would mean a low protein diet might be harmful to bone because it increases bone breakdown.

What happens long term?

While the studies above are short term, the most important question is: What happens to calcium and bone metabolism when dietary protein is chronically low? To answer this question, we have turned to large population studies where people’s diets and bone health are carefully characterized. With very few exceptions, these studies show that the lowest bone mineral density is seen in those groups consuming the lowest protein diets. As protein in the diet increases, so does bone mineral density. Therefore, both our experimental and population studies agree: A low protein diet appears to be detrimental to bone.

How much protein is enough?

Our studies show that a diet moderate in protein helps us absorb calcium. Does ‘moderation’ sound familiar? By moderate we mean approximately 0.45 - 0.68 grams of protein per pound of body weight. So, an adult weighing 150 pounds could consume 68-100 grams of protein safely. Lower protein intakes may impair calcium absorption. Estimating protein intake from our diet is not difficult by using the table below:

Food	Quantity	Grams of Protein
Meat *	1 oz	7
Egg	1 each	7
Milk	1 cup	8
Starch **	1/2 cup	3
Fruits & fruit juices		0

* = fish, meat, poultry

** = rice, pasta, bread etc

Got soy?

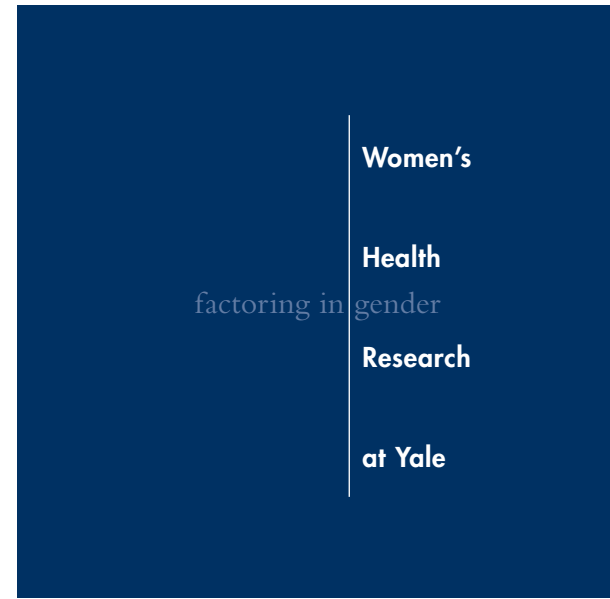
The experimental diets that we use in our studies contain a mix of animal and plant proteins, typical of what many Americans consume. What happens when we use soy foods as our source of protein? To answer this question, we repeated our studies and replaced all meat and animal protein with soy. Surprisingly, the low soy protein diet seemed to interfere with intestinal calcium absorption to an even greater extent than did the low mixed source protein diet. Should this be confirmed in ongoing studies, we may need to include additional calcium in our diet when we consume soy foods.

Soy beans as they grow out of the ground are relatively low in calcium. It is during the processing that additional calcium may or may not be added. Please be sure that you read the label on soy food before you purchase it to be sure it has been fortified with calcium.

Summary

- Nutrition plays a very important role in skeletal health.
- The skeleton is a complex organ system and the effects of either a “bone-healthy” or “bone-bad” diet may not be seen for many years.
- Conducting well designed studies to evaluate how a nutrient affects bone remains a challenge, which is why we still have so much to learn.
- We know that obtaining adequate calcium and vitamin D are central to bone health, no matter what our age.
- Newer research suggests that adequate dietary protein is also required to absorb calcium normally so that bone is protected.
- Given the increasing prevalence of osteoporosis, clinical intervention studies designed to unravel the complex relationship between nutrition and bone are needed now more than ever.

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