

Beating Osteoporosis with Nutrition and Exercise- Part 1

Project B.O.N.E.

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MedFit Education Foundation**

Osteoporosis Fitness Specialist Modules

Module 1: Boning up on Bones:
Understanding the Anatomy and Physiology of Bone

Module 2: How nutrition can increase or decrease bone density

Module 3: How exercise can increase bone density

Module 4: Assessing- how to find out where your client should start

Module 5- Programming- putting it all together

Module 6- Marketing and Promotion: Getting the word out and monetizing your knowledge and skill

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New Paradigms in this Program

- Focus on **bone health NOT disease**
- Focus on the **interactivity of various factors to combat osteoporosis**
- The use of **typical intensity scales DON'T work** for osteoporosis
 - Heart rate- % max, % HRR max, or % of lactate threshold not important
 - % 1 Rep Max- 1RM also not that important, although should be considered
- **A New scale** that looks at how the bone is being stressed needs to be used versus looking at exercise intensity (4 level system)
- The amount of weight used during a lift is not important, but the change in speed or direction is important toward stressing the bone
- The use **eccentric** motion and **multiplanar** movement is critical
- Evaluating a client for balance, movement skills, and functionality critical
- **Assigning a client to an appropriate level** to match their capacities
- Using a **“team”** approach involving an M.D., R.D., and C.P.T. (MedFit)

What is Bone Health?



- Bone health is **NOT** about just avoiding osteoporosis
 - This defensive posture focuses on the bad
 - This assumes that not having osteoporosis is “fine”
- Bone health is **NOT** about avoiding osteopenia
 - Osteopenia is a normal process in the body and it takes place as we age
 - Osteopenia **CAN BE** minimized and even **reversed** in some cases
- Bone health **IS** about keeping your bone density once achieved
 - After our 30’s we have achieved a maximum bone density
 - Bone density plateaus and then decreases after our mid 40’s and faster after mid 60’s
- Bone health **IS** about avoiding breaks due to falls
- Bone health **IS** about keeping the muscles strong and used

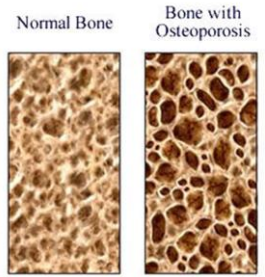
Statistics from NOF- Incidence and Cost

- Approximately 10 million Americans have osteoporosis and another 44 million have low bone density, placing them at increased risk.
- 54 million Americans, half of all adults age 50 and older, are at risk of breaking a bone and should be concerned about bone health.
- One in two women and up to one in four men will break a bone in their lifetime due to osteoporosis. For women, the incidence is greater than that of heart attack, stroke and breast cancer combined, and for men greater than the incidence of prostate cancer.
- Osteoporosis-related bone breaks cost patients, their families and the healthcare system \$19 billion annually.
- By 2025, experts predict that osteoporosis will be responsible for three million fractures resulting in \$25.3 billion in costs.



Statistics from NOF-

Fragility → Falling → Fracture → Fatality
Fragility → Fracture → Falling → Fatality

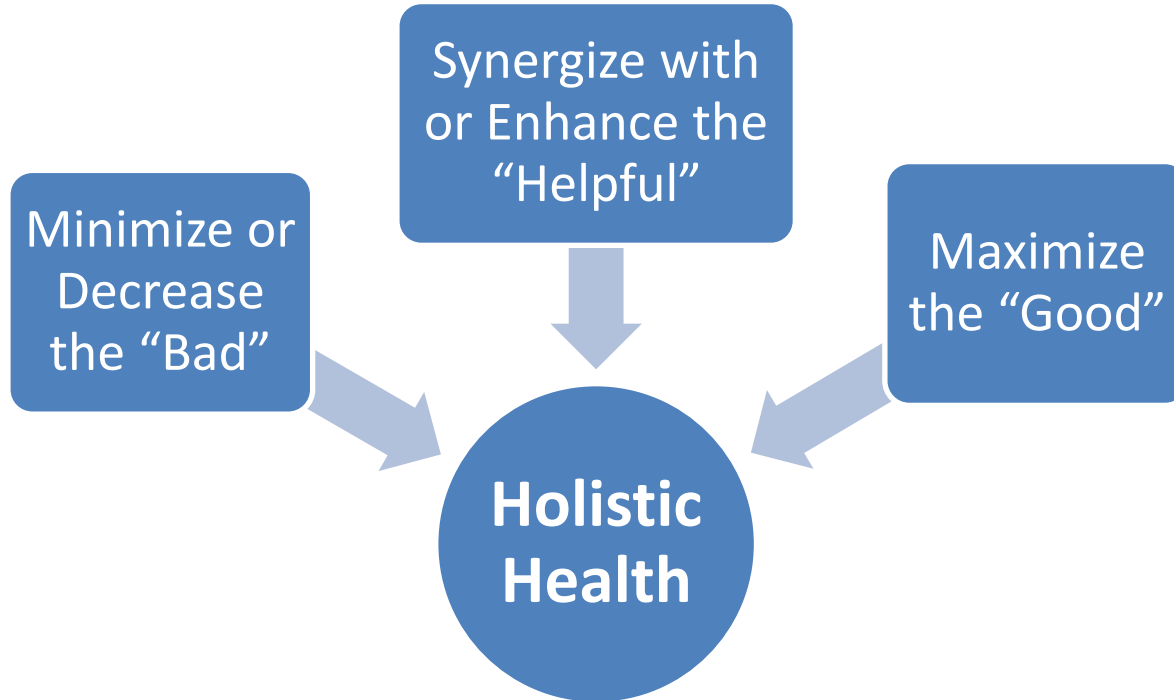


- The disease is responsible for an estimated two million broken bones per year, yet nearly 80 percent of older Americans who suffer bone breaks are not tested or treated for osteoporosis.
- A woman's risk of fracture is equal to her combined risk of breast, uterine and ovarian cancer.
- Every year, of nearly 300,000 hip fracture patients, one-quarter end up in nursing homes and half never regain previous function.
- Six months after a hip fracture, only 15 percent of patients can walk across a room unaided.
- 24 percent of hip fracture patients age 50 and over die in the year following the fracture.

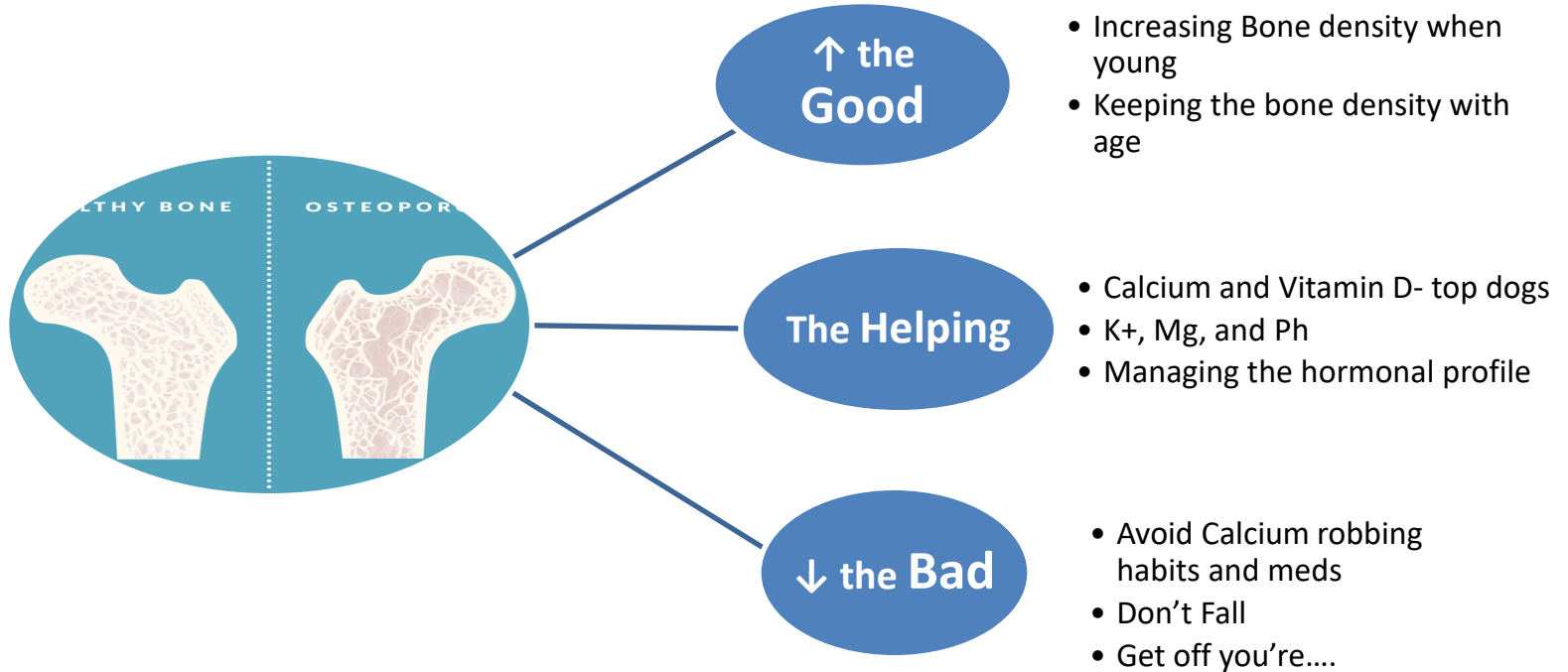
Myths of Exercise for Osteoporosis Prevention

1. Swimming is good for bone building.
 - The National Osteoporosis Society does not recommend swimming since it does not stimulate bone building. Aquatic exercise or aquacise has been shown to offer some bone building and maintenance in older people with osteoporosis.
2. Men don't get osteoporosis.
 - Yes, 1 in 5 men will suffer from some level of osteoporosis
3. You can't prevent it- it is just part of aging.
 - Bone mineral density (BMD) will decrease with age, but only too a small degree if proper care is taken, and definitely not osteoporosis
4. Tai Chi is not beneficial for helping osteoporosis.
 - *Tai Chi* has been shown to help those with osteoporosis and help prevent falls.
 - Caution must be taken with *yoga and Pilates* due to some positions especially those with spinal tension.
5. Genes have no effect-
 - Yes, some people and races are more prone to get osteoporosis
6. Walking is good for increasing BMD.
 - No! Drinkwater (1994), Palombaro (2005) found no meaningful increase in BMD and walking only should not be recommended.

Perspectives with Holistic Health

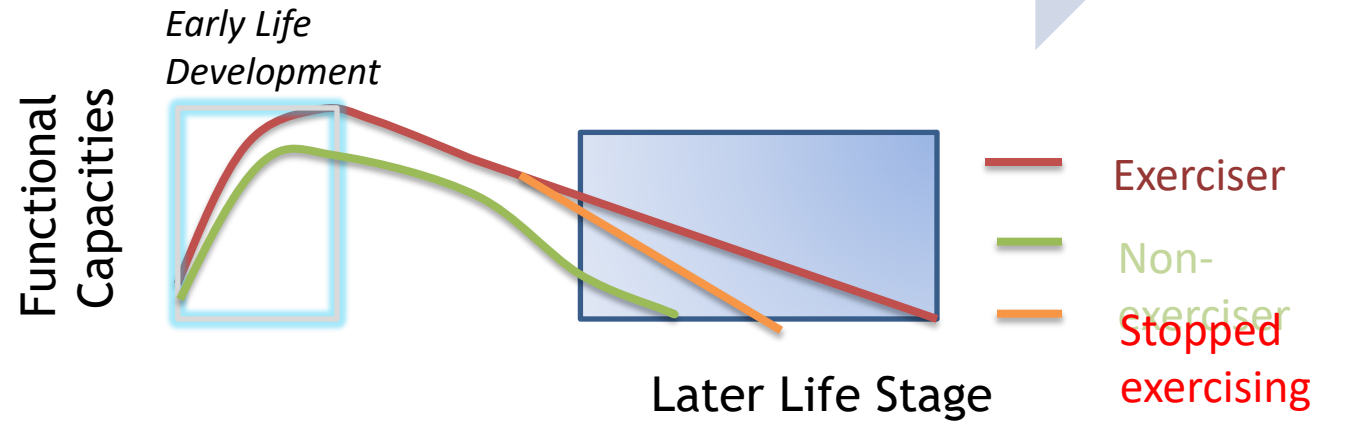
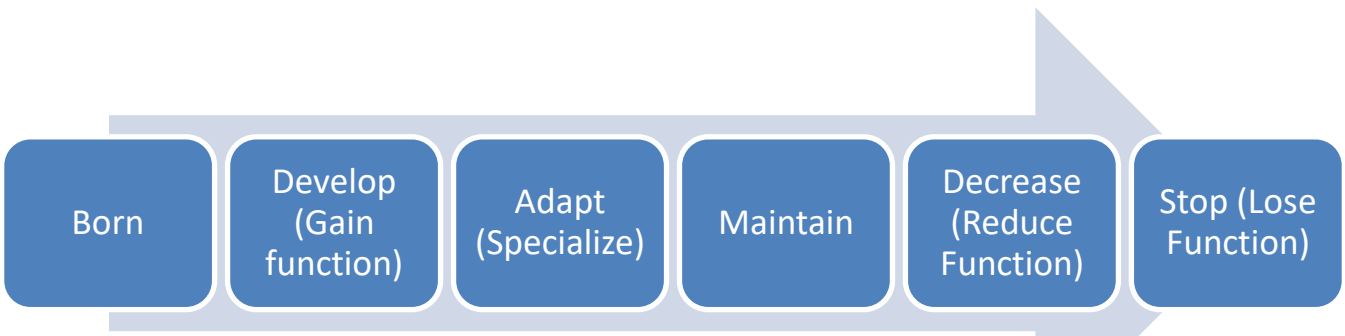


Holistic Health with Bones



Once Osteoporosis detected- often by a fracture- it is **too late**. Early detection and prevention is key!

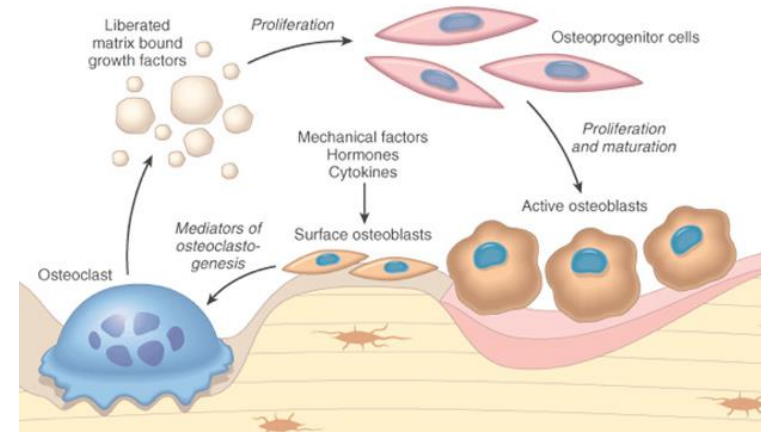
Not Going Backwards is Going Forward



Bone Growth and Loss

- Because bone is so dynamic it is constantly coming and going.
- **Early in Life- Osteogenesis**
 - Growth and Deposition > Loss and Breakdown
 - Benefit to bone is doubled if HI activity started before puberty vs after (Sabatier et al, 1999)
 - Bounce at the Bell initiative- ↑ bone health
- **Early to Mid-Adulthood- Maintenance**
 - Growth and Deposition = Loss and Breakdown
- **Mid to Late Adulthood- Mild Osteopenia**
 - Growth and Deposition < Loss and Breakdown
- **Late Adulthood to Old Age- Moderate to Severe Osteopenia**
 - (in some) faster Osteopenia or Osteoporosis

Bone Remodeling



Form fits Function

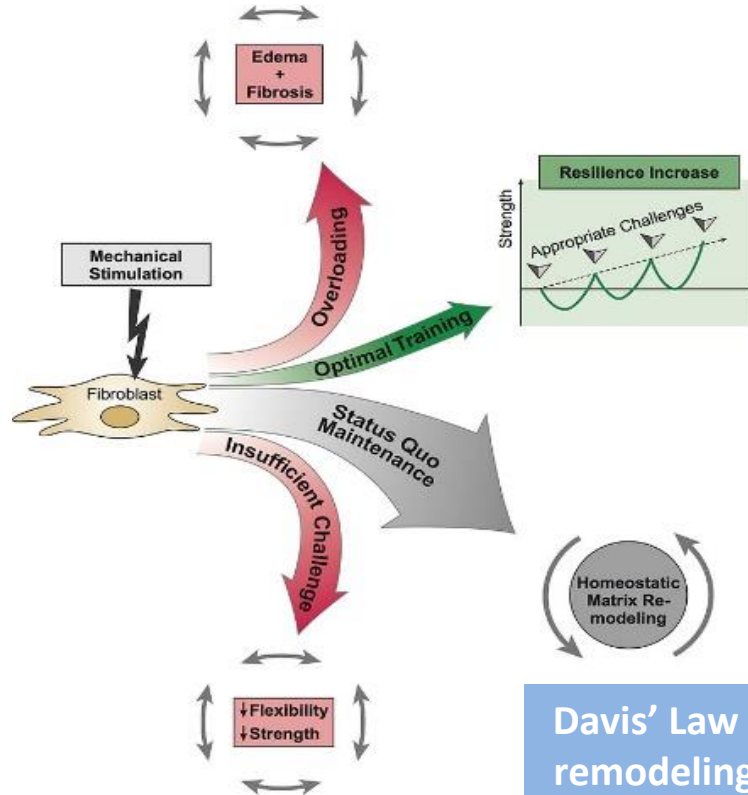
& Vice Versa



SIT AT THE COMPUTER MUCH?



Soft and Hard Tissue- Remodeling Laws



Mechanical properties of bone

- Wolff's Law: bone will adapt to the loads under which it is placed.

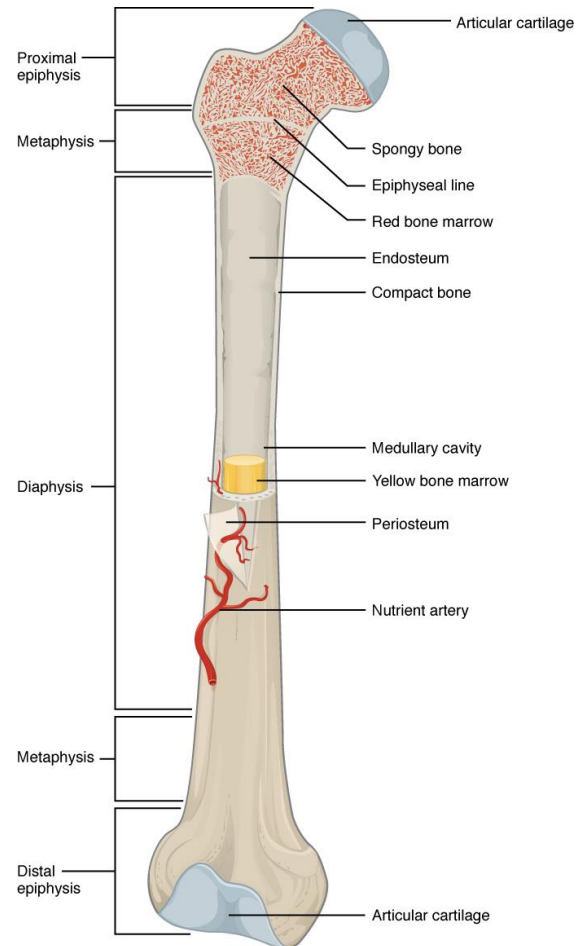


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EDUCATION

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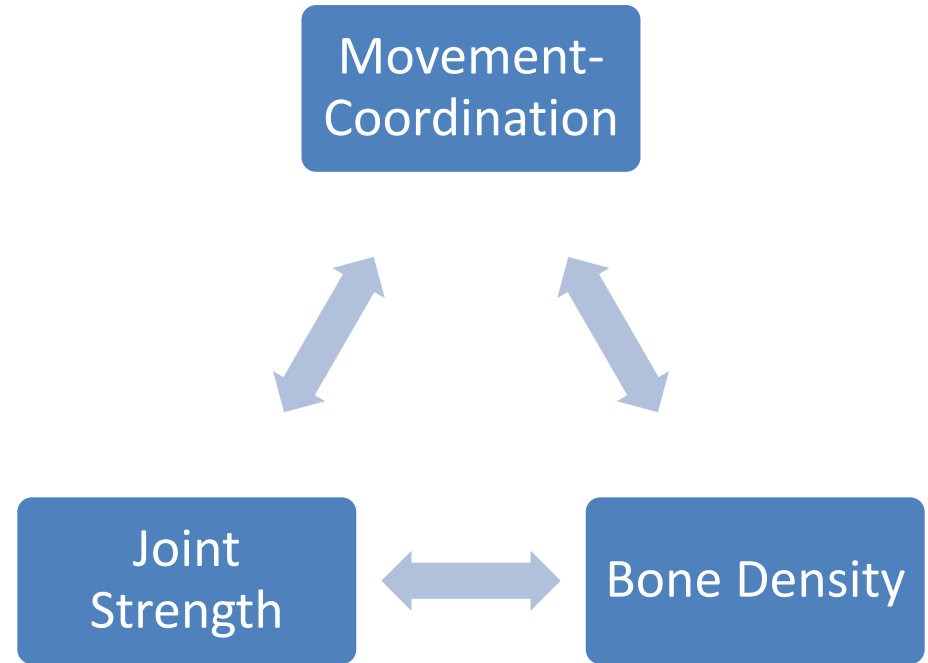
Bone Structures

- **Bone is a very dynamic organ**
 - Significant blood flow- especially in the red marrow where RBCs are made
 - Storage site for fat and calcium
 - Yellow marrow rich with fats
 - Blood calcium and bone calcium must work together to maintain proper levels in the body (*also with Phosphate*)
 - Calcium levels are under controls of hormones
 - Parathyroid hormone
 - Calcitonin
- **Different regions have different functions**
 - Epiphysis, Metaphysis, Diaphysis
 - Periosteum outside membrane, Compact (cortical) bone, Spongy (trabecular) bone,
 - Endosteum/Medullary canal/cavity



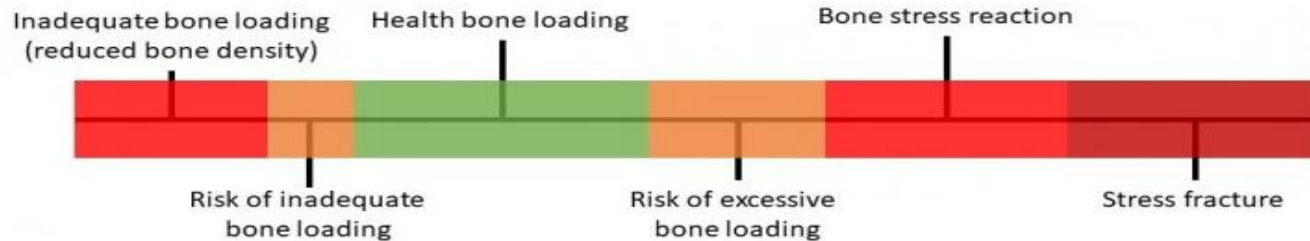
Bone, Joints & Movement: The Terrific Trio

- **Movement quality** itself will improve when there is confidence that bones are strong and joints are stable.
- **Bone** is a very dynamic organ the more you use it or stress it- the stronger it gets.
- **Joint strength or stability** is a function of cartilage, connective tissue, alignment
- Synergistic, feed-forward mechanism is enabled



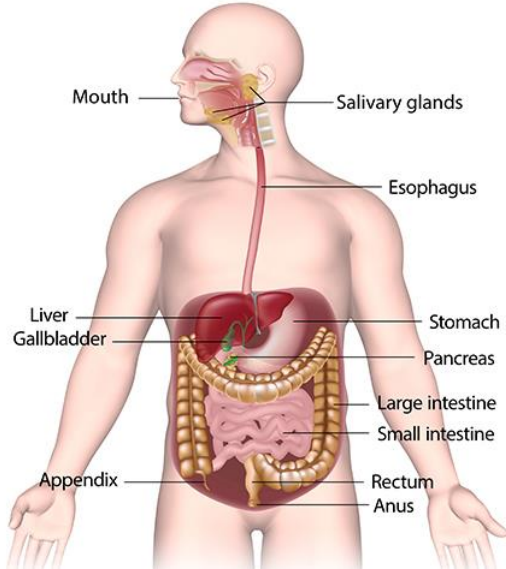
Osteogenic Stimuli- Finding the “Sweet Spot”

- Too little stress does not stimulate the transition of osteogenic cells to osteoblasts. The “threshold” is not reached.
- Healthy bone loading = increasing bone density
- Too much stress will weaken and potentially fracture bone



The Whole Picture with Bone Nutrition

The Digestive System



Ingestion- taking food in

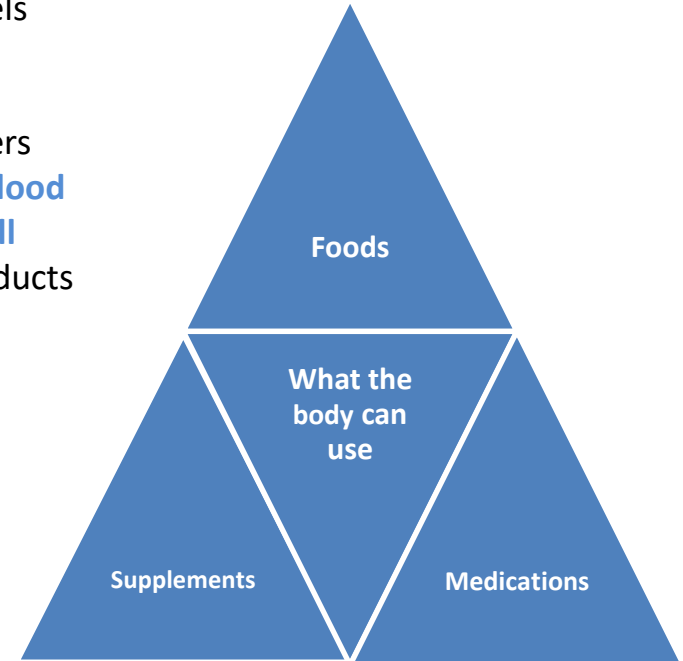
Propulsion- swallow & food travels down

Digestion- physical and chemical breakdown of food into monomers

Absorption- nutrients into the blood

Utilization- nutrients into the cell

Excretion/Defecation- waste products out

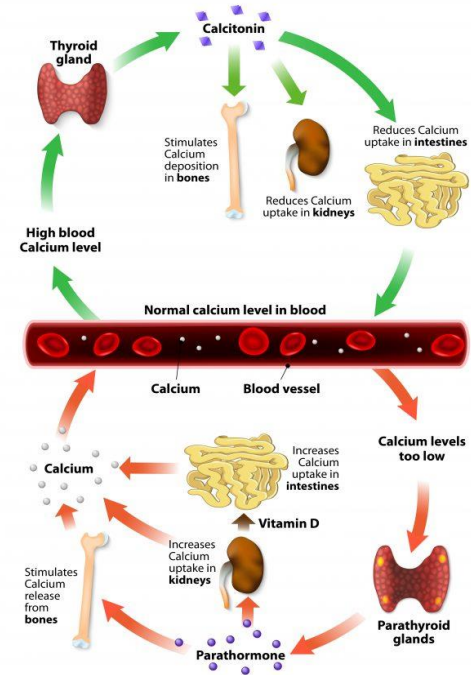


Two sides to Calcium Regulation

The Players

1. **Hormones-** Parathyroid hormone from parathyroid glands and Calcitonin from thyroid gland
2. **The gut** can increase or decrease the amount it takes into the bloodstream (absorption) via Vitamin D
3. **The kidneys** can increase or decrease the amount they release. Reabsorption brings it back into the blood, secretion and excretion will lower it in the blood.
4. **The bone** is a storage site for it so it can be stored or released by the bone matrix.

CALCITONIN and PARATHORMONE (hormonal regulation of blood calcium levels)



Fantastic Four: Synergistic Vitamins and Minerals

Vitamin D₃- King of
Boning Up

Vitamin K

Bone Density

Calcium

Phosphorus

Dem Bones- Support Crew

- **Vitamins A & C**
 - also play a minor role- too much A bad
- **Minerals**
 - **Magnesium**
 - ❖ Magnesium is needed in about a 2:1 portion relative to calcium, thus $\frac{1}{2}$
 - ❖ Magnesium keeps the calcium dissolved in blood
 - **Fluoride**
 - ❖ Good ol' tap water with Fluoride is better than bottled water
 - ❖ In a study in Finland (2000) improved **bone** density in women drinking fluoridated water reduced their risk of hip and spine fractures
 - ❖ Too much Fluoride (like protein) is not good for the bones
- **Other (trace) minerals-** support staff
 - silicon, strontium, **vanadium**, **zinc**, **copper** and boron
- **Phytochemicals-** Polyphenols, and Phytoestrogens- Soy products
- Thyroid gland produces **calcitonin** a bone builder and regulate parathyroid and its **parathyroid hormone** which breaks bone down



Vitamin D Supplements- Effects on Osteoporosis

Harvard Health Publishing
HARVARD MEDICAL SCHOOL
Trusted advice for a healthier life

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HEART HEALTH MIND & MOOD PAIN STAYING HEALTHY CANCER DISEASES & CONDITIONS

Harvard Women's Health Watch

Taking too much vitamin D can cloud its benefits and create health risks

Some people are overdoing it in search of better health.



Updated: December 15, 2019 Published: November, 2017

Vitamin D is having its day in the sun. In recent years, research has associated low blood levels of the vitamin with higher risks of everything from heart disease, diabetes, and cancer to mood disorders and dementia. The findings have not gone unnoticed. Vitamin D supplements and screening tests have surged in popularity.

"Vitamin D testing is one of the top Medicare lab tests performed in the United States in recent years," says Dr. JoAnn E. Manson, the Michael and Lee Bell Professor of Women's

NIH Fact Sheet on Vitamin D

1. Most supplementation trials of the effects of vitamin D on bone health also include calcium, so it is difficult to isolate the effects of each nutrient.
2. Among postmenopausal women and older men, supplements of both vitamin D and calcium result in **small increases in bone mineral density throughout the skeleton**. They also help to reduce fractures in institutionalized older populations, although the benefit is inconsistent in community-dwelling individuals [1,2,48].
3. Vitamin D supplementation alone appears to have **no effect on risk reduction** for fractures nor does it appear to reduce falls among the elderly [1,2,48];
4. One widely-cited meta-analysis suggesting a protective benefit of supplemental vitamin D against falls [49] has been **severely critiqued** [1].
5. However, a large study of women aged ≥ 69 years followed for an average of 4.5 years **found both lower (<50 nmol/L [<20 ng/mL]) and higher (≥ 75 nmol/L [≥ 30 ng/mL]) 25(OH)D levels at baseline to be associated w/ \uparrow risk of frailty [50].**

<https://ods.od.nih.gov/factsheets/VitaminD-health%20Professional/>

Breaking old paradigms- Engaging Truth

Food not supplements for calcium and absolutely not more than 500 mg!
Prebiotic may help absorption of Ca²⁺ and bone density.

Review | Calcif Tissue Int. 2018 Apr;102(4):443-479. doi: 10.1007/s00223-017-0339-3.
Epub 2017 Oct 27.

Prebiotics, Bone and Mineral Metabolism

Corrie M Whisner¹, Luisa F Castillo²

Affiliations + expand

PMID: 29079996 PMCID: PMC5851694 DOI: 10.1007/s00223-017-0339-3

Free PMC article

Abstract

Increasing interest in functional foods has driven discovery in the area of bioactive compounds. Prebiotics are non-digestible carbohydrate compounds that, when consumed, elicit health benefits and aid in the prevention and treatment of chronic diseases. While prebiotics have been shown to improve a number of chronic, inflammatory conditions, growing evidence exists for prebiotic effects on calcium metabolism and bone health. These novel dietary fibers have been shown to increase calcium absorption in the lower intestines of both preclinical and human models. Rodent models have also been imperative for understanding prebiotic effects on bone mineral density and measures of skeletal strength. Although fewer data are available for humans, bone-related prebiotic effects exist across the lifecycle, suggesting benefits for attainment of peak bone mass during adolescence and minimized bone resorption among postmenopausal women. These effects are thought to occur through prebiotic-microbe interactions in the large intestine. Current prebiotic mechanisms for improved mineral absorption and skeletal health include alterations in gut microbiota composition, production of short-chain fatty acids, altered intestinal pH, biomarker modification, and immune system regulation. While the majority of available data support improved mineral bioavailability, emerging evidence suggests alternate microbial roles and the presence of an intricate gut-bone signaling axis. Overall, the current scientific literature supports prebiotic consumption as a cost-effective and sustainable approach for improved skeletal health and/or fracture prevention. The goal of this review is to discuss both foundational and recent research in the area of prebiotics, mineral metabolism, and bone health.



Health

Conditions and Diseases | Treatments, Tests and Therapies | Wellness and Prevention | Caregiving

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Calcium Supplements: Should You Take Them?



Fitness and Performance | Food and Nutrition

When you were a child, your mom may have encouraged you to drink milk to build strong bones. But as an adult, you're much more likely to take a calcium supplement than down four glasses of milk a day to protect your bone health. However you do it, getting enough calcium is a good idea, since women are far more likely than men to develop osteoporosis — a condition of weak and fragile bones that makes you prone to fractures. Of the 10 million Americans with osteoporosis, 80 percent are women.

But before you unwrap that chocolate-flavored calcium chew or swallow a calcium pill, you should know that taking calcium supplements may not be helping your bones at all. Even worse? The supplements may lead to major health problems

The Best Calcium
Supplement Is



News and Publications

Overview

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Calcium Supplements May Damage the Heart

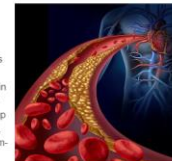
Experts recommend caution before taking calcium supplements

Release Date: October 11, 2016

SHARE FAST FACTS

- Twitter Calcium-rich diet may be protective for the heart. - Click to Tweet
- Twitter Calcium supplements may damage the heart. - Click to Tweet
- Twitter Check with your physician before taking calcium supplements. - Click to Tweet

After analyzing 10 years of medical tests on more than 2,700 people in a federally funded heart disease study, researchers at Johns Hopkins Medicine and elsewhere conclude that taking calcium in the form of supplements may raise the risk of plaque buildup in arteries and heart damage, although a diet high in calcium-rich foods appears to be protective.



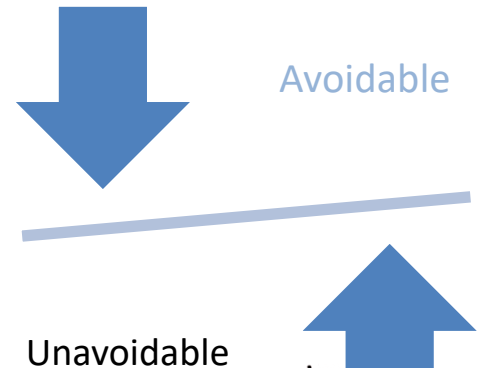
Clogged artery
Clear Blood

In a report on the research, published Oct. 10 in the

Breaking Bad- What can I do...or not?

- thinness or small frame
- family history of the disease, and White or Asian ethnicity
- being postmenopausal and particularly having had early menopause
- abnormal absence of menstrual periods (amenorrhea)
- prolonged use of certain medications
 - those used to treat lupus, asthma, thyroid deficiencies, and seizures
- smoking
- low calcium/Vit D intake
- lack of physical activity
- Excessive salt intake
- excessive alcohol intake

Partly
avoidable



What Can Decrease Bone Density?

- **Alcohol-** Excessive alcoholic beverage consumption is also associated with lower bone density
 - alcohol interferes with the absorption of calcium and vitamin D.
 - To lower your risk for osteoporosis, limit your intake of alcohol to one drink a day.
- **Protein-** Too much of a good thing is not a good thing.
 - You need protein to build strong bones
 - With too much [protein](#) intake, your body produces sulfates that can cause calcium to leach out of the bones.
 - More likely to occur with animal protein than vegetable protein.

In the recent Nurses Health Study II, conducted by Harvard Medical School, 116,686 women were followed for 10 years. The researchers found that women who ate red meat at least five times a week were more likely to have a bone fracture than women who ate red meat only once a week.

Diet and Osteoporosis:

Other Factors That May Raise Your Risk

- **Sodium-** too much sodium in your diet can cause you to excrete calcium in your urine and perspiration.
 - Sodium is found in table salt (NaCl) and many processed foods.
- **Oxalates-** can prevent you from absorbing calcium if the oxalates and calcium are contained in the same food product.
 - Spinach, rhubarb, sweet potatoes, and bran fiber contain oxalates.
 - they should not be considered sources of calcium.
 - Fortunately, oxalates don't interfere with the calcium absorption from other foods eaten at the same time as the oxalate-containing foods.
- **Wheat bran-** only food known to reduce the absorption of calcium when eaten at the same time as calcium is 100 % wheat bran.
 - If you take calcium supplements, foods containing wheat bran should be eaten **two or more hours before** or after taking the supplement.

Diet and Osteoporosis: The Role of Caffeinated or Carbonated Drinks

- In a recent study of 31,527 Swedish women ages 40 to 76, conducted by the Swedish Department of Toxicology's National Food Administration:
 - researchers found that women who drink **330 milligrams of caffeine or more a day** — the equivalent of about four cups of coffee — have an increased risk of bone fractures.
 - This risk was especially noted in women who had a lower consumption of calcium.
 - The researchers did not find an association between tea consumption and increased risk for bone fractures.
 - One reason could be that the caffeine content of tea is typically half that of coffee.
- Framingham Osteoporosis Study measured the bone mineral density in the spines and hips of 1,413 women and 1,125 men against the frequency of their soft drink consumption.
 - The researchers concluded that cola and diet cola beverages (though not other carbonated drinks) may cause bone loss in women and may involve not just the caffeine, but the phosphorus in colas, too.
 - It may be that the connection between colas and bone loss is due in part to the substitution of soda for milk, decreasing calcium intake



Diet and Osteoporosis:

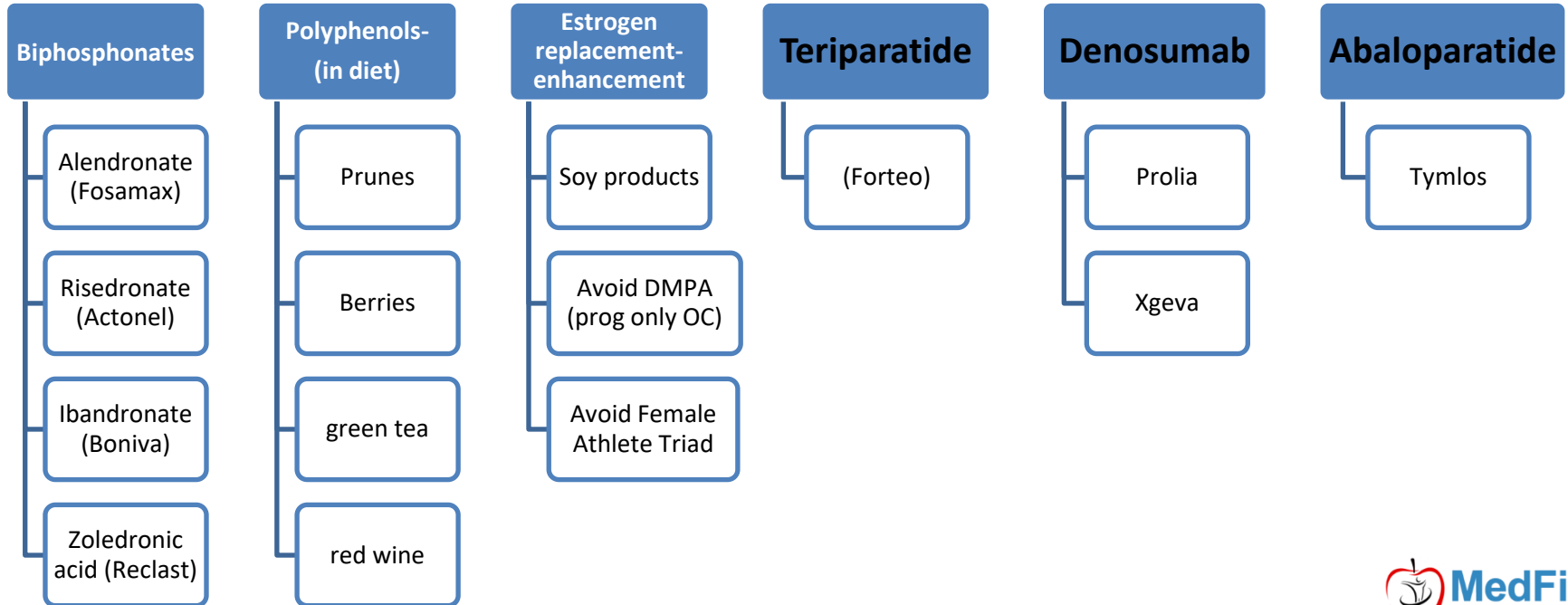
Rebalance With Fruits and Vegetables

- Diets low in fruits and vegetables and high in animal protein and carbs,
 - may lead to mild acidosis which, over time, can contribute to significant bone loss,”.
 - Neutralizing an acid-producing diet by eating fruits and vegetables, may reduce bone loss while aging.
- Eating (taking supplements for) the recommended amount of **calcium** each day to offset any loss of calcium caused by any other foods you eat will go along way to preventing bone loss.
- Daily calcium needs 1,000-1,200 milligrams for adults
 - If over 50 years old
 - 1,000 mg for adults ages 19 to 50
 - 1,300 mg for children ages 9 to 18

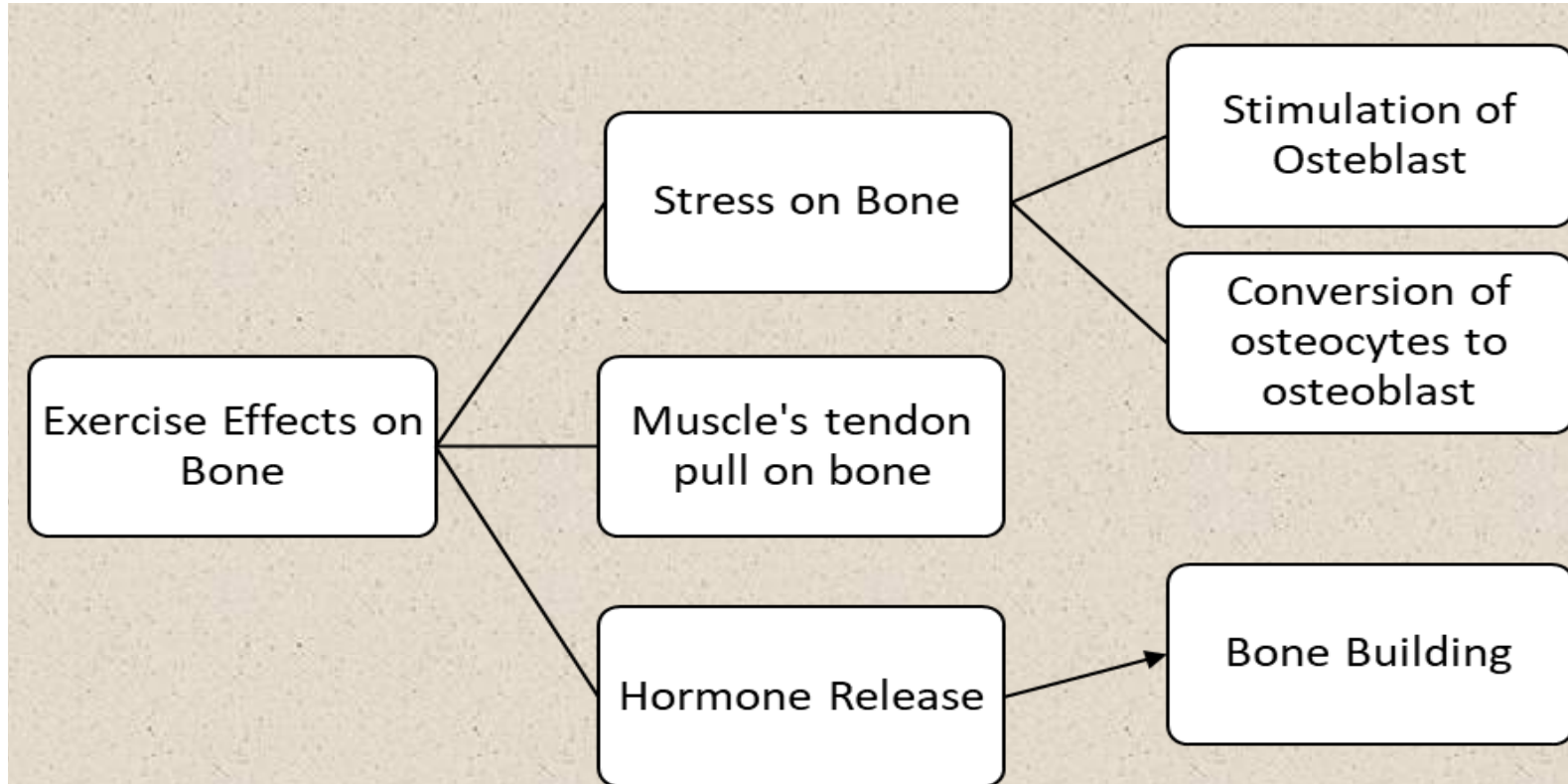


Other Nutritional and Drug Agents

- White font- slow breakdown, **Black font-** have potential to rebuild bone.



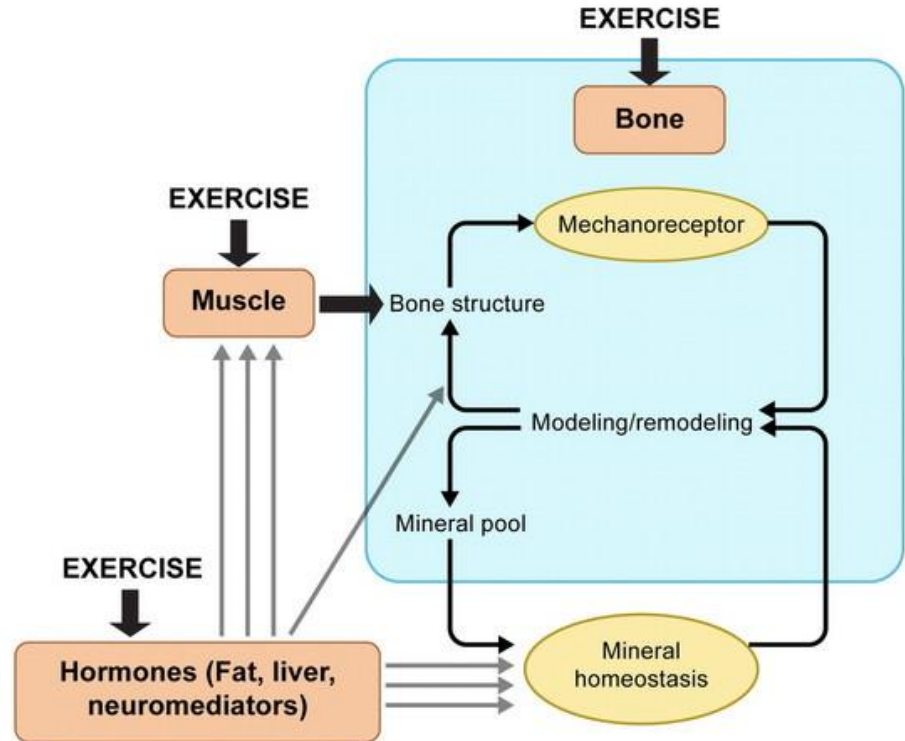
Exercise Effects on Bone- Triple Play



How does Exercise increase Bone Density?

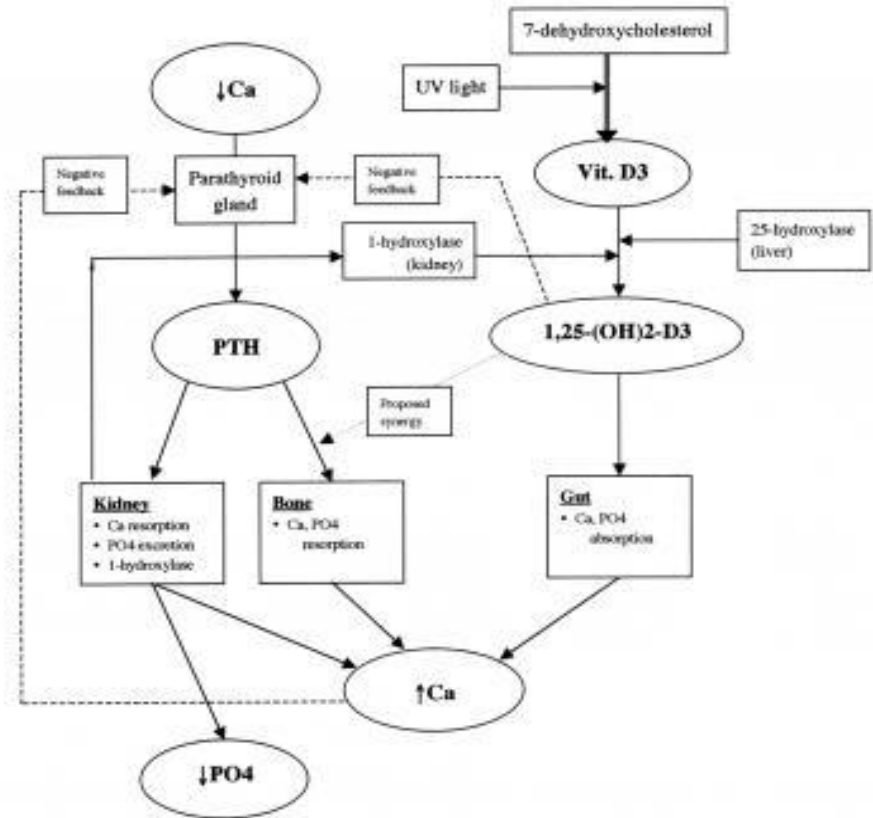
Exercise does multiple actions

- Muscle- tendon pulls on bone
- Bone growth is stimulated directly via **mechanoreceptors**
- Hormones are released during exercise to alter **mineral homeostasis**
- Enhanced blood flow in red marrow increases nutrient supply and **bone anabolism**



What Can Increase Bone Density?

- The Agents
 - Calcium
 - Vitamin D3
 - Parathyroid Hormone
 - Phosphorus/Phosphate
- The Organs – SiLK for Vitamin D3
 - Skin
 - Liver
 - Kidneys
- Bone and Blood- Calcium levels
 - Thyroid
 - Parathyroid



Exercise Principles- Adapted to Bone Health

Specificity

- Site Specific- right vs left or upper vs lower
- Bone specific- cortical vs trabecular

Progressive Overload

- GRF > Muscle tendon pull (multidirectional) > Muscle tendon pull (unidirectional)
- Define “starting point”- overload to one person is not threshold to another

Reversibility

- Langendonck et al (2003) concluded- continued participation in high impact sports necessary to ensure bone health throughout adulthood
- Start early- the more bone density at younger ages is retained much better (after stopping) than in people who gain some later- Nordström et al (2006).

Initial values and diminishing returns

- Runners who averaged over 95km (almost 60 mi/wk) weekly actually had equal bone density to active controls and less than those averaging 64-80 (40-50 mi/wk). Thus, intensity of strain most important!

What are the Target Areas to Exercise?

1. Spine

- The Spinal Compression fracture will result in Dowager's hump or kyphosis often seen in elderly women

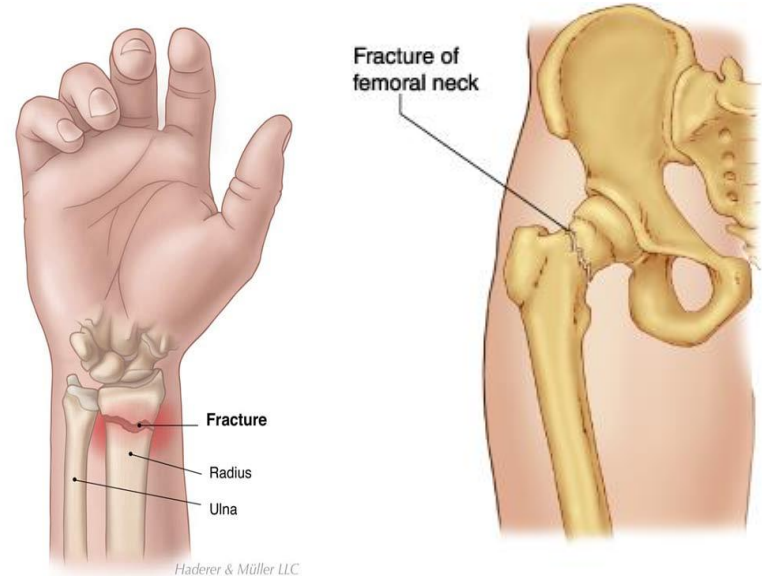
2. Hip- Femoral neck likely to fracture

- Compression forces from the pelvic girdle (acetabulum) hip socket paired with lateral motion of the femoral shaft causes sheering stress on neck.

3. Wrist- in region by distal radius shaft

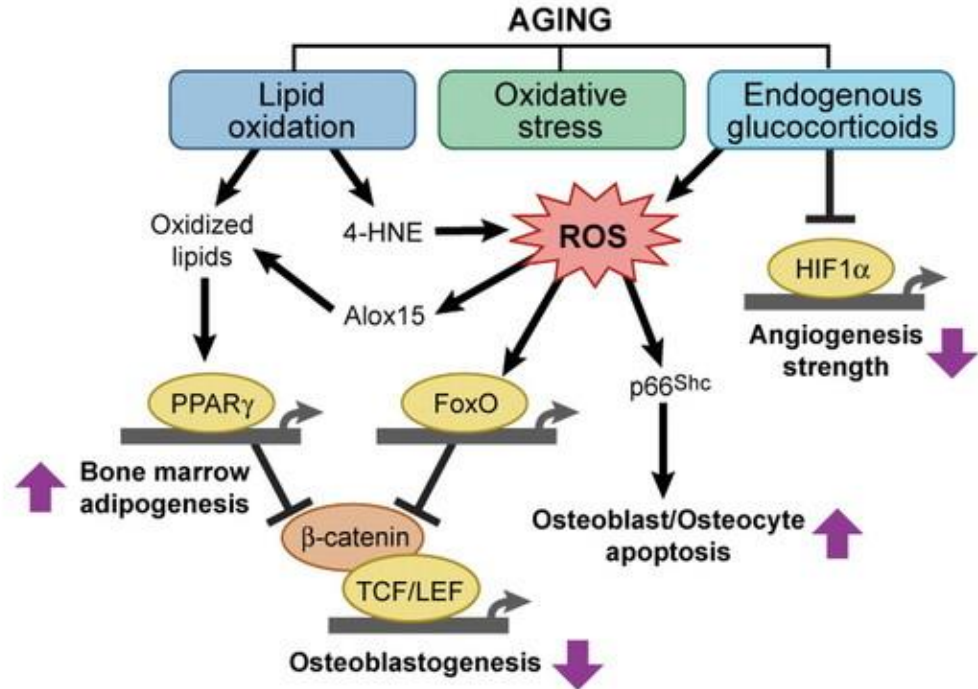
4. Train the chain.

- All parts in a system must be strong enough.
- Most functional movements fall into this arena.

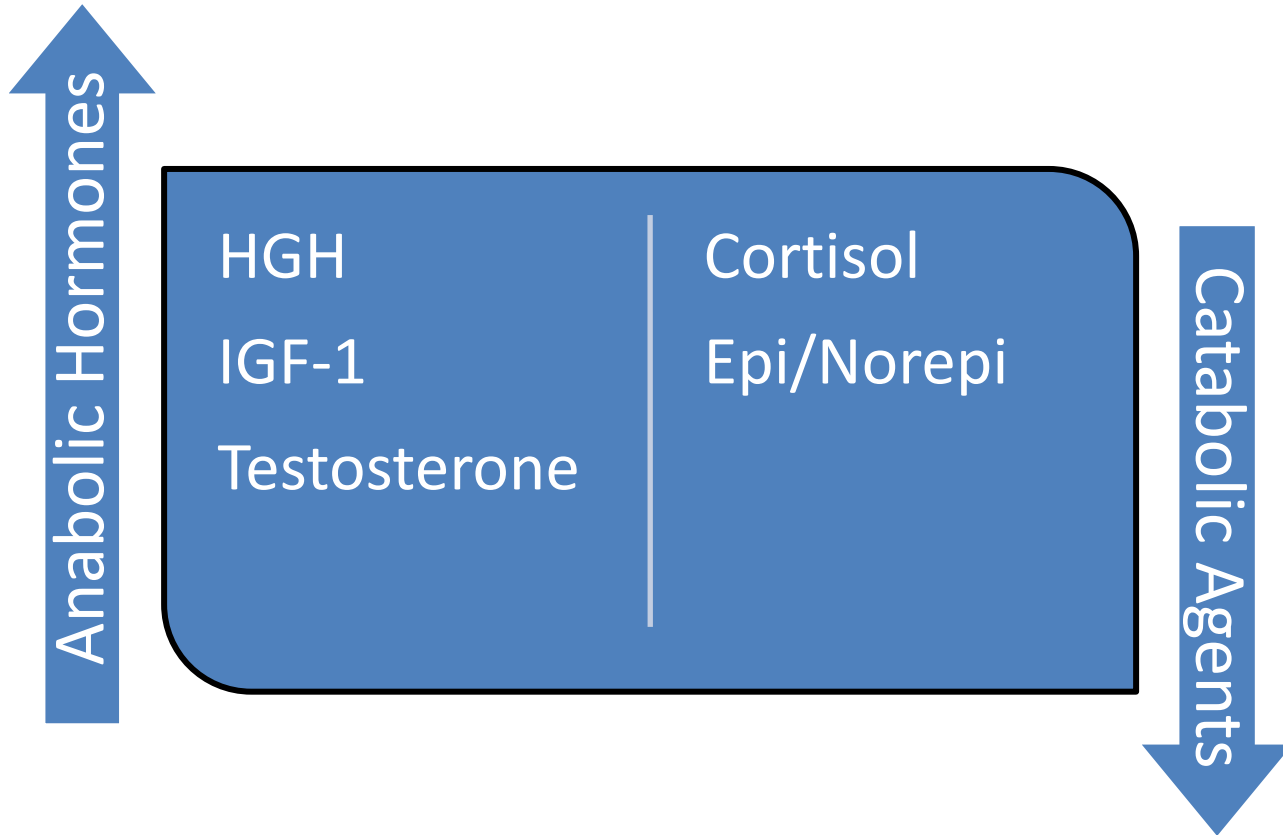


Why does Aging decrease Bone Density?

- Oxidized lipids
- Cortisol
- Radical Oxidative Species
 - Inflammatory Agents
- Apoptosis- cell death
- Adipogenesis- fat production
- Osteoblast- build
- Osteoclast- breakdown



Maximize Anabolic- Minimize Catabolic



A Comprehensive Physical Assessment

PHYSICAL EXAM

- Risk Factors
 - Gauge modifiability
 - DEXA- T score
 - Medications (any exercise contraindications?)
- Anthropometrics
 - Height- ,58kg
 - Weight
 - BMI
 - Hip and wrist mobility
 - Blood pressure (esp if cardio program)

AGILITY/MOBILITY

- Can client perform ballistic movement
- Change direction
- Dynamic balance
- Joint flexibility
- Get up
- Joint strengthening

FLEXIBILITY

- Dynamic Warm up
- Emphasis mobility joints
- Multi-planar movement
- Kinetic chain emphasis

EQUILLIBRIUM

- Balance- static and dynamic tests
- Kinesthetic awareness
- Proprioceptive feedback ↑
- Multi-joint coordination

Summary of Part 1

- Take a fresh look at bones as a dynamic organ that deserves attention as part of your health plan.
- Falls can actually be deadly in the long run
- Bone density (BMD) needs to be established early in life and maintained later in life.
- Supplements can be dangerous when taken improperly
- Exercise works to increase BMD in several different ways.
- A comprehensive physical exam should be done before an exercise program and identify areas of improvement or risk.