

OPTIMAL BONE HEALTH

BONE FOUNDATIONS WORKBOOK



Support Guide for the
Bone Foundations Course

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Bone Foundations Workbook Overview

Optimal Bone Health MD was started by Dr. Doug Lucas, a double board-certified physician in anti-aging and regenerative medicine as well as orthopedic surgery. He created the company to revolutionize the way we treat Osteoporosis. Bone health is critical to health and longevity considering that 50% of women and 25% of men will sustain an osteoporotic fracture in their lifetime and **20%** of women and **30%** of men ***will DIE within 12 months of sustaining a hip fracture.***

Optimal Bone Health is a combination of programs that utilize a team approach to fully assess and treat your Osteoporosis. Our Team consists of physicians, dietitians and coaches who are trained in both conventional and functional medicine who guide clients through the 4R Bone Optimization Method. The 4R Bone Optimization Method is designed to help prevent further bone loss and support bone growth.

This workbook serves as a supplemental manual to the self-paced Bone Foundations Group Program and the 4R Bone Optimization Signature Program. You can use this workbook to help organize and manage your Osteoporosis treatment, follow along with the Bone Foundations Course, and track your progress towards building bone!

The Bone Foundations Online Modules contain additional electronic resources that will supplement the use of the workbook.

Bone Foundations Online Exclusives:

- Nutrition Libraries and Food Product Guides
- Exercise Libraries
- Digital Lab Tracking
- Food Tracking Software

The workbook and Bone Foundations Course material are provided as part of the program in which you are enrolled. Please refer to your onboarding material to check what resources are available to you. Additional opportunities for support may be available. Reach out to your team if you need additional support.

Disclaimer

This workbook is for general informational purposes only. The purchase of this workbook and accompanying education does not form a physician-patient relationship. To access healthcare services, you must be part of the Optimal Bone Health 4R Bone Optimization Signature Program and have completed the appropriate paperwork. Educational videos and texts do not constitute the practice of medicine, professional healthcare services, or the giving of medical advice.

The use of this information and the materials linked to this workbook are at the user's own risk. This workbook and the accompanying videos are not intended to be a substitute for professional medical advice, diagnosis, or treatment.

Welcome to Bone Foundations

Congratulations, you have taken an important step to improving your bone health!

If you are a current OBH patient, make sure you check in with your team and get your bloodwork and functional testing completed as soon as possible so your program is not delayed!

If you have taken the first step by starting the self-guided Bone Foundations Program, please review the *Getting Started* videos that walk you through how to use the technology will enhance your experience.

The Bone Foundations Course will guide you through the Optimal Bone Health 4R Bone Optimization Method.

4R Bone Optimization Method:

- Recognize
- Reverse
- Retest
- Revive

The basis of the 4R Bone Optimization Method will be covered in depth in Module 3.



Bone Basics

To gain the most from this program, it's important that you have a foundational knowledge of the components of bone and osteoporosis.

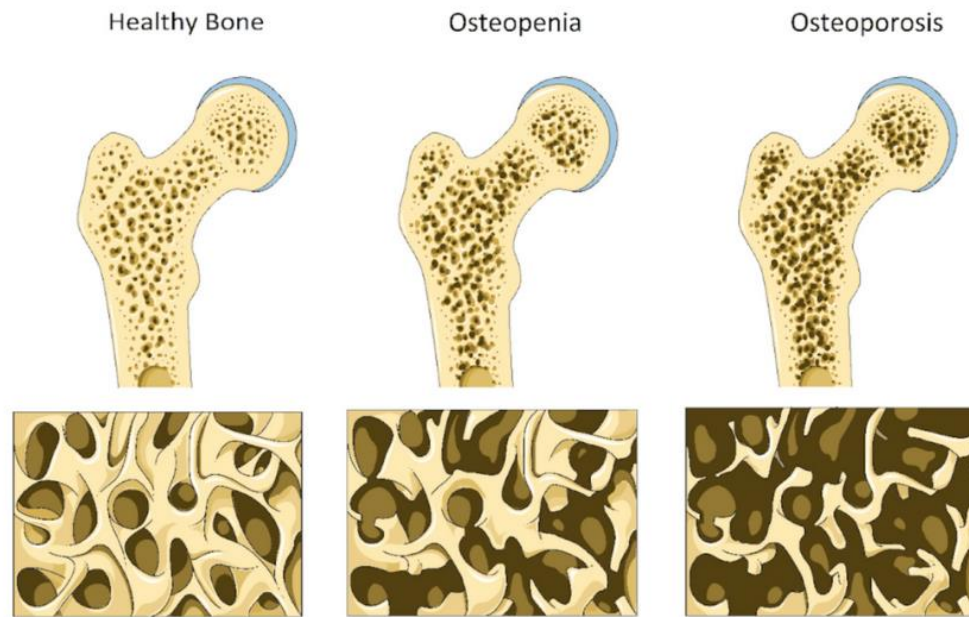


Figure 5. Loss of bone mass in decline from healthy bone to osteoporosis. Source: [Advocate Medical Group](#): Adult Down Syndrome Center.

Osteoporosis: Is a bone condition that develops when bone mineral density and bone mass decreases, or when the structure and strength of bone changes. This can lead to a decrease in bone strength that can increase the risk of fractures. The root cause is an imbalance of bone metabolism. Too much bone loss or too little bone building, or both.

Osteopenia: Is the weakening of bone and bone mineral loss that may lead to Osteoporosis. **It is not a true diagnosis but a continuum of bone loss from peak bone mass to the threshold of osteoporosis.**

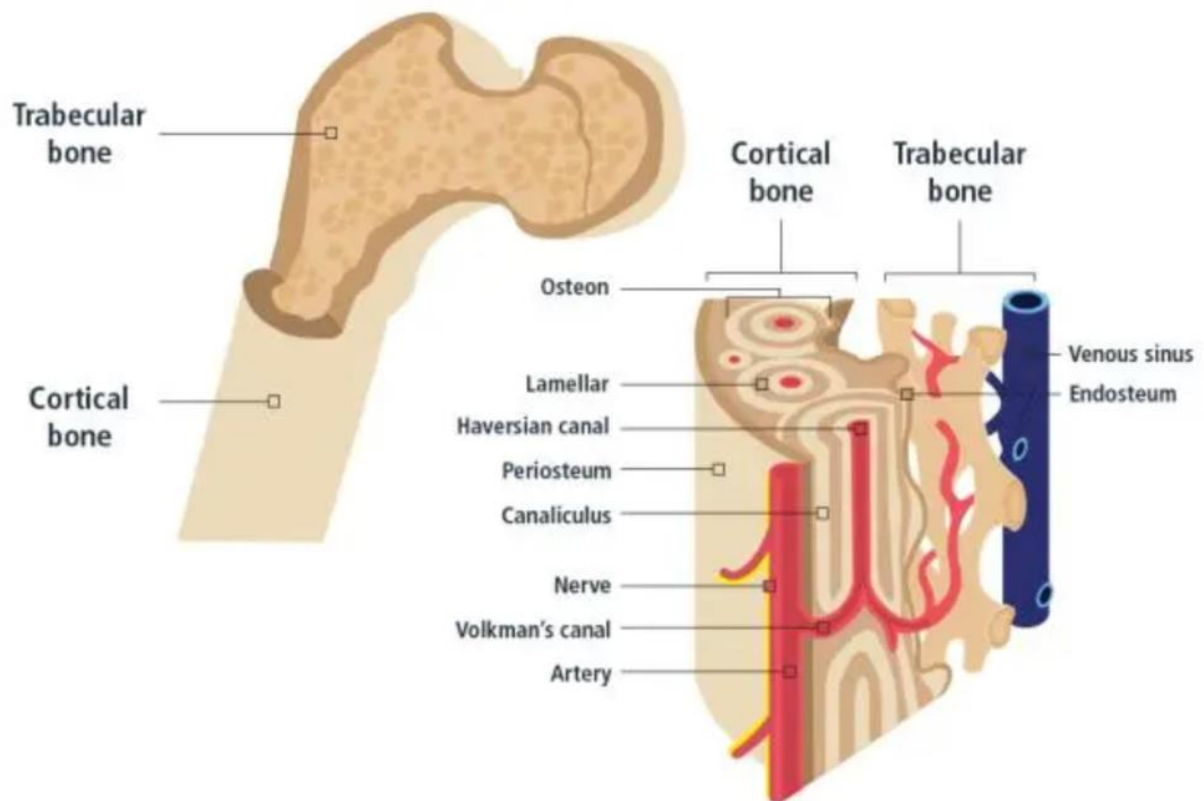
Osteoblasts: Bone-building cells that develop from bone marrow stem cells. These stem cells turn into osteoblasts based on their environment and cues. They can also become adipocytes or fat cells and our goal is to encourage them to become bone-building cells!

Osteoclasts: Cells that break down bone. We need osteoclasts to make room for new, healthy bone cells. Osteoclasts come from immune system components called *macrophage precursor cells* derived from bone marrow.

Osteocytes: Mature osteoblasts that are no longer making bone but orchestrating bone metabolism and function.

Cortical Bone: Also known as compact bone, is the outer layer of long bones. Osteoporosis Can result in thinner and weaker cortical bone.

Trabecular Bone: Thin lattice-shaped (trabeculae) units inside bone. The bone marrow is located in the intermediate space of the trabecular bone. Osteoporosis results in a loss of structural integrity in trabecular bone



The structure of bone

RANK: Is the receptor on osteoclasts and osteoclast precursors, for interaction with osteoblasts.

RANK-L: Stimulates osteoclasts and is a target for the pharmaceutical Prolia

Sclerostin: Is a protein made by osteocytes which communicates with osteoblasts and osteoclasts to balance bone metabolism. Sclerostin is the target of the pharmaceutical Evenity®.

What is Osteoporosis?

As previously covered, Osteoporosis is a condition where the main characteristic is weak bones. In this module we will take a closer look at what Osteoporosis actually is and how it informs how we, at Optimal Bone Health, think about Osteoporosis treatment.

Key Characteristics of Osteoporosis:

- Low Bone Mass
- Deterioration of Bone Tissue
- Disruption of Bone Architecture
- Compromised Bone Strength
- Increased Risk of Fracture

Many Clients come to us living, what they feel, are healthy and active lives, not knowing that they are Osteoporotic until their first DEXA. Others have felt their health declining or have had small and frequent health concerns for the majority of their adult lives. Regardless of what category you fall into, at Optimal Bone Health MD, we specialize in reviving people's lives and improving their health and wellness from their Bones to their Brains.

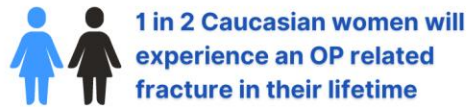
Osteoporosis typically does not cause any symptoms until someone experiences a fracture, this often leads to Osteoporosis diagnosis catching people off guard and creating fear that prevents them from living the life they desire.

The consequences of fracture are serious with 20-30% of those experiencing a hip fracture dying in 1 year and 30% of people permanently moving to a skilled nursing facility after 1 year. The statistics are frightening, but not having a clear path to preventing fracture adds unnecessary stress.

The good news is, 50% of fragility fractures could be prevented with the appropriate screening and treatment! This means that you have already taken steps to prevent fractures by working with our team or participating in this course!

YOU ARE NOT ALONE

- More than 9.9 million Americans have osteoporosis
- 43.1 million have low bone density



Know Your Risk:

To better understand your risk of a hip fracture or other major osteoporotic event, calculate your FRAX[®] Score.

FRAX[®] is a Fracture Risk Assessment Tool that uses various factors to stratify your risk for having a potentially devastating Osteoporotic Event. Once you calculate your FRAX[®] Score add your results to your lab tracker (See Below). If you are working with the OBH team, they will have calculated your FRAX[®] Score and added it to your patient report and bone health scorecard.

[Calculate your FRAX[®] Score Here](#)

Lab Trackers:

- [Men's Lab Tracker](#)
- [Post- Menopausal Women's Lab Tracker](#)
- [Pre-Menopausal Women's Lab Tracker](#)

Risk Factors:

Below are special considerations and specifics on risk factors that should be reviewed before calculating your FRAX score:

Age	The model accepts ages between 40 and 90 years. If ages below or above are entered, the program will compute probabilities at 40 and 90 years, respectively.
Sex	Male or Female.
Weight	The form only accepts Kg but there is a box to the right that converts pounds to Kg for those that need it.
Height	The form only accepts CM but use the same box to the right to convert feet and inches easily.
Previous fracture	A previous fracture denotes more accurately a previous fracture in adult life occurring spontaneously, or a fracture arising from trauma which, in a healthy individual, would not have resulted in a fracture. Bones included in this list should ONLY be spine, femur (hip), pelvis, humerus (upper arm), wrist and forearm. Toes and ankles don't count. Enter yes or no (see also notes on risk factors). These fractures are considered "fragility fractures" and are not the same as a fracture from a significant trauma.
Parent fractured hip	This inquires about a history of hip fracture in the patient's mother or father. Enter yes or no.
Current smoking	Enter yes or no depending on whether the patient currently smokes tobacco (see also notes on risk factors).
Glucocorticoids	Enter yes if the patient is currently exposed to oral glucocorticoids or has been exposed to oral glucocorticoids for more than 3 months at a dose of prednisolone of 5mg daily or more (or equivalent doses of other glucocorticoids) (see also notes on risk factors).
Rheumatoid arthritis	Enter yes where the patient has a confirmed diagnosis of rheumatoid arthritis. Otherwise, enter no (see also notes on risk factors).
Secondary osteoporosis	Enter yes if the patient has a disorder strongly associated with osteoporosis. These include type I (insulin-dependent) diabetes, osteogenesis imperfecta in adults, untreated long-standing hyperthyroidism, hypogonadism or premature menopause (<45 years), chronic malnutrition, or malabsorption and chronic liver disease

Alcohol 3 or more units/day	Enter yes if the patient takes 3 or more units of alcohol daily. A unit of alcohol varies slightly in different countries from 8-10g of alcohol. This is equivalent to a standard glass of beer (285ml), a single measure of spirits (30ml), a medium-sized glass of wine (120ml), or 1 measure of an aperitif (60ml) (see also notes on risk factors).
Bone mineral density (BMD)	(BMD) Please select the make of DXA scanning equipment used and then enter the actual femoral neck BMD (in g/cm ²). Alternatively, enter the T-score based on the NHANES III female reference data. In patients without a BMD test, the field should be left blank (see also notes on risk factors) (provided by Oregon Osteoporosis Center).

Special Considerations/Notes on Risk Factors:

Previous fracture

A special situation pertains to a prior history of vertebral fracture. A fracture detected as a radiographic observation alone (a morphometric vertebral fracture) counts as a previous fracture. A prior clinical vertebral fracture or a hip fracture is an especially strong risk factor. The probability of fracture computed may therefore be underestimated. Fracture probability is also underestimated with multiple fractures.

Smoking, alcohol, glucocorticoids

These risk factors appear to have a dose-dependent effect, i.e., the higher the exposure, the greater the risk. This is not taken into account and the computations assume average exposure. Clinical judgment should be used for low or high exposures.

Rheumatoid arthritis (RA)

RA is a risk factor for fracture. However, osteoarthritis is, if anything, protective. For this reason, reliance should not be placed on a patient's report of 'arthritis' unless there is clinical or laboratory evidence to support the diagnosis.

Bone mineral density (BMD)

The site and reference technology are DXA at the femoral neck. T-scores are based on the NHANES reference values for women aged 20-29 years. The same absolute values are used in men.

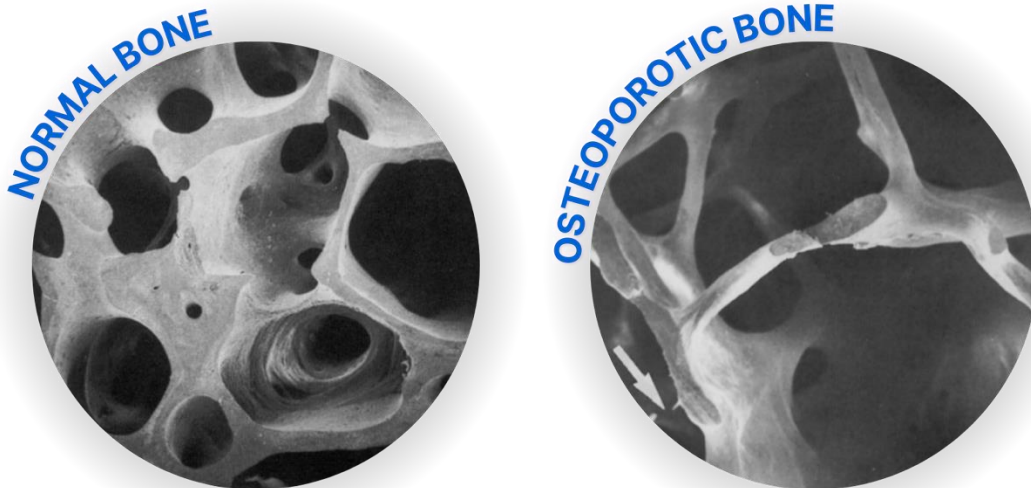
Bone Strength:

DEXA is the primary way bone density is measured, however, solely using DEXA data to measure bone health is flawed. More information regarding the best imaging for Osteoporosis will be covered in the next module.

BONE STRENGTH = BONE DENSITY + BONE QUALITY

Bone density makes up 60% of bone strength and is measured with DEXA.

Bone quality accounts for 40% of bone strength and is measured with Trabecular Bone Score (TBS) and Radiofrequency Echographic Multi Spectrometry (REMS).



Measuring bone density is independent of bone quality. Bone quality decreases with age, which means your DEXA data/bone density may stay the same but your risk fracture increases. At OBH we focus on maintaining bone quality to reduce fracture risk.

Consider adding your DEXA data to your lab tracker. If you are an OBH patient, be sure to send your team any previous DEXA, TBS, and REMS data you may have.

Why Are You Losing Bone?

Bone loss occurs for several different reasons. The primary mission of Optimal Bone Health MD is to help you identify **WHY** you are losing bone to stop boneless, rebuild bone, and reverse osteoporosis.

Contributing Factors for Bone Loss:

- Genetics
- Gut Dysfunction
- Nutrient Deficiencies
- Sarcopenia
- Chronic Stress
- Chronic Inflammation
- Hormone Imbalance
- Pharmaceuticals
- Smoking and Alcohol
- Toxins
- Bariatric Surgery

How Does Bone Loss Happen:

Bone is constantly being replaced to keep it healthy. To maintain homeostasis in your bones, your body is constantly breaking down and rebuilding bone. As you age or experience other risk factors for Osteoporosis, this process becomes less efficient and ***the net loss of bone will occur when there is an imbalance between bone breakdown and bone formation.***

Bone Remodeling: Healing of broken bones or healing bones from daily wear and tear.

Bone Resorption: Old bone cells are removed (bone breakdown). Bone resorption is a necessary part of maintaining healthy bones.

Bone Formation: New bone is built!

Preventing Bone Loss:

Preventing bone loss relies on identifying the root cause of **YOUR** bone loss. To uncover where your bone loss is coming from, use the 4R Bone Optimization Method and the tools contained in the program to guide your journey.

4R Bone Optimization Method:

- Recognize
- Reverse
- Retest
- Revive

To efficiently revive your bones, we assess five key components of Bone Health.



- Nutrition
- Gut Health
- Exercise
- Nutraceuticals
- Pharmaceuticals (based on discussions with your physician and your health priorities).

Each of these will be covered in depth in upcoming modules.

Risk Factors & Causes

Understanding the risk factors for Osteoporosis is an incredibly important starting point!

RECOGNIZE is the first "R" of the 4R Bone Optimization method for a good reason. If we don't know what's causing your bone loss, how will we know how to stop it?

Blood work and Functional Testing are Helpful, and covered in future modules, but we need to take holistic look at your ENTIRE Osteoporosis Story to truly understand the root cause of your bone loss.

Risk Factors for Osteoporosis:

- Genetics
- Nutrient Deficiencies
- Gut Health
- Sarcopenia
- Chronic Stress
- Inflammation
- Hormones
- Pharmaceuticals
- Lifestyle - Smoking/Alcohol Use
- Bariatric Surgery
- Peak Bone Mass

It's easier to stop bone loss than it is to reverse bone loss.

Genetics:

Up to **80% of Peak Bone Mass** is determined by genetics! If you have a family history of osteoporosis or if you or someone you know has a parent who has experienced a fragility fracture, the risk of Osteoporosis is significantly higher!

However, just because you have a genetic predisposition to Osteoporosis does not mean that you don't have the ability to build bone. But we must determine where your bone health is so we can make a clear plan for what to do next.

Nutrient Deficiencies:

One of the most common reasons, we see low bone mass, is related to nutrient deficiencies. Nutrient deficiencies are multifactorial. Nutrient deficiencies can be caused by chronic dieting, only having access to poor quality food,

In the US, many deficiencies are caused by only having access to poor quality food,

Bone metabolism requires the right building blocks!

Key nutrients for Bone Metabolism:

- Calcium
- Vitamin D
- Vitamin K
- Vitamin B6
- Vitamin B12
- Folate
- Boron
- Magnesium
- Zinc
- Copper
- Phosphorus

***These nutrients will be discussed in depth in the nutrition and supplementation modules.*

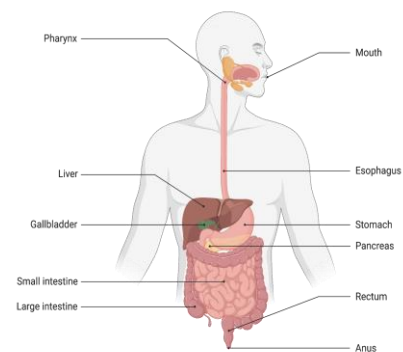
To get adequate amounts of these necessary nutrients, prioritize whole foods, non-toxic plants, fruit, vegetables, and animal products. Aim for minimally processed food sourced from high quality production means when possible. If possible, aim for local, organic, or regeneratively grown/raised food.

Gut Dysfunction:

Gut dysfunction is a broad term used to address the improper functioning of the GI tract. The term “gut” is used because ultimately the dysfunction impacts the intestinal tract, however the dysfunction can occur anywhere along the GI tract which starts at the mouth and ends at their anus. If you have a history of any GI dysfunction, this should be discussed with your team to uncover how it may be impacting your bone health.

Two commonly overlooked GI conditions that have a significant impact on bone health are Acid Reflux/GERD and Celiac Disease.

Digestive System



*Salivary glands

Acid Reflux/GERD:

When Gastroesophageal reflux disease (GERD) is diagnosed, many people are prescribed medication to reduce stomach acid. However, 40% of post-menopausal women have low stomach acid. Low stomach acid often presents in the same way as Acid Reflux/GERD or heartburn. When your body doesn't produce adequate amounts of stomach acid, it is more difficult for your body to digest food and it ends up sitting your stomach longer, which then causes the GERD symptoms. This contributes to further development of Osteoporosis as a result of stomach acid suppression inhibiting optimal digestion and absorption. By optimizing your stomach acid levels (if needed), your body will be able to move food through the GI tract quickly, decrease reflux symptoms, improve digestion, and improve absorption of nutrients.

Celiac Disease:



Celiac Disease is an immune condition to eating gluten, the protein found in wheat, barley, and rye. Celiac disease causes the finger-like projections in the gut called microvilli, to deteriorate and flatten. Microvilli are responsible for nutrient absorption and they Those with Celiac disease have a 5x greater risk of developing osteoporosis than those without Celiac disease. Celiac Disease presents on a spectrum from mild disease, those in this category may not even know they have it, to severe disease and early diagnosis.

There is no difference in the rate of Osteoporosis with increased severity of Celiac. This means that many people with mild/undiagnosed celiac may end up with Osteoporosis before they even know they have Celiac Disease!

We will further discuss Gut Dysfunction and its role in Osteoporosis in the Gut-Bone Axis Module.

Sarcopenia:

Sarcopenia is the loss of muscle as a result of the aging process. This is a natural part of the aging process, but we can control how quickly this happens and mitigate loss as much as possible.

Muscle mass is directly related to bone mass. You are 2x more likely to have osteoporosis if you have sarcopenia (1).

Reduce Muscle Loss:

- Consume Adequate Protein
- Resistance Training
- Hormone Optimization

Chronic Stress:

Stress is a risk factor for Osteoporosis. We know that taking corticosteroids rapidly increases bone loss. But the natural production of cortisol, your body's stress hormone, will have the same effect (2), although it will be more subtle.

By practicing stress management techniques and getting adequate sleep, you can mitigate the production of cortisol and keep your cortisol levels within normal limits. Review Measuring Bone Health Part 2 for additional information on cortisol and how to test it.

Chronic Inflammation:

Not all inflammation is created equal. Short-term inflammation is part of the healing process in the body. It's the natural process of fighting illness, healing from an injury, or repairing muscle after exercise. Chronic inflammation is associated with most chronic disease; heart disease, diabetes, stroke, and arthritis. Chronic inflammation also contributes to Osteoporosis (3).

Inflammatory molecules called cytokines increase during times of inflammation. The chronic activation of cytokines creates an elevated inflammatory response, overactive or underactive immune system, and can result in damaged tissues.

Hormones:

Primary Osteoporosis is the development of Osteoporosis as a result of the loss of estrogen in women and decrease in estrogen as a result of reduced testosterone in men.

Unfortunately, it's not as simple as replacing hormones and eliminating bone loss. We see bone loss begin early in several of our patients before hormone levels begin to decline. However, replacing hormones can be a powerful tool in your bone health journey.

Hormones are not FDA approved to treat bone loss, but we have seen effects of reduced bone loss and bone building in those who are treated for hormone dysfunction.

When assessing hormone status, you should assess Estrogen, testosterone, and progesterone in women and estrogen and testosterone levels in men with a Prostate-Specific Antigen test (men only) to ensure that testosterone replacement is a safe.

Hormone replacement is not for everyone, there are risks that are higher in specific patient populations. Always review the risks with your healthcare provider before beginning hormone replacement therapy.

Pharmaceutical Contributors:

Many pharmaceuticals can contribute to osteoporosis. We have included a non-exhaustive list below. Do not discontinue any medications before speaking with your healthcare provider first. Use this list as a tool to open the conversation about the medications use and the risks and benefits of continuing as it relates to Osteoporosis and overall health.

These are medication classes; you may need to look up your specific medications to determine what type of medication they are. You can always review the risk of Osteoporosis and side effects of your current medications with your pharmacist.

Pharmaceuticals:

- PPI/H2 Blockers
- Oral Birth Control
- Thiazolidinediones
 - Avandia/Actos
- Benzodiazepines
- SSRI/SNRI
- Anticonvulsants
 - Often benefits outweigh the risks of Osteoporosis - work with your team to support bone health!
- Nutrient Depleting Medications
 - Metformin
 - Blood Pressure Medications
- And More!

DO NOT stop any medications without guidance from your healthcare provider. Withdrawal from some medications can cause death.

Smoking & Alcohol:

There are no health benefits from smoking and consuming alcohol. Regardless of bone health status, these lifestyle behaviors should be discontinued for optimal health.

Tobacco & Nicotine:

Nicotine depresses osteoblast function. Cadmium in Nicotine activates osteoclast function and increases cortisol both of which have a negative effect on bone health.

Alcohol:

Alcohol is often thought of as safe in moderation with a standard recommendation of 1 drink for women and 2 drinks for men per day. However, more than 2 drinks per day increases the risk of hip fracture by ~70% (4) and **1 drink per week** increased the risk of breast cancer.

Outside of the potential health implications. Alcohol is routinely relied on as a coping mechanism. There are additional health benefits that come from learning how to exist without alcohol as a crutch to alter our mental state. Learning to cope with anxiety, participate in social situations, and find fun outside of alcohol are incredibly important skills!

Bariatric Surgery:

There are different variations of bariatric surgery that may impact nutrient absorption more than others. If you have undergone gastric bypass surgery, otherwise called a Roux-en-Y, you need to be particularly mindful of your bone health. A Roux-en-Y not only involves removing a portion of the stomach, but also bypassing the portion of the small intestine where a majority of nutrients are absorbed.

The Duodenum is completely bypassed as well as most of the jejunum (the upper portion of the small intestine). Additionally, the portion of the stomach that is bypassed is responsible for stomach acid production, which we discussed earlier in this module. Combined, this results in increased Parathyroid Hormone and increases osteoclast activity (5).

Figure 1: Gropper, S. S., Smith, J. L., & Carr, T. P. (2022). *Advanced Nutrition & Human Metabolism* (8th ed., p. 50). Cengage.

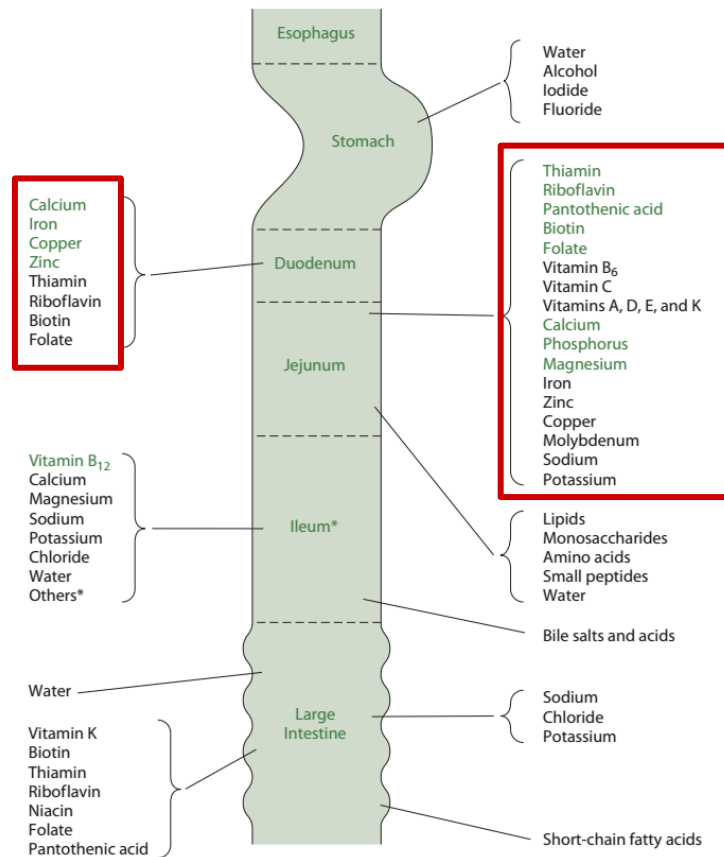


Figure 2.16 Primary sites of nutrient absorption in the gastrointestinal tract.

Peak Bone Mass:

Unfortunately, the only way to know if you reached peak bone mass is to get a DEXA in early adulthood, which is very uncommon. If you have a family history of Osteoporosis, you may consider advising your children to get a DEXA done early to take proactive steps to prevent bone loss.

Your peak bone mass is dependent on a combination of genetics, activity level, and diet as an adolescent.

What Imaging is Best for Bone Health?

The first step to assessing your bone health risk is receiving the proper imaging. Rates of screening for Osteoporosis are declining and only ~10% of those who should be screened end up getting the appropriate testing. The traditional criteria for bone density screening are below. If you pay attention to the risk factors you can see that most people meet the criteria for screening but most don't get screened until they have lost considerable bone.

Traditional Criteria for Bone Density Screening:

- Traditional Screening Criteria
 - Women over 65 years old
 - Men over 70 years old
- OR under 65 with 1 or more additional risk factors
 - History of an eating disorder
 - Chronic stress
 - Poor gut health
 - A sedentary lifestyle
 - Poor diet or nutritional deficiency
 - Excessive alcohol use
 - History of smoking
 - Diabetes, prediabetes, or metabolic disease
 - Adrenal dysfunction
 - Chronic Inflammation
 - Use of steroids in the past for more than 7 days
 - Use of medications for depression (SSRI's) or GERD/heartburn (PPI's)

4 Imaging Tests for Osteoporosis:

- DEXA
- DEXA with TBS
- Echolite REMS
- Dynamic CT

DEXA:

Dual Energy X-Ray Absorptiometry (DEXA) is a low dose X-ray that measures bone density. Currently, DEXA is the gold standard for osteoporosis imaging and it is widely available and easy to access. However, there are limitations of a DEXA scan. The results vary between machines and operators; therefore, you want to be retested on the same machine if possible. Additionally, it only measures bone density, not bone quality and the scan is slow to reflect changes from treatment.

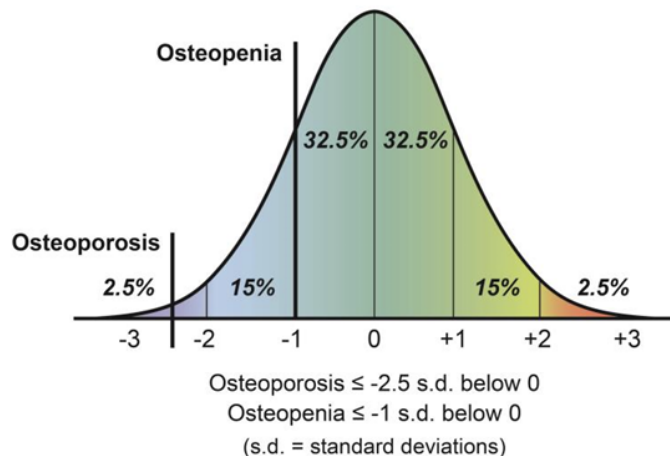
It is recommended that you receive a DEXA every 2 years unless of pharmacologic treatment. However, 2 years is a long time to wait to see if you've made progress toward your bone health goals. We recommend using bone turnover markers to provide intermediate data between DEXAs to assess how your bone might be changing. You can learn more about bone turnover markers in the Measuring Bone Health Modules.

DEXA data is presented as either a t-Score or a z-score.

T-scores: used for post-menopausal women, men over the age of 50, and as an indication for osteoporosis treatment. A t-score is the number of standard deviations away from the *average result of a healthy ~30-year-old of the same sex and ethnicity.*

Z-scores: sometimes used for pre-menopausal women and men under the age of 50. A z-score is the standard deviation away from the *average result of a healthy adult of the same sex and the same age.*

Figure 1: Bone Density Scores and Standard Deviation



A bone density bell curve demonstrating how T and Z scores are obtained.

T scores and Z scores represent the number of standard deviations from median bone density. For 100 percent of patients, the 2.5% with the lowest bone density will be classed as having osteoporosis. Another 15% will be classed with osteopenia. Note that this is always in comparison to a young healthy person of the same gender.

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The difference between t-scores and z-scores are what population your data is being compared to. Many patients express frustration about the design of a t-score and over time it will demonstrate osteopenia and even osteoporosis in most people if they live long enough. Comparing bone quality to a 30-year-old as a 90-year-old does seem like an unfair comparison. However, comparing the bone density of a 90-year-old to other 90-year old's doesn't help us to understand the risk associated with the decline. So, we have to accept that yes, a t-score will eventually show osteoporosis in most people if they live long enough but its power lies in the difference between peak bone mass and where they are now.

For more information on DEXA, [review this resource.](#)

DEXA with TBS:

DEXA with Trabecular Bone Score (TBS) estimates the bone architecture, quantity, and quality of bone. The biggest limitations for DEXA with TBS are that the results can be limited by arthritis, surgery, or deformity of the bone. We have not found this to be as useful as the other studies available to us such as REMS.

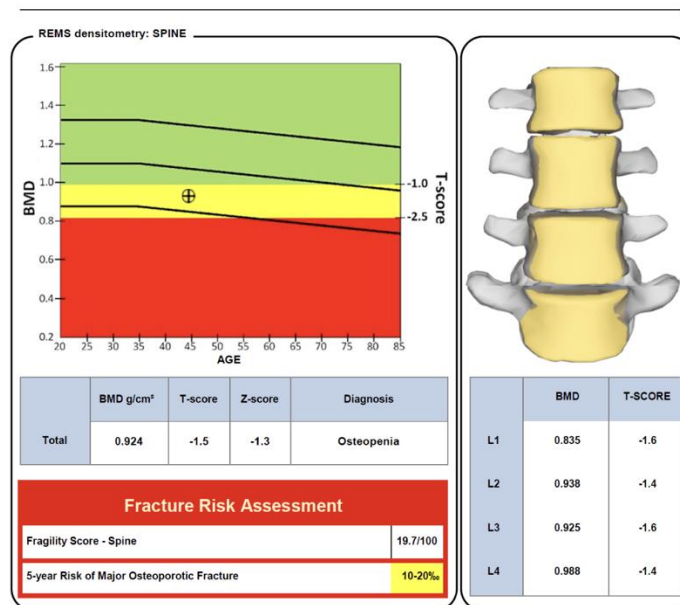
Quantitative CT:

A quantitative CT to assess your bone health provides a more detailed analysis than DEXA, provides more views of the bone, improving the analysis, and it provides better insight into past injuries. Unfortunately, these scanners are difficult to find and if available expose you to more radiation than could be recommended on a repeating basis.

Echolite REMS:

Radiofrequency Echographic Multi Spectrometry (REMS) measures both bone quality and bone without the use of radiation. It is an ultrasound exam and is an accurate method of measuring bone health and provides a better evaluation of your fracture risk. It will also measure changes in bone health in a shorter period of time compared to DEXA.

The biggest limitation for REMS is access. There are few locations that have REMS machines. Additionally, it is generally not covered by insurance. If you are interested in REMS and you are an Optimal Bone Health patient, please reach out to your team.



Measuring Bone Health – Part 1

As previously discussed, DEXA is not the only way to measure bone health. It's important to have a comprehensive analysis of all the factors that contribute to bone health.

In the Additional Resources section of this module, you will find a Google spreadsheet to track your labs. If you prefer to track your labs on paper, you will be able to download and print a PDF with the lab recommendations and reference ranges. For those working with Optimal Bone Health, your labs are included in the cost of your program and your physician and dietitian team will be reviewing your data and creating a comprehensive custom health plan.

The labs listed below are specifically for bone health optimization. They may have other health implications; however, this is not a complete list of labs that are recommended for clients working within the Optimal Bone Health program. For clients who have signed up for one-on-one support, you will receive a comprehensive lab analysis that assesses multiple factors that contribute to health and longevity.

Lab List for Bone Health:

Lab Name	Reference Range	Lab Name	Reference Range
Vitamin D	60-100 ng/dL	Omega Check	8-12%
Magnesium RBC	5.8-6.5 mg/dL	AM Cortisol	< 12 µl/dL
Zinc RBC	1200-1660 µg/dL	Hs-CRP	< 1 mg/L
Vitamin B12	1000-1200 pg/mL	P1NP	80 - 100 µg/L
Homocysteine	<7 µmol/L	CTX	200 – 300 pg/mL
Folate	>20 ng/mL		

Home Testing Options:

If you are not a member of the Optimal Bone Health one-on-one program, you may have some difficulty accessing the labs you need. You can always request that your Primary Care Physician (PCP) order the recommended labs, however, this will vary based on your PCP's comfort level with these labs and your insurance coverage for the labs may vary. Please be aware that if running these labs through insurance your costs may actually be higher. Private insurance and Medicare may not cover these labs and if they don't lab companies will bill you the insurance rates for the cost of the labs. This can be 10 times the cash rates and once the lab is drawn you cannot go back. We include labs for our patients at cash rates for this reason and to keep the costs consistent and predictable.

There are cash-based home testing options that you can pursue, you can find these recommendations and links in the module description since they are subject to change. These labs will typically be an out-of-pocket cost but comparable to the price you would pay as part of

a one-on-one program. To find home testing options, start by searching the recommended test at Quest, LabCorp, and Life Extension.

After you have been tested, it is best practice to work with a qualified healthcare provider who is knowledgeable in bone health and osteoporosis to interpret the labs and make recommendations. This module demonstrates the optimal ranges that we use in our Optimal Bone Health MD programs but how to get there is an art and guidance may be required.

Lab interpretation is not as black and white as staying within the reference ranges. There are often nuances that can be uncovered by seemingly normal ranges when working with a trained professional. Remember, your lab results aren't always stand-alone pieces of data, there are interactions and connections between the labs that you might not be able to find in a google search.

Optimal Bone Health Labs - Female

- Uric Acid (001057)
- Phosphorus (001024)
- Complete Blood Count (CBC) With Differential (005009)
- Comprehensive Metabolic Panel (CMP-14) (322000)
- Hemoglobin (Hb) A1c With eAG (102525)
- Lipid Panel + VLDL + Non-HDL Cholesterol + TC/HDL Ratio (346644)
- Fibrinogen Activity (Factor I Activity) (001610)
- Insulin (004333)
- Magnesium, RBC (080283)
- Cortisol, AM (104018)
- C-Reactive Protein (CRP), High Sensitivity (120766)
- Zinc, RBC (070029)
- Ferritin + Iron + Total Iron-binding Capacity (TIBC) (324741)
- Vitamin B12 and Folates (000810)
- Thyroid Antibodies (Thyroglobulin Antibody + Thyroid Peroxidase (TPO) Antibody) (006684)
- Apolipoprotein B (167015)
- DHEA-S (Dehydroepiandrosterone Sulfate) (004020)
- Calcium, Ionized (004804)
- Parathyroid Hormone (PTH), Intact (015610)
- Vitamin D, 25-Hydroxy (081950)
- Homocysteine (706994)
- Insulin-like Growth Factor 1 (IGF-1) (010363)
- Testosterone, Free, Direct With Total Testosterone (140103)
- Follicle-stimulating Hormone (FSH) and Luteinizing Hormone (LH) (028480)
- Reverse T3 (070104)
- TSH+T3Free+T4Free Reflex to TPO* (237393)
- Progesterone (4317)
- Lipoprotein-Associated Phospholipase A2 Activity (PLAC®) (123283)
- Estradiol (4515)
- C-Telopeptide (Collagen Cross-linked C-Telopeptide) (500089)
- Intact N-Terminal Propeptide of Type 1 Procollagen (140850)
- OmegaCheck (TM) (EPA+DPA+DHA) (823430)
- Lipoprotein (a) (120188)

****Initial Female OBH Premium Lab Panel 4.2023***

IMPORTANT: These numbers reflect LABCORP test codes and can only be used at LABCORP testing facilities. The use of these codes at any other facility may result in the wrong markers being tested. If you are using a facility other than LabCorp it is your responsibility to make sure the correct listed marker is used as named.

Optimal Bone Health Labs - Male

- Uric Acid (001057)
- Phosphorus (001024)
- Complete Blood Count (CBC) With Differential (005009)
- Comprehensive Metabolic Panel (CMP-14) (322000)
- Hemoglobin (Hb) A1c With eAG (102525)
- Lipid Panel + VLDL + Non-HDL Cholesterol + TC/HDL Ratio (346644)
- Fibrinogen Activity (Factor I Activity) (001610)
- Prolactin (004465)
- Insulin (004333)
- Magnesium, RBC (080283)
- Cortisol, AM (104018)
- Prostate-specific Antigen (PSA) (010322)
- C-Reactive Protein (CRP), High Sensitivity (120766)
- Zinc, RBC (070029)
- Ferritin + Iron + Total Iron-binding Capacity (TIBC) (324741)
- Vitamin B12 and Folates (000810)
- Thyroid Antibodies (Thyroglobulin Antibody + Thyroid Peroxidase (TPO) Antibody) (006684)
- Apolipoprotein B (167015)
- DHEA-S (Dehydroepiandrosterone Sulfate) (004020)
- Calcium, Ionized (004804)
- Parathyroid Hormone (PTH), Intact (015610)
- Sex Hormone-binding Globulin (SHBG) (082016)
- Vitamin D, 25-Hydroxy (081950)
- Homocysteine (706994)
- Insulin-like Growth Factor 1 (IGF-1) (010363)
- Testosterone, Free, Direct With Total Testosterone (140103)
- Follicle-stimulating Hormone (FSH) and Luteinizing Hormone (LH) (028480)
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- Estradiol (4515)
- C-Telopeptide (Collagen Cross-linked C-Telopeptide) (500089)
- Intact N-Terminal Propeptide of Type 1 Procollagen (140850)
- OmegaCheck(TM) (EPA+DPA+DHA) (823430)
- Lipoprotein (a) (120188)

****Initial Male OBH Premium Lab Panel 4.23***

IMPORTANT: These numbers reflect LABCORP test codes and can only be used at LABCORP testing facilities. The use of these codes at any other facility may result in the wrong markers being tested. If you are using a facility other than LabCorp it is your responsibility to make sure the correct listed marker is used as named.

Bone Turnover Markers:

Bone Turnover Markers can provide additional insight into your bone health between imaging studies. They demonstrate the balance of bone metabolism and are crucial in the process of understanding your progress.

C-Telopeptide Cross-Linked (CTX): Measures OsteoCLAST function or bone breakdown. The optimal range for CTX is between 200-300 pg/mL.

Intact N-Terminal Propeptide of Type 1 Procollagen (P1NP): Measures OsteoBLAST function or bone building activity. The optimal range for P1NP is 80-100 ug/ml. For those that need to build bone, we want your levels as close to or above 100 ug/mL as possible.

Calcium:

Serum calcium is **NOT** a helpful marker to assess bone health. Your body is great at maintaining blood levels of calcium by pulling calcium from the bone when intake of dietary calcium is low. This will further progress osteoporosis. Measuring serum calcium can be helpful when looking for treatment response to vitamin D. If serum calcium rises above the reference range vitamin D levels may be too high. Discuss these findings with your healthcare provider if you find them.

A 24-hour urinary calcium can be used to more accurately assess calcium loss. However, reliance on this tool to determine adequate calcium intake is also fraught with potential errors. Urinary calcium is only showing us the results of mineral metabolism and if you have high levels in urine it could be from the breakdown of bone, dietary intake, or acid-base buffering. We have stopped using this as a tool in the Optimal Bone Health MD programs because it is often misleading and confusing for patients.

Focus on tracking your calcium intake and maintaining calcium balance through diet and/or supplementation. Do NOT use large doses of calcium alone. The evidence clearly shows that this will increase the risk of heart attack.

Parathyroid Hormone (PTH):

Parathyroid Hormone is used to assess potential underlying causes of osteoporosis or **Secondary Osteoporosis**. PTH regulates calcium resorption.

Secondary osteoporosis: is typically the result of an endocrine abnormality, chronic disease, or as a result of taking specific medications that are known to contribute to secondary osteoporosis.

- Hyperthyroidism
- Hypogonadism
- Cushing's Syndrome
- Hyperparathyroidism
- Malabsorption
- Immobilization
- Liver disease
- Renal Disease
- Medications

High PTH may be related to vitamin D deficiency or indicate a cause of secondary osteoporosis like parathyroid tumors and rarely cancer. If your levels are high, discuss it with your healthcare team urgently. If they are slightly elevated, consider supplementing with vitamin D while you wait for your appointment. When they repeat the labs you may see a resolution of the issue.

The normal range for PTH is 10-65 (pg/mL). The reference range may vary based on the laboratory.

Homocysteine:

Homocysteine is a marker of B vitamin metabolism and methylation status. The optimal range for homocysteine is <7 μ mol/L.

Elevated homocysteine is associated with:

- Bone Loss
- Dementia
- Heart Disease

Homocysteine is a marker for the process of methylation. Methylation is a biochemical process that occurs constantly in the body and is how we activate vitamins in order to use them in reactions. Genetics plays a role in how we effectively methylate and can be measured by looking at MTHFR genes and others. If homocysteine is high you either have deficient nutrients (B-vitamins, choline, creatine) or are not efficiently methylating. We will discuss supplement recommendations for these scenarios in the supplement section.

Vitamin D:

Vitamin D supports bone health by interacting with PTH and calcium absorption. At high levels, vitamin D can be toxic so you should limit your vitamin D supplementation to 1000 IU or 25 mcg unless working with a physician or dietitian. The optimal range for vitamin D is between 80-100 ng/mL, but if you are not working closely with a practitioner you should aim for levels around 60 ng/mL to mitigate risk of vitamin D toxicity.

When supplementing with high doses of vitamin D, test your levels at the following intervals.

5,000 IU: Test in 6 months.

10,000 IU: Test in 3 months.

Be mindful of how much vitamin D is contained in other supplements you are taking. Learn more about supplementing with vitamin D in the supplements section.

Omega-3 Fatty Acids:

Omega-3 fatty acids are a form of polyunsaturated fatty acids (PUFA) that support heart, brain, and bone health. Omega-3s are essential for an optimal health span because they reduce systemic inflammation and act as an antioxidant.

Interpreting Omega-3 labs can be complicated because optimal lab ranges are based on the balance between EPA and DHA. Work with a qualified healthcare provider to dial in your Omega-3 balance.

As a general rule of thumb, aim for 1,000-1,500 mg of Omega-3s per day (EPA and DHA combined).

C-Reactive Protein (CRP):

CRP is a marker of inflammation. It's one of the few tools we have to assess systemic inflammation, however, CRP is very volatile and is easily influenced by acute inflammatory events like surgery, a cold or even a hard workout. Take it easy the day before your blood work for more accurate levels.

Measuring inflammation is critical for optimizing bone health. High levels of inflammation create an environment for bones to break down.

The optimal range for CRP is <1 mg/dL.

Hormones:

Optimal hormone levels are critical components of bone health. Estrogen, progesterone and testosterone should be optimized for both men and women. Post-menopausal women are at an increased risk for bone breakdown due to a reduction in sex hormone production.

Interpreting hormone labs is a complex process and involves assessing hormone balance and symptoms. This analysis involves clinical judgment and expertise and should be discussed and managed with a qualified healthcare provider. There are broad differences of opinion in this space. Seeking out a bio-identical hormone provider is a good start.

Hormone labs will be covered in depth in Part 2 of this module.

Testosterone:

Testosterone deficiency can result in sarcopenia (loss of muscle) which is associated with bone loss. Increasing testosterone can improve muscle mass and, secondarily, bone health. Testosterone also directly impacts osteoblasts which will improve bone building.



Estradiol:

Estradiol is one of three primary estrogens in the human body. It plays the greatest role of the three in osteoclast function and when absent results in rapidly increasing breakdown of bone. Estriol is often replaced with estradiol to balance symptoms and mitigate risk. Estrone can be measured to verify proper metabolism of estrogens.



Magnesium:

Magnesium is not just critical for bone health. It's used in over 300 metabolic actions, making optimal magnesium levels critical for bone health and healthspan.

Magnesium supports vitamin and calcium metabolism, therefore, building bone requires magnesium and deficiency has a negative impact on bone health.

Serum magnesium is not a helpful marker for magnesium stores. When getting labs, opt for RBC Magnesium. The goal range for RBC Magnesium is 5.8 mg/dL to 6.5 mg/dL.

B Vitamins:

There are several B vitamins that play a role in optimal health; however, they are not all easy to measure. For optimal bone health, focus on vitamin B12 and Folate. Vitamin B12 and Folate play a role in the methylation cycle.

Vitamin B12: supports homocysteine reduction, energy levels methylation and detoxification cycles. Deficiency is associated with dementia, metabolic disturbances and osteoporosis. The goal range for vitamin B12 is >1000 pg/mL.

Folate: or vitamin B9 supports homocysteine reduction, methylation, and detoxification cycles. The goal range for folate is >20 ng/mL.

Celiac Testing:

Osteoporosis can be a result of untreated Celiac Disease. Celiac Disease can be easily tested at home to rule out this potential cause.

Those with unmanaged Celiac disease will have damage to their gut lining that prevents nutrients from being absorbed. This will impact the absorption of calcium and vitamin D, resulting in poor bone mineral density.

Testing Options:

Life Extension:

- Deaminated gliadin IgA
- Tissue transglutaminase IgA

Functional Testing:

- Non-celiac Gluten Sensitivity
- Vibrant

If you have severe gastrointestinal symptoms, you should see a gastroenterologist for a complete workup including colonoscopy

Special Note: If you have already been avoiding gluten, you will likely not have a positive result from a biopsy or test for celiac disease

Ordering Labs:

To get Bone Turnover Markers and other relevant labs, Life Extension offers direct to consumer labs, [learn more about their testing services here](#). If you want to [order Bone Turnover Markers](#) you will find self-pay options on Life Extension as well.

To easily track your labs over time, use these digital lab trackers, or download the pdf that accompanies this module.

Get a Copy our Digital Lab Tracker:

- [Men's Lab Tracker](#)
- [Post- Menopausal Women's Lab Tracker](#)
- [Pre-Menopausal Women's Lab Tracker](#)

Measuring Bone Health – Part 2

To help you better understand the interconnectedness between bone health and the rest of your symptoms, this module will take a deeper dive into hormones, functional testing, and bone health labs.

Estrogen:

Estrogen supports the health of bone cells, therefore, both men and women benefit from optimized estrogen levels. Optimized levels vary based on sex.

Women: Estrogen deficiency can be a primary cause of osteoporosis.

Men: Testosterone is the primary sex hormone but is converted to estrogen in small amounts. Low testosterone will therefore reduce estrogen levels and is a risk factor for osteoporosis in men. We are seeing an epidemic of low testosterone putting men at an increased risk for fracture.

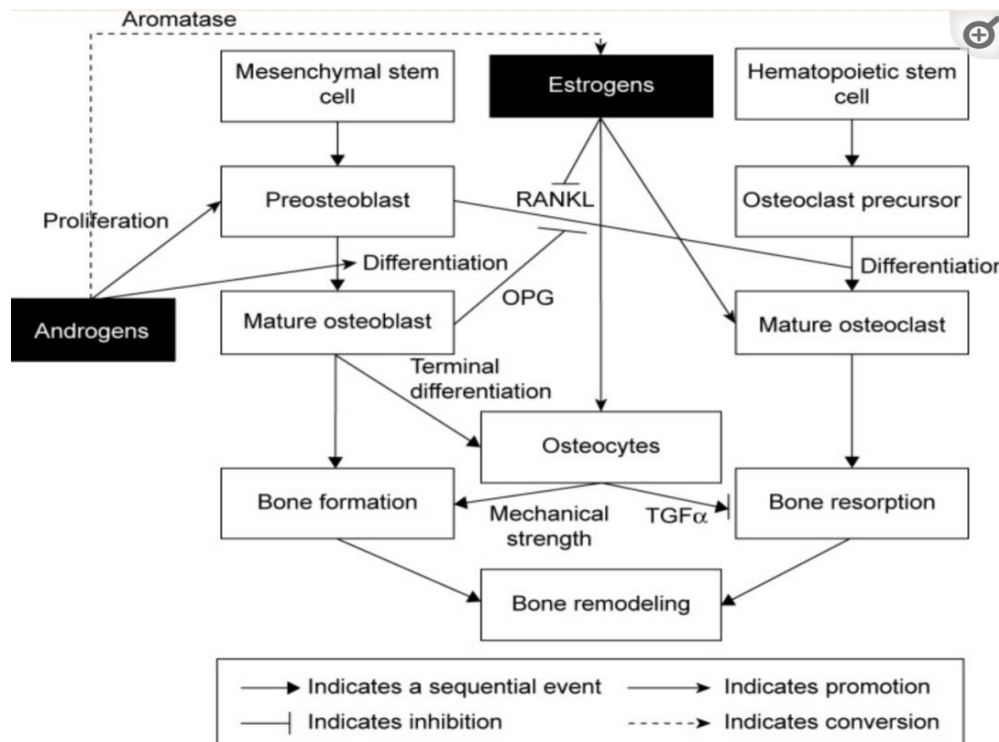


Figure 2: Mohamad, et al. 2016 (6)

Progesterone:

Progesterone is only tested in women.

Progesterone is a critical component of bone health for women. It increases osteoblast differentiation and supports peak bone mass. Progesterone is needed to balance estrogen and must be present monthly. Deficiency can lead to symptoms in multiple systems and must be considered in any replacement strategy for women regardless of the presence of a uterus (7).

Ovarian hormones and folliculogenesis throughout the human menstrual cycle

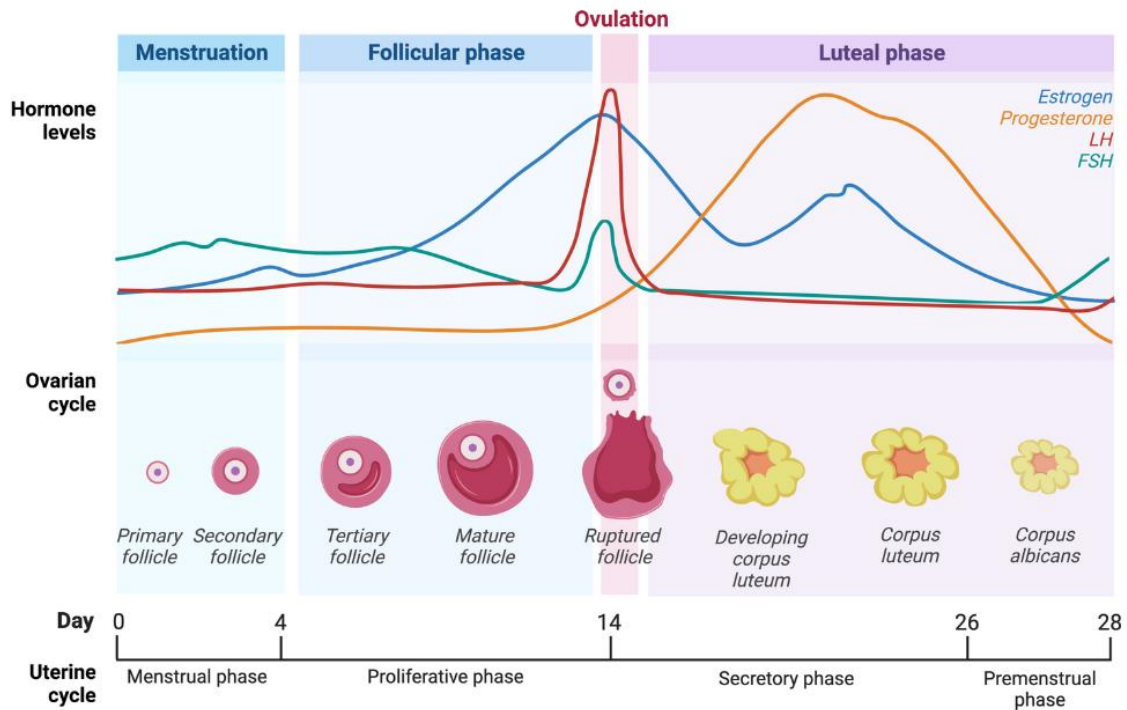


Figure 3 Custom Image from BioRender

Women's hormones fluctuate monthly and the impact on bone building fluctuates in response to your cycle. Alterations in your cycle from lifestyle and some forms of birth control will disrupt this cycle and your bone health.

Testosterone:

Testosterone deficiency impacts bone mineral density in men and women, but it is the primary cause of osteoporosis in men. Testosterone stimulates the production of osteoblasts and decreases the rate of osteoblast cell death, promoting bone synthesis.

Testosterone deficiency stimulates RANK-L, stimulating osteoclast production.

Testosterone is a key component for building muscle in both men and women, leading to increased muscle mass which supports strong bones.

DUTCH Testing:

To better understand your own personal hormone balance, a DUTCH test can provide significant insight. DUTCH Tests can help map your cycle to better understand where you might be experiencing dysregulation. This test is difficult to interpret and should be assessed by a qualified healthcare provider with experience interpreting the DUTCH test.

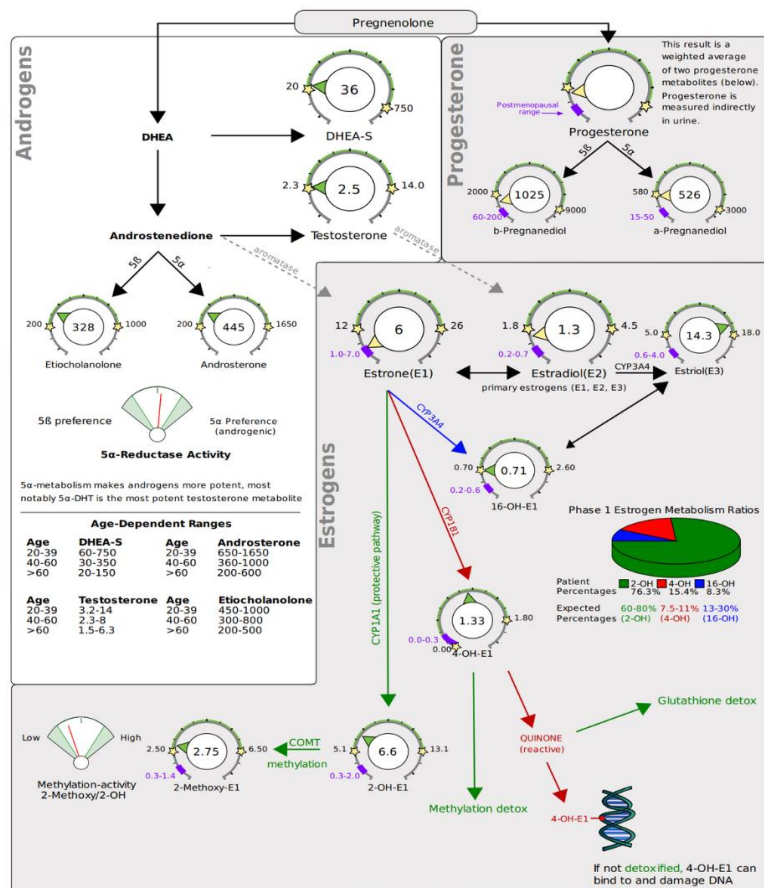


Figure 4 Sample DUTCH Test from Precision Analytics

Functional Testing Overview:

Functional Testing takes a deeper look at what is happening in your body, however, getting the right functional tests at the right time and in the right order is challenging.

Some functional tests may be altered by dysfunctions of other body systems. As we discuss the functional tests, we will make note of these potential contraindications.

The best way to be sure that you are spending your money wisely is to work with a qualified team who can order and interpret the results.

The rest of this module will take a deeper look into the following functional tests:

- Stool Testing
- Nutrient Analysis
- Organic Acid Testing (OAT)
- Toxins Panel
- Food Sensitivity Testing
- DUTCH Test
 - Hormone Pathway Deep Dive
- Daily Cortisol Testing

Stool Testing:

Review the Gut Bone Connection Module for more insight into the impact of Gut Health and Osteoporosis and what actions you take to improve gut health without a stool test.

The information provided in a stool test varies based on the company you use. We recommend looking for a stool test that looks deeper than just bacterial balance to ensure you can uncover why you might be experiencing dysbiosis in the first place.

The benefits of a stool test allow you to understand your body's ability to digest and absorb the nutrients you are putting into it. If you have significant GI symptoms, you should work closely with a functionally trained GI physician or dietitian.

Key Elements of an Effective Stool Test:

- Assesses maldigestion with fecal elastase and byproducts of digestion.
- Assesses inflammation in the gut
- Assesses secretory IgA to gain insight into intestinal permeability
- Tests for parasites
- Assesses Short Chain Fatty Acid production
- Assesses yeast or methane bacterial overgrowths
- Assesses microbiome diversity

Ordering your own stool test*:

- [GI Effects](#)
- [GI MAP](#)

*Stool Tests require a trained practitioner to interpret their results. These companies may offer interpretation for a fee. It is strongly recommended NOT to use generic recommendations for altering your gut health because you run the risk of doing more harm than good.

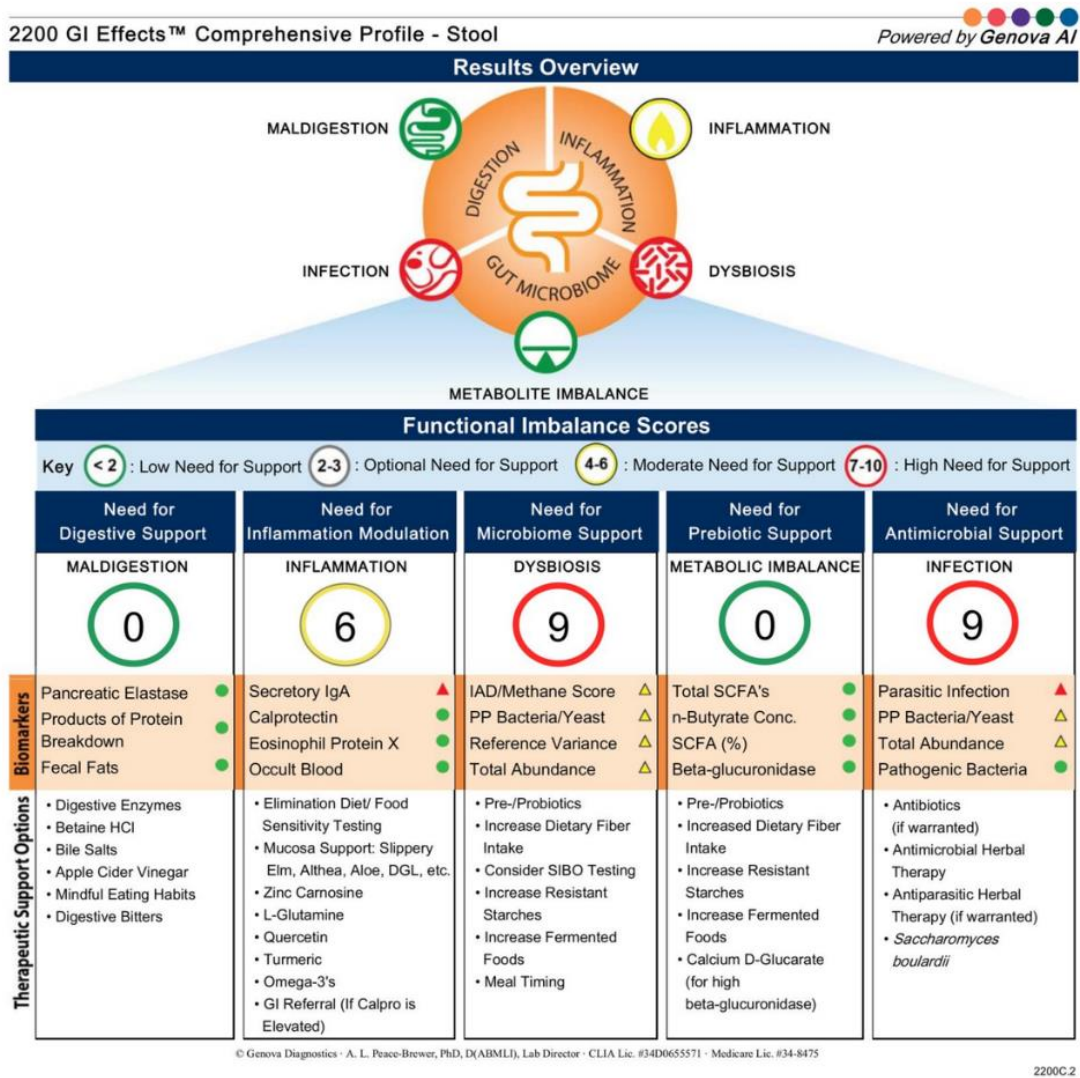


Figure 5 Sample GI Effects report from Genova Diagnostics.

Nutrient analysis:

Functional Nutrient Analysis tests look deeper than traditional blood tests. These tests can be very valuable for assessing what nutrients your body is absorbing and how your body is using them. Serum levels are not always accurate representations of your total nutrient status. This is why our standard Optimal Bone Health lab panel only assesses a small number of nutrients. The nutrients on our panel are clinically significant when measured as Serum or RBC levels.

Tests we recommend for a thorough assessment of nutrient status measure blood markers and metabolic byproducts to show how efficiently your body is using the nutrients you are supplying.

Ordering Your Own Nutrient Analysis:

- NutraEval
- Metabolomix
- Organic Acids Test (OAT)

Special Note: Nutrient status is impacted by the health of your GI tract. If you have any concerns about GI dysfunction, you should prioritize a stool test over nutrient analysis due to the impact your gut health has on the absorption of micronutrients. Once you see improvement in GI status, consider additional nutrient testing.

Food Sensitivity Testing:

Food sensitivities can impact GI health and function, however, several products on the market will not effectively analyze food sensitivities and result in over-restriction of foods that may be well tolerated. If you are concerned about food sensitivities, it's strongly encouraged that you work closely with a trained physician, dietitian, or team.

Food sensitivity testing is not a perfect science, these tests should be used as a guide to creating an elimination diet. After an elimination period of a minimum of 30 days, the excluded foods should be reintroduced to check for symptoms and verify results before excluding them for good.

Before ordering a food sensitivity test, it's important to understand the difference between an allergy, intolerance, and sensitivity. Many professionals will use these terms interchangeably; however, they are very different mechanisms of action.

Food Allergy:

Traditional food allergies are what's called an IgE mediated response. This may result in diarrhea, vomiting, or anaphylaxis. Food allergy testing is the traditional method of diagnosis but the field has changed in recent years due to the variability in response to testing and treatment.

Keep in mind, many allergists do not recognize the presence of food sensitivities.

Food Intolerance:

A food intolerance relates to your body's ability to digest a particular food. Intolerance is generally caused by your body lacking a necessary enzyme or the inability for your body to activate the enzyme. This typically results in unpleasant GI symptoms such as constipation or diarrhea. As an example, lactose intolerance is caused by the lack of the lactase enzyme that breaks down the carbohydrate in dairy products. Food Intolerance is better assessed with a stool test.

Food Sensitivity:

Food sensitivities are the result of an immune reaction to a particular food. This is similar to the metabolic reaction of an IgE mediated allergic reaction, however, a food sensitivity will activate a combination of IgG, IgA, IgG4, C3D, and other inflammatory markers in your body.

Tests that exclusively measure IgG levels should be avoided. These tests are a better marker of what you have recently eaten or eaten a lot of rather than what you are sensitive to. IgG can still be helpful when measured with other markers, however, this is one of the reasons why you must verify sensitivity with reintroduction.

Food sensitivities change based on the presence of intestinal permeability and should be measured after focusing on gut healing aided by a stool test for the most accurate results.

Food sensitivities can present in a variety of ways and impact all body systems, not just the GI tract. Use the symptom tracker to identify what symptoms you experience and uncover if they are related to the food you are eating.

Food sensitivity Testing Options:

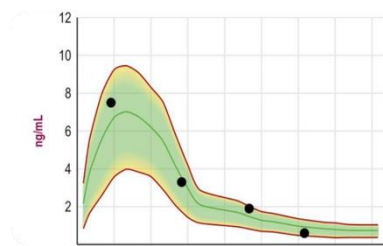
- Vibrant America Zoomers
- Cyrex

Currently, we do not recommend any at home food sensitivity test due to the lack of accuracy and subsequent over restriction.

Cortisol Testing:

Cortisol is your stress hormone and it assesses the health of your adrenal glands. Our goal is to have a balanced stress response. Ideally, you want a cortisol spike in the morning that decreases throughout the day and tapers off at night.

Morning cortisol is often tested, but assessing your cortisol levels over the course of 24 hours allows us to better understand your stress response throughout the day.



Exercise & Bone Health

After receiving a diagnosis of Osteoporosis, exercise can be terrifying, especially when you have been living an active lifestyle. Exercise is a critical component to maintaining bone health, however, it's important to understand what exercises are safe for you to participate in, which exercises promote bone health, and which exercises you may need to forgo until you've been cleared by a doctor or therapist.

Review the Bone Foundations Exercise Library to find exercises that are safe for you to participate in and will support and promote higher bone density.

Discovering what exercises are the best for bone health can be broken down into two main questions:

1. What exercises are best for stimulating bone mineral density?
2. What exercises are right for YOU?

Types of Exercise:

There are two main types of exercise that support optimal bone health:

- Weight Bearing Aerobic Training Examples:
 - Walking
 - Stair Climbing
 - Jogging
 - Volleyball
 - Tennis
- Strength/Resistance Training Examples:
 - Free Weights
 - Weight Machines
 - Body Weight
 - Swimming
 - Cycling

When trying to evaluate which is best consider three main variables that show benefits when combined:

- Weight Bearing (Effect of gravity on bones)
- Muscle Load (Effect of muscles on bones)
- Impact (Increased forces on bones through impact with the ground)

Each plays a role but the benefits increase with more of each variable. Activities that include only one variable will have minimal impact on bone development.

Weight-Bearing Exercise:

Although weight-bearing exercises are beneficial for Osteoporosis, it's important to know that weight-bearing activities must achieve a sufficient level of force to improve BMD. Walking is a weight-bearing exercise that is comfortable for many that will slow the rate of bone loss if done consistently, however, walking will not change BMD if it's your only form of exercise.

High-intensity aerobic exercise will limit BMD loss, but it should not be the only form of exercise for Osteoporosis treatment either.

Low-impact exercises can also stimulate BMD. For instance, bone mass in the spine and wrist can be improved with consistent participation in Tai Chi, however, participation must be for a minimum of 6 months (8).

Strength & Resistance Training:

Strength & Resistance Training is critical for improving BMD. For the best results, train multiple muscle groups. Resistance Training directly improves BMD at muscle insertion sites based on the type of muscle contractions from each movement. Therefore, doing the same workout routine over and over will limit the benefits of strength/resistance training.

Research shows that the effectiveness of strength training on BMD is related to the intensity of the training. To get the best results, use a load of 70-90% of your max for 2-3 sets of 8-10 reps performed 3 times per week for 1 year. Strength training has the potential to improve BMD by 1-3% so stay committed and stay consistent (9).

Working with a physical therapist or personal trainer who specializes in Osteoporosis may be a great addition to your Bone Optimization Team.

Metabolic Benefits of Resistance Training:

Resistance training has benefits outside of improving bone health. Inactive adults experience a 3-8% loss of muscle mass per decade, resulting in bone loss and other metabolic problems (10).

Research shows that 10 weeks of resistance training resulted in (11):

- Increase of 3 lbs of muscle mass
- Increased metabolic rate by 7%
- Reduced Fat Mass by 4 lbs

Other benefits of resistance training include (10):

- Improved movement control
- Improved functional independence
- Improved cognitive abilities
- Improved metabolic health

Strength Training for Bone Health:

If you are confused about how you can optimize your exercise routine for improved bone health, use this list of exercises to discuss with your doctor, physical therapist, or personal trainer.

Your ability to participate in these activities may be limited based on your fracture risk and DEXA score. **Always be sure you are cleared for the exercises you participate in and remember the #1 rule in training for bone health, Don't Get Injured!**

Exercises to include:

- Weighted squats
- Hack squats
- Leg press
- Hip extension
- Hip adduction
- Knee extension
- Hamstring curls
- Triceps extension
- Forearm pronation/supination
- Bench Press
- Stair climbing/step-ups with weighted vest
- Power cleans with weighted vest
- Military press
- Lat pull-downs
- Seated rowing
- Rotary torso
- Back extension exercises with weighted backpack

Multicomponent Exercises:

Multicomponent exercises should be incorporated into your exercise regimen as deemed safe. Multicomponent exercises are a combination of different movement methods like aerobics, strength training, progressive resistance, balancing, dancing, etc.

These exercises preserve bone mass; however, they must also incorporate strengthening and resistance exercises for results.

Vibration:

Whole Body Vibration does improve BMD in studies but should be considered carefully. WBV when performed at low frequency and small amplitude has been shown to increase BMD in well-designed studies. There are a few companies that make high-quality machines for home use you may want to consider, find our recommendations [here](#). There are risks to consider though. Higher intensity and larger amplitude machines can cause falls and aggravate injuries

and arthritis. Those with eye disorders sensitive to vibration will want to ask their healthcare team before considering this modality as well.

Other benefits of low frequency, small amplitude whole-body vibration include enhanced muscle mass, improved balance, and reduced risk of falls. It is also a more efficient activity than walking.

Osteogenic Loading (OsteoStrong/BioDensity):

Osteogenic loading is a concept created by John Jaquish, PhD. This concept and subsequent technology are available for use through the franchise OsteoStrong and BioDensity machines throughout the world. The research supporting this approach is based on smaller studies and there is some controversy within the bone health community but the benefits far outweigh the risks if access is reasonable to one of these devices.

The Best Exercise for Osteoporosis:

The best exercise plan is a plan you can maintain!

If you are nervous to get started with exercise after your Osteoporosis diagnosis, reach out to a trained professional to get you started. The primary focus around exercise should be creating a habit around daily exercise by incorporating safe activities that you enjoy. Once you have a consistent exercise routine, begin to explore and incorporate exercises that promote bone health!

The biggest priority when it comes to exercise is to AVOID INJURY!

- Understand where you are
- Ask for help

Review your [OBH exercise library](#) and check out the [Resources](#) pages for additional support.

Nutrition & Bone Health – Macronutrients

Proper nutrition is critical for optimizing bone health. Nutrition and bone health are dependent on your ability to digest, absorb, and metabolize nutrients, however, it starts with WHAT you are putting into your body.

Gut health is a critical component of optimizing nutrition for bone health and will be covered in *“The Gut Bone Connection”* Module.

In this module, you will discover the critical components of a diet that supports optimal bone health and receive an overview of a diet pattern that supports bone health. Remember, this is generalized diet advice on Bone Health. The Optimal Bone Health Team provides access to

Registered Dietitians who provide individualized diet advice for bone health through the lens of your total health, driven and verified by bloodwork.

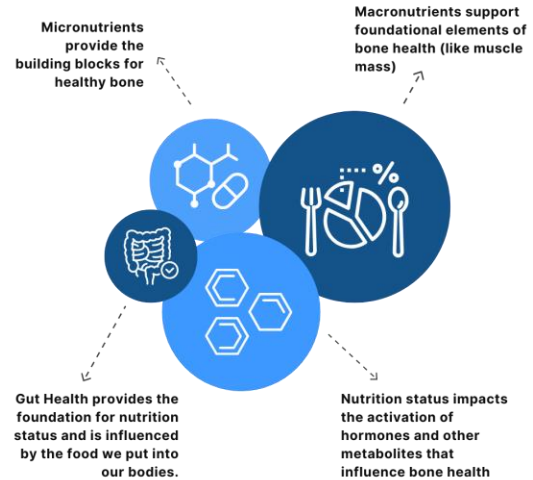
Nutrition and Osteoporosis Overview:

Macronutrients: Support foundational elements of bone and muscle mass.

Micronutrients: Provide the building blocks for healthy bone and nutrients to fuel your metabolism.

Gut Health: Provides the foundation for nutrition status and is influenced by the food we put into our bodies.

Nutrition Status: Impacts the activation of hormones and other metabolites that influence bone health.



Components of an Osteoporosis Diet:

There are 4 main components of nutrition that support Optimal Bone Health. These overarching ideas can be modified based on your body's unique needs. For additional support and guidance on how to make these components work for you, consult your medical team.

-  **Adequate Protein**
-  **Nutrient Dense**
-  **Promotes gut health**
-  **Reduces inflammation**

Nutrition Considerations for Osteoporosis:

Consider these 4 questions when making decisions about what foods to choose:

- What foods do you tolerate?

This is useful when evaluating if you should include items like dairy. Dairy is great for Osteoporosis but may be difficult to include if it causes GI dysfunction and inflammation. If you don't tolerate any dairy, you will need to find a way to meet your calcium needs from other sources and supplements. Remember that there are numerous sources of dairy and some may be better tolerated than others.

- Do you have food sensitivities?

Diet variety is key to treating Osteoporosis, but if the food you're eating is causing leaky gut, you need to be critical of what you are eating. There are several ways to test food sensitivities – review *“Measuring Bone Health - Part 2”* for the best measures. Remember, food sensitivities need to be verified by reintroducing foods and tracking your symptoms to avoid over-restriction. You can find a food sensitivity tracker at the end of this module.

- Do you have an auto-immune condition?

To take a whole-person approach to bone health, you will need to look at more than just what's good for bone health. If you have other health conditions or an auto-immune condition, you'll need to look at a diet that meets those needs first, then layer on components that support bone health. It's hard to build bone in an environment of immune dysfunction! This can feel overwhelming. Reach out to a qualified healthcare provider for further assistance if you have questions about your next steps.

- Do you have pre-diabetes/diabetes?

Pre-diabetes/diabetes needs to be addressed for health and longevity. Often the nutrition approaches for metabolic dysfunction and weight loss are not supportive of bone health. Consider discussing your options with your team at OBH for additional resources.

Diets to Avoid:

There is a lot of talk about the *best diet* for Osteoporosis, but the rigid diet prescriptions you'll find on the internet aren't generally backed by data. It's important to be critical of generalized nutrition advice, your health needs are unique and any way of eating needs to be customized to your genetics, culture, and desires. You should always verify your health and diet with biomarkers because there is no one size fits all approach that actually fits all! The Optimal Bone Health Team always verifies the exact intake of our patients and makes specific diet and

product recommendations to meet their goals. However, for the sake of this program, we have put together some necessary components that can be generalized to fit everyone regardless of your preferred dietary patterns. These broad recommendations can be adjusted to fit the above criteria.

When patients come to us they are generally eating one of the following diets. We will review these and then suggest our evidence-based approach to eat for your bones!

Common diets:

- Alkaline Diet
- Western Diet
- Vegan Diet
- Vegetarian Diet

Alkaline Diet:

The Alkaline Diet is focused on consuming foods that supposedly create an alkaline environment in your body. This diet can be incredibly confusing to follow because many acidic foods, like lemon, are actually considered alkaline foods. The basis of this diet is heavily focused on eating fruits and vegetables, alkaline water, and excluding meat and other animal products.

The theory behind the alkaline diet is that an acidic environment increases bone breakdown.

Acid-Base Balance:

The reason why this approach to eating is confusing is because the pH of foods and their impact on the body's pH are two different things. Lemons as mentioned above are acidic by nature. If you test their pH you will verify that. However, the impact on the body after digestion is net alkaline. It will raise your pH slightly and temporarily. So, is it good for you or bad for you? Probably net beneficial but this has nothing to do with the pH. Meat on the other hand is not acidic when tested outside of the body but the sulfur containing amino acids methionine and cysteine will decrease pH after consumption but again, slightly and briefly. So, is meat bad for you? In my opinion, no.

Problems with the Alkaline Diet:

- Nearly impossible to meet protein needs which leads to reduced muscle mass and worsening bone strength.
- Your body naturally regulates its acid-base balance. The foods you eat will not have a significant impact on your internal acid-base balance.
- Research shows that meat intake is only negatively associated with bone markers when consumed as part of a Western Diet (12).

You do not need to follow an alkaline diet to prioritize anti-inflammatory vegetables that contain polyphenols that improve inflammation, immunity, and bone health. Additionally, alkaline water only acts to reduce acid in your stomach which inhibits your ability to break down protein and absorb nutrients. Avoid this marketing scheme and drink regular pH filtered water!

Western Diet:

The Western Diet, also known as the Standard American Diet or appropriately shortened to SAD has damaging impacts on bone health. The Western Diet is high in starches that are combined with inflammatory fats, refined grains, food additives, alcohol, and sugar.

Problems with the Western Diet:

- Low in bone-building nutrients
- Nutrient-poor and calorie-dense.
- Creates inflammation and contributes to intestinal permeability which leads to deteriorating bone health.
- Creates metabolic dysfunction that worsens total health.
- Associated with lower Bone Mineral Density and an increased risk of fracture (13).

Vegetarian/Vegan Diets:

Vegetarian and Vegan diets are often marketed to those with Osteoporosis for similar reasons the alkaline diet is marketed. Vegetarian diets generally exclude meat but include milk, dairy, and eggs. Vegan diets generally exclude all products derived from an animal. Despite this being a common recommendation or dietary pattern, we see patients follow, the research does not support these recommendations for bone health or healthspan.

Problems with Vegetarian/Vegan Diets:

- Challenging to meet protein needs which results in suboptimal muscle mass and bone density.
- Vegetarians had 4% lower BMD than omnivores (14).
- Vegans had 6% lower BMD than omnivores and 2.3% increased risk of hip fracture (15) .
- Meat intake does not have a negative impact on bone health when consumed as part of an anti-inflammatory diet and supports bone strength and muscle development.

The Optimal Bone Health Diet for Osteoporosis:

Now that we have reviewed all the diets that won't improve your bone health, let's discuss what will! At Optimal Bone Health MD, we recommend following an anti-inflammatory and nutrient-rich diet that includes macronutrients and micronutrients that work together to support bone strength and bone density.

Diets that Support Bone Health:

- Modified Mediterranean Diet
- Korean Inspired Anti-Inflammatory Diet
- Elimination Diet Guided by your healthcare team

A modified Mediterranean diet is the basis for our approach. The Mediterranean diet consistently comes out on top for health when compared to other eating styles. However, the defining characteristics are a bit vague. So, we define a “modified” approach to this popular and tasty eating style that supports bone health and is anti-inflammatory.

The Bone Foundations Nutrition Protocol includes:

- Protein forward with a goal of 1g/lb of ideal body weight for daily consumption.
- Protein mostly from animal sources
- 8 servings of non-starchy vegetables daily
- Additional starchy veggies as needed for carbohydrate needs
- Fruit for vitamin C and additional nutrients as tolerated
- Dairy if tolerated as discussed below
- Avoidance of inflammatory foods including grains, beans, nuts and legumes initially.
 - These foods may be tolerated and added back through the process of elimination and reintroduction.

View the [Optimal Bone Health Nutrition Library](#) for additional guidance and tools!

Dairy and Osteoporosis:

One of the most controversial topics in Osteoporosis nutrition therapy is if you should include or avoid dairy products.

Dairy Products:

- Milk
- Yogurt
- Cheese
- Butter
- Cream

Whether or not you should include dairy products or not is incredibly individualized. Dairy can be a powerful tool for improving bone health, as long as you tolerate it and it’s not contributing to a decline in your gut health. 6-8 oz of milk daily is associated with reduced fracture risk by 5% (13) which demonstrates the potential but milk is not our preferred source of dairy. There are additional concerns around milk and dairy in general from conflicting evidence often cited by those that recommend avoiding dairy. Many people respond differently to different kinds of dairy, if you don’t tolerate or are sensitive to Cow’s milk, you may have a different reaction to A2 cow’s milk and products, sheep, goat, or camel products. To determine if dairy is causing

you symptoms you can work with a team to create an elimination diet designed to uncover your food sensitivities or utilize food sensitivity testing (Review *“Measuring Bone Health - Part 2”* for additional guidance).

Dairy can be beneficial by combining protein with calcium, phosphorus, and vitamin D. Be sure to include Vitamin D because it interacts with calcium to improve bone health benefits!

Note: You must have a source of dietary fat to absorb Vitamin D!

Benefits of Dairy (13):

- Reduced PTH
- Increased IGF-1
- Decrease in Bone Resorption Markers
- Improved Bone Mineral Density
- Weight Gain

Protein & Osteoporosis:

Protein is essential for bone health. ~50% of bone volume and ~30% of bone mass is made of proteins. When you consume foods that are high in protein, they break down into amino acids as they are digested, providing your body with the building blocks to make new materials and enzymes.

Benefits of Protein:

- Increases the secretion and action of IGF-1 (see below)
- Supports muscle protein synthesis which supports strong bones and muscles.

Insulin-like Growth Factor-1 (IGF-1):

- Is the body's switch for building versus burning. When up you are building bone and muscle. When down you are breaking down bone, muscle and fat.
- Supports bone formation
- Improves calcium and phosphorus absorption in the gut
- Supports the synthesis of calcitriol (most active form of vitamin D)
- Increases phosphate reabsorption in the kidney (needed for bone formation)

Protein is important and should be consumed regularly throughout the day. At Optimal Bone Health, we recommend consuming 1 gm of protein per pound of ideal body weight for those without additional health concerns. Keep in mind, your body can only absorb 30-50 grams of protein at a time (this varies by exercise status and genetics).

We recommend aiming for a **minimum of 30 gm of protein per meal**. 30 grams of protein equates to approximately a palm-sized portion of meat. If you have difficulty eating animal proteins, you should reach out to a gut health specialist to uncover any underlying GI

dysfunction that may be contributing to difficulty digesting proteins. This type of GI dysfunction will play a major role in your ability to rebuild bone.

To better understand your current protein intake, consider tracking your intake on a nutrition tracking app. We recommend Cronometer. Often those with Osteoporosis have been chronically undernourished when it comes to protein intake and looking at their current protein intake compared to their protein goal is overwhelming. Remember, increasing your protein intake is a process and any progress you make will have a positive impact on bone and metabolic health. Our team recommends creating goals that increase your protein intake by 20 grams every two weeks until you get to your final goal.

Meat & Osteoporosis:

As previously mentioned, meat intake comes across as a controversial topic in the world of Osteoporosis. However, from our perspective, it's not controversial and the research is clear. Animal protein intake is a simple way to achieve the recommended amount of protein that supports bone health and muscle mass.

Meat intake has not been associated with lower Bone Mineral Density or other bone health markers UNLESS eaten in the context of a Western Diet containing refined carbs, alcohol, sugar, and other inflammatory foods. When meat is consumed as part of an anti-inflammatory diet, meat has no negative impact on bone makers. To reap the full benefits of optimal protein intake for your bone health, be sure you are meeting your daily calcium goals.

Soy & Osteoporosis:

Soy intake is controversial due to the potential anti-nutrient content. However, evidence suggests that soy is protective for bone health.

Soy is a perfect example to demonstrate that everyone has their own individual nutrition needs even in the context of Osteoporosis. There are many people that are sensitive to soy products. If you are sensitive to soy, you should not include it since it will increase inflammation. Ultra-processed soy is frequently consumed in a Western Diet, consuming soy in this way should be avoided by everyone. If you are not sensitive to soy products, consider consuming organic, unprocessed soy, like edamame and tofu.

Benefits of Soy:

- Soy isoflavones have a positive effect on Bone Health, particularly in post-menopausal women.
- Consuming Soy products with Omega-3 fats can improve bone status
 - Improved bone formation
 - Decreases bone resorption.

- Intake of Natto (fermented Soy) positively correlates with higher lumbar spine Bone Mineral Density.

Overall, improving bone health through diet takes a comprehensive approach that strategically addresses the root cause of bone loss.

Nutrition & Bone Health – Micronutrients

Now that we have discussed the dietary patterns to prioritize for optimal bone health, we will dive into the micronutrients that are critical components of bone health and review the importance of specific nutrients that need to be included in food!

Note: This module focuses on nutrients that support bone health when included as part of your diet based on the current literature. Specifics on nutrients to supplement with will be covered in the Nutraceuticals Modules.

Macronutrients: Refers to the components of food that are large nutrient particles - Proteins, Carbohydrates, and Dietary Fats.

Micronutrients: Refers to the components of food that are small nutrient particles like vitamins, minerals, and trace minerals.

Micronutrients are critical components of health. They facilitate ALL biological processes and provide structural support for bone.

Key Nutrients for Osteoporosis:

There are 9 micronutrients that need to be prioritized in an Osteoporosis diet.

- Calcium
- Vitamin D
- Potassium
- Magnesium
- Vitamin K
- Vitamin C
- Omega-3's
- Vitamin B12
- Folate

The best way to ensure you are meeting all of your micronutrient needs, is to track your intake in a nutrition tracking software. All Optimal Bone Health MD patients and group coaching clients have access to [Cronometer](#) to track their nutrition. We offer the Pro version but there is a free version available for public use as well.

Calcium:

Calcium provides structural support for the bone matrix. However, calcium only provides a positive impact on bone health when taken with Vitamin D. Taking Calcium on its own can increase your risk of cardiovascular disease, especially at high doses (16). Getting adequate calcium through diet is possible and supplementation may not be necessary.

BONE FOUNDATIONS HIGH CALCIUM FOODS

KEY



DAIRY



PROTEIN



PRODUCE



MAY EXCLUDE BASED ON PLAN

	FOOD	SERVING	MG CALCIUM
	Ricotta, part-skim	4 oz	335
	Sardines, canned with bones	3 oz	325
	Yogurt, plain	6 oz	310
	Almond milk, rice milk or soy milk, fortified	8 oz	300
	Milk, skim, low-fat, whole	8 oz	300
	Orange juice and other fruit juices, fortified	8 oz	300
	Collard greens, cooked	1 cup	266
	Yogurt with fruit	6 oz	260
	Mozzarella, part-skim	1 oz	210
	Cheddar	1 oz	205
	Tofu, prepared with calcium	4 oz	205
	Yogurt, Greek	6 oz	200
	American Cheese	1 oz	195
	Salmon, canned with bones	3 oz	180
	Kale, cooked	1 cup	179
	Edamame	1 cup	175
	Beans, baked, canned	4 oz	160
	Bok Choy, cooked	1 cup	160
	Feta Cheese	4 oz	140
	Oatmeal, fortified	1 packet	140
	Shrimp, cooked	3 oz	60
	Cottage Cheese, 2%	4 oz	105
	Broccoli rabe, cooked	1 cup	100
	Figs, dried	2 figs	65
	Broccoli, fresh, cooked	1 cup	60
	Oranges	1 whole	55
	Parmesan	1 tbsp	55

Vitamin D:

Vitamin D has several benefits for Osteoporosis:

- Improves calcium absorption
- Supports muscle mass and strength
- Maximizes efficacy of anti-osteoporosis drugs if utilized
- Foods fortified with vitamin D improve BMD and PTH, however, they have no impact on bone turnover markers.

Vitamin D is a fat-soluble vitamin which means that it can only be absorbed when consumed with a source of dietary fat. If you have difficulty digesting fats, you will likely have difficulty absorbing vitamin D.

The optimal serum level of vitamin D for bone health is > 50 nmol/dL. See Testing Module for more details.

Potassium:

Eating foods high in potassium is one of the reasons an alkaline diet is theorized to improve bone health. The potassium, not the pH effect of eating potassium, has unique benefits for bone health and overall health.

Studies that reviewed potassium intake and Osteoporosis showed that the highest potassium intake was associated with increased BMD in men over 50 and in post-menopausal women (17). Additionally, using Alkaline Potassium Phosphate Salts significantly lowered NTX but had no impact on BMD (18). The applications of Alkaline Potassium Phosphate Salts are unclear, but there may be low-risk applications in Bone Health.

Potassium can be dangerous and even lethal at high doses; therefore, you should avoid supplementing with potassium without the guidance of a healthcare team and focus on prioritizing foods high in potassium.

BONE FOUNDATIONS

HIGH POTASSIUM FOODS

KEY



STARCH



NON-STARCHY VEGETABLE



LEGUMES

	FOOD	SERVING	MG POTASSIUM
	Beet Greens, cooked	1 cup	1309
	Lima Beans, cooked	1 cup	969
	Swiss Chard, Cooked	1 cup	961
	Potato, baked, with skin	1 med	926
	Yam, cooked	1 cup	911
	Acorn Squash, cooked	1 cup	896
	Amaranth Leaves, cooked	1 cup	846
	Spinach, cooked	1 cup	839
	Bamboo Shoots, raw	1 cup	805
	Water Chestnuts	1 cup	724
	Carrot Juice, 100%	1 cup	689
	Plantains, cooked	1 cup	663
	Taro Root, cooked	1 cup	639
	Adzuki Beans, cooked	1/2 cup	612
	Cress, raw	2 cups	606
	Butternut Squash, cooked	1 cup	582
	Parsnips, cooked	1 cup	572
	Sweet Potato, cooked	1 cup	572
	Kohlrabi, cooked	1 cup	561
	Broccoli Rabe, cooked	1 cup	550
	Portabella Mushrooms, cooked	1 cup	529
	Stewed Tomatoes, canned	1 cup	528
	Tomato Juice, 100%	1 cup	527
	Mustard Greens, cooked	1 cup	513
	Pumpkin, canned	1 cup	505
	White Beans, cooked	1/2 cup	502
	Artichoke, cooked	1 cup	480

Magnesium:

Magnesium is a powerful nutrient involved in over 300 metabolic reactions, including calcium and potassium metabolism. Magnesium also induces osteoblast proliferation and activates vitamin D.

Magnesium can be challenging to get through food. Most foods that are traditionally high in magnesium now have lower levels of magnesium due to nutrient depletion of the soil our food is grown in (19). For more information on supplementing with magnesium for optimal intake, review the supplements modules. RBC magnesium can be tested and should be tested to verify adequate consumption.

Vitamin K:

Proteins that support bone matrix formation are Vitamin K dependent. Vitamin K is a fat-soluble vitamin just like Vitamin D. This means you need to consume Vitamin K with a source of dietary fat for optimal impact. There are different kinds of Vitamin K that come from different sources and play different roles in your health.

Types of Vitamin K:

- K1- Formed by plants
- K2 synthesized by bacteria
 - Found in cheese and fermented foods

Vitamin K1 can be converted to K2 for utilization in the human body but conversion is genetically variable and inconsistent. Vitamin K2 intake and supplementation is therefore critical and is found in two different forms. There is Vitamin K2-MK7 and Vitamin K2-MK4. These subtly different forms are processed differently in the body. MK7 is preferred because it has a longer half-life, meaning it will stick around longer than MK4. As a result, it has a bigger impact on bone and artery health and can be dosed 1-2 times per day when supplemented.

There is often concern over vitamin K consumption and blood clots. This concern stems from the use of a drug that has fallen out of favor called Coumadin or Warfarin. This blood thinner acts on vitamin K dependent blood clotting factors and if vitamin K rich foods were consumed by patients on this drug the “thinning” effect would vary and clot risk went up. However, consumption of foods rich in vitamin K1 and K2 have no increased risk of blood clot in any other circumstance. Newer blood thinning drugs like Eliquis act further down the pathway of blood clotting and are not influenced by vitamin K consumption or supplementation. Discuss this with your medical team if you are on a blood thinner. Optimal Bone Health MD patients are recommended to eat vitamin K rich foods and supplement with vitamin K2 and MK7 as long as they are not on Coumadin or Warfarin.

Vitamin C:

Vitamin C is a powerful antioxidant that has several impacts on bone health.

- Cofactor for osteoblast differentiation
- Cofactor for Collagen synthesis
- Correlated with increased BMD
 - Reduced risk of hip fracture
 - Reduced risk of osteoporosis
 - Higher BMD at lumbar spine and femoral neck

Increasing your vitamin C intake could decrease your risk of hip fractures!

Omega-3 Fatty Acids:

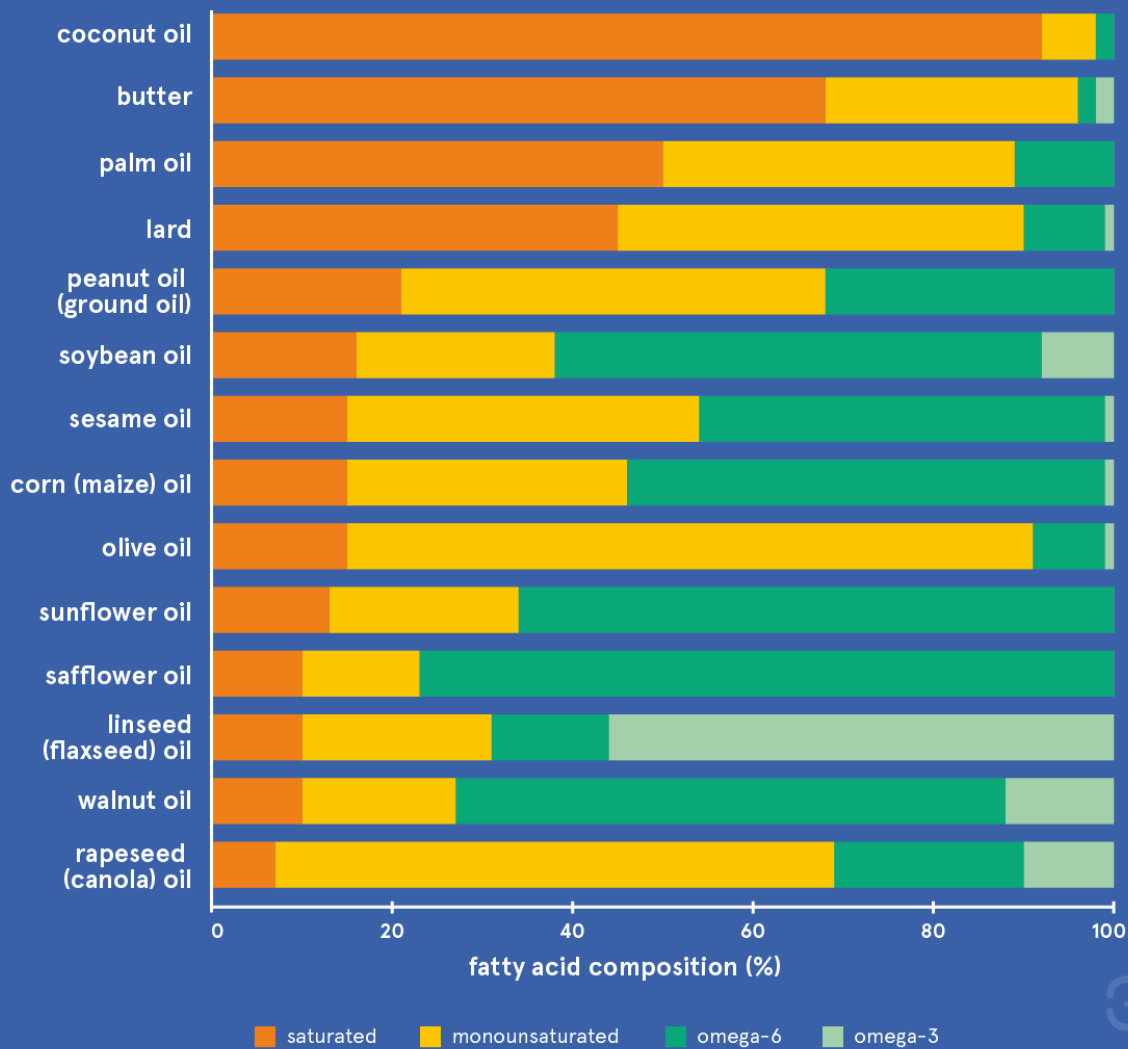
Omega-3 Fatty Acids are one of the many kinds of dietary fat that are present in our food. The research shows conflicting evidence on the impact of Omega-3's and bone health. Before we discuss the benefits of Omega-3's, let's break down the components of Dietary Fat.

Types of Dietary Fat:

- Monounsaturated fatty acids
- Polyunsaturated fatty acids
 - Omega-3
 - Omega-6
 - Omega-9
- Saturated fatty acids

All dietary fat sources contain ALL the different types of dietary fats to varying degrees. Therefore, when you look for foods that are good sources of Omega-3's you need to be aware that they may still contain the other types of dietary fat. Your dietary fat choices will vary based on your other health needs.

culinary oils & fats



<https://www.eufic.org/en/whats-in-food/article/8-facts-on-fats>

We do not consume nutrients in isolation, many foods that contain dietary fat also contain other nutrients that may have positive or negative impacts on your health. Saturated fat in particular is often a point of fear and avoidance in diet. Tolerance of saturated fat is dependent on genetics and understanding unique tolerance is helpful to knowing if this form of energy is helpful or harmful to your body and bones. Review your dietary fat goals with a healthcare provider educated in this space.

Omega-3's and Bone Health:

PUFA's may regulate osteoprotegerin and receptor activation of RANK but balance more towards bone formation. EPA and DHA may influence bone growth and remodeling in humans by inhibiting bone resorption AND stimulating bone formation. Omega-3's reduced osteocalcin serum levels in post-menopausal women, but had no significant reduction in bone-specific alkaline phosphatase. Dietary sources of omega-3's can be found in fish and seafood which are known to have anti-inflammatory effects that have been shown to improve bone quality.

Vitamin B12 & Folate:

As discussed in depth in the *"Measuring Bone Health"*, reducing homocysteine levels and optimizing your methylation cycle with Vitamin B12 and Folate is a critical component of bone health. Elevated homocysteine levels have been linked to lower BMD, suggesting that Vitamin B12 and Folate may be helpful in improving BMD and reducing homocysteine.

Research indicates that for each 50 pmol/dL increase in Vitamin B12 concentration, you have a 4% lower fracture risk (20)! There is obviously a ceiling to this effect so don't drive levels above optimal levels.

Nutrition is foundational to optimizing your bone health. To improve osteoporosis, nutrients need to be thoughtfully paired together and viewed in the context of your whole diet.

Module 10: Antinutrients

Antinutrients are found in several foods derived from plants. In this module, we will take a closer look at what antinutrients are, what foods they are found in, how you can reduce antinutrient content, and why antinutrients matter when it comes to Bone Health.

Antinutrients: Refers to the compounds in food that either interfere with the digestion and absorption of nutrients or can cause inflammation or both. Understanding what foods have antinutrients and how to prepare the foods to mitigate them is critical if these foods are going to be consumed!

There are three types of antinutrients found in plants:

- Lectins
- Oxalates
- Phytates

Lectins:

Lectins are found in almost all plants and even in small amounts in animal products. They serve as a defense mechanism against insects, mold, fungi, and diseases. Lectins are resistant to enzymatic digestion and may alter gut function, increase inflammation, and cause food poisoning.

Foods High in Lectins:

- Legumes
- Nuts & Seeds
- Fruit
- Vegetables
- Grains

Oxalates:

Oxalates inhibit the absorption of nutrients like calcium by binding to them. Oxalates can also contribute to calcium oxalate kidney stones. Additionally, those with digestive disorders like inflammatory bowel disease have been shown to have a higher risk of calcium oxalate kidney stones likely as a result of the over-absorption of oxalates in food.

Foods High in Oxalates:

- Spinach
- Kale
- Swiss Chard
- Legumes
- Cereal Grains

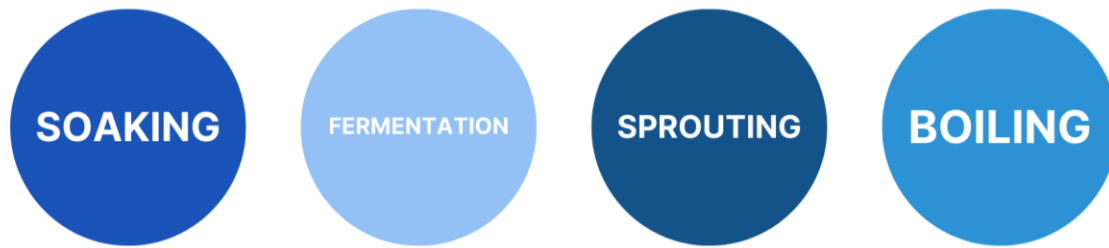
Phytates:

Phytates can inhibit the absorption of iron, zinc, copper, and calcium. To reduce the effect of phytic acid, eat foods high in vitamin C!

- Legumes
- Nuts & Seeds
- Grains
- Pseudo-Cereals

Techniques for Decreasing Antinutrients:

If you're feeling discouraged about what you can eat, don't worry, there are several ways you can decrease the antinutrient content in various foods.



When cooked/prepared appropriately there is not strong evidence that anti-nutrient foods cause inflammation, intestinal permeability, or decreased nutrient absorption. Many people do not tolerate foods that are high in antinutrients and it may be best to exclude them. If you do tolerate these foods, include them in ways that decrease the antinutrient content. Ask your team for recommendations on specific foods.

Phytoestrogens:

Phytoestrogens are compounds found in plants that are a similar structure to estradiol, the primary sex hormone in women. Due to their similarity, these compounds can bind to estrogen receptors and alter estrogen activity. Phytoestrogens are often referred to as estrogen disruptors and are found primarily in soybeans and flax seeds.

The research on phytoestrogens and female reproductive health have mixed results. Studies have found that phytoestrogens have a minimal or no effect on endometrial thickness, breast density, HPA-axis, and circulating hormones like Sex Hormone Binding Globulin, FSH, LH, TSH, and other forms of estrogen.

The health impact of phytoestrogens will be influenced by your gut microbiome, the phytoestrogen source, and your unique biochemistry. Overall, large studies indicate that the benefits of consuming an anti-inflammatory diet including phytoestrogens, essential vitamins, minerals, fiber, and other health-promoting compounds outweigh any other concerns.

The impact on bone health is not well established either. There is some evidence to support using phytoestrogens in postmenopausal women to reduce bone resorption. The effect is small and consuming large amounts of foods containing these compounds may not fit the other goals of dietary intake.

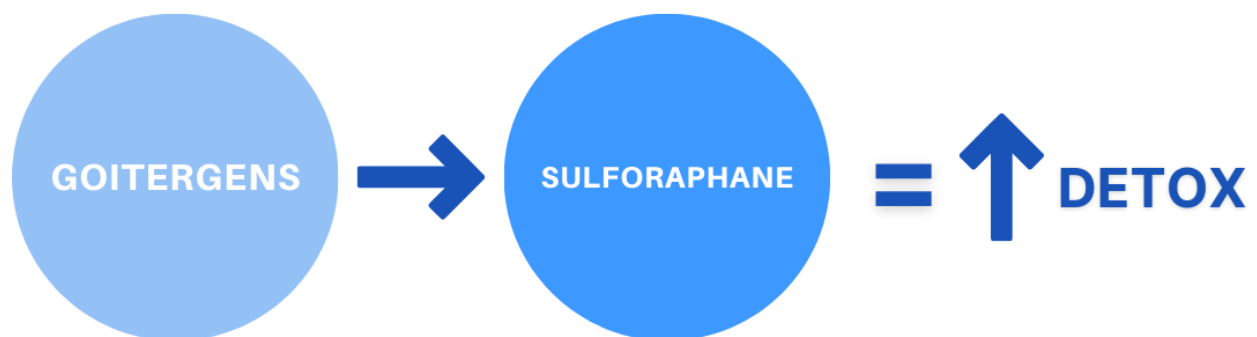
Goitrogens:

Goitrogens are compounds that can interfere with iodine uptake and potentially increase the risk for hypothyroidism and/or goiter development. Iodine deficiency is challenging to measure, be sure you are including iodine-rich foods when consuming foods that are higher in goitrogens.

Foods High in Goitrogens:

- Brussels sprouts
- Kale
- Millet
- Cassava
- Broccoli
- Cabbage

You can reduce goitrogens by cooking foods that are high in glucosinolates. Cooking goitrogens can convert the glucosinolates into sulforaphane and improve detoxification.

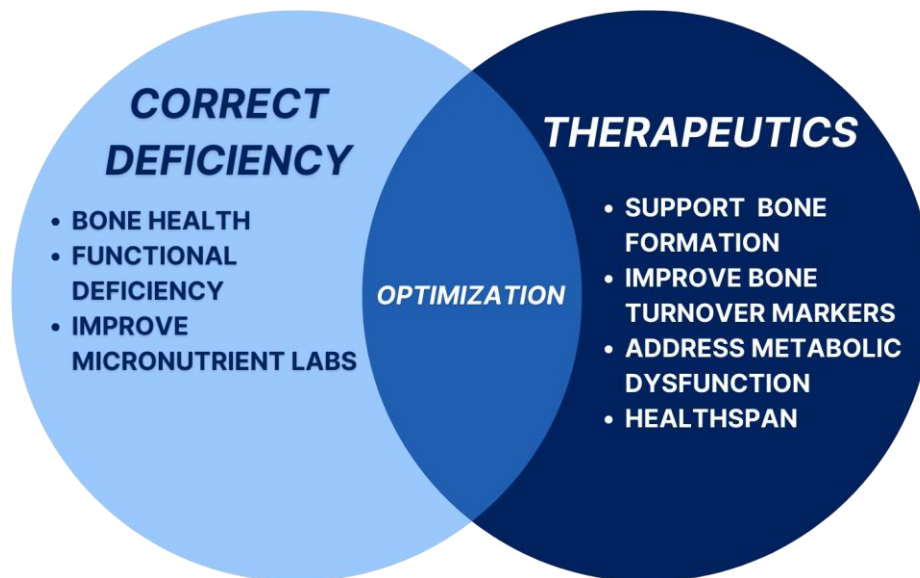


You can safely consume foods that contain antinutrients by cooking and preparing them to improve the absorption of key nutrients. Use the Antinutrients Preparation Guide to avoid unnecessary restriction and stress around food. At the beginning of your healing journey, antinutrient restriction may be something that needs to be explored, however, reintroduction should be used to verify their impact on your health. The benefits of foods that contain antinutrients far outweigh the risks, if you're concerned about foods you're eating that are high in antinutrients, reach out to your healthcare team.

Supplements for Bone Health – Vitamins

We have covered several of the core nutrients that you want to get from food. Now, let's look at what nutrients you may consider supplementing. Supplements can be a helpful tool for stopping bone loss and building bone. Supplements provide high doses of nutrients that may be difficult to get through food and you can find them in high-quality formulations that are designed for optimal absorption.

At Optimal Bone Health, we leverage supplements to correct deficiency and as therapeutics.



Many studies focus on dietary intake of various nutrients, which have been identified in previous modules, however, if you are not meeting the daily recommended intake, or you have identified a higher need for specific nutrients through testing, you should consider supplementing to ensure your needs are being met.

Supplementation is just that, supplemental. If you are deficient in a particular nutrient, you need to identify the root cause of nutrient depletion.

Purchasing Supplements:

Supplements can be incredibly helpful to fill in gaps in your intake and provide additional tools for your body to build bone more effectively. Unfortunately, the supplements industry is not

well regulated and many supplements on the market do not contain what they say they contain, and/or they may have more than what's indicated. When looking for supplements, you should look for supplements that have been third-party tested and avoid purchasing supplements from places like Amazon, Costco, and CVS.

We use an online supplement dispensary that verifies the quality of the provided supplements and contracts with trusted suppliers to provide our clients with access to high-quality supplements. You can access our bone health supplement protocol on Fullscript.

[ACCESS THE PROTOCOL HERE](#)

Absorption:

When starting a supplementation protocol, you should be mindful of optimizing the absorption of the nutrients you are supplying your body to limit waste. Some supplements may compete with each other for absorption, this occurs naturally when consuming food, however, when you are consuming supplements, you should avoid taking competing supplements together.

Common Nutrients that Compete for Absorption:

- **Iron & Calcium**
 - Iron and calcium compete for absorption, therefore, if you require both, you should take them at different times of the day.
- **Zinc & Copper**
 - Zinc and copper compete for absorption. If you are supplementing with zinc greater than 15 mg per day, on a daily basis, you are at risk for copper deficiency and may need additional copper supplementation.
- **Magnesium vs Calcium**
 - Magnesium and calcium also compete for the same receptors and magnesium may inhibit calcium absorption when taken in large doses. However, magnesium is critical for bone health and the doses should be split up during the day to avoid this interaction if you are taking high doses.
- **Calcium vs Strontium**
 - Calcium and strontium do compete and it's best to take strontium before bed and space your calcium out during the day.

Gut Health:

Gut health is foundational for optimal nutrient absorption. If you experience maldigestion, intestinal permeability, or inflammation in your gut, you may not be able to efficiently absorb all the nutrients you put in your body. Supplements can also be beneficial for improving gut health. Review *“The Gut Bone Connection”* module for more information on supplements for gut health, and probiotics.

Vitamins:

This module will focus on the supplementation of vitamins. Minerals will be covered in the next module.

There are two different types of vitamins; fat-soluble and water-soluble.

Fat-Soluble Vitamins:

- Vitamin A
- Vitamin D
- Vitamin E
- Vitamin K

Water soluble vitamins:

- Thiamine
- Riboflavin
- Niacin
- Vitamin B6
- Folate
- Vitamin B12
- Vitamin C

Each of the fat-soluble vitamins plays an important role in bone health. As you are looking for supplements, look for formulations that contain all the fat-soluble vitamins. These must be consumed with a source of dietary fat to be digested and absorbed.

Vitamin A:

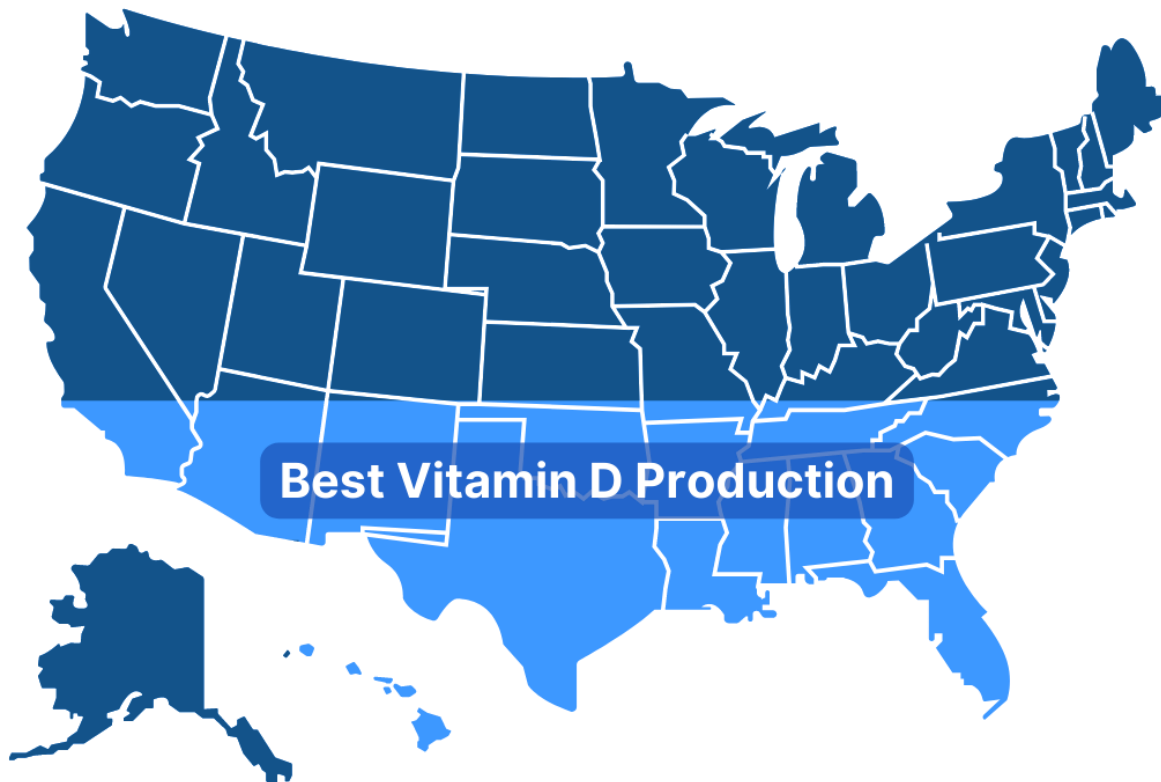
Vitamin A regulates osteoclast function and supports the development of osteoblasts. Vitamin A deficiency decreases calcium absorption and metabolism. Serum blood levels of Vitamin A are not good markers of Vitamin A status, however, both low and high concentrations of Vitamin A can increase the risk of hip fracture. Therefore, we recommend additional functional testing of vitamin A if you have concerns.

When you are looking for a Vitamin A supplement, look for the active form of vitamin A, Retinol, which is found in animal products instead of Beta-Carotene which is derived from plants and often the primary source of Vitamin A found in many supplements. Retinol is usually listed in supplements as Retinyl Palmitate which converts easily to Retinol once consumed.

Vitamin D:

As discussed in the Nutrients module, adequate Vitamin D is critical for calcium absorption, and calcium can only be utilized when vitamin D is optimized. Vitamin D can be difficult to get through food in large enough quantities to avoid the need for supplementation. You might be thinking that you can get Vitamin D from the sun, this is true but not as straightforward as it might sound.

Making vitamin D from sun exposure is impacted by your genetic ability to do so efficiently and your geographic location. Anything above a latitude of 35 degrees north, decreases your body's ability to absorb Vitamin D from the sun in the winter months and cloud coverage will impact vitamin d productions all year round (21).



It's recommended that you measure your vitamin D levels before supplementing to better understand the dose of supplemental Vitamin D your body needs. If you are you are able to get

repeat labs within 6 months of starting your vitamin D supplement, the optimal range is 80-100 ng/mL, however, due to the potential impact of vitamin D toxicity, if you will not be able to get an updated Vitamin D within 6 months, you should aim for a serum Vitamin D of 60-80 ng/dl.

When choosing a vitamin D supplement, look for 25-hydroxy Vitamin D combined with Vitamin K2-MK7. It's ideal if the supplement also contains retinol (Vitamin A) and a mix of alpha-tocopherol and tocotrienols.

Vitamin E:

Vitamin E's impact on bone health isn't currently well defined by the literature. Some studies indicate that Vitamin E significantly reduces fracture risk (22). Vitamin E acts as an antioxidant making it beneficial for overall health regardless of its true impact on bone health.

Vitamin E is not risk-free, some people are genetically predisposed to increased inflammation with high doses of alpha-tocopherol, a form of Vitamin E. This can be easily tested with a genetic test or you can look for vitamin E supplements that contain both alpha-tocopherols and mixed tocotrienols.

Vitamin E is not easily tested in blood work. To check Vitamin E levels, consider functional testing for micronutrients and assess your dietary intake.

Vitamin K:

Vitamin K plays a critical role in bone health and is often overlooked. Vitamin K regulates the genetic transcription of osteoblasts and allows for the optimal use of calcium (23). There is also evidence that suggests Vitamin K can prevent and possibly reverse calcification in arteries (24).

When looking for Vitamin K, look for Menaquinone, also written as K2-MK7, for the best impact on bone health (25). Vitamin K is generally not assessed through lab work but can be assessed with functional micronutrient testing.

Vitamin B1:

Also known as Thiamine, Vitamin B1 has several health benefits and secondary effects on bone health. Thiamine is needed for protein and carbohydrate metabolism, without it, you'll have difficulty with building muscle and managing your blood sugar levels. A deficiency in Thiamin results in decreased stomach acid and reduces Calcium absorption and has a secondary increase in fracture risk.

There is no optimal range for Thiamine because it is not assessed with general blood work and requires functional testing.

B vitamins are water-soluble and there is no adverse impact noted from consuming high levels of Thiamine. At a minimum, meet the daily recommended intake for Thiamine.

Thiamine Daily Recommended Intake:

Age	Men	Women
19 - 50	1.2 mg	1.1 mg
51+	1.2 mg	1.1 mg

<https://ods.od.nih.gov/factsheets/Thiamin-HealthProfessional/>

***Ranges vary for pregnancy and lactation**

Vitamin B2:

Riboflavin is the common name for Vitamin B2. It plays an important role in the methylation/detoxification process, reduces homocysteine, and improves antioxidant activity. Increased dietary intake of Riboflavin is associated with higher BMD, therefore if you are eating a diet rich in nutrient-dense foods, but still struggling to meet your daily intake of riboflavin, you may consider supplementing with a B complex that contains adequate amounts of Riboflavin.

There is no adverse reaction from consuming high doses of riboflavin and it is not tested with conventional blood work. Measuring riboflavin status requires functional testing.

Riboflavin Daily Recommended Intake:

Age	Men	Women
19 - 50	1.3 mg	1.1 mg
51+	1.3 mg	1.1 mg

<https://ods.od.nih.gov/factsheets/Riboflavin-HealthProfessional/>

***Ranges vary for pregnancy and lactation**

Vitamin B3:

Commonly referred to as niacin, Vitamin B3 has many benefits for bone and metabolic health. Niacin assists in Calcium Signaling, improves glucose tolerance and insulin sensitivity, adiponectin secretion, and supports omega-3 metabolism.

Adiponectin is a hormone that is produced by fat cells. It supports insulin sensitivity and reduces inflammation and fatty deposits in arteries.

There is no meaningful measure of Niacin in conventional blood work and the most beneficial labs come from functional testing.

Niacin Daily Recommended Intake:

Age	Men	Women
19 +	16 mg	14 mg

<https://ods.od.nih.gov/factsheets/Niacin-HealthProfessional/>

***Ranges vary for pregnancy and lactation**

Pantothenic Acid:

Pantothenic Acids is the common name for vitamin B5. Pantothenic Acid plays an essential role in metabolism, it's the critical component for the synthesis of Coenzyme A. Coenzyme A is the main cofactor for energy metabolism in the body.

Other roles of pantothenic acid include supporting adrenal function, breaking down fatty acids, and maintaining healthy insulin metabolism.

Pantothenic acid is not typically assessed with conventional blood work and a full assessment requires functional testing.

Pantothenic Acid Daily Recommended Intake:

Age	Men	Women
19 +	5 mg	5 mg

<https://ods.od.nih.gov/factsheets/PantothenicAcid-HealthProfessional/>

***Ranges vary for pregnancy and lactation**

Vitamin B6:

The scientific name of vitamin B6 is pyridoxine, but it is typically referred to as vitamin B6. B6 supplementation connects the dots between several common comorbid conditions that are seen in the Osteoporosis population.

B6 helps regulate homocysteine metabolism (see Testing Module for more details),

B6 is essential for collagen cross-linking and bone strength. Collagen, the collagen that forms in your body, not supplemental dietary collagen, is critical for building bone strength. Additionally, B6 deficiency can create an imbalance in the coupling between osteoblasts and osteoclasts, resulting in increased bone cavities and reduced bone formation.

Research shows that adequate B6 intake is associated with higher BMD. For the best results with B6 supplementation, make sure you are taking the best B6 supplements for your genetic profile. Many people will need a methylated B vitamin if they are a poor methylator. Methylated supplements in those who methylate well may result in anxiety and negative consequences.

B6 is challenging to measure in conventional blood work, consider functional testing to verify your B6 status. B6 is water soluble but it can be toxic with consistently high doses with supplementation. The Upper limit is 100 mg per day and over 250 mg per day you may experience some of the following symptoms:

- peripheral neuropathy
- dermatoses
- photosensitivity
- dizziness
- nausea
- ataxia
- dysesthesias.

Vitamin B6 Daily Recommended Intake:

Age	Men	Women
19 - 50	1.3 mg	1.3 mg
51+	1.7 mg	1.5 mg

<https://ods.od.nih.gov/factsheets/VitaminB6-HealthProfessional/>

***Ranges vary for pregnancy and lactation**

Vitamin B7:

Generally referred to as biotin, vitamin B7 plays a role in macronutrient metabolism, the synthesis of bone marrow, and a biotin deficiency impacts iGF-1 status (see Testing Module) and therefore bone formation.

Biotin is not typically assessed in conventional blood work and functional testing should be considered.

Biotin Daily Recommended Intake:

Age	Men	Women
19 +	30 mcg	30 mcg

<https://ods.od.nih.gov/factsheets/Biotin-HealthProfessional/>

***Ranges vary for pregnancy and lactation**

Vitamin B9:

Otherwise known as Folate, vitamin B9 impacts several upstream health markers. Getting the correct form of Folate is essential to the effectiveness of folate supplementation. The form of folate you want to look for depends on your methylation status and can be verified with genetic testing. To be on the safe side, you can always start with methylated-tetrahydrofolic acid (5-MTHF or 5,10-MTHF).

Folate is a key driver of homocysteine levels, with higher homocysteine levels, you are at a higher risk of an osteoporotic bone fracture. Additionally, folate supports the synthesis of neurotransmitters and supports brain health and longevity.

Folate can be measured in conventional blood work, for a deeper look at how your body is using folate consider functional testing.

The goal range for folate is > 20 ng/ml. Be aware that different labs may use different ranges or units of measurement.

Folate Daily Recommended Intake:

Age	Men	Women
19 +	400 mcg	400 mcg

<https://ods.od.nih.gov/factsheets/Folate-HealthProfessional/>

***Ranges vary for pregnancy and lactation**

Vitamin B12:

The scientific name for vitamin B12 is cobalamin but may be listed on labels as cyano-cobalamin or methyl-cobalamin. Cyano-cobalamin denotes a synthetic form of B12 whereas methyl-cobalamin indicates a natural form. Your body can convert cyano-cobalamin to methyl-

cobalamin, but this will vary based on your methylation status, be mindful of this when choosing a supplement. Methylation status can be verified with genetic testing.

B12 is required for osteoblast function and has a protective effect on BMD and fracture risk (26).

B12 is almost exclusively found in animal-based products, like meat, eggs, and dairy. There are few plants that contain small amounts of B12 but far less than animal products. Nutritional Yeast can be a good way to get additional dietary vitamin B12. However, supplemental vitamin B12 is often needed in the beginning of your bone health journey to provide therapeutic doses and move the needle on B12 status while you work on correcting underlying contributors to deficiency.

Vitamin B12 is generally easy to measure in conventional blood work. The optimal range of B12 is between 800-1200 pg/ml.

Vitamin B12 Daily Recommended Intake:

Age	Men	Women
19 +	2.4 mcg	2.4 mcg

<https://ods.od.nih.gov/factsheets/VitaminB12-HealthProfessional/>

***Ranges vary for pregnancy and lactation**

Vitamin C:

Vitamin C is often thought of exclusively as an antioxidant. However, Vitamin C is the critical component for collagen synthesis and supports bone matrix and tendon health.

Vitamin C has several benefits for bone health including improvements in calcium production, amplification of vitamin D's effect on bone metabolism, and improving iron absorption. A higher intake of vitamin C is associated with a lower risk of osteoporosis in adults over the age of 50.

Vitamin C is water soluble and does not have an upper limit, however, you should discuss vitamin C supplementation with your healthcare team if you have a history of kidney stones.

Vitamin C is not tested in standard blood work.

Vitamin C Daily Recommended Intake:

Age	Men	Women
19 +	90 mg	75 mg

<https://ods.od.nih.gov/factsheets/VitaminB12-HealthProfessional/>

***Ranges vary for pregnancy and lactation**

Supplements for Bone Health - Minerals

Vitamins are just one category of micronutrients that impact bone health. In this module, we will dive into minerals for Bone Health. Minerals are critical components of Bone Health because they are not only cofactors for bone metabolism but they provide structural support to the bone matrix.

Boron:

Boron is a trace mineral that increases calcium absorption, supports estrogen metabolism, decreased excretion of magnesium, and is necessary to convert vitamin D to its active form. Boron supplements may increase bone formation and inhibit bone resorption.

Look for supplements that contain 3-5 mg of boron.

Calcium:

As one of the most well-known minerals for bone health, it's likely not surprising that you might need supplemental calcium. Since Calcium is found in many food sources, consider tracking your intake to get a better understanding of how much calcium you need to supplement with. The need for supplemental calcium is variable and there is not a one size fits all approach.

If deficient in calcium, supplemental calcium will increase bone mineral density but needs to be combined with vitamin D and vitamin K to optimize bone health and avoid the increased risk of heart attack associated with taking calcium alone.

As previously mentioned, calcium levels reported in standard blood work are not helpful for measuring calcium status. However, if you do not have adequate stomach acid production, optimal vitamin D levels, and/or poor gut health, your body may not be utilizing calcium appropriately.

Calcium is absorbed in limited quantities and depending on your current intake, supplements should be taken 2-3 times per day for optimal absorption. Your body can only absorb ~500 mg at a time, this reflects the total absorbable from both supplementation and dietary intake. Total intake of calcium should be between 800-1000 mg per day. This is lower than most standard recommendations. Based on the literature, many cultures with lower intake of calcium do not have progressive rates of osteoporosis. Check-in with your healthcare time to verify what your personal calcium needs are.

We recommend a form of calcium called microcrystalline hydroxyapatite calcium (MCHC). Hydroxyapatite interacts with bone cells and improves osteoblast differentiation. Review our fullscript protocol for our current calcium supplement recommendations (27).

[ACCESS FULLSCRIPT PROTOCOLS HERE](#)

Chromium:

Chromium is a trace mineral that reduces calcium loss in urine, supports collagen production, increases DHEA, a precursor for sex hormones, and reduces the rate of bone resorption. Chromium can also support healthy insulin metabolism.

Chromium is easiest to get through a multimineral that contains 600-1,000 mcg of chromium.

Chromium is not measured in conventional blood work, but can be measured in functional testing.

Iron:

Iron status is foundational for several components of health. As it relates to bone, iron works with Vitamin C as a cofactor in collagen synthesis. Chronic iron deficiency can increase bone resorption and risk of osteoporosis.

Iron status is easy to check in standard blood work, however, you need to get ALL iron labs for an adequate assessment. Interpreting the interplay between these labs is best done by a qualified member of your healthcare team because there is nuance to the interpretation.

Labs to Assess:

- Hemoglobin
- Ferritin
- Iron binding capacity
- Unsaturated iron binding capacity

Lab Name	Reference Range
Hemoglobin - Women	11.1-15.9 g/dL
Hemoglobin - Men	13-17.7 g/dL
Ferritin	38 - 399 ng/mL
Iron Binding Capacity	250 - 425 mcg/dL
Unsaturated Iron Binding Capacity	118 - 369 mcg/dL

High dose iron supplementation may cause constipation. Depending on your level of deficiency and the dosing of iron, you can take your iron supplement every other day to get the same increase in serum levels, the lower frequency of iron supplementation reduces the risk for constipation. Iron absorption is regulated by hepcidin, the more iron you take, the more you drive hepcidin up. Higher hepcidin levels result in lower iron absorption. This is why iron supplementation every other day can be just as effective as taking the same dose twice per day (28).

Avoid taking iron supplements with calcium supplements, they compete for absorption and you will not be taking the dose you think you are.

Without verifying iron deficiency, aim for the DRI for Iron. If additional supplementation is needed, do not exceed 100 mg of supplemental Iron. Iron can be consumed at toxic doses with significant adverse effects. Vitamin C supplementation or vitamin C rich foods can help with absorption of iron.

Iron Daily Recommended Intake:

Age	Men	Women
19 - 50	8 mg	18 mg
51+	8 mg	8 mg

<https://ods.od.nih.gov/factsheets/Iron-HealthProfessional/>

***Ranges vary for pregnancy and lactation**

Iron Upper Intake Levels - **DO NOT EXCEED WITHOUT MEDICAL SUPERVISION**

Some individuals may have a condition that requires higher doses of Iron than the Upper Level. Common side effects of excessive iron supplementation include: constipation, nausea, abdominal pain, vomiting and diarrhea and reduced absorption of zinc.

The risk of iron overload is low for adults with normal intestinal function.

Age	Men	Women
19 - 50	45 mg	45 mg
51+	45 mg	45 mg

<https://ods.od.nih.gov/factsheets/Iron-HealthProfessional/>

Review Iron Supplementation with a Healthcare provider if you take:

- Levodopa
- Levothyroxine
- Proton Pump Inhibitors

Magnesium:

Magnesium is a critical component of optimal health. It serves as a cofactor for 300+ reactions in the body. When it comes to bone health, Magnesium supports bone matrix and osteoblast production, development, and activity. Magnesium also aids in calcium absorption, is required for bone formation, and regulates parathyroid hormone (13).

Outside of bone health, Magnesium supports healthy HPA axis function, reducing anxiety and depression, improves slow motility in the GI tract, and can reduce blood pressure.

When measuring Magnesium in blood work, serum magnesium is not a good marker of magnesium status, be sure to request RBC Magnesium.

The optimal reference range for RBC Magnesium is 5.8-6.5 mg/dL.

Because Magnesium is vital to many different systems, you'll want to choose the form that will impact your symptoms most effectively. When choosing a supplement look for chelated forms, including glycinate, citrate, and threonate.

Forms of Magnesium		
Form	Use Cases	Absorption
Magnesium Glycinate	Anxiety, Depression, Stress, Insomnia	Easily absorbed
Magnesium Citrate	Raise magnesium levels, relieve constipation	Easily absorbed

Magnesium Threonate	Brain Benefits; Depression, Alzheimer's Disease, Age related memory loss	Easily absorbed
Magnesium Oxide	Constipation, indigestion, heartburn	Poorly absorbed
Magnesium Chloride	Raise magnesium levels, topically relieves pain, potential relieve fibromyalgia	Easily absorbed
Magnesium Lactate	Used for high-dose needs, food fortification (not generally supplemental)	Easily absorbed, low risk of side effects
Magnesium Sulfate	Epsom Salts, muscle relaxation, stress relieve	Not well documented

Aim for around **300 mg/day of Supplemental Magnesium as tolerated by your GI tract.**
Consider splitting your dose up into 150 mg, twice per day.

Magnesium in any form can cause diarrhea in excessive doses.

Magnesium Daily Recommended Intake:

The DRI for Magnesium is often lower than the Upper Level for Magnesium. This is a result of the DRI combining all forms of magnesium (dietary and supplemental) and the Upper Level is from supplements alone.

Age	Men	Women
19 - 30	400 mg	310 mg
31 - 50	420 mg	320 mg
51+	420	320 mg

<https://ods.od.nih.gov/factsheets/Magnesium-HealthProfessional/>

***Ranges vary for pregnancy and lactation**

Magnesium Upper Intake Levels

Many conditions require exceeding the Upper Level of Magnesium and usually result in diarrhea. However, nausea, abdominal cramping, and low blood pressure may be other signs of

excessive magnesium intake. **Magnesium can be found in many supplements, and you should assess your total magnesium intake from supplements together.**

Age	Men	Women
19+	350 mg	350 mg

<https://ods.od.nih.gov/factsheets/Magnesium-HealthProfessional/>

Review Magnesium Supplementation with a Healthcare provider if you take:

- Bisphosonates
- Antibiotics
- Diuretics
- Proton Pump Inhibitors

Selenium:

Selenium is a micronutrient that you do not need a lot of, but deficiency can have an impact on bone health and immunity. Selenium is challenging to get through food and it is primarily found in soil. The best forms of dietary selenium are Brazil nuts and animal products.

It may be easiest to supplement with Selenium. You can have too much selenium.

Recommended intake from all forms: 100-200 mcg

Do not exceed: 300 mcg of selenium

Selenium Daily Recommended Intake:

Age	Men	Women
19 - 50	55 mcg	55 mcg
51+	55 mcg	55 mcg

<https://ods.od.nih.gov/factsheets/Selenium-HealthProfessional/>

***Ranges vary for pregnancy and lactation**

Selenium Upper Intake Levels

Excessive intake of selenium from diet and supplementation can cause adverse effects such as hair loss, brittle nails, cardiac failure, kidney failure, nervous system abnormalities, irritability, diarrhea, and skin flushing.

Age	Men	Women
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19+	400 mcg	400 mcg
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<https://ods.od.nih.gov/factsheets/Selenium-HealthProfessional/>

Zinc:

Zinc plays a role in immunity, mental health, blood sugar regulation, and osteoblast and osteoclast activities. Zinc will stimulate osteoblasts and decrease bone loss.

Zinc is often taken in high doses for immunity, however, chronic intake of zinc above the DRI can contribute to copper deficiency.

We don't often recommend supplementing with zinc specifically for bone health since we find most people have RBC zinc levels in a healthy range.

Age	Men	Women
19 +	11 mg	8 mg

<https://ods.od.nih.gov/factsheets/Zinc-HealthProfessional/>

***Ranges vary for pregnancy and lactation**

Strontium:

Strontium is an element that is quite controversial in the bone health world. Historically, strontium has been used in a medication called strontium ranelate that was pulled from the market for increased risk of deep vein thrombosis (DVT) and DRESS Syndrome. However, the form of strontium we recommend and the option that is available in supplemental forms in the United States is strontium citrate and it does not come with the same risks as strontium ranelate.

In the osteoporosis community, there are several books that misinterpret the studies done with strontium ranelate and apply those to strontium citrate which is a flawed method of research. However, there are recent human studies that look at strontium citrate in combination with other micronutrients and interventions including DHA or Melatonin, Vitamin D3, Vitamin K2-MK7, Elemental Magnesium, dietary calcium, and daily impact exercise.

These studies show benefits to osteoblast activation and they do not show any adverse effects.

Strontium will show improvements with your DEXA T-scores due to the higher atomic weight of strontium when compared to calcium, which is a positive impact we are looking for.

Dosing of strontium should reflect 600-800 mg of *elemental strontium* which is about 2,000 mg of Strontium Citrate.

There is not DRI or Upper Level documented for strontium.

Avoid taking strontium with calcium, we recommend taking calcium during the day and strontium before bed to optimize absorption.

Melatonin:

Melatonin is often associated with sleep. However, Melatonin's impact on sleep is largely genetic and may impact individuals differently. We are discussing melatonin because it can also improve bone formation.

The recommended dosing for melatonin to see bone benefits is 0.3 mg to 200 mg. However, some people are very sensitive to melatonin and may not be able to tolerate any outside of the range of 1-5 mg. There are other people who may not be sensitive to melatonin and may tolerate up to 200 mg.

There is no DRI for Melatonin and no Upper Level.

When supplementing with melatonin, you can start with 5 mg and cut the dose in half to determine how you metabolize melatonin and titrate up from there.

Considerations for Supplements:

We have covered several supplements and nutrients that are beneficial for optimal bone health. There may be additional supplemental tools that will have an impact on other parts of your health as determined by lab results and symptoms. Unfortunately, we cannot cover all of them in this workbook.

Remember, it is always best to work with a qualified provider to be sure you are getting the proper doses of supplements. Toxicity can happen. You should also be mindful of getting your supplements from high quality sources and trusted suppliers because supplements are not a well-regulated industry.

[ACCESS FULLSCRIPT PROTOCOL](#)

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