A Certificate of Specialization Course

Osteoporosis Fitness Specialist

Beating Osteoporosis with Nutrition and Exercise

(a.k.a., Project B.O.N.E.)

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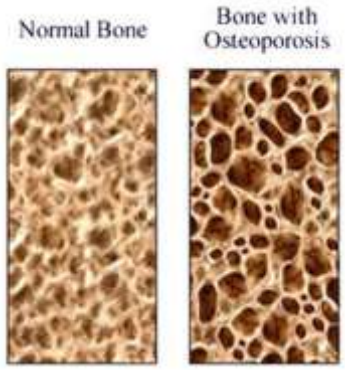
Module 1: Introduction

Beating Osteoporosis with Nutrition and Exercise (a.k.a., "Project BONE")

The MedFit Education Foundation is dedicated toward increasing the knowledge, skills, and abilities of the exercise training community on subject matter related to chronic diseases. The amazingly powerful tools of exercise and nutrition are easy to access and very potent in their capacities to delay, relieve and, in some cases, remove the life-destroying aspects of these diseases.

Interestingly, many diseases accompany aging. There are many theories on why this occurs, but the bottom line is that bodily systems, composed of individual cells, get weaker after they have peaked. When they peak, the amount and rate at which they decline is adjustable based on genetics and lifestyle habits. When tissues are growing and dividing, they are going through ***hypertrophy*** or ***hyperplasia***. This is the increase in size or number of that cell, respectively. The decrease is due to disuse or aging, and is known as ***atrophy***.



Osteoporosis is defined as a bone disease that develops when bone mineral density and bone mass decreases, or when the quality or structure of bone changes. This can lead to a decrease in bone strength that can (as mentioned in the definition) increase the risk of bone fractures.

It is an odd disease in that there are genetic components, and it meets many of the criteria for a disease, but it is actually the exaggerated state of something that is very natural and normal in our bodies—losing bone mass with aging known as **osteopenia**. Several diseases of aging are often not the result of something "bad" we are doing to our bodies, but rather the lack of doing something "good." One of the tissues that atrophies with aging is skeletal muscle. The loss of muscle mass (i.e., **sarcopenia**) is normal, but beyond a particular point it is a disease (i.e., **wasting**). The same principle applies with fat gain. It is recognized that we gain body fat as we age, but beyond a certain point (>30 BMI) it is called **obesity**, and is accompanied by several other risk factors which may shorten your life. Thus, by doing something good—eating right and exercising—we delay these age-related diseases (Fox, 2019).

The term osteopenia is used to describe the natural loss of bones humans experience as they age. The rate of bone loss can be accelerated or minimized with a just a few lifestyle changes or additions. When the loss of bone exceeds a certain standard, as noted on the T-score for instance, it is labelled osteoporosis. Thus, osteoporosis is a condition when the spongy or trabecular bone density is too low to support the physical stresses, and become prone to breaking. This course will show you what bone loss is

and how to minimize it, and it will carefully guide you to the proper foods to eat along with the best exercises to perform in order to keep your bones healthy. So, let us press forward toward bone health, and have our bodies in a place to look backward at osteoporosis and the disability it causes.

There are many statistics on osteoporosis, and we won't go into all the different numbers, but we will jump into the trends and how this relates to who gets it, and why. As mentioned, osteoporosis is actually an advanced state of what normally occurs in the body with aging. Thus, given the aging population as a whole, the prevalence of this disease is very high, and both genetic and personal lifestyle factors are involved.

About 80% of all people diagnosed with osteoporosis are women. One in two women, and one in four men, will break a bone in their lifetime due to osteoporosis. Thus, men who have osteoporosis are more likely to fracture a bone than a woman. One must remember women live longer so this influences the statistics a bit. If women are diagnosed with this disease four times more frequently than men, why? Two main reasons are prominent: One is that the bone mass of men is higher than that of women to begin with, and the other is that once a woman hits menopause, the amount of bone-saving estrogen goes down, dramatically. These factors, combined with the longer life span of women, are reasons for the greater prevalence in women than men (Schnell et al., 2010).

Another shocking statistic is the prevalence of death soon after a hip fracture. The ratio of hip fractures in women versus men seems to match that of osteoporosis in that 1 in 3 women and 1 in 12 men will sustain a hip fracture in their lifetime. Age is a huge factor in hip fractures, with 86% of the fractures being in people over 65 years.

Unfortunately, hip fractures have a significant association with morbidity, mortality, and financial burden. The first year after a hip fracture seems to be the critical time, as the 1-year mortality rate after a fracture is estimated to be 14-58%. When compared to those of the same age and sex who do not have a hip fracture, there is a 5-fold increase in the likelihood of death in women, and an 8-fold increase in the likelihood of death in men, within the first 3 months for those who experience a fracture. After 2 years, the mortality rate in those with fractures lowered dramatically, but still remained higher than those without (Phy et al., 2005).

Don't Fear the Negative - Embrace the Positive

When we think of bones and aging, often the first thing to pop into our heads is osteoporosis. The clinical world has focused everything on avoiding the awe-inspiring **O disease** - osteoporosis. We have been led to believe that when something isn't terribly wrong, that it is right. In other words, much of the

Western World believes in *reactive medicine* rather than *proactive health care*. In some instances, this concept does apply, and we actually do not know what diseases or disabilities we may encounter down the road, or even the next day. The amount of information and scientific studies performed on the human condition, however, has allowed us to have a really good picture of the preventative actions that can be taken to keep our bodily systems functioning properly, and avoid most chronic diseases. For instance, smoking in the U.S. and worldwide has dramatically decreased because the odds of getting lung cancer, heart disease, or some other life-ending condition is dramatically higher in smokers than non-smokers. In fact, smoking even increases your chances of getting osteoporosis.

It is of critical importance to stay in good health and perform actions to keep you there. Perform appropriate tests, such as bone mass density tests, on a regular basis, and if numbers are not where they should be, do something about it - be proactive. Do not wait until something goes wrong, then have to be reactive because it may be too late, and you may not be able to change the prognosis. In fact, of the 54 million people with low bone density, 80% do not know they have it until they fracture a bone as a result of it! (NOF Fast Facts, 2015).

What is bone health?

The old expression, “if it ain’t broke, don’t fix it” is a cute statement, but what it implies is a lack of proactivity, and that things are either in a “broken state” or “fixed or great state” when in reality there are many levels of “broken.” We need to understand what bone health is, then eat and exercise to obtain and preserve it. Bone health is more than the avoidance of bone disease. It is the capacity to have bone tissue which will endure whatever stresses you put on them during life’s activities. While it would not be smart for a 90-year-old woman to do plyometric box jumps (if she even could jump), it would be within reason for her to be able to dance, or go down some stairs and not worry about bones breaking.

The sad fact is that it is basically too late to do a whole lot about osteoporosis once it has been discovered. In other words, to reverse the state of porous bone after a certain age is difficult to impossible. Yet, most people below the age of 60 do not get their bone density checked. They do little to actually ensure their bone density is maintained, or loss is minimized until they find out they have osteoporosis (NOF, 2015). Bone health has four aspects:

1. When you are young gain as much bone density as possible.
2. Keep what bone density you have in your plateau stage.
3. If you are losing bone(osteopenia), minimize the loss.
4. If you are in an osteoporotic state, try to gain some bone mass, and avoid a fracture at all costs.

Bone Physiology

As we are developing and growing, our bones are going through a lot of remodeling (where bone material is constantly being broken down and rebuilt). In fact, they are very active tissues with the osteoblasts or bone builders laying down new bone by the **epiphyseal plate**. It is almost a race for the osteoblasts to lay down the necessary amount before that epiphyseal plate closes and no more elongation can occur. You stop growing in height when the epiphyseal plate closes. In women, this is often between ages 13 and 18, and in men often between 15 and 21. Sure, there are a lot of individual variances on how long people continue growing, or when the "growth spurt" actually starts. In addition, as we grow, our blood supply needs to increase and the **red bone marrow** is busy producing red blood cells in response to the erythropoietin from the kidneys.

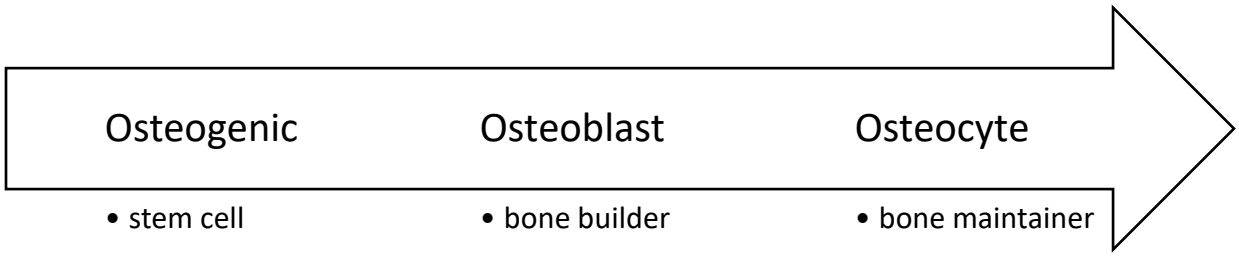


Figure 1: The life cycle of a bone cell. Three phases and functions

After we stop growing lengthwise (i.e., **longitudinal growth**), our bodies are still increasing in size with additional muscle, fat, and even bone girth (i.e., *circumferential hypertrophy*). This is called **appositional growth** and the epiphyseal plate does not affect this type of growth. This is where boys and girls become men and women. The man's back and shoulders widen, and the woman's hips do the same. Bone material is constantly being broken down and rebuilt throughout our lives, but there is a plateau at some point where the break down and buildup of material are equal for a couple of decades (roughly 20-40 yrs.). After this point, there is a mild net loss of bone, which in some can be very little. This mild osteopenia may be occurring for 15-20 years. Generally, after the age of 60 yrs., the rate of osteopenia increases, and it does so again when we hit 80 years of age (Fox, 2019).

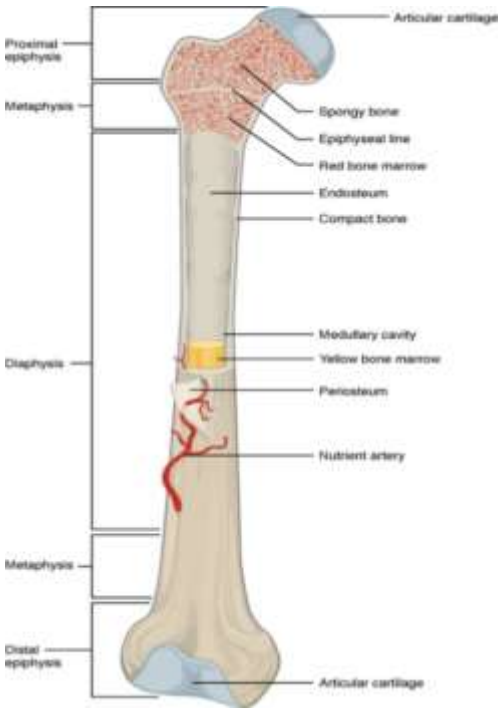


Figure 2: Various structures of human long bone

The standard long bone in our bodies consists of two types of bone. **Compact bone** (called, cortical bone) is the hard bone we may see on the outer layer, but underneath this is **spongy bone** (called, trabecular bone) and this is where osteoporosis takes effect. Our bone matrix is maintained by *osteogenic stimuli*, which is a fancy word for bone impact or pounding. We now know that astronauts in space flight do not have gravitational pull, and thus no body weight to stimulate the bone, so they will begin to have demineralization of their bone, and it occurs very quickly after prolonged weightlessness. As a result, astronauts now exercise on treadmills and perform other bone stressing activities while in flight (Fox, 2019).

What are some of the Statistics on Osteoporosis?

Please note that the focus of this course is not on osteoporosis directly, but rather on the *avoidance of osteoporosis*, and the keeping of bones healthy. With this being said, many understand that there are some "built in" risk factors such as being female, Caucasian or Asian, thin, and a smoker. The reason being female is a risk factor is two-pronged. First, after menopause, females lose estrogen-based maintenance of the bone, and secondly, females have a lower peak bone mass than men. Here are some more statistics (NOF Fast Facts, 2015):

- More than 3 million new cases of osteoporosis are diagnosed every year, with 2 million breaking bones, and yet nearly 80% are not tested for osteoporosis after the fracture.
- 54 million people have low bone density, representing 55% of those over 50 yrs. old in the U.S.
- 50% of post-menopausal women, and 25% of men will break a bone due to osteoporosis.
- Currently $19 billion is spent annually on osteoporosis bone breaks, and this is predicted to increase to $25.3 billion in the next 5 years.
- Every year about 300,000 hip fractures occur, and 1/4th end up in nursing homes.
- Of those with the hip fractures, half never regain previous function.
- Six months after hip fracture only 15% can walk across a room unaided.
- Almost 1/4th of hip fracture patients over 50 die the following year.

Form Fits Function, and Vice Versa

While the saying, "form fits function" applies to many aspects of life, both living and non-living, it is especially true and evident in bone growth and remodeling. As mentioned, during our younger years our bones are busy growing and forming according to the forces placed upon them. We cannot always predict someone's fitness by their form, but most often you can. The guy in this picture can probably lift a lot of weight, a lot of times, and perform many physical feats. This is pretty obvious if you look at him! The reverse, "function fits form" is also true here. You function a certain way, and your from will adapt to optimize that function. Just look at the Olympic athletes in a given event. They will all have similar physiques and body types. If you were in a wheelchair, you would likely lose bone mass in the lower body over time, but that's not necessarily true of the upper body, so long as you were active with your upper body. Of course, the same would go for muscle mass.

The Body's Remodeling Processes

We mentioned remodeling previously, and **Wolfe's law** is the term applied to bone tissue remodeling according to the forces (or lack thereof) that are put upon it. An active young child, I developed Osgood-Schlatter disease, which is a bump on the top of the shin. Technically, it is hypertrophy of the tibial tuberosity. It is associated with adolescents going through the growth spurt, and in those who do a lot of running and jumping and shifting weight or agility. It is most common in boys and catchers, surfers, and jumpers will get it more often. It is extra bone laid down where the stress of the quadriceps femoris pulls on the patellar tendon, which attaches on the tibial tuberosity. This can also occur in a negative way as in the *Dowager's hump*, which is the hunch back look seen in older ladies. **Davis' law** is the term applied to soft tissue remodeling. The ever-popular "tech neck" which is just starting to develop. **Upper Cross Syndrome** is a classic example of form fitting function, and its ability to literally mold you into place. This often occurs in the desk jockey with an upper body having arms internally rotated, protracted scapula, a hunched-back, and a forward protruding head. The **lower cross syndrome** is noticed with tight iliopsoas and erector spinae, and weak abdominal and gluteal muscle groups. Once the body acclimates to this position, it becomes the new normal even though it can cause misalignment and dysfunctional movement. Thus, function or

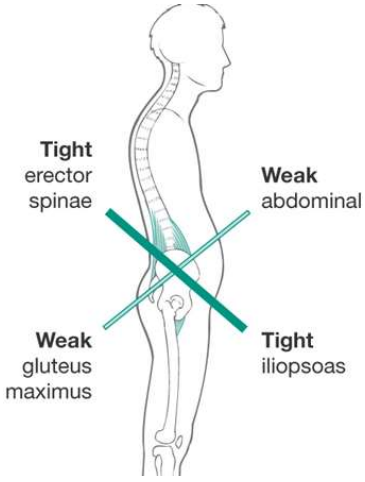


Figure 3: Example of lower cross syndrome in humans

dysfunction can equal form. When we are misaligned or must compensate for some weakness in the kinetic chain, we move incorrectly and increase our chances of injury, which can cause further deformation (Fox, 2016).

Taking a Holistic Approach to Bone Health

In preventative medicine, there are several areas that are simultaneously addressed. We want to **maximize the good, synergize with the helpful, and minimize or eliminate the bad.** This means we want

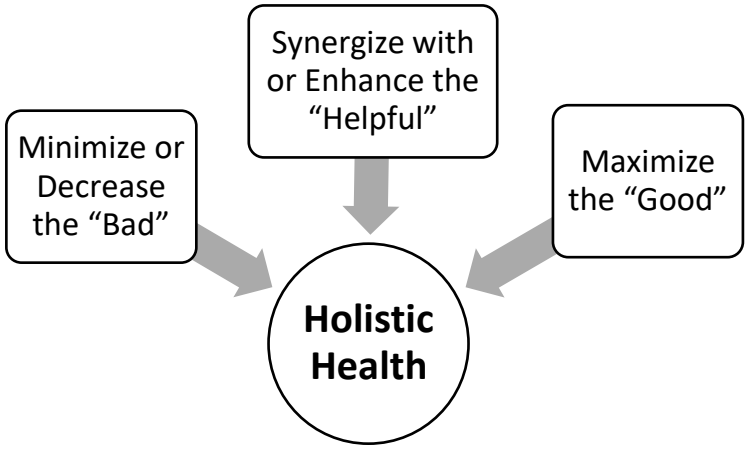


Figure 4: The Holistic Health Approach- The main 3 perspectives

to increase bone density when we are young and developing by doing a lot of bone-stressing exercises. We want to synergize the helpful by eating a diet that supplies enough calcium, phosphorus, potassium, magnesium, sulfur, vitamin D, C, K and even A for optimizing bone density and joint health. We also want to avoid the bone robbing items, or decrease the bad, such as excessive alcohol consumption, smoking, certain medications and, of course, not exercising.

When taking a holistic approach, you must consider that not "doing good" is similar to "doing bad." This sounds very simplistic, but the reactive approach developed by standard medical practices, has ingrained itself as a societal norm. Meaning, if we are not injured or sick, we are fine! This is not the case. We can be on the verge of a break down, and may not know it unless we *proactively* test for it, and counteract the condition.

Bone, Movement, and Joint Strength - Form and Function Feed Each Other

As previously explained, form fits function because the body will remodel itself based on the stresses put on it, the stresses are based on the functions the human frame undergoes. It is not just the frame but also the mind that gets transformed during movement. Muscular coordination and even the motivation to move is increased by moving itself. It goes back to the specificity and reversibility of training or the use it or lose it, and the way you use it will transform it.

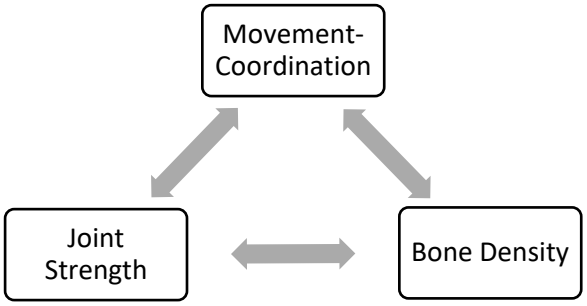


Figure 5: The synergistic interplay between movement, bone strength, and joint strength

There are many centers in the brain involved with movement and exercise. The basal ganglia, cerebellum, thalamus, as well as the pre-motor cortex, motor cortex, and limbic system all have roles in movement. The proprioceptors in the peripheral nervous system are also activated during movement. By moving more, we stimulate these receptors and actually increase the neural connections through a process called *neurogenesis*. Various chemicals such as dopamine and Brain Derived Neurotropic Factors (BDNF) are released, and performs this neurogenesis. Thus, like most things in life, the more we do something, the better we get at it. In this case, the better you get at it, the more you do it! Because the neurologic connections are getting reinforced, your ability and desire to move is enhanced, and you stay better.

The joint strength is also increased as someone moves, which in turn increases the ability to shift weight and move in a coordinated fashion. This causes someone to fall less, or never, and increases tendon and ligament strength, not to mention muscle and bone. As the joint strength increases, an individual's confidence in that joint increases, further enhancing all the process mentioned (NIH, 2018).

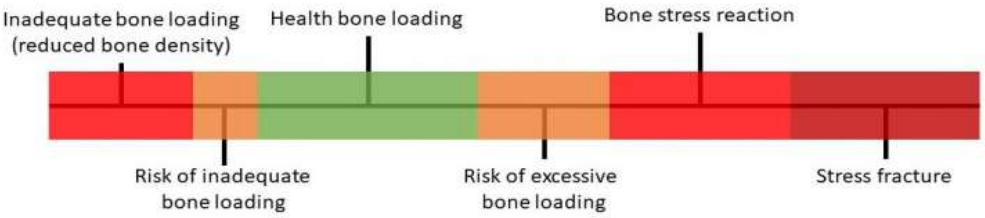


Figure 6: The Different ways to stress a bone- too little, just right, and too much

The "sweet spot" in training an *osteo client* is finding the right level of strain or load to apply to the bone to cause an osteogenic stimulus, but not so much that a bone gets broken or other injury occurs. The primary reason the approach in this course has four stages is to adjust the osteogenic stimuli for that person's health state. The above figure shows the green area as the sweet spot, orange being caution, and red being danger.

Why does Aging cause a decrease Bone Density?

The aging process has several factors associated with it that cause bone density to decrease. The amount of bone deposition or laying down new bone is due to the osteoblast activity. The amount of bone resorption or pulling bone materials back into the bloodstream is due to osteoclast activity. Cortisol is a catabolic (stress) hormone released by the adrenal cortex, which has widespread effects throughout the body. In the bone, it will inhibit blood flow to bone, known as angiogenesis, and it will cause the release of **radical oxidative species (ROS)**, otherwise known as free radicals. The ROS will in turn, increase a substance that inhibits osteoblast activity. The ROS will also enhance **oxidized lipids** which activates fat deposition into the bone but also inhibits osteoblast activity. Lipid oxidation is a third age-related factor which also stimulates the same mechanisms as the ROS. The bottom line is to prevent or slow the age-related processes by an exercise and diet program. It is not necessary to gain bone mass, but it is necessary to slow the loss of it (Alemeida, 2010).

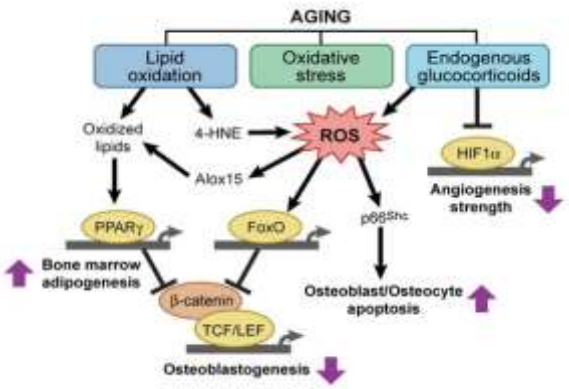


Figure 7: The effects of aging on factors related to bone density (Alemeida, 2010)

As we age, there are more degenerative processes occurring than regenerative processes. It is through diet and exercise we attempt to minimize this imbalance, or even reverse it in some cases. Aging generally causes increased lipid oxidation, more oxidative stress to occur, and more cortisol secretion. These three factors are interactive and end up increasing the radical oxidative species, and reducing osteoblastogenesis, or the making of more bone building cells. Interestingly, exercise of a relatively moderate intensity will reduce the oxidative species, reduce the mental stress, and subsequent ROS production.

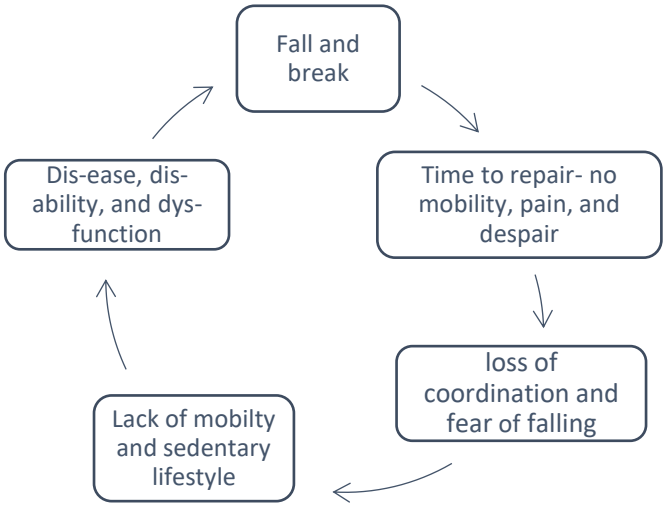


Figure 8: The dysfunctional cycle from osteoporosis

Osteoporosis – A Killer or Not?

Many will say that osteoporosis has never killed anyone, so what is the big deal. Actually, it probably has, but it has taken a circuitous or indirect route, and often several years before eventually killing someone. When someone takes a fall, and breaks a hip due osteoporosis, there are several circumstances that are set into motion. One being the person must now heal. This means being laid up in bed and not moving. This often slows healing, but also causes muscle wasting and a lack of balance and coordination. The old saying of "use it or lose it" definitely applies to moving; walking, in particular. Once the person has fallen and broken a hip, they start to fear falling. They also start to fear walking or even standing, and so they do these things less. This further weakens their coordination and balance skills,

which causes more falls which, in turn, augments the fear, and so on. It is quite common to see people die within months of their first significant fall.

Why Does Aging Cause an Increase of Falls?

Although we discussed the reasons for someone dying from broken bones due to falls, and how that process occurs, the factors contributing to "why" were not. As someone ages, several senses and skills diminish that help keep our equilibrium or staying balanced. The cerebellum is a major brain area responsible for coordinated movement and balance. This will atrophy with age.

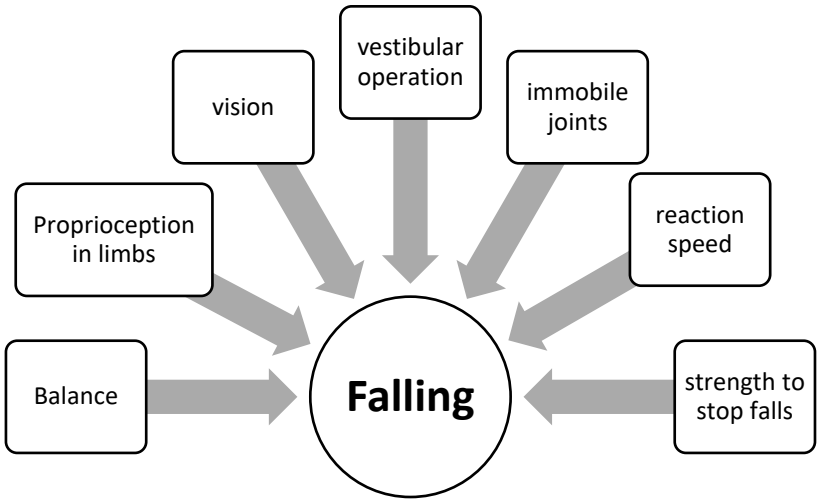


Figure 9: The many contributors to falling or not falling

The sensory integration and reweighting in the thalamus and reticular area also decreases. Vision and the vestibular apparatus in our inner ear are critical for balance and both of these decrease. Biomechanical constraints such as stiff joints, pain, or arthritis in joints, weakened muscles and slowed reaction time all contribute to falls as well. Even the postural muscles that keep us upright lose the feedback correction signals and the perception of verticality decreases. Finally, the reaction speed and even strength to catch ourselves is slow and weakened, respectively. Thus, falling prevalence is higher and the damage that occurs because of a fall also dramatically increases.

In summary, it is important to understand that the bone is a dynamic organ, and it is under the influence of many physiological and mechanical processes. The more someone moves the better their bones will be and the less likely they are to fall. Once a hip is fractured, the odds of dying go up

dramatically. Knowing how and why the bone mass increases or decreases will help you understand how to program a client for a complete bone health program.

A Review of Major Concepts in Module 1

Please take a moment to review each of the following questions below. Taking time to answer the questions below will assist you in your learning of the material presenting in this module.

1. What is hypertrophy vs. hyperplasia vs atrophy?
2. What is osteopenia and sarcopenia?
3. What is osteoporosis? How is it measured?
4. Why is osteoporosis a disease that goes “undetected” until it is “too late”?
5. What is the difference between an osteoprogenitor cell, osteoblast, osteoclast and osteocyte?
6. What is longitudinal vs appositional bone growth?
7. What is compact vs spongy bone? What type is more prone toward fractures?
8. Where is the epiphysis, metaphysis, and diaphysis on the typical long bone?
9. What are two reasons women get osteoporosis more than men?
10. What is so dangerous about breaking a hip? How can it lead to death?
11. How does Wolfe’s law apply to form equals (is due to) function?
12. Give an example of how function is due to form or dysfunction is due to deformation.
13. What three factors go into a holistic approach?
14. What is a reactive vs a proactive approach with health?
15. Explain how movement, joint strength, and function are interrelated.
16. What is a reactive vs a proactive approach with health?
17. What does the term- osteogenic stimulus mean? What is an osteogenic threshold?
18. Name three factors associated with aging that can contribute to osteoporosis.
19. Name at least five factors related to balance and falls.

Module 2: Nutritional Aspects of Bone Health

Trying to decipher the world of nutrition is often a difficult task. There are many interactions that take place when we eat something. Not only is the food we consume broken down into its essential elements, but various endocrine and organ reactions are occurring. Trying to eat something in an attempt to improve your health or enhance some bodily structure, is not as easy as you would think.

First, it must be recognized that just because we eat something this does not mean it makes it to the cell where we need it. After we take something into our mouth **(ingestion**), we begin **physical digestion** with chewing, known as mastication. We also begin **chemical digestion** with salivary amylases and lipases which breakdown complex carbohydrates, and lipids or fats, respectively. Then the stomach goes to town, churning and burning and breaking down proteins. It gets passed on the small intestine with chemical help from the liver, gall bladder and pancreas where the vast majority of **absorption** occurs. This is the movement of small particles called monomers into the bloodstream. Monomers get transported into a cell in a process called **utilization**. It is these last two processes that are the most important because unless something makes it into the cell, *and* is actually used, the previous steps do not matter!

How the chemical agent or fuel gets utilized is a function of the stresses and needs of the body. Thus, exercise and stress can affect how are nutrients are used. By stressing our bones, we give it the stimulus for certain cells (osteoblasts) to take up calcium and phosphorus, and all the other necessary ingredients for bone to build up the new bone and breakdown the old bone (Fox, 2016).

Remember the Holistic Perspective - Confusing at Times

The holistic perspective was mentioned with lowering the bad, synergizing with the helpful, and raising the good. You would think that is easy with nutrition, thinking, “I will consume more foods that are good, and less that are bad.” Unfortunately, it is not that simple, and there are many facets of nutrition to which we need to simultaneously pay attention. This complexity and multifaceted nature of nutrition is why you hear of so-called, “scientific fact” changing across time! The above-mentioned digestive processes can be promoted or inhibited by various agents, as well. For example, something in spinach known as an oxalate can bind calcium, and prevent its release into the system so that no absorption occurs. Something like wheat bran, an insoluble fiber, can actually inhibit calcium absorption of any food it is eaten with, but only in its pure form! Likewise, caffeine, red meats and high-salt foods seem to lower calcium stores. Note that it is not in the *scope of practice* of this author to give clinical nutritional advice, so please consult with a physician, registered dietitians, and national organizations specializing in osteoporosis.

Too much of a Good Thing- is not a Good Thing

This old saying is quite true when it comes to enhancing bone density via nutrient intake. There are several nutritional agents that are beneficial for bone when taken in the proper quantity. While protein a necessary component of a bone enhancing diet, too much is not good, especially when it comes from animal sources. Too much protein can increase the sulfates in the blood, which can cause the calcium in bones to leach out. In a study performed by the *Harvard Medical School*, known as the *Nurses' Health Study II*, researchers followed 116,686 women for 10 years. They found that those women eating red meat at least five times a week were more likely to have bone fractures than women who ate red meat once a week.

Another nutrient, the mineral fluoride, is also in this "too much of a good thing is not a good thing" category. Fluoride is often associated with keeping the teeth free from cavities or plaque. Some fluoride is also very good for the bones. A study from Finland (2000) found that women who drank fluoridated tap water had reduced risk of hip and spine fractures than those drinking bottled water. Too much fluoride, however, negated these positive effects.

Two of the most recognized supplement agents for bone are vitamin D3 (calcitriol) and calcium. Several studies have reported on the dangers of high doses of these key bone nutrients, and how they actually may not reduce fractures, but may even increase them. This finding has not been verified by all sources, but it is interesting, and obviously flies right in the face of the so-called standard knowledge on calcium intake.

In an NIH fact sheet, several studies on Vitamin D intake were reviewed, and found only small increases in bone mineral density in institutionalized older adults, but not in community-dwelling people, and there was no reduction in falls, and no reduction in fractures. Another study found if vitamin D levels were low or high, there was a greater risk of frailty (see list of references). This finding was in agreement with a Lancet article in 2013, and another Journal of American Medical Association (JAMA) article in 2010 that found high doses of Vitamin D associated with more falls and fractures. In addition, vitamin D in high doses can be toxic, can cause hypercalcemia (high blood calcium levels), and this can cause deposits in the arteries and kidney stones. High calcium has also been associated with heart problems, and bowel issues. A study on women worldwide found in the countries that consumed higher levels of calcium tended to have more fractures per 100,000 person-years. In addition, high sodium intake is not only related to high blood pressure, but also high urinary calcium which is indicative of bone mineral loss, and may cause kidney stones (Woo, 2009).

Guilty of Guilty Pleasures?

Some of the things we enjoy, often called the guilty pleasures, may actually be bad for the bone health beside other systems. Alcohol in excess interferes with the absorption of calcium and vitamin D. Lowering your limit down to one drink a day may improve the bone density. Smoking also interferes with nutrient adsorption and utilization and is associated with reduced bone mass density.

Two beverages commonly consumed by people worldwide, coffee, and soft drinks also have evidence to show they are not beneficial for bone health. A recent epidemiological study performed in Sweden on 31,527 women ages 40 to 76, found that women who drank 330 milligrams or more of caffeine in a day, roughly four cups of standard coffee, had an increased risk of bone fractures. Interestingly this same relationship did not ring true for tea drinkers. It is believed that the lower (typically half) caffeine content in tea is the reason.

The famous *Framingham longitudinal study* also looked at bone mineral density in the spines and hips of women (n= 1413) men (n= 1125) and compared this to the soft drink consumption. The data showed that cola and diet cola, and no other soft drinks, were associated with bone loss in women. The researcher believes the phosphorus in colas may be factor, not the caffeine. It is also speculated that the sodas may substitute for milk drinks which would enhance the bone density.

Some of the things we consider good for us may not be so great if you are a candidate for osteoporosis. Sodium is one of the most important minerals we can consume. However, excess sodium in the diet will cause you to excrete calcium in your urine and perspiration. Fiber is also good for our digestive system and it can lower risk factors for heart disease, but wheat bran eaten at the same time as calcium consumption can bind it prevent absorption. **Oxalates** also found in spinach, rhubarb, sweet potatoes, and bran fiber will also interfere with calcium absorption but only when eaten at the same time as the calcium.

What about Enhancing the Positive?

While much of the public seems to be interested in avoiding the negative, proactive “health care” advocates and coaches will want you to gravitate toward the good as well. What seems to be good for overall health is also good for bone health- fruits and vegetables. A diet low in fruits and vegetables may lead to mild acidosis which may contribute to bone loss. Of course, very good sources of calcium can be found in vegetables, not just dairy products.

On the positive side, several studies have mentioned how **beneficial gut microbes** may to help calcium absorption. A study in 2017 researchers found prebiotics may enhance the absorption of calcium in the gut and metabolism to improve bone health (Whisner & Castillo, 2017).

Supplements are vastly overdone by much of the public, but they do serve a valid role when ensuring the proper intake of a given substance. Make sure to pay attention to the seven recommendations for calcium supplementation. *The Fantastic Four*- as termed by this author- consists of two vitamins and two minerals. Most people identify the importance of Vitamin D for bone health. It is important that Vitamin D be the active form- calcitriol- known as D3. What most people don't realize is Vitamin K plays a significant role in bone mineral content of the two primary minerals of bone- calcium and phosphorus make up the fantastic four.

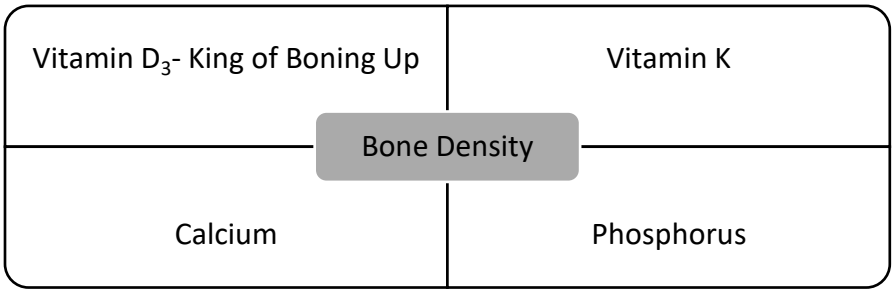


Figure 10: The Fantastic Four nutrients for healthy bones- 2 vitamins and 2 minerals

Calcium and phosphorus have antagonistic effects on the absorption of each other so make sure you are taking them in a 2 to 1 ratio (respectively Ca 2: Phosphorus 1) and you are not mega dosing either. There are many types of calcium supplements out there and some are better absorbed than others. In general, most individuals over 50 need between 1000 and 1200 milligrams per day (mg/d), and growing children (9-18) should consume about 1300 mg/d. Adults between 18 and 50 can keep it to about 1000 mg/d. The supplements on the market often exceed these levels but remember- just because it goes in your mouth does not mean it makes it to the cell.

Support Crew for Dem Bones

In addition to the *Fantastic Four*, other vitamins, minerals, and even phytochemicals should be part of the complete nutritional program to enhance bone health. Vitamins A and C, both of which are also associated with antioxidant activity also can be helpful for bone health. Be careful not to overdose on the Vitamin A since it is detrimental in high doses. Magnesium, zinc, copper, sulfur, are good major minerals to take, and silicon, strontium and boron are trace minerals that help bone health.

Phytochemicals are plant chemicals that have very beneficial effects in humans. Much of the public may have heard about the role of phytochemicals in heart disease, cancer, and maybe weight loss.

Polyphenols found in red wine, grapes, berries and other red, blue, or purple foods are beneficial as are **phytoestrogens** found in soy products. Phytochemicals that support the thyroid and parathyroid glands, which control calcium blood levels and thus bone mineral content are also recommended for bone health.

Going to the Medicine Cabinet to Bone Up

Again, it is not in the authority of the author to recommend medicines or even supplements that have curative purposes. This section is only trying to make you aware of the mechanisms some drugs use to prevent or reduce osteoporosis. There are many drugs on the market to help fight osteoporosis. Where most of the older generation drugs were designed to slow breakdown, the more recent ones are designed to rebuild bone, thus reverse this degenerative disease! Bisphosphonates such as Fosamax or Boniva are designed to slow the bone loss. Teriparatides, Denosumab and Abaloparatides may actually act to rebuild the bone mass back.

Parathyroid hormone (PTH) is often thought of as the enemy when it comes to bone density. The main reason is because in order to raise blood calcium levels it will remove it from bone. However, it actually increases the reabsorption of calcium by the kidneys and stimulates vitamin D3 (calcitriol) to absorb more calcium in the gut. Thus, it conserves or enhances calcium availability. Because of this, PTH is used as a therapeutic agent to enhance bone anabolism. Vitamin D3 has many different effects and reduces osteoblast apoptosis or cell death, thus keeping the bone builders around longer.

Eat This, Not That! (See the Video Segment)

There is a lot of advice out there on how to eat for increasing your bone health. It is best to keep things simple. In attempt to do this, I will replicate a past title by Men's Health- **Eat This, Not That**. Basically, I am showing a food that could potentially be detrimental to bone health and one that is beneficial to bone health. The motive of this was to gradually transition someone's food choices toward those that provide calcium, magnesium, phosphorus, or Vitamin D, C and various antioxidants vs those that diminish the stores of nutrients that build bone.

Trying to radically change someone's diet will often end in failure and rejection of change altogether. Interestingly, a few minor changes across time can make major differences in your bone health and much easier to tolerate mentally. There are a few central features that should be recognized and then the variety of foods that satisfy those features are numerous.

A couple of guiding principles to the foods that should be consumed for stronger or better bones include going for foods with calcium, phosphorus, magnesium, and fluoride for minerals, A, C, and D for vitamins, and phytochemicals, especially those that reduce oxidation to tissues (antioxidants). Another set

of guiding principles is about what can rob your bones of calcium. These include foods that are high in sodium, those that contain oxalates and phytates, those with wheat bran, and caffeinated and sodas with phosphoric acid and caffeine.

This video discusses why one food or drink might be chosen over another. It also tried to use foods that you could substitute for another. For example, you may want a pickle on the side of a sandwich. Wild berries or cherries could substitute. A cold-water fish like tuna, or salmon may substitute for a hamburger. What is odd is that something like instant macaroni and cheese is actually better than whole wheat bread for your bones, but no one would argue whole wheat is better for your overall health.

EAT this, NOT that- Video Segments

Table 1: Segments included in the EAT this, NOT that video

1	**Introduction**
2	**EAT Oranges and Cherries NOT Apples**
3	**EAT Berries NOT Pickles**
4	**EAT Nuts NOT Chips**
5	**DRINK Orange Juice NOT Caffeinated Sodas**
6	**DRINK Milk NOT Coffee**
7	**EAT Coldwater Fish NOT Hamburger**
8	**EAT Good Fats NOT Bad Fats**
9	**EAT Yogurt/Avocado Dips NOT Bean/Legume Side Dishes**
10	**DRINK Red Wine NOT Spirits**
11	**EAT "Anytime" Greens NOT Spinach**
12	**EAT Mac n' Cheese NOT Whole Wheat Bread**
13	**EAT Cheese and Marinara Sauce NOT Ranch Dressing**

The thirteen segments mentioned above are all under a minute except the introduction. While there is no perfect diet for osteoporosis, trying to keep toward the main guidelines and making some simple substitutions can do your bones a lot of good.

A Review of Major Concepts in Module 2

Please take a moment to review each of the following questions below. Taking time to answer the questions below will assist you in your learning of the material presenting in this module.

1. What is the difference between ingestion, digestion, absorption, and utilization?
2. What does the phrase- *too much of a good thing is not a good thing*- mean in nutrition?
3. What does smoking, or a high consumption of coffee, alcohol, and red meat do to bone health?
4. Why is spinach both good and bad for bone building?
5. Name two vitamins and two minerals that are beneficial for bone health.
6. Name two phytochemicals that are beneficial for bone health.
7. What is the difference between bisphosphonates and teriparatides, or Abaloparatids in their physiological actions?
8. Name three actions of parathyroid hormone to increase blood calcium.

Module 3: What Can Exercise Do to Help Bone Health?

You are What You Do

The old expression, "you are what you eat," has been mentioned previously as a fallacy, as we are actually what we *utilize*. What we utilize is regulated to a large degree by what we do. Thus, in a roundabout way, "we are what we do, when given the proper nutrients, recovery time, and genetics."

As mentioned earlier, Wolff's Law of bone tissue adapting to the stress put on it suggests that form follows function, or we shape ourselves according to what we do. Remember, when we have bad joints or weak muscles or bad alignment we will not move well. So, function definitely follows form, as well. The pictures of the very muscular men, who were CrossFit® finalists, confirms this theory. In order to function at that level, they will begin to look like they did—very lean and very muscular.

By this same analogy, when we do not exercise nor eat well, our bodies become weak, atrophied and out of shape. Thus, we are also what we "don't do!" Or, looking at it in a different way, we are not what we don't do. If this has you totally confused, don't worry. Just remember you are a product of your environment and when you eat, exercise, and sleep well you perform well and vice versa.

The Terrific Trio

The several things in life that come in "threes." The interrelationship between the bone density, the joint strength, and movement and coordination skills is one such example. The more you use your muscles, the stronger the bones connected to those muscles become. The more you move fast or ballistically, the stronger your joints get. The stronger your joints and muscles are, the more confidence you will have in your movement capacities. The more confidence you have, the more you will try higher intensity exercise and more complex movements requiring more coordination and balance. The more coordination and balance you gain, the more you can do things to strengthen joints, bones, and muscles! I think you get picture—these factors are self-serving or self-potentiating.

Unfortunately, for every action there is usually an equal and opposite reaction. This is true here, as well. When you stop moving much, your confidence in balance and coordination start waning. The old saying, "use it or lose it," is quite true for bone health and movement. When you do not have confidence in movement, you decrease the stresses from exercise and daily living activities. The weak joints now hurt with certain exertions. When you stop that exertion, you weaken the muscles and bones. When the muscles are weak and the movement skills are in decline, so to follow the bone strength and joint integrity. Thus, you will need to "flip the script" if you are already on this declining end. Start slowly, BUT START MOVING! One last analogy from one of the original physicists, Sir Issac Newton: *"A body in motion*

tends to stay in motion, and a body at rest tends to stay at rest; unless acted upon by an external force." The trainer *is* that external force. Getting into the habit of moving is probably the most important part of any exercise program. You can look all the details later, but start enjoying the process of moving first and foremost.

The Triple Play of Exercise

There are actually three different ways that exercise can stimulate bone density or minimize losses. The first, and most commonly known reason, is the actual impact the bone sustains when moving the body. This is known as "**weight-bearing activities**," and these have significant effects on maintaining bone mass density. Thus, the harder you "pound" a bone into the ground, otherwise known as ground reaction force, the higher the impact. Of equal or perhaps greater importance is the forces involved in changing momentum or direction. Therefore, I have emphasized that eccentric forces or those that occur when slowing a limb down, like running downhill or landing from a jump are very effective for building bone. Unfortunately, they can also break a bone. So, a lot of care must be taken when doing eccentric exercises.

A second factor is the **tendon actually pulling on the bone to cause joint movement.** This pull imposes shearing forces, and thus bone strengthening **anabolic stimuli**. When the pulling happens at different angles there is a shearing force on the bone, which also stimulates it growth and density. Thus, multiplanar activities are favored over those going in a single plane of motion.

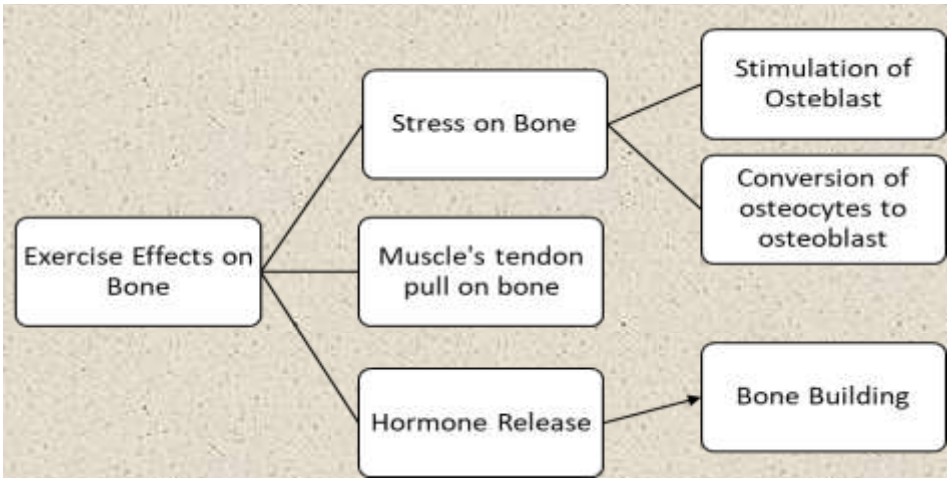


Figure 11: Three different ways exercise stimulates bone density

Finally (#3), the least known about reason, **the endocrine effect of exercise.** When someone begins to exercise, especially with high intensity exercise, many hormones are released and some of the anabolic ones such as growth hormone, insulin like growth factor, testosterone, estrogens and

androsterones, all have bone building effects. An added bonus to testosterone being secreted is that it will lower the amount of cortisol released, which is a catabolic hormone, and this causes broken break down or degradation when chronically elevated. Exercise of almost any nature or intensity will cause the tendons to pull on muscles as mentioned but it will also **enhance the blood flow in the bone and joint** and alter the mineral homeostasis to promote bone anabolism or bone building. It is also important to remember when you are exercising and using your bones,

Heavy Duty Science behind Exercise Effects on Bone

This next section is not critical to know to be a good or even great trainer of individual's trying to combat osteoporosis. It is what I will call "heavy duty science," and I want to lay it out for those who want to take it in. For every cause-and-effect relationship we as humans see or experience, there is likely some mechanism much deeper that is operating, and we must go down to the cellular, or more often, sub-cellular level to really find out of what is going. So, here it is.

In exercise-related changes, very often it is due to a **peroxisome proliferator activated receptor-gamma or PPAR-gamma** that is triggering the activation. In the case of bone, there is also a **receptor activator nuclear factor- Kappa B ligand or RANKL** for short (McClung, 2007).

It just so happens there are osteoblastic RANKLs and osteoclastic RANKLs, and exercise will stimulate the osteoblastic ones and inhibit the osteoclastic ones. Exercise also stimulates the PPARs to decrease adipocyte differentiation in bone and increase the pre-osteoblast replication which will increase the osteoblast function and decrease the osteoblast (**apoptosis)** death, so you have more bone building. The exercise will also stimulate mechanoreceptors to induce growth factors that cause more bone building as well as increase anti-inflammatory mechanisms and modulates immunity to reduce cortisol which breaks bone down. Thus, exercise again fulfills multiple ways to preserve bone and aid in its regeneration (McClung, 2007).

Stress- Physical is Good, Mental is Bad

Interesting what people think of when the word "stress" is mentioned. To most of us, we likely think of mental stress of a very negative nature, like taking a test, or public speaking, or meeting an important person for the first time, or an unpleasant job that needs to get done. The list can go endlessly for the negative aspects, but how often do with think of having a baby, making a baby, doing a fun workout, or even going to an amusement park with "thriller rides" as "stressful situations?" These are stresses as well, but they are known as *eustress* (i.e., good stress), and *distress* (i.e., bad stress). Stress is

simply an external force which our mind and body must withstand or be broken by it. Thus, stress strengthens us.

When we push our bodies to their limits or even put in a light workout, we are stressing our bodies and causing adaptations to take place to tolerate that stress in the future. A series of reactions and repair mechanisms must be set into action for this to occur. One of the "flight or fight" reactions is the release of glucocorticoids from the adrenal cortex. The best-known glucocorticoid is **cortisol**, and this hormone causes many different reactions in different bodily organs. Unfortunately, it can hang around a while and when we are in a stressed state a lot, we get chronically high levels, which cause radical oxidative species to increase and this will break down bone and inhibit the anabolic or bone building processes.

SHoW ME Exercises

Mnemonics and acronyms are used for all kinds of things nowadays. The **SHoW ME** acronym used here stands for the body regions where bones are likely to break due to osteoporosis (Spine, Hip, and Wrist) and ME for the type of exercise (multiplanar, and eccentric) that best builds bones. The multiplanar and eccentric exercises put great stress on bone and in different directions. Obviously, if the client is in a 1 or 2 level condition, they should not have this form of exercise yet. The SHoW ME mnemonic is not saying all body parts should not be exercised, nor is it stating that all people should be trying to do multiplanar or eccentric movements. It is saying that to get the most bang for your exercising "buck" try to perform exercises that meet this criterion or moving toward that criterion.

The spine may be a difficult one to target but core exercises and overall impact with the whole body will develop spine bone density. The **SAFE mnemonic** was developed based on the National Osteoporosis Foundation's exercise priorities. They mentioned exercises which enhanced strength, agility, flexibility, and balance were best. This program expanded the balance concept into proprioception and limb awareness; thus, **equilibrium** was applied for the 'E' in SAFE exercises. This mnemonic will be discussed later in this section.

Boning Up on Dose-Response- The F.I.T.T. equation for Fitness

Similar to the pharmaceutical world, the exercise world uses *dose and response relationships* all the time. It is also similar to the pharmaceutical world in that how often you take a given drug (**frequency**) and how potent the drug dosage is (**intensity**) will determine the total amount of drug received per day. The number of days you are supposed to take the drug (**time**, or duration) is also used in exercise

prescriptions; however, with exercise it applies to how long you are exercising in a given session. In addition, the last 'T' in FITT is for **type** of exercise. Often, "type" is classified in strength or power, muscular endurance, or cardiorespiratory endurance. It can include flexibility and agility or even reaction speed, but the type of exercise will determine the training effect.

With weightlifting, the amount of weight, number of sets and repetitions you perform, and the tempo with which you perform those reps will reflect the intensity, frequency, and time, respectively. The frequency and time someone exercises are known as exercise **volume**. So, if someone was exercising 3 sessions a week, for 25 minutes per session, the volume of exercise would be 75 minutes per week. When intensity and volume are combined (multiplied), it is known as **exercise load**. Because intensity units are mixed, it is difficult to calculate the cumulative effect of those three variables. This is where a rating of perceived exertion (RPE) is useful.

So, why is all this important for bone health exercises? Because the exercise intensity must be at a certain **threshold level** or it must elicit a threshold stimulus to generate an ***osteogenic response***. The categories and ranking systems normally associated with exercise, such as % of heart rate maximum, % heart rate reserve, and % of one repetition maximum (%1-RM) do not really apply to bone exercises. What is important is the stress the bone experiences from a given movement or set of movements.

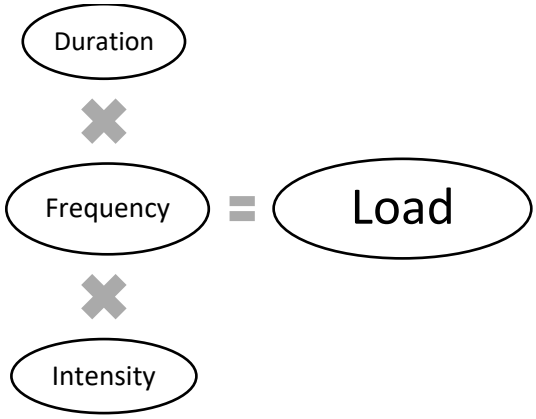


Figure 12: An illustration of the variables that make up exercise load

The American College of Sports Medicine is the foremost authority and top organization in exercise physiology. It is recommendations from this organization that are used by the medical community and accepted by the U.S. governmental agencies (DHH, CDC) as the "gold standard" or "official stance." With this being said, I am not impressed by the recommendations given for osteoporosis. The guidelines are not specific, and seem to just obey the standard guidelines. They are:

- Mode

  - Weight-bearing endurance activities
  - Activities that involve jumping
  - Resistance training
- Intensity
  - Moderate to high (Using an RPE 10 pt scale it is 5-8).
- Frequency
  - Weight-bearing activities 3–5 x/ week
  - Resistance exercise 2–3 x/ week
- Duration
  - 30–60 minutes/day of combined activity

The National Osteoporosis Foundation recommendations were more diverse in grouping exercise first into **weight bearing** and **muscle strengthening**. Of course, assignments to these categories does not imply exclusivity but it does imply the emphasis of it. For the weight bearing group it split into **high and low impact** subcategories. Since weight bearing is harder or more impactful on the bone, this program recommends to start with "muscle strengthening" weights or bands and tubes for resistance. This program sub-divided exercises into inside and outside to aid those who prefer inside tasks, or vice versa. Keep in mind, certain types of exercise can do several things to enhance bone density.

- Impose a stress directly onto the bone, or indirectly via the tendon pull on the bone
- Induce anabolic hormones to help cause bone building
- Increase the blood flow and nutrient delivery to the bones
- Reduces the oxidation and other determinantal catabolic factors causing bone atrophy.

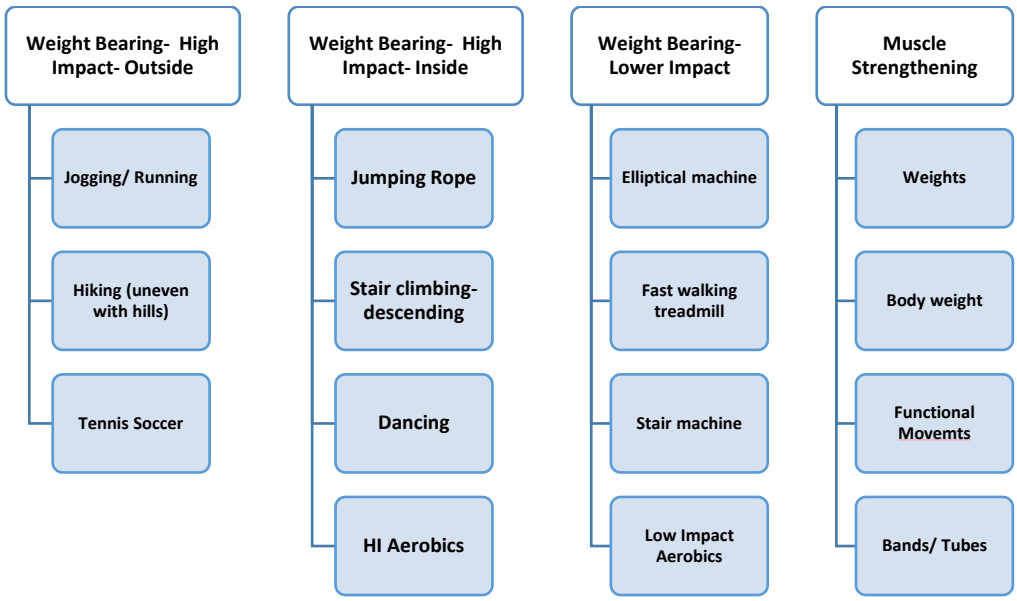


Figure 13: The different groups of exercises for building healthy bones

Exercise Principles Applied to Bone Health

- **Specificity-** bones will strengthen specifically according to stress imposed on them. As was mentioned with Wolf's Law previously. Not only will the specific bone that is exercised be strengthened but the region of the bone- outside (cortical) versus inside (trabecular) can even be specifically hypertrophied, although how to do this is not covered in this paper.
- **Progressive Overload-** This is a very important variable to remember for osteoporosis patients. What is not even threshold stimulus to one person may represent overload to another. It is absolutely critical that the exercise is appropriate for that individual. In fact, beginners will need to gradually build up to even threshold stimulus. Once they are able to tolerate a given level is should be raised but no more than 10% at a time. The calculation of the 10% needs to be on the total load. Thus, you may need to lower intensity if you are raising frequency or duration and vice versa.
- **Reversibility**- This is basically the opposite of progressive overload and it too is of critical importance. This is also why it is important that the bone health participant keep going and have no extended breaks away from exercise.
- **Initial values and Diminishing Returns-** This principle is more critical for the advanced participant than anyone else. As it will be discussed soon, the necessary volume of exercise to elicit an osteogenic stimulus is very small relative to other systems. The intensity is more important than duration and breaks in the bone often occur with excessive durations.

S.A.F.E. Exercises

Let's get to another acronym—SAFE exercises. Not only is it hoped that these exercises are safe to perform, but we hope it addresses all of the following: **Strength, Agility, Flexibility and Equilibrium** (i.e., balance). Based on the literature from the National Osteoporosis Foundation (NOF), these were the most critical components that should be addressed a in a given program.

- **Strength** can be increased in many ways and for this program strength should really represent power or the ability to move quickly with some resistance. When someone is about to fall, often they are not able to pull there leg out from under them or pull their arm up fast enough to catch themselves. Technically the ability to move fast and quickly is known as power.
- **Agility** is another very important aspect for two reasons. Unless a person can both shift their weight and move quickly, gravity becomes the victor and they will sustain a fall. If they can react quickly with agility, most often they can stop the fall or minimize its impact. Also, when someone needs to stop and shift their center of balance, they are putting a lot of stress on the bones that will help keep them strong.
- **Flexibility** may not seem like much of a reason to protect your bones from damage but think about it a second. To have proper joint movement, you must be flexible enough in one joint to have stability in the next and vice versa. Thus, when a joint like the ankle is stiff, then balance is greatly affected, and the risk of falling is greatly increased. Our bodies move according to kinetic chains, where one must have proper stability or flexibility or a combination of the two to perform activities.
- **Equilibrium** is actually a more accurate term to describe why older people fall and break their bones. What is equilibrium? Chemically speaking. It is when two sides of the equation are changing at equal rates. This a good way to associate it with our balance in that we could be a dynamic state, but our bodies are able to stay upright. Equilibrium is thought to be a function of the fluid in the semi-circular cancels in the inner ear. It is also a function of our proprioception or knowledge of where the limbs and torso are located in the external environment.

ACCESS to your Bones

While we are discussing mnemonics, and now that we have covered the nutritional section, here is a useful mnemonic for the various risk factors of osteoporosis—**ACCESS**: 'A' is for excessive **ALCOHOL** consumption; 'C' is for **CORTICOSTEROID** use; 'C' is for low **CALCIUM** in the diet; 'E' is for low **ESTROGEN** in the female system; 'S' is for **SMOKING**; and finally, 'S' is for **SEDENTARY** lifestyle. Interestingly, this

covers several different areas of intervention mentioned in this course. The alcohol and smoking are lifestyle factors, the corticosteroid use and estrogen and hormones and potentially can be taken in pharmaceuticals, calcium is a nutritional agent, and sedentary lifestyle is an exercise (or, lack thereof) issue.

A Review of Major Concepts in Module 3

Please take a moment to review each of the following questions below. Taking time to answer the questions below will assist you in your learning of the material presenting in this module.

1. How does function fit form? Give an example or a "Law".
2. How does the "use it or lose it" saying operate with bone health and movement in general?
3. What does the triple play of exercise mean in terms of enhancing bone density?
4. Would exercise tend to stimulate an osteoclast or osteoblast?
5. Is cortisol good or bad for bones in the short term? In the long term?
6. What does the SHOW ME mnemonic stand for?
7. What does the SAFE exercises mnemonic stand for?
8. What is the FITT formula? Can you apply to bone health?
9. What were the four divisions of recommended exercises?
10. What four things does exercise do to enhance bone density?

Module 4: Assessment for Exercise Programming

This program takes a holistic approach to combating osteoporosis. Not only is it helpful to incorporate multiple strategies from multiple disciplines to beat osteoporosis, but it is essential. Integrative medicine was once described as, "trying to understand the patient that the disease has, not the disease that the patient has." I like this approach because it is both highly personalized, and it focuses on getting a person "in tune" to fight a disease, versus just trying to get rid of the symptoms caused by a disease.

Several factors need to be considered when developing a complete program for an individual with osteoporosis, or trying to prevent from getting osteoporosis. **Personal traits** such as their race, gender, age, and family history (i.e., genetics) certainly play a role, as elderly, white and Asian women will be diagnosed with it more than other groups, for example. **Personal habits** of health behaviors such as smoking, excessive alcohol, sedentary lifestyle, and dietary habits such as low calcium intake, high caffeine or sodas, a diet high in wheat bran or oxalates all need to be evaluated. These habits can include what they are currently eating (diet), any so-called vices they may have such as smoking, drinking, or drugs they may be taking, and what they are doing on a daily basis (ADLs). These are known as **activities of daily living** (ADLs) and they can make or break how fit the individual is.

Understanding what **medications**, the person is on, **past injuries**, **current limitations,** and current pain or disease states all need to be considered. **Activities** they are able to perform in their daily living, their current movement skills, balance, fall risk, strength, endurance, agility, and flexibility are all important in the development of the exercise program design and to prevent falls from occurring. Last but not least, the **bone density** of the individual should be known. This is quantified as a **T-score**. Factors such as a person's frame size, and if they've had a bone fracture after age 50 also factor into a complete assessment.

Finally, inquire about clients' **stress levels** and what they are doing to combat that stress. Cortisol levels, which can be measured by blood tests, can have detrimental effects on bone, not to mention other aspects of health. Oxidative stresses should also be included in the assessments of stress and antioxidants in the diet can help counter oxidative stress quite well.

Components of a Physical Assessment - Movement skills and bone health

The results of an assessment should be what guides the development of an exercise program for any client, and it is no different for someone concerned about osteoporosis. In this situation, the client needs to be assessed for bone health and movement capacities. The cardiorespiratory or metabolic

factors have little to do with bone health, per se, but still have a lot to do with programming. You don't want to give an intensely cardiovascular exercise regimen to someone who has good bone density but a poor cardiovascular conditioning level as this could lead to a heart damaging event.

The age of someone does not directly determine her fitness, but it is a strong indicator of bone density and movement capacities. Similarly, the sex and current movement capacities are important in programming to ensure safety. If someone is prone toward falls or lacks certain coordination, then they must be careful when attempting complex movements and putting undue stress on bones which have the potential for fracture. Some basic movement and balance tests should be executed before any exercise engagement, so the individual can be appropriately programmed, and then progressed. The figure below shows the order of progressions for movement.

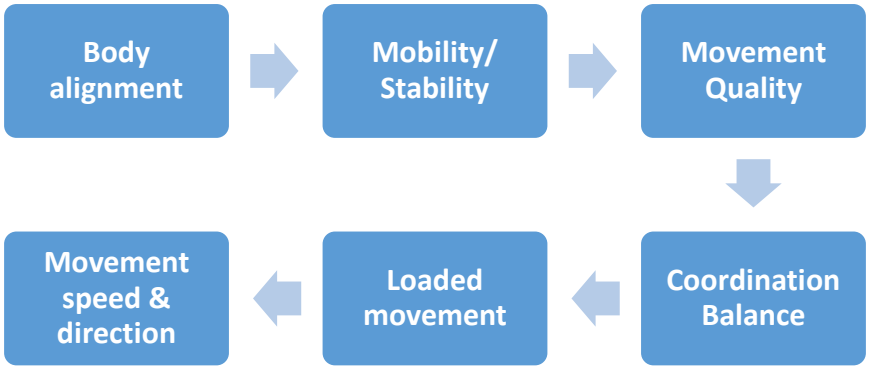


Figure 14: The training progression. Each level needs to mastered before moving to the next.

In general, this program assigns Level 1 clients to the first 3 blocks across the top, establishing movement quality. The Level 2 clients need to have balance and coordination. Level 3 clients will usually require some sort of resistance or load imposed on them, and Level 4 clients often are given high speed motions with rapid changes in direction.

A Very Comprehensive Physical Assessment: The BONE Score

Recall the subtitle of this course: **Project BONE™**. The holistic nature of our approach here is extended to a comprehensive analysis or assessment known as the ***ABCDEFF Test Battery®.*** A letter has been assigned to a necessary function that should be assessed in order to create an exercise program, and then reassessed in order to determine the effectiveness of that program. Table 1 below shows the different dimensions or capabilities assessed, the name of the assessment, and how performance will be measured. Please note that these tests, and assignment of levels, is focused on elderly clients and the

typical skills sets seen in that group. If you are working with younger individuals, some adaptations will need to be made. Also note that no test in this battery was developed by this course author. Some tests in the assessment battery have well-developed criteria based on large population norms and statistical analysis. Other tests have very little normative data or standardization, and some were not necessarily intended for subjects of advanced age. This course author plans to establish standard testing protocols (as shown in the video portion of this course), and hopes to establish well-recognized standards for programming into the four levels.

Table 2: The function, test name, and measurement made for the ABCDEFF tests

FUNCTION TESTED	TEST NAME[1]	MEASUREMENT IN TEST
AGILITY	**8' up and go**	Time to complete
BALANCE-STATIC	4 stage balance	10 sec position hold, eyes closed repeat
BALANCE- DYNAMIC	Tandem Walk, Head up, Eyes closed	10 steps without losing balance
COORDINATION	Alternate Ball Toss	5 ft distance, # of catches in 30 sec
DEXTERITY/DEFTNESS	Soda can turnover	Time to complete
ENDURANCE 1	**2 min march**	Steps completed on one leg
ENDURANCE 2	**2 min walk (50 ft cone lengths)**	Distance covered in feet
ENDURANCE 3	**6 min walk (50 ft cone lengths)**	Distance covered in feet
FLEXIBILITY- UPPER	**Back Scratch**	Distance between or overlap middle fingers
FLEXIBILITY- LOWER	**Chair Sit 'n Reach**	Distance/overlap- finger tip to shoe tip
FORCE-UPPER	**Arm Curls**	Repetitions in 30 sec
FORCE- LOWER	**Chair Stands**	Repetitions in 30 sec
BONE DENSITY	T-Score	Percentile in the population (T#)
PRIOR FRACTURE		YES or NO to fracture after 50

[1]Tests in bold were adapted from Jones and Rikili (2002), and Rikili and Jones-Fullerton's (2014) Fullerton Functional Fitness Test (FFFT), sometimes called *Senior Fitness Test*.

Agility- 8 foot up and go test

Place the chair next to a wall for safety, and a cone or marker 8 feet in front of the chair. Clear the path between the chair and the marker. The subject starts fully seated, hands resting on the knees and feet flat on the ground. On the command, "Go," timing is started and the subject stands and *walks* (running is not allowed) as quickly and safely as possible to and around the cone, returning to the chair to sit down. Timing stops as they sit down. Perform two trials. Take the best time of the two trails to the nearest 1/10th of a second. Below is a table showing the recommended ranges in seconds for this test, based on age groups (Jones & Rikli, 2002).

Table 3: Combined Men's and Women's ratings for 8 ft up-and-go

Men's Results

Age	below average	average	above average
60-64	> 5.6	5.6 to 3.8	< 3.8
65-69	> 5.7	5.7 to 4.3	< 4.3
70-74	> 6.0	6.0 to 4.2	< 4.2
75-79	> 7.2	7.2 to 4.6	< 4.6
80-84	> 7.6	7.6 to 5.2	< 5.2
85-89	> 8.9	8.9 to 5.3	< 5.3
90-94	> 10.0	10.0 to 6.2	< 6.2

Women's Results

Age	below average	average	above average
60-64	> 6.0	6.0 to 4.4	< 4.4
65-69	> 6.4	6.4 to 4.8	< 4.8
70-74	> 7.1	7.1 to 4.9	< 4.9
75-79	> 7.4	7.4 to 5.2	< 5.2
80-84	> 8.7	8.7 to 5.7	< 5.7
85-89	> 9.6	9.6 to 6.2	< 6.2
90-94	> 11.5	11.5 to 7.3	< 7.3

Balance Tests- Static and Dynamic

Balance or the ability to keep your body under its base of support should be measured both statically and dynamically. In this program, tests include the 4-stage balance test, but we have added an eyes closed set to determine balance without vision or vestibular and proprioceptive capacities. A Level 2 person should be able to balance in the second position. A Level 3 person should be able to balance on one leg with eyes open and stand with eyes closed. A Level 4 person should be able to stand in the instep (#2) pose with eyes closed. All positions must be held for 10 seconds without the individual falling to be considered completed.

If the individual cannot march in place without assistance, then they should not have unsupported exercises. In other words, chair-based exercise or certain exercise with a walker may be integrated. A

dynamic balance test is the simple to measure but difficult to perform tandem walk. This also has four testing conditions: eyes open; eyes open but looking at the ceiling; eyes at ceiling going backwards; and eyes closed. A Level 2 person should be able to do a tandem walk. A Level 3 person should be able to walk with their head up, and a Level 4 person should be able to walk with their head up and backwards.

Coordination

There are several ways to measure coordination, but this test is looking at hand-eye coordination and reactivity with the ball toss. It involves standing about 6 feet or 2 meters away from a flat wall and tossing a tennis ball from one hand to the wall and catching it with the other. The number completed in 30 seconds is what is counted. If a ball is dropped that does not count and the clock is still running while the individual picks it up. Level 2 person should be able to do 5 to 10, Level 3 person should be able to do 11-20, and a Level 4 person should be able to do more than 20. Keep in mind these are not the standards used for younger people, but they should be appropriate for populations over 65 years of age.

Dexterity and Deftness

The ability to effectively use one's hands is called **dexterity or deftness** and a simple test which measures this is known as the **Soda Pop test**. The name is derived from the fact you are using cans of soda pop (standard 12 oz) and turning them over from one circle to the next. It was basically impossible to find norms for this and many sources had multiple ways to do it. This program will use the version from the more recognized authorities which involves 6 circles with soda cans placed on circles 1, 3, and 5, and the person must turn them over and place them in circles 2, 4, and 6 (upside down). The person then needs to go back to the first can they turned over and put it in the original location (#1) and in the upright position and continue to do that to the next 2 cans. The person then must repeat this again and the administer then stops the watch.

A Level 2 person should do in less than 25 seconds, a Level 3 person in less than 15 seconds and a Level 4 person is faster than 15 seconds. Two different versions of this test have been presented. One version (shown in the course accompanying video) has the participant (if right-handed) going from right to left, then left to right and repeating that. Another version has the participant always starting on the right and going left each of the four times. Either method is acceptable for this program.

Endurance

Because of the vast differences in mobility and endurance capacities in older people we have included three different tests. The first test- a march in place- can be modified to using a walker for those requiring this, but this modification needs to recorded and can't be used for normative comparisons. The

march test was demonstrated in an accompanying video. The subject needed to raise their knees to the midway point between the hip and knee (mid-thigh). Only one leg is counted, and this is done for a 2-minute duration.

The two-minute walk test was also shown in an accompanying video. The distance is recorded in feet. Each lap is 100 feet and then the individual must stop at the point they reached at the end of two minutes and this distance is measured. There is also a 6-minute version of the test, and it should be used for clients with good mobility and conditioning.

Flexibility

The ability to take a limb through a range of motion is known as flexibility. Flexibility is important in osteoporosis for two main reasons. First, if a joint that is supposed to be mobile is not, then proper movement is limited in that joint and this means compensation in a neighboring joint or improper movement- both of which can lead to a break and fall, in either order.

A good flexibility test will measure multiple joints at once and both the upper and lower body regions should be tested. This program is using the tried-and-true tests from the *Senior Fitness Test* protocol which include the Chair Sit and Reach for lower body and the Appley Scratch (or Back Scratch) test for upper body. Flexibility can improve quite rapidly when done regularly and quite rapidly for someone who has not tried to stretch their limbs much. It is important to have good mobility in ankles, hips, and shoulders for proper daily functioning.

Force (Strength or Power)

The ability to generate a certain amount of force within a certain limb is called strength. The ability to generate that force with a certain velocity or speed is known as power. Both strength and power are important, but it is power that prevents falls more than strength. The person who catches themselves before falling needs to react quicky and resist the force of gravity taking them to the ground.

The Chair Stand test is actually a power test because the resistance is a person's body weight, and they are trying to move it as fast as possible in the up and down motions for 30 seconds. The Arm Curl test is also testing power because the light weight, 5 pounds for women, and 8 pounds for men, is light, and many repetitions can be done in the 30 seconds, thus speed of movement is critical for good performance in both. While other tests exist, these two tests have great normative data, reliability, and validity, and they are simple to administer requiring minimal equipment.

Other potential tests

There are several things that can be screened for quite simply.

- **Posture -** Both the alignment of the joints with a person standing sideways and then looking a bilateral symmetry especially with lateral alignment with a frontal view.
- **Torso mobility -** Can be quickly assessed with the person standing feet straight forward, knuckles of two-fisted hands adjoining each other in the middle of the chest. with the elbows at the same height straight to the side. They should then turn as far as they can, to the right and to the left. They should be able to turn 45 degrees with the hips, and 90 with the shoulders.
- **Agility tests -** There are many types of agility tests but the individual should be able to handle high impacts before doing these tests.
- **Power -** Lower body with a vertical jump, and the upper body with a medicine ball toss on. These tests are not going to be discussed here, but they are easily found with a bit of research.

The Five Levels of Bone Health

Most of the medical community breaks stages of bone health into three categories based on the bone mineral density (BMD). One either has normal bone density, is pre-osteoporotic (lower than normal BMD), or has osteoporosis. This scale is limited in that it does not go into high BMD or designate between mild osteoporosis and more severe osteoporosis. These areas need to be designated since the exercise programs will vary based upon these levels. It was decided to break Level 1 into two sub-sections based on their having a bone fracture after the age of 50. Both categories will be in the osteoporosis range of BMD, but a bit more caution should be taken with someone in Level 1a. Movement skills will usually be low for these groups.

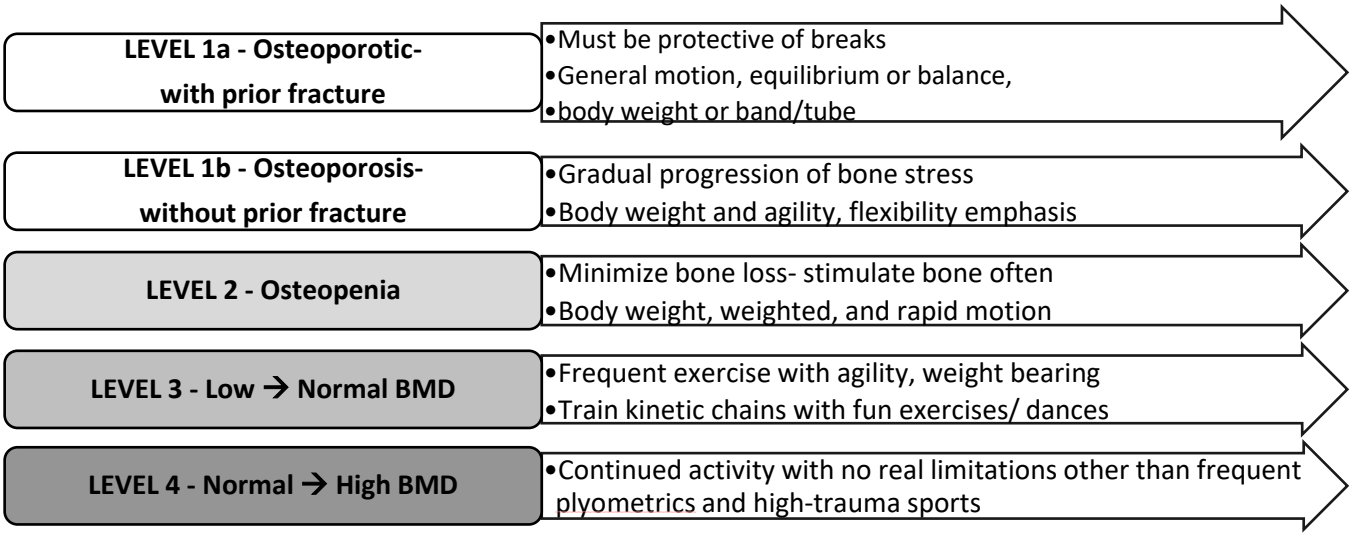


Figure 15: The Four Levels for programming.

Describing and Progressing with the Four Levels

The full-blown osteoporotic client who has fractured a bone because of osteoporosis **(Level 1a)** must be treated very carefully since the chance of their breaking a bone again is high. Keeping functional states like balance and the ability to do basic life skills should be the focus. The next level down is concerned with those who are in mild stages of osteoporosis **(Level 1b)** and can perform many exercises that a full blown osteoporotic cannot. The primary goal at this stage is to be protective of falls and breaks. You may be able to do body weight and loaded training with this individual. The person in level one could be on a walker, could be quite weak from a muscle standpoint, but they need to encouraged not to sit, and to learn to have balance.

Level 2 is common or the norm for people of advanced age, which is the natural loss of bone mass with age-related osteopenia. The movement skills can vary quite significantly in this stage as well, but in general, care must be taken when exercising someone at this stage. The individual should be able to walk without a walker and be able to bend over without falling. No jolting exercises and many body weight-based exercises should be permitted. As you can see in this module's accompanying video, someone at this level should be able to shift their weight side to side without falling and even be able to step down off a stair without assistance.

On the healthier side of the scale is **Level 3**. This person should have normal to slightly above normal BMD and this individual is in a good position to dramatically decrease osteopenia and even increase BMD. The person should be able to perform a wide variety of movements and even support themselves in a push-up position and withstand some mild to moderated pounding.

The Level 3 is a great place to be for preventative exercises since the risk of fracture due to impact is low, generally the movement skills will often be quite decent with this person, and the variety and intensity of the exercise can be increased. These people can do weight and agility and flexibility exercises. It is very important these exercises are performed regularly to reduce falls and potential for bones getting broken. This client should be an active elderly person or moderately active middle-aged person. Build up someone's joint strength and movement skills if they have been away from activity.

The Level 4 is for the healthy individual who has no sign of osteoporosis, and actually has a high BMD score. This person should have good movement skills, good joint strength, very good balance and agility, and decent cardiovascular conditioning as well. The odds of this person ever becoming osteoporotic is low at best. You want to work on keeping this person at a high functioning capacity. He or

she should be able to do ballistic and relatively high impact activities. As mentioned, there are few to any limitations on this group other than plyometrics and impact sports.

T-Score: The Measure of one's BMD compared to one's peer group

The **T-score** or one's **bone mineral density** is also broken into four categories. The first category is the criterial for osteoporosis. This is a -2.5 score. In this program, if someone has a -2.5 score and a break after age 50, they are considered group 1a- the lowest level. If they have a -2.5 score and no fracture after 50, then they are a 1b. The movement skills of the individual also need to be taken into account when programming, but the *bone stresses need to be kept quite low* until improvement in the T score has occurred.

- T score of 2.4 to -1 is the osteopenia category or level 2 in this program.
- T score of -0.99 to +1 is level 3
- T score of > +1 is level 4

Of course, T scores alone should not determine the level of exercise programming. Movement skills and the results of the assessment battery also need to be considered when beginning to build an individual's program.

Physical Assets- How to Assess and Progress

Now you can move on to classifying your client into exercise categories. In general, we will use a 4-stage category system for most of the ABCDEF assets or capabilities. In general, it would represent someone in each quartile of the population. Someone should cycle before they walk, walk slow before they walk fast, walk fast before they jog. Likewise, weights, bands and tubes should be used before using assisted body weight, and assisted body weight should be employed before using one's body weight unassisted. Gravity can be slowed by various devices and increased by some others.

A Review of Major Concepts in Module 4

Please take a moment to review each of the following questions below. Taking time to answer the questions below will assist you in your learning of the material presenting in this module.

1. What is the difference between personal traits and personal habits?
2. What is a T-score? What does it measure or compare?

3. Place the following in the correct order: (a) body alignment, (b) loaded movement, (c) movement quality, (d) movement with speed and changing direction, (e) mobility and stability in joints, and (f) loaded movement.
4. For what does each letter of the ABCDEFF assessment battery stand?
5. What is an assessment with normative comparisons mean? Why is this important?
6. Name 3 additional tests that could be helpful to screen someone for function.
7. What is the “scoring system” for the assessments?
8. What are the five levels of bone health and what are they based on?

Module 5: Programming - Putting It All Together

This program has been designed to assess your client accurately and safely, and to use those results when building an exercise program that will challenge your clients, but not injure them. There really is no perfect science to this, yet, but the three main factors to start with are movement skills, balance, and coordination, in that order, and to do so while achieving osteogenic threshold stimulus. I have included a lot of exercises emphasizing the **SAFE** and **SHoW ME** mnemonics to help guide your programming in a meaningful way, and you should have the appropriate Level 1-4 for their abilities. Remember to focus exercises on the hip first, then spine, and wrist to address the "hot spots" for injury. Also, never progress a person too soon or too fast as you may increase the risk of injury, like breaking a bone!

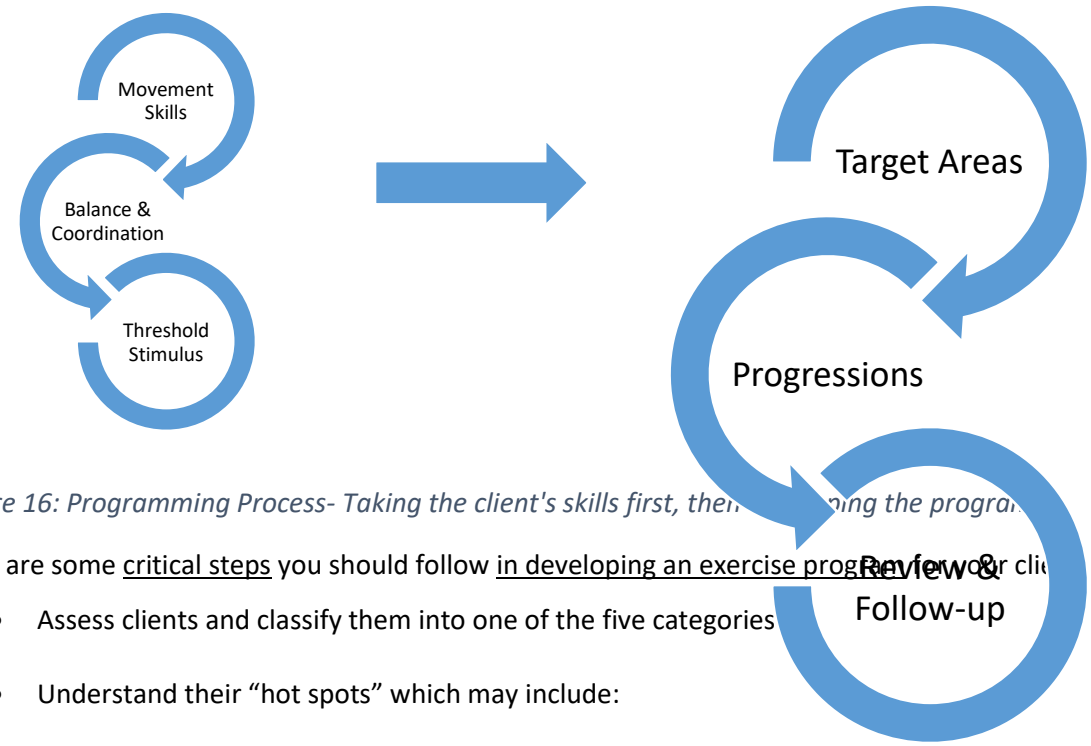


Figure 16: Programming Process- Taking the client's skills first, then ming the progra

Here are some critical steps you should follow in developing an exercise program for your cli

- Assess clients and classify them into one of the five categories
- Understand their "hot spots" which may include:
    - Previously injured areas,
    - Currently injured areas,
    - Areas with limited joint mobility or inflexibility
    - Joint instability.

- Activities they enjoy, or to which they'd like to return.
- S.H.o.W. M.E – Use as an emphasis for progressions.
- S.A.F.E.
- Reassess, and progress/regress depending on results.

The Workouts

Three different workouts have been developed and presented for you in this course. These are by no means the only sets of exercises for you to use. In fact, our hope is that you will learn to develop a bunch of routines on your own that have the main **fun**-damentals needed for bone building and, of course, are **fun**-ctional in terms of the individual's goals for activities of daily living. Some things you want to consider:

1. UCLA - Include a mixture of the Upper, Core, Lower and All.
2. Vary the planes of motion - Sagittal (front-back), Frontal (right-left), Transverse (twisting).
3. Focus on movements performed in their daily living activities.
4. Mix up the use of equipment with body weight only exercises.
5. Challenge balance whenever it is required, or can be accommodated.
6. Speed up, and slow down, and focus on their braking force capabilities needed (i.e., deceleration; eccentric contractions).
7. Change the environment systematically.
8. Vary the order of the exercises.
9. Work large muscle groups, and perform **compound motions** (i.e., more than one joint) first.
10. Warm-up briefly with cardio, and include a flexibility session—note that a **dynamic warm-up** can accomplish both.

Locations- Gym, Park, Home

For our purposes here, we'll focus on three different environments (i.e., Places or locations) to conduct training/coaching sessions. Not all clients nor trainers will have access to the same type of

facilities at any given time. Also, as we learned from the Covid-19 pandemic, one never knows when facilities will no longer be available, and so being able adapt is important.

Let's begin with the **Gym**. A gym workout is fantastic because it was designed for just this purpose—to exercise! It is great because there are weights, machines, and equipment that you will likely not find in other locations.

The workout in the video included the most exercises but tried to minimize the specific equipment needed down to a cable station, an incline board, free weights, a medicine ball, and a Roman Chair. There are many options in a gym but the main focus for now needs to be keeping proper distance from others. Many boutique style gyms will have the equipment in this video and workout. It is quite basic.

The Gym Workout shown in the video segment included (no particular order):

Table 4: Exercises included in the Gym Workout Video

1	**Walking Lunge Series**
2	**Roman Chair Series**
3	**Squat Series**
4	**Cable Chest Fly Series**
5	**Hip Hinge Series**
6	**Medicine Ball Series**
7	**Step and Jump Down Series**
8	**Cable Rotation/Anti-rotation Series**
9	**Hip Hinge with Arm Curl Series**
10	**Knees to Overhead Lift Series**
11	**Incline Bench Core Series**
12	**Walking Jog in Place Series**
13	**Burpee Series**
14	**Weighted Bench Row Series**
15	**Push Up and Away Series**
16	**Horizontal Row Series**

The gym can be problematic for some clients due to cost, transportation, convenience, and access. Not everyone can afford or travel to a local gym. Many areas have few to no gyms close to clients, and clients may be intimidated or not feel accommodated to their special needs. Often gyms appear to be only for healthy people getting healthier while everyone else be damned! The park workout is a nice alternative, and can be designed for the person who either does not want to go to a gym, or cannot go to a gym.

I used to run a bootcamp business. It was really just outdoor adult group fitness, but the industry gave in to the “bootcamp” moniker, and it stuck. It was really fun, and in Southern California, it can be done much of the year. Fresh air and sunlight are wonderful for working out.

Equipment needs to be portable. The use of tubes, bands, hurdles, hoops, and agility ladders are not only fantastic for a great workout that tones the bones, but it is a ton of fun. Things like jump ropes and running around cones puts a lot of stress on the bones and is really fun. Most parks will have benches with a back and light pole. These are perfect to do many different exercises with. A park bench can be great place to do pushups, step-ups, leg raises, planks, and whatever else your imagination can make it. A lamp post can be a place to do squats or use with bands to do pulls or chest flys or bicep curls and triceps extensions. Some parks have hills that you can use for tough running, or basketball or tennis courts that can be used for training.

The advantages are huge with large groups being accommodated and the camaraderie and close location for many residents being very convenient. If you are training an individual there is usually not an issue with using a park facility. The workout in the accompanying video was limited by the knowledge of what would be available in the park and redundancy to the home or gym workout. Remember, anything that does not require specialized equipment can be done in a park.

The equipment in the park workout included only resistance tubes and yoga mats. The hoops, hopscotch and hurdles section required a bit more, but still very affordable equipment. So, when the weather is nice investigate taking your client or clients out to a park. Chances are you both will love the fresh air, sunshine, and sounds of nature. During the pandemic this is an easy choice. After it, this choice is still a winner!

Park Workout Video

Table 5: Exercises included in the Park Workout Video

1	**Bench Push Up Series**
2	**Pole Squat Series**
3	**Standing Elbow to Knee Series**
4	**Bench Planks Series**
5	**Side Step and Curtsy Series**
6	**Bicep Curl and Tricep Extension w/ Tube Series**
7	**Hoops, hopscotch, hurdles**
8	**Side Step with Punch Series**

The park can be problematic also. Many cities or municipalities not only require proper insurance but make you pay a fee for park use, or they will not allow you to use it at all as a professional trainer. Weather and lighting are always an issue in fall and winter, and parking may often be an issue, too. The alternative to gyms and parks is the **home workout**. Many a session have been conducted within the home of the client, and as long as you have built trust and rapport, you should not find it hard to have your client ask you to come to them.

The Covid-19 pandemic resulted in more time being spent at home by people in the year 2020 than anyone can ever remember! There is no doubt that the home is still a place of sanctuary and peace and belonging. When we are at home, however, workouts are usually not a high priority or top concern. We usually "go out" to exercise, but we don't always need to any longer. Online or streaming, and virtual reality training world is erupting now, especially in areas where shut downs and quarantines are still frequent.

Home workouts can be done simply and easily with only a few pieces of equipment or furnishings that are already in the home. I remember watching this muscular guy in a jump-suit on TV when I was a kid. There was a corny organ playing in the background sometimes, and I would watch and sometimes do the workouts that this guy did with a chair and a towel. Yep, the guy was named Jack LaLane! A man I had the absolute honor to meet before he died. Any personal trainer in the world owes this guy massive credit for "plowing the original fields" of fitness training for the rest of the world.

So, the home workout I've provided in the accompanying video is also short (12 exercises), but hopefully it gives you an idea of how many things can be done in the privacy and convenience of your own home or apartment with little to no equipment. Space and ability to use equipment are at a minimum in a house or apartment, but many of the basic exercises and calisthenics can be done here. Many of the home workout exercises were replicating the gym workouts to emphasize that practical exercises needed for everyday living activities could be done in the home or gym.

Home Workout Video

Table 6: Exercises included in the Home Workout Video

1	**Walk- Lunge-Jog**
2	**Hip Hinge Series**
3	**Get out of a Chair**
4	**Push Up and Away**
5	**Twister Series**

6	**Lunge Series**
7	**Step Down & Jump Down Series**
8	**Overhead Series**
9	**Sidestep Series**
10	**Burpee Series**
11	**Tube Horizontal Pull Series**
12	**Plank Series**

Myths of Exercise for Osteoporosis Prevention

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

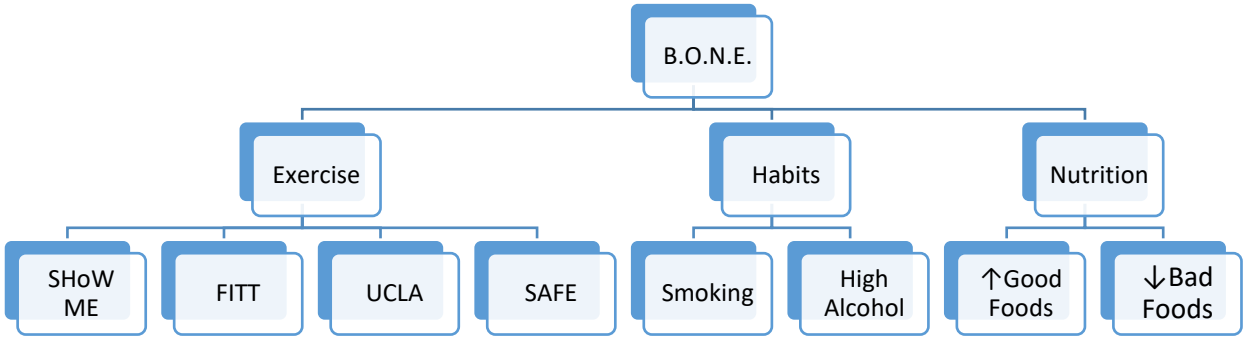


Figure 17: Overview of the Many Aspects to Beat Osteoporosis with Nutrition and Exercise

A Review of Major Concepts in Module 5

Please take a moment to review each of the following questions below. Taking time to answer the questions below will assist you in your learning of the material presenting in this module.

1. What are 3 major aspects that should be included in developing a bone health program?
2. What are the 3 "funs" that should be included in a bone health program?
3. What does the UCLA mnemonic stand for (with exercises- not colleges)?
4. What three location were presented in the video series?
5. What are some advantages and disadvantages to each?
6. In the EAT this, NOT that video series, what was the main idea behind it?
7. What are five different aspects that can go into a complete bone health program?
8. Name a few allied health professionals that you may be able to team up with in your community?

Module 6: Marketing and Promotion:

Marketing is the umbrella term under which the term promotion does fall. There is a lot to **marketing** and **promotion** that goes into developing and running a good business. So much so that quite often it will not be the best or most knowledgeable trainer that is the busiest, that makes the most money, or that is the most popular. Rather, much of the market share (i.e., customer base) to be had will go to the professional who knows how to market themselves the best. My advice to you would be to get a good marketing person on your team, or hire a firm that knows how to do this small businesses. You can also go the route of many, which is *live and learn*, or *fake it until you make it*. The problem is that you won't have many chances to get things wrong, and you never have a second chance to make a first impression, as they say.

The promotion of a product is only one aspect of marketing. Being able to communicate the value of your product to your target audience, and getting their feedback, is essential. The sale of a product is the desirable result of promotion, and a strong promotion will lead to numerous sales as long as other aspects of marketing are being addressed. Your income, or the company's income, is a function of sales, but a company must also be efficient with expenditures (i.e., **costs**), or actual net profit is reduced. Looking at every aspect of what your target market desires, and understanding your client's values and emotions, are important. Knowing how your product can be improved, what would make your product more effective, and how it can be easier to buy (and use), would fall under the marketing umbrella, as well.

Figure 18: A look at what marketing represents. The inner circles are sub-sets of the outer circles.

Getting the Word Out and Monetizing Your Knowledge and Skills

Marketing is performed very differently for different industries, and for different sizes of companies. Of course, if that company is international, cultural differences may be significant. One of the main distinctions in marketing is between internal and external marketing, and your focus will be on the external, or on the target customer. You want to create a **"brand"** that shows you truly care for the customer, and one they will easily recognize. Sometimes, this means "going the extra mile" for no additional pay, or even giving away services for free to accommodate customers and their needs. Many potential customers who receive something free do not convert, and you may need to "swallow the loss," but for the vast majority, offering something complimentary will win them as long-term clients and advocates who'll refer others to you via the a effective method of promotion—word of mouth.

There are a lot *P's* in marketing, and you are probably saying to yourself, "But, I don't see any P's in the word 'marketing.'" True, but those in marketing love their P's, so let's look at seven of them:

1. **Place –** Where you conduct your business. Proximity to the target audience (TA) is key. You may be centralized where clients come to you (e.g., *gym/studio*; *parks*), or more mobile by going to client *homes*. This program understands that professionals train in multiple environments, and we've created sample workouts for these three venues. Note: Professionals often charge more when conducting business at client homes because of the added convenience for the client, and travel expenses incurred.

2. **Price –** Considers the value of your services to your TA, your immediate costs, future expansion, personal salary needs, and local market rates. Your services as an Osteoporosis Fitness Specialist is of very high value to those who need and seek it. It is a specialty, or a "boutique service," so to speak. Small group sessions can be lower price point per person, but you'll earn a higher rate per hour because of the additional effort.
3. **Promotion –** Use the best "vehicle" to reach your TA. This could be difficult for older clients who don't get out much, and who don't engage in social media. Often, they have someone younger- a son, daughter, or even grandchildren who are social media savvy that may find you that way. Social media is a must. Whatever mode you use, you need to repeat often and consistently. Use branding techniques early.
4. **Physical evidence –** Science and facts can be somewhat helpful, but actual testimonials, word-of-mouth, and demonstrating results. I used to be the scientist on many infomercial products, proclaiming "I am Dr. Mark Kelly, and I speak from total authority and knowledge." I was on the screen maybe 10-15 seconds, and the personal testimonies were on for at least 10-15 minutes . . . you tell me which was more important.
5. **People –** Those working for or with you are critical components of your image, mission, and brand. Select them carefully as, "You often get for what you pay!"
6. **Product –** Obviously, the key ingredient in the marketing soup. Nothing speaks louder than a quality product that delivers results with customers who are happy. The product extends to your offerings, branding, image and setting.
7. **Process –** Getting your marketing going in a smooth and formulaic manner. It is important to note everything you do so that you can learn from your mistakes, as well as your victories. The masters of business (e.g., TV's Shark Tank) know the process well, and they rarely fail. Understand the customer experience from *A to Z – just like Amazon.com®*!

To Treat a Patient, it requires a Team

The health field is changing at a quick pace in present times and thank God it has, because the past system was not working so well. Currently, more and more duties are being given to members of a health care team. While the physician (M.D. or D.O.) still stands at the top position, many other doctors such as chiropractors (D.C.), naturopathic doctors (N.D.), and even acupuncturists are taking the lead, as well. It is now recognized that each health care worker on a team has their field of specialty, and that no one can be a master of all trades. Thus, the Osteoporosis Fitness Specialist now has a role alongside the nutritionist, life-style coaches or health coaches, physicians, nurse practitioners, or nurses, physical and occupational therapists, as well as massage therapists.

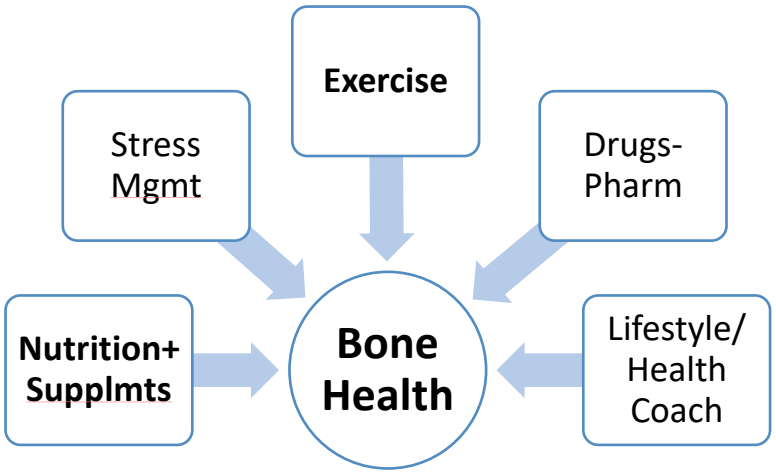


Figure 19: A Comprehensive Approach: Nutrition, stress management, exercise, pharmaceuticals, and a lifestyle coach are used together to develop bone health

What to do Now? Your Call to Action

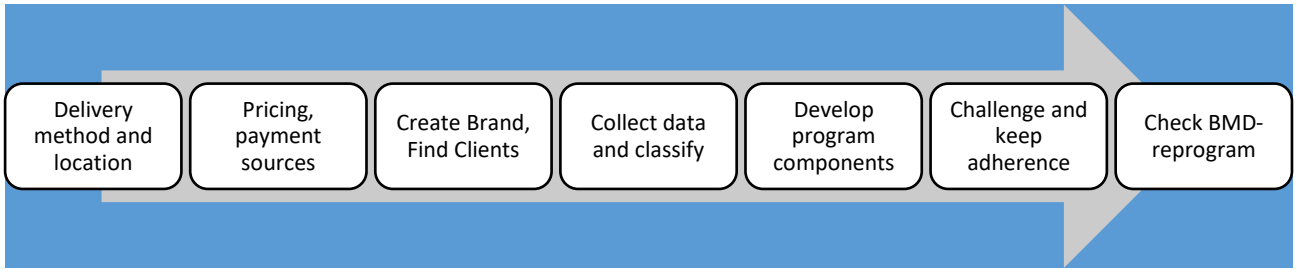


Figure 20: Putting first things first. the tasks and order when developing your medical exercise business

Decisions and Punch List to start your Medical Exercise Practice

- Class or individual? Decide on delivery method and location.
- Decide on pricing and if there are charitable or insurance funding possibilities.
- Make sure your prices take in all your costs and predicted volume, yet stays competitive in the marketplace for that kind of service.
- Finding Clients? MFN, Physician's Office, Senior Centers, NOF.
- Collect data on client- Classify the client in the assessment battery- establish the start point.
- Develop the program - use progressions and regressions as needed in the various locations.
- Check on adherence of program and client retention.
- Check on BMD - Reprogram based on new level.
- Other certificate programs and continuing education via the MedFit Education Foundation.

Summary

- Don't be the same trainer or product out there. This is a unique course with a unique, seamless structure you won't find in many programs in the industry. It takes you from A to Z in the process, and you have flexibility within the boundaries to adjust to client needs. This is golden!
- Classic scales used for exercise are of little use for bone health.
- Smaller amounts of higher impact (bone strain) repeated more often is the best for bone health.
- Starting early is critical, keeping up with it also very important.
- **SHoW-ME**: **S**pine, **H**ips (**o**verall), **W**rist via **M**ultiplanar, **E**ccentric movement, if tolerable, is best.
- Understand the scales/levels and principles for bone health.
- Must start the client at the appropriate level and build from there.
- More is not better, harder is better- up to a point!

Appendix 1: MOFS- Sample Assessment Sheet-

- Name:
- Phone/Email:
- Gender:
- DOB:

- Emergency Contact:
- Prior broken bone in past three years (if over 50 y.o.)
- Have had a bone scan (T-score) in the past 3 years? If so, what was the score?
- Current medications:
- Current activities of daily living:
- Current physical or mental limitations/ pain:
- Past injuries or medical conditions:

Note- that all upper and lower tests should be performed unless the individual cannot perform them. Both static and dynamic tests should be performed if the individual can walk unassisted. Choose only one of the endurance tests based on the client's mobility and cardiorespiratory limitations. Consult the video and instructions on testing protocols. Substitute feet and meters as needed. 1meter= 3.28 feet or 1yd = .914 m,

Analysis from assessment- Male 70 y.o. – strong-force (4), inflexible (2), good balance & agility & endurance (3). Great coordination and dexterity (4). Needs to work on flexibility and a bit on balance. Should be trained at a 3.

Table 7: A display of the variable tested, the test name, what is being measured.

FUNCTION TESTED	TEST NAME	MEASUREMENT IN TEST	SCORE	RANK (1-4)
AGILITY	8' up and go	Time to complete. The lower the time the more agile the client.	5	3
BALANCE-STATIC	4 stage balance test	10" hold position, eyes closed repeat	1leg EO	3
BALANCE- DYNAMIC	Tandem Walk, Head up, Eyes open/close	10 steps without losing balance	Tandem EO	3
COORDINATION	Alternate Ball Toss	5 ft distance, # of catches in 30"	14	4
DEXTERITY/DEFTNESS	Soda can turnover	Time to complete	23	4
ENDURANCE 1	2 min march	Steps completed on one leg		
ENDURANCE 2	2 min walk (50 ft cone)	Distance covered in meters/ft		
ENDURANCE 3	6 min walk (50 ft cone)	Distance covered in meters/ft	635	3
FLEXIBILITY- UPPER	Back Scratch	Distance between or overlap middle fingers	4.8	2
FLEXIBILITY- LOWER	Chair Sit n Reach	Distance/overlap- finger tip to shoe tip	2.1	2
FORCE-UPPER	Arm Curls	Repetitions in 30 sec	25	4
FORCE- LOWER	Chair Stands	Repetitions in 30 sec	23	4
BONE DENSITY	T-Score	Percentile in the population (T#)	.7	3
PRIOR FRACTURE		YES or NO to fracture after 50	no	no

Appendix 2: Sample Nutritional intake

Does the client…?

Negatives

1. Consume large amounts of coffee or caffeinated beverages?
2. Consume large quantities of alcohol on a daily basis?
3. Have a high sodium diet
4. Consume large amounts of animal protein
5. Consume spinach, rhubarb, and wheat bran regularly?

Positives

6. Eat some dairy products regularly?
7. Try to eat plant-based proteins?
8. Try to get antioxidants in their diet?
9. Take moderate amounts of supplements like calcium, Vitamin D3, magnesium, or Vitamin K
10. Try to encourage the gut microbiome to stay healthy

There is no "judgement" on how the client answers the questions. It is important to impart this to your client, but also that you are their "coach" which guides and encourages them to modify nutritional practices. In general, questions 1-5 would be a negative habits or dietary practices, and 6-10 would be positive practices. Always try to give your client ideas on what to substitute. Do not be "that" health professional that only scolds a client or patient on "what" they are supposed to do and gives no guidance on "how" to correct a behavior. Of the 10 you could score each negative they DO NOT DO as a point, and each positive they DO as a point. Have them change one habit every two weeks.

Remember, eating behaviors are closely tied to emotions and when you "deprive" someone of their creature comforts, especially in a rapid fashion, you will get reaction and often a relapse. Make the transitions gradual and let the client understand the "why" of any action, and how it affects them personally.

Appendix 3: Scoring Sheet (Male)

Proper protocols and measuring systems must be used for accurate classification. The table below was developed for 60-80-year old clients. It is important to let your client know this is not for rating or grading just for exercise programming. Try to practice how to deliver the test prior to meeting with your client so you look professional and anticipate any issues. Rest assured, if there is a wrong or easier way to do some task, the client will probably fall into that.

Table 8: Scoring system for classifying your male client

	Men						
	function tested	**TEST NAME**	**MEASUREMENT**	**1**	**2**	**3**	**4**
1	***agility***	8' up and go	Time to complete	> 6	6	5	< 4
2	***Balance-static***	4 stage balance test	10" hold position, eyes open and closed- *stand, instep, tandem, 1 leg*	Stands-EO	Instep-EO	1 leg-EO	Instep- EC
2	***Balance- dynamic***	Tandem Walk, Head up, Eyes closed	10 steps without losing balance- tandem, tand-bwrds, tand-look up, EC	N/A	N/A	Tandem	Backward
3	***Coordination***	Alternate Ball Toss	5 ft distance, # of catches in 30"	<5	5-10	11-20	>20
4	***Dexterity/Deftness***	Soda can turnover	Time to complete	>35	25	15-24	<15
5	***Endurance 1***	2 min march	Steps completed-one leg	85	85-104	105-120	>120
5	***endurance 2***	2 min walk (50 ft cone)	Distance covered in meters	<160	160-174	175-190	>190
5	***endurance 3***	6 min walk (50 ft cone)	Distance covered in meters	525	525-599	600-650	>650
6	***flexibility- Upper***	Back Scratch	Distance between (-) or overlap (+) of the middle fingers	< -7	-3.6 to -7	0 - 3.5	>0
6	***Flexibility- Lower***	Chair Sit n Reach	Distance/overlap- finger tip to shoe tip	< -1	-1 -2.4	2.5- 4	>4
7	***force-upper***	Arm Curls	Repetitions in 30 sec	<15	15-19	20-23	>23
7	***Force- Lower***	Chair Stands	Repetitions in 30 sec	<12	12-16	17-20	>20
	Bone Density	T-Score	Percentile in the population (T#)	< -2.5	-1.0 - (-)2.5	0.9 to (-)1.0	1
	Prior Fracture		YES or NO to fracture after 50	Yes	No	No	No

Appendix 4: Scoring Sheet (Female)

Similar to the previous table, the performances are intended for 60-80 year old's. The age is not particularly relevant because it is intended for programming purposes. All tests should be delivered similarly for women and men alike. Exercises or tests should be modified so performance of it can be completed. You should make notations on any modifications made and you cannot compare that to a normative test value. For example, if a person needs a walker to perform the 2-minute march, then it should be noted, and progressed from there.

Table 9: Scoring system for classifying your female client.

	Women						
	function tested	**TEST NAME**	**MEASUREMENT IN TEST**	**1**	**2**	**3**	**4**
1	***agility***	8' up and go	Time to complete	> 6.5	6.5	5.5	< 4.5
2	***Balance-static***	4 stage balance test	10" hold position, eyes open and closed- *stand, instep, tandem, 1 leg*	Stands - EO	Instep-EO	1 leg-EO	Instep-EC
2	***Balance-dynamic***	Tandem Walk, Head up, Eyes closed	10 steps without losing balance- tandem, tand-bwrds, tand-look up, EO eyes open, EC- eyes closed	N/A	N/A	Tandem	Bkwrds
3	***Coordination***	Alternate Ball Toss	5 ft distance, # of catches in 30"	<5	5-10	11-20	>20
4	***Dexterity/ Deftness***	Soda can turnover	Time to complete	>35	25	15	<15
5	***Endurance 1***	2 min march	Steps completed on one leg	70	70	90	>110
5	***endurance 2***	2 min walk (50 ft cone)	Distance covered in meters	<145	145	160	>170
5	***endurance 3***	6 min walk (50 ft cone)	Distance covered in meters	470	470	540	>600
6	***flexibility-Upper***	Back Scratch	Distance between (-) or overlap (+) of the middle fingers	-3	-3	0	>+1.5
6	***Flexibility-Lower***	Chair Sit n Reach	Distance/overlap- finger tip to shoe tip	0	0	3	>5
7	***force-upper***	Arm Curls	Repetitions in 30 sec	12	12	17	>20
7	***Force- Lower***	Chair Stands	Repetitions in 30 sec	11	11	15	>18
	Bone Density	T-Score	Percentile in the population (T#)	< -2.5	-1.0- -2.5	0.9- -1.0	1
	Prior Fracture		YES or NO to fracture after 50	Yes	No	No	No

Appendix 5: Exercise Progressions & Regression, Client Operations

sTable 10: Example of Progressing and Regressing SHOW ME for Bone Health

Body Location	Level 3	Progression (L 4-5)	Regression (L 1-2)	F.I.T.
Spine	Toe Touches 1 legged burpees	Dead lifts or Burpees Hip hip hooray jumps Inch Worms	Bird dogs Hip hinges *Head, shoulders, hips & knees…*	2x/day 4 day/wk 10-30 rep/session
Hip/ Lower	Body Weight Squat Side steps- BWt	Jump squat Box jumps Side lunges-alt	Hand on Knee squats Chair sits and ups	2x/day 4 day/wk 10-30 rep/session
Wrist/ Upper	Ball squeeze Planks- incline	Medicine Ball catches Push ups- flat or incline Planks- challenged "	Can of food, Dbs wrist curl/ext/lat deviations	2x/day 4 day/wk 10-30 rep/session
Multiplanar	Touch opposite foot, windmills	Lunge with elbow to knee, skaters w/ toe touch, 180 jumps	Windshield wipers with wts, point in- elbow flx, pt out- ext	Hay bailers or chops with lunge or not
Eccentric	Power cleans Fast 3-pt toe touch			

Table 11: Example of Exercise Progressions Using 3 levels

Exercise	1	2	3
Walk	Walk	Bounce Walk	Jog in place- or slow
Bend over	Hip hinge	Dead lift	Dead lift- Jump
Push Up/Away	Wall Push	Bench Push Up	Bench Push Up & Away
Twister	Twist w/ elbows in	Partial Windmill	Windmill or Chop
Lunge	Partial Lunge	Lunge Walk	Lunge with a twist
Medicine Ball pass	Medicine ball hand off	MB Push	MB Launch and catch
Step Down	Asstd slow- step down	Step down 1 leg	Jump down 2 legs
Side step	Stepping sideways easy	Fast Side step	Skaters w/ arms and not
Overhead	Overhead arm raise	Weighted overhead	Overhead MB SquatnToss
Burpee	One leg burpee- slow	Inclined 2 leg burpee	Standard burpee w jump
Lat pull down	Wt machine easy	Wt machine	Hang or pull up- jerk up
Get out of Chair	Armed chair get ups	No arm chair fast	Low chair/bench fast

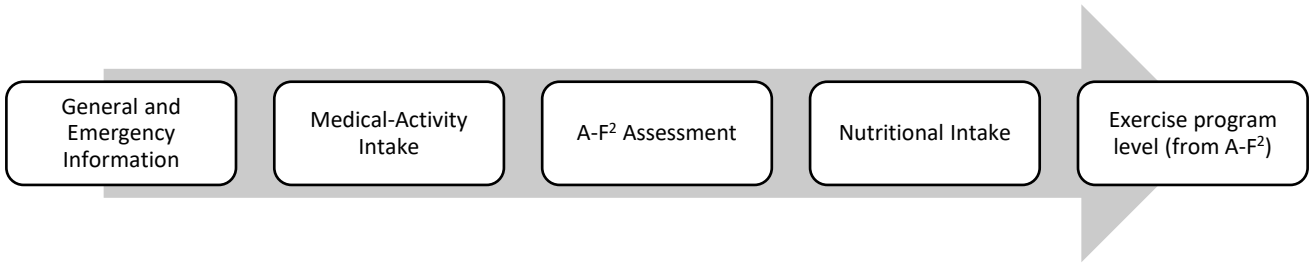


Figure 21: Order of Operations in Client matters

List of Terms

(As applied in this Course- alphabetical order in each module)

Module 1

- **Appositional growth-** the circumferential growth of bone which occurs due to stresses placed
- **Atrophy-** a loss of cell size or number due to a lack of stimulus
- **Compact bone-** the outer superficial region of bone under the periosteum
- **Davis' law-** soft tissue in a healthy person will heal in a manner according the mechanical stresses place on it. Connective tissues such as ligaments, tendons and fascia are included in the soft tissue category.
- **Epiphyseal plate-** the thin layer of hyaline cartilage that unites an epiphysis with the shaft of a long bone (diaphysis) and is the site where the bone grows in length (longitudinally).
- **Epiphysis-** the usually rounded end of the shaft of a long bone that is composed mainly of cancellous bone covered by a thin layer of compact bone
- **Hyperplasia-** a responsive increase in cell number due to an anabolic stimulus
- **Hypertrophy-** a responsive growth of cell size due to an anabolic stimulus
- **Longitudinal growth-** the lengthwise growth in bone that ceases when the epiphyseal plate closes.
- **Lower cross syndrome-** a set of biomechanical irregularities in the hips described by weak abdominals and gluteus maximus, and tight hip flexors and thoracolumbar extensors (erector spinae).
- **Osteopenia-** a natural decrease in bone mass that accompanies aging or lack of use.
- **Osteoporosis-** a bone disease that is characterized by decrease in bone mass with decreased density and enlargement of bone spaces producing porosity and fragility
- **Proactive approach-** addressing a problem or disease before it has appeared or fully developed
- **Red bone marrow-** a portion of the cancellous bone in the epiphysis responsible for red blood cell production stimulated by erythropoietin.
- **Reactive approach-** addressing a problem or disease after it has developed.
- Sarcopenia- a natural decrease in muscle mass that accompanies aging or lack of use.
- **Spongy bone-** also known as trabecular cancellous bone is the inner porous bone making it lighter weight, weaker, and better suited for metabolic activities. This bone is primarily affected by osteoporosis and is subject to fracture with progression of this disease.
- **Upper crossed syndrome**- a set of biomechanical irregularities in the neck, shoulders and chest with the neck protruding anteriorly, the shoulders internally rotated, the pectorals, trapezius, and levator. scapula tightened and upper back and neck extenders weakened.
- **Wolff's law-** bone in a healthy person will develop and adapt in according the mechanical stresses placed on it. The process of remodeling is a function of the osteoclasts and osteoblasts in the bone.

Module 2

- **Absorption-** the translocation of nutrients from the gastrointestinal tract to the bloodstream.
- **Chemical digestion-** decomposition of food particles by enzymes by breaking chemical bonds eventually in into monomers for absorption into the bloodstream.
- **Ingestion-** the process of taking food into the mouth for consumption
- **Oxalates-** a naturally occurring substance in plant-based foods that bind calcium. When bound to calcium they exit via the feces, when not bound to calcium they exit in the urine.
- **Physical (mechanical) digestion-** breaking larger food substances into smaller particles by chewing, segmentation, and gastric agitation.
- **Phytoestrogens-** naturally occurring in foods, this is a sub-category of polyphenols shown to some estrogenic effects and some anti-estrogenic effects. Isoflavones found in soy products are high in them and quercetin and resveratrol also contain phytoestrogens.
- **Polyphenols-** a molecule with multiple phenolic rings that have been show to have many health benefits including antioxidant properties protecting against obesity, T2 diabetes, cardiovascular disease, and neurodegenerative diseases.
- **Utilization-** the translocation of nutrients from the bloodstream to the cell for metabolism.

Module 3

- **Anabolic stimulus-** any mechanical or chemical factor causing the body to build tissues or store fuel sources. The stimulus must meet a "threshold" level to be effective.
- **Apoptosis-** the naturally occurring programmed cell death as part of the growth, maintenance and repair processes in an organism.
- **Cortisol-** a glucocorticoid hormone released from adrenal cortex, which has many different effects throughout the body during stress including anti-inflammatory and raising blood glucose.
- **Exercise load-** a combined effect of exercise volume and intensity. Exercise volume is the frequency and duration. Intensity is the level of exertion often described in percentages of maximum.
- **Initial values and diminishing returns-** a concept as applied to exercise stating there is a point where increases in volume or intensity will not return increasing proportional benefits.
- **Osteogenic stimulus-** the necessary stress on the bone to elicit an anabolic effect
- **Principles of exercise-** factors that occur in exercise training that are very repeatable and reliable.
- **Progressive overload-** the exercise principle stating that you must continually overload the body's current capacity to get adaptations.
- **Reversibility-** the exercise principle stating if you do not overload the system it will regress and changes that occurred due to the overload will be reversed.
- **SAFE exercises (mnemonic)-** represents the four modalities of exercises to focus on for osteoporosis- strength, agility, flexibility, and equilibrium (balance).

- **SHOW ME (mnemonic)-** represents the target areas for osteoporosis prevention- spine, hips, and wrists and the type of exercises to perform- multiplanar and eccentric loading
- **Specificity principle-** the exercise principle stating that the body will adapt a specific stress in a specific manner. The type or modality of exercise, area of the body, and tissue stress all obey specificity.
- **Weight bearing activity-** activities involving the body weight as a resistance or in need of support

Module 4

- **ABCDEF^2 test battery-** a set of tests which measures- agility, balance, coordination, dexterity or deftness, endurance, force (strength) and flexibility.
- **Activities of daily living-** the physical actions an individual regularly performs throughout the day.
- **Dexterity/deftness-** the ability to use one's hands skillfully for various tasks.
- **Personal habits-** developed behaviors in an individual which are repeatedly performed
- **Personal traits-** the inherent characteristics of an individual which are stable across time.
- **T-score-** bone mineral density- an estimate of the amount of minerals contained in a bone. The T-score is referenced based on the age and gender of the individual compared to their reference group.

Module 5

- **UCLA (mnemonic)**- represents the Upper, Core, Lower, All- divisions for exercise emphasizing a given body region. Some exercises may not fall into one category only and should be considered "all".
- **Compound motion**- An exercise or motion that works multiple joints. For example, a shoulder press would work the deltoids (glenohumeral, sternoclavicular) and the back (scapulothoracic, and internal rotators) and the elbows (triceps). These motions tend to work large amounts of muscle mass and should be done first.
- **Dynamic Warm-up**- warm up exercises that involve moving multiple joints at one in relatively rapid manner, and through an increasing range of motion. The warmups should be performed rapidly and repeatedly to get the cardiovascular system up to 30-50% of the heart rate reserve.

Module 6

- **Marketing**- the term used for all aspects of product development, promotion, pricing and sales. It is a comprehensive term that covers most business issues.
- **Promotion**- a branch of marketing dealing with the branding, image, and communication, to the target audience to enhance the reputation and sales of a given product.
- **Brand**- the image and perspective a potential customer has of a company.

List of Figures

List of Tables

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