BONE HEALTH

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The New York Times Magazine

The Island Where People Forget to Die

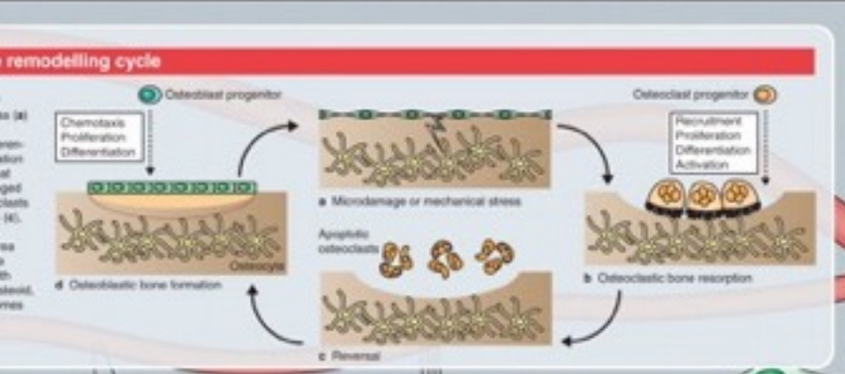
By DAN BUETTNER OCT. 24, 2012

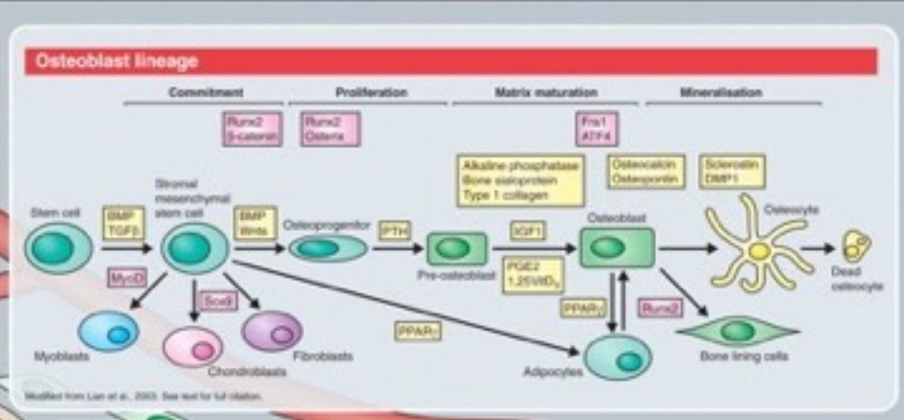
In 1943, a Greek war veteran named Stamatis Moraitis came to the United States for treatment of a combat-mangled arm. He'd survived a gunshot wound, escaped to Turkey and eventually talked his way onto the Queen Elizabeth, then serving as a troopship, to cross the Atlantic. Moraitis settled in Port Jefferson, N.Y., an enclave of countrymen from his native island, Ikaria. He quickly landed a job doing manual labor. Later, he moved to Boynton Beach, Fla. Along the way, Moraitis married a Greek-American woman, had three children and bought a three-bedroom house and a 1951 Chevrolet.

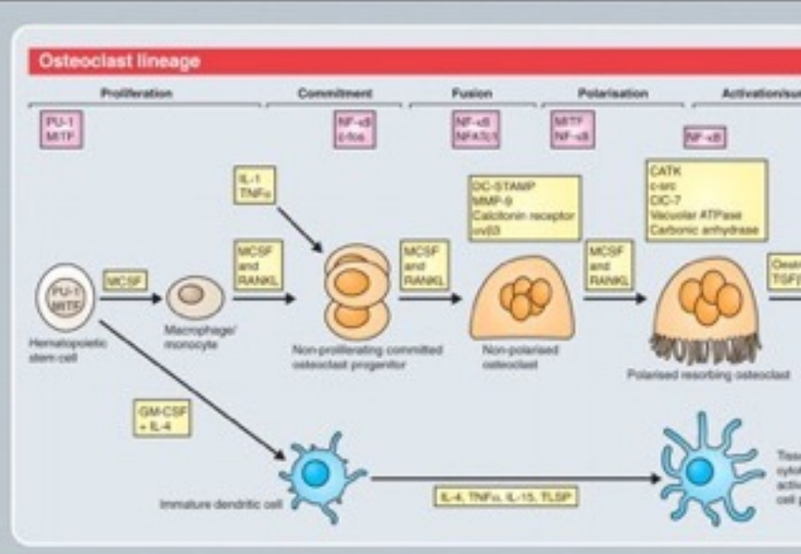
Science
jcs.biologists.org

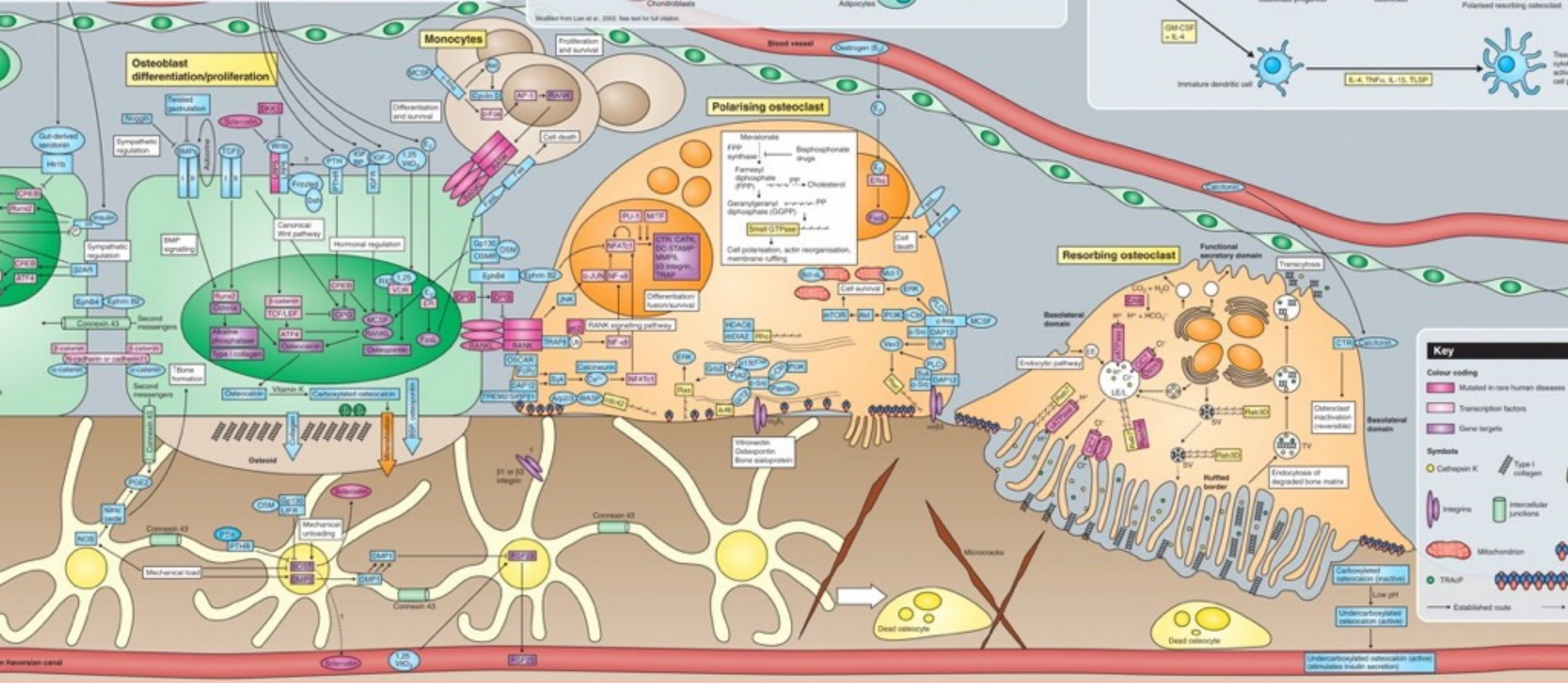
Bone Remodelling at a Glance

Julie C. Crockett, Michael J. Rogers, Fraser P. Coxon, Lynne J. Hocking and Miep H. Helfrich









1,25(OH)$_2$D$_3$, 1,25 dihydroxy vitamin D$_3$; AP, alkaline phosphatase; AP-1, activator protein-1; ARE, ADP-ribosylation factor-related proteins 2 and 3; ATF4, activating transcription factor 4; αvβ3, vitronectin receptor; β2 AR, β2 adrenergic receptor; BMP, bone morphogenetic protein; BSP, bone sialoprotein; CAII, carbonic anhydrase II; CATK, cathepsin K; ClC7, chloride channel 7; CLOCK, circadian locomotor output cycles kaput; CREB, cAMP responsive binding protein; CTR, calcitonin receptor; DAP12, DNAX-activation protein of 12 kDa; DC-STAMP, dendritic cell-specific transmembrane protein; DKK1, dickkopf-1; DMP1, dentin matrix acidic phosphoprotein 1; E2, oestrogen; EphB4, Eph receptor B4; ER, oestrogen receptor; ERK, extracellular signal-regulated kinase; FcRγ, Fc receptor γ; FGF, fibroblast growth factor; Fra1, fos-related antigen 1; GIT2, G-protein-coupled receptor kinase-interactor 2; GM-CSF, granulocyte-macrophage colony stimulating factor; Grb2, growth factor receptor-bound protein 2; HDAC6, histone deacetylase 6; Hr1b, 5-hydroxytryptamine receptor 1B; IGF1, insulin-like growth factor 1; IGFBP, IGF-binding protein; IL, interleukin; IR, insulin receptor; LE/L, late endosome or lysosome; LIFR, leukemia inhibitory factor receptor; LRP, lipoprotein-related protein; Mkl-1, myeloid cell leukemia sequence 1, isoform 1; MCSF, macrophage colony-stimulating factor; mDia2, mammalian diaphanous protein 2; MITF, microphthalmia-associated transcription factor; MMP-9, matrix metalloproteinase-9; mTOR, mammalian target of rapamycin; MyoD, myoblast determination protein 1; NFATc1, nuclear factor of activated T-cells cytoplasmic 1; NOS, nitric oxide synthase; OPG, osteoprotegerin; OSCAR, osteoclast-associated receptor; OSM, oncostatin M; OSMR, oncostatin M receptor; PGE2, prostaglandin E2; PI3K, phosphoinositide 3-kinase; PLC-γ, phospholipase-Cγ; Plekhm, pleckstrin homology domain containing family M; PPARγ, peroxisome proliferator activator γ; PTH, parathyroid hormone; PTHR, parathyroid hormone receptor; PykO, proline-rich tyrosine kinase 2; RANK, receptor activator of NF-κB; RANKL, receptor activator of NF-κB ligand; Runx2, runt-related transcription factor 2; RXR, retinoic acid receptor; SIRPβ1, signal-regulatory protein β1; SOST, sclerostin; SV, secretory vesicle; Syk, spleen tyrosine kinase; TCF/LEF, T-cell factor and lymphoid enhancer factor family of transcription factors; TGFβ, transforming growth factor β; TLSP, thymic stromal lymphopoietin; TNF-α, tumour necrosis factor α; TRAcP, tartrate-resistant acid phosphatase; TRAF6, TNF-receptor associated factor 6; TREM2, triggering receptor expressed in myeloid cells-2; TV, transcytotic vesicle; Ub, ubiquitin; VDR, vitamin-D receptor; WASP, Wiskott–Aldrich syndrome protein.

Anabolic vs Catabolic

- **Anabolic** refers to the ability of the body to build, repair, and strengthen. The body responds appropriately to stressors and can recover optimally.

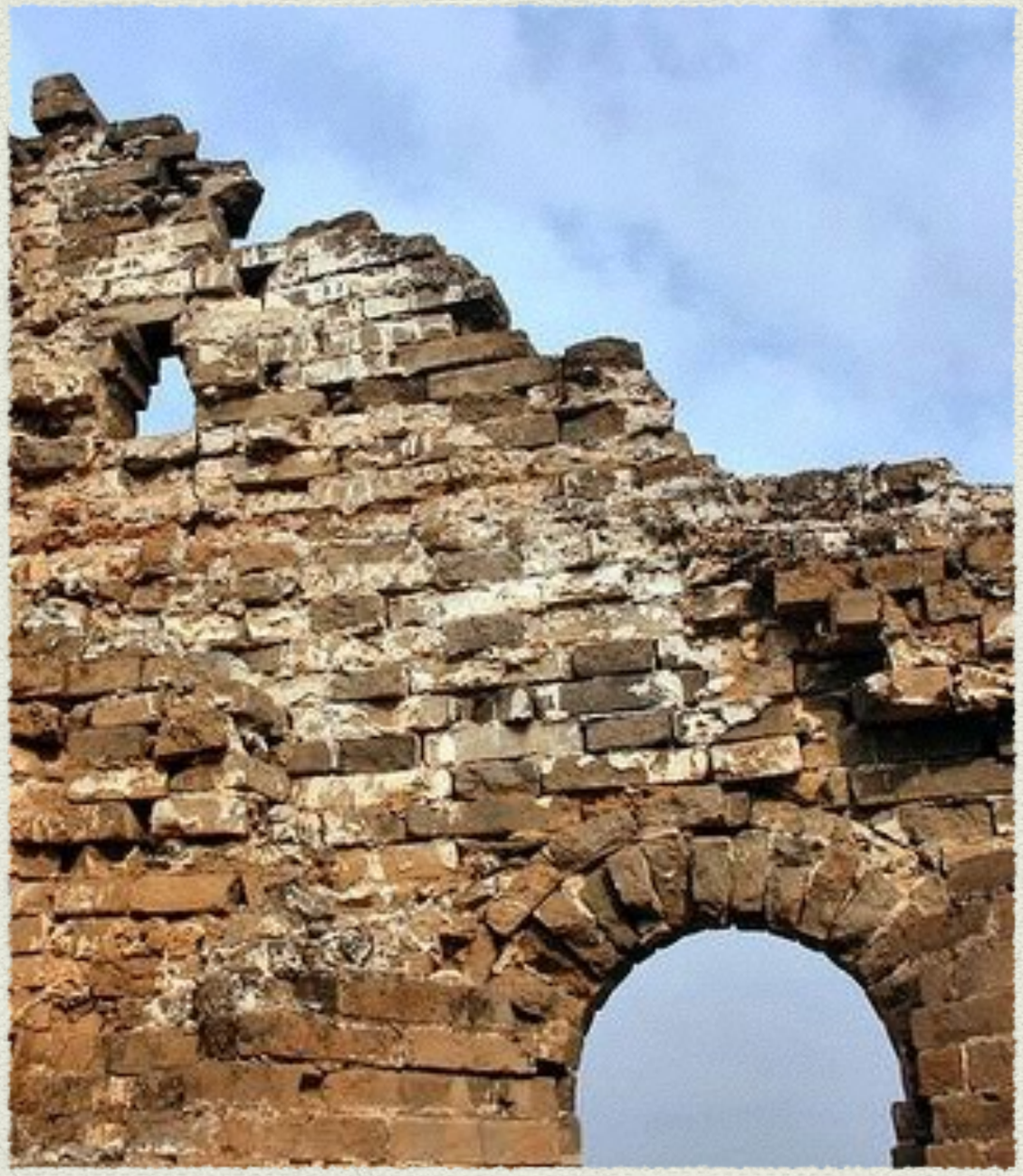
- **Catabolic** is about tissue breakdown, hormonal insufficiency, increased fatigue, poor renewal/restoration.

- This dynamic process is ongoing but we always want to be tilting the balance towards greater anabolic activity and minimize the catabolic.

- By middle age if we have withdrawn more from our energy bank than we have deposited, the system can no longer keep up and continue to optimally repair and regulate hormones appropriately.

Conditions related to increased catabolism

- Osteoporosis
- Autoimmune diseases
- Arthritis
- Neurodegenerative diseases
- Surgery
- Cancer
- **Also think on a much broader scale of catabolism both causing and being caused by hormonal dysfunction, poor digestion, insufficient detoxification, weakened repair mechanisms.**



Bone Building and Rebuilding

- Is a very dynamic process, at it's peak before we are 30
- OsteoClasts= catabolic= break down old, mineralized bone, followed osteoBlastic activity which builds bone matrix, which then becomes mineralized…
- Adjusts to changing mechanical needs as well as repairs micro- damage in bone matrix, and prevents unwanted accumulation of old bone.
- Bone remodeling also plays an important role in maintaining normal serum calcium levels
- In response to low serum calcium, the parathyroid releases parathormone (PTH) which stimulates bone breakdown to free calcium for release into the blood.
- Calcitonin, which is released from the parafollicular cells of the thyroid, exerts the opposite effect, inhibiting bone breakdown, and therefore preserving skeletal integrity.

Bone Health Assessment beyond DEXA

- Gold standard in primary care is the DEXA scan: Dual Energy X-ray Absorptiometry. DEXA does not tell if what they are seeing is healthy bone or calcified but they can at least see density.
- **<u>Lab assessment includes:</u>**
- N-telopeptide (NTX): collagen peptides mobilized from bone during osteoclast activity and excreted through the urine. Helps assess bone turnover.
- Parathyroid Hormone: PTH. This is tested in the context of high serum calcium.
- Vitamin D3, 1, 25 dihydroxycholecalciferol
- Thyroid: TSH, freeT3, freeT4. A hypothyroid mismanages calcium deposition in bones and hyperthyroid leads to osteoporosis by speeding up osteoclast metabolism.
- Comprehensive Metabolic to see serum calcium
- hs-CRP= high-sensitivity C-Reactive Protein
- Homocysteine

Homocysteine

- Made in the body from the amino acid methionine, and then enzymatically recycled back into methionine or cysteine.
- People who have low B12, folate, or mutated MTHFR genes can have trouble methylating the homocysteine to turn it back into methionine, so the homocysteine builds up.
- Studies have found that elevated homocysteine + low B12 =increased risk for osteoporosis
- Elevated homocysteine is a huge risk factor in cardiovascular disease but also can damage nerves, and has been linked to a broad range of illnesses: cancer, gout, Alzheimer's, cervical dysplasia, erectile dysfunction. Interferes with nitric oxide leading to impaired blood flow.
- This process can be assisted by taking a methylated folate (I usually start with 1mg) and sublingual B12.
- If foggy-brained, the P-5-P (pyridoxal-5-phosphate) form of B6 can also help

Mainstream Interventions

Bisphosphonates (Fosamax or Reclast)

- Bisphosphonates are inserted into the bone itself to stop bone from breaking down.
- Do not create new bone growth, so the bone that remains is brittle and inflexible
- Poorly available orally and lead to esophagitis because when they bind, they destroy the protective mucous layer, allowing gastric acid to reach the tissue below.
- It was theorized that they led to an increase in esophageal cancer but that seems to not be true
- Shown to reduce the risk of hip, vertebral, and femoral fracture, as well as height loss and vertebral deformity
- Use is only recommended for 3-5 years
- **Two rare side effects:**
- Can lead to femur fracture with little or no external cause. This is because inhibiting the bone turnover also inhibits the toughening of cortical bone
- Osteonecrosis of the jaw: Happens in 1-2% of cases. 94% of these cases have been in patients receiving high doses in the metastatic cancer setting
- Can also lead to atrial fibrillation, hypocalcemia, acute inflammatory response, and severe musculoskeletal pain

Prolia (Denosumab)

- This is a RANK-ligand inhibitor.
- Prolia blocks the binding of RANKL to RANK (it's receptor), therefore stopping the formation and activity of osteoclasts
- Less esophageal symptoms than Fosamax: 10.5 vs 26%
- Less nausea: 11 vs 21.7%
- 4/6 trials found Prolia statistically superior to Fosamax, other trials have shown no difference
- Prolia is certainly a better option when inflammatory markers are high.

Calcium

- Of course optimal calcium levels are needed to maintain good bones
- AMA now recommends 1000mg/day pre-menopausal and 1200mg/day post-.
- I believe this is too much and actually do not recommend supplemental calcium at all. If someone wants to take some I start with bioavailable forms at lower doses: 400-600mg.

Does calcium help?

- A meta-analysis in 2007 of 23 trials of 41,419 subjects in which changes in BMD were the outcome measure.
- No studies reported that supplementation [with calcium and vitamin D3] worsened age-related declines in BMD.
- Nor were there any studies suggesting that supplementation increased BMD over the study period. The overall finding was that with or without vitamin D3, calcium supplementation was associated with a “reduced rate of bone loss”.

Lancet. 2007 Aug 25;370(9588):657-66.

Use of calcium or calcium in combination with vitamin D supplementation to prevent fractures and bone loss in people aged 50 years and older: a meta-analysis.

Tang BM[1], Eslick GD, Nowson C, Smith C, Bensoussan A.

Calcium: some risks…

- Excess calcium supplementation has been shown to deposit it in places other than our bones.
- Johns Hopkins 2016 study looked the coronary calcium scores of 2742 people over 10 years. The coronary calcium score is a measure of calcification of the heart's arteries.
- Those with the highest *dietary* calcium (from food) were 20% less likely to develop heart disease
- Those with the highest calcium from *supplements* had a 22% increased likelihood of developing calcified arteries.

Vitamin D, The Sunshine Vitamin

- Vitamin D3 is formed in the skin with exposure to UV light.
- Must be converted in the liver, kidneys, into the active form: 1,25 dihydroxycholecalciferol.
- The liver has a feedback loop which moderates how quickly this conversion reaction happens, which balances levels even when new D intake is erratic
- Vitamin D promotes intestinal absorption of calcium and phosphorus for bone mineralization, growth, and repair.
- Decreases renal calcium excretion
- Generally enhances calcium availability
- I like to see levels >50 with moderate dosing

More on D

- For many types of cancer, but particularly breast, prostate, ovarian, lung, and colon, having optimal levels of vitamin D improves overall survival.

- Vitamin D deficiency has been linked to Type I diabetes, multiple sclerosis, increased inflammation, asthma, increased cardiovascular events, osteoarthritis, and increased falls in the elderly.

- As far as bone health: calcium supplementation alone has not shown to increase bone density. Only in the context of Vitamin D + calcium, or really even vitamin D alone, does PTH decrease or stabilize. And vitamin D stabilizes PTH even when calcium intake is low…meaning even if dietary intake is not ideal, the PTH is not stimulating release of calcium from the bones to compensate as long as we are replete with D.

…at least let's add Vitamin K!

- Widely shown to enhance bone mineral density
- Even in women who already have osteoporosis, it decreases incidence of fractures and enhances the microarchitecture of bones
- Enhances bone density where osteoporosis is due to long-term steroid therapy
- Vitamin K deficiency could be the answer to the "calcium paradox" which is too much calcium in the tissues and not enough in the bones.
- Involved in clotting but also keeps blood appropriately thin
- **2 main forms in bone health**:
- K1 is found in plants (especially alfalfa) needs to be turned into the active form in our bodies. K1 preferentially goes to the liver vs. the bones but it does still have some bone activity. Dose is around 500 mcg/day
- K2 is found in cheese, egg yolks, dark meats and natto and the "K2" refers to a collection of menaquinone (MK-7), has been widely studied in Japan- it is stronger but also much more expensive: 50 mcg/day. Much better at directing it's activity towards bone building and anti-cancer (gene-regulation)

What does a wholistic bone health program look like?

Adaptogens:
Our #1 way of replenishing our Essence and staying strong

- Adaptogens are a broad category of herbs that build energy and neuroendocrine health
- "Any substance that exerts effects on both sick and healthy individuals by correcting dysfunction without producing unwanted side effects" - Dr. Nickolai Lazarev
- **The 3 N's**: must be Non-specific, Normalizing, and Non-toxic.
- Our "Foundation"

Adaptogens' structure

- Contain many saponins: which are widely distributed in the plant world, contained in over 100 plant families.
- Generally non-toxic
- **Saponins have a steroidal basis**: they are built on the same backbone as cholesterol and many of our endogenous hormones: sex hormones, cortisol. So we have physiological responses because they look so similar to substances in our bodies.
- Therefore many of our saponin-rich herbs are active in the neuroendocrine system.

General over-view of saponin actions

- Lots of anti-inflammatory actions due to it's structural overlap with cortisol: licorice, astragalus, wild yam, fenugreek
- Adrenal tonic, cortisol sparing (help you get out of alarm phase)
- Promote detox in the liver
- Lower absorption of dietary cholesterol: sequestration of cholesterol in the bowel, prevents reabsorption
- Hormone modulating: licorice, wild yam, tribulus, smilax

Where Adaptogens work…

- Adaptogens work in the whole Endocrine (Hormonal) system system as normalizers
- Detox systems: kidneys, liver, lungs, skin
- In the nervous system balancing sympathetic (action) and parasympathetic (rest and digest)
- Immune and digestive symptoms (GALT= gut-associated lymphoid tissue=where the GI mucosa and the immune system work to prevent immune compromise via the GI)
- Return one to *Allostasis*= to balance, to be flexible according to need but still return to balance…help you adapt appropriately

Eleutherococcus - Siberian Ginseng "King of the Adaptogens"

- In the same plant family as ginseng, but found and researched extensively in the Soviet Union
- Olympic teams: Improved stamina and recovery, increased oxygen intake
- In 14,000 auto workers-> 40% drop in high blood pressure and CVD
- Decreases adrenal hypertrophy, allows for a more modest alarm phase during stress, allowing the body to more easily return to rest/anabolic phase
- Normalizes blood pressure and blood sugars in both too high and too low
- Has been shown to have a neuro-regenerative effect
- Moderates lipids, moderates blood coagulation
- **Decreases calcium excretion and has been shown to build femoral bone density**

Panax Ginseng

- Shown to prevent bone loss in both rats and humans—yay!
- A more stimulating adaptogen, used when there are symptoms of cold, a weak pulse, blood deficiency, profuse sweating due to deficiency.
- Tonifies weak digestion that results in diarrhea, bloating, prolapse
- Inhibits inflammation
- Modulate insulin activity by balancing cortisol release
- Improves maximal oxygen uptake and recovery from exertion
- 2006: 1500 breast cancer patients followed for 4-6 years found that *Panax* improved the quality of life, reduced recurrence, and prolonged life. And- for those who had been using ginseng before their diagnosis, it was associated with a significantly reduced risk of death.
- Inhibit cancer cell proliferation, enhance immuno-surveillance.

Ashwagandha somnifera
“Strong like a horse” + “restful sleep”

- Remarkably similar to Eleuthero and Panax… significant anti-stress and anabolic activity, balances blood sugar and moderates cortisol levels
- Flavor is sharp and pungent, it is warming and promotes digestion
- Enhances bone mineralization and prevents bone loss: when compared with estradiol and bisphosphonate drugs, bone turnover markers and inflammatory markers were reduced. “Not fraught with estrogenic or anti-estrogenic effects”
- Anxiolytic and anti-depressant effects similar to Lorazepam and Imipramine.

Ashwaganda continues to amaze…

- Enhances cognition, improves memory, regenerates neurons
- Exerts anabolic effect of osteoporotic bone
- Supports sleep but is best taken in the morning to modulate cortisol levels, which allows healthy sleep at night.

Other great Adaptogens:

- Schisandra: Great for kidneys, lung, and liver. Balances stomach pH (either up or down), anti-toxin, highly liver-protective, in CCM it is used for insomnia, irritability, fortifies lungs, astringes excess fluids, increases sports performance and recovery, boosts energy, improves eyesight and mental acuity, relieves stress….

- Tulsi/Holy Basil: "The Incomparable One", great general immune support, uplifting, frequently drunk as part of a meditation practice, supports thyroid, normalizes all body functions during stress, reduces exhaustion. Improves sexual function in men and women.

Optimize digestion

- Digestion starts in the mouth and the stomach has no teeth so please CHEW YOUR FOOD.
- Eat in a calm environment
- Acid is excreted into the stomach as you prepare to eat…as you smell food and anticipate eating HCL is released.
- This small amount of acid “primes the pump” and starts the release of more acid as food arrives in your stomach.
- You can support this process by sipping a little **apple cider vinegar** (best if naturally fermented and unpasteurized) mixed with water at the beginning of a meal: 1/2-1 tsp.
- Increased acidity helps us absorb our minerals> better bone health

Betaine HCL

- This is a stronger therapeutic…
- For people with truly weak digestive ability…bloating after meals, a feeling of food just sitting, weak nails, low vitality.
- Can also be used to prevent GERD by enhancing closure of the valve between the esophagus and the stomach
- Helps prevent SIBO: Small Intestinal Bacterial Overgrowth because the acids kill bacteria in our food, and also stimulates movement of the small intestine so food does not sit and start to ferment.

Bitters and Bitter foods

- When bitter flavor hits the tongue its starts a cascade of events:
- Increased saliva,
- increased secretion of digestive enzymes in the stomach,
- promote bile flow,
- supports the inmate self-repair mechanisms in the gut,
- improves esophageal sphincter tone,
- enhances pancreatic function and bicarbonate production,
- regulates bowel activity,
- bacterial environment,
- and liver detox.

Proton Pump Inhibitors (Prilosec, Nexium)

Osteoporos Int. 2018 Jan;29(1):153-162. doi: 10.1007/s00198-017-4262-2. Epub 2017 Oct 14.

Proton pump inhibitor use and the risk of osteoporosis and fracture in stroke patients: a population-based cohort study.

Lin SM[1], Yang SH[1,2], Liang CC[1], Huang HK[3].

⊕ Author information

Abstract

A considerable proportion of stroke survivors are prescribed with proton pump inhibitors (PPIs). Our study indicated that PPI use is associated with an increased risk of osteoporosis, hip fracture, and vertebral fracture in stroke patients. The risk tends to increase as the cumulative doses of PPIs increase.

Association of Long-term Proton Pump Inhibitor Therapy with Bone Fractures and effects on Absorption of Calcium, Vitamin B12, Iron, and Magnesium

Tetsuhide Ito, MD, PhD[1] and **Robert T. Jensen, MD[2]**

Climacteric. 2016 Oct;19(5):478-81. doi: 10.1080/13697137.2016.1200549. Epub 2016 Jun 29.

The use of proton pump inhibitors is positively associated with osteoporosis in postmenopausal women in Germany.

Jacob L[1], Hadji P[2], Kostev K[3].

Herbs to support digestion and assimilation

- *Scutellaria lateriflora* (not *baical,* which is more anti-inflammatory). It is a nervine, meaning it is calming and also slightly bitter, which will help digestion.

- *Chamomile*: also slightly bitter and calming, and with a nice carminative effect (anti-gas)

Donnie's Mineralizing Tea

from *Adaptogen's in Medical Herbalism*

- Horsetail: traditionally used as a soothing diuretic, great for kidney stones, urinary tract inflammation, bone healing and osteoporosis. Rich in silica.
- Nettles: very nutritive, high mineral content: potassium, magnesium, phosphorus, manganese, silica, calcium. Also high in chlorophyll. A bit drying so best drunk with some licorice or marshmallow.
- Hibiscus: inhibits inappropriate calcifications, so calcium goes into the bones vs. into our arterial linings. Also great for kidneys and elevated blood pressure. Normalizes cholesterol, perhaps because it is rich in polyphenols.

Other minerals: Magnesium

- With magnesium deficiency bones become brittle and weak.
- About 60% of total magnesium is stored in bones, with the majority being on the external (cortical) surface so it can act as an extracellular reservoir. Bone surface magnesium reflects serum magnesium.
- Low magnesium reduces osteoblastic (building) activity, and increases osteoclasts (bone break-down)
- Low magnesium reduces the secretion of PTH which reduces the activation of 1,25-(OH)Vitamin D, which > less bone building
- Low magnesium increases the inflammatory markers TNF-a and IL-6
- Wheat bran! Nuts! Greens! or…400-600mg/day Mg glycinate or citrate.

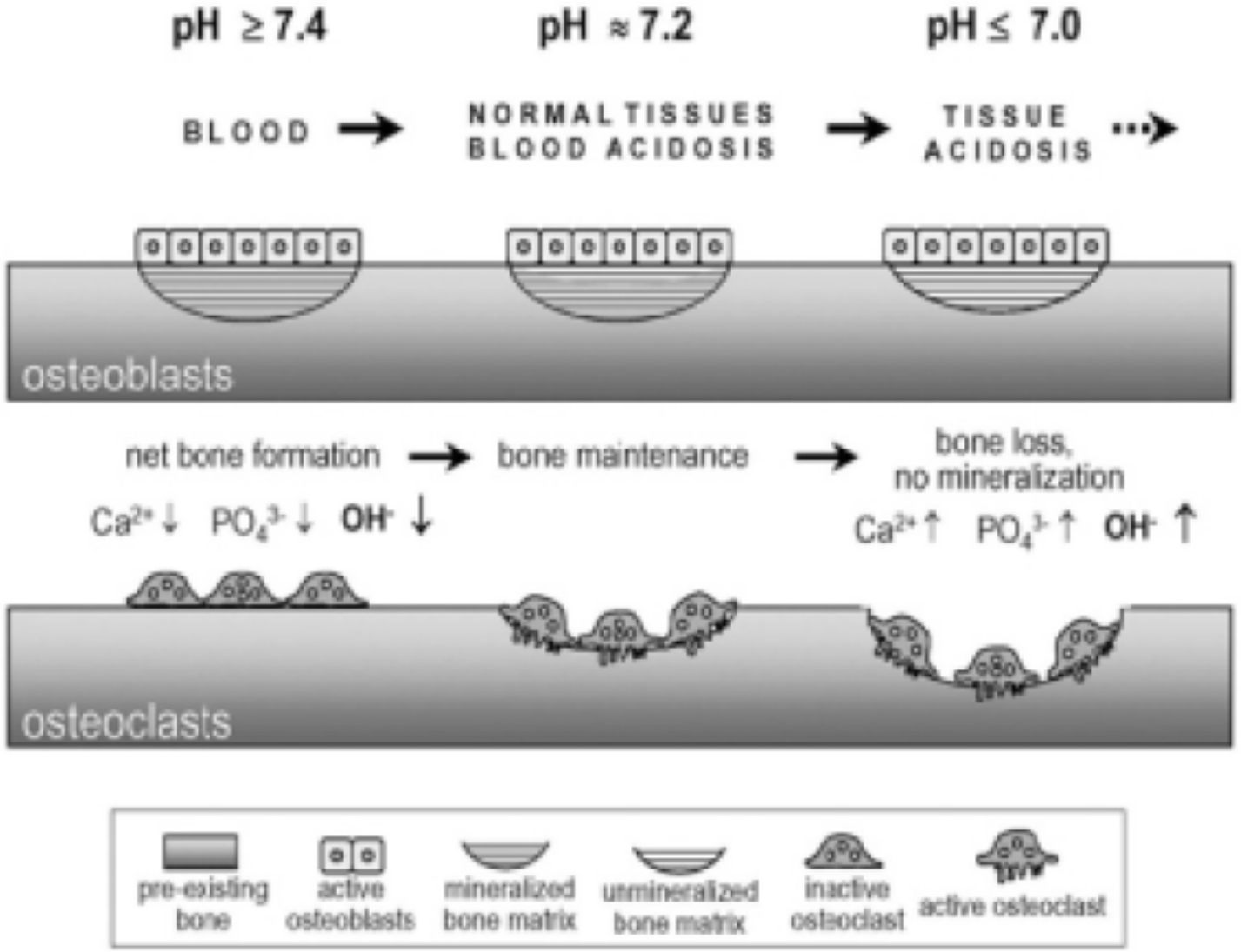
Alkalinity and bone health

- Manage alkalinity in the body.The bones are our main sink of acid-buffering calcium, which will leach out to counteract high blood and tissue acidity. Acidity triggers osteoclasts. Potassium:Sodium balance seems to be the determinant of acidity. In modern diets the potassium:sodium ratio is reversed from earlier hominid diets from 3:1 to 1:10.

- Note that there is a lot of confusion around acidosis/pH in the body. The pH of the serum is VERY tightly regulated because it affects every aspect of our function, from heart contractility to nerve impulses. Changing the *urine* pH reflects the degree of acidic waste products being processed through the kidneys but this should not be confused with changing the pH of the tissues. *Cellular* acidosis is what impacts bone health. *Acidemia* refers to a blood pH <7.35, a medical emergency.

Acidosis Inhibits Bone Mineralization

- Bone health best documented clinical consequence of diet-induced acidosis
- Not a “passive process” as previously thought
- Rather, active resorption by osteoclasts; H^+ is the trigger
- Acidosis also inhibits mineral deposition by osteoblasts



Arnett TR. Extracellular pH regulates bone cell function. J Nutr. 2008 Feb;138(2):415S-418S.

Does protein make you "acidic" and therefore more prone to bone loss?

- Recent epidemiological, isotopic and meta-analysis studies suggest that dietary protein works synergistically with calcium to improve calcium retention and bone metabolism. The recommendation to intentionally restrict dietary protein to improve bone health is unwarranted, and potentially even dangerous to those individuals who consume inadequate protein.

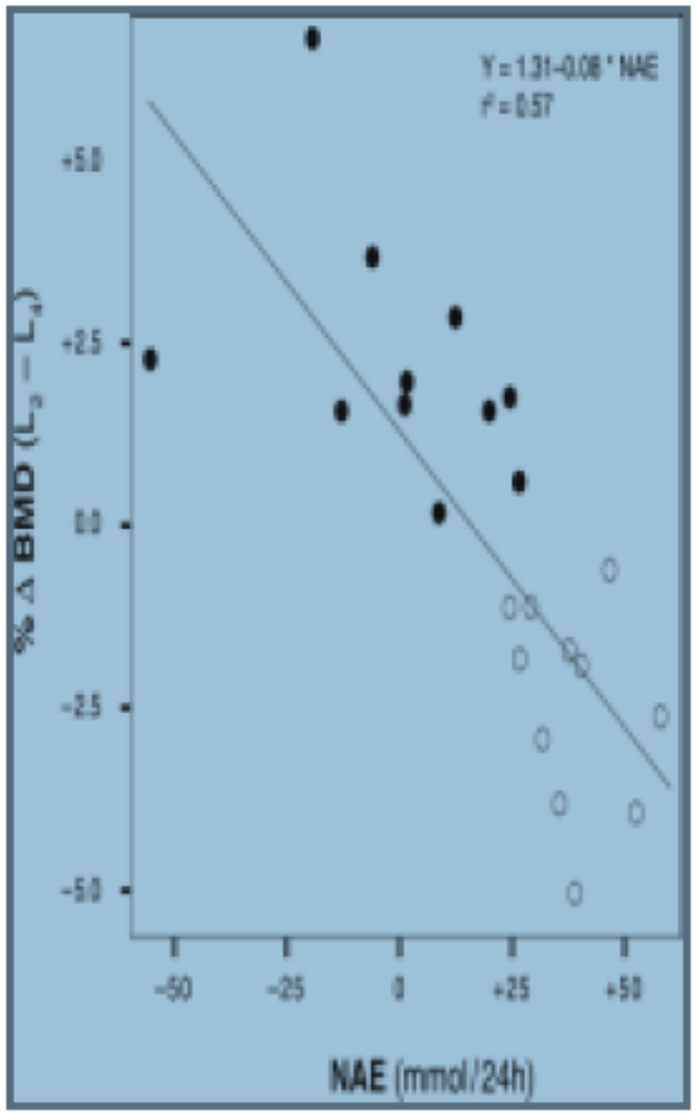
- Kerstetter, J. E., Kenny, A. M., & Insogna, K. L. (2011). Dietary protein and skeletal health: a review of recent human research. Current opinion in lipidology, 22(1), 16-20. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4659357/pdf/nihms-735357.pdf 2006:

Potassium citrate

- 60-99 mg/day of **potassium citrate** enhanced femoral neck and lumbar L2-L4 bone mass in post-menopausal women with osteopenia. Potassium *chloride* did not have the same effect. The potassium citrate group showed significantly lowered urinary calcium excretion as well.

Bone – Prospective Trials

- Randomized, prospective, controlled, double-blind trial
- 161 postmenopausal women (age 58.6 +/- 4.8 yr), received 30 mEq of oral potassium (K) citrate (Kcitrate) or 30 mEq of K chloride (KCl) daily.
- Compared with the women who received KCl, women who received Kcitrate exhibited an intergroup increase in BMD of 1.87 ± 0.50% at L2 through L4 ($P < 0.001$), of 1.39 ± 0.48% ($P < 0.001$) at femoral neck, and of 1.98 ± 0.51% ($P < 0.001$) at total hip
- "Magnitude of the effect is large, and the safety profile was found to be excellent"
- Conclusion: "Bone mass can be increased significantly in postmenopausal women with osteopenia by increasing their daily alkali intake as Kcitrate and that this effect is independent of reported in vitro skeletal effects of co-administered K"



Jehle 2006

Jehle S, et al. (2006) Partial neutralization of the acidogenic Western diet with potassium citrate increases bone mass in postmenopausal women with osteopenia. J Am Soc Nephrol 17, 3213–3222.

Potassium bicarbonate

- Lots of data on the benefits of potassium bicarb in building bone:
- Has been shown to neutralize endogenous acids in the body.
- Reduces bone resorption and enhances bone formation.
- Reduces N-telopeptide excretion=less bone turnover, reduces urinary calcium excretion.
- Use of potassium bicarb in postmenopausal women led to significant increases in osteocalcin. Osteocalcin is secreted solely by the osteoBlasts and is used as a marker of bone formation.
- Bicarb is found in a plant-based diet as it is produced from the potassium anions in the plants. EAT YOUR VEGGIES!
- Can also be supplemented but should be taken AWAY from food so it does not neutralize stomach acids during digestion.

Bicarbonate but not potassium *chloride* reduced bone turnover.

J Clin Endocrinol Metab. 2009 Jan;94(1):96-102. doi: 10.1210/jc.2008-1662. Epub 2008 Oct 21.

Treatment with potassium bicarbonate lowers calcium excretion and bone resorption in older men and women.

Dawson-Hughes B[1], Harris SS, Palermo NJ, Castaneda-Sceppa C, Rasmussen HM, Dallal GE.

⊕ Author information

Abstract

CONTEXT: Bicarbonate has been implicated in bone health in older subjects on acid-producing diets in short-term studies.

OBJECTIVE: The objective of this study was to determine the effects of potassium bicarbonate and its components on changes in bone resorption and calcium excretion over 3 months in older men and women.

DESIGN, PARTICIPANTS, AND INTERVENTION: In this double-blind, controlled trial, 171 men and women age 50 and older were randomized to receive placebo or 67.5 mmol/d of potassium bicarbonate, sodium bicarbonate, or potassium chloride for 3 months. All subjects received calcium (600 mg of calcium as triphosphate) and 525 IU of vitamin D(3) daily.

MAIN OUTCOME MEASURES: Twenty-four-hour urinary N-telopeptide and calcium were measured at entry and after 3 months. Changes in these measures were compared across treatment groups in the 162 participants included in the analyses.

RESULTS: Bicarbonate affected the study outcomes, whereas potassium did not; the two bicarbonate groups and the two no bicarbonate groups were therefore combined. Subjects taking bicarbonate had significant reductions in urinary N-telopeptide and calcium excretion, when compared with subjects taking no bicarbonate (both before and after adjustment for baseline laboratory value, sex, and changes in urinary sodium and potassium; $P = 0.001$ for both, adjusted). Potassium supplementation did not significantly affect N-telopeptide or calcium excretion.

CONCLUSIONS: Bicarbonate, but not potassium, had a favorable effect on bone resorption and calcium excretion. This suggests that increasing the alkali content of the diet may attenuate bone loss in healthy older adults.

Potassium references

J Am Soc Nephrol. 2006 Nov;17(11):3213-22. Epub 2006 Oct 11.

Partial neutralization of the acidogenic Western diet with potassium citrate increases bone mass in postmenopausal women with osteopenia.

Jehle S[1], Zanetti A, Muser J, Hulter HN, Krapf R.

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Kidney Int. 1989 Feb;35(2):688-95.

Potassium bicarbonate, but not sodium bicarbonate, reduces urinary calcium excretion and improves calcium balance in healthy men.

Lemann J Jr[1], Gray RW, Pleuss JA.

J Clin Endocrinol Metab. 2002 May;87(5):2008-12.

Potassium citrate prevents increased urine calcium excretion and bone resorption induced by a high sodium chloride diet.

Sellmeyer DE[1], Schloetter M, Sebastian A.

Salt and Alkalinity

- Sadly , it seems that NaCl (ie, table salt) is one of the biggest culprits in cellular acidosis.
- A typical modern diet shows salt intake far above evolutionary norms and potassium far below.
- Diets that contain high sodium are net-acid producing.

Am J Physiol Renal Physiol. 2007 Aug;293(2):F521-5. Epub 2007 May 23.

Dietary sodium chloride intake independently predicts the degree of hyperchloremic metabolic acidosis in healthy humans consuming a net acid-producing diet.

Frassetto LA[1], Morris RC Jr, Sebastian A.

- The NaCl load predicts the metabolic acidosis level.

Careful with alkalinizing supplements if you have:

- Congestive heart failure
- COPD
- Kidney failure
- or are on diuretics

Bone-specific Adaptogens: “Yang” Support

Rhapunticum carthamoides

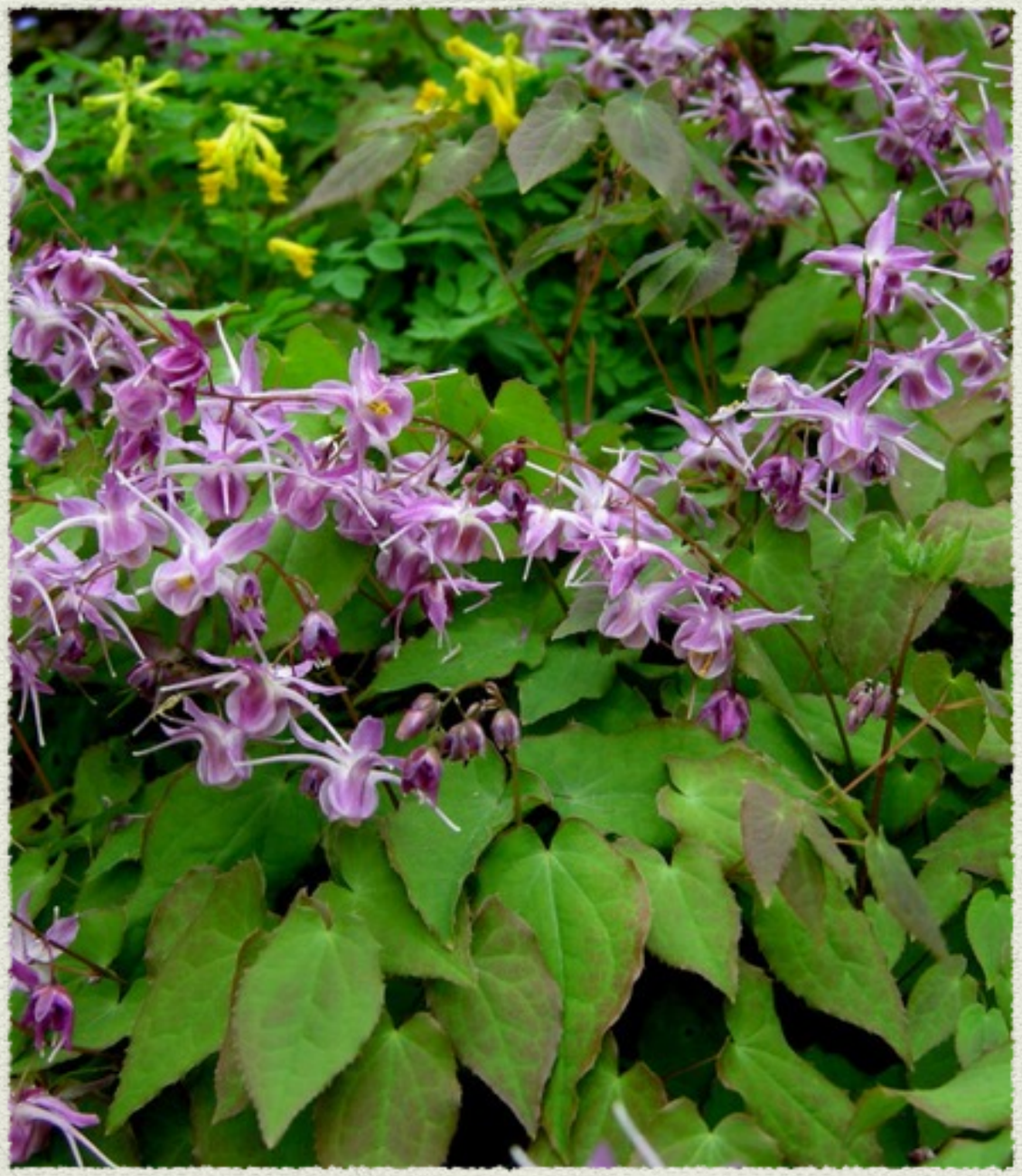
- Probably the strongest herb at increasing stamina and strength. Great after a big illness or a big output of energy …#1 rebuilder
- A bit "pushy" whereas people can feel a bit more wired
- The ecdysterones stimulate protein synthesis in the liver-> stimulates muscle-building and rebuilding in general, protective against muscle loss of aging
- Contains flavonoids that combat post-menopausal bone loss
- Regenerates osteoblast formation
- Shortens the recovery period after exercise and increase exercise capability

Cissus quadrangularis

- Traditionally used in India to treat bone inflammation and bone loss
- Shown in studies with ovariectimized mice to maintain bone density even in the absence of estrogen.
- Increases both cortical and trabecular bone density

Epimedium

- A Kidney yang tonic, meaning it works on the neuroendocrine system in an energizing way, very anabolic, normalizes the HPA axis.
- Balances endocrine health, enhances androgens while preventing PrCA.
- Increases peripheral dilation via nitric oxide production
- Builds bones independent of serum calcium levels (ie, does not increase calcium)



Epimedium studies

Bone. 2009 Sep;45(3):534-44. doi: 10.1016/j.bone.2009.05.022. Epub 2009 Jun 6.

Epimedium-derived flavonoids promote osteoblastogenesis and suppress adipogenesis in bone marrow stromal cells while exerting an anabolic effect on osteoporotic bone.

Peng S[1], Zhang G, He Y, Wang X, Leung P, Leung K, Qin L.

Phytomedicine. 2010 May;17(6):414-23. doi: 10.1016/j.phymed.2009.08.007. Epub 2009 Sep 10.

Icariin isolated from Epimedium pubescens regulates osteoblasts anabolism through BMP-2, SMAD4, and Cbfa1 expression.

Hsieh TP[1], Sheu SY, Sun JS, Chen MH, Liu MH.

Menopause. 2016 Oct;23(10):1152-7. doi: 10.1097/GME.0000000000000673.

Bone mass improved effect of icariin for postmenopausal osteoporosis in ovariectomy-induced rats: a meta-analysis and systematic review.

Xu JH[1], Yao M, Ye J, Wang GD, Wang J, Cui XJ, Mo W.

Mumie
“Russian mountain rock juice”

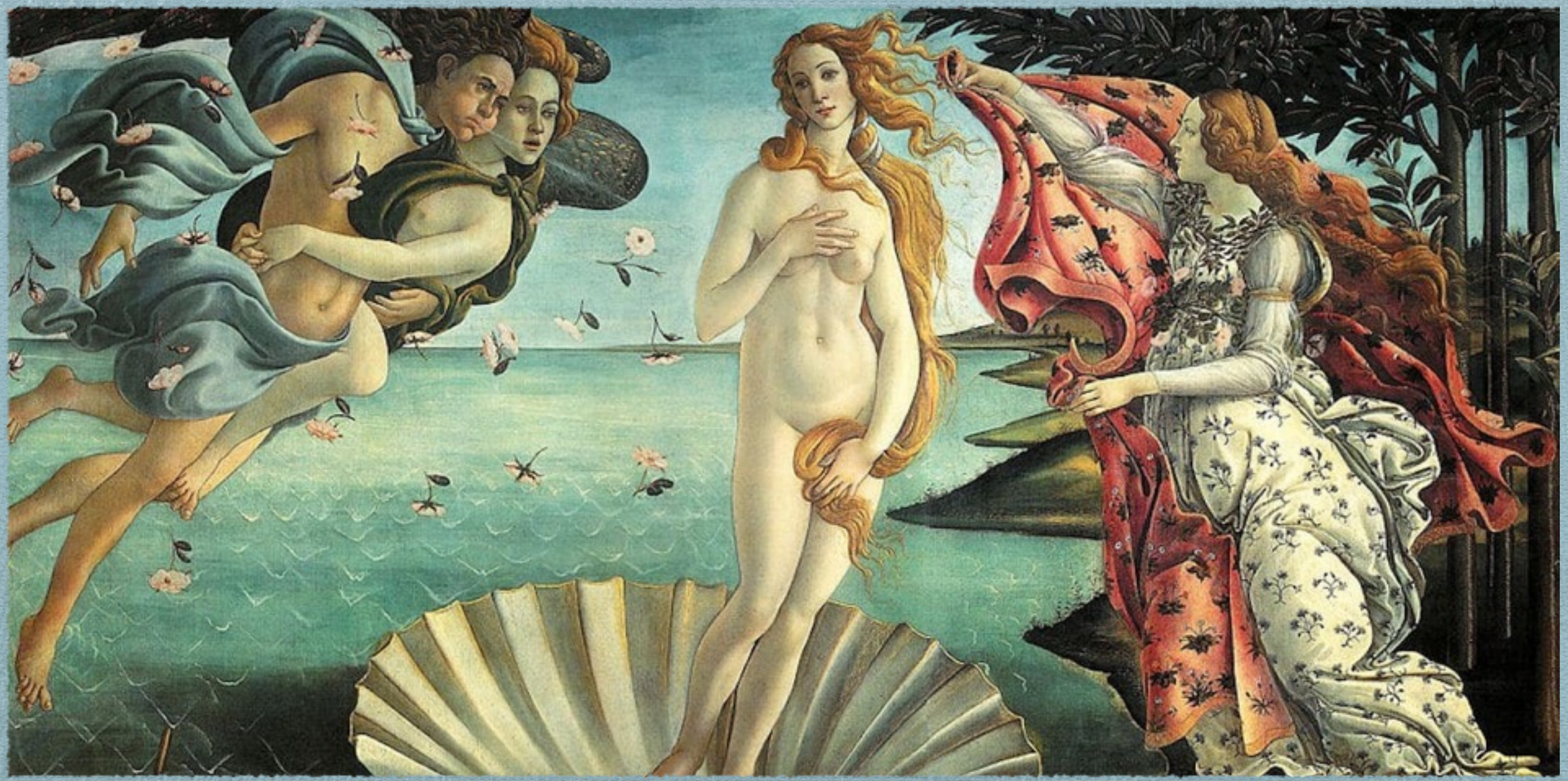
- Nobody knows quite what it is…grows at 10,000+ feet and the tar exudes from the rocks.
- Has the most research of herbs in bone-generating effects. Increases osteoblasts
- Super anabolic, accelerates healing throughout the body. Donnie calls it “The Strongest Anabolic in the World”
- Anti-stress, anti-cancer, enhances cognitive abilities
- shortens recovery time in athletes, decreases joint soreness

Eucommia

- Another great Chinese herb for bones and ligaments.
- Is the lead-herb in the most-prescribed formula in China for osteoporosis
- Prevents post-menopausal osteoporosis as well as osteoporosis from disuse, Coryceps also helps with this.

What about just taking some testosterone?

- Testosterone certainly supports bone maintenance along with estrogens.
- 800 men went on a 1 year trial where 1/2 used testosterone gel and 1/2 had a placebo.
- Initially serum levels in the testosterone group jumped up and so did libido and energy.
- By the end of the study each group was exactly the same.
- Overall, data is still very contradictory but there is a justified concern about increased CV events in men on T replacement: Narrower arteries, more plaque, and more CV events.



Bone-Specific Adaptogens
The Yin-side

What about estrogen and estrogen-replacement?

- Estrogen promotes the formation of osteoblasts
- It also down-regulates the pro-inflammatory cytokines TNF-alpha, Interleukin-6, IL-1, and Macrophage Colony Stimulating Factor.
- Estrogen also up-regulates TGF-beta, which suppresses bone breakdown
- The American Menopause Society states: “For women who initiate HT more than 10 years from menopause onset or are aged 60 years or older, the benefit-risk ratio appears less favorable because of the greater absolute risks of coronary heart disease, stroke, venous thromboembolism, and dementia.”
- Is that worth it? I think herbs and foods work really beautifully in menopause, while reducing cancer and osteoporosis risk.

Rehmannia
Chinese Foxglove

- Considered a Kidney yin tonifier in Chinese medicine with a long history of nourishing joints and bones.
- Increases bone mineral density without affecting estrogen levels
- Inhibits the inflammatory cytokines IL-1 and TNF-a to stop bone breakdown
- Blood-building and moistening

Actea racemosa
Black cohosh

- Very moistening and supportive to mucosal tissue
- In a study with 62 women over 12 weeks it showed similar efficacy on bone turnover as conjugated estrogens, but without the estrogen effects on the uterus or breasts.

Isoflavones:
Soy, kudzu, and red clover

- Traditional soy foods high in isoflavones have been shown to be almost as bone-protective as HRT, but without the health risks: tempeh and miso are best. I do not supplement with capsules of isoflavones but one can.
- They act as both SERMs (Selective Estrogen Receptor Modulators, which is the same category as the anti-breast cancer drug Tamoxifen), and also phytoestrogens.
- Can reduce ischemic heart disease, lower LDL, improve endothelial function to modulate vascular disease.
- Kudzu is another isoflavone-containing plant shown to significantly increase BMD and calcium levels in bone. Protects against cartilage degradation. Also demonstrates a positive effect on metabolic health, gently supporting abdominal weight loss. Mix a tsp of kudzu powder into your smoothie.
- Red clover is a lovely old naturopathic herb known as an alterative or a “blood cleanser”. Also great with a dry, irritable cough. It has been shown to stop bone turnover, enhance BMD, and modulate abdominal adiposity. Even stronger when combined with pomegranate, soy, and an alkaline supplement. Beautiful as a tea with other mineral rich herbs and dandelion root.

SEAWEEDS!

- Moistening and mineral-dense
- Many brown seaweeds contain fucoidans which are polysaccharides shown to inhibit bone turnover and strengthen the femoral bone

Other foods you might not think of:

- Sesame seeds are very high in calcium
- Whey protein, colostrum, and lactoferrin
- Prunes contain boron which is a great mineral for building bones
- Fatty fish…the EPA and DHA work to maintain bone density.

THANK YOU to my TEACHERS

- Donnie Yance CN, MH (AHG) for his help understanding the dynamism of the body and importance of foundational anabolic support.
- Joesph Pizzorno ND for his information regarding alkalinity and bone health.

THANK YOU for coming!