No Bones About it:
Novel Strategies to Prevent and Treat Osteopenia and Osteoporosis Using Genomics

Susan Allen-Evenson, RDN, LDN, CCN

This webinar will be recorded and available. A copy of the slides and CEU will be emailed to you after the event.

Contact the Academy’s membership team at Phone: 312/899-0040 (ext. 5000) or email membership@eatright.org to join.


Community Leader: Manjushree Karkare MS RDN LDN CLT FAND
Communications Coordinator: Aarti Batavia RDN CLT FSCP IFMCP
Public Policy Leader and Reimbursement Representative: Rita K Batheja MS RDN CDN FAND
No Bones About it:
Novel Strategies to Prevent and Treat Osteopenia and Osteoporosis Using Genomics

Susan Allen-Evenson, RDN, LDN, CCN
AIND: May 16, 2017
Objectives:

1. Identify Genomic single nucleotide polymorphisms (SNPs) indicated in bone health
2. Examine key assessment parameters that help identify epigenetic expression of SNPs.
3. Explore diet, nutritional supplement and lifestyle support to influence gene expression and overcome genomic weaknesses.
World-wide Statistics

- ~30% of women and 20% of men over 50 suffer from osteoporosis or osteoporotic fractures.
- Worldwide, osteoporosis causes >8.9 million fractures annually, resulting in an osteoporotic fracture every 3 seconds.
- Osteoporosis is estimated to affect 200 million women worldwide.
- Osteoporotic fractures are not only associated with increased mortality in both sexes, but are also responsible for about 1% of the worldwide disability caused by prevalent noncommunicable diseases.

NHANES: 10.2 million adults (8.2/women and 2.0/men) had osteoporosis and 43.4 million (27.3/women and 16.1/men) had low bone mass in 2010.

Dietitians Have a Golden Opportunity!

• Recent trend in healthcare moving in the direction away from disease-centric to the whole-person approach

• Nutrition is a key component in the newly emerging "Functional Medicine" health model that goes under the diagnosis to look at the root causes, or the set of circumstances that allows the progression of ill health to move into a disease state.
Heart Disease

Cancer

Allergies

Anxiety

Depression

Thyroid Issues

Hormone Imbalances

Diabetes

Chronic Fatigue

Inflammation

Poor Digestion

Stress

Genetics

Poor Diet

Trauma

Toxins

Toxic Thoughts

Lack of Sleep

Lack of Exercise

Poor Relationships

Nutrient Deficiencies

The Living Proof Institute | “ADD MORE LIVE TO YOUR LIFE”™

©2017 COPYRIGHT. ALL RIGHTS RESERVED
Going Beyond the Conventional

By harnessing the power of a deeper assessment (including genomics), food as medicine, and dietary supplements as indicated, the RDN has a unique and vital role much beyond what is taught conventionally.
Human Genome Project: Genes, SNPs and Impaired Protein Function

• Genes have plasticity
• Gene expression can be up or down regulated
• Cell replication creates many opportunities for gene errors:
  – Gene sequence varies from its usual pattern = polymorphism
  – One nucleotide base pair is substituted for another = single nucleotide polymorphism (SNP)
• can alter function of protein encoded by gene if expressed (Epigenomics)
Nutrigenomics: Gene Variants, Food and Bioactives

• Dietary nutrients and bioactive compounds affect function of genes and proteins (health status)

• Food constituents can mitigate the effects of gene SNPs on biochemical and metabolic pathways in the prevention/treatment of chronic diseases
Bone Health

Should be considered throughout all stages of women’s life (not just menopause) and for men too!
Bone Metabolism

• Bone resorption: removing of mature bone tissues from the skeleton via osteoclast cells

• Bone remodeling - the formation of new bone via the process of ossification (osteogenesis) by osteoblast calls

• Bone health is homeostasis

• Osteoporosis is more resorption vs remodeling
Inflammation and Bone health

• Bone loss is due to direct effects of inflammation, poor nutrition, oxidative stress, reduced lean body mass, hypothyroid, immobility and the effects of treatments, especially glucocorticoids - ultimately mediated through effects on bone remodeling.

• Chronic inflammatory diseases of almost any cause are associated with bone loss.
  — increase bone resorption & decrease bone formation

Genomics & Bone Health

• SNPs Related to Bone Formation
  – COL1A1
  – GSTT1
  – GSTM1
  – CYP2R1
  – DHCR7
  – GC
  – VDRFokl
  – VDRBSml

• SNPs Related to Bone Resorption/Inflammation
  – APOE
  – IL-6
  – IL-6R
  – CYP1A2
  – DIO2
  – MTHFR
  – CRP
  – TNF-alpha
Bone Formation SNPs
Bone Formation COL1A1 (collagen type I alpha)

• Gene encodes for production of collagen 1A1
  – most predominant form of collagen in the body
  – major protein of bone matrix.
• Collagen provides strength and stability and also found in connective tissues, such as ligaments, tendons, and fascia
• SNP associated with decreased functional collagen formation
• May reduce bone mineral density particularly in the spine, increasing risk for osteoporosis and vertebral fractures.
• Impact of SNP with bone loss may not be seen until 6th decade of life.
• May be exacerbated by smoking, low protein and calcium intake.
Diet: Ensure adequate dietary protein, especially containing proline and glycine (collagen forming amino acids); increase intake of foods rich in calcium, vitamin D, including cold water fish. Silica containing foods: leeks, green beans, strawberries, mangoes and cucumbers

Lifestyle: Avoid smoking, excessive caffeine intake, excessive stress, dehydration

Exercise: Regular weight-bearing exercise, strength training.

Supplements: Vitamin D3, calcium, magnesium; hydroxyapatite, choline stabilized orthosilica, strontium citrate, MSM, good-quality multi vitamin-mineral supplying: Vit C, A, E, Cu, Zn, and Mn.

Collagen Cross-linking Markers

• In post-menopausal women, the markers that have been studied the most and also have the strongest negative correlations with BMD are alkaline phosphatase (ALP), osteocalcin (OC), type 1 cross-linked C-telopeptide (CTx), and type 1 cross-linked N-telopeptide (NTx).

• Mostly used in research and perhaps more in functional medicine (may not be covered well by insurances)

Collagen Crosslinks and Biochemical Markers of Bone Turnover. UnitedHealthcare Commercial Medical Policy Effective 03/01/2017 PDF
Updated: Jan 12, 2017 (Accessed 5/15/17)
Bone Formation GSTT1 & GSTM1 (Glutathione S-Transferase theta 1 & Mu 1)

- A member of a superfamily of proteins that catalyze the conjugation of reduced glutathione to a variety of electrophilic and hydrophobic compounds. GST enzymes have broad detoxifying abilities against carcinogens, drugs, or other toxins (oxidative stress).
- Due to the lack of functional GSTT1 and/or GSTM1, the null phenotype is unable to efficiently perform the conjugation reaction (biotransformation) and the subsequent elimination of toxic products via urine and bile.
- Absence of gene and therefore enzymatic activity associated with decreased bone mineral density
- Associations for Caucasians only.
GSTT1 and GSTM1

- **Diet**: increase intake of foods rich in antioxidants, cruciferous vegetables (broccoli, kale, Brussels sprouts, radish sprouts), onions, leeks, garlic.
- **Lifestyle**: minimize exposure to heavy metals, and other toxins
- **Supplements**: Antioxidants including Vitamins A, C, E; green tea extract; N-Acetyl-Cysteine (NAC), selenomethionine (active selenium), milk thistle.
- **Biomarker**: Bone mineral density, collagen cross-linking markers, C-telopeptide.
SNPS FOR Vitamin D

CYP2R1
DHCR7
GC
VDRFokl
VDRBSml
At Risk for Deficiency

• Absorption issues
  • Low fat diets/malabsorption
  • Older individuals
  • Celiac or other mucosal damage issues
  • Taking supplements without food (fat containing)

• Vit D receptor issues and SNPs for Vit D metabolism
Vitamin D: Sources and Products

Use if Gut, Liver, & Kidneys are all healthy

Sun/UVB

Supplement

Food

Vitamin D3

Skin

Gut

Topical D3

Sublingual D3

Oral D3

Fatty fish

Fortified food

Gut friendly D3

CALCIFEROL in Blood

Calcidiol

Liver

Gut

Calcitriol

Kidneys

Cells

25(OH)D = CALCIDIOL in Blood (blood test)

1,25(OH)₂D = CALCITRIOL in Blood

Fat storage

breast milk

urine

placenta

Use if GUT not healthy or poor compliance

Use if LIVER not healthy

Use if KIDNEYS not healthy

Injection

Injection

Injection
Adapted from: Nature Reviews Endocrinology 10, 175–186 (2014) doi:10.1038/nrendo.2013.262
<table>
<thead>
<tr>
<th>Gene</th>
<th>Protein Encoded by Gene</th>
<th>Biochemical Pathway</th>
<th>Metabolic Consequence of Gene SNP</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHCR7</td>
<td>7-dehydrocholesterol reductase</td>
<td>Conversion of Cholesterol to Cholecalciferol (Skin)</td>
<td>Reduced enzyme activity</td>
</tr>
<tr>
<td>CYP2R1</td>
<td>Vitamin D 25-hydrolase</td>
<td>Cholecalciferol to 25-OH Vit D (Liver)</td>
<td>Reduced enzyme activity</td>
</tr>
<tr>
<td>GC</td>
<td>Vitamin D Binding Protein</td>
<td>Carrier Protein (Liver) (Kidney)</td>
<td>Functionality of transport protein impaired</td>
</tr>
<tr>
<td>VDR</td>
<td>Vitamin D Receptors Bsm1 RRLP Fok1 Taq1</td>
<td>Inside nucleus RXR (Vitamin A) Vit D Response Element</td>
<td>Functionality of receptor site impaired</td>
</tr>
</tbody>
</table>

Note: if bone related SNPs like COL1A1 (Collagen-1-alpha-1) are expressing, there may decreased bone mineral density and increased fracture risk
Bone Formation DHCR7
(7-Dehydrocholesterol Reductase)

• Gene encodes for an enzyme that converts 7-dihydrocholesterol to cholecalciferol in response to UV radiation (sunlight).

• Associated with decreased enzyme activity and decreased production of vitamin D from sunlight, with increased risk of vitamin D deficiency, lower bone mineral density, and higher risk for osteoporosis and fractures.
Bone Formation CYP2R1 (cytochrome P450 family 2 subfamily R member 1)

- Gene encodes for an enzyme involved in vitamin D metabolism, converting vitamin D3 to 25-OH D3, the major circulating form of vitamin D.
- Associated with decreased enzymatic function, and increased risk of vitamin D deficiency, lower bone mineral density, and higher risk for osteoporosis and fractures.
Bone Formation GC
(Vitamin D-binding protein)

• Gene encodes for a multifunctional transport protein that binds to vitamin D metabolites, and helps regulate the amount of free vitamin D available to cells.
• Plays a role in immune function and inflammatory response, binding of fatty acids, and bone development independent of vitamin D.
• Associated with decreased ability to bind with vitamin D metabolites, with increased risk for vitamin D deficiency and osteoporosis. May also have suboptimal response to vitamin D3 supplementation.
Bone Formation Vit D SNPs

• **Diet:** Increase intake of foods rich in Vitamin D, including cold water fish.

• **Lifestyle:** Balance potential benefits of sun exposure for increased vitamin D production versus risks of skin damage.

• **Exercise:** Regular weight bearing exercise, strength training.

• **Supplements:** Vitamin D3

• **Biomarker:** 25-OH Vitamin D3, 1,25-OH2 Vitamin D3
Bone Formation VDR Bsml and VDR FokI (Vitamin D Receptors)

- Genes encode for several receptors for 1,25OH2 Vitamin D3, which is an important hormone involved in many different systems including immune, glucose regulation, and bone health.
- Associated with decreased receptor function, which may lead to lower uptake of vitamin D into cells and functional vitamin D deficiency, lower calcium levels, and increased risk of lower bone mass and osteoporosis, especially when calcium intake is low.
VDR BsmI & VDR FokI

- **Diet**: Increase intake of foods rich in calcium and Vitamin D, including cold water fish.
- **Lifestyle**: Balance potential benefit of increased sun exposure for vitamin D production with potential risk of skin damage from ultraviolet light.
- **Exercise**: Regular weight bearing exercise, strength training.
- **Supplements**: Vitamin D, K2, calcium, magnesium.
- **Biomarker**: 25-OH Vitamin D3, 1,25-OH2 Vitamin D3, bone mineral density, collagen cross-linking markers, C-telopeptide.
Vit D 3 Labs

• D3 depends on lab values (not season!)
  – Off supplements for 1 week prior.
  – Labs drawn fasting

• Lab may be normal but conversion to active may be suboptimal with CG SNP affecting kidney (check 1,25 OH)

• Lab may be normal but utilization suboptimal with receptor SNPs. Look at alternative markers and associated signs/symptoms
Supplementing with Vitamin D

• Dosing
  • Less than 400 IU/day is ineffective
  • Routine to need 2,000 to 5,000 IU per day to maintain adequate blood level (children 800-2,000)
  • D2 Rx 50,000 per week for 6 weeks (not as effective)
  • Re-evaluate labs periodically
Vitamin D Supplementation

• If any gut problems of malabsorption, dysbiosis, hx gall bladder removal – maybe best to use an emulsified form not so dependent on adequate bile and absorption chemistry.

• Be sure Calcium is adequate before higher dose D
  Consider Vit K2 status: supplement?

• Vit D and Vit A use some same receptor sites – monitor both if supplementing
Toxicity of Vit D Supplements:

- Nausea
- Vomiting
- Poor appetite
- Constipation
- Weakness
- Weight loss
- Tingling sensations in the mouth
- Confusion
- Heart rhythm abnormalities
Bone Resorption SNPs
Bone Resorption/Inflammation

CYP1A2

• Gene encodes for CYP1A2, a cytochrome P450 enzyme that metabolizes caffeine, along with other substances and drugs.

• Associated with decreased bone density with caffeine consumption.

• **Recommended Action Steps**
  
  – **Diet:** Minimize intake of caffeinated foods and beverages.

  – **Biomarker:** Bone mineral density, collagen cross-linking markers, C-telopeptide.
MTHFR: Methylenetetrahydrofolate reductase

- **MTHFR-1**: Associated with decreased enzymatic activity, which may lead to decreased levels of 5MTHF (active form) and elevated homocysteine.
  - Exacerbated by low folate intake.
- Can manifests in increased homocysteine levels; associated with lower bone density of femoral neck in postmenopausal women.
Methylation

• Major pathway that produces methyl groups involved in numerous metabolic pathways, DNA repair and epigenetic DNA modification.

• Global methylation patterns of genes are highly associated with BMD in postmenopausal women
  – Major signaling pathways in osteoblasts affected by DNA methylation
  – DNA methylation affects osteoclast activity

• **Recommended Action Steps**
  
  – **Diet:** Increase intake of folate and B-complex rich foods.
  
  – **Supplements:** folic acid or 5-L-methylfolate
  
  – **Biomarker:** Folate, homocysteine, bone mineral density.

Folate

• Plays a role in
  – Osteoporosis
    • independent of homocysteine
  – Homocysteine and B12 metabolism
    • tHcy is negatively associated with BMD of the total femur, but studies are mixed

Folate Drug Interactions:

• Anticonvulsants interfere with folic acid absorption
  – Correction of folate deficiency with large doses of folic acid may decrease blood levels of anti-convulsants

• Methotrexate is a folate antagonist.
  – Folic acid reduces the toxicity of methotrexate in the use with rheumatoid arthritis

• Metformin associated with decreased folate (and B12)
Biomarkers

- Only test available is folic acid, not 5 methyl
- High serum may be showing problem getting intracellular
- Best to test RBC folate blood level preferred
  - But, we still don’t know methylated amount
    - still need MTHFR status
Red Cell Distribution Width (RDW)

• Increased in B12 anemia, iron and folic acid anemia
  – Related MCV, MCH, MCHC to determine anemia
  – Related iron markers to determine anemia
  – Related to Homocysteine levels
  – Related SNPs (MYR, MTRR, FUT2, MMAB, TCN2
Folic Acid Food Sources

- Dark Leafy Greens
- Beans, Peas, and Lentils
- Asparagus
- Broccoli
- Avocado
- Citrus Fruits
- Okra
- Brussels Sprout
- Seeds and Nuts
Folate Deficiency

- Absorption seems to be enhanced by gastric HCl
- Absorption of food derived folate is about ½ that of folic acid
Folate

• RDA adults 400mcg
• Folic acid is the synthetic version in supplements
  – Supplements typically 400-800mcg
• Biologically active supplement forms
  – 5 methyltetrahydrofolate
  – 5,10 methylenetetrahydrofolate
Toxicity of Folic Acid

- Supplementation can mask a vitamin B12 deficiency.
- Folic acid supplementation may increase vitamin B12 requirements and aggravate the neurological symptoms of vitamin B12 deficiency.
- Be alert of the possibility of B12 deficiency symptoms in patients receiving folic acid supplements, even in the absence of labmarkers.
Methylfolate Side Effects

- Irritability
- Insomnia
- Sore muscles
- Achy joints
- Acne
- Rash
- Severe anxiety
- Palpitations
- Nausea
- Headaches
- Migraines

Reason to start with lowest amount and increase slowly.

Alternative is to start with folinic acid or a combination, especially if SHMT (Serine hydroxymethylmethyltransferase) mutations that affect the transport of methylfolate into the folate cycle.

— SHMT is B6 (P5P) dependent
Gene encodes for a pleiotropic cytokine, which activates cell signaling when bound to IL6R. It is involved in the inflammatory response, regulation of CRP, and bone health.

Associated with increased risk of higher bone turnover, lower bone density and osteoporosis at femoral neck.

IL-6

• **Diet**: Anti-inflammatory; increase intake of turmeric, and foods rich in omega 3 fatty acids.

• **Lifestyle**: Stress management, adequate sleep.

• **Exercise**: Regular weight-bearing exercise, strength training. **Supplements**: Anti-inflammatory; EPA/DHA, curcumin.

• **Biomarker**: IL-6, bone mineral density, collagen cross-linking markers, C-telopeptide. Monitor EFA balance.
Bone Resorption/Inflammation IL-6R

• Gene encodes for IL6 receptor, which binds IL6 as part of the inflammatory response, and is also involved in signaling to various T cells and monocytes.

• Associated with increased levels of soluble IL6R, circulating IL6, and decreased CRP. Increases immune response associated with soluble IL6R complex; in osteoblasts, only the soluble form can transmit IL6 signaling. A SNP here may increase the risk of lower bone density.
**Diet:** Increase intake of colorful fruits and vegetables, foods rich in omega 3, turmeric; limit intake of sugars and simple carbohydrates.

**Lifestyle:** Stress management, adequate sleep.

**Exercise:** Regular aerobic exercise.

**Supplements:** Curcumin, EPA/DHA.

**Biomarker:** Bone mineral density, collagen cross-linking markers, C-telopeptide.
Bone Resorption/Inflammation APOE (Apolipoprotein E)

• Mediates metabolism of cholesterol and triglycerides by clearing chylomicrons and VLDL, is responsible for cholesterol and lipid transport, as well as modulation of cell signaling, oxidation, and enzyme activation, and exists as several different variants: E2, E3, and E4.

• E4 associated with reduced fat soluble vitamin absorption

• E2 associated with increased risk of higher bone turnover and resorption. May have increased risk of vertebral fracture.

APOE

- **Diet**: Minimize intake of saturated fats, simple carbohydrates and sugars. Increase intake of turmeric, colorful fruits and vegetables, and foods rich in omega 3 essentials fatty acids
- **Supplements**: EPA/DHA, curcumin, possibly Vit D, K2, A
- **Biomarker**: ApoE, bone mineral density, collagen cross-linking markers, C-telopeptide. Check fat soluble vitamin status. Monitor EFA balance.
Bone Resorption/Inflammation CRP (C-Reactive Protein)

• Gene encodes for this protein produced in the liver that is involved in the inflammatory response.

• Associated with increased activity and higher levels of CRP, which may increase osteoclastic activity and result in lower bone mineral density and higher risk of osteoporosis.
CRP

• **Diet**: Anti-inflammatory diet. Increase intake of foods rich in omega 3 fatty acids, quercetin & turmeric.
• **Lifestyle**: Stress management, adequate sleep.
• **Exercise**: Regular aerobic exercise.
• **Supplements**: EPA/DHA, curcumin, quercetin.
• **Biomarker**: hsCRP, bone mineral density, collagen cross-linking markers, C-telopeptide. Monitor EFA balance.
Bone Resorption/Inflammation
DIO2 (Iodothyronine Deiodinase 2)

• Gene encodes for an iodothyronine deiodinase enzyme that converts thyroxine (T4) to the bioactive 3,3',5-triiodothyronine (T3). It also has cell signaling functions independent of T3.

• Associated with increased enzyme activity in cartilage, and increased risk of osteoarthritis. Independent of T3. May be exacerbated by inadequate methylation (see folate/homocysteine genes).
DIO2

• **Diet**: Anti-inflammatory diet; Increase intake of foods rich in omega 3 & turmeric.
• **Lifestyle**: Stress management
• **Supplements**: EPA/DHA, curcumin
• **Biomarkers**: TSH, FT3, FT4; possible rT3, Se and Zn. Monitor EFA balance.
Bone Resorption/Inflammation
TNF-alpha (Tumor Necrosis Factor)

• Gene encodes for tumor necrosis factor alpha, a pro-inflammatory cytokine secreted by macrophages, adipocytes, and plays a role in inflammation, cell proliferation, differentiation and apoptosis; it also modulates NF-kB through ROS production.
TNF-Alpha

- **Diet**: Anti-inflammatory diet. Increase intake of foods rich in omega 3 fatty acids, quercetin & turmeric.
- **Lifestyle**: Stress management, adequate sleep, control weight.
- **Exercise**: Regular aerobic exercise.
- **Supplements**: EPA/DHA, curcumin, quercetin.
- **Biomarker**: TNF-a, bone mineral density, collagen cross-linking markers, C-telopeptide. Monitor EFA balance.
Turmeric/Curcumin

- Curcuminoids are turmeric’s principal bioactive ingredients
  - Anti-inflammatory
  - Bone as an antioxidant reduces oxidative stress and raises the level of antioxidant enzymes which favorably impact bone health
- Curcumin (Meriva) has dose dependent effects on bone cells. Research has found that curcumin can affect the activity of...
  - Osteoblasts, Osteoclasts & Chondrocytes: cells that make up cartilage
- Dose: Average 1,000 mg Meriva (root extract and phospholipid complex) providing 200 mg curcumin per day

Golden Paste

• 1 teaspoon of good quality turmeric powder with a pinch of black pepper and/or fats is helpful. The best ways to take turmeric are Golden Paste and Turmeric Milk
• 1/2 cup turmeric powder (125 mls)
• 1 cup water (250 mls)
• 1/2 cup water extra, if needed (125 mls)
• 1 1/2 teaspoons ground black pepper (7.5 mls) Piperine present in black pepper helps in turmeric’s absorption.
• 70 ml cold pressed Olive or Coconut oil – Adding fats is another way to increase the absorption of turmeric in body. Chose healthy oils such as virgin coconut to virgin olive oil.
Turmeric Milk

• To make the organic golden turmeric milk, take a teaspoon of the turmeric paste and combine with a cup of organic milk. The milk can be soy, goat, cow, coconut, almond or any other milk of choice. Let this mixture boil well.

• Take off the stove and add some honey or maple syrup to taste. To this add ½ teaspoon of organic sesame or almond oil or ghee (clarified butter). Turmeric milk is ready to enjoy.
Calcium & Other Bone Health Support

• Of the estimated 10.2 million Americans with osteoporosis, about 80% are women
• Importance of pre-menopausal bone density; the greater your bone density is to begin with, the lower your chance of developing osteoporosis.

Boron

• Important component in bone health
  – Increases osteoblast activity
  – Increases circulating levels of osteocalcin
  – Important biological role in metabolism of other nutrients involved in bone health (Vit D, Ca, P, Mg, Zinc)

• Contraindicated in hormone-sensitive conditions (breast cancer, uterine cancer, ovarian cancer, endometriosis, uterine fibroids), as it may have estrogen-like effects

• Studies have shown boron was found to increase the body's own estrogen levels, especially in women on estrogen-replacement therapy

• Typical Dose: 2.5 – 6 mg/day

Vitamin K2

• Unlike vitamin K1 or synthetic vitamin K2 levels, which rise and fall, natural vitamin K2 has a relatively constant level in the blood leading to superior absorption.

• There have been several clinical studies of natto (MK-7) for bone support.

• Vitamin K2 helps to activate vitamin K-dependent proteins responsible for healthy tissues.
  - In bone, it activates osteocalcin, a protein required to bind calcium to the mineral matrix, thus strengthening the skeleton.
  - In circulation, Vitamin K2 participates in carboxylation of Matrix Gla Protein (MGP), the most potent inhibitor of arterial calcification known, lowering the risk of vascular damage.

• Dose: 90 to 320 mcg/day

Calcium Dosing

• Depends on Calcium in diet
  – Typically, 200-1000mg/day (divided doses with higher amts)
  – Body can’t typically absorb more than about 500-600 mg at once

• Multi’s typically don’t give enough Ca (Mg too)
• Ensure adequate co-nutrients, i.e. magnesium, Vit K2, Vit D, boron
Calcium

• pH balance will impact calcium levels in bone
• Possibility of excess free Calcium (unbound)
• Increased extracellular Ca activates the NLRP3 inflammasome (protein that initiates an inflammatory cascade) leading to pro-inflammatory cytokines IL-1B, IL-18


Calcium Magnesium Relationship

• Over supplementation of Ca can cause decrease Mg tissue levels, increase Mg requirements, and increase severity of Mg deficiency

• Mg may reduce inflammation, just as Ca may increase

Magnesium

• Just as important as calcium

• Chelated forms better absorbed: Glycinate, aspartate, taurate, citrate, malate

• 100 - 400 mg typical dosing (start low and work up)

Drugs that may contribute to/exacerbate osteoporosis

- Aluminum-containing antacids
- Antiseizure medicines (only some) such as Dilantin® or Phenobarbital
- Aromatase inhibitors such as Arimidex®, Aromasin® and Femara®
- Cancer chemotherapeutic drugs
- Cyclosporine A and FK506 (Tacrolimus)
- Gonadotropin releasing hormone (GnRH) such as Lupron® and Zoladex®
- Heparin
- Lithium
- Medroxyprogesterone acetate for contraception (Depo-Provera®)
- Methotrexate
- Proton pump inhibitors (PPIs) such as Nexium®, Prevacid® and Prilosec®
- Selective serotonin reuptake inhibitors (SSRIs) such as Lexapro®, Prozac® and Zoloft®
- Steroids (glucocorticoids) such as cortisone and prednisone
- Tamoxifen® (premenopausal use)
- Thiazolidinediones such as Actos® and Avandia®
- Thyroid hormones in excess
Genomic Testing
Genomic Testing: Where to Begin?

• Evaluate Genomic Testing Companies
  – Criteria Used to Select SNPs
    • Relevant, Prevalent, Modifiable, Measureable (RPMM)
  – Types of Panels
    • Quality (What Panel(s) Best Fits with My Clinical Needs)
    • Quantity (Polygenic versus Monogenic)
  – Reports and Interpretation
    • User-friendly
    • Evidenced-based action steps
    • Biomarkers and Biochemical Pathways

• Clinical Lab or Research Lab
• Customer Service/Educational Webinars
Collecting DNA is Easy

- **Buccal swab**
- **Non-invasive**
- **Convenient**
  - Collect at home
  - Collect at office
- **Appropriate for any age (no age limit)**
- **Only test once**

COLLECT YOUR DNA USING BUCCAL SWAB
Genomic Testing

- **Clinical Labs (Results + clinical interpretation)**
  - Genova DX (5 genomic panels)
  - Genomic Solutions NOW!® (15 + genomic panels)
    - Provides application details
  - Pathway Genomics (12 genetic + genomic panels)
  - My Genes Rx (Pharmacogenomics)
  - GenoMind (Pharmacogenomics)
  - Others – limited results/interpretation, sometimes misleading

- **Research (Raw data, no interpretation, no application info)**
  - 23andme
Prevention

- Stop smoking
- Calcium
- Vitamin D
- Medication
- Preventing Osteoporosis in all Women
- Weight-bearing exercise
- Check your risk factors
- Reduce Alcohol
- Check Genomic SNPS!
New Nutrition Paradigm

• Know your gene SNPs:
  – Nutrient requirements
  – Disease prevention and management
  – Mitigate gene SNPs with appropriate nutrigenomic/lifestyle interventions
To quiet SNP expression in general, strive to:

- Balanced diet with least amount of processed food
  - 5-12 srvgs fruit/veggies a day
  - Keep insulin in check
- Identify and reduce inflammation from all sources
  - Gut health/Microbiome diversity
- Reduce Oxidative stress
  - Toxic burden
  - Remember oil quality/cooking methods
- Exercise, but not too much
- Get enough good quality sleep
- Balance work/play – stress management
- Experience joy and gratitude everyday!
Summary

- Trends are fast emerging toward Functional Medicine model
- Nutrition has a vital role in health and as such, we should always strive for balance
- **Optimizing a person’s health requires an understanding of his/her genotype.**

- Identifying potential for genomic expression that affects bone health is helpful to more efficiently support individual clients using diet, lifestyle and nutritional supplements
RDNs wishing to be on the leading edge of their profession will advance their knowledge in the emerging science of Nutrigenomics and appreciate the related applications they can utilize to provide more personalize clinical support.
• Susan Allen-Evenson, RDN, CCN
• IFMNTRD@gmail.com
• Online training in Integrative and Functional Medical Nutrition Therapy (IFMNT)
• Upcoming webinar series:
  Applied Biochemistry: The Bridge Between Genomic Results and Functional Nutrition Action Steps (May 22\textsuperscript{nd} and 30\textsuperscript{th} 8-9:30 PM ET)
  ➢ Register: http://nextlevelfunctionalnutrition.com/
Additional Resources

• The “Genomic Resources” research group: http://www.genomic-resources.eus/
• Human Ageing Genomic Resources: http://genomics.senescence.info/
• Genomics Solutions Now!: https://genomicsolutionsnow.com/my-library/
• SNPedia: https://www.snpedia.com/
• International Osteoporosis Foundation: https://www.iofbonehealth.org/facts-statistics#category-14
AIND Year-Round Supporters

- ROBIN GENTRY MCGEE'S
  functional formularies®
  let food be thy medicine

- The Metagenics
  Healthcare Institute
  for Clinical Nutrition

- KIBOW® BIOTECH
  Passionate about your health.

- Fullscript™

- Empirical Labs
  Liposomes Perfected

- MEGA sporebiotic

- gaia HERBS
  PROFESSIONAL
  SOLUTIONS
Thank you!!

FREE- eBook 3 on Functional Medicine & Nutritional Genomics--- www.aapiusa.org

Dr. Jeff Bland - Father of Functional Medicine & Kelly Brogan MD, Rita Batheja in NYC @ studio
James Maskell, Cofounder Evomed.com w/ AIND members @ IHSymposium

Alex Lubarsky, CEO Health Media & Ellen Kamhi, RN, Natural Nurse @ NAVEL Expo - Nutrition, Aesthetics, Vitality, Efficacy & Life

AIND members Aarti & Rita @ IFM Nutrition Course in NYC

Rita w/ James Gordon MD, Founder Center for Mind Body Medicine - www.cmbm.org @ Braham Kumaries World Spiritual Org in Greatneck, NY - 5/12/2001
Dr. Oz MD speaker on spiritualism @ HIP insurance co headquarters, Wall Street -NY to MD providers 10/12/2006

Dietitians @ IADA's exhibit booth @ Gujarati Samaj Health Expo, Queens, NY 9/10/1995

IADA annual gathering @ Namaskar Indian rest, NJ w/ 110 Indian dietitians fr 11 states, MD, Pharmacist, Oxford Regional dir & prof fr Baroda -India 5/4/1997

Reimbursement Chair's 1st mtg @ Lowes, FNCE Pa w Nutrition Coverage Team fr academy, 10/7/2012

AIND members Cathy Conway & Rita B w/ Marsha S, Dir Governance, Mary Pat & Jeanne B, DC off staff @ PPW in Washington, DC 4/17/2012

Alice Wimpfheimer, Molly Joshi, President, Indian Dietetic assoc-India, Marsha Sharp- ICDA sec, Bev Bajus - Academy CEO, Rita B @ FNCE Kansas 10/19/1998

1st Diversity show" Beat Diabetes " on dLife TV in NYC w TV Hosts, AIND members Lorena Drago & Rita Batheja 2/17/2005
Thank you!

Contact Rita Batheja for questions about AIND. krbatheja@gmail.com aind.webauthor.com

Visit eatrightpro.org to join the AIND community.

Register for AIND’s Upcoming Webinar: Gut and Cardiometabolic Diseases

Presented by: Liz Lipski, PhD, CCN, CNS, IFMCP, BCHN, LDN

Tuesday, August 8, 2017 1:00 pm eastern http://bit.ly/2mMKPLI
Questions?