If Low Calcium Is Not the Cause of Osteoporosis . . .

What Is?

Rethinking the Nature and Causes of Osteoporosis

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Osteoporosis Statistics

54 million American adults over the age of 50 are affected by osteoporosis and osteopenia:

- **10+ million with osteoporosis**
- **43.4 million with osteopenia**

By 2030:

- **71.2 million is projected**

The real "proof of the pudding" diagnosis of osteoporosis (fragile bones) is the occurrence of a low-trauma fracture.

1 in 2 women and up to 1 in 4 men over age 50 will break a bone due to osteoporosis.

Defining Osteoporosis

Classification	T-score
Normal	-1.00 or greater
Osteopenia	Between -1.00 and -2.50
Osteoporosis	-2.50 or less
Severe/Established Osteoporosis	-2.50 or less and fragility fracture

Bone Mineral Density Does Not Predict Fracture Risk

- The US Study of Osteoporotic Fractures (SOF) looked at 8,065 women 65 and older.
- They reported that only 10 to 44% of osteoporotic fractures occurred in those women with an "osteoporotic bone density."
- European trials report that **only 18% of all fractures occur in women with "osteoporotic" bone density.**

– Stone et al. 2003; Seeman et al. 2008

So What Is a Better Definition of Osteoporosis?

In 1993, a U.S. Consensus Development Conference defined osteoporosis as:

"A systemic skeletal disease characterized by low bone mass and architectural deterioration of bone tissue with a consequent increase in bone fragility and susceptibility to fractures"

– Consensus Development Conference 1993

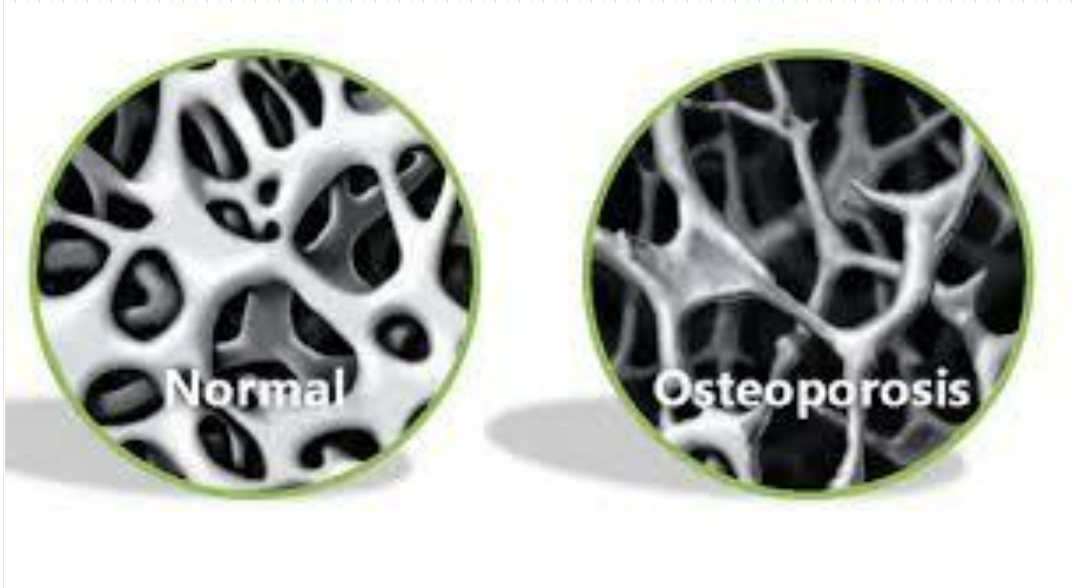
RETHINKING THE NATURE OF OSTEOPOROSIS

Osteoporosis is not just . . .

- Thin bone or low bone density
- A disorder of the elderly
- A disorder of women
- Something "gone wrong" in the body

- Peak bone mass is achieved in our late 20s or early 30s.
- Bone loss begins shortly after that.
- There are various reasons for low bone mass in young folks.

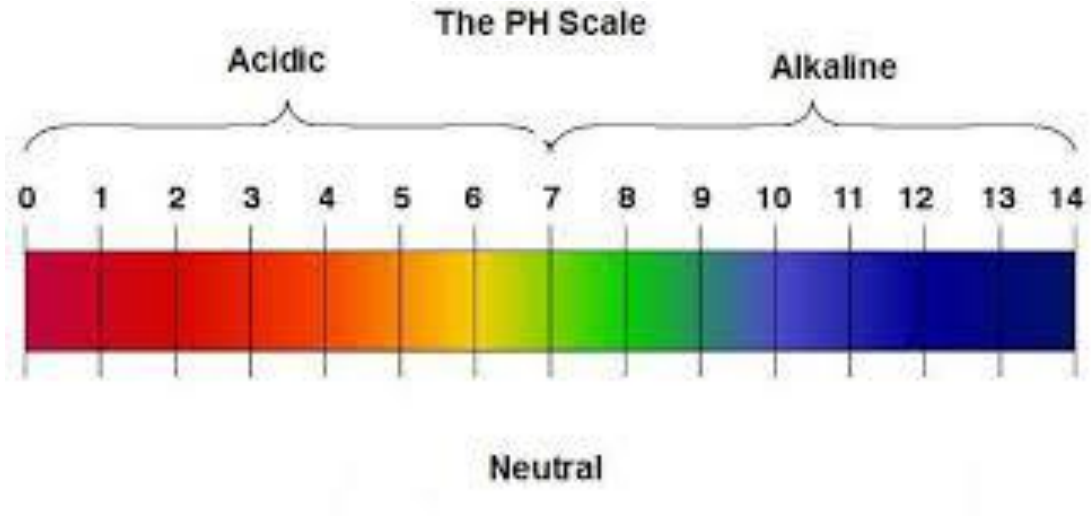
Osteoporosis Is Not Something "Gone Wrong" with Your Bones



- Osteoporosis is our magical body's intelligent response to long-term imbalances and stressors.
- Bone is a gigantic reservoir of essential nutrients that can be made available to the body instantly.
- Osteoporosis is best seen as a positive coping mechanism by an intelligent biological system that is under stress.

- Osteoporosis is really just the end product "disorder" of our body's lifelong attempt to maintain a crucial internal "order."

Ca+



- It is a positive, life-supporting coping mechanism which allows the body to maintain internal balance.

Osteoporosis Is a Complicated Disorder . . .

. . . that everyday medicine presents as simple.

Osteoporosis Does Not Stand Alone

- The body is one whole, interconnected unit.
- Fragile bones are not an isolated disorder.

Muscle and Bone

- As we lose muscle mass over time, we also lose bone mass.
- Back muscle strength has been shown to decrease 50% in women as they age from 50 to 80.
- The average woman loses 47% of her spinal bone mass during her lifetime, while most men lose 30%.

– Riggs et al. 1986; Sinaki 2003; Sinaki et al. 2002

Aging and Muscle

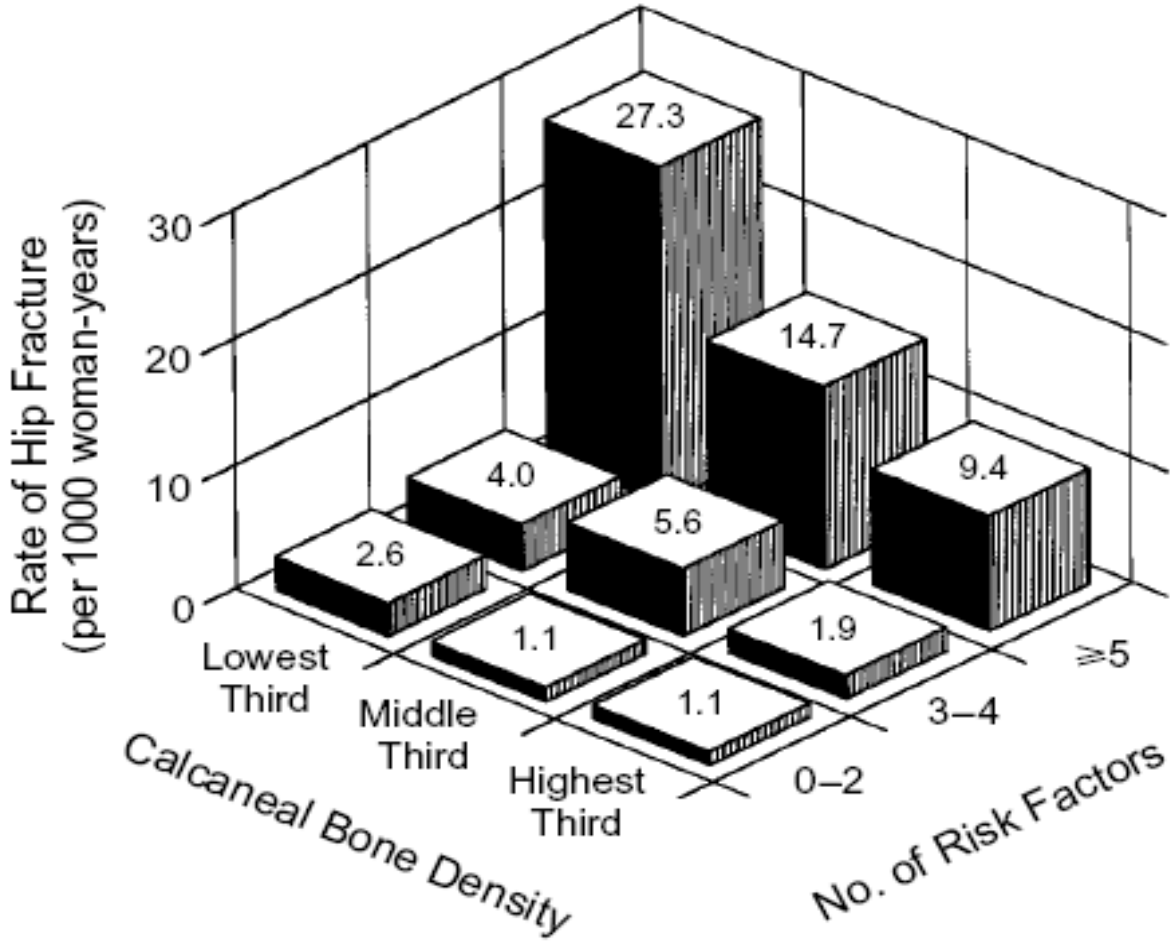
- Back muscle strength has been shown to decrease 50% in women and 64% in men as they age from 50 to 80.
- Reduction in height with aging has also been reported.

– Sinaki et al. 2002

RETHINKING THE CAUSES OF OSTEOPOROSIS

Total Load


TOXIC METALS
COLA
PROCESSED FOOD
SOME PRESCRIPTION DRUGS
CORTICOSTEROIDS
HIGH SALT
EARLY MENOPAUSE
DIETING AND UNDER WEIGHT
INFLAMMATION
HORMONAL IMBALANCE
TOO MUCH ANIMAL PROTEIN
DIGESTIVE WEAKNESS
SEDENTARY LIFESTYLE
INADEQUATE FRUITS AND VEGETABLE INTAKE
pH IMBALANCE
ALCOHOL AND DRUG USE
HYSTERECTOMY
STRESS ANXIETY AND WORRY
SMOKING
SUGAR
EATING HABITS
POOR
LOW SUN EXPOSURE = POOR VITAMIN D
HIGH CAFFEINE USE
LACK OF SLEEP
NUTRIENT DEFICIENCY
YOUR BONE HEALTH



Annual Risk of Hip Fracture According to the Number of Risk Factors and the Age-Specific Calcaneal Bone

– Cummings et al. 1995

The Importance of Multiple Risk Factors

Hip fracture risk was **17 times greater** among the **15 percent of the women** who had **five or more risk factors** (exclusive of bone density) than the 47 percent of the women with **two or fewer risk factors.**

– Cummings et al. 1995

Muscle and bone wasters include:

- Sugar and sugar substitutes
- Refined carbs
- Processed vegetable oils
- Soda
- Excessive caffeine
- Smoking
- Medications
- Transfats
- Preservatives
- Excessive alcohol

Stress-Induced Muscle and Bone Loss

Ann N Y Acad Sci. 2009 August ; 1172: 34–53. doi:10.1111/j.1749-6632.2009.04414.x.

Can meditation slow rate of cellular aging? Cognitive stress, mindfulness, and telomeres

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PLOS ONE

Relaxation Response Induces Temporal Transcriptome Changes in Energy Metabolism, Insulin Secretion and Inflammatory Pathways

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JBMR®

Neuropeptide Y Attenuates Stress-Induced Bone Loss Through Suppression of Noradrenaline Circuits

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ABSTRACT

Chronic stress and depression have adverse consequences on many organ systems, including the skeleton, but the mechanisms underlying stress-induced bone loss remain unclear. Here we demonstrate that neuropeptide Y (NPY), centrally and peripherally, plays a critical role in protecting against stress-induced bone loss. Mice lacking the anxiolytic factor NPY exhibit more anxious [illegible] and elevated corticosterone levels. Additionally, following a 6-week restraint, or cold-stress protocol, *Npy*-null mice exhibit [illegible] owing to suppression of osteoblast activity. This stress-protective NPY [illegible] corticotropin-releasing factor expression and inhibit [illegible] noradrenaline release from

How Many Hours Did You Sleep Last Night?

Happiness Matters

Older women who are satisfied with their lives have higher bone density and are less likely to develop osteoporosis than their unsatisfied peers, according to a study in Finland.

– n.a. Nursing Standard 2015

Highlights of Bone Depleting Factors

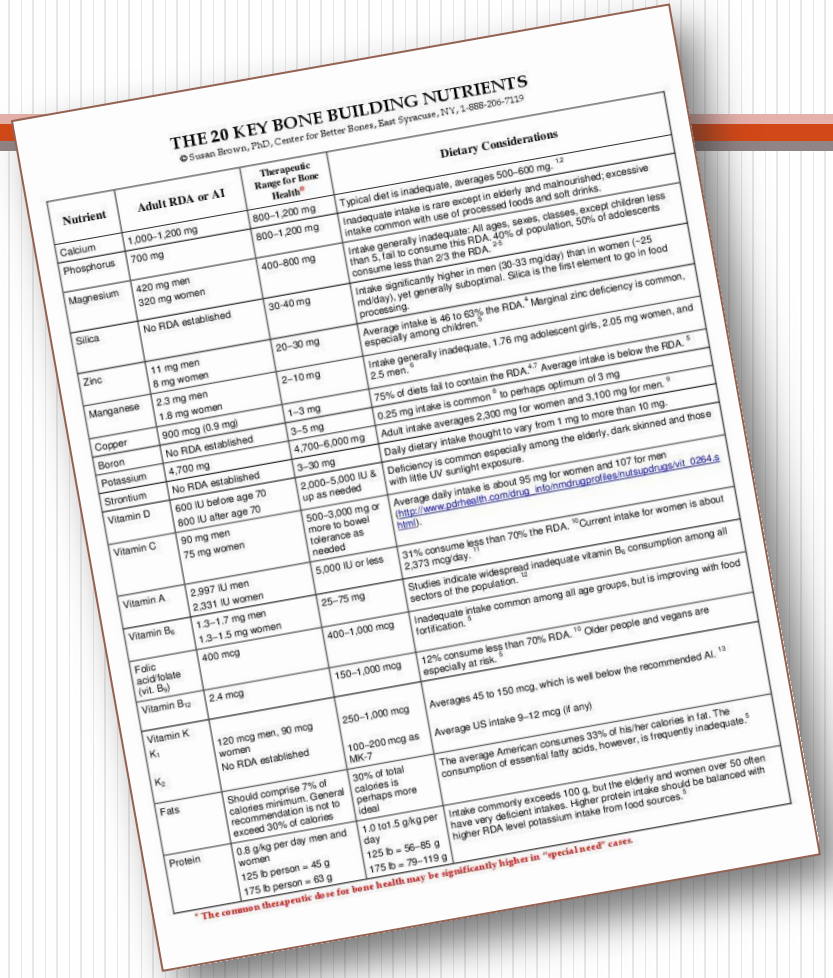
- Low Levels of Any of the 20 Key Bone Nutrients
- Chronic Low-Grade Metabolic Acidosis — Acid-Base Balance
- Contemporary Life Style:
  - ✓ physical inactivity
  - ✓ emotional over-activity
  - ✓ medication use
  - ✓ medical disorders

To Protect Your Bones, You Need at Least 20 Key Nutrients, Not Just Calcium

Nutrient Repletion: The Key Bone Nutrients

- Chromium
- Vitamin D
- Vitamin C
- Vitamin A
- Vitamin B_6
- Vitamin B_{12}
- Folate
- Vitamins K_1 and K_2
- Essential Fats
- Protein
- Calcium
- Phosphorus
- Magnesium
- Silicon
- Zinc
- Manganese
- Copper
- Boron
- Potassium
- Strontium

THE 20 KEY BONE BUILDING NUTRIENTS



THE 20 KEY BONE BUILDING NUTRIENTS

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Nutrient	Adult RDA or AI	Therapeutic Range for Bone Health*	Dietary Considerations
Calcium	1,000–1,200 mg	800–1,200 mg	Typical diet is inadequate, averages 500–600 mg.[1,2]
Phosphorus	700 mg	800–1,200 mg	Inadequate intake is rare except in elderly and malnourished; excessive intake common with use of processed foods and soft drinks.
Magnesium	420 mg men 320 mg women	400–800 mg	Inadequate: All ages, sexes, classes, except children less than 5, fail to consume this RDA. 40% of population, 50% of adolescents consume less than 2/3 the RDA.[2-5]
Silica	No RDA established	30-40 mg	Intake generally higher in men (30-33 mg/day) than in women (~25 md/day), yet generally suboptimal. Silica is the first element to go in food processing.
Zinc	11 mg men 8 mg women	20–30 mg	Intake significantly higher in men (30-33 mg/day) than in women (~25 md/day), yet generally suboptimal. Silica is the first element to go in food processing.
Manganese	2.3 mg men 1.8 mg women	2–10 mg	Average intake is 46 to 63% the RDA.[4] Marginal zinc deficiency is common, especially among children.[5]
Copper	900 mcg (0.9 mg)	1–3 mg	Intake generally inadequate, 1.76 mg adolescent girls, 2.05 mg women, and 2.5 men.[6]
Boron	No RDA established	3–5 mg	75% of diets fail to contain the RDA.[4,7] Average intake is below the RDA.[5]
Potassium	4,700 mg	4,700–6,000 mg	0.25 mg intake is common[8] to perhaps optimum of 3 mg
Strontium	No RDA established	3–30 mg	Adult intake averages 2,300 mg for women and 3,100 mg for men.[9]
Vitamin D	600 IU before age 70 800 IU after age 70	2,000–5,000 IU & up as needed	Daily dietary intake thought to vary from 1 mg to more than 10 mg.
Vitamin C	90 mg men 75 mg women	500–3,000 mg or more to bowel tolerance as needed	Deficiency is common especially among the elderly, dark skinned and those with little UV sunlight exposure.
Vitamin A	2,997 IU men 2,331 IU women	5,000 IU or less	Average daily intake is about 95 mg for women and 107 for men (http://www.pdrhealth.com/drug_info/nmdrugprofiles/nutsupdrugs/vit_0264.shtml).
Vitamin B_6	1.3–1.7 mg men 1.3–1.5 mg women	25–75 mg	31% consume less than 70% the RDA.[10] Current intake for women is about 2,373 mcg/day.[11]
Folic acid/folate (vit. B_9)	400 mcg	400–1,000 mcg	Studies indicate widespread inadequate vitamin B_6 consumption among all sectors of the population.[12]
Vitamin B_{12}	2.4 mcg	150–1,000 mcg	Inadequate intake common among all age groups, but is improving with food fortification.[5]
Vitamin K K_1 K_2	120 mcg men, 90 mcg women No RDA established	250–1,000 mcg 100–200 mcg as MK-7	12% consume less than 70% RDA.[13] Older people and vegans are especially at risk.[5]
Fats	Should comprise 7% of calories minimum. General recommendation is not to exceed 30% of calories	30% of total calories is perhaps more ideal	Averages 45 to 150 mcg, which is well below the recommended AI.[13]
Protein	0.8 g/kg per day men and women 125 lb person = 45 g 175 lb person = 63 g	1.0 to1.5 g/kg per day 125 lb = 56–85 g 175 lb = 79–119 g	Average US intake 9–12 mcg (if any)
			The average American consumes 33% of his/her calories in fat. The consumption of essential fatty acids, however, is frequently inadequate.[5]
			Intake commonly exceeds 100 g, but the elderly and women over 50 often have very deficient intakes. Higher protein intake should be balanced with higher RDA level potassium intake from food sources.[5]

* The common therapeutic dose for bone health may be significantly higher in "special need" cases.

Sub-Optimal Nutrient Intake Is the Norm, Not the Exception

- Magnesium: all ages, sexes, and classes (except those under 5) fail to consume even the RDA
- Zinc: average intake is 46 to 63% the RDA
- Potassium: average intake is around 50% RDA
- Copper: 75% of diets fail to contain the RDA
- Vitamin D: Low serum levels are common
- Calcium: Average intake is 500 to 600 mg

http://www.betterbones.com/bonenutrition/20keybonenutrients.pdf

Nutrient Losses in Food (from 1950 to 1999)

Vegetable	Calcium	Iron	Phosphorus
Broccoli	↓63%	↓32%	↓13%
Carrots	↓31%	↓37%	↓19%
Kale	↓40%	↓23%	↓10%
Onions	↓37%	↓56%	↓25%
Potatoes	↓36%	↓8%	↓18%

Fruit	Calcium	Iron	Vit. A
Apples	None	↓40%	↓41.1%
Lemons	↓57.%	↓14.3%	↑3.3%
Oranges	↓2.4%	↓75%	↑2.5%
Strawberries	↓33.3%	↓62%	↓67.1%
Tangerines	↓65%	↓75%	↑119%

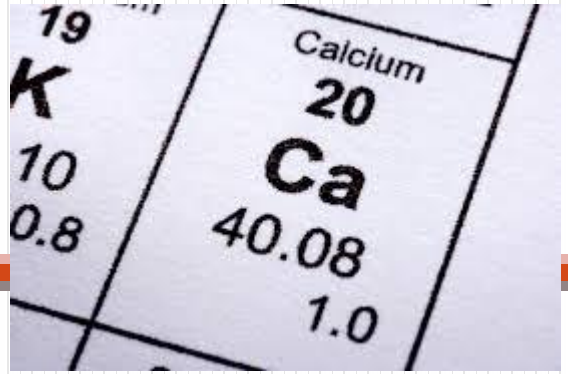
– Davis et al. 2004

Repair Deficit

What keeps you from having perfect health?

Are you in repair deficit?

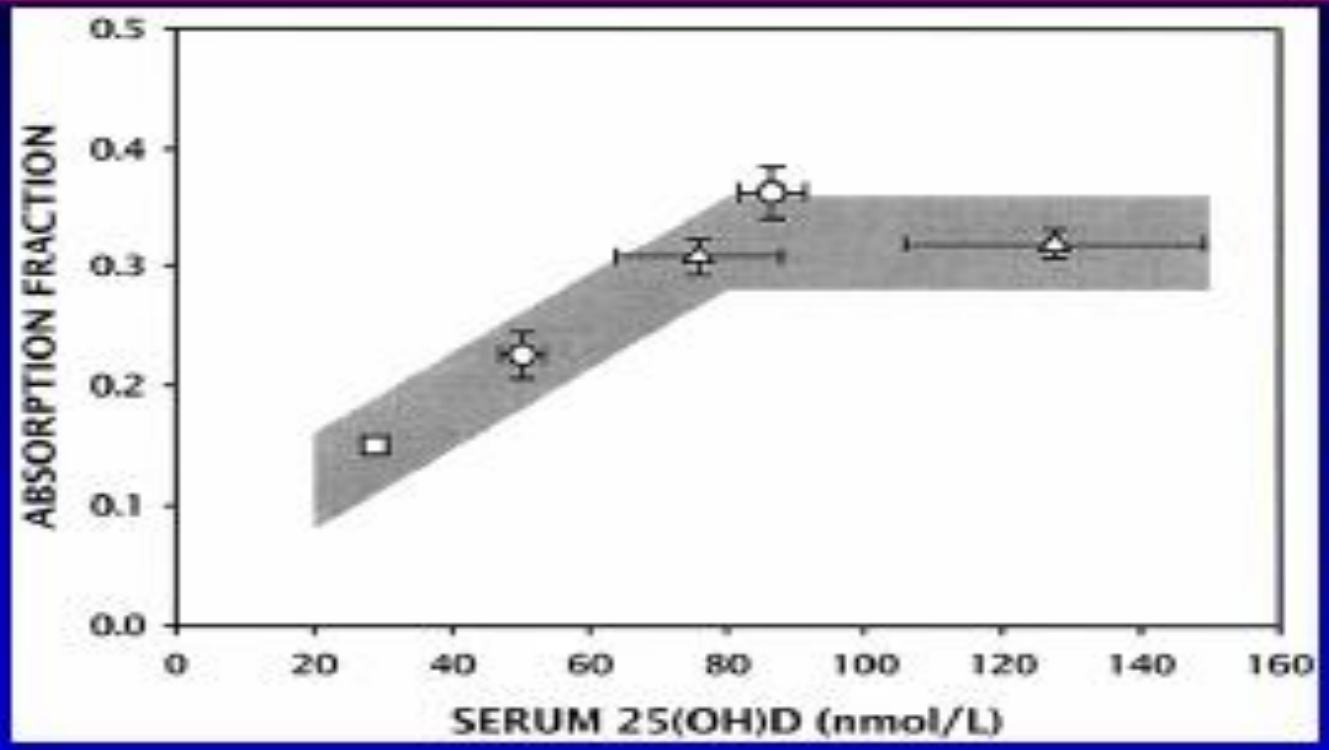
How do we stimulate repair?



Are There Nutrients More Important Than Calcium?

Vitamin D

Relation between Serum 25(OH)D and Calcium Absorption in Vitamin D Insufficiency



Calcium absorption fraction as a function of serum 25(OH)D3 concentrations (combined results of 3 studies)

□ Bischoff et al. J Bone Miner Res 2003; 18: 343–51.
○ Heaney et al. J Am Coll Nutr 2003; 22: 142–6.
△Barger-Lux et al. J Clin Endocrinol Metab 2002;87:4952–6.
Error bars indicate ± 1 SEM
From Heaney RP Am J Clin Nutr 2005; 80: 1706S-9S.

Vitamin D Inadequacy Is Widespread

- **1 billion** people worldwide are deficient in vitamin D, especially among the elderly and dark-skinned individuals.
- **Half of adults** in US, Europe, and **up to two-thirds** of post-menopausal women are deficient in vitamin D.
- **30 to 40%** of children in many cultures are deficient in vitamin D.
- **80%** of school children in New Delhi are deficient in vitamin D.
- **97%** of hip fracture patients in UK are deficient in vitamin D.
- **Half the population** of Tasmania is deficient in vitamin D.

Meta-Analysis Trials Using 700–800 IU Vitamin D_3 and Calcium

In a 1992 18-month study (n=3270), mean age 84, ambulatory elderly, using 1.2g calcium, 800 IU vitamin D_3 . . .

- ✓ **32% fewer non-vertebral fractures**
- ✓ **43% fewer hip fractures**

– Chapuy et al. 1992

Vitamin D and Fracture Reduction

The Better Bones Foundation estimates that supplementation with therapeutic levels of vitamin D could result in an overall **50- to 60-percent reduction** in low-trauma osteoporotic fractures.

Other vitamin D researchers who agree with this statement include:

- William Grant, PhD
- Cedric Garland, DrPH
- Michael Holick, MD, PhD

– Brown 2008

Vitamin K

Vitamin K and Bone

Vitamin K is essential for the carboxylation of osteocalcin, the bone protein which attracts calcium to the crystallization site.

– Hart et al. 1985

Vitamin K and Fracture Risk

Work with elderly French patients shows that **ucOC, but not conventional calcium metabolism parameters,** predicts the subsequent risk of hip fracture.

– Szulc et al. 1993

European EPIDOS Study found **ucOC to be major independent risk factor for hip fracture among healthy elderly women.** The women with low BMD and high ucOC had a **5.5x increased risk of hip** fracture as compared to those with only low BMD or high ucOC levels.

– Vergnaud et al. 1997

Dietary Vitamin K and Fracture

Data from the Framingham Heart Study revealed that those women and men in the **highest quintile of vitamin K intake (250 mcg/d) had one-third the risk of hip fracture** as those in the lowest quintile (75 mcg/d).

– Booth et al. 2000

The Nurses Health Study (N=72,732) also reported that the women in the **lowest quintile of vitamin K intake had an increased risk of hip fracture.**

– Feskanich et al. 1999

Meta-Analysis of Vitamin K and Fracture Reduction

7 RCTs using MK-4 (menatetrenone) (6 using 45 mg and 1 using 15 mg)

- 77% Reduction in Hip Fractures
- 60% Reduction in Vertebral Fractures
- 81% Reduction in all Non-Vertebral Fractures

– Cockayne et al. 2006

Ascorbate: The Best Form of Vitamin C

Vitamin C Is Essential for Healthy Bones

- As an antioxidant to protect bone from free radical damage
- As an electron donor to energize bone cells
- A key nutrient for healthy collagen

According to new research on the effects of vitamin C on bone health, **moderate amounts of vitamin C led to a nearly 44% reduction in risk of fracture.**

– Sahni 2015

Trace Minerals

MAGNESIUM, ZINC, MANGANESE, COPPER, BORON, SILICA, IRON

Inadequacy Is Common !!

Actual intake levels and therapeutic levels are outlined on the **20 Key Bone Building Nutrients Chart Handout**

Sub-Optimal Nutrient Intake Is the Norm

Magnesium: All ages, sexes, and classes (except those under 5) fail to consume even the RDA.

Zinc: Average intake is 46 to 63% the RDA.

Potassium: Average intake is around 50% RDA.

Copper: 75% of diets fail to contain the RDA.

Vitamin D: Low serum levels are common.

Calcium: Average intake is 500 to 600 mg.

http://www.betterbones.com/bonenutrition/20keybonenutrients.pdf

Bone Protein Matrix Minerals: Manganese, Zinc , Copper, and Iron

- Copper and iron act as cofactors in the cross-linking of collagen and elastins.
- Manganese participates in the biosynthesis of mucopolysaccharides.
- Zinc deficiency causes a reduction in osteoblastic activity, collagen and chondroitin sulfate synthesis, and alkaline phosphatase activity.

– Strause et al. 1994

Magnesium Depletion and Osteoporosis — Experimental Animal Models

- Universal observation is decreased growth of whole body and skeleton
- Reduced osteoblast formation
- Decreased collagen formation
- Impaired mineralization
- Production of brittle and fragile bone

– Rude 2001

Magnesium Builds Bone in Girls

RCT of 120 girls (8 to14 yrs) with magnesium intakes less than 220 mg/day and a 1-year intervention with 300 mg magnesium:

- Significant improvement in hip BMD.
- Slight increase in spinal BMD.

– Carpenter et al. 2006

Magnesium Builds Bone in Postmenopausal Women

Original Article

Magnesium, Zinc, Copper, Manganese, and Selenium Levels in Postmenopausal Women with Osteoporosis. Can Magnesium Play a Key Role in Osteoporosis?

Ersin Odabasi,[1] MD, Mustafa Turan,[1] MD, Ahmet Aydin,[2] MD, Cemal Akay,[2] MD, Mustafa Kutlu,[3] MD

Abstract

Introduction: There has been a resurgence of interest in stu
in the development and maintenance of the skeleton. The aim
and red blood concentrations of some elements in postm
Materials and Methods: Seventy-seven postmenopausal w
(median interquartile range, 7.5; range, 46 to 74) and 6
menopausal women aged 60 years (median interqua
included in the study. Element concentrations in plasma
(Mg), zinc, copper, manganese, and selenium w
spectrophotometry in both postmenopausal women wi
women. Results: Only statistically significant differe
μg/mL) and healthy subjects (54.54 [15.42] μg/m
magnesium concentration ($Z = -2.07$, $P = 0.039$). H

Magnesium intake, bone mineral density, and fractures: results from the Women's Health Initiative Observational Study[1–4]

Tonya S Orchard, Joseph C Larson, Nora Alghothani, Sharon Bout-Tabaku, Jane A Cauley, Zhao Chen, Andrea Z LaCroix, Jean Wactawski-Wende, and Rebecca D Jackson

ABSTRACT

Background: Magnesium is a necessary component of bone, but its relation to osteoporotic fractures is unclear.

Objective: We examined magnesium intake as osteoporotic fractures and altered bone mineral d

Design: This prospective cohort study included pausal women enrolled in the Women's tional Study. Total dai baseline

women, low magne rapid

Biol Trace Elem Res (2010) 133:136–143
DOI 10.1007/s12011-009-8416-8

Short-Term Oral Magnesium Supplementation Suppresses Bone Turnover in Postmenopausal Osteoporotic Women

Hasan Aydın · Oğuzhan Deyneli · Dilek Yavuz · Hülya Gözü · Nilgün Mutlu · Işık Kaygusuz · Sema Akalın

Received: 20 April 2009 / Accepted: 20 May 2009 /
Published online: 2 June 2009
© Humana Press Inc. 2009

Abstract Magnesium has been shown to increase bone mineral density whe
treatment of osteoporosis, yet its mechanism of action is obscure. In this stud
of daily oral magnesium supplementation on biochemical markers of bone t

Magnesium Intake from Food and Supplements Is Associated with Bone Mineral Density in Healthy Older White Subjects

Kathryn M. Ryder, MD, MS, Ronald I. Shorr, MD, MS,† Andrew J. Bush, PhD,† Stephen B. Kritchevsky, PhD,‡ Tamara Harris, MD, MPH,§ Katie Stone, PhD,‖ Jane Cauley, DrPH,¶ and Frances A. Tylavsky, DrPH†*

OBJECTIVES: To determine whether magnesium intake from supplemental and dietary sources is associated with bone mineral density (BMD) in older men and women.

DESIGN: Cross-sectional.

SETTING: Memphis, Tennessee, and Pittsburgh, Pennsylvania.

PARTICIPANTS: Two thousand thirty-eight older black and white men and women aged 70 to 79 at baseline enrolled in the Health, Aging and Body Composition Study.

MEASUREMENTS: Dietary intake of magnesium was assessed using a semiquantitative food frequency questionnaire, and supplement data were collected based on a medication inventory. BMD of the whole body was obtained using a fan-beam densitometer. Additional covariates included age, body mass index (BMI), smoking status, alcohol use, physical activity, estrogen use, and supplemen-

CONCLUSION: Greater magnesium intake was significantly related to higher BMD in white women and men. The lack of association observed in black women and men may be related to differences in Ca regulation or in nutrient reporting. J Am Geriatr Soc 53:1875–1880, 2005.

Key words: bone mineral density; nutrition; magnesium; osteoporosis; elderly

Osteoporotic fractures are a significant health problem in older adults, and the burden of osteoporosis is expected to increase as the population ages.[1] White woman have a lifetime risk of any clinical fracture approaching 75%[2] and a lifetime risk of hip fracture of 16%. White men

Zinc Is Essential for Bone Health

- Zinc stimulates osteoblast bone-building formation and mineralization.
- It facilitates bone collagen synthesis.
- It inhibits osteoclastic bone breakdown.
- Studies show women with osteoporosis have lower than normal levels of zinc.

Multiple Intervention Strategies

2-year multi-nutrient blinded, controlled study, N59 healthy postmenopausal women:

Intervention:

- Placebo
- Just Ca citrate malate (1,000 mg)
- Ca citrate malate (1,000 mg), zinc (15 mg), manganese (5 mg), and copper (2.5 mg).

BMD Changes:

The only significant change from placebo was **calcium plus trace minerals. This was the only group to halt loss and gain bone.**

– Strause et al. 1994

Multi-Nutrient Intake and Fracture Risk

In a Swedish observational study of 65,000 women aged 48 to 80, when highest quartile of intake was compared to lowest:

- Intakes of **iron, magnesium,** and **vitamin C** were found to be **independent risk factors** for hip fracture (or 3.3; 2.7; 1.9).
- **High calcium** intake **did not protect** against hip fracture.

– Michaëlsson et al. 1995

Potassium: The Unexpected Bone Builder

The RDA for potassium at 4,700 mg is nearly **four times** that of calcium (at 1,200 mg).

Potassium Protects Bone

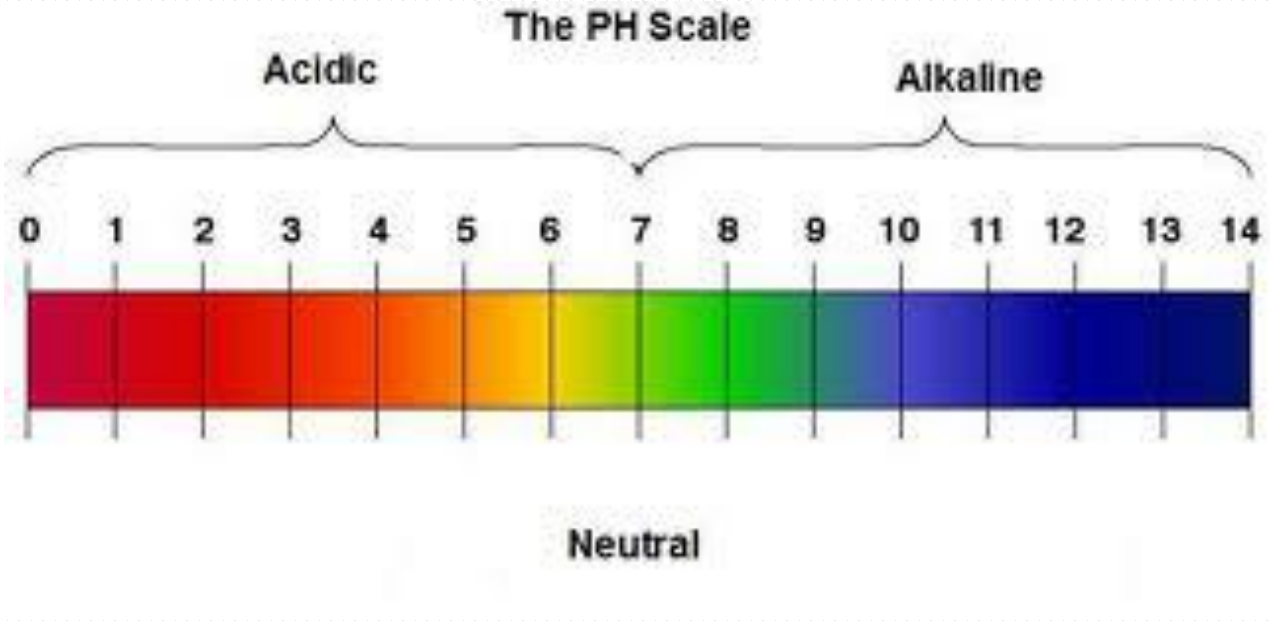
Metabolic Functions of Bone

- Serum Calcium Homeostasis
- Systemic Acid-Base Balance

Bone Sacrifices Structural Functions for Metabolic Functions

Obligatory pH Balance and Chronic Low Grade Metabolic Acidosis

pH homeostatic mechanisms are central to our discussion of toxic metals and bone health.



Our skeleton serves as a gigantic reserve of alkaline mineral compounds ready for transfer into the blood for maintenance of an obligatory, precise pH level.

– Brown and Jaffe 2000

Bone Is a Gigantic Alkali Buffer Exchange Column Loaded with Alkali Buffer Compounds

Bone and the hydration shell around it contain:

- 80% of body carbonate
- 80% of body citrate
- 35% of body sodium
- 53 to 80% of body magnesium
- 0.1 to 0.2% of body potassium

– Brown and Jaffe 2000; Green and Kleeman 1991a

If we do not maintain adequate alkaline-mineral reserves from our diet, our skeleton willingly sacrifices itself for survival of the whole.

Chronic Metabolic Acidosis

- Dietary changes over the last two centuries have resulted in a mismatch between genetically determined nutritional requirements and actual nutrient intake.
- This has resulted in ***chronic metabolic acidosis*** being the norm rather than the exception:
  - ✓ Deficiency of potassium, magnesium, and other essential minerals from alkaline-forming foods
  - ✓ Excess dietary intake of acid-forming foods
  - ✓ Excess sodium chloride

Cell Net Acid Excess (NAE)

NAE is a key determinant of bone health because of its role in:

- Regulating the efficiency of protein synthesis
- Controlling bone alkaline mineral reserves
- Regulating the efficiency of our elective protective and anti-toxic mechanisms

– Brown and Jaffe 2000

Metabolic Acidosis Is the Norm and It Endangers Bone

- Bone loss can be re-thought of and understood more fundamentally as a "hidden tax of high-tech living."
- People with high-tech diets and lifestyles usually acquire chronic metabolic cellular acidosis and become progressively more deficient in cell mineral reserves that proportionately impair efforts to rebuild bone matrix and detoxify.

– Frassetto et al. 2005; Jehle et al. 2013

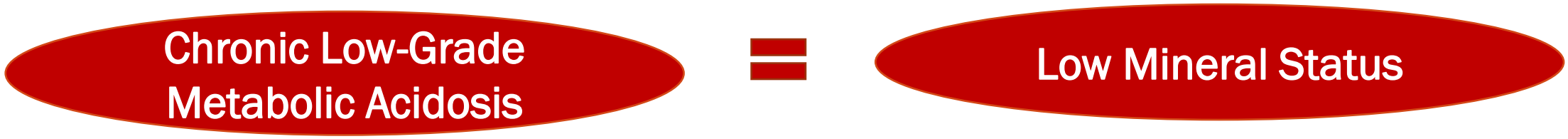
Chronic Low-Grade Metabolic Acidosis Damages Bone

These acid-forming excesses are not mediated by dietary bicarbonates and lead to chronic low-grade metabolic acidosis with ensuing damage to bone. Among other effects you see:

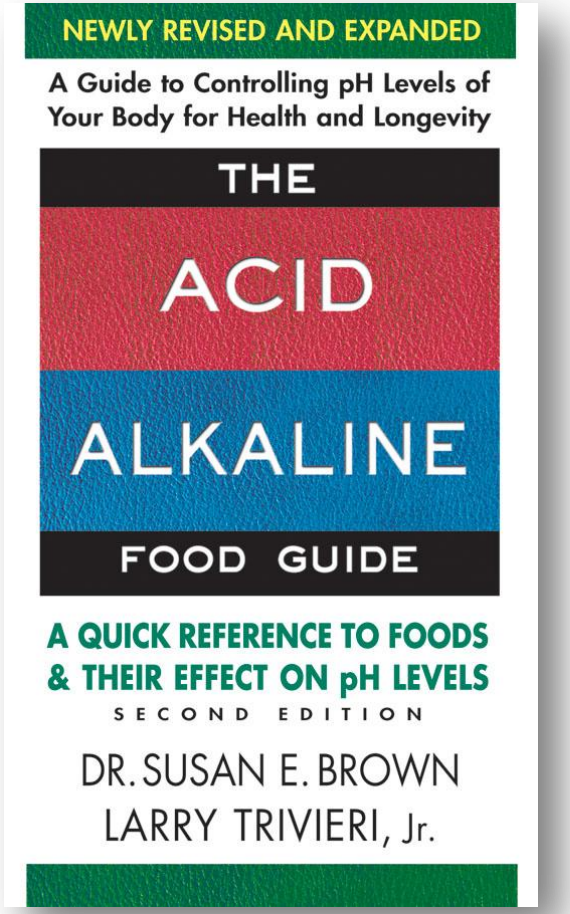
- Urinary loss of calcium
- Increased bone resorption
- Kidney function decline
- Reduction in growth hormone
- Nitrogen and muscle losses

– Frassetto et al. 2001; Frassetto and Sebastian 1996; Green and Kleeman 1991b

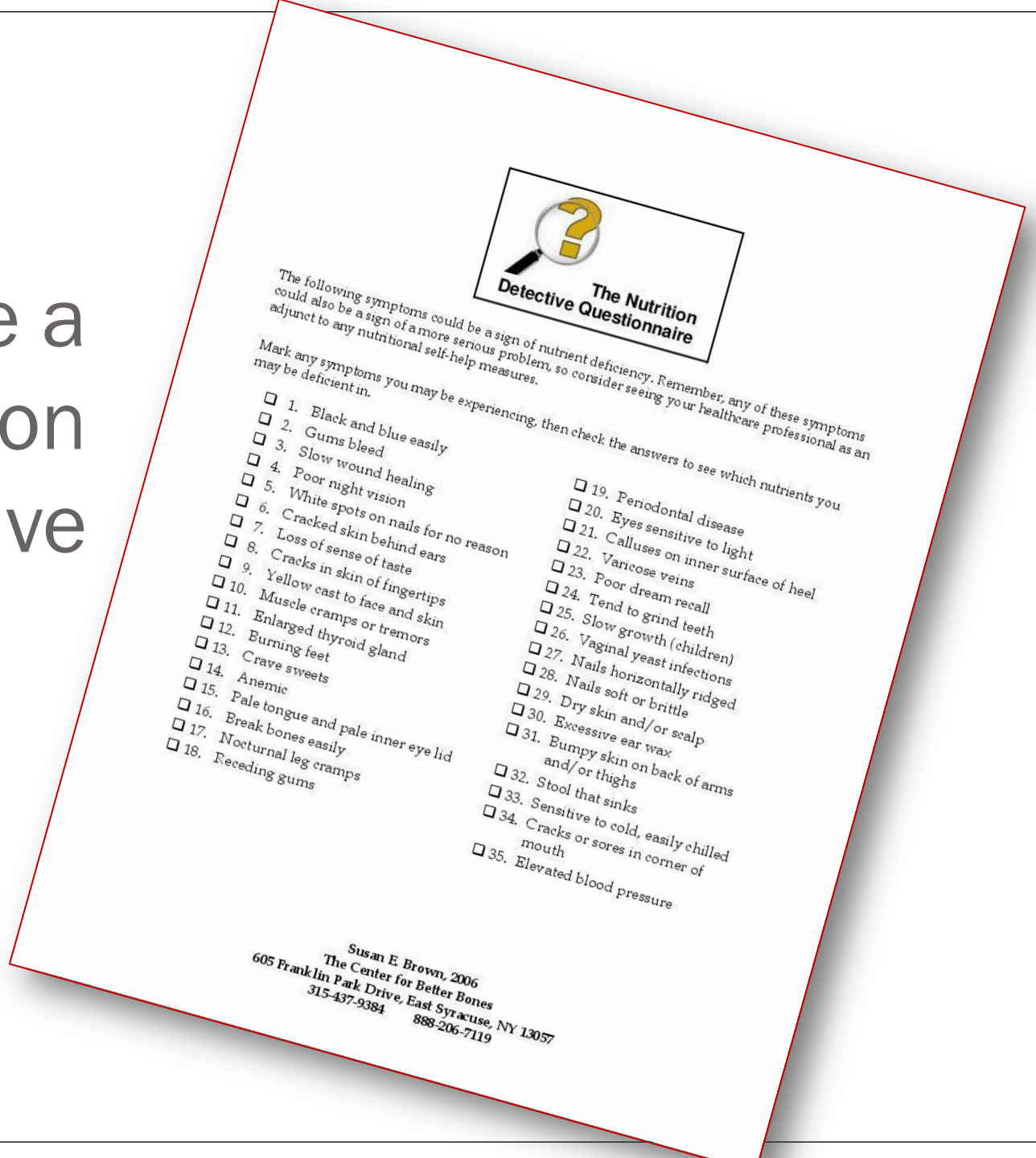
Remember . . .



The Acid-Alkaline Food Guide



Become a Nutrition Detective



The Nutrition Detective Questionnaire

The following symptoms could be a sign of nutrient deficiency. Remember, any of these symptoms could also be a sign of a more serious problem, so consider seeing your healthcare professional as an adjunct to any nutritional self-help measures.

Mark any symptoms you may be experiencing, then check the answers to see which nutrients you may be deficient in.

- ☐ 1. Black and blue easily
- ☐ 2. Gums bleed
- ☐ 3. Slow wound healing
- ☐ 4. Poor night vision
- ☐ 5. White spots on nails for no reason
- ☐ 6. Cracked skin behind ears
- ☐ 7. Loss of sense of taste
- ☐ 8. Cracks in skin of fingertips
- ☐ 9. Yellow cast to face and skin
- ☐ 10. Muscle cramps or tremors
- ☐ 11. Enlarged thyroid gland
- ☐ 12. Burning feet
- ☐ 13. Crave sweets
- ☐ 14. Anemic
- ☐ 15. Pale tongue and pale inner eye lid
- ☐ 16. Break bones easily
- ☐ 17. Nocturnal leg cramps
- ☐ 18. Receding gums
- ☐ 19. Periodontal disease
- ☐ 20. Eyes sensitive to light
- ☐ 21. Calluses on inner surface of heel
- ☐ 22. Varicose veins
- ☐ 23. Poor dream recall
- ☐ 24. Tend to grind teeth
- ☐ 25. Slow growth (children)
- ☐ 26. Vaginal yeast infections
- ☐ 27. Nails horizontally ridged
- ☐ 28. Nails soft or brittle
- ☐ 29. Dry skin and/or scalp
- ☐ 30. Excessive ear wax
- ☐ 31. Bumpy skin on back of arms and/or thighs
- ☐ 32. Stool that sinks
- ☐ 33. Sensitive to cold, easily chilled
- ☐ 34. Cracks or sores in corner of mouth
- ☐ 35. Elevated blood pressure

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