
A. Rosanoff, PhD
 Credentials / COI
Position: Director of CMER - Center for Magnesium Education & Research; Nutritional Biology Research, Independent Scholars
Education: BA, MS, Ph.D. Univ California, Berkeley
Consulting/Honoraria: Almond Board of California; Epsom Salt Council; Magnesium for Health Organization; Pharmavite; Neo-Life; Nutranext; Jigsaw Health
Royalty: Transdermal Mg product (as of Jan. 1, 2017)
Book Royalties: The Magnesium Factor by M.S. Seelig, MD and A. Rosanoff, PhD, 2003

S. Volpe, PhD, RDN, ACSM-CEP, FACSM
 Credentials / COI
Position: Professor and Chair of the Department of Nutrition Sciences at Drexel University College of Nursing and Health Professions
Fellowship: Fellow of the American College of Sports Medicine
Dr. Volpe is a nutritionist and exercise physiologist whose work on obesity and diabetes prevention, body composition, bone mineral density, and mineral metabolism and exercise represent more than a decade of consistent funding. Prior to beginning her appointment as Professor and Chair in January 2011 at Drexel University, Dr. Volpe was on faculty at the University of Pennsylvania from 2004 to 2010. Prior to that appointment, Dr. Volpe was on faculty at the University of Massachusetts from 1994 through 2003.

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After completing this continuing education course, nutrition professionals should be able to:

- **Discuss** the low magnesium status of age/gender groups in the United States
- **Identify** possible health impacts of the US population's generally low magnesium status
- **List** reasons for this generally low magnesium intake and develop strategies for overcoming barriers
- **Implement** dietary modifications to enhance magnesium intake, as well as supplementation if needed
- **Realize** the health impacts of our population's chronically low magnesium status

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Nutritional Mg: Widespread & Critical Basic Functional Roles

- Most ATP is Mg-ATP Storer, 1976; Garfinkel, 1985; Wilson, 1991
- DNA Synthesis Volpe, 2013; Abdelgawad, 2015
- RNA Synthesis Volpe, 2013
- Protein Synthesis Volpe, 2013; Romani, 2013; Long & Romani, 2014; Rubin, 2005; George, 1978
- Membrane Structure Weisinger et al., 1998
- Na/K Cellular Balance Dorup, 1993; Fischer, 1987; Fagher, 1987; Flatman, 1981
- Glycolysis & Krebs's Cycle Garfinkel, 1985
- Vitamin D Activation Deng, 2013; Rosanoff et al., 2016
- Control of Cholesterol Biosynthesis Rosanoff & Seelig, 2004
- Muscle Relaxation Volpe, 2013; Zhang, 1991; Altura, 1981; Konishi, 1998; Yang, 2000; Turlaplaty, 1980

Mg activity encompasses ~80% of known metabolic functions.
 Workinger et al., 2018

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Adequate Mg Nutrition - Why?

Peer-reviewed literature has associated Mg with several human disease states:

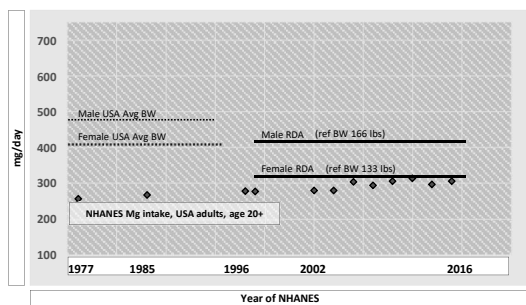
CIRCULATORY	RESPIRATORY	MUSCLE/SKELETAL
<ul style="list-style-type: none"> • Hypertension • Heart Disease • Stroke • Arrhythmias • Atrial Fibrillation • Dyslipidemia 	<ul style="list-style-type: none"> • Asthma • COPD • Other Lung/Respiratory 	<ul style="list-style-type: none"> • Low back pain • Osteoarthritis • Other musculoskeletal • Osteoporosis, Sarcopenia
METABOLIC	CNS	IMMUNITY/OTHER
<ul style="list-style-type: none"> • Diabetes • Metabolic Syndrome 	<ul style="list-style-type: none"> • Depression • Anxiety • Migraine • Addiction • Pain Relief • ADHD • Sleeplessness • Stress 	<ul style="list-style-type: none"> • Pre-eclampsia • Kidney disease • Crohn's Disease • Chronic Fatigue Syndrome • Colon Inflammatory Diseases, IBD • Inflammation • Some Cancers

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Seelig & Rosanoff, 2003

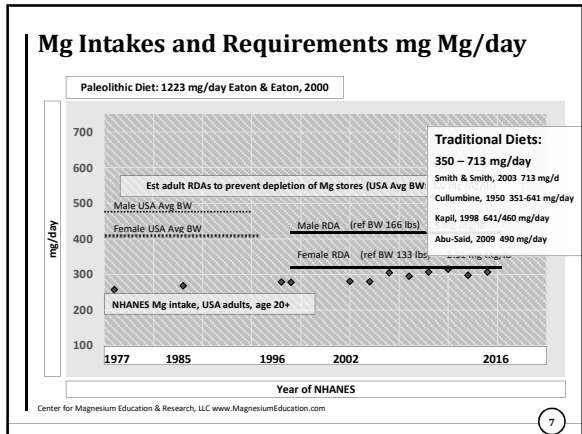
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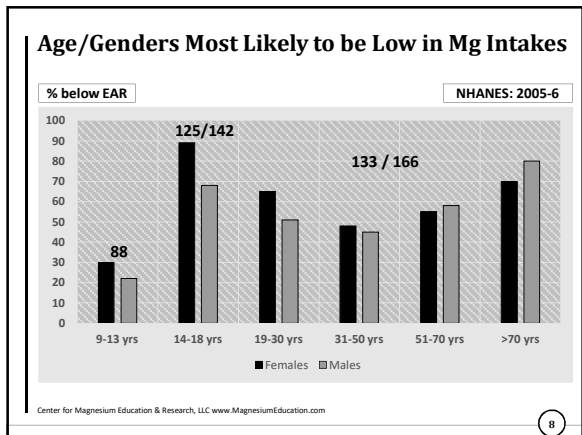
Mg Intakes and Requirements mg/day



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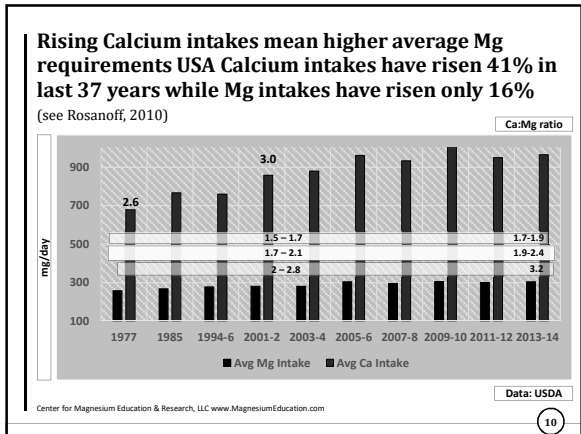




Ca Balance – A Basic Function Of Adequate Mg

- When Mg is low in a cell, there is a Ca rush into the cell cytoplasm
- Resnick found in 1990s that high Ca:Mg in cells causes
 - Vasoconstriction in smc and heart muscle cells, plus
 - Platelets get sticky and prone to clot, plus
 - Cholesterol over-production, plus
 - Hyper glucose production in liver cells, plus
 - Impaired glucose uptake in muscle and fat cells, plus
 - Hyper-excretion of insulin in pancreas cells,
 - Leading to hypertension, high blood glucose plus insulin resistance, i.e. Type 2 diabetes
- So Ca:Mg is quite important CVD and T2D

Resnick et al., 1993; 1999;
 Rosanoff, 2010; Rosanoff et al., 2012
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- ### Stresses That Affect Mg Status or Are Affected By Mg Status
- Noise
 - Hunger
 - Cold
 - Heat
 - Immobilization
 - Poisoning/chemical exposure
 - Trauma
 - Injury
 - Medical procedures
 - Surgery
 - Hospital Stays
 - Intense Physical Exercise
 - Emotions (fear, anxiety)
 - Psychological problems
 - Permanent standby duty
 - Political intolerance/friction
 - Awareness of potential military attack
 - Mortal danger
 - Childbirth
 - Aggression
 - Hostility
- Adapted from Seelig & Rosanoff, 2003

- ### Common Drugs Interact with Mg
- Some Can Increase Dietary Mg Need**
- Proton Pump Inhibitors and antacids – hypomagnesemia
 - Thiazide diuretics – increase urinary Mg
 - Cancer therapy drugs
 - Corticosteroids
 - Tetracycline antibiotics
 - Others
- Some Can “Spare” Mg**
- Aspirin
 - Blood Pressure Meds – ACE inhibitors; beta-blockers
 - Lithium
 - Vitamin D
- Pharmavite LLC, 2015; Seelig & Rosanoff, 2003

Mg Deficit Symptoms Are Treated With High-Cost Medicine

Symptom	Treated With
Calcium rush into cell	Calcium channel blockers
Hyper stress rxn	Beta blockers
High cholesterol	Statins
Blood Clots - stroke	Blood Thinners
High Blood Pressure	Anti-hypertensive Meds
Na:K imbalance	Anti-hypertensive Meds, Low Na Diets
Arteriosclerosis	By-pass, angioplasty surgery
Type 2 Diabetes	Insulin, Metformin, other Rx
Depression/anxiety	Anti-depressants, anti-anxiety Rx
Inflammation	Anti-inflammatory meds
Cancer	Surgery, Chemotherapy, Radiation
High Health Costs for Individual & Society	Healthcare Funds (that could go for food, research, education, etc.)

Adapted from Rosenoff, et al 2015

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Why Is Our Mg Intake So Low in the USA?

Common Ideas

- Decreasing nutritional content of foods
- ~~Soil Depletion of Mg~~
- ~~Low bioavailability~~
- Poor food choices
- Processing losses of Mg in food & water

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Mg losses in Modern Food Crop & Water Processing


- Milling of wheat loses
 - 56% of the Calcium
 - 73% of the Phosphorus
 - 73% of the Potassium
 - 0% of the Sodium
 - 59% of the Zinc
 - **82% of the Magnesium**
- Sugar Cane/Beet to **Sugar loses 100% Mg**
- Oilseeds to oil loses 100% Mg
- 20th C. switch to municipal, softened water – very low Mg
- Late 20th C. switch to **deionized, bottled water – 0 Mg**

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USDA NAL Database

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FRESH



PROCESSED



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Food Choice Impacts Mg Intake

3 BREAKFASTS COMPARED			
	One fried egg Sausage, 1 oz. Toast w/ butter, 2 sl. Orange Juice, 4 oz.	Med. Bagel with Lox and cream cheese, Orange Juice, 4 oz.	Oatmeal with 2% milk, 2 oz. pecans 4 oz. blueberries
Mg Content, mg	28	51	151
Whole Wheat	47	81	

Data from: USDA, SR28

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How can your patients improve their diets to ensure better Mg intakes?

- Whole grains, legumes, seeds, nuts, fruits & vegetables (leafy greens)
- Mg-rich drinking water (watch Calcium and Sodium levels)
- Every Day
- Every Meal
- Lifelong

Meds affect Mg need?

Overweight or obese?

High Calcium intake or supplements?

High Stress?

Past Stressful event(s)?

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Factors To Estimate Mg RDA For Healthy People, Using (Factor) x Bodyweight (BW) in Pounds (lbs)

Gender	Age Group	Factor x BW (lbs) to estimate Mg RDA
m, f	2-6 mos	2
m, f	7-12 mos	4.5
m, f	1-18 yrs	3-4
m, f	19+ yrs	3
Preg, Lac	14-18 yrs	3-4
Preg, Lac	19-50 yrs	3

Adapted from IOM, 1997; Seelig, 1964; Nielsen, 2018
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Using Factors to Estimate Mg Needs

Factor X Body Weight (BW) in Pounds (lbs.) = Body Weight (BW)-Corrected RDA

BW – lbs – Healthy adult: Factor = 3 mg Mg/lb	Mg requirement, mg Mg/day
100	300
150	450
175	525
200	600
225	675
250	750
275	825
300	900

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Can Supplemental Mg Play a Role?

Oral Mg Supplements have shown beneficial effects in adults with:

- Raise Serum Mg Zhang et al., 2016
- Migraine Chiu et al., 2016
- Fibromyalgia Bagis et al., 2013
- Anxiety Boyle & Dye, 2017
- Depression Tarleton et al., 2017; Li et al., 2017; Rajizadeh et al., 2017
- Bone Metabolism/turnover Aydin et al., 2010; Doyle et al., 1999
- Risk factors for CVD and DM:
 - Hypertension Zhang et al. 2016; Cunha et al., 2017; Verma & Garg, 2017
 - Fasting glucose, HDL, LDL, TG Song et al., 2006; Verma & Garg, 2017
- Atherosclerosis Cunha et al., 2017
- Atrial Fibrillation Brodsky et al., 1994; Gu et al., 2012; Miller et al., 2005; Kohno et al., 2005
- Mitral Valve Prolapse Martyov et al., 2000
- Prevention of Gallstones Daniells, 2008
- More

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Can Supplemental Mg Play a Role?

Promising Research using oral Mg therapy:

- Epilepsy Osborn et al., 2016; Yuen & Sander, 2012;
- Parkinson's Disease Vink, 2016; Kirkland et al., 2018
- Alzheimer's Disease Vink, 2016; Kirkland et al., 2018
- Post-Stroke outcomes Rabadi & Blass, 2008
- More

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Can Mg Supplements Play a Role?

- How do you know when to **initiate oral Mg therapy**?
- How much Mg via **supplementation is genuinely beneficial**?
- How do you **monitor oral Mg therapy**?

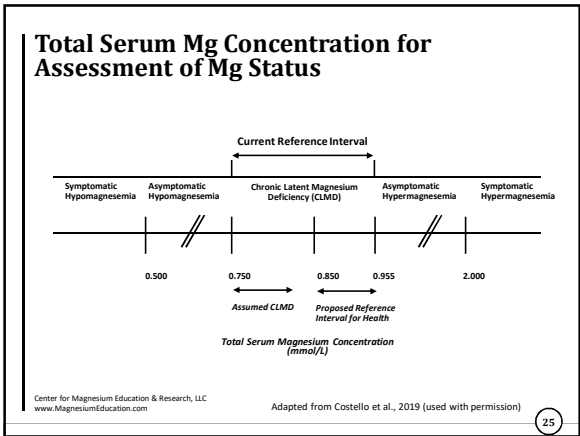
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Assessing Mg Status

- Serum Mg and other blood parameters
- Mg Load Test - CLMD
- Dietary questionnaire
- Assessment of Mg def symptoms

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Can Mg Supplements Play a Role?

- **Mg supplements in the range of 300 – 600 mg/day may not lower BP in Normotensive or non-medicated hypertensive patients, but do show**
 - Raised serum/plasma Mg Zhang et al., 2016
 - Improved endothelial function Barbagallo et al., 2010
 - Improved arterial flex (carotid-to-femoral pulse wave velocity) Joris et al., 2016
 - Lower CRP Simentel-Mendia et al., 2014
 - Improved fasting glucose & insulin resistance Guerrero-Romero et al., 2004; 2009; 2011; 2014
 - Improved Na metabolism (excretion, rbc) Plum-Wirrell et al., 1994
 - Improved cholesterol & triglycerides Guerrero-Romero et al., 2010
- **Mg supplements 240+ mg/day will lower both SBP and DBP in hypertensives taking anti-HT meds**

Source: Rosanoff, 2010; Rosanoff et al., 2018(in prep).

Can Mg Supplements Play a Role?

- **Water borne Mg**
- **IM Injections** – Baker, 1991
 - 50% MgSO4 – Once, weekly, monthly
- **Infusions** – Bouida et al., 2018
- **Transdermal** – Raises serum Mg Kass et al., 2017

Source: Center for Magnesium Education & Research, LLC.

Some Mg Deficit Symptoms

CARDIOVASCULAR	WOMEN/PREGNANCY/BIRTH	NERVOUS SYSTEM	
Irregular Heartbeats Cardiac Arrest (sudden death) Heart palpitations High blood pressure High cholesterol Mitral valve prolapse Angina	Menstrual cramps Pregnancy-induced hypertension Pre-eclampsia, eclampsia PMS Spontaneous abortion miscarriage Low birth weight	Nervous System Convulsions Migraine, other headaches Anxiety Depression Hostility Irritability Panic attacks Hearing loss, ringing in ear Restlessness Constant movement	Hyperactivity Insomnia Numbness Tingling Tinnitus Agoraphobia Chronic fatigue Sensitivity to bright lights Sensitivity to loud noises Apathy Spontaneous carpedal spasm
METABOLIC	MUSCULAR/SKELETAL	OTHER	
Metabolic syndrome Vitamin D resistance Low serum Ca and K Elevated serum P Type 2 diabetes Kidney stones Chronic fatigue Cravings for carbohydrates Cravings for salt	Muscle Cramps Muscle Soreness Muscle tension Muscle tetany Muscle twitches Osteoporosis	Constipation Difficulty swallowing Positive Chvostek Positive Trousseau	


Seeig & Rosanoff, 2003
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Stelle & Rosanoff, 2003

Mahalo Nui Loa

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Questions?



A. Rosanoff, PhD



**S. Volpe, PhD, RDN,
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Credit Claiming

You must complete a brief evaluation of the program in order to obtain your certificate. The evaluation will be available for 1 year; you do not have to complete it today.

CREDIT CLAIMING INSTRUCTIONS:

1. Go to www.CE.TodaysDietitian.com/Magnesium
OR Log in to www.CE.TodaysDietitian.com and go to "My Courses" and click on the webinar title.
2. Click "Take Course" on the webinar description page.
3. Select "Start/Resume" Course to complete and submit the evaluation.
4. Download and print your certificate.
