

# WHY DO WE NEED MAGNESIUM?



# WE ALL NEED MAGNESIUM



To grow<sup>(28-32)</sup>



**MAGNESIUM**

To balance the calcium in our food and supplements<sup>(36-39)</sup>



To change proteins we eat into our own personal enzymes<sup>(2, 32, 34, 35)</sup> and our own protein structures<sup>(32)</sup> that help build cells, bone<sup>(35)</sup> and muscle (especially heart muscle<sup>(2)</sup>).



To convert food we eat into usable life energy<sup>(14, 32-34)</sup>



**EVERY LIVING CELL  
ON EARTH NEEDS  
THE ESSENTIAL  
MINERAL  
MAGNESIUM<sup>(1)</sup>**

**MAGNESIUM LETS US**



See<sup>(15-18)</sup>



Breathe<sup>(2, 5)</sup>



Move<sup>(2, 4, 13, 14)</sup>



Walk<sup>(3, 4, 13)</sup>



Dance<sup>(3, 4, 13, 14)</sup>



Think<sup>(2, 55-56)</sup>



Hear<sup>(19-27)</sup>



Run<sup>(3, 4, 13, 14)</sup>



Sleep<sup>(6-12)</sup>

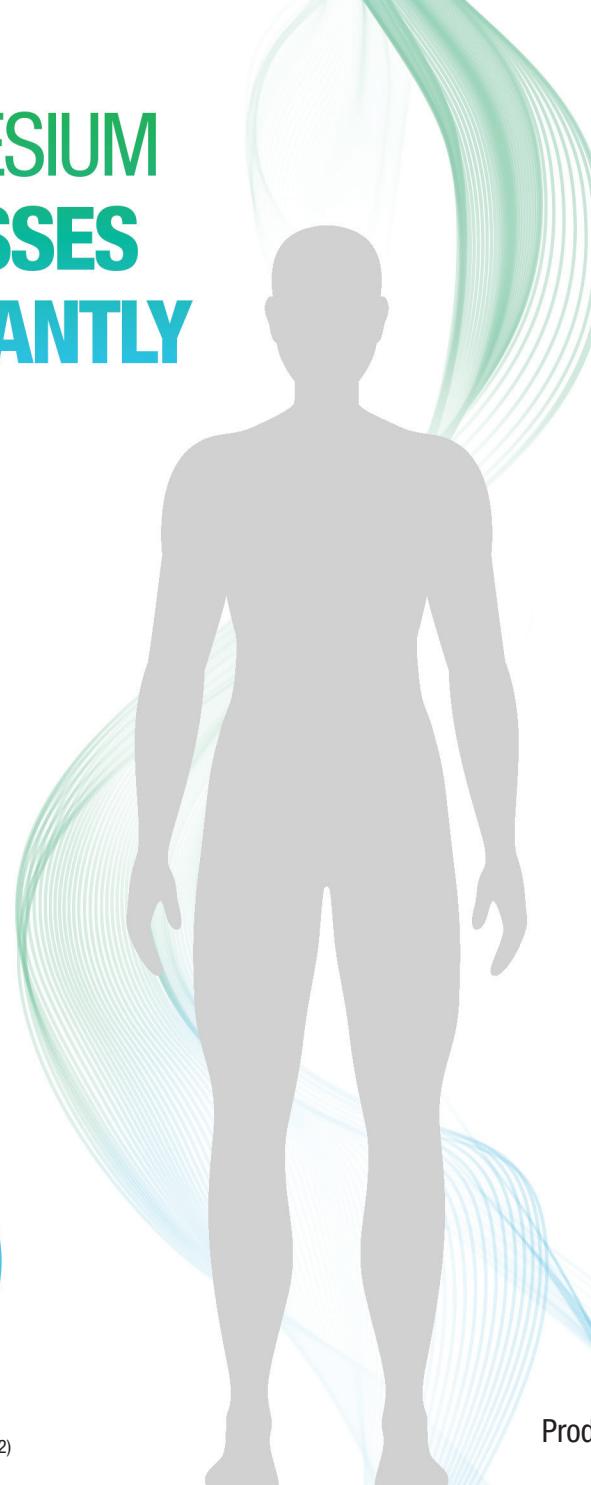
# WE ALL NEED MAGNESIUM FOR LIVING PROCESSES THAT GO ON CONSTANTLY AND CONTINUALLY:



Nerves actively firing and then being able to rest<sup>(32)</sup>



Muscle cells flexing and then being able to relax<sup>(32)</sup>



Hormones produced and put into circulation when stimulated and going back to “resting” state<sup>(41)</sup>



Blood vessels expanding and contracting<sup>(40)</sup>



Producing DNA<sup>(32, 42)</sup>; Making and using proteins<sup>(32)</sup>

# WE NEED TO REPLENISH OUR SUPPLY OF MAGNESIUM EVERY DAY.

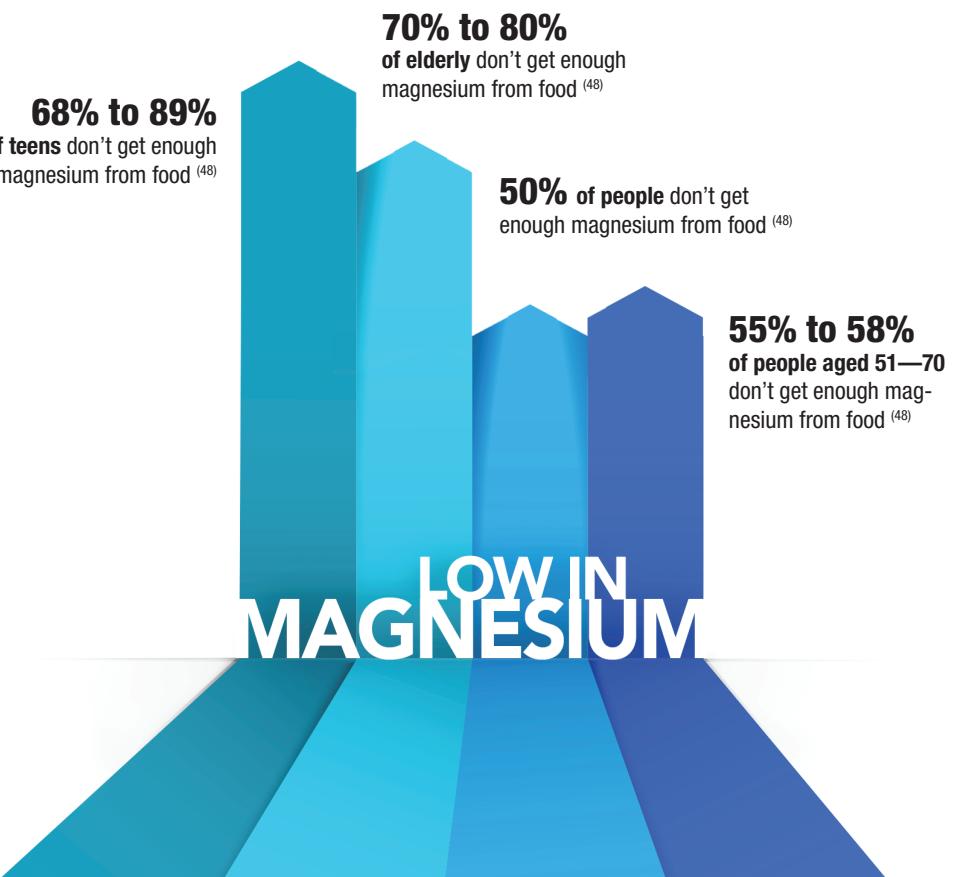
Since magnesium is constantly in motion in our cells, tissues and circulating blood, we lose a bit each day as skin cells slough off, as we sweat, as our hair and fingernails grow, and in our urine as our kidneys clean our blood.



**Many of us are low in magnesium because our diets are low in magnesium.**

Getting enough daily magnesium from the food you eat is possible<sup>(43)</sup> but, for many, very difficult<sup>(44-46)</sup>. With such crucial need, how can we be sure we have enough? Unfortunately about half of us do not get enough from our diets<sup>(47)</sup>.

Unfortunately there's not a really reliable test to determine your magnesium status<sup>(35)</sup>. Your blood values can be "normal" even if your whole body is low and getting lower<sup>(49)</sup>. So, how can you tell? Most magnesium is inside cells; very little is in the blood. Low cellular or unbalanced magnesium can show up as various symptoms, such as muscle cramps, anxiety, sleeplessness, constipation, migraine headaches<sup>(2, 32)</sup>, depression<sup>(2, 50)</sup>, high blood pressure<sup>(32, 51)</sup>, high cholesterol<sup>(51)</sup>, heart flutters<sup>(40)</sup>, difficulty getting a deep breath<sup>(2, 57)</sup>, diabetes<sup>(32, 52, 53)</sup> and heart disease<sup>(2, 32, 51)</sup>, including stroke. With such consequences, it can be a good idea to supplement with magnesium since oral magnesium is very, very safe for everyone with normal kidney function<sup>(54)</sup>.



# Center for Magnesium Education & Research, LLC

By Andrea Rosanoff, PhD

Dr. Rosanoff is a nutritional biologist, co-author with Mildred Selig, MD, MPH, of *The Magnesium Factor* (Avery) as well as author of numerous peer-reviewed journal articles and is Director of Research at the Center for Magnesium Education & Research. The center, located in Pahoa, Hawaii, is dedicated to the health of humankind—through increased knowledge of nutritional magnesium and its peer-reviewed science:

[www.magnesiumeducation.com](http://www.magnesiumeducation.com).

## REFERENCES

1. Berg JM, Tymoczko JL, Stryer L. Biochemistry, Seventh Edition: W. H. Freeman, 2010.
2. de Baaij JH, Hoenderop JG, Bindels RJ. Magnesium in Man: Implications for Health and Disease. *Physiol Rev* 2015;95(1):1-46. doi: 10.1152/physrev.00012.2014.
3. Shi J, Krishnamoorthy G, Yang Y, Hu L, Chaturvedi N, Harilal D, Qin J, Cui J. Mechanism of magnesium activation of calcium-activated potassium channels. *Nature* 2002;418(6900):876-80.
4. Nielsen FH, Lukaski HC. Update on the relationship between magnesium and exercise. *Magnes Res* 2006;19(3):180-9.
5. Landon RA, Young EA. Role of magnesium in regulation of lung function. *J Am Diet Assoc* 1993;93(6):674-7.
6. Dralle D, Bodeker RH. Serum magnesium level and sleep behavior of newborn infants. *European journal of pediatrics* 1980;134(3):239-43.
7. Held K, Antonijevic IA, Kunzel H, Uhr M, Wetter TC, Golly IC, Steiger A, Murck H. Oral Mg(2+) supplementation reverses age-related neuroendocrine and sleep EEG changes in humans. *Pharmacopsychiatry* 2002;35(4):135-43. doi: 10.1055/s-2002-33195.
8. Nielsen FH, Johnson LK, Zeng H. Magnesium supplementation improves indicators of low magnesium status and inflammatory stress in adults older than 51 years with poor quality sleep. *Magnes Res* 2010;23(4):158-68. doi: mrh.2010.0220 [pii] 10.1684/mrh.2010.0220.
9. Omiya K, Akashi YJ, Yoneyama K, Osada N, Tanabe K, Miyake F. Heart-rate response to sympathetic nervous stimulation, exercise, and magnesium concentration in various sleep conditions. *Int J Sport Nutr Exerc Metab* 2009;19(2):127-35.
10. Takase B, Akima T, Satomura K, Ohsuzu F, Mastui T, Ishihara M, Kurita A. Effects of chronic sleep deprivation on autonomic activity by examining heart rate variability, plasma catecholamine, and intracellular magnesium levels. *Biomed Pharmacother* 2004;58 Suppl 1:S35-9.
11. Takase B, Akima T, Uehata A, Ohsuzu F, Kurita A. Effect of chronic stress and sleep deprivation on both flow-mediated dilation in the brachial artery and the intracellular magnesium level in humans. *Clin Cardiol* 2004;27(4):223-7.
12. Billyard AJ, Eggett DL, Franz KB. Dietary magnesium deficiency decreases plasma melatonin in rats. *Magnes Res* 2006;19(3):157-61.
13. Veronese N, Berton L, Carraro S, Bolzetta F, De Rui M, Perissinotto E, Toffanello ED, Bano G, Pizzato S, Miotto F, et al. Effect of oral magnesium supplementation on physical performance in healthy elderly women involved in a weekly exercise program: a randomized controlled trial. *Am J Clin Nutr* 2014. doi: 10.3945/ajcn.113.080168.
14. Chen HY, Cheng FC, Pan HC, Hsu JC, Wang MF. Magnesium enhances exercise performance via increasing glucose availability in the blood, muscle, and brain during exercise. *PLoS One* 2014;9(1):e85486. doi: 10.1371/journal.pone.0085486.
15. Peshenko IV, Dizhoor AM. Ca<sup>2+</sup> and Mg<sup>2+</sup> binding properties of GCAP-1. Evidence that Mg<sup>2+</sup>-bound form is the physiological activator of photoreceptor guanylyl cyclase. *J Biol Chem* 2006;281(33):23830-41. doi: 10.1074/jbc.M600257200.
16. Gong H, Takami Y, Amemiya T. Ultrastructure of the optic nerve in magnesium-deficient rats. *Ophthalmic research* 2003;35(2):84-92. doi: 69132.
17. Gong H, Takami Y, Kitaoaka T, Amemiya T. Corneal changes in magnesium-deficient rats. *Cornea* 2003;22(5):448-56.
18. Cohen L, Laor A, Kitzes R. Reversible retinal vasospasm in magnesium-treated hypertension despite no significant change in blood pressure. *Magnesium* 1984;3(3):159-63.
19. Ising H, Handrock M, Gunther T, Fischer R, Dombrowski M. Increased noise trauma in guinea pigs through magnesium deficiency. *Arch Otorhinolaryngol* 1982;236(2):139-46.
20. Johnson S. The multifaceted and widespread pathology of magnesium deficiency. *Med Hypotheses* 2001;56(2):163-70.
21. Moccia F, Canalis P, Tomasi PA, Casu F, Pettinato S. The effect of noise on serum and urinary magnesium and catecholamines in humans. *Occup Med (Lond)* 2001;51(1):56-61.
22. Cevette MJ, Vormann J, Franz K. Magnesium and hearing. *Journal of the American Academy of Audiology* 2003;14(4):202-12.
23. Sendowski I. Magnesium therapy in acoustic trauma. *Magnes Res* 2006;19(4):244-54.
24. Alvarado JC, Fuentes-Santamaría V, Melgar-Rojas P, Valero ML, Gabaldón-Uli MC, Miller JM, Juiz JM. Synergistic effects of free radical scavengers and cochlear vasodilators: a new otoprotective strategy for age-related hearing loss. *Frontiers in aging neuroscience* 2015;7:86. doi: 10.3389/fnagi.2015.00086.
25. Choi YH, Miller JM, Tucker KL, Hu H, Park SK. Antioxidant vitamins and magnesium and the risk of hearing loss in the US general population. *Am J Clin Nutr* 2014;99(1):148-55. doi: 10.3945/ajcn.113.068437.
26. Sendowski I, Raffin F, Braillon-Cros A. Therapeutic efficacy of magnesium after acoustic trauma caused by gunshot noise in guinea pigs. *Acta oto-laryngologica* 2006;126(2):122-9. doi: 10.1080/00016480500312547.
27. Xiong M, Wang J, Yang C, Lai H. The cochlea magnesium content is negatively correlated with hearing loss induced by impulse noise. *American journal of otolaryngology* 2013;34(3):209-15. doi: 10.1016/j.amjoto.2012.11.015.
28. Altura BM, Altura BT, Carella A. Magnesium deficiency-induced spasms of umbilical vessels: relation to preeclampsia, hypertension, growth retardation. *Science* 1983;221(4608):376-8.
29. Clausen T, Dorup I. Micronutrients, minerals and growth control. *Bibliotheca nutritio et dieta* 1998;(54):84-92.
30. Gupta M, Solanki MH, Chatterjee PK, Xue X, Roman A, Desai N, Rochelson B, Metz CN. Maternal magnesium deficiency in mice leads to maternal metabolic dysfunction and altered lipid metabolism with fetal growth restriction. *Mol Med* 2014;20:332-40. doi: 10.2119/molmed.2014.00137.
31. Rubin H. Central roles of Mg<sup>2+</sup> and MgATP<sup>2-</sup> in the regulation of protein synthesis and cell proliferation: significance for neoplastic transformation. *Adv Cancer Res* 2005;93:1-58.
32. Volpe SL. Magnesium in disease prevention and overall health. *Advances in nutrition (Bethesda, Md)* 2013;4(3):378S-83S.
33. Garfinkel L, Garfinkel D. Magnesium regulation of the glycolytic pathway and the enzymes involved. *Magnesium* 1985;4(2-3):60-72.
34. Romani AM. Magnesium in health and disease. Metal ions in life sciences 2013;13:49-79. doi: 10.1007/978-94-007-7500-8\_3.
35. Long S, Romani AM. Role of Cellular Magnesium in Human Diseases. *Austin journal of nutrition and food sciences* 2014;2(10).
36. Nicoll R, Howard JM, Henein MY. A review of the effect of diet on cardiovascular calcification. *Int J Mol Sci* 2015;16(4):8861-83. doi: 10.3390/ijms16048861.
37. Louvet L, Buchel J, Steppan S, Passlick-Deetjen J, Massy ZA. Magnesium prevents phosphate-induced calcification in human aortic vascular smooth muscle cells. *Nephrol Dial Transplant* 2013;28(4):869-78. doi: 10.1093/ndt/gfs520.
38. Louvet L, Bazin D, Buchel J, Steppan S, Passlick-Deetjen J, Massy ZA. Characterisation of calcium phosphate crystals on calcified human aortic vascular smooth muscle cells and potential role of magnesium. *PLoS One* 2015;10(1):e0115342. doi: 10.1371/journal.pone.0115342.
39. Hruby A, O'Donnell CJ, Jacques PF, Meigs JB, Hoffmann U, McKeown NM. Magnesium intake is inversely associated with coronary artery calcification: the Framingham Heart Study. *JACC Cardiovascular imaging* 2014;7(1):59-69. doi: 10.1016/j.jcmg.2013.10.006.
40. Kolte D, Vijayaraghavan K, Khera S, Sica DA, Frishman WH. Role of magnesium in cardiovascular diseases. *Cardiology in review* 2014;22(4):182-92. doi: 10.1097/CRD.0000000000000003.
41. Hypomagnesaemia. Drug and therapeutics bulletin 2013;51(3):33-6. doi: 10.1136/dtb.2013.1.0169.
42. Abdalgawad IA, El-Mously RH, Saber MM, Mansour OA, Shouman SA. Significance of serum levels of vitamin D and some related minerals in breast cancer patients. *International journal of clinical and experimental pathology* 2015;8(4):4074-82.

43. Salehi-Abargouei A, Maghsoudi Z, Shirani F, Azadbakht L. Effects of Dietary Approaches to Stop Hypertension (DASH)-style diet on fatal or nonfatal cardiovascular diseases--incidence: a systematic review and meta-analysis on observational prospective studies. *Nutrition* 2013;29(4):611-8. doi: 10.1016/j.nut.2012.12.018.
44. Leon-Munoz LM, Guallar-Castillon P, Graciani A, Lopez-Garcia E, Mesas AE, Taboada JM, Banegas JR, Rodriguez-Artalejo F. Dietary habits of the hypertensive population of Spain: accordance with the DASH diet and the Mediterranean diet. *J Hypertens* 2012;30(7):1373-82. doi: 10.1097/JHH.0b013e328353b1c1.
45. Racine E, Troyer JL, Warren-Findlow J, McAuley WJ. The effect of medical nutrition therapy on changes in dietary knowledge and DASH diet adherence in older adults with cardiovascular disease. *J Nutr Health Aging* 2011;15(10):868-76.
46. Kwan MW, Wong MC, Wang HH, Liu KQ, Lee CL, Yan BP, Yu CM, Griffiths SM. Compliance with the Dietary Approaches to Stop Hypertension (DASH) diet: a systematic review. *PLoS One* 2013;8(10):e78412. doi: 10.1371/journal.pone.0078412.
47. Ford ES, Mokdad AH. Dietary magnesium intake in a national sample of US adults. *J Nutr* 2003;133(9):2879-82.
48. Rosanoff A, Weaver CM, Rude RK. Suboptimal magnesium status in the United States: are the health consequences underestimated? *Nutr Rev* 2012;70(3):153-64. doi: 10.1111/j.1753-4887.2011.00465.x.
49. Elin RJ. Assessment of magnesium status for diagnosis and therapy. *Magnes Res* 2010;23(4):194-8.
50. Tarleton EK, Littenberg B. Magnesium intake and depression in adults. *Journal of the American Board of Family Medicine* : JABFM 2015;28(2):249-56. doi: 10.3122/jabfm.2015.02.140176.
51. Bain LK, Myint PK, Jennings A, Lentjes MA, Luben RN, Khaw KT, Wareham NJ, Welch AA. The relationship between dietary magnesium intake, stroke and its major risk factors, blood pressure and cholesterol, in the EPIC-Norfolk cohort. *Int J Cardiol* 2015;196:108-14. doi: 10.1016/j.ijcard.2015.05.166.
52. Hruby A, Meigs JB, O'Donnell CJ, Jacques PF, McKeown NM. Higher magnesium intake reduces risk of impaired glucose and insulin metabolism and progression from prediabetes to diabetes in middle-aged americans. *Diabetes Care* 2014;37(2):419-27. doi: 10.2337/dc13-1397.
53. Wang J, Persutti G, Olendzki B, Wedick N, Zhang Z, Merriam P, Fang H, Carmody J, Olendzki G-F, Ma Y. Dietary Magnesium Intake Improves Insulin Resistance among Non-Diabetic Individuals with Metabolic Syndrome Participating in a Dietary Trial. *Nutrients* 2013;5(10):3910-9.
54. Ayuk J, Gittoes NJ. Contemporary view of the clinical relevance of magnesium homeostasis. *Annals of clinical biochemistry* 2014;51(Pt 2):179-88. doi: 10.1177/0004563213517628.
55. Hoane MR. Assessment of cognitive function following magnesium therapy in the traumatically injured brain. *Magnes Res* 2007;20(4):229-36.
56. Slutsky I, Abumaria N, Wu LJ, Huang C, Zhang L, Li B, Zhao X, Govindarajan A, Zhao MG, Zhuo M, et al. Enhancement of learning and memory by elevating brain magnesium. *Neuron* 2010;65(2):165-77. doi: 10.1016/j.neuron.2009.12.026.
57. Seelig MS, Rosanoff A. The Magnesium Factor. Page 279. 1st ed. New York: Avery Penguin Group, 2003.

#### OTHER REFERENCES:

1. NIH. Magnesium Fact Sheet for Consumers. In: Supplements NIH, ODS, ed., 2014.
2. Volpe SL. Magnesium. Edition ed. In: J.W. EJ, Macdonald IA, Zeisel SH, eds. *Present Knowledge in Nutrition*: Wiley-Blackwell, 2012:459-74.
3. ter Borg S, Verlaan S, Hemsworth J, Mijnarends DM, Schols JM, Luiking YC, de Groot LC. Micronutrient intakes and potential inadequacies of community-dwelling older adults: a systematic review. *Br J Nutr* 2015;113(8):1195-206. doi: 10.1017/S0007114515000203.
4. Mursu J, Nurmi T, Voutilainen S, Tuomainen TP, Virtanen JK. The association between serum 25-hydroxyvitamin D3 concentration and risk of disease death in men: modification by magnesium intake. *Eur J Epidemiol* 2015;30(4):343-7. doi: 10.1007/s10654-015-0006-9.
5. Shah NC, Shah GJ, Li Z, Jiang XC, Altura BT, Altura BM. Short-term magnesium deficiency downregulates telomerase, upregulates neutral sphingomyelinase and induces oxidative DNA damage in cardiovascular tissues: relevance to atherosclerosis, cardiovascular diseases and aging. *International journal of clinical and experimental medicine* 2014;7(3):497-514.
6. Seelig MS, Rosanoff A. The Magnesium Factor. 1st ed. New York: Avery Penguin Group, 2003.

