

Is There an Ideal Calcium: Magnesium Dietary Intake Ratio for Healthy Living?

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Introduction

The 2015-2020 US Dietary Guidelines considered magnesium (Mg) a shortfall nutrient that was under consumed relative to the estimated average requirement (EAR) for many Americans in the 2007–2010 NHANES What We Eat in America survey (USDA, 2015). Low intakes of dietary Mg have been associated with type 2 diabetes mellitus, CVD, hypertension, and elevated CRP levels. In 2012, 29.1 million Americans (or 9.3% of the population) were living with diabetes. Data from NHANES 2003-2010 estimates that 30.4% of American adults have hypertension. Studies conducted in the USA have shown that increasing Mg intakes by 200-375 mg/day will significantly lower CVD rates in populations consuming diets with a high Ca:Mg ratio (Chiuve et al, 2001; Zhang et al. 2012; Del Gobbo et al., 2013).

Objective: *We sought to survey the literature for studies reporting dietary intakes of calcium (Ca) and Mg in various population groups across the globe, either as single food sources or as part of a total dietary pattern.*

Among its many physiologic functions, Mg plays a key role in maintaining cellular and systemic homeostasis of Ca, sodium, and potassium and is essential for stabilizing excitable membranes. It acts as a calcium channel antagonist, stimulates production of vasodilator prostacyclins and nitric oxide, and modulates vascular responses to vasoactive agonists. A cellular imbalance between Ca and Mg is a predisposing factor to both CVD and type 2 diabetes. As intracellular Mg goes down, Ca influx into cells rises, raising the intracellular Ca:Mg ratio [\[FIGURE 1\]](#).

Milk, meat, and fish, as well as fortified foods, such as breakfast cereals contribute to dietary Mg to some degree. Magnesium is also present in tap, mineral, and bottled waters at varying concentrations; however, most deionized, bottled waters sold in the United States contain zero magnesium. Many foods of plant origin are rich sources of Mg, including whole grains, green vegetables, nuts, and pulses. Despite large variations of Mg content, plants remain the major source of foods that supply the human requirement for Mg. [\[TABLE I – FOOD SOURCES\]](#)

Magnesium in plant foods can be influenced by a number of factors: the availability of Mg to plants from the soil, plant genotype, crop breeding and cultural practices, time of harvest, harvesting method, and year-to-year environmental factors can all impact the amount of Mg in plant-origin foods. However, the largest factor in dietary availability of Mg from plant foods comes from processing, which can remove 85% of Mg from wheat, 80% from corn, 99% from oil seeds in producing oils, and 99+% from cane sources processed for sugar (USDA, 2001). These highly refined plant foods are all significant components of the modern processed food diet, which is low in Mg compared with more traditional diets.

Ca:Mg Ratio – Why It is Important

With low dietary Mg can come a lower ratio of Mg with other essential nutrients. The ratio of Ca: Mg in the diet appears to be steadily increasing worldwide. Populations consuming traditional diets comprised largely of seeds, nuts, whole grains, and traditional vegetables have dietary Ca:Mg ratios <1.0. These populations have a high dietary Mg intake >400 and up to 600 mg Mg/day (Rosanoff, 2013). Populations in “transition” from their traditional diets to the modern processed-food diet have dietary intake Ca:Mg ratios that increase from approximately 1 to 1.5 as their mean dietary Mg intakes fall to <350 mg/day [\[TABLE II POPULATION RANGES\]](#). These transition populations have rising levels of CVD and type 2 diabetes. Populations consuming modern processed-food diets have Ca:Mg dietary intake ratios >1.5 and some >2.8, a value above which has been determined to be a risk for disease. Increasing Ca: Mg ratios >2.8, such as those seen in recent NHANES surveys [\[TABLE III - NHANES\]](#), have been associated with higher rates of morbidity and mortality (Dai et al, 2007, 2011, 2012, 2016, Dai and Baron 2008). Currently, several dietary patterns are being promoted as healthier alternatives to the traditional Western diet that has been responsible for increasing the risk of chronic diseases. These dietary patterns include the Healthy Eating Index based on US DRI goals, DASH diet, Mediterranean diet, and vegetarian diets that have Ca:Mg ratios that range from 1.58 to 3.75 [\[TABLE IV- PATTERNS\]](#).

It is interesting to note that several of these diets target magnesium intakes higher than the current RDA for magnesium.

[\[CASE STUDY\]](#)

Underdeveloped Countries

In a number of underdeveloped countries, micronutrient deficiency is a serious public health problem. Attempts to enhance the quality of native foods to resolve the problem of mineral malnutrition are currently focused on food biofortification, dietary supplements, and diet diversification. A number of botanical “super foods” are being touted as nutrient dense and key to sustaining life in a number of underdeveloped nations. Foods such as acai, bitter melon, cocoa beans, mate tea, moringa, and taro have been researched for their nutritional or medicinal qualities. Ca: Mg ratios for these foods range from 0.61 to 9.72 [\[TABLE V- SUPER FOODS\]](#). In general these foods have desirable Ca:Mg ratios but some with dramatically high Ca:Mg, if adopted large scale, may be detrimental to health over time.

Conclusion

Clearly, primary and secondary prevention strategies to decrease risk from chronic diseases and their complications are a public health imperative. Hence, the need exists to more closely monitor the Mg content, as well as the Ca content of the food supply, in order to adjust estimates of population-wide Mg intakes and the balance of Ca:Mg for epidemiological research monitoring health outcomes. Increased attention to dietary patterns shown to lower the risk for chronic disease should provide adequate as well as balanced levels of Mg in the diet drawing largely from unrefined plant sources of Mg.

[Reference list](#) available at the end.

