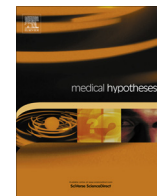


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# Medical Hypotheses

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## The high heart health value of drinking-water magnesium <sup>☆</sup>

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### ABSTRACT

Universal drinking water and beverages containing moderate to high levels of magnesium (10–100 ppm) could potentially prevent 4.5 million heart disease and stroke deaths per year, worldwide. This potential is calculated with 2010 global mortality figures combined with a recent quantification of water-magnesium's inverse association with heart disease and stroke mortality. The modern processed food diet, low in magnesium and spreading globally, makes this well-researched potential of drinking-water magnesium worth serious consideration, especially in areas where insufficient dietary intake of magnesium is prevalent.

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### Introduction

Recent studies confirm the strong, essential role magnesium plays in the prevention of cardiovascular diseases [1,2], a role that has been long and robustly elucidated. Adequate magnesium is vital in preventing atherogenesis and inappropriate clotting, in maintaining vascular tone, electrolyte balance and a host of other cellular, biochemical and physiological processes crucial to cardiovascular function and health [3–10].

#### Quantification & hypothesis

People living in areas with low-magnesium water have high rates of heart attack and stroke death, higher than people living in areas of high-magnesium water who seem to be protected from this scourge [11–38]. In fact, data tells us that consumption of drinking water even moderately high in magnesium (at least 10 ppm and up to 40 ppm and higher) can be expected to reduce cardiovascular mortality by 30–35% [39].

In 2010, 25% (12.9 million deaths) of all global deaths (52.8 million deaths) were deaths due to ischaemic heart disease or stroke, a rate up from 20% of all global deaths in 1990 [40]. Could as simple a solution as providing 10–100 ppm magnesium in drinking water and beverages have saved 30% to 35% of these people, up to 4.5 million lives in 2010 alone? [39,40]. How could such a simple and inexpensive adjustment make such a huge difference?

#### Discussion of hypothesis

The “Magnesium-in-water” effect was long ago pinpointed as most beneficial to people on diets low in magnesium. [12,23,41–44]. Is this common? International studies as early as 1961 to 1980 showed substantial dietary magnesium shortfalls ranging from 7% to 65% below RDA [45–57]. This is certainly the case today in the USA where highly processed foods quite low in magnesium [58] make up much of the diet. Recent studies show a significant portion of all age-gender groups of Americans NOT getting their daily magnesium requirement from foods [9,59–61], with 68–89% teens and 70–80% of the elderly falling into this low-magnesium category. These are all people who could benefit from the “Magnesium-in-water” effect. The highly processed, low magnesium diet so entrenched in the USA is spreading to developing nations, and as we saw above [40], so are death rates due to heart disease. Never before has the “Magnesium-in-water” effect been more promising to the health of the USA and the world.

Magnesium in the USA food supply dropped substantially between 1900 and 2010 [7,44], mostly due to food processing advances [58]. However, significant decreases in magnesium concentration of vegetables and high-yield grains of the Green Revolution have been documented [10,62–67]. Additionally, water-softening technology has become almost universal in USA homes during the past half century, removing all magnesium and calcium from household water supplies used for cooking and drinking, among other uses.

Could drinking water high in magnesium really make a difference? Experimental animals made magnesium deficient with low magnesium food show subcellular markers linked to heart disease [68–71]. Giving drinking-water with added magnesium to these animals lessens these markers even at such low magnesium levels as 15 ppm. Water magnesium levels of 100 ppm

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can completely reverse some of these markers [68–73]. Similar to these animal study experiments, human population studies show that populations with less than 3–6 ppm magnesium drinking water have very high rates of mortality from heart disease, and that rate goes down as the magnesium concentration of their water goes up, the higher the better [74]. Experts in this field tell us that total magnesium intake must be at least 450–500 mg per day, and drinking water should contain a minimum of 25–50 ppm magnesium [75]. Two liters of 25–50 ppm magnesium water would provide 15–25% of adult RDAs. To ascertain a minimum level of effective water-magnesium we can draw from studies by Rubenowitz et al. [31–33,76] that found only daily water-magnesium intakes above 13.8 mg to be protective (i.e., 2 liters per day of 6.9 ppm magnesium water). At present, many USA potable water sources contain less than 7 ppm magnesium and most bottled waters contain little, if any, magnesium [77]. No wonder USA death rates from heart disease are so high [40].

At this time in the USA, very few high magnesium mineral waters are available. One, Adobe Springs water, appears to be an exception as it is both high in magnesium (96–110 ppm) as well as low in both calcium and sodium [77], aspects that can be important to health. Calcium intakes from food have risen substantially in the USA over the past 30 years [78], just as recommendations for calcium supplementation to prevent osteoporosis became widespread. Both of these high calcium trends have occurred in the face of low magnesium intakes, and there is rising evidence that this trend poses dangers to heart health [9,79–84].

## Conclusion

It would be wise and forward-thinking for public health officials to consider how high-magnesium drinking water might be made available to communities, i.e., water with magnesium levels of at least 10 ppm and ideally 25–100 ppm. Bottled beverage makers might well be encouraged to consider how raising the magnesium content could improve the quality (and possibly future marketability) of their products. Certainly labeling of magnesium content in beverages and bottled waters (along with calcium and sodium) is justified.

As so well stated by Calderon and Hunter in the 2009 World Health Organization report, Calcium and Magnesium in Drinking Water, Public Health Significance (74, Page 141): . . . Epidemiological evidence supports the link between magnesium and cardiovascular mortality. Such an association is consistent with evidence of the cardiovascular effects of magnesium deprivation and of inadequate magnesium in the diets of people from developing countries. . . . ***How strong does the epidemiological and other evidence need to be before society acts*** to reduce a potential public health threat rather than await further evidence that such a threat is real? . . . There is a growing consensus among epidemiologists that the epidemiological evidence, along with clinical and nutritional evidence, is already strong enough to suggest that new guidance should be issued. [Bold italics added.]

## Conflict of interest

Dr. Rosanoff has received small sporadic honoraria and travel funding from Adobe Springs, California, over the past ten years, always with no input as to usage of said funding. Adobe Springs sponsored research for this paper but had no role or input in the collection, analysis or interpretation of scientific literature, nor in the writing of the manuscript, nor in the decision to submit this manuscript for publication. This paper was written and researched in complete autonomy.

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