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Magnesium and Calcium in Drinking Water

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While magnesium is one of the elements that supports life, many studies have been performed regarding physiological functions as well as correlation with diseases. Seelig and Rosanoff reviewed interesting data describing correlations between magnesium deficiency and disease.¹ Magnesium deficiency causes arrhythmia, overactivity to stress hormones (adrenalin), overproduction of cholesterol, blood clotting in blood vessels, constriction of blood vessels, high sodium–potassium ratio, insulin resistance, coronary atherosclerosis, and vulnerability to oxidative stress. Thus, Seelig and Rosanoff showed that magnesium content in hearts from cadavers of those who died of heart disease were much less than controls. Cadaver hearts from people who had lived in areas with hard drinking water had higher amounts of magnesium than cadaver hearts from soft-water areas. In 1957, Kobayashi indicated that the hardness of drinking water is related to the incidence of apoplexy.²

Materials and Methods

Water samples were collected from various sources in the world: hotel aqueduct, river, spring, and other sources. Countries included the United States, France, Belgium, Turkey, Greece, Chili, Egypt, China, Korea, Mongol, Indonesia, and Japan. Mineral content was measured at Sakai Institute of Public Health, Sakai, Japan, and Takeda Research Institute Life Science and Preventive Medicine, Kyoto, Japan.

Results

Calcium and magnesium as well as calcium/magnesium in drinking water showed considerably different levels in various parts of the world. Generally speaking, both calcium and magnesium levels are higher in Europe compared to other areas. Mineral content in Pamukkale in Turkey was the highest among sampled water. Contrexville in France had high levels of calcium and
magnesium. In Asian countries, some areas showed relatively higher levels of calcium and magnesium. Sang Sa Village has been known as a longevity village in Korea and has its own spring from which drinking water is obtained. Zhoukoudian area, located 50 kilometers southwest of Beijing, where Peking man (Sinanthropus pekinensis) was discovered, has wells nearby still being utilized by neighborhood populations; water from one had calcium and magnesium levels that were remarkably high. Marie Eugene Francois Thomas Dubois (1858–1940) discovered fossils of Pithecanthropus near Solo River in 1890. Drinking water was collected in this region and compared with that collected near Jakarta, Indonesia. Calcium and magnesium content in the former was higher compared with the latter. In Japan, calcium and magnesium content are not so high compared with other areas in the world, especially in comparison with those in Europe.

Discussion

Cardiovascular Disease and Mineral Content

Regarding the effect of both magnesium and calcium on blood pressure and incidence of cardiovascular disease, there have been many studies that are contradictory. However, Seelig and Rosanoff showed that cardiovascular and overall rates were found to be lower in hard-water areas than in soft-water areas. Deaths rates from coronary heart disease are approximately 300 per 1,000,000 people in Lincoln, Nebraska, where water hardness level was 147 ppm, a little more than 600 in Washington, DC, where water hardness level was 96 ppm, and more than 800 in Savannah, Georgia, where water hardness level was 41 ppm.

Recent statistics in the United States (Table 2.1) indicate that areas with high incidence of total death (as well as cardiovascular deaths) are located in the southeastern part of the country, including approximately 10 states. Among the top 10 areas with high mortality rates for both total deaths and cardiovascular deaths, six area are included for both causes of death: Mississippi, the District of Columbia, Kentucky, Alabama, Tennessee, and Oklahoma (Table 2.1). In the state of Tennessee, the water hardness is not so high in the present study.

Water hardness in France seems to be high compared with other countries outside Europe. The idea of a French paradox has been proposed for the low incidence of cardiovascular deaths in France compared with some neighboring countries in Europe. One of the contributing factors was ascribed to the high consumption of polyphenol supplied from red wine, but the water hardness could be another factor. Marque collected information about all deaths of 14,311 individuals in 69 parishes of southwest France from 1990–1996. A significant relationship was observed between calcium and cardiovascular mortality with relative risk (RR) = 0.90 for noncerebrovascular causes and