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Content of Magnesium in Drinking Water and Deaths from Ischaemic Heart Disease in White South Africans[1]

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Abstract. Mortality rates for acute myocardial infarction and ischaemic heart disease (IHD) of white males and females in South Africa are much higher than those in the USA, Australia, England and Wales when individuals in the 15- to 64-year age group are considered. Magnesium levels in the drinking water of 12 South African districts and deaths due to IHD assessed on the basis of corrected statistics for deaths apparently due to IHD in white residents were studied and a significant negative correlation was found between these two variables. No such correlation has been demonstrated in blacks.

Introduction

Ischaemic heart disease (IHD) accounts for the deaths of more white South Africans than cancer and road accidents combined. Within South Africa, IHD mortality rates for whites are higher than those for blacks and are also higher than rates in America, England and Wales and West Germany when individuals aged 15–64 are considered [3, 14].

No doubt, some South African deaths ascribed to IHD by medical practitioners completing death certificates are due to acute cardiac arrhythmias unrelated to IHD or, in some cases, to catastrophic cerebrovascular accidents, but diagnostic errors of this kind occur in most countries, particularly in rural areas, where autopsies are seldom performed, and are unlikely to account for any major bias in analyses of IHD rates.

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Whereas it is generally accepted that risk factors such as smoking, high serum cholesterol levels and hypertension are of primary importance in the pathogenesis of IHD, data from various sources suggest that the incidences of death from IHD and acute cardiac arrhythmias may be influenced by regional differences in dietary magnesium content [4, 8, 10]. This view is supported by clinical and pathophysiological evidence that serious disorders of cardiac rhythm may occur in magnesium deficiency of any origin [7, 12].

When domestic water is supplied from natural sources, its magnesium content approximates that of the local soil and farm produce and, in the absence of significant supplementation from other sources, the level of magnesium in drinking water provides an acceptable indication of total average magnesium intake in any given area [4, 8, 10]. Utilizing this principle, official data have been examined to determine whether any apparent relationship exists between deaths ascribed to IHD and magnesium levels in the drinking water of several selected South African towns [5, 6].

Methods

The average magnesium content of drinking water in various districts has been determined by the South African Department of Environmental Affairs [6]. Data were based on a sampling procedure whereby water from regional dams and rivers supplying them was repeatedly examined by atomic absorption spectrophotometry.

Analysis of these data allowed identification of localities where the magnesium content of water varied from 0.04 to 1.85 mmol/l (1–45 mg/l) covering a wide range of possible magnesium intakes. Twelve districts were chosen on the basis of high or low magnesium contents in drinking water prior to the acquisition of any data on regional death rates from IHD.

Corrected statistics for deaths in white males, apparently due to IHD and derived from death certificates issued during 1978, were supplied by the Department of Statistics, Pretoria [2, 5]. Spearman's (non-parametric) correlation coefficient (rho) was calculated to determine whether any correlation existed between deaths attributed to IHD and magnesium content in drinking water.

Results

The results of this analysis have been published elsewhere [9] and indicated a significant negative correlation between the incidence of death apparently due to IHD and the magnesium content of drinking water ($rho = 0.68$; $p < 0.02$).

Discussion

The incidence of magnesium deficiency in South Africa is unknown, although the low magnesium content of drinking water in many areas and the popularity of alcoholic beverages and use of laxatives and diuretics, which deplete the body of possibly limited magnesium resources, suggest quite clearly that deficiency is not uncommon. Certainly, careful studies carried out in parts of Finland, in which water supplies are relatively magnesium-deficient and sudden death, apparently from cardiac causes, is common [8], suggest that magnesium deficiency is a major cardiovascular risk factor. Furthermore, the view that magnesium deficiency could be of pathogenic importance in precipitating deaths from IHD is supported by experimental [13] and epidemiological findings [4, 8,

10]. The mechanisms involved are not clear although frank magnesium deficiency is associated with changes in glucose tolerance, arterial resistance and the high-density/low-density lipoprotein ratio [11] which aggravate the risk of IHD.

The death rates for IHD used in the South African study were undoubtedly biased by the inclusion of patients who did not suffer from IHD but died as a result of unrelated acute cardiac arrhythmias. However, since magnesium deficiency is a proven determinant of cardiac arrhythmias [12], this bias is probably of minor importance. It is possible that a small percentage of the sudden deaths attributed to IHD were caused by acute cerebrovascular events. It is unlikely that such misdiagnoses occurred with greater frequency in low- or high-magnesium-level areas, but it should be noted that experimental evidence has been published, indicating that magnesium depletion causes spasm of cerebral arteries [1] and may thus contribute to the pathogenesis of cerebrovascular accidents.

In considering these preliminary findings, it would be as well to note that IHD is relatively rare amongst black South Africans who do, however, commonly suffer from stroke, hypertension and cardiomyopathy. Since interracial differences in magnesium intake are likely to be small, variables other than magnesium intake and output must clearly be investigated in both population groups with the objective of explaining the different incidences of IHD observed in blacks and whites. Factors such as sodium, potassium, calcium, alcohol and dietary unsaturated fat intakes all deserve attention; clearly the problem is both interesting and challenging and deserves extensive epidemiologically based research.

La teneur en Mg de l'eau de boisson et les décès par suite d'affections cardiaques ischémiques chez des Sud-Africains de race blanche

Les taux de mortalité par suite d'infarctus aigu du myocarde et de maladie cardiaque ischémique d'hommes et de femmes de race blanche en Afrique du Sud sont beaucoup plus élevés que ceux observés aux Etats-Unis, en Australie, en Angleterre et au Pays de Galles quand on prend en considération le groupe d'âge de 15 à 64 ans. Les taux de magnésium dans l'eau de boisson de 12 districts d'Afrique de Sud et les décès par suite d'affections cardiaques ischémiques, étudiés à l'aide de statistiques corrigées de décès d'habitants blancs, ont été analysés et une corrélation négative significative a pu être établie entre ces deux variables. Une telle corrélation n'a pas été mise en évidence chez les noirs.

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