

# Calcium and Cancer: A Geographical Perspective

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*Cancer in North America*,<sup>1</sup> a report released in April 1998, provided an overview of mortality, for the years between 1990 and 1994, from this cause in both Canada and the United States. During this time period, a total of 2,604,650 Americans and 274,742 Canadians died from cancer, at an average rate of 520,930 a year in the United States and 54,950 annually in Canada. To dramatize these losses further, they were characterized by the press as being equivalent to one Titanic sinking each day, or 12 survivorless jumbo jet crashes each week.<sup>2</sup> These figures give further support to Simone and colleagues<sup>3</sup> percent prediction that, by the year 2000, "cancer will emerge as the number one cause of death in the United States".

Despite the fact that there are more than a hundred specific cancers, the recent North American report established that approximately half of all these deaths were caused by only four; those of the lung, colorectum, breast and prostate. This is of particular interest because, in the United States, these cancers have been shown to have very similar spatial distribution patterns.<sup>4</sup> This author has demonstrated that US states, during the period 1950 to 1967, that had experienced elevated white male mortality from cancers of the digestive tract, for example, also experienced high death rates for cancer of the lung. Similarly, breast cancer mortality, in white women, appeared elevated in those states where digestive cancers were commonest.<sup>4</sup> Such clustering suggests that causal variables may be the same for some, if not all, of these major cancers. In an attempt to determine what these variables might be, this author correlated the spatial distributions of mortality from 66 cancers and groups of cancers with 219 natural and man-made substances in the United States. The results obtained suggested that the most likely environmental variables

responsible for US cancer mortality are depressed soil calcium and selenium levels and elevated soil mercury. In addition, a wide range of cancers show strong positive correlations with road salt use.<sup>5</sup>

In an earlier editorial, this author provided strong evidence that much of North America's cancer mortality could be prevented by increasing dietary intake of selenium, through measures such as supplements, addition of this element to table salt and/or to animal food stocks and fertilizers. The following discussion, therefore, focuses on calcium as a possible cancer prophylactic. In addition to demonstrating statistically significant correlations between a variety of cancers and soil calcium levels in the United States, the 1986 study also provided evidence that, in England and Wales, highly calcareous drinking water was associated with depressed overall cancer mortality.<sup>4</sup> In addition, evidence was presented from Brittany, Normandy, Romania, Italy, Zimbabwe, Senegal, Iran, Afghanistan, the Soviet Union and China that strongly suggested that mortality from cancer of the esophagus was largely a reflection of levels of environmental calcium.

In 1989 Norie and I published a study that showed that cancer of the digestive tract, from the tongue and mouth to the rectum, was less common in Canadian communities drinking calcium and magnesium enriched water.<sup>6</sup> This survey was based on water samples from 526 settlements with populations of at least 1000 and on data abstracted from the *Mortality Atlas of Canada, Volume 1: Canada*.<sup>7</sup>

More recently, Yang and co-workers<sup>8</sup> established that in Taiwan, mortality from colon cancer declined as the calcium content of drinking water increased. In this study, all eligible colon cancer mortalities, a total of 1714 cases, that had occurred between

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1989 through 1993, were matched with a control group of the same size the members of which had died from other causes. The levels of calcium and magnesium in the residential drinking water of these two groups of individuals was then established from the records of the Taiwan Water Supply Corporation. Adjusted odds ratios showed that drinking calcium-enriched water seemed to have significantly reduced the probability of death from colon cancer. A parallel study,<sup>9</sup> using the same technique, also established that in Taiwan, gastric cancer occurred most often amongst soft water drinkers.

In addition to the evidence that calcium may act as a prophylactic for cancer of the digestive tract, it has been suggested that it may play the same role for breast cancer. To illustrate, Garland and co-workers<sup>10</sup> argued that, as sunlight levels increase, in the United States, breast cancer mortality declines. They claimed that this was because many American women lack adequate exposure to sunlight to manufacture sufficient active vitamin D to utilize calcium effectively. The current author made a similar suggestion in 1986, when he demonstrated a strong negative relationship between breast cancer mortality and sunlight, both in the United States and globally.<sup>4</sup> Further evidence to suggest that inadequate exposure to sunlight and associated calcium deficiency may be risk factors in breast cancer is provided by the observation that this disease is unusually common in women with primary hyperparathyroidism. Excesses of parathyroid hormone, characteristic of this illness, results in calcium removal from the bone, similar to that experienced when diet contains inadequate calcium.<sup>11</sup> More recently, Heerdt and colleagues<sup>12</sup> have suggested that calcium glucarate could be used as a breast cancer prophylactic, arguing that it would change both the internal hormonal milieu and also directly detoxify environmental agents responsible for breast cancer.

Why may calcium provide protection

against several of the most common cancers? Orally ingested calcium appears to lower digestive cancer risk by binding fatty acids and so reducing exposure to toxic intraluminal substances.<sup>13</sup> In addition, experimental studies using rodents have shown that calcium citrate seems to decrease colonic epithelial cell proliferation.<sup>14</sup> A similar effect also has been described in humans.<sup>15,16</sup>

Although field trials with calcium lag behind those for selenium, there is some direct evidence that calcium can protect against certain cancers. To illustrate, the Chinese have been using jiangshi, concretions precipitated from groundwater into loess (wind blown silt), for hundreds of years to treat esophageal cancer. In 1970, Goa and colleagues<sup>17</sup> began lining waterwells in Xingtai county, Hebei province with jiangshi. This county had experienced one of the worlds highest esophageal cancer mortality rates, 275.28 per 100,000, in the five years prior to this experiment. During the ten years of the investigation, the annual mortality rate from esophageal cancer fell to 54.28 per 100,000, a more than 5-fold decrease. Only a minor decline in mortality occurred in the control group. Gao and co-workers also reported a statistically significant decline in esophageal cancer in residents of Shahe, Lingjin and Xingtai counties, after jiangshi had been dropped into their drinking water towers.<sup>18</sup> Although the main component of jiangshi is calcium (23 - 29%), these concretions also contain a variety of other bulk and trace elements. For this reason, the cause(s) of these declines in esophageal cancer mortality in China cannot be linked definitively to an increase in dissolved calcium in drinking water, although it seems likely.

More recently, however, Duris and colleagues<sup>19</sup> have showed that the cumulative survival rate of patients after surgery for colorectal carcinoma was significantly higher if they received calcium supplements than if they did not. In addition, polyps recurrence

after polypectomy was only 12.9% in a calcium treated group, compared with 55% in a control group, with a mean follow-up time of 3.1 years.

While the evidence that calcium may be a cancer prophylactic is poorer than that for selenium,<sup>20</sup> it is clearly time for a major field trial, preferably one using both elements in combination. Of course, a geographer like myself already considers such a trial to be ongoing in Senegal. Inhabitants of this West African country drink the world's hardest water, which can contain as much as 3.5 grams per litre of dissolved calcium and magnesium salts.<sup>21</sup> In addition, Senegal's bedrock is dominated by lime phosphorite, a marine precipitate that is typically highly selenium enriched. It is perhaps more than an interesting coincidence that the globe's lowest recorded incidences of cancer of the trachea, bronchus and lung occur in both genders in Senegal.<sup>22</sup> Similarly, the world's lowest incidences of esophageal, stomach, colon and rectum cancer also occur in Senegalese males and females. In addition, males in Senegal experience the fourth lowest known incidence of prostate cancer and its women the second lowest incidence of cancer of the breast. In summary, the four major killers of North America; lung, colorectal, breast and prostate cancer are virtually unknown in Senegal, a country where diet is high in selenium and calcium and exposure to mercury and road salt are minimal.

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