The importance of solar ultraviolet-B irradiance and vitamin D in reducing the risk of cancer in Australia and New Zealand

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Abstract. This paper examines the latitudinal variation in cancer mortality rates in Australia and New Zealand in order to estimate the effect of solar ultraviolet-B irradiance in reducing the risk of cancer in these countries.

Introduction

The ultraviolet-B (UVB)/vitamin D/cancer hypothesis was proposed over 25 years ago [Garland and Garland, 1980], and has received considerable support, especially in ecologic studies in the U.S. [Grant, 2002; Grant and Garland, 2006], Europe [Grant, 2003], and Japan [Mizoue, 2004]. The mechanisms whereby vitamin D reduces the risk of cancer are well known, and a meta-analysis of case-control and cohort studies has estimated the amount of vitamin D required to reduce the risk of colorectal cancer by 50% [Gorham et al., 2005]. A recent cohort study also found that a vitamin D index was inversely correlated with about a dozen types of cancer, including some of the rarer types such as leukemia and esophageal, pancreatic and renal cancer [Giovannucci et al., 2006]. A study reported an increase in cancer rates in Australia with increasing latitude, but attributed the effect to cosmic rays, which peak near the poles in accordance with the Earth's magnetic field [Astbury, 2004].

This paper examines the latitudinal variation in cancer mortality rates in Australia and New Zealand in terms of the UVB/vitamin D/cancer hypothesis.

Materials and Methods

Cancer mortality rate data were obtained from the Australian Institute of Health and Welfare (AIHW) [2005]. Data were obtained by cancer and state or territory from 1968 to 2003. The latitude of each state was taken as that of the capital, and is used as the index of annual vitamin D production from solar UVB. Data for the Northern Territory were omitted from the analysis since it is largely populated by indigenous peoples with dark skin and who have a high prevalence of smoking and a short life expectancy. Inclusion of these data would have increased the latitudinal gradient. Data were averaged for 7-8 years in order to reduce statistical uncertainties.

Data for cancer mortality rates for 1980 and 2000 were obtained from Ferlay et al. [2004].

Results and Discussion

Figure 1 shows the latitudinal variation in colorectal cancer mortality rates for males for various periods from 1968-75 to 1998-2003. Among the cancers investigated, those that show similar latitudinal variations include all, all less lung cancer, breast, colorectal, gastric, leukemia (females only), ovarian, and prostate cancer. Melanoma has an inverse association with latitude, as expected for a cancer related to solar UVA [Moan et al., 1999], but the difference in melanoma deaths with latitude is much lower than the corresponding difference for other cancers.

Table 1 gives the data for cancer mortality rates for females for Australia and New Zealand for 1980 and 2000. The differences for males were much lower.

Discussion

These results indicate that there is a latitudinal gradient for cancer mortality rates in Australia that is likely associated with solar UVB doses. The fact that similar gradients have been found in Europe, Japan, and the U.S. strongly suggests that a similar mechanism is involved. No other viable mechanism has been proposed. The UVB/ vitamin D link is further strengthened by the recent adoption of new policy statement [Working Group, 2005].

The fact that there are smaller differences between cancer mortality rates between Australia and New Zealand for males compared with females may be due to New Zealand men spending more time out of doors than Australian men and women in both countries.

There is some indication that the latitudinal gradients in cancer mortality rates have decreased with time. In the U.S. this finding seems to be related to increased cancer screening and better cancer treatment. However, it may also be related to increased travel to sunny vacation spots as well as increased use of sunscreen, which reduces vitamin D production.

Recent analyses of cancer incidence rates with respect to vitamin D found that between 1000 and 2000 I.U. of vitamin D per day are required to reduce the risk of various types of cancer [Gorham et al., 2005; Garland et al., 2006; Giovannucci et al., 2006]. These values are likely not met through casual solar UVB irradiance in Australia or New Zealand given the current paranoia about the risk of melanoma and skin cancer. While solar UV irradiance does entail the risk of skin cancer and melanoma, if people do not get sufficient vitamin D from solar UVB, they should be encouraged to get it from supplements. Alternatively, commonly consumed foods, such as bread, could be more heavily fortified [Natri et al., 2006], but it would be difficult to fortify foods to the point where the population would average over 1000 I.U. per day.

Conclusions

This paper provides strong evidence that solar UVB irradiance, through production of vitamin D, reduces the risk of cancer in Australia and New Zealand. However, the amount of vitamin D from solar UVB and oral intake is far below that required to provide optimal cancer risk reduction. It is hoped that there will further efforts to increase the vitamin D status of Australians and New Zealanders.

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Figure 1. Graph showing the variation in colorectal cancer mortality rate for males as a function of latitude for several time periods.

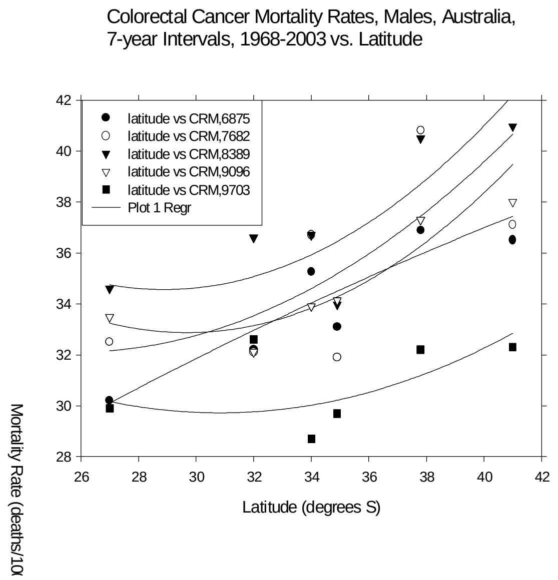

Table 1. Comparison of cancer mortality rates for females over the age of 40 years in Australia and New Zealand for 1980 and 2000 [IARC, 2005].

Cancer	Aus – Female (Rates, 1980 and 2000)	NZ – Female (Rates, 1980 and 2000)
Bladder	**4.7/3.1**	**5.1/3.7**
Breast	**56.4/48.3**	**80.2/60.7**
Cervical	**9.5/4.9**	**12.5/6.9**
Colon	**39.9/46.7**	**42.3/49.8**
Esophageal	4.7/4.2	5.3/4.1
Gastric	**13.5/6.6**	**17.3/9.5**
Gallbladder	**4.6/3.3**	**6.3/3.5**
Leukemia	9.5/8.4	9.4/7.9
Lung	**30.0/43.0**	**40.6/53.3**
Melanoma	**6.0/6.0**	**7.8/9.2**
Multiple myeloma	4.2/5.5	5.0/5.1
NHL	10.3/12.2	8.0/8.5
Pancreatic	14.9/13.8	14.9/12.5
Rectum and anus	**11.6/8.5**	**20.0/14.5**
Renal	5.3/5.0	5.3/4.3
Uterine, corpus	**16.0/9.4**	**21.5/15.9**