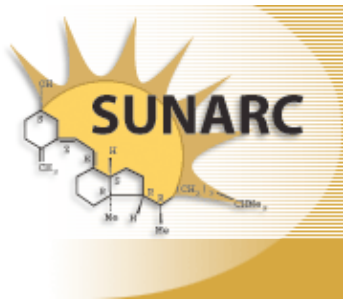

Sunlight, Nutrition And Health Research Center

The role of ultraviolet-B (UVB) radiation (290-315 nm) and vitamin D in reducing the risk of cancer*

William B. Grant, Ph.D.

SUNARC

Abstract

Cancer is group of chronic diseases for which the protective role of UVB and vitamin D is fairly well established. The most recent study found that UVB radiation was inversely correlated with 16 types of cancer for white Americans, primarily epithelial cancers of the digestive and reproductive systems [Grant, submitted]. Six types of cancer (breast, colon, endometrial, esophageal, ovarian, and NHL) were inversely correlated to both incident solar UVB irradiance and rural residence. Another 10 types of cancer (bladder, gallbladder, gastric, pancreatic, prostate, rectal, renal, testicular, and vulvar cancer and NHL) were inversely correlated with UVB radiation but not rural residence. Ten types of cancer were significantly correlated with lung cancer mortality rates, in excellent agreement with the literature on the risk for cancer from smoking [147], 6 types with alcohol consumption, again with excellent agreement with the literature [Grant, submitted], and 7 types with Hispanic heritage. Three types of cancer had been linked to Hispanic heritage [144]. Since the results for alcohol, Hispanic heritage, and smoking agree well with the literature, they provide a high level of confidence in the approach and its results for UVB irradiance and degree of urbanization, and, thus, the protective role of vitamin D. A review of the literature on vitamin D and colorectal cancer concluded that dietary vitamin D is insufficient in and by itself to have a significant impact on the risk of colorectal cancer [19]. Thus, in addition to diet, exercise, and lifestyle, one can reduce one's risk of cancer considerably by obtaining adequate amounts of vitamin D, from natural and artificial UVB, supplements, and diet. In obtaining vitamin D from UVB, the amount of exposure is far less than that which is generally associated with skin cancer: the important things to do are get regular, moderate amounts of UVB and avoid any reddening of the skin or sunburning.

Introduction

Cancer is group of chronic diseases for which the protective role of vitamin D is fairly well established. The evidence for the protective role of vitamin D

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Position of health organizations and agencies in Australia, Canada, New Zealand, the United Kingdom, and the United States, and the World Health Organization, on UV radiation and vitamin D

against cancer includes ecologic studies of geographic variation [4,21,22,130], various studies relating to vitamin D status and disease outcome [19], and a good understanding of the role of vitamin D in reducing the risk of cancer [25,52].

While most studies on vitamin D and cancer have been limited to the more common cancers - breast, colon, ovarian, prostate cancer and non-Hodgkin's lymphoma [NHL], the ecologic approach has extended the connection between UVB and vitamin D risk reduction to a total of 16 cancers [4; Grant, submitted].

In ecologic studies, populations are treated as entities within geographic boundaries, and both measures of disease outcome and possible disease influencing factors are determined for the populations so defined. Regression analyses are then performed. While the ecologic approach does not enjoy a good reputation, it has withstood many tests, and it is noted that case-control and cohort studies often take years to decades to confirm the findings of ecologic studies. Examples of successful identification of disease risk or risk reduction factors using the ecologic approach include solar radiation exposure as a risk reduction factor for internal cancers [4,21,130], dietary fiber as a risk reduction factor for colon cancer [131-133], animal fat as a risk factor for breast cancer [134-136], and dietary components as risk and risk reduction factors for Alzheimer's disease [137-139].

The most recent ecologic study used state-averaged mortality data [140] for all contiguous states plus the District of Columbia (DC) with July incident UVB [141] and additional risk factors and [Grant, submitted]. These factors included degree of urbanization, alcohol consumption, fraction of population of Hispanic heritage or living below the poverty level, and lung cancer mortality rates. Lung cancer mortality rates were used to account for the long-term adverse health effects of smoking, noting that smoking accounts for about 87% of lung cancer mortality rates in the U.S. [142]. Data on the proportion of population of Hispanic heritage [143] were included since Hispanics are included in the category of white Americans, and Hispanics have somewhat elevated rates for several types of cancer [144].

This study found that UVB radiation was inversely correlated with 16 types of cancer for white Americans, primarily epithelial cancers of the digestive and reproductive systems [Grant, submitted]. Six types of cancer (breast, colon, endometrial, esophageal, ovarian, and NHL) were inversely correlated to both incident solar UVB irradiance and rural residence. This study found that the fraction of the variance associated with UVB radiation (incident UVB plus rural or urban residence) increased by 0.07 to 0.28, except for rectal cancer for females compared to the original study [4]. Living in an urban area is associated with reduced UVB exposure compared to living in a rural area, thus reducing the effect of incident UVB. Doll (145) identified UV radiation as one of the factors explaining the lower cancer rates in rural regions compared to urban regions. Also, urban residence was identified as a risk factor for colon cancer in other studies [146].

Another 10 types of cancer (bladder, gallbladder, gastric, pancreatic, prostate, rectal, renal, testicular, and vulvar cancer and NHL) were inversely correlated with UVB radiation but not rural residence. Ten types of cancer were significantly correlated with lung cancer mortality rates, in excellent agreement with the literature on the risk for cancer from smoking [147], 6 types with alcohol consumption, again with excellent agreement with the literature [Grant, submitted], and 7 types with Hispanic heritage. Three types

of cancer had been linked to Hispanic heritage [144]. Poverty status was inversely correlated with 7 types of cancer. Since the results for alcohol, Hispanic heritage, and smoking agree well with the literature, they provide a high level of confidence in the approach and its results for UVB radiation and degree of urbanization. Solar UVB radiation is an important source of vitamin D in the U.S. [10,12], with seasonal variations in solar UVB explaining the seasonal variations in serum 25(OH)D levels [148-150]. Since various types of cancer have some shared and some unique risk factors, it would be surprising if a factor other than vitamin D explained the solar UVB link, especially since the mechanisms whereby vitamin D reduces the risk of cancer are well known [12,25,52].

The only major risk factor for cancer not included in this study is diet. However, a study of regional dietary intake in the U.S. in 1977-8 found that dietary macro and micro nutrients did not vary by more than 10-20% for each of the 4 major regions of the U.S. [151]. In order to explain the cancer mortality rates by diet, the diet would have to approximate the northern European diet in the northeastern states and the Japanese diet in the southwestern states [4,135,152]. That is simply not the case.

Colorectal cancer
A cursory review of the literature regarding the relation between vitamin D status and colorectal cancer suggests that there is a general inconsistency in the findings: ecologic studies always find that incident UVB is a significant risk reduction factor, while case-control and cohort studies almost always fail to find that dietary vitamin D is a significant risk reduction factor (other than [152]), although total vitamin D intake including supplements, prediagnostic serum 25(OH)D, or personal UVB exposure generally are [19]. Using Hill's criteria for causality, it was shown that vitamin D sufficiency should be considered a risk reduction factor for colorectal cancer, even though dietary sources of vitamin D alone are not, since the quantities of vitamin D in food are small, requiring additional sources such as supplements or natural or artificial UVB to bring serum 25(OH)D to adequate levels.

Prostate cancer
The case of prostate cancer is interesting for a different reason, namely that the normal average serum concentration of 25(OH)D (40-60 nmol/L) comprises the lowest risk of prostate cancer [46]. The role of UVB and vitamin D status in reducing the risk of prostate cancer is well established [42,43,45,47]. However, the geographic variation of prostate cancer mortality rates in the U.S. is not at all similar to those of many cancers for which vitamin D is a well-established risk factor (high in the northeast, low in the southwest) [4,140], but, instead, has a strong latitudinal variation independent of longitude. The Scandinavian finding spurred a new ecologic study of prostate cancer mortality rates in the U.S., with the result that in a multiple linear regression, latitude had the highest correlation, while summertime UVB had a moderately high correlation as well [41]. Wintertime serum 25(OH)D is assumed to vary more uniformly with latitude than is summertime serum 25(OH)D since the number of months during which vitamin D can be produced from solar UVB appears to be a function of latitude with a reduced effect of surface elevation that plays a role in summertime incident UVB.

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