What are the key goals of your current investigation of the role of solar ultraviolet-B (UVB) and vitamin D in reducing the risk of cancer and other types of disease?

I aim to convince other researchers to conduct the types of research necessary to gain acceptance of UVB and vitamin D in preventing and treating disease, as well as to educate the public on the health benefits of both. After I published my ecological studies of UVB and cancer, for example, researchers in several universities were prompted to conduct observational studies and randomised controlled trials to evaluate my findings.

Are there specific areas you find particularly interesting about this research?

Personally, I find it interesting that, with no formal education in health research, I can make important findings that alter the course of health research and public policy. We happen to be in the ‘golden age’ of vitamin D research, and there is still plenty to learn and demonstrate regarding the roles of UVB and vitamin D. There are several recent papers indicating that UVB has important health benefits in addition to the production of vitamin D, and I am eagerly awaiting more findings on this topic.

Do your UVB studies link with your research into the role of diet in chronic disease risk?

I use the geographical ecological approach for linking UVB and dietary factors to risk of chronic diseases, and check my findings with results from observational studies as well as looking for identified mechanisms to explain the links. The geographical units can be small, such as counties, or large, such as countries. The important thing is to use data for health outcomes averaged over the population of each unit as well as indices for risk-modifying factors averaged for the same populations. For some diseases, temporal ecological studies are also conducted in which the seasonality of health outcomes is investigated, such as respiratory infections, or trends, such as for Alzheimer’s disease. In all ecological studies, it is important to consider possible confounding risk-modifying factors.

You have been quoted as saying that increasing serum 25-hydroxyvitamin D (25(OH)D) levels is the most cost-effective way of reducing global mortality rates. Can you provide a brief overview of the analysis that led you to this conclusion?

The approach I used to reach that conclusion was to take the 25(OH)D concentration-disease outcome relation for the diseases with the greatest impact on mortality rates, obtain mean population values of 25(OH)D concentrations (generally near 54 nmolL⁻¹), determine the fraction of deaths that would be reduced if 25(OH)D concentrations were raised to, say, 110 nmolL⁻¹, and then sum the reductions in mortality rates for those diseases.

Globally, I found reductions in mortality rates ranging from 7 per cent in Africa to 17 per cent in northern Europe, corresponding for all regions to an increase in life expectancy of two years. The annual cost of 2,000-5,000 international units per day vitamin D₃ is as low as US $10.

Looking ahead to the next five to 10 years, what research plans do you have in the pipeline?

At present, I plan to continue with the same type of research I have been conducting for the past 18 years. I am always on the lookout for datasets that I can use to find new insights into disease-environment links.

I also plan to continue writing reviews on the health benefits of UVB and vitamin D. As it generally takes 17 years for scientific discoveries to alter medical practice, there is still much work ahead to make vitamin D accepted as a prevention and treatment measure for disease, as well as to dispel the notion that solar UV is dangerous. In addition, I am considering whether I can apply the ecological approach to find beneficial effects of UVB separate from inducing production of vitamin D.

In terms of diet, my research on Alzheimer’s disease, cancer and cardiovascular disease found and/or confirmed that animal products, such as meat, are important risk factors for chronic diseases. However, countries with high consumption of animal products also have long life expectancies. Thus, there is much more to learn about the role of diet and health, and the ecological approach may provide some more answers.
A researcher from the Sunlight, Nutrition, and Health Research Center in San Francisco, California, has applied his experience as a former physicist and atmospheric scientist to health research. His unique perspective has led to important discoveries on the roles of sunlight and diet as factors in various life-threatening conditions.

VITAMIN D HAS long been known to be crucial in bone development and maintenance, with deficiency causing rickets in children and osteomalacia in adults, and also contributing to osteoporosis in the elderly. Unusually for a vitamin, vitamin D is not primarily taken in by the body as part of diet, as few foods naturally harbour the nutrient – although dietary supplements do exist. Instead, it is mainly produced endogenously when ultraviolet-B (UVB) rays from sunlight strike the skin and trigger vitamin D synthesis.

A biologically inert compound, vitamin D must undergo two hydroxylations in the body for activation. The first occurs in the liver and converts vitamin D to 25-hydroxyvitamin D (25(OH)D), also known as calcidiol. The second happens primarily in the kidneys and forms the physiologically active 1,25-dihydroxyvitamin D (1,25(OH)2D), also known as calcitriol.

SUNLIGHT STUDIES IN THE GOLDEN STATE

It is the former of these two processes that Dr William B Grant – epidemiologist, board member of the Vitamin D Council and Founder of the non-profit Sunlight, Nutrition, and Health Research Center (SUNARC) in San Francisco, California, USA – utilises in his current research to decipher the role of vitamin D in cancer and various other diseases and conditions.

VITAMIN D AND CANCER

“I developed a novel index of integrated UVB dose by occupation for people living in the five Nordic countries: lip cancer less lung cancer incidence,” explains Grant, whose study was aimed at adding to the evidence base that solar UVB exposure reduces the risk of various cancer types. “This index was inversely correlated with 14 types of cancer in several countries, alongside tooth decay and autism in the US.”

Grant’s unconventional path to health and medical research has provided an alternative perspective that has allowed him to uncover novel findings. Grant worked as a senior research scientist in optical and laser remote sensing of the atmosphere and atmospheric sciences at SRI International, the Jet Propulsion Laboratory and the NASA Langley Research Center. While working in Virginia in the early 1990s, he voluntarily conducted a three-year study of the effect of acid rain and ozone on eastern hardwood forests for the Sierra Club. This experience provided him with the skills to undertake ecological studies – an approach he uses to this day.

In 1996, Grant learned that Japanese-American men in Hawaii had 2.5 times the prevalence of Alzheimer’s disease as native Japanese men: “I already knew that those with Alzheimer’s disease had higher concentrations of aluminium in their brains, as did trees in forests impacted by acid rain, so I conducted an ecological study of Alzheimer’s disease prevalence with respect to dietary factors using data from 11 countries”. The resulting paper caused a groundswell of media interest, as it was the first to link diet to risk of Alzheimer’s. “My press conference was covered on national TV and CNN in June 1997,” he reveals. “This reaction inspired me to continue my health studies.” After further success in linking diet with coronary heart disease and ultraviolet-B with cancer, Grant took the bold step of completely changing his discipline: “When I turned 62 years of age, I took early retirement from NASA to work full time on health research.”

A LIFE LESS ORDINARY

Grant and his SUNARC team employ an unconventional approach to studying the role of UVB and thus vitamin D in human health. They undertake ecological studies, in which geographical variations in disease outcome are compared to indices of UVB doses and other risk-modifying factors. These ecological studies have found strong inverse correlations between solar UVB doses and 19 types of cancer in several countries, alongside tooth decay and autism in the US.
women wear lipstick.” Importantly, the study was the first to show that UVB can reduce the risk of cancer at high latitudes if people spend enough time in the sun. It also revealed that UVB is weakly inversely correlated with melanoma and non-melanoma skin cancer, for which ultraviolet-A is a more important risk factor.

In another landmark investigation, Grant led the vitamin D taskforce for the American Academy of Developmental Medicine and Dentistry in developing guidelines for those with neurodevelopmental disorders and intellectual disabilities. The research was commissioned because people with such ailments generally have low 25(OH)D concentrations. Factors common to this group include sedentary indoor lifestyles, being overweight/obese, having to take deleterious medications that reduce 25(OH)D concentrations, and not taking supplements – all of which play a part in a lack of vitamin D. “We reviewed the journal literature regarding the role of 25(OH)D concentrations on health outcomes that affect these patients such as cardiovascular disease, diabetes, falls and fractures, and respiratory tract infections, relying primarily on observational studies,” Grant describes. “From this, we recommended 25(OH)D concentrations of 100-150 nmol L⁻¹ with 75-250 nmol L⁻¹ being acceptable; to reach these concentrations would take 2,000-5,000 international units per day vitamin D₃.” This is a level easily attainable through regular vitamin supplementation.

WIDE-RANGING IMPACT

Alongside these targeted analyses, Grant has also published results based on global metadata in the European Journal of Clinical Nutrition, offering startling conclusions on the potential benefits vitamin D supplementation could have on health worldwide. By the study’s calculations, doubling serum 25(OH)D levels and thus vitamin D would have a beneficial effect for patients experiencing various conditions – namely, cardiovascular disease, cancer, respiratory infections, respiratory diseases, tuberculosis, diabetes, Alzheimer’s, Parkinson’s, falls, meningitis, maternal sepsis and hypertension, and multiple sclerosis – and could increase life expectancy worldwide by two years.

HEALTH FOODS

Turning his hand to examining the role diet plays in health and wellbeing, in an article published in the Journal of Alzheimer’s Disease in 2014, Grant reported how Alzheimer’s disease risk increases when countries move away from their traditional foods and opt instead for a Western diet.

With a focus on previously identified disease risk factors – alcohol consumption, cholesterol, diabetes, dietary fat, obesity, smoking and poor fitness – Grant analysed data between 1961 and 1985 on Japan obtained from the Food and Agriculture Organization of the United Nations. Among other findings, Grant showed that switching from the traditional Japanese diet – with only 15 per cent of the energy derived from animal products and 42 per cent from rice – towards a meat-heavy Western diet is strongly associated with the rapid rise in Alzheimer’s prevalence in Japan between 1985 and 2008.

DNA spectral exposure (K jm⁻²) for July 1992.

Although data were not as comprehensive, Brazil, China, Cuba, Egypt, India, Nigeria, Korea and Sri Lanka were studied too, and their results mirrored those from Japan. “This work shows the importance of ecological studies in identifying current health problems related to diet,” Grant underlines.

WINNING HEARTS AND MINDS

Since his initial foray into health and medical research in the mid-1990s, Grant has utilised the skills and experience gleaned from working in other disciplines to carve a unique path. He has been at the forefront of studies linking health to vitamin D and diet, and is a vocal supporter of increased vitamin D supplementation and/or more time spent in the sunshine, as well as a return to a less meat-centric diet worldwide. However, barriers remain strong in opposition to some of his positions, and so he continues to amass evidence to win over both decision makers and the public.

Colon cancer mortality rates for white males by state economic area (age-adjusted from the US population in the 1970s), 1950-69.

INTELLIGENCE

SUNLIGHT, NUTRITION, AND HEALTH RESEARCH CENTER

OBJECTIVES

To research and provide information on the primary prevention of chronic and infectious diseases through lifestyle and dietary choices. This includes:

- Advancing understanding of ultraviolet-B radiation and vitamin D as important positive health factors for chronic and infectious diseases, as well as neurological disorders
- Evaluating dietary risk-modifying factors for chronic diseases

KEY COLLABORATORS

Dr Barbara J Boucher, The Blizard Institute, London, UK • Professor Cedric F Garland, University of California-San Diego, USA • Dr John Jacob Cannell, The Vitamin D Council, USA • Professor Michael F Holick, Boston University, USA • Dr Asta Juzeniene; Professor Johan Moan, Institute for Cancer Research, Norwegian Radium Hospital, Norway • Professor Meis Moukayed, American University in Dubai, UAE • Dr Pawel Pludowski, The Children’s Memorial Health Institute, Poland • Dr Dima Youssef, East Tennessee State University, USA

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WILLIAM B GRANT obtained his PhD from the University of California, Berkeley in 1971 and has enjoyed a 30-year career in atmospheric sciences. After retirement from NASA in 2004, Grant formed the non-profit organisation Sunlight, Nutrition, and Health Research Center.