A role for ultraviolet radiation in multiple sclerosis

Research Objectives

Dr George E Davis investigates the relationship between UV radiation, geographic latitude, and the role of vitamin D in the autoimmune disease multiple sclerosis.

Detail

Bio
George E Davis Jr, MD, FACP, FACG has practiced gastroenterology and internal medicine for 50 years, mostly in the state of Maine. Teaming up with Dr Walter E Lowell and later, Dr MJ Davis, Dr George Davis took a special interest in the environmental effects of solar radiation on human lifespan, major mental illnesses, and multiple sclerosis.

Collaborators
• Matthew J Davis, MD
• Walter E Lowell, EdD

References

• Davis, GE, Davis, MJ, Lowell, WE, (2023) Triggering multiple sclerosis at conception and early gestation: The variation in ultraviolet radiation is as important as its intensity. Heliyon, 9(6), e16954. doi.org/10.1016/j.heliyon.2023.e16954

Personal Response

Where would you like to take this work next?

We are keen to see other researchers repeat the findings in this paper at a higher latitude than ours, which is at approximately 45 degrees north. A study from Norway or Sweden would be welcome to see if the UVR coefficient of variation has an even greater slope than ours in Maine, which I suspect will be the case. A recent study from Sweden, which has a high incidence of multiple sclerosis (MS), found normal vitamin D levels which supports our suspicion that vitamin D alone is not as critical in engendering MS as latitude, and by extension, UVR variation as well as intensity are.
A role for ultraviolet radiation in multiple sclerosis

There are more cases of multiple sclerosis (MS), a condition caused by impaired immune responses, in northern countries compared to southern countries. Dr George E Davis, who is affiliated with the Riverview Psychiatric Centre in Maine, USA, has explored the links between latitude, MS, and UV radiation. He puts forward the idea that UV radiation levels during month of conception offer a better predictor of MS development than the month of birth. Detailing the links between solar radiation, vitamin D, and the immune system, Davis suggests that these may influence the development of MS.

Multiple sclerosis (MS) affects around 2.8 million people around the world. MS is caused by the immune system mistakenly attacking the brain and spinal cord. Depending on the affected part of the nervous system, the disease can affect function in cognitive, emotional, or sensory or visual areas of the brain.

The exact cause of MS is still unknown, but there is likely to be a genetic element as a family history can increase the risk of an individual having MS, albeit in a non-Mendelian fashion. Women are more disposed to having MS, with the disease being two to three times more common in females. Statistics show that the incidence of MS increases linearly by latitude; northern latitudes have the highest levels as seen in countries such as Canada, Denmark, Sweden, the Faroe Islands, and even the state of Maine in the USA.

The US has twice as many MS cases in the northern states compared to the southern states, with incidences around 110–140 cases per 100,000 and 57–78 cases per 100,000 inhabitants, respectively.

There is no cure available for MS, so treatment focuses on improving symptoms presumably by reducing inflammation. Understanding more about what increases the risk of MS and the mechanisms behind the disease may help reduce the frequency of cases, especially in northern countries. The hope is that this will lead to novel treatment methods.

Dr George E Davis and colleagues at Riverview Psychiatric Center in Augusta, Maine, USA wanted to test the idea that variation in ultraviolet radiation (UVR) may be as important its intensity in engendering MS. The US has twice as many MS cases in the northern states compared to the southern states, with incidences around 110–140 cases per 100,000 and 57–78 cases per 100,000 inhabitants, respectively. Detailing the links between solar radiation, vitamin D, and the immune system, Davis suggests that these may influence the development of MS.

UV radiation and vitamin D: the sunshine vitamin

Reviewing many previous studies, Davis noted that latitude and UVR appeared more important in the association with MS than vitamin D levels per se or ambient temperature. The variation of UVR increases with increasing latitude; conversely, UVR intensity decreases. High UVR closer to the Equator prompts the development of protective melanin in the skin. UVR in its more penetrating UV-A wavelength (315–400 nm) suppresses immune activity while the shorter UV-B wavelength (280–315 nm) can stimulate immune disorders like lupus, but also produces an important vitamin D precursor.

Vitamin D is a fat-soluble vitamin well known to promote calcium absorption from the intestine which is salutary to bone health, especially in infants and children thereby preventing rickets. Vitamin D receptors (VDRs) are ubiquitous throughout the body, particularly in the gut, and appear to have a range of functions, especially fortifying our immune system.

Vitamin D is required in adulthood to stimulate the mechanisms behind the disease may help reduce the frequency of cases, especially in northern countries. The hope is that this will lead to novel treatment methods.

OBSERVATORY DATA

Davis collected UV radiation data from an observatory in Maine, for a 15-year period from 2007 to 2021. The coefficient of variation ($CV_{UV}$) increased linearly three times faster from August to December than from January to August. More variation with less consistent $CV_{UV}$ should stimulate more VDRs but this does not appear to occur in northern latitudes where MS incidence is high. Perhaps these VDRs become fixed at a low level in later fetal development and more UVR is required in adulthood to stimulate the receptors and exert their effect on the immune system.

TIMING MATTERS

There is published literature evidencing that certain diseases are more prevalent in persons born in certain months; for example, the levels of UVR are linked to the incidence of major mental illnesses, like schizophrenia, bipolar disorder, and schizoaffective disorder, as well as seasonal affective disorder (Davis, 2022). Evidence shows that peaks of 11-year solar cycles also affect mental illnesses, particularly when these cycles are very strong. So yearly levels of radiation are important as well as monthly levels, especially when both are concordant.

According to Davis’ study, the month-of-conception (MOC) is more important than month-of-birth (MOB) as related to the intensity of UVR in its effect on MS. For instance, MS cases born in the month of May have August as the MOC. UVR intensity is highly likely to be suppressing embryonic VDRs by a hypothesised mechanism of maternal dermal T lymphocytes being exposed to UV radiation, which eventually pass through the placenta, thereby reducing the number of embryonic VDRs. After conception and later in gestation, the embryo is exposed to the rapidly increasing variation in UVR from autumn through winter, which does not foster an increase in VDRs possibly because they are already fixed. This research hypothesises the sensitivity of human embryos to the effects of UVR.

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The vitamin D-VDR complex appears to be salutary for our immune system function, but too much UVR may overwhelm the benefits of this complex.