The D-lemma: narrow-band UV type B radiation versus vitamin D supplementation versus sunlight for cardiovascular and immune health

Michael F Holick* and Arash Hossein-Nezhad

Section of Endocrinology, Nutrition, and Diabetes, Department of Medicine, Boston University Medical Center, Boston, MA

In this issue of the Journal, Ponda et al. (1) report on the role of vitamin D and narrow-band UV type B (UVB) irradiation on the blood lipid profile of healthy adults. They previously observed that there was a relation between dyslipidemia and vitamin D status and that oral vitamin D₃ failed to provide any benefit in the lipid profile. They therefore explored the possibility that exposure to narrow-band UVB radiation might have a direct influence on blood cholesterol concentrations. In their previous observational study, they showed an association between LDL cholesterol and vitamin D status (25-hydroxyvitamin D [25(OH)D]) in the range of 5 mg/dL. In this study, for unclear reasons, they chose a goal of seeing a difference in LDL cholesterol of 9 mg/dL. This has important implications for the determination of sample size and the results. The lipid profile was noticeably different between the UVB group and the oral vitamin D₃ group (~2-fold), but the difference was not significant because of the small sample size. The small sample size and the many confounders such as different skin types, age, and baseline concentrations of LDL cholesterol were important limitations of this study. The observation that exposure to narrow-band UVB, which resulted in significant increases in circulating concentrations of 25(OH)D while having no effect on lipoprotein concentrations, confirms the observation by Carbone et al. (2).

The connection between UVB radiation and cholesterol dates back to the 1920s, when it was first observed that the irradiation of cholesterol resulted in the production of the antirachitic factor vitamin D (3). Eventually, it was appreciated that cholesterol was stable to exposure to UVB radiation and that it was the tiny amount of its precursor, 7-dehydrocholesterol, which was present as a contaminant in the cholesterol preparation, that was sensitive to UVB radiation, resulting in its conversion to the antirachitic factor vitamin D. There was some consideration that because 7-dehydrocholesterol was the precursor of cholesterol, exposure to sunlight would reduce blood cholesterol concentrations because its precursor was being used. 7-Dehydrocholesterol is produced by the epidermal cells, and during exposure to sunlight only a tiny fraction, <5%, is ever converted to previtamin D₃ (3). This is the reason why statins, which can lower blood cholesterol concentrations, have no influence on the cutaneous production of vitamin D₃. The amount of 7-dehydrocholesterol and cholesterol in epidermal cells is independent of circulating concentrations of cholesterol.

Ponda et al. (1) reported on 58 adults exposed to suberythemal doses of whole-body irradiation from lamps emitting narrow-band UVB radiation 2 times/wk for ≥8 wk and showed no significant differences in the treated and controlled groups in any lipoproteins or apolipoproteins. What would have been helpful to have known is whether any of their subjects in their study were hypertensive and whether the narrow-band UVB radiation had any influence on their blood pressure?

There have been a multitude of mainly association studies suggesting that vitamin D deficiency is associated with hypertension, cardiovascular disease, and cardiovascular mortality (2). Season has a dramatic influence on cardiac mortality, and it has also been observed that serum cholesterol concentrations and blood pressure are lower during the summer than in winter in both men and women (3). Furthermore, systolic and diastolic blood pressure increases as distance from the equator increases (3). A 6-wk study in patients with chronic kidney disease who were exposed to either UVB or UVA radiation showed that not only did the UVB-irradiated patients increase their 25(OH)D concentrations by 180%, they also had a significant 6–mm Hg decrease in their systolic and diastolic blood pressures. Those exposed to UVA radiation did not show any improvement in their blood pressure nor in their blood concentrations of 25(OH)D. A follow-up study for a duration of 26 wk yielded similar results, and what was remarkable was that the improvement in blood pressure was sustained for an additional 9 mo (4). As noted by the authors, during exposure to sunlight there are innumerable photochemical and biological processes that occur in the skin. These include, among others, the production and release of nitric oxide, carbon monoxide, and β-endorphin; increased expression of the proopiomelanocortin gene, resulting in an increase in adrenocorticotropic hormone; and enhancement of collagen synthesis and wound healing, to name a few (3–5). These processes are controlled by various energies (i.e., wavelengths within the solar spectrum including UV A, UVB, and visible and infrared radiation) (4). In addition, it is well documented that solar exposure has a direct influence on the immune system, inducing immune tolerance and enhancing the production of cathelicidin to reduce

* To whom correspondence should be addressed. E-mail: mholick@bu.edu.

First published online April 19, 2017; doi: 10.3945/ajcn.117.155713.
infection by virulent pathogens (4–6). Therefore, the observation by Ponda et al. (1) that exposure to narrow-band UVB radiation had a different effect on gene expression in both the peripheral blood and skin compared with oral vitamin D$_3$ was not unexpected. It was previously reported that vitamin D supplementation of 2000 IU daily to healthy adults altered the expression of 291 genes in the peripheral blood white blood cells, affecting >80 different metabolic processes (7).

When all of this is taken into consideration, one can begin to appreciate that Mother Nature never intended to have vitamin D be the panacea nutrient or hormone to treat and prevent a multitude of chronic illnesses, including cardiovascular disease, type 2 diabetes, autoimmune diseases, neurocognitive dysfunction, and deadly cancers (3–6). Instead, Mother Nature purposefully designed us with a lack of substantial body hair and an appropriate amount of skin melanin to take advantage of the plethora of beneficial photobiological processes that occur in the skin as a result of being exposed to the broad spectrum of solar radiation (spanning energies of 290 to >2500 nm) while minimizing skin damage and skin cancer. The sunshine vitamin D$_3$ is just one of the many photochemicals and photo-byproducts produced in the skin that have important implications for overall health. The observation of Felton et al. (8) showed that adults with a skin type 2 (based on the Fitzpatrick skin-type classification) exposed to stimulated low-level United Kingdom midday sunlight 6 times/wk for 6 wk resulted in increasing their blood concentrations of 25(OH)D by 49%, while at the same time, inducing mechanisms to minimize UVB-induced DNA damage, supports the premise that you can have your cake and eat it too. Narrow-band UVB radiation can be helpful to treat several chronic skin disorders and improve vitamin D status but is not likely to provide health benefits afforded by exposure to sunlight (9). We should consider the skin as a recipient of a panoply of wavelengths that, in concert, provides the perfect symphony for good health.

MFH and AH-N jointly prepared the editorial; and MFH provided critical review and edited the manuscript for content. Neither of the authors reported a financial conflict of interest.

REFERENCES