BACKGROUND

Media attention to the potential role of vitamin D as a powerful anti-cancer agent has resulted in conflicting opinions regarding sun exposure and sunscreen use among Canadians. The Institute of Medicine (IOM) currently recommends 400 IU/day for individuals over four years old, with the recommended dietary allowance at 600 IU/day and the upper level intake at 4000 IU/day.\(^1\) While vitamin D can be obtained from a number of dietary sources, it is also produced naturally in human skin exposed to ultraviolet (UV) light.

With recent emphasis on the importance of maximizing vitamin D intake through diet and sunlight exposure, there is a concern that the increase in UV irradiation could lead to increasing incidence of skin cancer.\(^2\) This commentary delves into the potential benefits of vitamin D as an anti-cancer agent and discusses whether they may outweigh the potential risk of UV-induced skin cancer.

ROLE OF VITAMIN D

Vitamin D acts as a hormone that is integral to calcium homeostasis in the body. The two main forms of vitamin D are vitamin D3 (cholecalciferol) and vitamin D2 (ergocalciferol). Once transported to the liver, vitamin D3 and vitamin D2 are converted to 25-hydroxyvitamin D3 and 25-hydroxyvitamin D2, which are the major circulating metabolites of vitamin D. The measurement of these metabolites in serum is an indicator of vitamin D status in humans. In response to falling blood calcium concentrations, 25-hydroxyvitamin D is further hydroxylated in the kidney, forming 1,25-dihydroxyvitamin D3 (calcitriol). This metabolically active hormone serves important roles including enhancing calcium and phosphate absorption, inhibiting parathyroid hormone synthesis, and mineralizing bone matrix.\(^3\)

VITAMIN D AND CANCER

Vitamin D is classically described as an essential agent in improving bone health, reducing fractures, and lowering the risk of falls. Recent research, however, has taken a new direction, probing the non-traditional roles of vitamin D. Epidemiological studies suggest a link between vitamin D deficiency and developing type 1 diabetes. The importance of vitamin D in the endocrine system is further supported by animal models which demonstrate impaired insulin synthesis and secretion in the setting of vitamin D deficiency.\(^4\) In the immune system, vitamin D plays a role in increasing the production of cathelicidin, an antimicrobial peptide that is produced by macrophages in response to bacteria, viruses and fungi.\(^2\) Consequently, individuals deficient in vitamin D are at increased risk for microbial infections.

One of the most intriguing areas of current vitamin D research is its impact on cancer risk. Several epidemiological studies have found an association between low circulating vitamin D levels and an elevated risk for developing cancer. Others have demonstrated that a low serum level of 25-hydroxyvitamin D is associated with increased risk for colorectal cancer and adenoma only.\(^2\) Further, another study links seasons with increased cancer risk, noting that individuals are at greater risk during winter months due to lower amounts of sunlight exposure.\(^5\) Yet current research predominantly consists of observational studies, rather than randomized controlled trials, as revealed in a systematic review by the World Health Organization and the International Agency for Research on Cancer.\(^2\) Evidently, further research is needed to determine the exact relationship between vitamin D and cancer.

Researchers posit that vitamin D plays a role in the body’s fight against cancer through its action on the vitamin D receptor (VDR). Polymorphisms of the gene encoding VDR have been linked to an increased risk for developing certain cancers, including prostate, colorectal, breast, bladder and melanoma.\(^5\) CYP3A4 is another vitamin D-regulated gene whose protein product detoxifies a carcinogenic agent called lithocholic acid (LCA). Elevated LCA levels have been shown to play a role in promoting colon carcinogenesis by damaging intestinal cell DNA.\(^5\)

Cancer impacts the lives of Canadians nationwide, making it no surprise that news of anti-cancer agents quickly captures the public’s interest. Although some researchers are fascinated by the promise of vitamin D, others remain
cautious. Vitamin C was previously promoted for its anti-cancer properties but subsequent trials did not confirm any benefits; in fact very large doses of vitamin C were associated with increased risk of cancer in some populations. As vitamin D has yet to be subjected to large-scale clinical trials, it is difficult to draw accurate conclusions about its role in cancer.

MEDIA CONTROVERSY

There is controversy over the ideal amount of circulating vitamin D levels in the blood. Statistics Canada reports readings of at least 75 nmol/L of vitamin D as being ideal, while the IOM study recommends a target 60 nmol/L. Statistics Canada also showed that two-thirds of the population has vitamin D levels that are lower than the amount associated with reducing the risk of chronic disease. However, 90% of Canadians have levels that are adequate for good bone health, begging the question of whether deficiency really is a major health concern.

Canadians are at increased risk for vitamin D deficiency as a result of decreased sunlight exposure during long winter months and use of sunscreen in the summer. While the evidence has shown that sunscreen does lower the rate of vitamin D synthesis, its use has not been associated with vitamin D deficiency. As such, it is reasonable to conclude that Canadians should not be avoiding sun-protective agents out of fear of such a deficiency.

Statistics Canada also cited a significant disparity in vitamin D levels amongst Canadians of different racial origins. Caucasian individuals had an average of 40% more circulating vitamin D than non-Caucasian individuals. The average Caucasian had 71 nmol/L, modestly under the purported optimum threshold, while non-Caucasian individuals had lower levels, averaging 52 nmol/L. While racial differences in vitamin D levels are significant, it is important to note that these statistics may be based on inconclusive studies rather than evidence-based research.

RECOMMENDATIONS

The current evidence, which is based predominantly on observational studies, suggests that benefits of vitamin D in non-traditional roles are associated with levels above 75 nmol/L. Assuming this to be true, Canadians can maintain sufficient circulating levels of the vitamin by following IOM recommendations. To obtain a vitamin D level equivalent to a blood concentration of 75 nmol/L from exposure to sunlight, a Caucasian individual requires approximately 24 minutes of exposure to 25% of the body surface (arms and most of the legs). Older or dark-skinned individuals may need as long as 18 minutes. Evidently, it is unnecessary to avoid sunlight in favour of achieving presumed therapeutic vitamin D concentrations. Further, UV radiation has cumulative effects, and dermatologists recommend avoiding strong sun exposure particularly in the summer months and instead relying on oral intake of vitamin D. Dietary sources of vitamin D include fatty fish like salmon and tuna, as well as vitamin D-fortified foods such as cow’s milk and margarine (in Canada), and some orange juices, yogurts and cereals. Following the above recommendations ensures good bone health while mediating cancer risk.

REFERENCES


Author Biographies

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