

## The Role and Benefits of Sunlight

The warmth and light of the sun is an essential hygienic requirement that provides nurturing and nutrition for all plants and animals. As such, the National Health Association (NHA) promotes moderate and routine sun exposure as a crucial factor for health promotion and recovery. All too often, sun exposure has been vilified because of the skin cancers and cataracts that can result from excessive exposure to radiation from the sun. However, it must be emphasized that consistent but moderate sun exposure has significant and wide-ranging health benefits.

### Biology of Vitamin D

Many, but not all of these health benefits are the direct result of the action of vitamin D that is produced in the body from sun exposure. Vitamin D is a fat-soluble vitamin that acts like a steroid hormone. The ultraviolet B radiation in sunlight converts the cholesterol in the skin to inactive vitamin D<sub>3</sub> that is then converted in the liver to 25-hydroxyvitamin D (25(OH)D) and ultimately to calcitriol, its most active form in the kidney. The production of vitamin D relies on the exposure of bare skin to direct sunlight. Sunscreen with a sun protection factor (SPF) of 30 can decrease the synthesis of vitamin D in the skin by 95%.<sup>1</sup> Lifestyle and environmental factors that reduce your exposure to sunlight result in substantial vitamin D deficiency worldwide.<sup>2</sup> Abnormally low vitamin D is a significant public health problem that is a major risk factor for total mortality of the general population.<sup>3,4</sup>

Performing a blood test to assess the blood level of 25(OH)D that is released

from the liver is recommended to determine vitamin D sufficiency; a value less than 30ng/ml is considered deficient.<sup>5,6</sup> Typically, 15–20 minutes of sun exposure a few times a week should maintain adequate vitamin D levels. However, if this does not satisfy your need or if you live in an environment that limits your opportunity for direct natural sun exposure, daily supplementation of 1000–2000 IU of vitamin D<sub>3</sub> is recommended. However, keep in mind that getting the amount of sun in a bathing suit that creates a slight pinkness to your skin 24 hours after exposure is equivalent to ingesting 10,000–20,000 IU of vitamin D.<sup>7</sup>

The need for vitamin D is greater in people who can't metabolize it efficiently or who have lower levels of circulating vitamin D. This includes people of color with darker skin; the elderly, who have compromised metabolisms and reduced absorption of nutrients; and people who are overweight and overfat, since fat cells sequester and store vitamin D, making it less available in the blood.<sup>8</sup>

---

Typically, 15–20 minutes of sun exposure a few times a week should maintain adequate vitamin D levels.

---

### Benefits of sunlight and vitamin D

Receptors for vitamin D exist on most cells of the body, promoting a diversity of biological functions, including bone production, kidney hormone production, insulin production, and the activity of white blood cells/host defense proteins that are essential for the protective capability of the immune system.<sup>9</sup>

#### BONE/MUSCLE HEALTH AND FRACTURE RISK

Vitamin D stimulates calcium and phosphorous absorption by 40% and 80%, respectively, to support bone production and density.<sup>10</sup> A variety of studies have also shown that vitamin D

may increase muscle strength to prevent falls, suggesting a correlation between low vitamin D and the increased risk of fractures and falls in older adults.<sup>11</sup>

#### HEART DISEASE AND CANCER RISK

Several studies suggest that vitamin D has a protective effect on the heart and may suppress inflammation on heart cells and in the walls of blood vessels to reduce the risk of heart disease, the number one killer of men and women. In the Framingham Heart Study, people with low levels of vitamin D (<15 ng/ml) had a 60% higher risk of heart disease than those with higher levels.<sup>12</sup> Ultraviolet radiation (UVR) from the sun, independent of the effects of vitamin D, promotes the release of nitric oxide, which dilates blood vessels, decreases blood pressure, and reduces the risk of heart disease.<sup>13</sup>

Vitamin D also decreases the abnormal growth of cells and blood vessels while exerting significant anti-inflammatory effects, reducing the risk of a variety of cancers, including breast and, especially, colon cancer.<sup>14,15</sup>

Over time, consistent long-term exposure to UVR from the sun, independent of the effects of vitamin D, is also associated with significant reductions in the incidence of breast, prostate, and colon/rectal cancers, as well as non-Hodgkin's lymphoma.<sup>16,17,18</sup>

#### AUTOIMMUNE DISEASE, BRAIN, AND MENTAL HEALTH

Increased sun exposure is associated with a decreased development and severity of autoimmune disorders, including rheumatoid arthritis, multiple sclerosis, irritable bowel syndrome, and asthma.<sup>19,20,21</sup>

An analysis of multiple studies showed that vitamin D deficiency (<30 ng/ml) was associated with an increased risk of Parkinson's disease, whereas sunlight exposure greater than 15 minutes a week correlated with a decreased risk of developing Parkinson's. However, vitamin D supplementation did not improve the motor dysfunction of Parkinson's, and it is not a viable treatment option for already existing Parkinson's disease.<sup>22</sup>

Both direct and indirect sunlight are important resources for physical and mental health. Sunlight enhances the activity of the neurotransmitters serotonin and beta-endorphin in the brain.<sup>23</sup> This can promote a general feeling of well-being

and have a positive impact on several life-disturbing conditions, including seasonal affective disorder, depression,<sup>24</sup> migraine headache,<sup>25</sup> and Alzheimer's disease.<sup>26</sup> The availability of modest exposure to both direct and indirect sunlight for office workers during their workday significantly reduced anxiety and depression while promoting calmness, alertness, feelings of vitality, and positive reports of job satisfaction.<sup>27</sup>

---

**Increased sun exposure is associated with a decreased development and severity of autoimmune disorders, including rheumatoid arthritis, multiple sclerosis, irritable bowel syndrome, and asthma.**

---

There are significant seasonal variations in depression and brain chemistry that are linked to the amount of available sunlight. Depressive behavior in the population is less and the release and turnover of serotonin in the brain is at its highest when days and ambient sunlight last longer in spring and summer.<sup>28,29</sup> The mechanism for this effect on depression and serotonin activity may occur via an important growth factor in the brain (brain-derived growth factor) that shows similar strong seasonal variations with highest concentrations in spring and summer and plays a significant role in the growth and plasticity of brain cells as well as depression.<sup>30</sup>

#### IMMUNE SYSTEM FUNCTION

Vitamin D production via sunlight directly activates white blood cells (T and B cells) that play a major role in immune protection, reducing bacterial/viral infection (especially lung infection), and promoting antibody production.

Eating a whole-plant-food diet promotes the healthiest diversity of gut microbiota. These organisms ferment the fiber in plants to produce butyrate and other short-chain fatty acids that maintain the protective mucous lining of the intestine and lungs and are an integral part of your innate immune system. Vitamin D works

in synergy with butyrate to enhance the activity of host-defense proteins like cathelicidin that significantly inhibit viral respiratory infections and are a major foundation of immune protection.

#### CIRCADIAN RHYTHM AND SLEEP

As the earth spins on its axis in a 24-hour period, daily (circadian) rhythms synchronized to the daily 24-hour cycle of light and dark establish our very important sleep-wake cycle and are an essential part of the body's ability to maintain balance and homeostasis.<sup>31</sup> Circadian rhythms are driven by a group of nerve cells in the hypothalamus of the brain called the suprachiasmatic nucleus (SCN) that function as your internal clock. The SCN is the pacemaker for your circadian rhythm, and the timing of sleep and wakefulness for animals in nature is closely tied to this circadian directive.

Exposing the eyes to direct sunlight in morning hours improves sleep at night. The wavelength of blue light from the morning sun signals the SCN to wake you up and start your day. This morning exposure to sunlight also triggers the body to produce the hormone melatonin earlier in the evening, making falling asleep easier. (This is why having blue light in your bedroom at night from electronic devices makes falling sleep more difficult, if not impossible; it tricks your brain into believing that it is time to get up.)

#### Conclusion

The benefits of routine sun exposure strongly emphasize that sunlight is an important biological requirement of life and health. As a result, the NHA strongly recommends the need for routine, consistent, moderate sun exposure for health promotion. The misguided narrative of fear and avoidance of the sun needs to be replaced with a narrative that recognizes the need for sun exposure in amounts that adequately provide for essential nutritional and health requirements yet do not burn or damage the skin.

## REFERENCES

- <sup>1</sup> Matsuoaka LY, Ide L, Wortsman J, MacLaughlin JA, Holick MF. Sunscreens suppress cutaneous vitamin D3 synthesis. *J Clin Endocrinol Metab.* 1987 Jun;64(6):1165-8. doi: 10.1210/jcem-64-6-1165.
- <sup>2</sup> Nair R, Maseeh A. Vitamin D: the “sunshine” vitamin. *J Pharmacol Pharmacother.* 2012 Apr;3(2):118-26. doi: 10.4103/0976-500X.95506.
- <sup>3</sup> Melamed ML, Michos ED, Post W, Astor B. 25-hydroxyvitamin D levels and the risk of mortality in the general population. *Arch Intern Med.* 2008 Aug 11;168(15):1629-37. doi: 10.1001/archinte.168.15.1629.
- <sup>4</sup> Autier P, Gardini S. Vitamin D supplementation and total mortality: A meta-analysis of randomized controlled trials. *Arch Intern Med.* 2007 Sep 10;167(16):1730-7. doi: 10.1001/archinte.167.16.1730.
- <sup>5</sup> Holick MF. Vitamin D deficiency. *N Engl J Med.* 2007 Jul 19;357(3):266-81. doi: 10.1056/NEJMr070553.
- <sup>6</sup> Malabanan A, Veronikis IE, Holick MF. Redefining vitamin D insufficiency. *Lancet.* 1998 Mar 14;351(9105):805-6. doi: 10.1016/s0140-6736(05)78933-9.
- <sup>7</sup> Holick MF, Chen TC. Vitamin D deficiency: a worldwide problem with health consequences. *Am J Clin Nutr.* 2008 Apr;87(4):1080S-6S. doi: 10.1093/ajcn/87.4.1080S.
- <sup>8</sup> Institute of Medicine (US): Ross C, Taylor CL, Yaktine AL, Del Valle HB, editors. *Dietary Reference Intakes for Calcium and vitamin D.* Washington DC: National Academies Press (US); 2011. Institute of Medicine.
- <sup>9</sup> Chebowski RT, Johnson KC, Kooperberg C, et al. Calcium plus vitamin D supplementation and the risk of breast cancer. *J Natl Cancer Inst.* 2008 Nov 19;100(22):1581-91. doi: 10.1093/jnci/djn360.
- <sup>10</sup> Lips P, Hosking D, Lippuner K, et al. The prevalence of vitamin D inadequacy amongst women with osteoporosis: an international epidemiological investigation. *J Intern Med.* 2006 Sep;260(3):245-54. doi: 10.1111/j.1365-2796.2006.01685.x.
- <sup>11</sup> Vitamin D and health. Harvard School of Public Health Nutrition Sources.
- <sup>12</sup> Wang TJ, Pencina MJ, Booth SL, et al. Vitamin D deficiency and the risk of cardiovascular disease. *Circulation.* 2008 Jan 29;117(4):503-11. doi: 10.1161/CIRCULATIONAHA.107.706127.
- <sup>13</sup> Fleury N, Geldenhuys S, Gorman S. Sun exposure and its effects on human health: mechanisms through which sun exposure could reduce the risk of developing obesity and cardiometabolic dysfunction. *Int J Environ Res Public Health.* 2016 Oct 11;13(10):999. doi: 10.3390/ijerph13100999.
- <sup>14</sup> Ahn J, Peters U, Albanes D, et al. Serum vitamin D concentration and prostate cancer risk: a nested case-control study. *J Natl Cancer Inst.* 2008 Jun 4;100(11):796-804. doi: 10.1093/jnci/djn152.
- <sup>15</sup> Anderson LN, Cotterchio M, Vieth R, Knight JA. Vitamin D and calcium intakes and breast cancer risk in pre- and postmenopausal women. *Am J Clin Nutr.* 2010 Jun;91(6):1699-707. doi: 10.3945/ajcn.2009.28869.
- <sup>16</sup> Freedman DM, Dosemeci M, McGlynn K. Sunlight and mortality from breast, ovarian, colon, prostate, and non-melanoma skin cancer: a composite death certificate based case-control study. *Occup Environ Med.* 2002 Apr;59(4):257-62. doi: 10.1136/oem.59.4.257.
- <sup>17</sup> Gilbert R, Metcalfe C, Oliver SE, et al. Life course sun exposure and risk of prostate cancer: population-based nested case-control study and meta-analysis. *Int J Cancer.* 2009 Sep 15;125(6):1414-23. doi: 10.1002/ijc.24411.
- <sup>18</sup> Kricker A, Armstrong BK, Hughes AM, et al. Personal sun exposure and the risk of non-Hodgkin lymphoma: a pooled analysis from the Interlymph Consortium. *Int J Cancer.* 2008 Jan 1;122(1):144-54. doi: 10.1002/ijc.23003.
- <sup>19</sup> Ding C, Cicuttini F, Parameswaran V, Burgess J Quinn S, Jones G. Serum levels of vitamin D, sunlight exposure, and knee cartilage loss in older adults: the Tasmanian older adult cohort study. *Arthritis Rheum.* 2009 May;60(5):1381-9. doi: 10.1002/art.24486.
- <sup>20</sup> Bäärnhielm M, Hedström AK, Kockum I, et al. Sunlight is associated with decreased multiple sclerosis risk: no interaction with human leukocyte antigen-DRB1\*15. *Eur J Neurol.* 2012 Jul;19(7):955-62. doi: 10.1111/j.1468-1331.2011.03650.x.
- <sup>21</sup> Khalili H, Huang ES, Ananthakrishnan AN, et al. Geographical variation and incidence of inflammatory bowel disease among US women. *Gut.* 2012 Dec;61(12):1686-92. doi: 10.1136/gutjnl-2011-301574.
- <sup>22</sup> Zonglei Z, Zhou R, Zhang Z, Li K. The association between vitamin D status, vitamin D supplementation, sunlight exposure, and Parkinson's disease: a systematic review and meta-analysis. *Med Sci Monit.* 2019 Jan 23;25:666-674. doi: 10.12659/MSM.912840.
- <sup>23</sup> Lambert GW, Reid C, Kaye DM, Jennings GL, Esler MD. Effect of sunlight and season on serotonin turnover in the brain. *Lancet.* 2002 Dec 7;360(9348):1840-2. doi: 10.1016/s0140-6736(02)11737-5.
- <sup>24</sup> Svenningsson P, Chergui K, Rachleff I, et al. Alterations in 5-HT1B receptor function by p11 in depression-like states. *Science.* 2006 Jan 6;311(5757):77-80. doi: 10.1126/science.1117571.
- <sup>25</sup> Hamel E. Serotonin and migraine: biology and clinical implications. *Cephalalgia.* 2007 Nov;27(11):1293-300. doi: 10.1111/j.1468-2982.2007.01476.x.
- <sup>26</sup> Cross AJ. Serotonin in Alzheimer-type dementia and other dementing illnesses. *Ann N Y Acad Sci.* 1990;600:405-15; discussion 415-7. doi: 10.1111/j.1749-6632.1990.tb16897.x.
- <sup>27</sup> Mihyang A, Colarelli SM, O'Brien K, Boyajian ME. Why we need more nature at work: effects of natural elements and sunlight on employee mental health and work attitudes. *PLoS One.* 2016 May 23;11(5):e0155614. doi: 10.1371/journal.pone.0155614.
- <sup>28</sup> Lambert GW, Reid C, Kaye DM, Esler MD. Effect of sunlight and season on serotonin turnover in the brain. *Lancet.* 2002 Dec 7;360(9348):1840-2. doi: 10.1016/s0140-6736(02)11737-5.
- <sup>29</sup> Praschak-Reider N et al. Seasonal variation in human brain serotonin transporter binding. *Arch Gen Psychiatry.* 2008 Sep;65(9):1072-8. doi: 10.1001/archpsyc.65.9.1072.
- <sup>30</sup> Molendijk M et al. Serum BDNF concentrations show strong seasonal variations and correlations with the amount of ambient sunlight. *PLoS One* 2012; 7(11):e48046.
- <sup>31</sup> Arendt J et al. Biological rhythms: the science of chronobiology. *Coll Physicians Lond.* Jan-Feb 1998.