

SUSPECTED EFFECTS OF VITAMIN D

Vitamin D has a variety of actions in the body. It binds to the vitamin D receptor (VDR), which then binds to the retinoid X receptor (RXR) and activates the expression of numerous genes. Through this mechanism, vitamin D promotes calcium absorption in the gut and helps maintain calcium and phosphate levels to promote healthy bones. It also helps regulate genes involved in cell growth, neuromuscular and immune function, and reduction of inflammation. Accordingly, vitamin D deficiency has been linked with a wide range of diseases.

1 MULTIPLE SCLEROSIS

Several studies have associated low levels of vitamin D with a higher risk of developing multiple sclerosis (MS). This link may have to do with vitamin D's effect on the immune system—promoting the induction of regulatory T cells and decreasing the production of pro-inflammatory cytokines—as MS is an autoimmune disorder in which a patient's immune system attacks the myelin coating that protects the axons of neurons.

2 HEART DISEASE

Multiple studies have linked vitamin D deficiency with higher risks of high blood pressure and cardiomyopathy. Conversely, vitamin D supplements appear to lower risk of death from these ailments in certain at-risk populations. In vitro and animal studies suggest that vitamin D modulates such risks via the inhibition of the renin-angiotensin-aldosterone system, a hormone system that regulates blood pressure. Vitamin D may also directly affect cardiomyocytes.

3 TUBERCULOSIS

Vitamin D deficiency has been associated with susceptibility to *Mycobacterium tuberculosis* in some human populations, and supplementation of the vitamin appears to enhance immunity to mycobacteria. In vitro experiments suggest that vitamin D helps macrophages fight the bacterium.

4 ASTHMA

Observational studies have shown that higher maternal vitamin D intake during pregnancy is inversely associated with asthma in 3- to 5-year-old children. The vitamin might tame inflammation related to wheezing by boosting regulatory T cell numbers while inhibiting pro-inflammatory cytokines and increasing anti-inflammatory cytokines.

5 DIABETES

Vitamin D deficiency has been linked to an increased risk of type 2 diabetes. Conversely, sun exposure and increased intake of vitamin D and calcium has been associated with a lower risk of developing the disease. Though the mechanism by which vitamin D affects diabetes risk is unclear, in vitro and in vivo animal studies have suggested that low levels of vitamin D impair insulin secretion from pancreatic β cells, while vitamin D supplementation improves insulin secretion.

6 BONE HEALTH

Vitamin D's most conclusively demonstrated effects are in maintaining healthy bones. Vitamin D promotes calcium absorption and helps maintain calcium and phosphate levels necessary for mineralization of bone. It is also needed for bone growth and bone remodeling by osteoblasts and osteoclasts. Vitamin D deficiency can result in thin, brittle, or misshapen bones, as well as rickets in children and osteomalacia in adults. Together with calcium, vitamin D also helps prevent osteoporosis in older individuals.

7 CANCER

A number of observational studies have found that people with higher levels of vitamin D have lower risks of cancer, particularly colorectal and breast cancers. In culture, vitamin D slowed the proliferation and promoted differentiation and apoptosis of cancer cells. One possible mechanism for this protective effect is the promotion of the expression of the gene *CYP3A4*. *CYP3A4* encodes a detoxifying enzyme that neutralizes the bile acid lithocholic acid, which is believed to damage the DNA of intestinal cells and may promote colon carcinogenesis.

