12.1A: Environmental Factors That Impact Vitamin D₃ Synthesis

There are a number of environmental factors that affect vitamin D₃ synthesis:

**Latitude**

The *latitude* a person is at affects that person's ability to synthesize vitamin D₃. There is an inverse relationship between the distance from the equator and UV light exposure. Thus, with increased distance from the equator (increased latitude), there is decreased UV light exposure and vitamin D₃ synthesis. The link below shows the latitude and longitude lines of the United States.

![Illustration of geographic latitude](https://med.libretexts.org/TextMaps/Book%3A_Intermediate_Nutrition_(Lindshield)/12%3A_Blood%2C_Bones%2C_and_Teeth_I/12.1%3A_Vitamin_D/12.1A%3A_Environmental_Factors_That_Impact_Vitamin_D%E2%82%83_Synthesis)

*Figure 12.111: Illustration of geographic latitude. Image used with permission (Public Domain; Djexplo).*
Seasons

Seasons also make a difference in vitamin D₃ synthesis. In Boston (42° N), vitamin D synthesis only occurs from March-October, because during late fall and winter, not enough UV-B reaches the earth’s surface to synthesize vitamin D₃. However, in Los Angeles (34° N), vitamin D₃ synthesis occurs year round. The difference is the angle of the sun relative to latitude and how many UV-B photons are absorbed before they reach the earth’s surface.

Time

Time of day is also an important factor in affecting vitamin D₃ synthesis. Vitamin D₃ synthesis increases in the morning before peaking at noon then declines the rest of the day.
Skin pigmentation

Another factor that plays an important role in vitamin D₃ synthesis is **skin pigmentation**. As shown in the figure below, skin pigmentation tends to be darker around the equator to help protect inhabitants from the harmful effects of sun exposure.

![Skin Color Distribution](image)

*Figure 12.113 Skin color distribution where a darker color equals darker skin color*

Skin color is the result of increased production of the pigment melanin, as shown in the link below.

**Web Link**

[Melanin](https://med.libretexts.org/TextMaps/Book%3A_Intermediate_Nutrition_(Lindshield)/12%3A_Blood%2C_Bones%2C_and_Teeth—I/12.1%3A_Vitamin_D/12.1A%3A_Environmental_Factors_That_Impact_Vitamin_D%E2%82%83_Synthesis)

Very dark skin color can provide a sun protection factor (SPF) 8-30 for those individuals who never burn. These individuals will require approximately 5- to 10-times greater sunlight exposure than a light-skinned, white person to synthesize the same amount of vitamin D₃.

**Age**

**Age** also plays a factor in vitamin D₃ synthesis. Aging results in decreased 7-dehydrocholesterol concentrations in the skin, resulting in an approximately 75% reduction in the vitamin D₃ synthesis capability by age 70.

![Aging and Vitamin D Synthesis](image)

*Figure 12.114 Aging decreases vitamin D synthesis*
Clothing

Clothing is another factor that influences vitamin D₃ synthesis. More clothing means that less sun reaches your skin, and thus less vitamin D₃ synthesis.

Figure 12.115 Which of these 2 do you think is synthesizing less vitamin D?

Sunscreen, "Sensible Sun Exposure", and Tanning

There is quite a spirited debate on sunscreen, sun exposure, skin cancer, and vitamin D synthesis. On one side are the vitamin D researchers, on the other side are dermatologists. Vitamin D research found that SPF 8 sunscreen almost totally blocked vitamin D₃ synthesis. However, the SPF value equals 1/(# photons that reach your skin) meaning that SPF 30 means 1/30 UV photons reach your skin. Thus, vitamin D₃ synthesis shouldn't be totally blocked. In addition, studies indicate that consumers apply 1/2 or less of the amount required to get the listed SPF protection. Researchers recommend sun exposure on the face, arms, and hands for 10-15 minutes 2-3 times per week between 10 AM-3 PM. However, dermatologists do not like "sensible sun exposure" because this is also the peak time for harmful sun exposure. Dermatologists say that "sensible sun exposure" appeals to those who are looking for reasons to support tanning and are at highest risk (primarily young, fair-skinned females) of sun damage. They argue that vitamin D can be provided through supplementation.

What about tanning beds? Not all tanning beds provide UV-B rays that are needed for vitamin D₃ synthesis. In fact, some advertise that they only use UV-A rays that are safer, even though this is not the case. Virtually every health organization advises against using tanning beds, because the risks are far greater than the potential benefits.

References & Links


Links
