11.11 Environmental Factors That Impact Vitamin D₃ Synthesis

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

- Latitude
- Season
- Time of Day
- Skin Color
- Age
- Clothing
- Sunscreen

**Latitude**

The latitude a person is at affects that person's ability to synthesize vitamin D₃. There is an inverse relationship between 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 figure below shows the latitude and longitude lines of the United States.

![United State's latitude and longitude lines](image)

Figure 11.11 United State's latitude and longitude lines

**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 round². 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 surface².

Figure 11.12 Seasons are also an important factor affecting vitamin D₃ synthesis

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 day³.

Figure 11.13 Time of day is an important factor for vitamin D₃ synthesis

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

**Web Link**

*Melanin*

Very dark skin color can provide a sun protection factor (SPF) 8-30 for those individuals who never burn\(^4\). 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 D\(_3\)\(^4,5\).

**Age**

Age also plays a factor in vitamin D\(_3\) synthesis. Aging results in decreased 7-dehydrocholesterol concentrations in the skin, resulting in an approximately 75% reduction in the vitamin D\(_3\) synthesis capability by age 70\(^5\).

**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 11.116 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 synthesis⁵. However, the SPF value equals 1/(# photons that reaches 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 protection⁶. Researchers recommend sun exposure on the face, arms, and hands for 10-15 minutes 2-3 times per week between 10AM-3PM⁴. 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 a 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 supplementation⁶.

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 isn't the case⁸. Virtually every health organization advises against using tanning beds, because the risks are far greater than the potential benefits⁸,⁹.
References & Links
1. http://www.hightunnels.org/ForEducators/Planning/FullMoonFarmCaseStudy/planningorientationlatitude.htm

Links