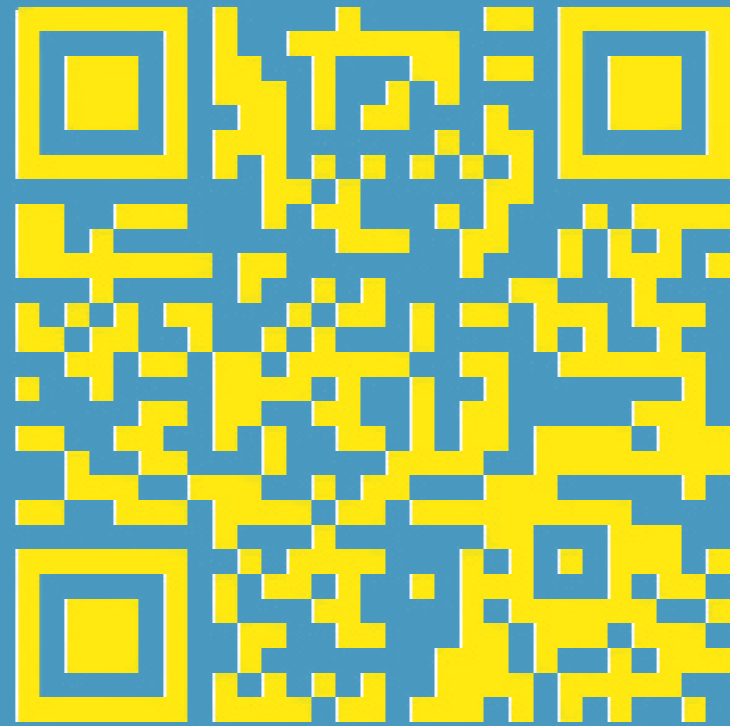


Are You a Ray of
Sunshine or are You
Vitamin D-ficient?



Justin Batchelder / Kelly LeGros Strickler / Karina Montero

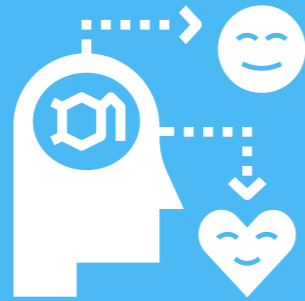
What do you already
know about Vitamin D?



<http://bit.ly/3ZLwqA0>



What Is Vitamin D?



A hormone?



Health Implications

- Bone Health
- Immune health
- Depression

1, 2

How Much Vitamin D do I Need?



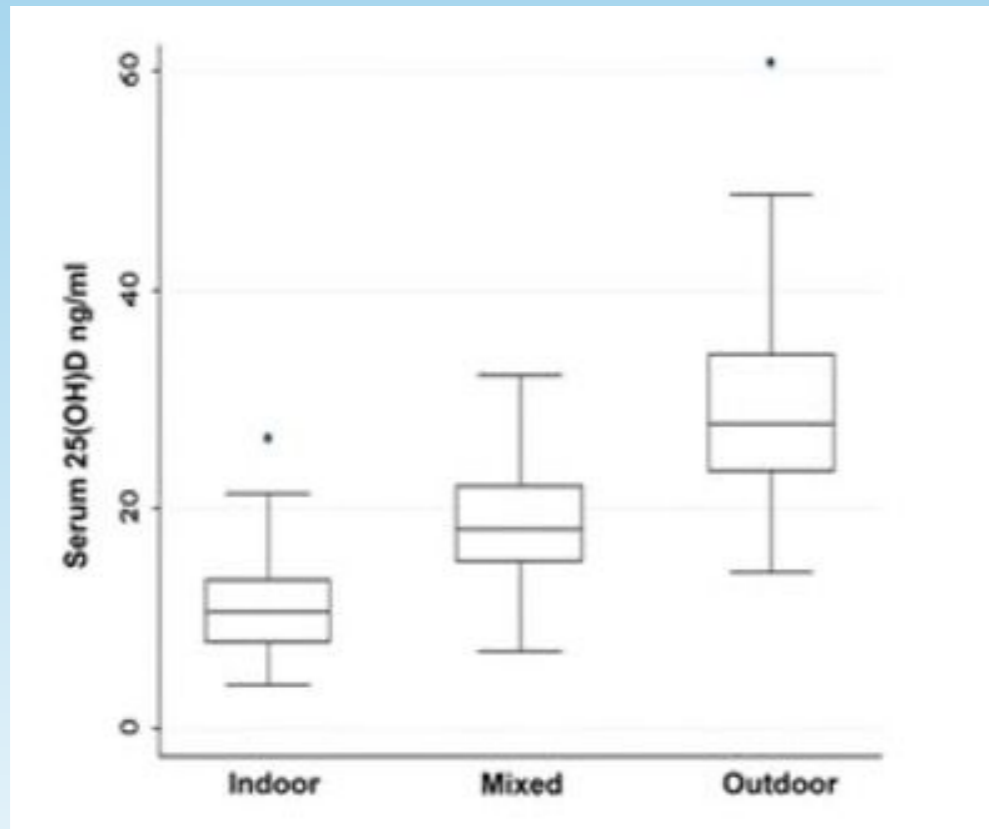
The U.S. Recommended Dietary Allowance (RDA) for vitamin D: 15mcg (**600 IU**) for individuals aged 1-70¹²



This number assumes minimal exposure to sunlight

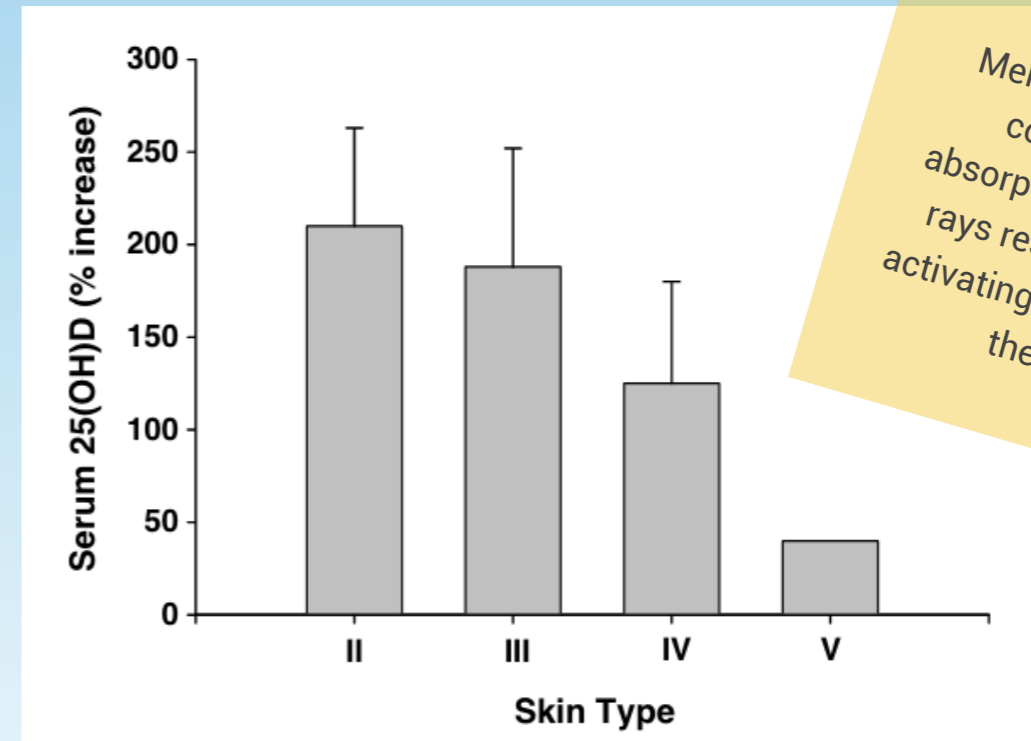
Who is at Risk of Deficiency?

Individuals who work indoors



Average vitamin D serum levels were 2.5x higher in men working outdoors than men indoors¹³

Individuals with darker skin pigmentation



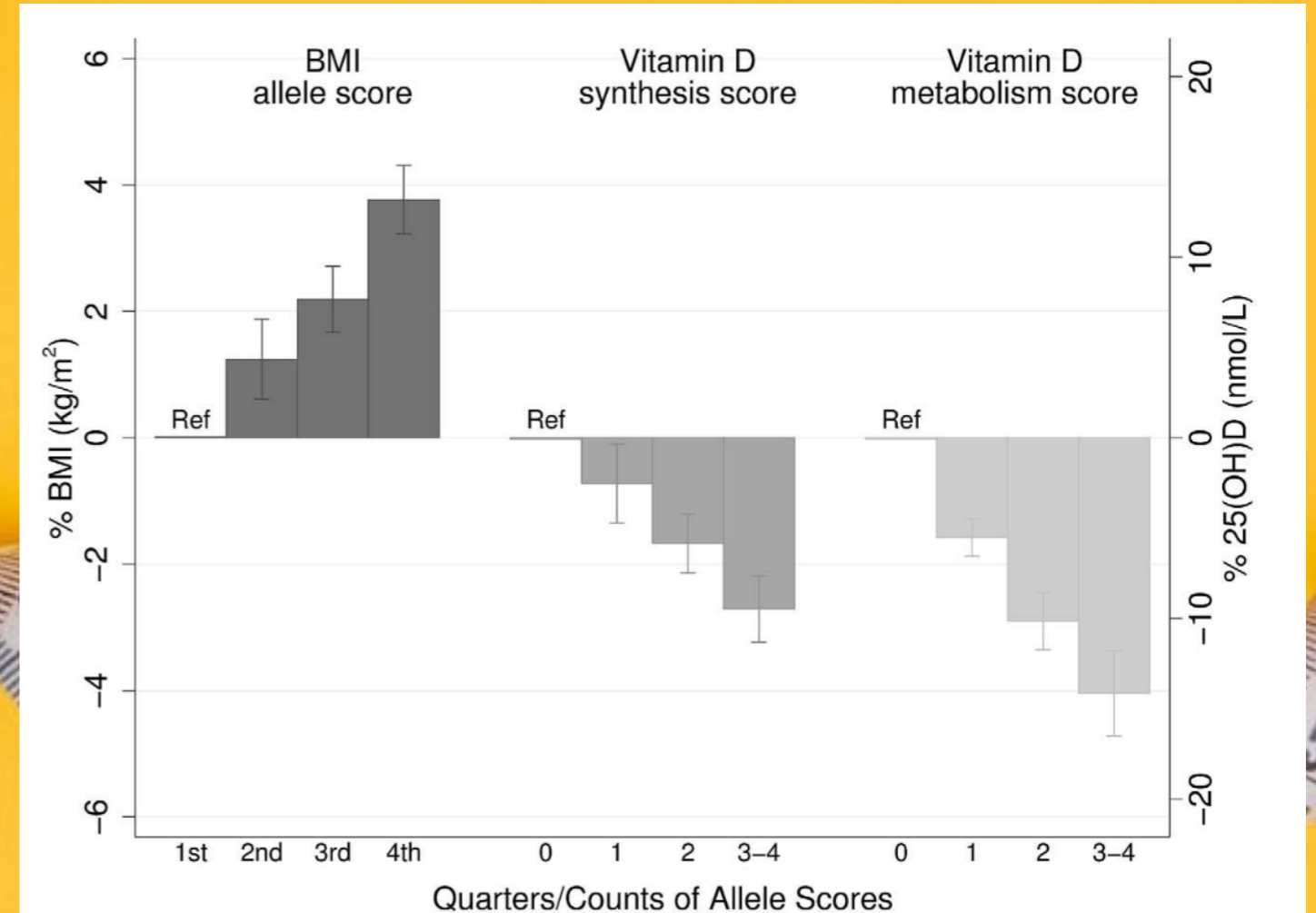
Melanin in the skin competes for absorption of the UVB rays responsible for activating vitamin D3 in the skin.

Lighter (less melanated) skin types convert UVB into pre-vitamin D3 5-10x more efficiently than darker pigments³

Who is at Risk of Deficiency?

Individuals with obesity

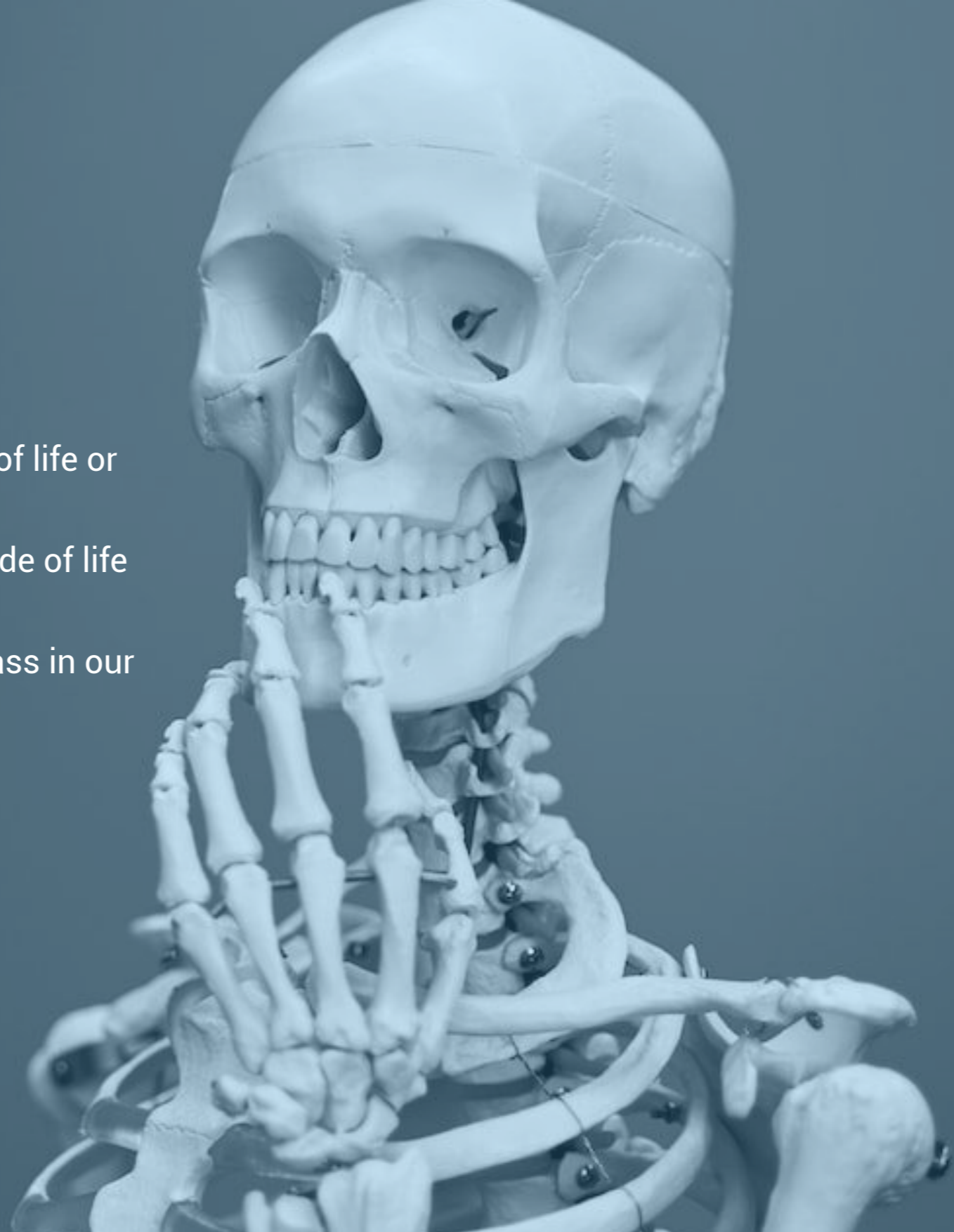
- Each 1 kg/m² higher BMI is associated with 1.15% lower serum vitamin D levels¹⁴
- The reverse association does not appear to exist, meaning that low serum vitamin D levels do not *cause* an increase in BMI levels¹⁴



"Patients who have a BMI > 30 often need 3–5 times as much vitamin D to both treat and prevent recurrence of vitamin D deficiency."

Bone Health

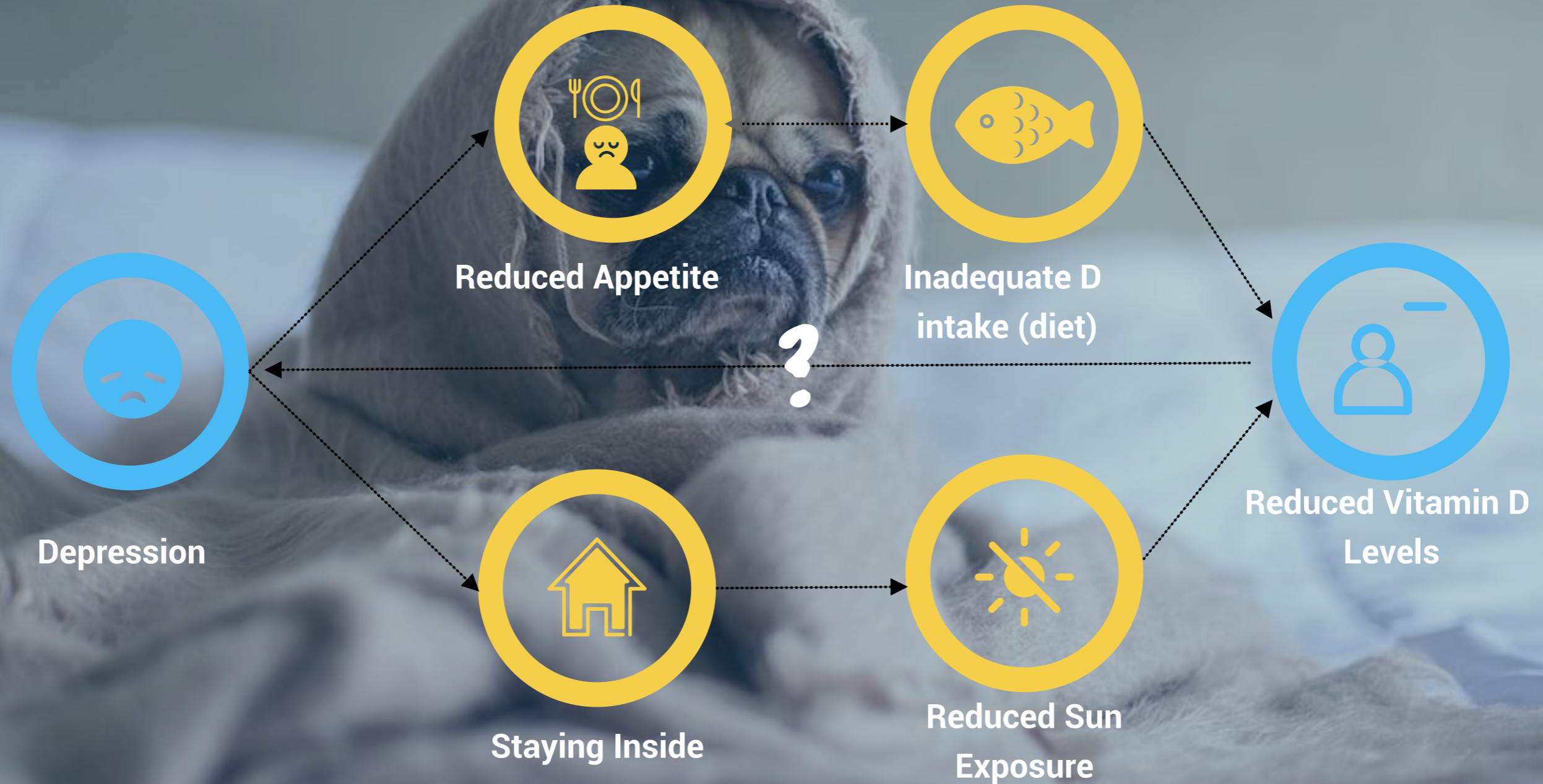
- Peak bone mass is attained by our 3rd decade of life or in our 20s
- Age-related bone loss occurs by our ~4th decade of life or in our 30s
- Our ability to attain and maintain peak bone mass in our 20s will impact our future bone health¹⁸



Vitamin D and Depression^{18,19,20}



Depression; Potential Reverse Association?



Sources of Vitamin D

UV Radiation

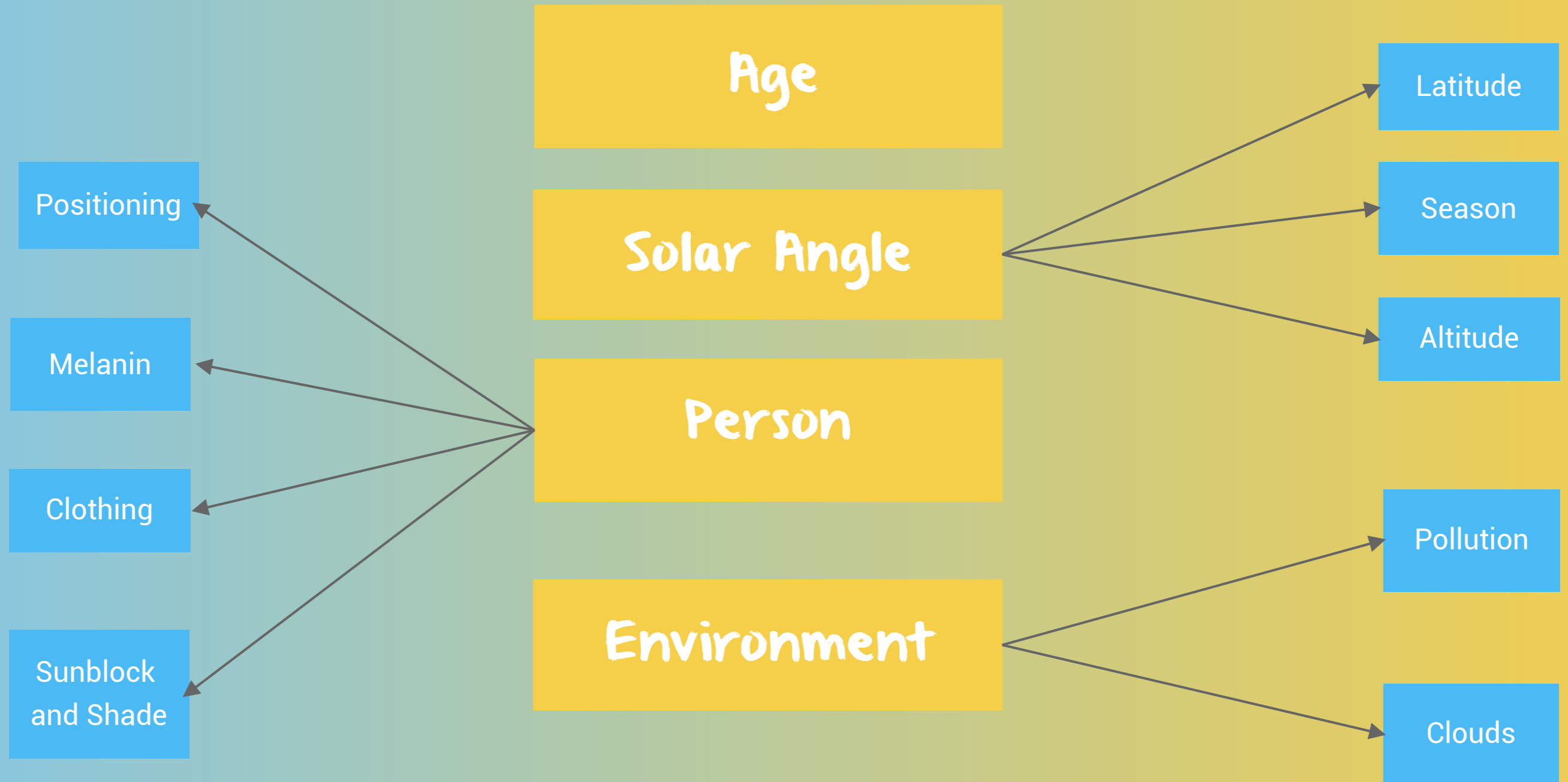
Artificial
(tanning beds)

Sunlight











100% skin exposure to sunlight to reach skin
minimal erythema dose (skin pinkening)
provides 20,000 IU⁶

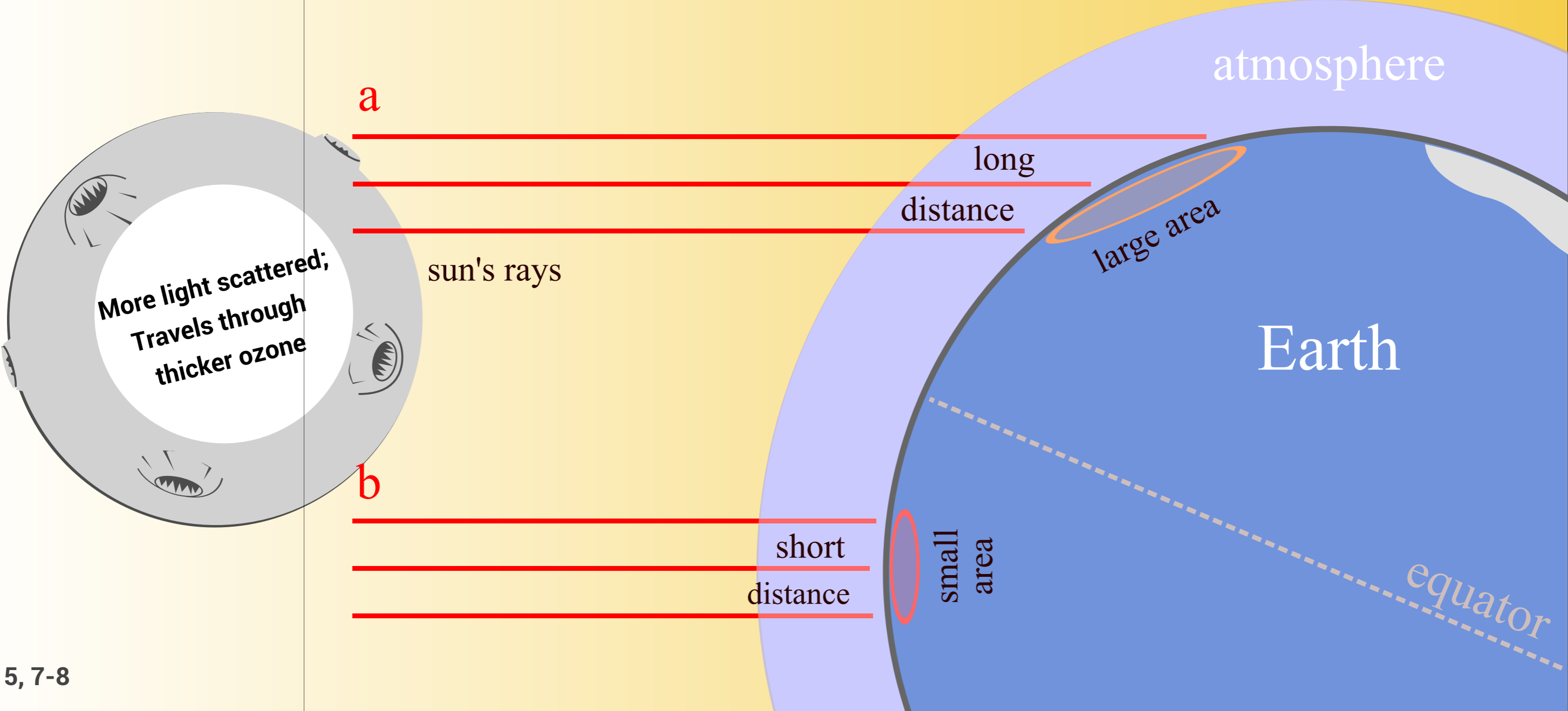
Factors that Influence Solar Formation



Fitzpatrick Skin Type Scale

| | | | | | |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|  |  |  |  |  |  |
|  |  |  |  |  |  |
| Type I | Type II | Type III | Type IV | Type V | Type VI |
| Light, Pale White | White, Fair | Medium White to Olive | Olive Tone | Light Brown | Dark Brown |
| Always burns, never tans | Usually burns, tans with difficulty | Sometimes mild burn, gradually tans to olive | Rarely burns, tans with ease to moderate brown | Very rarely burns, tans very easily | Never burns, tans very easily, deeply pigmented |

Vitamin D - what's your angle?



Colorado Latitude > Altitude?

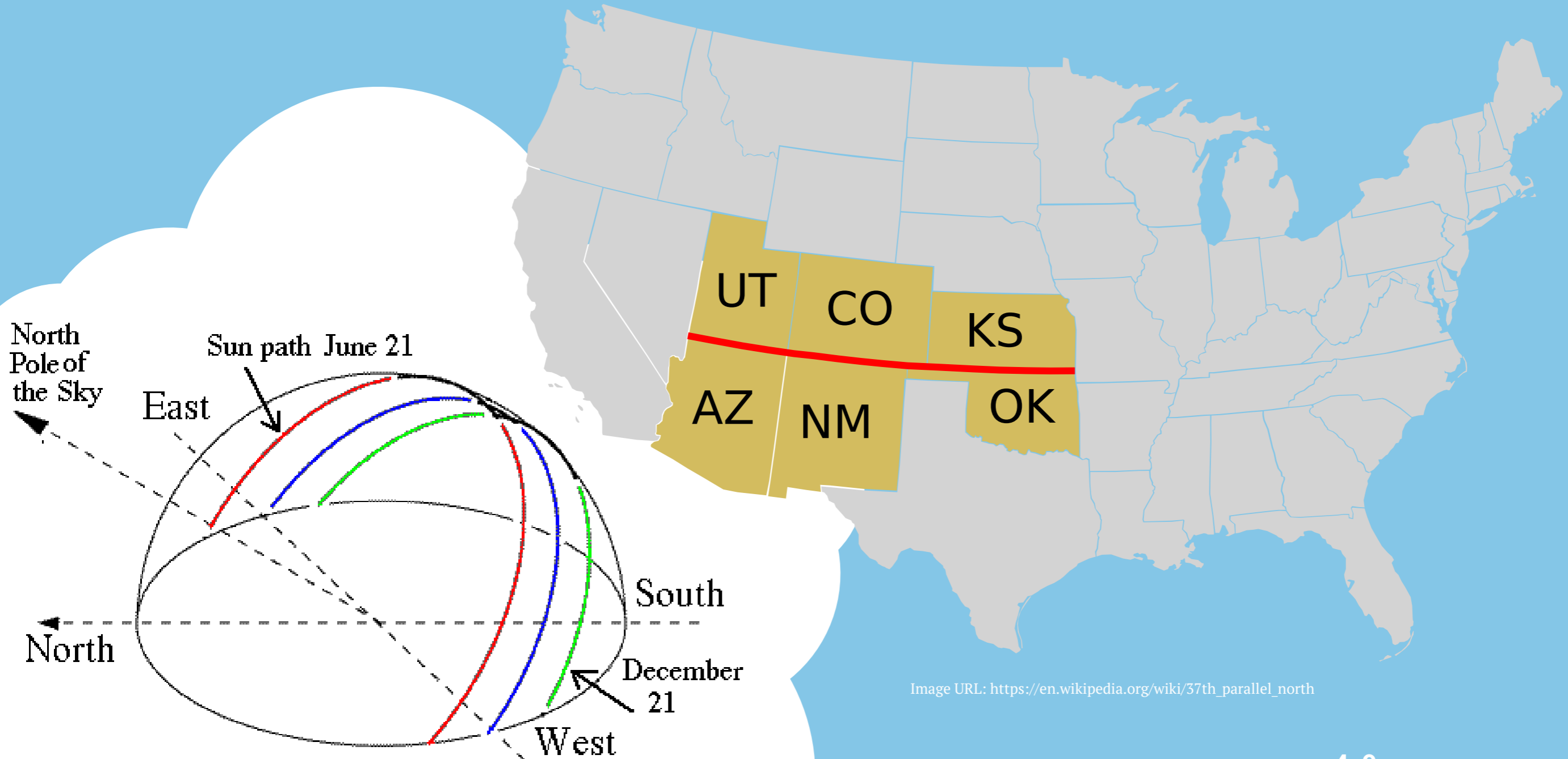
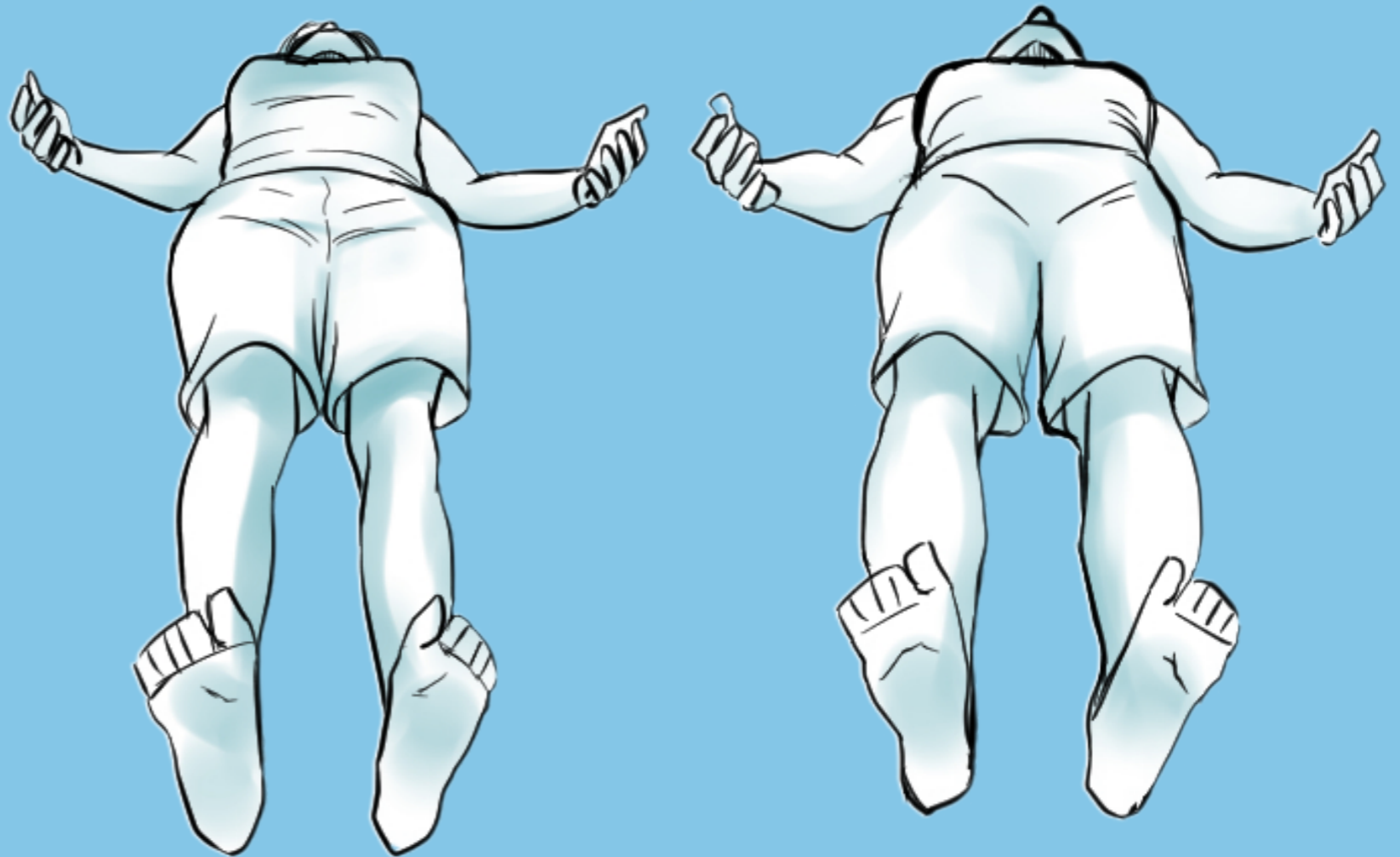


Image URL: <https://pwg.gsfc.nasa.gov/stargaze/Sunangle.htm>

Image URL: https://en.wikipedia.org/wiki/37th_parallel_north

Keep Your Face to the Sun?

- Skin synthesis is affected by:
- time of day
 - your body's angle
 - clothing choice
 - sunscreen



Cloudy with a Chance of Sunblock

Cloud differences in northern/southern hemispheres? ⁴

Pollution may decrease vitamin D by blocking sunlight, keeping people indoors, and contribute to kidney dysfunction. ⁷

Individuals in areas with higher ozone pollution (typically from cars), had lower average serum Vitamin D levels than those in less polluted cities. ¹¹

Sources of Vitamin D

Diet

Oily Fish



- 3oz of oily fish provides **570 IU** (salmon) and **675 IU** (trout)¹²

Irradiated Mushrooms



½ cup of raw, UV treated mushrooms provides **366 IU**¹²

Dairy, eggs, organ meats, other animal proteins



- 1 cup fortified milk provides **120 IU**¹²

Sample Menu: Can I get enough D through Diet?

| Breakfast | Lunch | Dinner | Snack | RDA ~600 IU |
|----------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------|--------------------------------------|-------------------|
| Low fat Greek yogurt with Sliced almonds and blueberries | Tuna fish sandwich with tomato and lettuce | Mushroom burger with low fat Monterey jack cheese | Bowl bran flakes with low fat milk | 1300 IU Vitamin D |
| Latte with Soy Milk | Mixed salad with yogurt ranch dressing | Sliced carrots, celery, and cucumbers with tzatziki sauce made with low fat yogurt | | |
| Low fat cheese and mushroom omelet | White bean soup with onion, kale, mushrooms, and whole wheat orzo pasta | Risotto with Tilapia and broccoli | Sardines in tomato sauce on crackers | 1200 IU Vitamin D |
| Fortified Orange juice | Toasted whole grain baguette with melted low fat mozzarella cheese | Traditional Caesar salad | Rice milk chia seed pudding | |

Sources of Vitamin D

Supplementation

Typical Vitamin D
supplement provides
2000 IU^{1, 12}



Vitamin D Toxicity?

Too much sun exposure?

No, D synthesis from the sun is a self-limiting reaction. Tachysterol and lumisterol are produced which act as a sunblock to prevent D toxicity

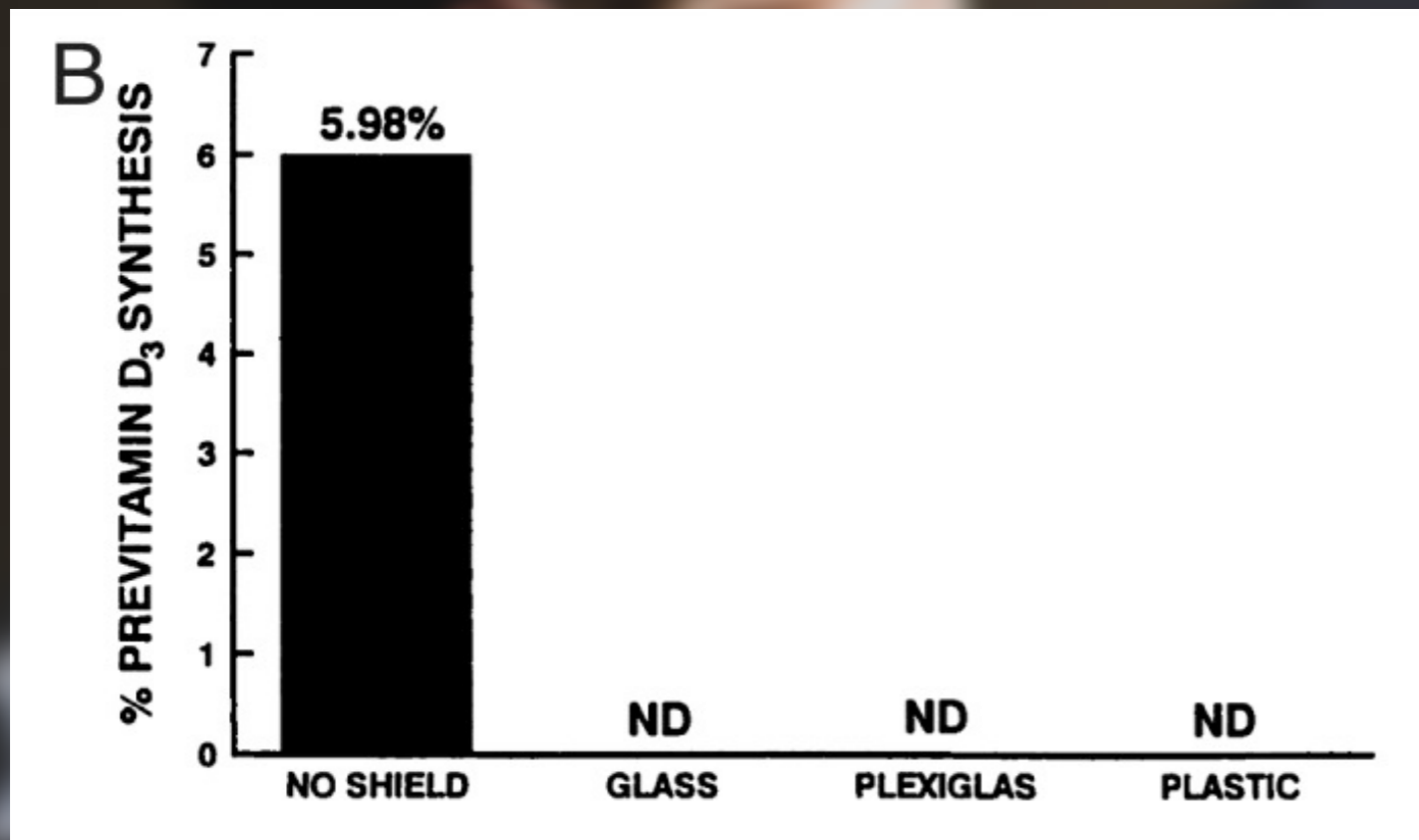
Toxicity through food?

Possible, but unlikely. Fortification of milk has been done for 80+ years with no adverse reactions.

Toxicity is more likely to happen with prolonged high doses of supplements.

doi:10.4161/derm.24494

D-bunking the Myths



Does showering after sun exposure reduce the amount of vitamin D my skin can synthesize?

Showering does not interrupt synthesis in the skin. It takes 8 hours to fully convert pre-d3 to active D

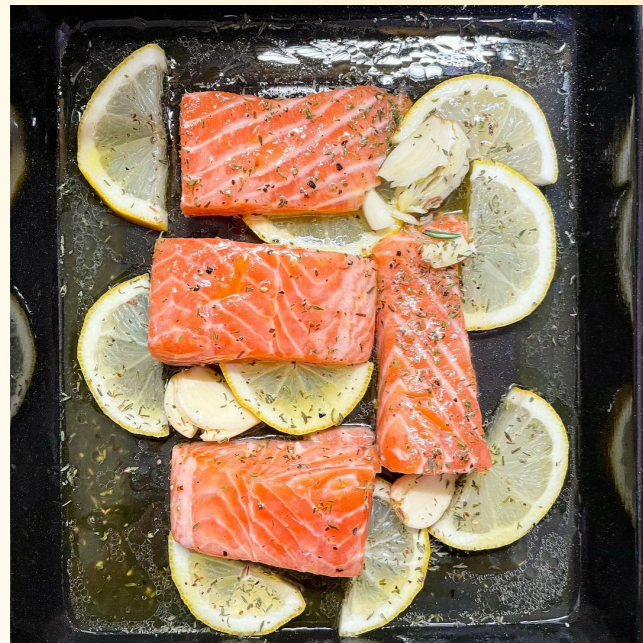
Can I get enough vitamin D through a window?

Nope. Glass and plastic absorb all UVB.

What about a tanning bed?

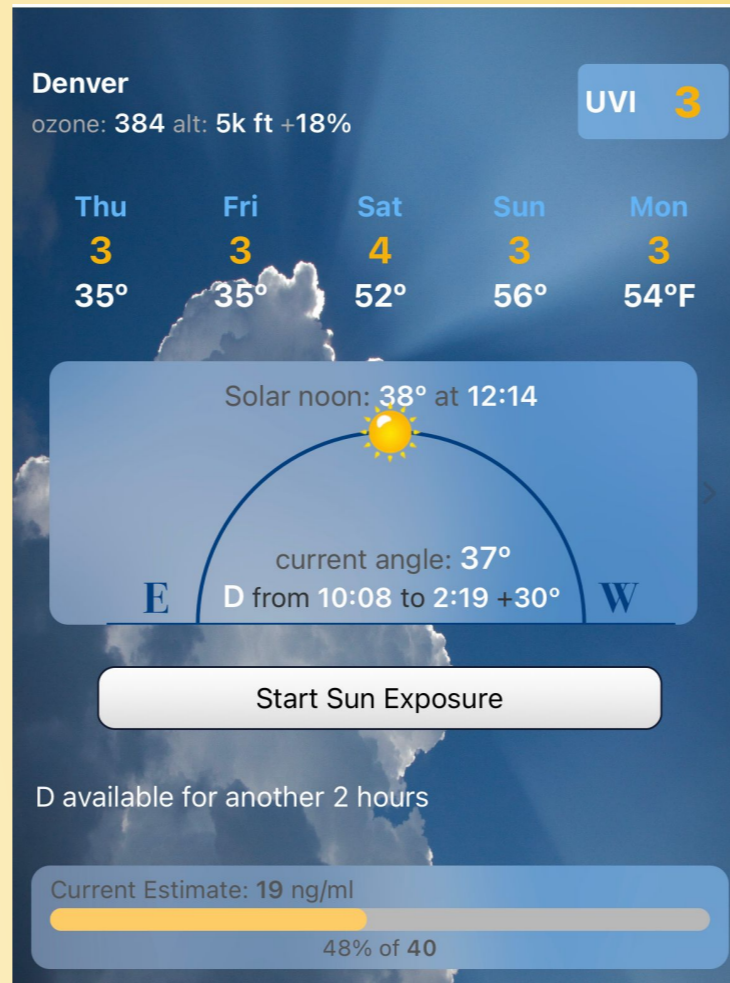
Nope! Tanning beds mostly offer UVA and not UVB rays.

Improving Vitamin D Status



Consuming (more) oily fish

Like salmon and trout¹²



D Minder App

Can *estimate* your vitamin D levels based on current angle of sun, how much skin is exposed and how long you expect to be in the sun



Supplementation

Under the supervision of a healthcare provider¹²

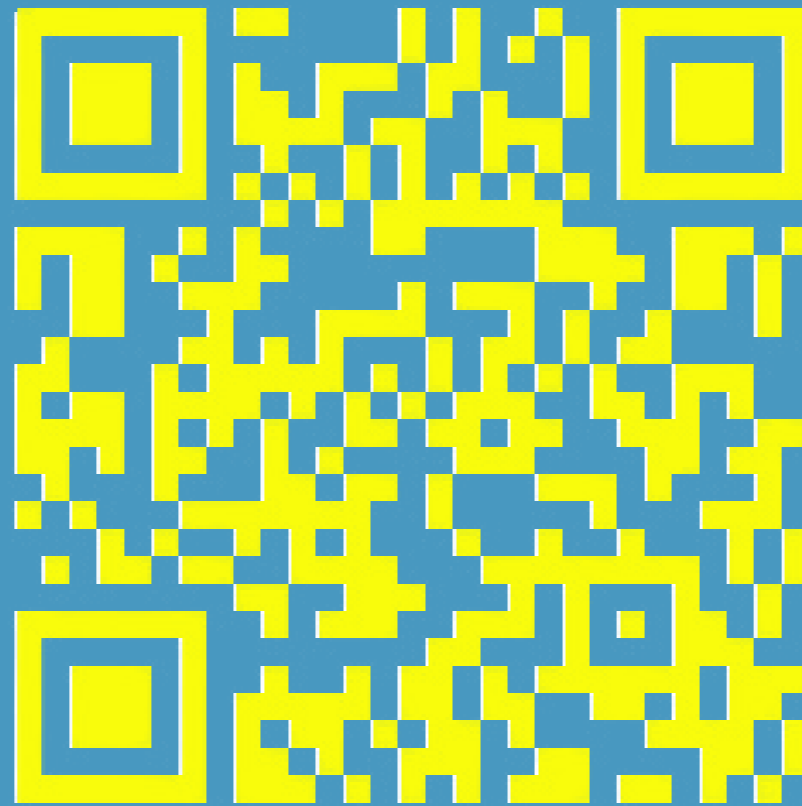


Topical products?

Summary

- Vitamin D is essential
- Vitamin D Sources in order of effectiveness (Sun, diet, supplementation)
- Deficiency causes problems (Bone Demineralization, Depression)
- Supplementation via fortified foods and nutrition supplements

What did you learn about
Vitamin D?



<http://bit.ly/3meq8vm>



Thank you!

Hope you are all a ray of sunshine!



Kelly LeGros Strickler, MS

Dietetic Intern



**Justin Batchelder,
MS, DTR**

Dietetic Intern



Karina Montero

Dietetic Intern

Sources

1. Dominguez LJ, Farruggia M, Veronese N, Barbagallo M. Vitamin D Sources, Metabolism, and Deficiency: Available Compounds and Guidelines for Its Treatment. *Metabolites*. 2021;11(4):255. doi:10.3390/metabo11040255
2. Ellison DL, Moran HR. Vitamin D: Vitamin or Hormone? *Nurs Clin North Am*. 2021;56(1):47-57. doi:10.1016/j.cnur.2020.10.004
3. Chen TC, Chimeh F, Lu Z, et al. Factors that influence the cutaneous synthesis and dietary sources of vitamin D. *Arch Biochem Biophys*. 2007;460(2):213-217. doi:10.1016/j.abb.2006.12.017
4. Seckmeyer G, Mustert C, Schrempf M, et al. Why is it so hard to gain enough Vitamin D by solar exposure in the European winter? *Meteorol Z*. Published online September 17, 2018:223-233. doi:10.1127/metz/2018/0855
5. Liu Y, Hu L, Wang F, et al. The angular distributions of ultraviolet spectral irradiance at different solar elevation angles under clear sky conditions. *Int J Biometeorol*. 2016;60(1):63-72. doi:10.1007/s00484-015-1005-y
6. Holick MF. Vitamin D: A D-Lightful Solution for Health. *J Investig Med*. 2011;59(6):872-880. doi:10.2310/JIM.0b013e318214ea2d
7. Mousavi SE, Amini H, Heydarpour P, Amini Chermahini F, Godderis L. Air pollution, environmental chemicals, and smoking may trigger vitamin D deficiency: Evidence and potential mechanisms. *Environ Int*. 2019;122:67-90. doi:10.1016/j.envint.2018.11.052
8. Munigoti SP. Exposure to Sunlight and Vitamin D Synthesis. *Indian J Endocrinol Metab*. 2018;22(6):854-855. doi:10.4103/ijem.IJEM_406_18
9. O'Sullivan F, Raftery T, van Weele M, et al. Sunshine is an Important Determinant of Vitamin D Status Even Among High-dose Supplement Users: Secondary Analysis of a Randomized Controlled Trial in Crohn's Disease Patients. *Photochem Photobiol*. 2019;95(4):1060-1067. doi:10.1111/php.13086

Sources

10. Serrano MA, Moreno JC. Spectral transmission of solar radiation by plastic and glass materials. *J Photochem Photobiol B*. 2020;208:111894. doi:10.1016/j.jphotobiol.2020.111894
11. Agerwal KS, Mughal MZ, Upadhyay P, Berry JL, Mawer EB, Puliyeel JM. The impact of atmospheric pollution on vitamin D status of infants and toddlers in Delhi, India. *2002;87:111-113*. doi:10.1136/adc.87.2.111
12. National Institute of Health. Vitamin D Fact Sheet for Health Professionals. Accessed March 8, 2023. <https://ods.od.nih.gov/factsheets/VitaminD-HealthProfessional/>
13. Goswami R, Saha S, Sreenivas V, Singh N, Lakshmy R. Vitamin D-binding protein, vitamin D status and serum bioavailable 25(OH)D of young Asian Indian males working in outdoor and indoor environments. *J Bone Miner Metab*. 2017;35(2):177-184. doi:10.1007/s00774-016-0739-x
14. Vimalaswaran KS, Berry DJ, Lu C, et al. Causal Relationship between Obesity and Vitamin D Status: Bi-Directional Mendelian Randomization Analysis of Multiple Cohorts. Minelli C, ed. *PLoS Med*. 2013;10(2):e1001383. doi:10.1371/journal.pmed.1001383
15. Ghassab R. The effect of vitamin D deficiency and vitamin D supplementation on the risk of cardiovascular diseases. *Fam Med Prim Care Rev*. 2021;23(1):87-92. doi:10.5114/fmpcr.2021.103161
16. El Mokadem M, Boshra H, Abd el Hady Y, Abd el Hameed AS. Relationship of serum vitamin D deficiency with coronary artery disease severity using multislice CT coronary angiography. *Clínica E Investig En Arterioscler*. 2021;33(6):282-288. doi:10.1016/j.arteri.2021.02.008
17. Karlsland Akeson P, Åkesson KE, Lind T, Hernell O, Silfverdal SA, Öhlund I. Vitamin D Intervention and Bone: A Randomized Clinical Trial in Fair- and Dark-skinned Children at Northern Latitudes. *J Pediatr Gastroenterol Nutr*. 2018;67(3):388-394. doi:10.1097/MPG.0000000000002031

18. Laird E, Ward M, McSorley E, Strain JJ, Wallace J. Vitamin D and Bone Health; Potential Mechanisms. *Nutrients*. 2010;2(7):693-724. doi:10.3390/nu2070693

19. Parker GB, Brotchie H, Graham RK. Vitamin D and depression. *J Affect Disord*. 2017;208:56-61. doi:10.1016/j.jad.2016.08.082

20. Menon V, Kar SK, Suthar N, Nebhinani N. Vitamin D and Depression: A Critical Appraisal of the Evidence and Future Directions. *Indian J Psychol Med*. 2020;42(1):11-21. doi:10.4103/IJPSYM.IJPSYM_160_19