Vitamin D

Amongst all the vitamins, vitamin D is an exception that the body can make it's own with help from the sunlight. Both plant and animal sources of vitamin D are inadequate for the body's needs. Vitamin D in the body comes from 3 sources:

- Vitamin D of animal origin called Cholecalciferol (active vitamin D3)- It is the active form of vitamin D.
- Vitamin D of plant origin called ergocalciferol (Provitamin D2). It gets stored in the liver, and when needed, the kidneys, convert it to active vitamin D3.
- Vitamin D synthesized in the skin by sunlight – The best source of vitamin D is Ultraviolet rays- B (UV-B light) of the sun. The UV-B light initiates a photosynthetic reaction in the superficial layers of skin to make an inactive form of vitamin D (provitamin D2) which gets stored in the liver. In individuals under the age of 50, the liver can store up to six months supply of vitamin D. When required by the body, this stored inactive form of Vitamin D in the liver is converted to active Vitamin D3 by the kidneys. In the darker skin individuals who have more of the dark pigment melanin in their skin, UV-B light cannot penetrate the skin as efficiently as in light skin individuals. Darker skin individuals have to spend more time under the sunlight to get the right amount of vitamin D.

Beneficial effects of Sunlight and vitamin D

i. *Mead NM: Benefits of Sunlight; A bright spot for human health. Environmental Health Perspectives; 2008.*

ii. *Hoet DG et al. The risks and benefits of sun exposure. Dermatol endocrinology;2016*

Getting vitamin D from the sunlight has dual benefits because sunlight itself has many beneficial effects of its own. Vitamin D performs several functions in the body by regulating specific genes in many organs of the body. In this respect, vitamin D is unique because it works more like a hormone performing several functions. The global urban population, in general, suffer from vitamin D deficiency. A lack of sunlight exposure from an indoor lifestyle is the primary reason for this epidemic of Vitamin D deficiency. The widespread deficiency of vitamin D may also be the reason for an outbreak of several new diseases amongst city dwellers. Vitamin D, in conjunction with sunlight, has several benefits in the body in addition to bone health:

- *Bone health* – A significant role of vitamin D is to maintain blood levels of calcium and phosphorus for bone mineralization. Vitamin D does this by promoting the absorption of these minerals from the digestive tract. Low vitamin D levels lead to bone-thinning-osteoporosis with bone pain and risk of fractures. Vitamin D controls bone mineralization, bone restructuring, and new bone growth, specifically in growing children.

- *Hormonal balance* – The eyes perform the unique function of connecting the brain to sunlight. Vitamin D receptors have a universal presence in the body, including the brain. The blue light in the sunlight spectrum stimulates the retinal membrane of the eyes. The nerves from the eyes carrying the signal, in turn, stimulate the hypothalamus area of the brain. The hypothalamus is the master controller of many hormones in the body, including Insulin, Thyroid-stimulating hormone, Sleep hormone, Growth hormone, and Cortisol. Hormonal imbalance from lack of sunlight and vitamin D may have added to the risk of the modern epidemics of Insomnia, hypothyroidism, obesity, Type2 diabetes, and more.

- *Mood and Sleep* – The Pineal (so-called because of pine cone shape) gland in the brain secrets and stores melatonin – the sleep hormone. Secretion of melatonin occurs in the morning on exposure to sunlight or bright morning light. The Pineal gland makes the hormone melatonin as well as serotonin, which is a mood-elevating chemical neurotransmitter. Both melatonin and serotonin coexist in the pineal gland. Melatonin plays a vital role in regulating healthy, rejuvenating sleep. Its production is under the control of the light and dark cycles of the day; also called circadian cycle. The serotonin is a feel-good chemical neurotransmitter which controls mood and prevents depression. People who live in geographic areas of the world, where there is no sunlight for many days at a stretch, suffer from a high incidence of depression and higher suicide rates. The mental distress from the lack of sunlight exposure is called Seasonal Affective Disorder or SAD or winter blues. Since melatonin and serotonin are interrelated, Insomnia typically leads to depression and depression to insomnia.

- *Immune system* – The sun exposure increases the number of protector cells which defend the body against bacterial and viral infections. Respiratory diseases, such as common cold, influenza, and pneumonia, are more common during winter months. Sunlight and optimal vitamin D levels are protective against infections and cancers. Observations as early as in the 1930s revealed that people who live at higher latitudes where the sunlight is scarce are more prone to breast, ovarian, colon, pancreas, and lymphatic tissue cancers. Interestingly, cancer rates are rising all over the world, including in tropical countries. That could be related to the preference of the current urban population for an indoor lifestyle, with diminished exposure to sunlight and widespread vitamin D deficiency.

  Autoimmune diseases such as multiple sclerosis, Rheumatoid arthritis, Type1 diabetes, Hashimoto's thyroiditis is increasing in incidence amongst the global population in general. Reduced sunlight exposure and lower level of vitamin D are considered risk factors for these diseases. A Finnish study demonstrated that 2000 units of vitamin D given daily to children starting at one year of age, reduced the risk of Type1 diabetes.

- *Skin Health* – Vitamin D deficiency is associated with risk of skin conditions like Psoriasis and atopic dermatitis (eczema). Human skin is the site for vitamin D synthesis. Vitamin D affects multiple functions in the skin from its proliferation, a turnover of dead cells, and

immunity against infections. Several clinical studies suggest a beneficial effect of Vitamin D supplementation in the treatment of Psoriasis and eczema.

- *Brain function* – Exposure to sunlight increases cell growth in an area of the brain called hippocampus, which is the seat of forming new memories and cognitive function (awareness of new surroundings). Diminution in the size of the hippocampus with aging correlates with loss of memory-dementia and spatial coordination.

- *Metabolic diseases and Vitamin D deficiency* – Normalizing vitamin D level increases Insulin hormone sensitivity with improved glucose utilization. Insulin resistance is the root cause of obesity, metabolic syndrome, Type2 diabetes, high blood pressure, and heart disease.

- *Reduction in weight and food cravings* – the sun energy reduces the appetite. During the daylight hours, the body is more active, so it is Insulin sensitive with better utilization of the glucose for energy. At night time the body is inactive, in less need for glucose energy, and converting most of the glucose into reserve energy fat. Late eating invariably leads to obesity, even when one is consuming a healthy meal.

Vitamin D sources

There are two sources of vitamin D:

1. Dietary source from plants and animals – Most foods except for cod liver oil have negligible amounts of vitamin D. The dairy and eggs are considered poor sources. Overall the food sources of vitamin D are not adequate.

2. Sunlight exposure – ***"The best source of vitamin D is UV-B light from the sun."***

   Only the exposed part of the skin in direct contact with sunlight will have the capacity to synthesize vitamin D. Sunlight exposure can never overdose an individual with vitamin D. However, taking an excess of Vitamin D pills/ injections can overdose an individual so the supplements of Vitamin D should be taken with due consideration and under medical supervision. The ideal way to get vitamin D is a safe exposure to sunlight.

Vitamin D Overdosage – Excessive intake of oral or injectable vitamin D supplements can cause overdosage. Vitamin D is the most toxic of all the vitamins. The signs of overdosage are:

- Loss of appetite and nausea.

- Excessive thirst and stupor.

- High blood calcium levels due to excessive absorption of calcium from the digestive tract.

- Abnormal calcification in the body – Kidneys, blood vessels, and soft tissues.

Recommended blood levels of Vitamin D

The International Osteoporosis Foundation estimates that 80% of the urban Indians overall suffer from Vitamin D deficiency because of lack of sun exposure. Vitamin D fraction measured in the blood is active vitamin D3.

The usual range of levels of Vitamin D is – 20 to 40 ng/milliliter.

(The Institute of Medicine, USA, recommends that the Vitamin D levels greater than 30 ng/milliliter are not necessary. The levels in the range of 20 ng/milliliter are adequate for optimal bone health.)

Vitamin D deficiency levels are – Less than 12 ng/Milliliter.

Vitamin D overdose – Toxic levels are- Over 100 ng/milliliter, but doses higher than 50ng /milliliter should be considered too high and an indication for holding vitamin D supplementation.

Safe Dose for Vitamin D supplementation

Institute of Medicine, USA, recommends that daily Vitamin D requirement is 400-600 IU/ Day. Most popular multivitamin tablets have this amount of vitamin D.

When there is vitamin D deficiency (blood levels less than 12ng/milliliter), up to 4-10,000 units daily is prescribed. However, such high doses should be given only for a few weeks with caution, and Vitamin D levels monitored to ensure that blood level remains between 20-30 ng/milliliter. Nausea is the first sign of vitamin D overdose. Doses higher than 4000 units daily for prolonged periods is unsafe and may cause an excessively high level of calcium in the blood.

When there is vitamin D deficiency, it is safer to take Vitamin D orally in doses recommended above and avoid taking high dose injections. Close monitoring of vitamin D level is needed, when vitamin D supplements are administered in high doses orally or by injection.

A significant advantage of getting vitamin D naturally via sunlight is that it never poses a risk of overdosage. The urban population who prefers indoor lifestyle need to be educated on how to get a safe dose of the sun, both for vitamin D supplementation as well as for overall physical and mental health.

How to get a safe dose of Sunlight for vitamin D synthesis and other Health Benefits

Medical science has exaggerated the harmful effects of sunlight on the skin (skin cancer) and eyes (early cataract). Proper protection of skin and eyes prevents both these risks. Skin cancer is rare in dark skin individuals because of the protective effect of melanin skin pigment. To minimize the risk of early cataract, protect the eyes with sunglasses or hat or both. Healthy tips for safe sunlight therapy – sungazing (viewing the rising sun while it has its red glow) and sunbathing (UV-B rays of sunlight for Vitamin D synthesis) are as follows:

- *The optimal time for Sun gazing* – A safe time for sungazing is within one hour around the rising or setting sun when the sun has a red glow. The reliable duration of sungazing is only 5-15 minutes. Sungazing boosts hormonal balance, vigor, and vitality.
- The UV light of the sun is intense during the mid-day. That is not a safe time to sunbath for vitamin D despite protection with sunblock creams or sunscreen lotions.
- The UV-B light is in the safest range for vitamin D synthesis in the skin one hour after the sunrise when the red glow of the rising sun has disappeared. Typically, this time falls between 7 AM to 9 AM with more extended time during the winter months. In the evening, the safe time for sunbathing is 2 hours before the sunset between 5 PM to 7 PM.
- Heating and redness of the skin is a sign that sun-rays are too intense for safe sunbathing, and further sun exposure should stop.
- Global burden of the disease (skin cancer) due to sun exposure is only 0.1%. In contrast to this, there is a high global burden of the disease due to low vitamin D levels and lack of sun exposure. It is widely recognized currently, that Vitamin D receptors are present universally in the body. In this respect, vitamin D works more like a hormone with widespread health-boosting effects in the body. Low vitamin D level and overall poor health is an epidemic amongst the urban city dwellers. Awareness of this critical fact is the first step towards managing the epidemic of low vitamin D levels.
- The good news is that one can overdose easily with vitamin D supplements but can never overdose from vitamin D synthesized in the skin naturally by the sunlight. The Indian subcontinent remains blessed with the sunshine all the year-round.
- Safe duration of sun exposure at the appropriate times of the day are as follows:
    - In the individuals with fair and light-colored skin -15 to 30 minutes
    - In individuals with brown skin—30 to 60 minutes
    - In individuals with very dark skin-2-3 hours
- For maximum benefit, up to 40% of the body needs sunlight exposure or at least exposure of the palmar aspect of the hands, arms, and feet. The best UV-B ray absorption occurs from the lighter skin areas such as palms and the flexor surface of the arms.
- Do not sunbath with skin covered by sunblock lotions or heavy clothing. That is required only to protect the skin from the intense midday sun.
- Multiple 2-3 short exposures of 10-15 minutes are more useful for vitamin D synthesis in skin compared to one long 60-minute exposure.
- Sunlight exposure or sunbathing as described above, done 3-4 times per week will do the needful in light-colored individuals regarding adequate vitamin D levels. Darker skin

individuals will require longer exposure time. As mentioned previously, one can never overdose with natural vitamin D coming from the sunlight.

How to maximize health benefits from Sunlight

"There are all kinds of light for sight; but for health, there is only one light, that is SUNLIGHT."

By evolution, the human race originated at the sun-drenched equatorial region of the planet earth. There they established a strong relationship with sunlight; eating foods which grew and flourished under the energy of the sun. They also lived a balanced lifestyle dictated by the light and dark cues of the cycle of the sun. By evolution, therefore, humans are intimately connected to the bioenergy of the sun both for nourishing foods as well as for several essential survival behaviors such as:

- Fasting- Feeding cycle
- Sleep – awake Cycle
- Activity exercise and rest cycle

  By nature's design, the body's physiological functions are active during the daylight hours and get into the rest, repair and rejuvenating mode during the dark hours of the night.

  Foods which have grown under the energy of the sun and the balanced lifestyles lived in synchrony with daylight and dark hours of the day are the secret to the preservation of health and prevention of the diseases. Circadian rhythms of nature are under the control of brain clock called circadian clock- Circa means round, and Dien is the day. The circadian clock of the human brain controls all the physiological functions of the body, including- Digestion, Metabolism, Hormonal balance, Sleep, and Immune balance. Regular exposure to sunlight enhances physical, intellectual, and mental health. To maximize the health benefits of sunlight:

  (For detail on the subject of Brain clock and Sunlight review these sections on this website)

- The office workers who work the entire day indoors must take brief breaks of 10-15 minutes 2-3 times a day to get to the outdoor environment to get the benefit of the morning and evening sunlight.
- Wake up early to briefly view the rising sun or the bright morning light of the dawn to optimize hormones, especially the sleep hormone melatonin synthesis. An ideal way to reset a healthy rejuvenating sleep cycle is to get up at an early hour of the morning. Physiologically, the normal sleep cycle is intimately connected to the wake-up time in the morning and not to the time one gets in the bed at night.

- Sunglasses are effective in blocking the bright sunlight effect on the eyes. However, the sunglasses should be worn only to protect eyes from the bright mid-day sun and not the rising or the setting sun with the red glow.

Realigning our lives with the nature and the bioenergy of the sun concerning foods and a balanced lifestyle is the key to preventing and reversing the epidemic of common diseases affecting global population -such as Obesity, Type2 diabetes, High blood pressure, Heart disease, cancer and many more. The research into Circadian physiology of the day and night cycles and their critical role in health and illness earned three medical physiologists – Drs Hill, Rosbash and Young, a Nobel prize in October 2017.