### Vitamin D benefits:

**SKELETAL SYSTEM** [4]
- Plays a role in:
  - calcium/magnesium/phosphorus absorption/ transport/metabolism
  - strength of bone, cartilage
  - teeth and gum health
- Deficiency may cause:
  - osteoporosis, osteomalacia, osteoarthritis, muscle weakness and pains, periodontal disease
  - secondary hyperparathyroidism [15]

**GLUCOSE METABOLISM** [1]
- deficiency impairs insulin production and is associated with insulin resistance

**CARDIOVASCULAR** [9]
- May reduce:
  - lipid peroxidation
  - certain types of hypertension
  - CRP, fibrinogen, IL-6 [15]

**IMMUNE SYSTEM EFFECTS**
- May reduce [2,4]:
  1. **Inflammation**, such as caused by neuronal injury [14]
  2. **Autoimmune reactions:**
     - MS, Type I Diabetes [1,13], rheumatoid arthritis, psoriasis, inflammatory bowel disease (Crohn’s, ulcerative colitis), lupus, thyroiditis
     - reduces transplant rejection
  3. **Cancer risk & development** [4]
     - cancers: colon, breast, prostate, melanoma
- May enhance:
  - vaccines antibody response [12]
  - NK cell activity

**MOOD DISORDERS**
- may alleviate PMS and seasonal affective disorder

**ADRENAL SUPPORT**
- supports dopamine and adrenaline synthesis
- deficiency may cause fatigue and fibromyalgia-like symptoms
- May counteract some detrimental effects of corticosteroids, such as osteoporosis and susceptibility to infections [8, 13]
- Supports genomic stability

### Vitamin D

Current AI (Adequate Intake) for Vitamin D is set at 200-600IUs for 20 -75 year olds respectively. This level of supplementation seems inadequate in the light of recent research and the human physiological adaptations to the natural environment that shaped its genetic makeup.

**Vitamin D** contributes in multiple ways to the optimal function of the human body because virtually every cell has a receptor for it and can be significantly affected by it [2].

Vit D3 is synthesized in the skin from cholesterol in response to absorbing UVB rays. It is then converted by the liver into 25 (OH)-D3 and then by kidneys into the active hormone 1,25 (OH)-D3. We are just now becoming aware of how this hormone influences the genetic expression of many cells, having a profound effect on health and disease.

Humans have adapted for millions of years to the continuous exposure of a large surface of the body to sunlight, year round, while living close to the equator. This ensured the production of more than 10,000IUs of Vit D per day. In addition, Paleolithic humans used to eat foods from animals roaming in the sun, which had about 10 times higher content of vitamin D.

A high percentage of modern humans have sub optimal levels of vitamin D body stores because UVB exposure is too low at latitudes above 40 degrees, such as all northern American states, especially during cold seasons and due to the: smog/ozone layer, spending time indoors, clothing and sun block [3].

Deficiency of vit D has been linked to exacerbation of many conditions (see left box) and for all the reasons stated above including other factors that increase requirement (see list on reverse page), Vitamin D supplementation may be needed to support optimal physiological function.

The level of vit D supplementation depends on body stores, diet and sun exposure. Vit D is fat soluble and excessive levels can be toxic, so blood levels need to be assessed and followed up periodically. Calcium levels should also be monitored because they can be increased by high levels of vit D.

2000 IUs/day is considered the safe upper limit for long term supplementation by the same scientists that have devised the current RDI, but many researchers consider amounts of 4,000IUs- 10,000IUs/day more appropriate for maintaining optimal blood levels, if sun exposure is insufficient, see Table 1. [7]

**Assessing the status, need and efficiency of supplementation with vit D3**

Vitamin D circulates, bound to Vitamin D binding protein, in two forms: -25(OH)-D3 correlates with the level of vit D stored and available in the body tissues, and it is the best marker for vit D status. -1,25(OH)-D3 is the active hormone, which is kept in the normal reference range by regulatory mechanisms, even in deficiency states.

### Table 1 Vitamin D Status based on Blood levels [19]

<table>
<thead>
<tr>
<th>25(OH)D3</th>
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</thead>
<tbody>
<tr>
<td>(ng/mL)</td>
<td>(nmol/L)</td>
</tr>
<tr>
<td>&lt;20</td>
<td>&lt;50</td>
</tr>
<tr>
<td>20-32</td>
<td>50-80</td>
</tr>
<tr>
<td>32-100</td>
<td>80-250</td>
</tr>
<tr>
<td>54-90</td>
<td>135-225</td>
</tr>
<tr>
<td>&gt;100</td>
<td>&gt;250</td>
</tr>
<tr>
<td>&gt;150</td>
<td>&gt;325</td>
</tr>
</tbody>
</table>
Significant Vit D sources: fatty fish (320IU/3oz salmon or sardines, 100IU/8oz fortified milk)

How much Vitamin D do we get from the sun? For a light skin person, it takes about 15 min of full body sun exposure to produce 10,000IU of Vitamin D. However, a darker skin person (Indian, Asian) may require 2-3 times longer (30-45min), while an African descent person may take 8 times longer (120min) of sun exposure to produce the same amount of 10,000IU’s. This is because melanin blocks UVB rays.

Factors that can exacerbate Vitamin D deficiency:
- genetically dark skin or a dark tanned skin may require up to 3-8 times longer sun exposure to absorb the same amount of UVB as light or untanned skin. African decent individuals have a much higher incidence of vitamin D deficiency, especially in northern states.
- obese individuals can have 50% lower plasma levels of vit D than normal weight ones, for the same supplementation levels or sun exposure [10] This is because their increased fat mass takes in Vitamin D from the blood stream at the expense of other tissues.
- estrogen/progesterone deficiency (amenorhea, surgical or age-onset menopause) impairs the formation of the active form of vit D [18]. This is especially critical because the risk of auto-immune diseases increases with aging and vit D helps taper immune-mediated diseases. [13].
- aging skin has a reduced capacity of vitamin D synthesis, lower at age 75 by as much as 25% of young levels.
- fat mal absorption and poor digestion (due to inadequate fat digestion enzymes, bile production, gallbladder removal)
- excessive fat binding by drugs (bile acid sequesters such as Cholestyramine), soluble fiber or use of laxatives/ Olestra
- excessively low cholesterol due to malnutrition, excessive exercise, statin drugs

Vitamin D and vitamin K work together to build strong bones and prevent calcium deposition in the arterial walls
Adequate levels of vitamin D can increase calcium absorption 2-3 times higher, by stimulating the production of Vit D binding protein which transports it in the blood and makes it readily available to all tissues. Vit K reduces calcium loss in the urine by improving the kidneys efficiency in reabsorbing it. Adequate levels of Vit K are also necessary for directing the transport of calcium into bone and teeth with formation of proper architecture for optimal strength and away from soft tissues and plaque. [16]

Increasing the amount of calcium in the blood stream by proper supplementation with calcium and vit D in the presence of inadequate levels of vit K, can increase the risk of calcium deposition in soft tissue (arterial plaque, organs). This process may also be aggravated by oxidative stress or drugs such as Coumadin (Warfarin), which antagonize Vit K action. Vit K can be obtained from diet, supplements and can also be synthesized by intestinal friendly bacteria. DFH Osteoforce provides calcium, magnesium and vit K along with all the necessary cofactors for proper bone metabolism.

Vit D and Vit A compete for absorption and excessive Vit A levels can antagonize some of the beneficial effects of Vit D, and this may be why high intakes of Vit A (20,000IU) were shown to increase the risk of bone fractures.

How is Vit D reducing auto-immune disease activity?
Vit D acts as a controller that tempers down excessive proliferation of the immune cells (TH1 Type) that are responsible for attacking own body cells (such as nerve/brain cells for MS, joint structures in arthritis, pancreatic cells in Diabetes Type I)[12]. The effect of vit D supplementation can be noticed almost immediately, although body stores take time to get to optimal levels. One study noted that the down regulation of the autoimmune attack was dramatically reduced within 24-48hrs, following the ingestion or IV of a high dose of vitamin D (about 50,000IU).

“Alltogether, Vit D immunomodulatory potency is comparable to other established immunosuppressants without sharing their typical adverse effects. This profile makes 1,25(OH)(2)D(3) a potential drug for the treatment of immune-mediated diseases.” [13]. One important advantage of using Vit D for calming auto-immune disease is that it does not impair the resistance to infections and does not cause osteoporosis, like corticosteroids or other immune suppressants do.[8]. Adequate calcium intake was also shown to be important in realizing some of the immunological effects of Vit D.

Vit D mechanisms of reducing cancer risk and development and survival [4]: Vit D induces cell differentiation and apoptosis of the cancer cells, reduces excessive cell proliferation and increases Natural killer Cell activity. Resveratrol was shown to sensitize breast cancer cells to the apoptotic action of vit D. Tocotrienols and green tea support apoptosis also.

Vit D toxicity symptoms: nausea, headaches, constipation, kidney stones, mental confusion, heart arrhythmia

Contraindicated for the following conditions: primary hyperparathyroidism, sarcoidosis, tuberculosis. Any hypercalcemic state or any condition (tumors, bacterial load) that may overproduce 1,25(OH)D3.

Designs For Health Vitamin D Synergy contains 2000IU Vit D + 200IU Vit K1 /cap
Designs For Health Vitamin D Supreme contains 5000IU + 500vitamin K1 + 50mcg vitamin K2-MK-7/cap


