

## Defeat the 'D' deficiency – be sun smart

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Vitamin D, also known as the 'sunshine vitamin', is an essential hormone widely known to be involved in bone health. However, bone diseases are now being considered as the tip of the vitamin D deficiency iceberg. Increasing evidence from several epidemiological and *in vitro* studies indicates a protective role of vitamin D in a range of systemic illnesses like diabetes, multiple sclerosis, cardiovascular diseases, joint diseases, schizophrenia, depression and malignancy.<sup>1,2</sup> Recent studies have also shown its role in skin aging.<sup>3</sup> These beneficial effects are known to be due to its wide range of biological activities in cell differentiation, proliferation and immune functions and because of the fact that most tissues and cells in the body have vitamin D receptors and enzymes to convert the inactive form of vitamin D to the active form.<sup>1</sup>

The Institute of Medicine of The National Academies has suggested the levels of vitamin D as essential for health (**Table 1**). Similarly, recommendations from the Institute of Medicine for adequate daily intake of vitamin D are 200 International Units (IU) for children and adults up to 50 years of age, 400 IU for adults 51 to 70 years of age, and 600 IU for adults 71 years of age or older.<sup>4</sup> However, most experts agree that without adequate sun exposure, children and adults require approximately 800 to 1000 IU per day.<sup>5</sup>

In humans, approximately 90% of vitamin D is obtained through cutaneous sunlight exposure<sup>6</sup> and very little from foods, because very few foods in nature contain vitamin D and those that do, have it in small quantities. For instance, even an 8-ounce glass of whole milk fortified with 100 IU of vitamin D only provides about 10 percent of the Recommended Daily allowance (RDA). In contrast, sun exposure to the skin can potentially make a thousand units of vitamin D in a relatively short period of time. That is why sunlight remains the prime source of acquiring vitamin D.

It is the ultraviolet-B (UVB) portion of the solar spectrum (290-315 nm) that is responsible for the production of pre-vitamin D in skin.<sup>1</sup> UVB penetrates the skin and converts 7-dehydrocholesterol to pre-vitamin D<sub>3</sub>, which is rapidly converted to vitamin D<sub>3</sub> and further metabolised in liver and kidney to its active forms. Excessive exposure to sunlight does not cause vitamin D<sub>3</sub> intoxication because any excess pre-vitamin D<sub>3</sub> is destroyed by sunlight.<sup>1</sup> It has been suggested by some vitamin D researchers, for example, that approximately 5-30 minutes of sun exposure between 10 AM and 3 PM at least twice a week to the face, arms, legs, or back without sunscreen usually lead to sufficient vitamin D synthesis.<sup>1,6</sup> Thus, any alteration in the number of UVB photons reaching the epidermis can dramatically affect cutaneous production of vitamin D. Factors like season, length of day, time of day, cloud cover, melanin content of the skin, and sunscreen application can affect UV radiation

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**Table 1** Essential levels of vitamin D [4].

<i>nmol/L</i>	<i>Health status</i>
<30	Associated with vitamin D deficiency, leading to rickets in infants and children and osteomalacia in adults
30–50	Generally considered inadequate for bone and overall health in healthy individuals
≥50	Generally considered adequate for bone and overall health in healthy individuals
>125	Emerging evidence links potential adverse effects to such high levels, particularly >150 nmol/L (>60 ng/mL)

exposure and vitamin D synthesis.<sup>4</sup> Also, UVB radiation does not penetrate glass, so exposure to sunshine indoors through a window does not produce vitamin D.<sup>7</sup>

There is an increasing worldwide prevalence of vitamin D deficiency (VDD). In USA it is being regarded as an epidemic with a prevalence of 35%; the same has been reported from Europe and Australia.<sup>8</sup> The situation is even more alarming in Pakistan. There is growing evidence of VDD from several studies conducted in Pakistan. Zuberi *et al.*<sup>9</sup> have reported VDD numbers of 92% from an ambulatory care setting in a study from their centre in Karachi. Masood *et al.*<sup>10</sup> reported an overall VDD of 75.5% during a study conducted during peak summers of Faisalabad in 2009. Another study conducted by Khan *et al.*<sup>11</sup> in Islamabad in 2012 reported an increasing prevalence of VDD in females (56.2%) as compared to males (15.3%).

This growing data of ‘D’ deficiency in Pakistan may appear surprising since we receive ample sunshine almost all year round – no one would think that vitamin D would be a problem here. The possible causes for this deficiency are firstly and primarily attributed to our pigmented skin, because melanin absorbs a proportion of UVB and thus has a negative impact on vitamin D synthesis. Secondly, due to our social, cultural and religious norms we tend to cover up large portion of our body surface area (BSA) and most of our women do not go out of their homes during the day time. Thirdly, except for milk and dairy products, there is a lack of

awareness of the natural dietary products which are potential sources like oily fishes (salmon, sardines, and mackerel), red meat, liver, egg, etc. Finally, there is very little vitamin D fortification of food-products in our country.

Guideline studies on sun-exposure for vitamin D requirements have only been conducted in the West, thus giving very little guidance to people in Pakistan. Recently, however, due to the increasing evidence of vitamin D deficiency in the South-Asian population living in the UK, a group of researchers based in Manchester (UK) have conducted a study in the South-Asian population with exposure of UVB doses ranging from 0.65 to 3.9 standard erythema dose (SED) thrice weekly to 35% body surface area, i.e. wearing T shirts and knee length shorts.<sup>12</sup> This is the first study of its kind, giving a sun-exposure guideline for optimal vitamin D synthesis in South-Asian population. The study proposes 45 minutes of un-shaded noontime exposure 3 times/wk, with 35% skin surface area exposed to help achieve a vitamin D level >10ng 25(OH)D/mL [mean: 15ng 25(OH)D/mL] in this at-risk group. However, the biggest challenge for Pakistan would be the 35% exposure in females, who are also the most affected ones. UVB in our country is also different because of differences in our seasons, length of day, latitude, and varying altitudes, which markedly affect cutaneous production of vitamin D. Thus, there is a need to carry out similar studies locally, maybe considering less BSA exposure but increased time of exposure. Similarly the daily recommendations for

vitamin D are from western studies and for their populations. Being a different ethnic subgroup with different environment, lifestyle and skin type, there is a need for conducting local studies at a mass scale to create our own guidelines.

Hence, to control this epidemic of 'D' deficiency in Pakistan, there is a need for mass public awareness campaigns on the role of vitamin D beyond bone health. People should also be made aware of the dietary sources of vitamin D and the recommended portions of each food group. There is a pressing need for the government to put into practice a mandatory vitamin D supplementation program for selected food stuffs. For example, almost all of the U.S. milk supply is voluntarily fortified with 100 IU/cup.<sup>4</sup> In Canada also, milk is fortified by law with 35-40 IU/100 mL, as is margarine at  $\geq 530$  IU/100 g. Both the United States and Canada mandate the fortification of infant formula.<sup>4</sup>

Our role as healthcare professionals is to promote awareness on this vital public health issue. We can guide at-risk groups for vitamin D deficiency to take supplements in the form of pills or liquids, if their needs are not being met with sunlight and food alone. More specifically, as dermatologists - being aware of both the beneficial and harmful effects of sunlight – we need to educate the public on the critical need and best methodology for sun exposure. We also need to offer guidance on sun-block use in a way that maximises the benefits of UV and minimises its risk. This can be done by application on areas of greater cosmetic concern and focusing on people at risk of photo-damage.

In a nutshell, the battle against vitamin 'D' deficiency is upon us, and the only way

forward is by becoming, and helping others become sun-smart.

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