CHAPTER 6

CONCLUSION

Vitamin D is essential for natural bone metabolism, calcium and phosphorus homeostasis. One of the primary roles of vitamin D is the regulation of calcium and phosphorus absorption metabolism for bone health. This role is especially important during pregnancy and lactation because bones develop rapidly during this period. Women have less skin pigmentation than men, a finding attributed to women's greater need for vitamin D during pregnancy and lactation. Vitamin D is obtained either from the skin or through a few dietary sources mainly fatty fish, cod-liver oil, and fortified margarine or butter when exposed to ultraviolet radiation. Children born prematurely are likely enamel defects in both primary and permanent teeth. Maternal vitamin D is essential for proper fetal tooth development, as well as adequate calcium. An additional benefit of sufficient vitamin D and calcium during pregnancy is good for maternal bone health.

Vitamin D, produced due to the action of this short wavelength of UV-B radiation which is essential in the calcium metabolism. Consequently Vitamin D is necessary for good bone development,
prevention of rickets in children, osteoporosis and osteomalacia fractures in the elderly. Vitamin-D deficiency is known mainly for its association with fractures and bone disease. The high prevalence of vitamin D deficiency also associated with increased risk of certain type of cancers like colon, breast, ovarian and prostate and may account for several thousand deaths annually (Lefkowitz ES., 1994; Grant WB., 2002). This discovery creates a new impetus for ensuring adequate vitamin D intake in order to reduce the risk of cancer. Most observational studies have reported that vitamin D has a beneficial effect on risk of colon, breast, prostate, and ovarian cancer.

The ultraviolet radiation is important to us composed the variety of energy that is transmitted to earth in the form of electromagnetic waves from the sun. In this study we have used solar energy of the particular wavelength, for the synthesis of vitamin D molecule in the skin at a specific position, to reduce some above type of deficiency disease. The amount of UV-B radiation incident depends on the amount of ozone in the stratosphere and varies with season and latitude on the earth's surface. In winter, sunlight at high latitudes is ineffective for production of vitamin D. When the sun is low in the sky its zenith angle increases and UV-B radiation is subject to more scattering and absorption by ozone than the sun is directly overhead. The mechanism

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of photochemical conversion of vitamin D₃ depends on the environmental conditions such as season, latitude, altitude, stratosphere ozone, and solar zenith angle, time of day & year, and influence cutaneous production of vitamin D₃ (Holick MF., 1995). The trends in spectral change of ultraviolet-B radiation intensities with respect to change in ozone and solar zenith angle show in fig.3.2a. Increasing the sun’s zenith angle results an increased path length for the UV-B radiation photons to travel. Small amount of vitamin D₃ is produced in the skin from November to March at high latitudes (above 35° latitude).

When solar ultraviolet-B radiation (UVB: 290-315nm) penetrates to the skin, the 7-dehydrocholesterol in the plasma membrane of the skin cells absorbs it. This result is in the ring opening of 7-dehydrocholesterol to form previtaminD₃. PrevitaminD₃ is thermodynamically unstable and is rapidly converts by a temperature-dependent process to vitamin D₃ (MacLaughlin, J.A., Anderson, R.R., and Holick, M.F., 1982). Once formed, it is ejected out of the plasma membrane into the extracellular space where it finds its way into the dermal capillary bed, and is bound to the vitamin D binding protein (Holick M F et al., 2004). Anything that influences the number of UV-B radiation photons penetrating into the skin will be affect to the synthesis of vitamin D₃ (Holick M F et al., 1994; 2003).
The solutions of vitamin D give the best indication of pre vitamin D at the centre of the experiments whether formed at the time and those conditions. The FastRT UV simulation web based tool gives the average study of vitamin D. The program has designed to uncertainties better than the current high quality UV measurements when all input parameters are known (Engelsen O et al., 2005). Those measured irradiances are somewhat lower than those we would normally obtain from corresponding cloudless sky simulations at that time and location. FastRT simulation tool used to compute erythema and vitamin D3 effective UV doses (MacKinley, A. F. and B. L. Diffey., 1987). Total ozone has been measured using Dobson instrument; however, truly global monitoring has been possible only since the introduction of satellite-based instrument. In this present study we have used the data of average total ozone concentration by Total Ozone Mapping Spectrometers (TOMS) instrument, which is operated from 1st January 2005 to 31st October 2008 at New Delhi (28.65°N, 77.21°E).

We can measure total ozone in the atmosphere by satellite instrument like that Nimbus-7, TOMS, etc. Ozone is important factor to us for the synthesis of Vitamin D in skin because ultraviolet radiation depends on the ozone condition in the atmosphere. The ozone in the atmosphere is act as a filter. Consequently, UV-B radiation intensity decreases when it passes through ozone. Conclude study is that the
thickess of ozone provides the useful UV-B radiation which is beneficial and helpful in the synthesis of vitamin D in skin. The seasonal variation of ozone thickness in Dobson Unit at a particular longitude, latitude and altitude with the time of day and year may be measured. Seasonal variations of ozone have found that the 48DU average ozone decrease from 1st January to 31st December 2005 similarly as in 2006&2007 is 18; 17DU and it increase from 1st January to 31st August 2008 i.e. 5DU. Consequently average ozone decrease from 2005 to 2007 and there is small increase in next year at particular specified point (28.650N, 77.210E). The power of ultraviolet radiation varies considerably with latitude, time of year and time of day (Schulze R and Grafe K., 1969). The rapid decline of power ultraviolet radiation at 50 degree latitude after midsummer as compared to power is notable at 30 degree. Furthermore, most of the power of ultraviolet radiation is available between 8.00a.m to 4.00p.m. The 60 percent power of ultraviolet radiation occurs between 10.00a.m to 2.00p.m. In addition, there is almost no ultraviolet radiation is available in winter at above 50 degree latitude. The values of ultraviolet radiation energy for daily and yearly at different wavelengths of radiation depend on various latitudes which have been calculated (Johnson FS et al., 1976).

The photosynthesised of vitamin D3 in the skin of terrestrial vertebrates and birds by the action of UVB radiation on 7-
dehydrocholesterol (7-DHC). This is most sensitive steroid for the radiation range in between 290-315nm (MacLaughlin et al., 1982). This range coincides with the lowest wavelengths of sunlight that can actually penetrate the atmosphere, the lower limit of the active range being 295nm at the Delhi (28.65°N, 77.21°E) station. While absorbed by a 7-DHC molecule, the UV-B radiation photon opens the ring structure of the molecule and converts it to a precursor of vitaminD₃ (preD₃). Subsequently, this is thermally isomerised slowly, over several days, to cholecalciferol that is the actual vitaminD₃. The synthesis of vitamin D in skin is depends on the physical and environmental factor as well as skin pigmentation. The effective ultraviolet radiation wavelength (295nm) for the synthesis of vitamin D molecule in skin at Delhi and NCR region has shown in fig.3.10. The importance of vitamin D sufficiency for optimal health, and the fact that solar UV-B irradiation is the primary source of vitamin D for most people, it is imperative that guidelines for solar UV exposure be revised in consideration of overall health, rather than only for reducing the risk of skin cancer and melanoma.

The guidelines currently in place in the United States recommend 5µg/day (200 IU/day) of vitamin D for children and younger adults, 400 IU/day for those ages 51-70, and 600 IU/day for those over age70 (Standing Committee on the Scientific Evaluation of Dietary
Reference Intakes., 1997). The recommended Adequate Intake (AI) for children and adults up to 50 years of age set by the Food and Nutrition Board of the Institute of Medicine in 1997 is 5µg per day, or 200 International Units (IU). The amount of 5µg per day is based on the minimum requirement of 2.5µg (100IU) to keep blood levels of vitamin D at adequate levels, and doubled to cover needs regardless of exposure to sunlight (Food and Nutrition Board., 1997). As the age of the individual increases, the dietary requirement (AI) for vitamin D increases. This increase may be due a decrease in the amount of time spent outside, more concern about their skin resulting in the use of sunscreen and clothing to prevent aging and cancer, and a decrease in ability of the skin to make vitamin D (Food and Nutrition Board., 1997, Holick MF., 1999). Between the ages of 51 and 70 years, the AI is 10µg (400IU) and for individuals over 71 years of age, the AI is 15µg (600IU). Amounts of vitamin D are expressed either as International Units (IU) or micrograms (µg). One µg of vitamin D is biologically equivalent to 40IU. The importance of vitamin D sufficiency for optimal health, and the fact that solar UV-B irradiation is the primary source of vitamin D for most people, it is imperative that guidelines for solar UV exposure be revised in consideration of overall health, rather than only for reducing the risk of skin cancer and melanoma.
The sufficiency amount of UV-B irradiation for vitamin D can be calculated from the amount of vitamin D produced from one minimal erythemal dose (MED) 10,000-25,000IU of oral vitamin D (Holick MF., 2004). If 10,000 IU of vitamin D is produced from exposure of the full body to one MED, exposing the full body to 25 percent of the MED would produce 2,500 IU. In order to achieve 1,000 IU, 40 percent of the body should be exposed to 25 percent of the MED; if production is more efficient, less of the body need be exposed. For pale skin, the exposure time is 4-10 minutes for one MED in the summer noonday for the Southern United States; for dark skin, such as for African Americans, the corresponding time is 60-80 minutes. (Holick MF., 2003, 2004). Exposure times should be 25-50 percent of the MED. The length of time varies with geographical location, skin pigmentation, percent body fat, and age. The photo production of vitamin D is lowest near solar noon. In addition, basal cell carcinoma (BCC) and cutaneous malignant melanoma (CMM) are probably more susceptible to UVA irradiation than UVB irradiation (Armstrong BK, Kricker A., 2001)

Recognition of seasonal changes in vitamin D was an important observation in establishing the crucial role of UV radiation in the generation of 1,25(OH)_{2}D. Various factors which affect seasonal variation in vitamin D are now understood, and there is growing understanding of the additional biological roles for this steroid hormone
in many organs and tissues related to cellular growth and differentiation. However, much remains to be learned about the biological significance of these seasonal changes, especially for the wider cellular functions of vitamin D. The present review ends on a speculative note by suggesting that clinically dissimilar diseases may share an aberration in vitamin D. Nevertheless, the identification of a number of important clinical disorders characterized by seasonality or latitude prevalence provides a challenge to biologists and clinicians, and may suggest opportunities for epidemiological, clinical and laboratory investigation exploring the clinical relevance of seasonality.