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***Full Length Research Paper***

# Low Ultraviolet Index in Winter with Concomitant Hypovitaminosis D in Northern Indian Region (Amritsar) - A Pilot Study

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**Abstract**
Hypovitaminosis D is reported to be prevalent in Indian population (Concentration of <30 ng/ml as suboptimal and <20ng/ml as vitamin D deficiency). During winter it can fall to lowest when the UV index is lower ( ~ 3). The study aimed at finding out the Serum vitamin D concentration during the periods of low UV Index. A total of 20 adult males and females participated in this study. All belonged to Fitzpatrick skin type IV or V. Serum vitamin D was tested by Elisa method from the blood samples. UV Index was detected from the satellite data from temis.nl. on the dates when the sample was collected.-During low UV Index (~3) the hypovitaminosis was found in >50% of the people(n=10) with Serum Vit D levels less than 20ng/ml. UV Index ranged from 2.8 to 3.2 during the sample collection days. Serum Vitamin D concentration is less in periods of low UV Index at a northern Indian location like Amritsar. Thus an UV Index of three or less warrants additional measures to maintain normal serum vitamin D concentration in Indian (Dark skin) population at northern Indian locations.

***Key words:*** *UV Index, Serum Vitamin D, Winter*

## Introduction

Vitamin D is probably the oldest hormone in the living environment. It was believed to be present in the phytoplankton (ergosterol). It has played a major role in the process of evolution by controlling calcium metabolism and development of cytoskeleton *(Holick 2008).* Early humans lived in natural environment directly under the sun and wore minimum clothing; evolution of aristocracy, less sunlight exposure, dietary habits, longer life span and darker skin pigmentation are few factors which have produced a constant decline in the serum vitamin D concentration *(Mithal et al 2009).* Hypovitaminosis D is present in large proportion (>90% ) of people with pigmented skin *(Adams et al 2010).* Sunlight produces maximum of Vitamin D in the body 80% - 90% and a very small amount comes from diet. There are various guidelines for sunlight exposure, considering the beneficial effects of Serum Vitamin D over the skin cancer risk; flexibility is increasing in them *(Lucas et al, 2006 WHO bulletin).* Indian population even in the southern region are found to have hypovitaminosis D *(Goswami et al 2008)* though the specific UV Index is not quoted and season specific studies are less and this suggests that in northern region it is of utmost importance to find out serum vitamin D concentration and specially in winter where it can fall the lowest due to lesser UV Index.

This study specifically focuses on the UV Index and the serum vitamin D concentration at a northern Indian location (Amritsar) during winter.

## Materials and Methods

This study was carried out in the city of Amritsar during December 2011. It is located at latitude of 31° 37’ N and longitude of 74° 55’ E as per Compare Infobase Limited (www.mapsofindia.com). At this geographical location the Ultra Violet Index is low for the natural synthesis of Vitamin D from solar radiation during winters. This can lead to a fall in Vitamin D levels in blood. Such seasonal falls in the levels of Vitamin D can have health implications and are reported in literature. *(Maxwell et al1994), (Pasco et al 2004).* The measurement is done for serum 25 (OH) D levels which is the most important marker of vitamin D sufficiency *(Holick 2007).*

A total of twenty people participated in the study. All belonged to Fitzpatrick skin type IV or V. *(Sachdeva 2009).* Serum Vitamin D levels (25OH D) were found out using ELISA Kit D L D Germany. The kit performs enzyme Immuno assay for the quantitative determination of 25-OH-Vitamin –D in human serums. The blood samples were collected and centrifuged to separate the serum which was frozen for the determination of Vitamin – D

## Results

Twenty patients with mean age of 47.25 years were included in the study. The average BMI was 22.55 Kg/m$^2$. (Table 1).

The UV index mean was 3.01 and it varied from 2.8 to 3.2 during the seven days period when the samples were taken. (Table-2)

**Table 1**. Descriptive statistics of variables.

| S No. | Variable | Mean ± SD | Range(Min – Max) |
|---|---|---|---|
| 1 | Age | 47.25 ±10.25 Yrs | 26- 68 Yr |
| 2 | Weight | 66.90 ± 12.49 Kgs | 45-86.2 Kg |
| 3 | Height | 160.76 ±12.28 cms | 145-184.2 cm |
| 4 | Body Mass Index (BMI) | 22.55 ±2.73 Kg/m$^2$ | 18.2-29 Kg/m$^2$ |
| 5 | Serum Vitamin D | 18.06 ±9.06 ng/ml | 1.37-36.026 ng/dl |
| 6 | UV Index (13 Dec-19 Dec 2011) | 3.01±.2 | 2.8-3.2 |
| 7 | Ozone Column | 283.18±11.11 | 267.9-299.6 DU |

**Table 2.** UV Index at the time duration of sample collection.

| SNo. | Date | UV Index | Ozone Column DU |
|---|---|---|---|
| 1 | 13 Dec 2011 | 3.1 | 277.1 |
| 2 | 14 Dec 2011 | 3 | 282.3 |
| 3 | 15 Dec 2011 | 2.8 | 299.6 |
| 4 | 16 Dec 2011 | 2.9 | 294.8 |
| 5 | 17 Dec 2011 | 3.2 | 267.9 |
| 6 | 18 Dec 2011 | 3.1 | 275.4 |
| 7 | 19 Dec 2011 | 3 | 285.2 |
| | Mean (Average value) | 3.01 | 283.18 |

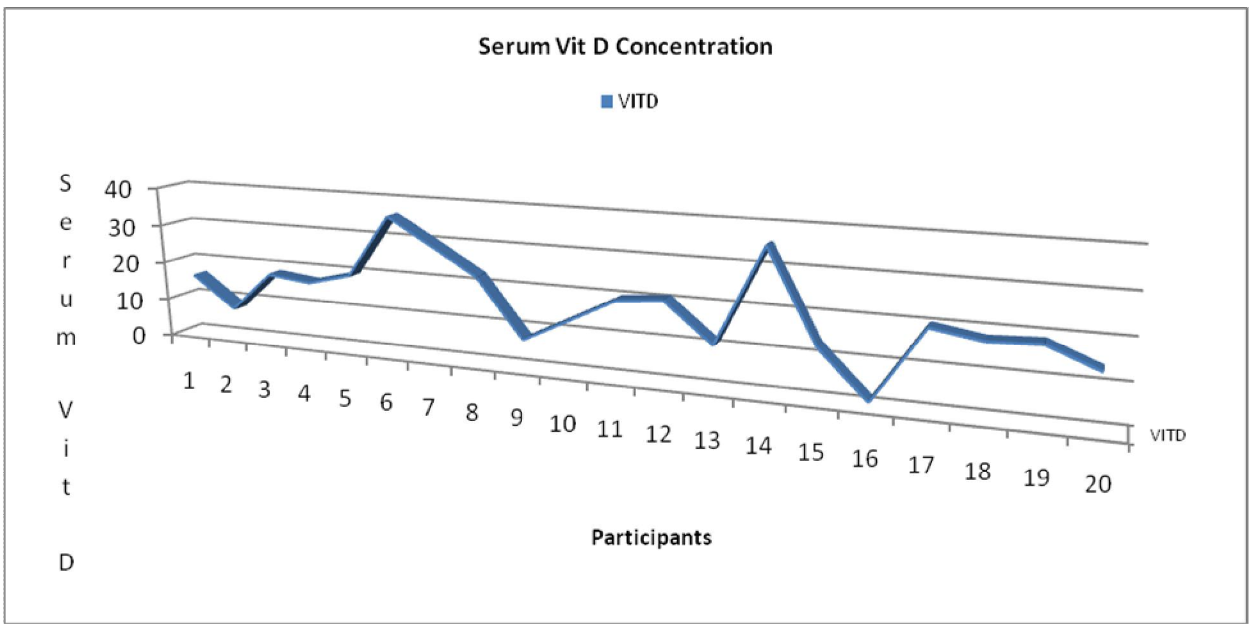


**Figure 1.** Graph showing Vitamin D concentration of Participants. Total 75% had Vit D Lower than suboptimal levels < 30ng/ml whereas >50% were found to be vitamin D deficient<20ng/ml.

Majority of the participants were found to be having suboptimal vitamin D levels. With more than 50% having hypovitaminosis D. (<20ng/ml). Only two are within the optimal range (30-50ng/ml).

## Discussion

Ultraviolet Index is jointly developed by various agencies like World Health Organization, World Meteorological Organization, United Nations Environment Programme and International Commission on Non-Ionizing Radiation Protection for developing general public guidelines on sun exposure. Though the emphasis has been on cancer protection the practical usefulness of this on Serum Vitamin D concentration is limited due to paucity of studies on this aspect *(WHO 2002).* Vitamin D synthesis is dependent upon the geographical location and varies with it *(Kimlin 2008)* traditionally errythemal reaction is used as a predictor for vitamin D production, UV Index has not been reported for this purpose, though it has been advised by *Feister et al (2011)* recently. For the synthesis of Vitamin D only sub-errythemal exposure is required and it is difficult to record this in heavily pigmented population. UV index has been found to have good correspondence with health effective radiance. *(Feister et al 2011).* Major intermediary molecule for sunlight induced health factors is 25 (OH) D, this is the most abundant form of vitamin D and it is used for the purpose of assessment of adequacy.

Many sun –Smart guidelines issued for the skin type I and II are erroneously being followed by (Indian population) skin type IV and V. Even for skin type I and II it has been recommended to use any sun protection only if the UV index is of more than 3. *(Van der Mei et al 2007).* This may lead to many behavioral blunders in this aspect by general population. It is probable that for skin type IV and V the uninhibited sun exposure can be advised at a higher UV Index than for the other lighter skin types. Use of sunscreen is one life style factor which can block all possible beneficial effects of the sunlight *(Sayre et al 2007),* though this has not been investigated in this investigation, but the results emphasize the need to have separate guidelines for skin type IV and V they may also be location specific. The maximum concentration of Serum 25 (OH) D that can be achieved through natural sun exposure is reported by *Binkley et al (2007)* to be 60 ng/ml, average value in their study remained low 24.7±1.3 ng/ml in asian population despite abundant sun exposure. They have not commented on the UV Index or other environmental factors. Our study also find the mean comparable value (18.06 ±9.06 ng/ml) at a UV Index range of (3.2 to 2.8) but could not find any such case(>60ng/ml i.e. possible maximum) this may be due to the low temperature found during winters that makes uninhibited exposure to considerable body surface area very difficult. The optimal serum concentration of 25 (OH)D is 30-50 ng/ml. This level can substantially improve health and decrease the mortality and morbidity due to various diseases of hypovitaminosis origin *( Autier et al 2007& Grant 2007).* Consequently Adequate UV radiation in the form of appropriate sun exposure is essential for human health. *(Feelisch 2010).* This can be measured using UV Index. UV index is dependent upon ozone levels and the various health effects also vary accordingly (United Nations Environment Programme, Environment Effects Assessment Panel 2012). Ozone column absorbs the UV radiation and in the locations where it is deficient this may lead to more than usual UV radiation. Indian region does not have any reported issues with the ozone column the average is 282 DU as checked over the studied region. The adverse effects of the UV R were highlighted in the context of developing ozone holes and it surpassed the rational development of sun exposure guidelines even after the depletion slowed down, further the darker pigmented population was affected more with these rigid guidelines. It is reported that during the first half of this century the recovery of Ozone layers will take place and it has already begun. (United Nations Environment Programme, Environment Effects Assessment Panel 2012). UV Index can found a suitable place in vitamin D related guidelines; thus more flexible or UV Index specific guidelines for the sun exposure should follow.

Thus this study shows that at a UV Index of around 3 in winters in Northern Indian Locations the Serum Vitamin D concentration falls below normal. This may imply that in such environmental situation additional measures to maintain normal serum vitamin D concentration (> 30ng/ml) are to be taken. Therefore we suggest a use of UV Index as a guide to maintain the serum Vitamin D concentration.

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