'Sunshine vitamin deficiency' – A myth or a fact?

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Abstract

As we live in a country with abundant sunshine the prevalence of this sunshine vitamin deficiency is around 70-100%. Minimum thirty minutes of UV B ray exposure causes the production of 600-1000IU of vitamin D in our body. The cut off values for 25-OH vitamin D deficiency is<20ng/ml. The exact cut off value for 'deficiency' and 'insufficiency' and its vitamin D therapy in India remains controversial. Despite the controversy the Clinicians often prescribe high dose vitamin D to treat the deficiency.

Objectives of the study: To compare the vitamin D levels in apparently healthy office workers and manual laborers.

Methods and Materials: This study was conducted on 50 apparently healthy office workers, working indoors from 9am to 5 pm and 50 apparently healthy manual labourers working outdoors, during the month of January and February in Mangalore, India.

Results: The mean vitamin D levels were significantly higher ($p < 0.001$) in manual labourers than the office workers (18.14 ± 6.98 and 11.16 ± 7.48). The vitamin D status among the office workers showed 2% having a normal vitamin D level(>30 ng/ml),12% having insufficiency(20 -30ng/ml), 28% having deficiency (<20ng/ml) and 58% having severe deficiency(<10ng/ml) similarly in the manual labourers 4% had normal vitamin D level,28% insufficiency,58% deficiency and 10% having severe deficiency. The hours of exposure and vitamin D concentration had significant correlation ($p<0.001$).

Conclusion: Though there was a positive correlation between the vitamin D levels and the hours of exposure, even then only 4% of the manual labourers were having a normal vitamin D level**,** hence we conclude by saying that either the hours of exposure to sunlight should be more than 5hrs or a new reference range of vitamin D must be established in our Indian population as majority of our study population were asymptomatic, which could also curb the unnecessary intake of the vitamin D drug.

Keywords: Hours of exposure and deficiency, Manual labourers, Office workers, Vitamin D.

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Introduction

Vitamin D is recognised as the sunshine vitamin. We live in a country full of sunshine, yet Indians are deprived of this sunshine vitamin. Vitamin D deficiency prevails in epidemic proportions all over the Indian subcontinents with a prevalence of 70 – 100% irrespective of their age, gender, race and geography.[1]

Vitamin D is a steroid hormone that could influence various other diseases such as rheumatoid arthritis, diabetes, multiple sclerosis, malignancies and hypertension, even though its main involvement is in bone formation, phosphorous and calcium metabolism.[2] This hormone is endogenously produced in the skin by the action of ultraviolet rays hence demographic features, seasons and geographic locations could change the production of vitamin D in the body. The dietary sources for vitamin D are meat, egg, fish (mainly non vegetarian food)and fortified vitamin D supplements, but the vitamin D amount is minute in the food, upto 20% of the body requirement.[3] Thirty minutes of exposure to ultraviolet B rays without the application of sunscreen results in conversion of 7- dehydrocholestrol, present on the epidermal layer of the skin to vitamin D3, followed by the two step activation process occurring first in the liver causing hydroxylation at the 25th position and second in the kidney causing hydroxylation at the first position, hence forming 1, 25 di hydroxyl cholecalciferol (calcitriol).

Instead of calcitriol, the active form, 25-OH vitamin D is the one which is measured in our body**.** According to the clinical practice guidelines issued by endocrine society on vitamin D, the cut off values for 25-OH vitamin D is 30ng/ml as normal, 20 -30ng/ml as insufficiency and <20ng/ml as deficiency.[4]

The maximum amount of UVB rays are received to places near the equator (latitudes 42N and 42S) and India is located north of the equator at 8.4 and 37.6N latitude. The widespread problem of vitamin D deficiency in India, even with adequate sunlight could be due to the

increased indoor lifestyle changes, dress code changes in the country and the alteration in the zenith angle which is attributed to pollution and increased melanin production amongst Indians. Asians are comparatively darker than Caucasians who get exposed to sunlight for 10- 15 minutes and receive 1 MED, which is equivalent to ingesting 600-1000IU of vitamin D orally, hence to get an equivalent dose Asians need to get exposed for a longer time around 30minutes.[5]

In adults and children the deficiency of vitamin D causes osteomalacia and rickets irrespectively. It is also manifested with unexplained muscle aches, pain and depression.

Methods and Materials

This study was conducted on 50 apparently healthy office workers who work indoors from 9am to 5 pm and 50 apparently healthy manual labourers working outdoors during the month of January and February in Mangalore, Dakshina Karnataka, India (latitude 12.91N and longtitude74.85E). The duration of sunshine in these months is around 7- 8 hours/day.

The subjects who were excluded were the ones with chronic illness, renal dysfunction, liver disorder, Malabsorption syndromes, taking vitamin D Supplements, diabetics, autoimmune disorders and pregnant ladies

An informed consent was obtained from the selected subjects and 2 ml of sample was collected in a plain vacutainer for the biochemical analysis and centrifuged for 10 minutes at 4000rpm and the serum was then analysed for 25 hydroxy vitamin D estimation.

Methods of estimation

25 -hydroxy vitamin D was analysed based on the principle of chemiluminescence – using three incubation steps. Kit provided by Roche diagnostics.

The sample is pre-treated with reagent 1 and 2, bound vitamin D (25-OH) is released from the vitamin D binding protein in the first incubation, in the2nd incubation the pre-treated sample reacts with ruthenium labelled vitamin D binding protein forming a complex between the two. The 3rd incubation causes the mixing of streptavidin coated micro particles and vitamin D labelled biotin and a complex of ruthenylated vitamin D binding protein and biotinylated vitamin D is formed which binds to the solid phase and the reaction mixture is captured onto the surface of the electrode, the unbound substances are removed. Current is passed to the electrode causing chemiluminescent emission which is measured by a photomultiplier.

Statistical Analysis

Student t test was used to compare the quantitative data between the two groups and correlation between variables was done using pearsons test. Qualitative data has been represented as frequency and percentage.

Statistical software

SPSS vs16 was used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc**.**

Results

A total of 100 subjects have participated in the present study of which 50 were manual labourers and 50 were office workers between the age group of 20 to 50 yrs. The mean vitamin D levels were significantly higher ($p < 0.001$) in manual labourers than the office workers (18.14 ± 6.98 and 11.16 ± 7.48) (Table 1) (Fig. 1).

Table 1: Comparison of vitamin D between office workers and manual labourers

Parameter	Office Workers (n=50)	Labourers (n=50)	p value
Vitamin D (ng/ml)	11.16 ± 7.48	18.14 ± 6.98	<0.001

Fig. 1: Mean Vitamin D level among office workers and labourers

The vitamin D status among the office workers showed that only 2% were having a normal vitamin D level (>30 ng/ml), 12% having insufficiency (20 -30ng/ml), 28% having deficiency (<20ng/ml) and 58% having severe deficiency (<10ng/ml) similarly the manual labourers showed that only 4% had normal vitamin D status, 28% had insufficiency, 58% had deficiency and 10% had severe deficiency (Table 2).

Table 2: Vitamin D status among office workers and manual labourers

Vitamin D Status (ng/ml)	Office Workers		Manual Labourers	
	Frequency	Percentage	Frequency	Percentage
Normal (>30)	1	2%	2	4%
Insufficiency (20-30)	6	12%	14	28%
Deficiency (<20)	14	28%	29	58%
Severe deficiency(<10)	29	58%	5	10%

Considering the total study population the mean vitamin D level was 9.49 ± 4.94 among the sunscreen users and 15.56± 8.12 in the non sunscreen users. There was a statistical significant increase in vitamin D levels in the non-sunscreen users (p -0.006) (Table 3). 100% of the sunscreen users were vitamin D deficient whereas74.1% of the non sunscreen users were vitamin D deficient (Fig. 2).

Table 3: Comparison of vitamin D between sunscreen users and non-sunscreen users

Parameter	Sunscreen Users (n=15)	Non Sunscreen users (n=85)	p value
Vitamin D (ng/ml)	9.49 ± 4.94	15.56 ± 8.12	0.006

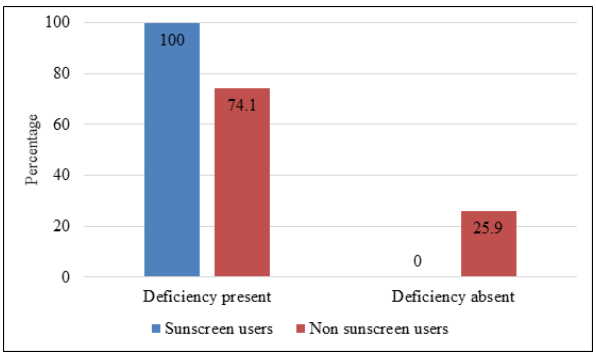

Fig. 2: Percentage of vitamin D deficiency in sunscreen users and non-users

The mean vitamin D level was 13.72 ± 6.73 in non vegeterians and 16.24 ± 9.71 in vegeterians which was not statistically significant (p -0.129) (Table 4).

Table 4: Comparison of vitamin D between non veg and veg

Parameter	Non veg (n=63)	Veg (n=37)	p value
Vitamin D (ng/ml)	13.72 ± 6.73	16.24 ± 9.71	0.129

Among the males and females in our study there was a statistical increase (p-0.002) in the mean vitamin D levels in males 16.85 ± 7.72 and 11.96 ± 7.60 in females.(Table 5)

Table 5: Comparison of vitamin D between males and females

Parameter	Males (n=55)	Females (n=45)	p value
Vitamin D (ng/ml)	16.85 ± 7.72	11.96 ± 7.60	0.002

The mean hours of exposure in the office workers was 0.98 ± 0.47and in manual labourers it was 4.96 ± 0.28. (Table 6) There was a positive correlation of vitamin D and hours of exposure (p-<0.001). (Fig. 4).

The percentage of vitamin D deficiency among both the apparently healthy groups was 78% and only 22% were non deficient (Fig. 4).

Table 6: The mean hours of exposure in the office workers and manual labourers

Hours of exposure	
Overall	2.97 ± 2.04
Office Workers	0.98 ± 0.47
Manual Labourers	4.96 ± 0.28

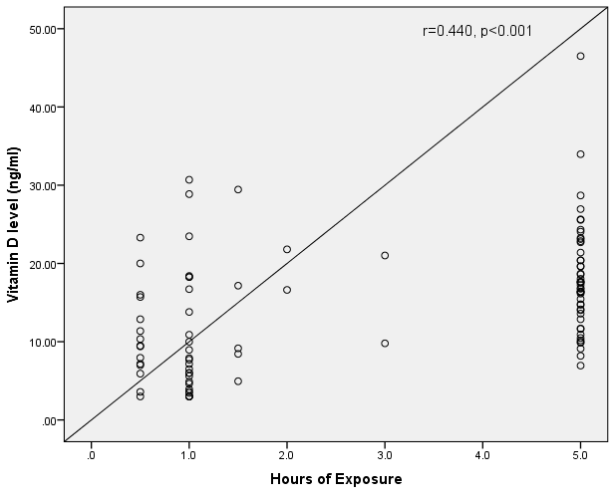

Fig. 3: Correlation of vitamin D and hours of exposure

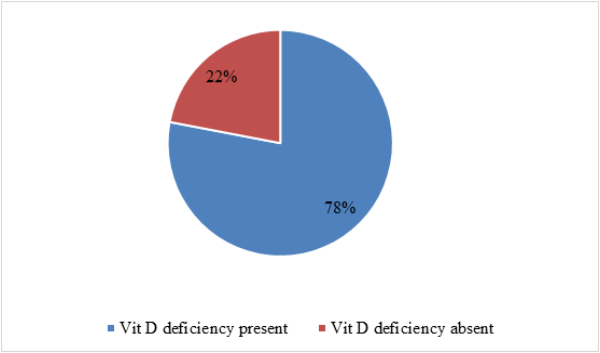

Fig. 4: Percentage of vitamin D deficiency in the total population

Discussion

This study was conducted to evaluate the vitamin D levels in 50 apparently healthy people who get exposed to sunlight for a longer duration like the manual labourers and 50 office workers with less sun exposure. The mean serum Vitamin D level in office workers was (11.16±7.48) whereas in manual labourers it was (18.14 ± 6.98), thus statistically higher in manual labourers than compared to the office workers which is similar to a study done by Munter G et al that showed higher vitamin D level among hospitalist and community based physicians who work more outdoors.[6] A similar study done in south Indian rural and urban population showed a statistical higher concentration of vitamin D level in the rural population as compared to the urban population.[7]

In our study 28% of the office workers were vitamin D deficient (<20ng/ml), 58% were severely deficient (<10 ng/ml) and only 2% having sufficient vitamin D levels whereas in manual labourers 58% were deficient, 10% severely deficient and merely 4% were having sufficient levels. A study done by C.V

harinarayan et al showed that 44% of men and 70% of women were deficient, 39.5% men and 29% women were insufficient and 16.5% men and 1% women in the rural area were sufficient whereas in the urban population 62% of the men and 75% of the females were deficient, 26% men and 19% females were insufficient and 12% of the men and 6% of the women were having sufficient levels respectively. Another study done among indoor employees in United Arab Emirates showed that 63.2% were severely deficient, 29.1% were deficient and 5.7% were insufficient.[8]

Our total study population had 55male participants and 45 female participants showing a higher mean vitamin D level in males (16.85 ± 7.72) than females (11.96 ± 7.60) which is similar to many studies and one such study is done in Iran where their 868 females were having lower vitamin D levels than their 243 males, they also showed 19.6% insufficiency, 23.9% deficiency and 26.9% severely deficiency in their total population by silva hovsepian et al.[9]

There was no statistical difference in the vitamin D level (p-0.129) among vegeterians and non vegetarian population in our study. The mean vitamin D level was higher in vegeterians (16.24 ± 9.71) than non vegeterians (13.72 ± 6.73) which contradicts many studies that say non vegetarian food is a rich source of vitamin D. One such study is done by zahid naeem et al where correlation of vitamin D status and consumption of vitamin D rich food like fish, egg, liver and cheese was done and people not consuming those food items had insufficient and deficient values whereas the rest had normal vitamin D value.[10]

The total study population had 15 sunscreen users and 85 non sunscreen users where the mean vitamin D level was statistically higher in the non sunscreen users than the sun screen users (p- 0.006) but Vitamin D deficiency was seen both in sun screen users(100%) and non sunscreen users (74.1%) which was also the case in a study done by N Al mutairi et al where the vitamin D levels were found to be deficient in both sunscreen users and non sunscreen users thus showing that majority of the people are having deficiency.[11]

The mean hours of sun exposure in office workers was 0.98 ± 0.47 and in manual labourers it was 4.96 ± 0.28. The working hours for the manual labourers was from 10 am to 4pm which is supposed to be the best time for the production of vitamin D with the minimum exposure of 30 minutes There was a positive correlation of hours of sun exposure with the vitamin D level. Only two manual labourers and one office worker was having a normal vitamin D level, this discrepancy was noticed even after four hours of exposure. A study group of 2500 adults of the African origin, residing at varying latitudes showed a negative correlation of vitamin D and distance from the equators.[12] N. Brinkley and colleagues conducted a study with 93 adults showing low serum vitamin D level in few of the subjects even after adequate sun exposure.[13] Similarly a study conducted with 141 employees in two major oil companies in abu dhabi showed a negative correlation between vitamin D levels and sun avoidance and a positive correlation with depression symptoms.

In our study 78% of the total population were vitamin D deficient and asymptomatic. Vitamin D deficiency in the general population is seen in many other studies like the study in eastern India, showed 47.5% of the total population being deficient and 40% with vitamin D insufficiency.[14] Another study with 771 healthy individuals of Mangalore 60% were vitamin D deficiency whereas 20% were having sufficient levels which is very much similar to our study.[15] A study in Punjab showed a high prevalence of vitamin D deficiency in their population. Lower prevalence was shown in subjects with greater opportunities for sunlight exposure such as farmers and rural individuals.[16]

Limitations

Reference range in this study population could not be established due to a small sample size, seasonal variation should have been compared with the concentration of vitamin D and a detailed diet history should have been taken.

Conclusion

Though there was a positive correlation between the vitamin D levels and the hours of exposure, even then only 4% of the manual labourers were having a normal vitamin D level**,** hence we conclude by saying that either the hours of exposure to sunlight should be more than 5hrs or a new reference range of vitamin D must be established in our Indian population as majority of our study population was asymptomatic, which could also curb the unnecessary intake of the vitamin D drug.

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