Original Article#

Presence of 25(OH) D Deficiency in a Rural North Indian Village Despite Abundant Sunshine

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Abstract

Background and Objective: Several studies have shown wide prevalence of vitamin D deficiency with serum 25(OH) D <49.9 nmol/L in urban Indians related to their poor sunshine exposure and skin pigmentation. However, there is limited information in rural Indians. We hypothesized presence of higher 25(OH)D in rural subjects as compared to urban because of farming related abundant sunshine exposure

Design and Methods: We assessed serum 25(OH)D levels in residents of a North Indian village with 200 families, located 90 km East of Delhi during February (winter). Fifty seven subjects (32 males and 25 females) from 50 families consented for the study.

Results: The mean 25(OH)D values of all subjects in the rural area was 36.4 ± 22.5 nmol/l/L. Males had significantly higher 25(OH)D values than females. When compared to urban subjects, the mean 25(OH)D value of rural males and females was six and three folds higher, respectively. However even with five hours of daily sunshine exposure only 31.5% had serum 25(OH)D levels ≥ 50 nmol/L.

Conclusions: Thus, with longer sunshine exposure subjects residing in rural area had better mean 25(OH)D values than that of urbans. However, 70% of them were still vitamin D deficient. These facts indicate the need for the countrywide vitamin D food fortification program irrespective of rural or urban setting. ©

Introduction

Vitamin D deficiency (VDD) was considered to be rare in India because of its sunny environment.[7] However, actual measurement of serum 25(OH)D in the year 2000, revealed values <49.9 nmol/L in most urban Indians with levels undetectable (<5.0 nmol/L) in 30.0%.[3,4] Studies from different parts of the country have shown similar hypovitaminosis D among all age groups including school children, pregnant women and their neonates.[3,8] Presence of melanin, poor sun exposure, vegetarian food and lack of vitamin D food fortification program explain the high prevalence of vitamin D deficiency in urban Indians. Currently physicians are considering possibility of vitamin D food fortification program in India to deal with widespread hypovitaminosis D. Though more than 60% of Indian population live in rural area, there is limited information on their 25(OH)D status. There is a possibility that because of longer duration of farming related sunshine exposure, 25(OH)D levels of rural Indians might be higher than that of urban. The current survey was conducted to assess the 25(OH)D status of Indian subjects residing in a rural north Indian village.

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Subjects And Methods

Subjects and sample size

The survey was carried out in the Agota village located 90 km east of New Delhi in the Bulandshar district of Uttar Pradesh (28.5^0 N and 77.8^0 E). The village had a total of 200 families. Survey was carried out in winter month of February because results of our previous study among urban Indians, revealed lower serum 25(OH) in winter as compared to summer.[3] A day before the survey, chief of the village visited each family and apprised them about the problem of hypovitaminosis D in urban Indians. Each family was requested to send at least one adult volunteer in the fasting state at 0800hr at the prefixed place in the village for assessment of their 25(OH)D status. Pregnant ladies, those with age <18 years and subjects already on medications were excluded. Institutional ethics committee approved the study protocol. A total of 57 subjects (32 males and 25 females) from 50 families came for the study.

Sample size and study power was calculated in retrospect based on assumption that mean 25(OH)D levels in rural

subjects would at least be double (equal to mean + four standard deviation score) than that of urban Indians reported in our earlier studies from Delhi (13.5 ± 3.0 ng/ml).[3] With these assumptions a sample size of 50 or more was considered sufficient for results with >90% power and confidence interval and an alpha error of 5%.

Assays

Ten ml of blood was drawn from the study subjects after obtaining their written informed consent. Whole blood was transported under chilled condition within a gap of 4 hr to All India Institute of Medical Sciences, Delhi. Serum was separated in a refrigerated centrifuge at 2500xg for 15 min at 4C and stored at –20C. Direct sunlight exposure was assessed by documenting average duration of exposure and percentage of the surface area of the body-exposed daily. Nutritional status was assessed by estimating the average composition of the daily diet using a semi quantitative food frequency questionnaire[11] and published data on the nutrient composition of Indian food.[2] Serum 25(OH)D (reference range 22.2-116.5 nmol/l) and iPTH (reference range 13-54 ng/L) were measured by radioimmunoassay and immunoradiometric assay (Diasorin, USA), respectively.

Statistical analysis

Data are presented as means ± SD. The students 't' test was used to compare differences in the various indices between males and females. Vitamin D deficiency, insufficiency and sufficiency were defined based on serum 25(OH)D concentration as <49.9 nmol/L, 49.9-79.8 nmol/L and > 79.8 nmol/L respectively.[1,5]

Results And Discussion

Table 1 gives the characteristics of the study subjects. The means 25(OH)D value of all subjects in the rural area was 36.4 ± 22.5 nmol/l/L. Only eighteen of the 57 subjects (31.5%, 15 males and three females) had serum 25(OH)D levels ≥ 50.0 nmol/L. The mean serum 25(OH)D levels of females was significantly less and their mean serum PTH significantly higher than that of males. Latter had significantly higher duration of sunshine exposure, body surface exposed and dietary calcium intake than that of females.

Comparative assessment of mean 25(OH)D values of the rural subjects with that of urban North Indians[3,4] revealed several interesting facts. These include:

1) The mean serum 25(OH)D values of males and females in rural area were six and four fold higher than that of urban subjects [mean 25(OH)D = 13.5 ± 3.0 nmol/L].[4] This could be explained by longer duration of the sunshine exposure in the former. The fact that higher sunshine exposure lead to better serum 25(OH)D levels of rural subjects was supported by the observation that when an urban group had equivalent daily sunshine exposure of five hours i. e. soldiers, their mean 25(OH) D levels (47.17 ± 11.73 nmol/L),[3] was similar to that observed in the males of the current study (44.2 + 24.4 nmol/L).
2) In our earlier study, urban Indian subjects with vitiligo universalis and albinism had higher mean serum 25(OH) D levels than those with normal skin complexion.[3] In the current study with an average daily sunshine and body surface area exposure of five hours and 10% respectively, two third of the rural subjects continued to had serum 25(OH)D in the deficient range (<49.9 nmol/L). This observation again confirms the role of melanin in blocking adequate vitamin D synthesis even in areas with abundant sunshine like India.
3) The significantly lower 25(OH)D levels in females as compared to males in rural areas was unlike the urban areas where males and females demonstrated similar values. This could be explained on account of the fact that purdha (veil) system is widely followed by females in rural areas than in the urban area.

The findings reported in the current study are important from the public health point of view in India and other tropical countries with similar skin complexion, dress code and body surface area exposure. Though longer sunshine exposure results in better 25(OH)D status among subject residing in rural areas as compared to urban, yet most of the former would remain 25(OH)D deficient with values < 49.9 nmol/L. In the only other study available on 25(OH)D status of rural subjects from India, similar 25(OH) D deficiency in rural South Indians.[6] In the recent Annual

Table 1 : Baseline characteristics and 25(OH)D status of study subjects in comparison to the previously published data in urban Indians

Parameters	Rural area (current study)		Urban Delhi (Goswami et al, 2000)
Season	Winter		Winter
N	Males (n=32)	Females (n=25)	Both sex (n= 19)
Age (yr)	42.8 ± 16.6	43.4 ± 12.6	23 ± 5
BMI (kg/m^2)	19.3 ± 3.0	19.0 ± 3.3	22.3 ± 2.8 (M) 20.0 ± 1.7 (F)
Sun exposure (min/d)	304 ± 155	305 ± 109	25 ± 5
Body surface area exposed (%)	11.3 ± 2.7	9.6 ± 5.9	9.0
Dietary calcium (mg/d)	905 ± 409*	595 ± 224	879 ± 165
Serum 25 (OH) D nmol/L	44.2 + 24.4$^{£}$	26.9 + 15.9	7.98 ± 3.49
Serum PTH (ng/ml)	25.1 ± 12.7§	35.3 ± 19.0	38.8 ± 18.2

*P = 0.004, $^{£}$P = 0.002, § P = 0.02 between rural males and females in the rural area

Meeting of Endocrine Society of India held at Tirupati in 2007, most of the participants in a debate on the need of vitamin D fortification program, considered it important in urban areas. However, results of the current study support universal supplementation program for vitamin D irrespective of rural or urban setting in the country.

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