Original Article

Period of Sun Exposure and Vitamin D Status among the Rural Elderly Women of West Bengal, India

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Abstract

Introduction: Vitamin D deficiency has been found to be prevalent among Indian elderly women. Aging has a significant association with decreased concentration of 7-dehydrocholesterol, the precursor of Vitamin D3 in the skin. **Objective:** The aim is to find out the association between the period of sun exposure and serum 25(OH) D level among rural elderly women of West Bengal, India. **Subjects and Methods:** The present study was conducted among 236 elderly women aged between 60 and 70 years residing at Amdanga Block, North 24th Parganas district of West Bengal, India. They were assessed for their period of sun exposure and serum 25(OH) D level. **Results:** The sun exposure index was low from sufficient to deficient Vitamin D status groups, but they were insignificant ($P = 0.09$). Spearman's correlation test revealed significant positive relationship (0.183 [$P = 0.005$]) between sun exposure and serum 25(OH) D level. **Conclusion:** Therefore, for maintaining optimum serum 25(OH) D level, adequate sun exposure for this population is needed, particularly for the individuals having suboptimal Vitamin D status.

Keywords: Elderly women, rural, serum 25(OH)D level, sun exposure, Vitamin D

Introduction

The principal source of Vitamin D among the human population is exposure of the skin to ultraviolet B (UVB) radiation (290–315 nm).[1-5] Maximum Vitamin D production reached after 10–15 min of sun exposure, especially during summer, while one erythema dose is achieved which is equivalent to intake of over 500 µg of Vitamin D3.[6] Aging has significant association with decreased concentrations of 7-dehydrocholesterol, the precursor of Vitamin D3 in the skin.[7] It has been observed that 70 years old had about 25% of the 7-dehydrocholesterol in comparison to a young adult and thus had 75% reduced capacity to make Vitamin D3 in the skin.[8] Moreover, reduced mobility or institutionalization causing reduced sun exposure.[8] Thus, reduced renal production of 1,25-dihydroxyvitamin D as well as decreased intake of fortified foods also pose great difficulties in Vitamin D formation in body.[8,9] High prevalence of Vitamin D deficiency was observed in India across different age groups and both sexes.[5] Vitamin D deficiency has been found to be prevalent among Indian elderly women.[10]

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With this background, the present study was conducted to find out the association between the period of sun exposure and Vitamin D status among the rural elderly women of West Bengal.

Subjects and Methods

Study type and design

This cross-sectional community-based study was conducted among 236 elderly women, aged between 60 to 70 years, selected randomly by multistage probability sampling from 80 villages of Amdanga block, North 24 Parganas district, West Bengal, India, from April 2014 to August 2018.

Ethical clearance was obtained from the Ethics Committee of All India Institute of Hygiene and Public Health, Kolkata. Informed written consent was obtained from the study participants.

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Elderly women having a history of thyroid dysfunction, on hormonal replacement therapy, with amenorrhea due to any pathological cause or surgery, on Vitamin D supplementation, with physically or mentally challenged, and with noncooperative in nature were excluded from the study.

Sample size calculation and sampling technique

The sample size was calculated by taking the previous prevalence of Vitamin D deficiency as 91.2%;[11] and using formula $n = (Z_{(1-\infty/2)})^2 pq/L^2$; where L is allowable error, which was taken as 5% of p, and $Z_{(1-\infty/2)}$ is the standard normal deviate at 95% confidence limit, which was 1.96. The calculated sample size came out to be 145. Since multistage random sampling was adopted, it was multiplied by 1.5 (design effect), which came out to be 217.5. Additional 10% was added to compensate the dropout and finally, it was calculated to be 239. Finally, 236 participants could be covered. Multistage random sampling was adopted. In the first stage, 30 villages were selected randomly from 80 total villages of Amdanga block. Women aged 60 years and above were selected from villages, and the number of participants from each village was calculated by population proportionate to size method. Following this, the required number of samples was drawn from the sampling frame from each village using the simple random sampling method. If the selected individual could not be contacted in three visits, that person was excluded from the study.

Serum 25(OH)D and sun exposure assessment

Blood sample was drawn by a trained phlebotomist by venipuncture after 10–12 h overnight fast. Samples were transported to the laboratory in an ice bucket within 2 hours of collection, and serum was separated by centrifugation of whole blood for 20 min at 2000 rpm. Serum 25(OH) D was measured by enzymatic immunoassay.[7]

A predesigned, pretested structured schedule in the local language (Bengali) was used to collect the data. The elderly women were interviewed about their exposure to direct sunlight, which included the type, frequency, and duration (in minutes per day in a week) of outdoor activities. Besides, the participants were asked about their sun protection measures, such as wearing of long sleeves, long skirt/Saree, long pants, veils/Burkhas, hat/cap, gloves, and the use of sunblock lotion and an umbrella. The "Rule of Nine" was used to estimate the fraction of body surface area (BSA) exposed to sunlight by the subject's attire during outdoor activity.[12] Sun exposure index (SEI) was calculated using the standard formula.[12]

Operational definitions

Deficiency, insufficiency, and sufficiency of 25(OH) D were defined as ≤20, 21–29, and ≥30 ng/ml of serum 25(OH) D in the human blood, respectively.[13] SEI which is an index combining a measure of time outdoors during daylight and BSA usually exposed during that time.[12]

Statistical analysis

Collected data were entered in MS Excel worksheet. Usage of sunscreen, average daily sun exposure and wearing of clothes, gloves, etc., were taken as independent variables. Discrete data were expressed in numbers and percentages. Continuous data were expressed in median and interquartile range. Nonparametric Mann–Whitney U-test was performed to see the differences between the two groups and Spearman's correlation coefficient was computed to find out the relationship between Vitamin D level and sun exposure. All such statistical analyses were performed in SPSS software (version 20.0) (Statistical Package for the Social Sciences Inc, Chicago, IL,USA).

Results

Around 27.4% of participants had sun exposure <5 min/day, 22.5% elderly had 5–15 min of sun exposure, 25.8% had 15–30 min of sun exposure and 24.3% elderly had >30 min of sun exposure per day. Majority, i.e., 99% of of participants did not use any sunscreen. About 48.3% of participants used half or full-sleeved garments, and 31.4% of participants used only half sleeves. Majority, i.e., 40.7% of participants used sandals and 30.1% used both sandals and shoes. Almost 97.9% of participantsbelieved that their face is exposed to sunlight. About 95.8% of participantsdid not use either gloves or scarf and only 4.3% used only scarf.

Among the 25(OH) D deficient group, 52% of participants had sun exposure <5 min/day and 21.95% of participants had sun exposure about 31–60 min/day [Table 1]. SEI was found to be the same in sufficient and insufficient group of Vitamin D level, but the median level was much lower (540 vs. 270) among the deficient group [Table 2]. This difference between the deficient and nondeficient groups was not found to be statistically significant using Mann–Whitney U-test ($Z = -1.67$ $P = 0.09$).

Vitamin D level is positively correlated with sun exposure and it was found to be statistically significant (Spearman's correlation coefficient 0.18, $P = 0.005$).

Table 1: Distribution of rural elderly women according to their daily sun exposure routine and 25(OH) D status (n=236)

Vitamin D status	Daily sun exposure routine					
	≤5 min/day, *n* (%)	5-15 min/day, *n* (%)	15-30 min/day, *n* (%)	31-60 min, *n* (%)	61-90 min/day, *n* (%)	Total, *n* (%)
Sufficient	16 (30.2)	25 (48.1)	27 (44.3)	27 (65.8)	15 (51.7)	110 (46.5)
Insufficient	9 (17.0)	11 (21.1)	14 (22.9)	5 (12.3)	7 (24.2)	46 (19.5)
Deficient	28 (52.8)	16 (30.8)	20 (32.8)	9 (21.9)	7 (24.1)	80 (34.0)
Total	53 (100)	52 (100)	61 (100)	41 (100)	29 (100)	236 (100)

Table 2: Distribution of rural elderly women according to their sun exposure index and different categories of serum 25(OH)D level (*n*=236)

Vitamin D status	Sun exposure index, median (IQR)*
Sufficient	540 (270-1080)
Insufficient	540 (270-1080)
Deficient	270 (90-540)
Total	540 (135-1080)

*IQR was represented as Q_1–Q_3. IQR: Interquartile range

Discussion

On significant areas of the skin, the sub-erythemal doses of appropriate UVB can produce large amounts of Vitamin D, enough in those regularly exposed to summer sunshine over much of their bodies, to maintain normal repletion during the months when sunlight provides noeffectiveUVB, as is seen in temperate zones for >6 months of the year.[1] However, in current lifestyles, adequate exposure to summer sunlight is unusual, even in fit young adults, because most people live, work and exercise indoors, behind glass (which blocks UVB).

The clothes block the UVB transmission; many rural females, especially older women favors covered-up clothing.[1,2] Through out the world, people mostly avoid sunshine, to stay cool, to prevent sun-related skin aging, to reduce the risks of skin cancer, and to avoid undue tanning. Thus, Westernized and urban communities worldwide, even in tropical countries, have a high prevalence of hypovitaminosis D, even in sunny climates.[1-3]

About 12.28% of the study participants had sun exposure of >60 min which is far below than previous two studies conducted among rural people in India[2,14] which is mostly due to the increased aging of the present population than the other studies. Furthermore, they are elderly women, rarely come outside from home. About 22% of this population have <5 min of sun exposure which is quite higher compared to other few studies conducted among rural adults, physicians, pregnant women, and depigmented persons of India.[2,14-16]

Research has proved that Vitamin D production is directly related to sunlight exposure.[2-4,17-20] The present study revealed that sunlight exposure has a significant positive relationship (P = 0.005) with serum 25(OH) D level. This corroborates earlier reports.[9,17,18,20,21] Thus, proper awareness and knowledge is prerequisite for the favorable practice among rural elderly.

Conclusion

The present study revealed that Vitamin D status of the studied population was dependent on sun exposure. Therefore, for maintaining optimum serum 25(OH) D level, adequate sun exposure for this population is needed, particularly for individuals having suboptimal Vitamin D status.

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Conflicts of interest

There are no conflicts of interest.

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