Endokrynologia Polska/Polish Journal of Endocrinology
Tom/Volume 62; Numer/Number 3/2011
ISSN 0423–104X

Vitamin D deficiency prevalence in summer compared to winter in a city with high humidity and a sultry climate

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Abstract

Background: Vitamin D deficiency is high in winter because of reduced exposure to sunlight. It seems that in places with high humidity and a sultry climate, exposure to sunlight in summer can be low too. This study was designed to determine the vitamin D deficiency prevalence in Sari, a city with a high humidity climate at the end of summer, and compare it to winter.

Material and methods: This cross-sectional study was carried out on men and women aged 10 to 70. Clustered blood samples were received from 351 subjects who participated in this study toward the end of summer, and in winter. The levels of serum vitamin D, calcium, phosphorus, alkaline phosphatase and PTH were measured. T test and X^2 were used for data analysis.

Results: 351subjects (66.4% women, 33.6% men) aged 11 to 69 (mean age ± SD 37.11 ± 12.6) participated in the study. The mean 25-(OH) D concentration in summer was 13.41 ± 13, and in winter it was 11.7 ± 11, and the difference was statistically significant ($p < 0.02$). The prevalence of 25-OHvitamin D deficiency was 87.5% (307) in winter and 78.6% (276) in summer ($p < 0.05$).

Conclusion: This study shows that although in this area with a high humidity climate, seasonal variation of vitamin D is statistically significant, the prevalence of Vitamin D insufficiency is as high in summer as in winter. **(Pol J Endocrinol 2011; 62 (3): 249–251)**

Key words: *vitamin D deficiency, seasonal variation, sultry climate, high humidity*

Introduction

Vitamin D is an essential material in bone metabolism, cell growth and differentiation, along with the regulation of body minerals. Vitamin D, in addition to its classical mechanism of action in different organs, has several non-classical mechanisms of action that may interact with thyroid hormones [1]. One of the important risk factors in the development of osteoporosis is chronic vitamin D deficiency. Most vitamin D requirements are formed in the skin as a result of sufficient sunlight exposure, and the remainder is met by diet [2, 3]. Vitamin D deficiency has various causes, including limitations in sunlight exposure (type of clothing, sunscreen usage, indoor activity), seasonal geographic latitude and altitude, atmospheric pollution, diet, and ageing [2, 4].

Within Europe, vitamin D deficiency has been reported in 2 to 30% of adults. This increases in the old and the institutionalized to more than 80% [5]. Vitamin D deficiency may also be seen in children, but not as often as in adults. In a recent study in Isfahan, Iran, mild vitamin D deficiency was detected only in 3% of 6–7-year old children [6]. Recently, vitamin D deficiency has been found to be more prevalent than expected in Mediterranean countries, which are sunny most of the time [2]. Iran is one of these sunny countries. Sari is located at latitude 36.6 adjacent to the Caspian Sea that also has Mediterranean weather. We suggest that because of high humidity through summer in our region, people avoid leaving their homes, and so vitamin D deficiency can even be as high in summer as winter. In this study, we determined seasonal variation of plasma vitamin D levels in residents of Sari aged 10 to 70.

Material and methods

This cross-sectional study was carried out among men and women aged between 10 and 70, who had resided in the city of Sari, in the north of Iran, for at least six months. Exclusion criteria were renal failure, hepatic failure, pregnancy or breast feeding at the time of study, bed rest for three months consecutively, use of anticonvulsant drugs, drugs that affect calcium and vitamin D metabolism (a tablet of calcium at least daily), Vitamin D supplementation (in the previous three months) and injection of vitamin D3 (in the previous year).

Sample design: The design used cluster sampling. The study was divided into 35 clusters, and 10 cases

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Table 1. *Mean and standard deviation of variables measured in summer and winter*

Lab data	Summer (mean ± SD)	Winter (mean ± SD)	p value
Vitamin D [ng/ml]	13.41 ± 13	11.7 ± 11	0.02
Calcium [mg/dl]	9.91 ± 4.8	9.85 ± 0.7	0.86
Phosphorus [mg/dl]	4 ± 0.6	4.6 ± 1.8	0.28
Alkaline phosphatase [lu/l]	143 ± 52	147.54 ± 57	0.02

were selected in each cluster of telephone-equipped households in Sari by preparing a list of each cluster. The sample was representative of the entire population.

Blood samples were received from 351 subjects who participated in this study toward the end of summer and winter. Serum was separated and kept at –80°C. Then 25-OHvitamin D, PTH, alkaline phosphatase, calcium and phosphorus were measured in one laboratory. Measurement of the levels of vitamin D and PTH (this parameter was measured only at the end of summer and winter was done via the ELISA method using DRG and Biomercia kits. The normal range of PTH was 9.4–81.6 pg/mc and its CV was less than 0.2 (this parameter was measured only at the end of summer and winter.

For our purposes, vitamin D deficiency was defined as serum 25-hydroxyvitamin D (25-(OH) D) < 20 ng/ml, while serum 25-hydroxyvitamin D (25-(OH) D) < 30 ng/ml was defined as vitamin insufficiency [7].

This research project was approved by the Research and Ethics Committee of Mazandaran University of Medical Sciences and participants' consent forms were obtained.

For comparison and determination of correlation between qualitative variables, χ^2 test was used. For comparison levels of vitamin D, calcium and phosphorus in different seasons, paired T test was used, and $p < 0.05$ was considered statistically significant.

Results

351 subjects (66.4%; 232 women, and 33.6%; 118 men) aged between 11 and 69 (mean age ± SD 37.11 ± 12.6) participated in the study.

The mean 25-(OH) D concentration in summer was 13.41 ± 13, and in winter 11.7 ± 11, and the difference was statistically significant ($p < 0.02$).

Mean serum alkaline phosphatase in summer was 143 ± 52 IU/L, and in winter 147.54 ± 57 IU/L, and this difference was also statistically significant ($p < 0.02$) (Table I).

The prevalence of vitamin D insufficiency was 93.2% (327) in winter and 90.6% (318) in summer ($p < 0.01$). Vitamin D deficiency was 87.5% (307) and 78.6% (276) in winter and summer respectively ($p < 0.05$) (Table II).

Table II. *Prevalence of vitamin D deficiency in the study population*

Season	Vitamin D insufficiency n (%)	Vitamin D deficiency n (%)
Winter		
Total	327 (93.2%)	307 (87.5%)
Men	91.5%	81.4%
Women	94%	90.6%
Summer		
Total	318 (90.6%)	276 (78.6%)
Men	89%	67%
Women	91.4%	84.5%
p value (between summer and winter)	< 0.001	< 0.05

Seasonal variation was statistically significant in both sexes ($p < 0.05$). (Table 2) Differences between the sexes in both seasons were statistically significant ($P < 0.0001$).

There was no significant statistical correlation between age and serum levels of vitamin D.

The correlation between calcium, phosphate, alkaline phosphatase and PTH were not statistically significant. There was a weak correlation between PTH and vitamin D ($r = –0.14$, $p < 0.05$). Among patients who had vitamin D deficiency, 13.6% used sunscreen regularly, 19% sometimes and 67.4% did not use sunscreen. In the normal vitamin D level group, 7% used sunscreen regularly, 25.4% sometimes and 67.6% did not use it. Analysis of data showed no significant statistical correlation between sunscreen use and vitamin D deficiency. There was no significant statistical correlation between the place of living (apartment or house) and vitamin D deficiency ($p = 0.2$).

Discussion

In our study, the prevalence of vitamin D deficiency was higher in summer (90.6%) than in winter (78.6%). Because of solar radiation in winter, the duration of sunlight exposure is limited compared to summer; vitamin D deficiency is high in winter, and likewise at high latitudes

[8]. Ono et al. in Japan reported that the mean serum level of 25-hydroxyvitamin D was lowest at the end of winter and the prevalence of vitamin D deficiency was 86.7% and 1.0% in March and September respectively [9]. In our study, vitamin D deficiency was as high at the end of summer as winter. Bener et al. reported a high prevalence of vitamin D deficiency in Qatar which has highly sunny humid weather [10]. It may be that in highly humid regions, people avoid leaving their homes because of the high humidity in summer.

In our study, both sexes had vitamin D deficiency in summer and winter (67% of men and 84.5% of women in summer, and 81.4% of men and 90.6% of women in winter). In a study conducted in Tehran by Ghazi et al. similar to our study, 60% of men and 91% of women were in the range of vitamin D deficiency during March or December [11]. Ono et al. showed that serum 25-OH D levels were higher in men than in women [9]. The difference between men and women could be the result of differences in their skin coverage and also their jobs. The high prevalence of vitamin D deficiency in both sexes in our study could be due to cloudy weather for most of the time in our region.

In addition to reduced exposure to sunlight, a diet low in vitamin D also causes vitamin D deficiency [12]. Some foods such as eggs, fish oils and fatty fish contain significant amounts of vitamin D [13]. One dietary factor that has been linked to vitamin D deficiency is bread. It has been presumed that the high phytate content of bread may arrest the enterohepatic circulation of vitamin D metabolites. In one adult study, high phytate consumption caused 12% of the variance in vitamin D level and was an important risk factor for rickets in the UK [4]. Thus, in individuals who don't take vitamin supplements, sufficient sun exposure is the main source of vitamin D [14].

Many epidemiological data and animal studies have evaluated the relationship between low vitamin D and rickets, bone mass loss, multiple sclerosis, breast cancer, hypertension, prostate cancer, colorectal cancer, insulin dependent diabetes and schizophrenia [15, 16].

Finding the causes of vitamin D deficiency in any country is very important. In our area, the north of Iran, sun exposure is low even in summer and bread is one of the principal features of the diet in Iran. Thus we believe that encouraging people to consume more foods containing vitamin D and calcium, and also fortifying food, are needed to prevent vitamin D deficiency and its complications in our region.

In Poland, to prevent vitamin D deficiency, national recommendations have been established for vitamin D supplementation and sun exposure during the different seasons and for various age and sex groups including infants, children, adolescents, adults and pregnant and lactating women [17].

The limitation of our study was that we did not evaluate the level of serum 1, 25 OH vitD although the serum concentration of 25-(OH) D is the most sensitive biochemical marker of a subject's vitamin D status [4].

Conclusion

In a high humidity climate, the prevalence of vitamin D deficiency is high, even in the summer. To prevent progressive damage and morbidity rates due to vitamin D deficiency, it is necessary to encourage people to increase sunlight exposure. Vitamin D should also be supplemented in food in places with a sultry climate.

Acknowledgment

The authors would like to express their sincere gratitude to the Farzan Institute for Research & Technology for technical assistance.

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