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Vitamin D status among healthy postmenopausal women in South America

A review

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Vitamin D status has been extensively studied throughout the world. However, most of the studies are from North America, Europe and Oceania. This review describes published evidence on vitamin D status among healthy postmenopausal women in South America, where food is not fortified with vitamin D. A literature search identified ten studies from only three countries in the region: Argentina, Brazil and Chile. These studies reported a high prevalence of vitamin D deficiency, in spite of their location at latitudes with abundant sunlight throughout the year. In studies with proper design, a clear North-South gradient was revealed with higher 25(OH)D levels toward the equator. Seasonal changes in 25(OH)D were more likely to be detected in younger subjects. These results are very similar to what has been reported in the Northern Hemisphere and they emphasize the importance of recommendations for a higher vitamin D intake in this population from South America.

Introduction

Vitamin D is essential for bone health throughout life. In healthy people the most important sources of the vitamin D are the cutaneous production of vitamin D stimulated by solar radiation and dietary intake.¹ The relative contribution from these two sources varies widely among individuals and between different geographic and ethnic groups, but the reduction in either of these sources can lead to vitamin D deficiency.² In adults, vitamin D deficiency causes osteomalacia and osteoporosis, with clinical findings of bone pain, muscle weakness, frequent falls and fragility fractures. In addition, vitamin D deficiency increases the risk of cancer, autoimmune, cardiovascular and infectious disease.¹ Serum circulating 25(OH)D level, measured by a reliable assay, is the best indicator of vitamin D status. Using this indicator and based on several studies of bone health, vitamin D deficiency has been defined as a 25(OH)D of less than 20 ng/ml.^{3,4} Vitamin D status has been extensively studied in different populations and countries around the world.⁵⁻⁹ Most of these studies have been

performed in patients at risk for vitamin D deficiency or among healthy adult residents in North America, Europe and Oceania, thus including some countries where food is fortified with vitamin D. Therefore, there are several reviews on the status of vitamin D and consequently guidelines on vitamin D deficiency that have been published for those regions of the world.^{4,10,11} However, for other regions of the world, such as South America, there are no specific guidelines.

South America is a continent that is very diverse in geography and population. It spans between the latitudes of 12°N and 55°S and has an area of 17,840,000 km² (6,890,000 sq mi). There are different climates in South America, ranging from a marked cold climate in the south to a tropical climate in the north. The estimated population for 2012 is approximately 400 million. Usually, food is not fortified with vitamin D in South America.

The aim of this review is to summarize the published evidence on vitamin D status among healthy postmenopausal women in South America, compare their findings with those from other regions and analyze the need for specific recommendations regarding vitamin D supplementation in this subgroup of people. The emphasis of this review is on healthy postmenopausal women since they are the main risk group for osteoporosis.

Studies of Vitamin D Status among Postmenopausal Women in South America

Studies reported since 1990 were identified by a computer search using PubMed. Vitamin D and South America were used as keywords. A literature review of all retrieved articles selected 10 studies including only or predominantly healthy postmenopausal women.¹²⁻²¹ Only studies from Argentina,^{15,19-21} Brazil^{12-14,18} and Chile^{16,17} were identified.

Argentina

The first published studies of vitamin D deficiency in South America were done in Argentina. Studies from Buenos Aires, (latitude 34°S), the capital and largest city in Argentina, reported a prevalence of vitamin D deficiency of up to 65% among more than 500 ambulatory postmenopausal women during the winter time.^{15,20,21} Fassi et al. including both young and elderly women, showed seasonal variations in serum 25(OH)

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D, with secondary hyperparathyroidism only among the elderly both in winter (28%) and summer (21%). In winter, 70% and 65% of young and elderly had serum 25(OH)D < 20 ng/ml, respectively; in summer time, the percentages were about 15% in both groups.²⁰

Oliveri et al.¹⁹ showed significant differences in mean values of serum 25(OH)D between inhabitants of northern (26°-27°S; 25(OH)D = 20.7 ng/ml), center (33°S-34°S; 25(OH)D = 17.9 ng/ml) and southern (41°S-55°S; 25(OH)D = 14.2 ng/ml) latitudes in healthy elderly men and women (n = 339) living in seven different Argentinian cities. Thus, a clear North-South gradient was demonstrated in vitamin D levels with lower vitamin D levels further from the equator. A high prevalence (52–87%) of subjects with serum 25(OH)D < 20 ng/ml was detected in this study. The serum levels of 25(OH)D were found to be in the middle range compared with US and European values and a high correlation was observed between the average 25(OH)D values and the corresponding average hours of sunshine and average temperatures in each of the seven cities. In addition, the study showed a cutoff level of serum 25(OH)D of 27.0 ng/ml at which serum PTH began to increase.

Brazil

In 2006, Bandeira et al.²² published a review of vitamin D that included most of the Brazilian studies published up to that date. The authors showed that vitamin D deficiency occurred frequently in Brazil, mainly in the elderly, in spite of abundant sunlight. Saraiva et al.¹⁸ reported in their study of 250 elderly people living in Sao Paulo (23°S) that serum 25(OH)D levels had a seasonal variation in inverse correlation with PTH levels. The percentages of people with serum 25(OH)D levels < 20 ng/ml were 66% in winter, 70% in spring, 33% in summer and 38% in autumn. The greatest seasonal difference in serum 25(OH)D was detected between July and February, the months following those of low and high UV radiation respectively. Secondary hyperparathyroidism also occurred frequently with figures of 70%, 62%, 36% and 41%, in the winter, spring, summer and autumn months, respectively.

The largest epidemiological study of vitamin D status from Brazil and also South America, was published 2 y ago by Unger et al.¹² They prospectively determined the prevalence and predictors of serum 25(OH)D in 603 (80.4% female; 67.2% white) Brazilian healthy subjects aged 18–90 y.o. from Sao Paulo (23°S) after the winter season and following the summer season. As the authors mention in their paper, Sao Paulo is the largest city in Brazil and the world's 7th largest metropolitan area, with nearly 20 million residents. It has a subtropical climate and sunlight is sufficient for the skin to be able to produce vitamin D during the entire year. Air pollution, sometimes related to vitamin D deficiency is highly prevalent in Sao Paulo. After the winter they observed 77.4% of subjects with serum 25(OH)D < 30 ng/ml (median 21.4 ng/ml). 25(OH)D level was associated with age, skin color, body mass index and serum glucose levels. After the summer, almost 40% of volunteers still presented serum 25(OH)D < 30 ng/ml. Secondary hyperparathyroidism was observed

with a prevalence of 20.8% and 4.9% in winter and summer seasons respectively.

Cross-sectional studies from Rio de Janeiro¹⁴ (22°S) and Recife¹³ (8°S) showed lower prevalence of vitamin D deficiency (serum 25(OH)D < 20 ng/ml (27% and 24% respectively). However, the number of volunteers in these studies was small compared with the study of Unger et al.

Chile

Only two studies on vitamin D status in Chilean healthy postmenopausal women have been published.^{16,17} In their study of 555 postmenopausal women screened for a clinical trial on osteoporosis in Santiago (33°S), Rodriguez et al.¹⁶ found that nearly half (48%) had serum 25(OH)D levels < 17 ng/ml, the cutoff point selected by the authors to define vitamin D deficiency according to results from a receiver operating characteristic curve for 25(OH)D vs. PTH. Overall, 35% of patients in this study had osteoporosis and 30% had at least one vertebral fracture. The season when the study was done was not reported.

In Santiago, González et al.¹⁷ reported that 60% of healthy postmenopausal women (n = 60) as well as 27% of healthy premenopausal women (n = 30) had serum 25(OH)D levels < 20 ng/mL. While food is not fortified with vitamin D in Chile, most of these women had normal sun exposure according to a score for sunlight exposure validated previously. At a latitude of 33°S, where this study was done, sunlight is strong enough year-round for cutaneous vitamin D synthesis with values two to three times higher during the summer than during the winter months.²² Nonetheless, many older women had inadequate vitamin D levels even in summer time: the percentages of postmenopausal women with levels of serum 25(OH)D < 20 ng/mL were 63% and 57% in winter and summer respectively and of premenopausal women, 47% and 7% respectively. This finding was associated with higher bone resorption during the winter time. In a multivariate analysis, only age and daily calcium intake were independent determinants of serum 25(OH)D levels.

Table 1 shows a summary of the studies of vitamin D status in postmenopausal South American women.

Conclusions

Population-based data on vitamin D deficiency in South America is scarce. In general, the few available studies show a high prevalence of vitamin D deficiency among healthy postmenopausal women in this region. Decreases in skin production of vitamin D related to aging and the probable low vitamin D intake explain this finding. These results are very similar to what has been reported in other regions of the world for this subgroup of subjects.^{5,23} Although there are methodological differences in subject selection, type of vitamin D assay used and study design, most of the studies from South America were done at latitudes with abundant sunlight present throughout the year. A clear North-South gradient can be observed with higher 25(OH)D levels closer to the equator. Seasonal changes in 25(OH)D were more likely to be detected in younger subjects compared with elderly subjects.²⁴

Table 1. Studies of Vitamin D Status among Postmenopausal Women in South America

	Design	Subjects	City	Results
Argentina				
Arévalo et al. ¹⁵	Prospective study from oct/2006 to mar/2008	224 outpatients women (mean age 58 ± 12.9 y.o.)	Buenos Aires (34°S)	26.8% had 25(OH)D < 20 ng/ml
Fassi et al. ²⁰	Cross-sectional study winter and summer	83 elderly (62 ♀) +76 young outpatients (mean age 71.9 ± 8.1 and 29.8 ± 6.6 y.o. respectively)	Buenos Aires (34°S)	Winter: 65.2% and 70.4% of elderly and young had 25(OH)D < 20 ng/mL, Summer: ~15% in both groups.
Fradinger et al. ²¹	Retrospective study using samples taken in winter	250 postmenopausal ambulatory women (mean age 60.8 ± 8.8 y.o.)	Buenos Aires (34°S)	52.0% had 25(OH)D < 20 ng/ml
Oliveri et al. ¹⁹	Cross-sectional study between the end of winter and beginning of spring	339 ambulatory subjects > 65 y.o. (226 ♀/113♂; mean age 71.3 ± 5.2 y.o.)	7 cities from Argentina (26°S to 55°S)	Depending on region, from 52% to 87% had 25(OH)D < 20 ng/ml
Brazil				
Bandeira et al. ¹³	Cross-sectional study. Study time uninformed	93 postmenopausal ambulatory patients (mean age 65.6 ± 7.1 y.o.)	Recife (8°S)	24.0% had 25(OH)D < 20 ng/ml
Russo et al. ¹⁴	Cross-sectional study done during winter	251 postmenopausal ambulatory women (mean age 67.4 ± 6.8y.o.)	Rio de Janeiro (22°S)	27.1% had 25(OH)D < 20 ng/ml
Saraiva et al. ¹⁸	Cross-sectional study from Jul/2000 to Nov/2001	250 free-living elderly volunteers (173 ♀/77♂; mean age 79.1 ± 5.9 y.o.)	Sao Paulo (23°S)	57.3% had 25(OH)D < 20 ng/ml
Unger et al. ¹²	Prospective study at the end of winter and following summer	603 healthy volunteers aged 18–90 y.o. (483 ♀) studied after winter and 209 (31♀) from original group after summer.	Sao Paulo (23°S)	Winter: Median 25(OH)D: 21.4 ng/ml; 77.4% < 30 ng/ml. Summer: 37.3% < 30 ng/ml
Chile				
González et al. ¹⁷	Cross-sectional study winter and summer	90 healthy ambulatory women; 30 pre and 60 postmenopausal women (mean age 32.6 ± 7.4 y.o. and 63.7 ± 9.7 y.o. respectively)	Santiago (33°S)	Winter: 46.7% and 63.3% of pre and postmenopausal women had 25(OH)D < 20 ng/ml, respectively. Summer: 6.7% and 56.7% of pre and postmenopausal women had 25(OH)D < 20 ng/ml, respectively.
Rodríguez et al. ¹⁶	Cross-sectional study	555 postmenopausal ambulatory women recruited for an osteoporosis study (mean age 67.5 ± 6.8 y.o.)	Santiago (33°S)	47.5% had 25(OH)D < 17 ng/ml.

There are no published studies on the epidemiology of vitamin D deficiency in healthy adults in most of the South American countries. Economic reasons and scarce research funding sources within the region could explain this lack of data. The future development of research on vitamin D in this region should include large prospective studies in healthy volunteers to assess the local determinants of vitamin D status and provide national recommendations for the prevention and treatment of vitamin

D deficiency in this population. Meanwhile, the available evidence emphasizes the importance of recommending an increase in vitamin D intake to healthy postmenopausal women in South America.

Disclosure of Potential Conflicts of Interest

No potential conflict of interest was disclosed.

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