Original Article

Birth season and vitamin D concentration in adulthood

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Background: Recent evidences suggest that the season of birth may influence human development and vulnerability to develop certain diseases.

Methods: A retrospective analysis was hence carried out in the laboratory information system of the University Hospital of Parma (North-West Italy), to retrieve values of total serum vitamin D (25-hydroxyvitamin D) measured in a the whole cohort of unselected outpatients age 18 years and older referred for routine health check-up during January to December 2014. Vitamin D was then stratified according to birth season.

Results: The study population consisted in 11,150 unselected Italian residents (median age 62 years; 8,592 women and 2,558 men). Serum vitamin D values were found to be significantly lower in subjects born in winter than in those born in spring and summer. More specifically, winter season birth was associated with 11% increased risk of developing vitamin D deficiency later in life compared to spring birth. Daily sunlight hours at birth independently predicted vitamin D concentration in adulthood.

Conclusions: The results of this large, cross-sectional retrospective investigation attest that subjects born in winter have a total vitamin D concentration in adulthood that is significantly lower than those born in seasons with longer daylight periods.

Keywords: Vitamin D; preanalytical variability; biological variability; seasons

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Introduction

Vitamin D is an essential nutrient in mammals, since is plays a substantial role in regulating calcium metabolism. Several lines of evidence also suggest that this hormone interplays with a variety of biological pathways, so that vitamin D deficiency is now considered a risk factor for cardiovascular disease, diabetes, cancer and infections (1,2).

Recent evidence was brought that the season of birth may influence human development and vulnerability to develop certain diseases. More specifically, birth seasonality has been associated with body weight (3), limb length (4), height (5), as well as with an enhanced risk of severe infections (6), allergy (7), immune-mediated diseases such as multiple sclerosis and type 1 diabetes (8), and even cancer (9). The seasonal fluctuation of vitamin D and its ensuing impact on the endocrine and immune systems is one of the leading mechanisms that has been brought to justify the convincing influence of birth season on human biology, wherein a relative deficiency of this important hormone during late pregnancy may be associated with substantial effects in adult life (10).

Due to the intriguing association between season of birth, vitamin D and health, we carried out a cross-sectional retrospective study to assess whether the concentration of total vitamin D in adulthood may be influenced by the season of birth in a large Italian resident population.

Methods

A retrospective analysis was carried out in the laboratory information system of the University Hospital of Parma (North-West Italy), to retrieve values of total serum vitamin D (25-hydroxyvitamin D) measured in a the whole cohort of unselected outpatients age 18 years and older referred for routine health check-up during January-December 2014. No exclusion criteria were used, in order to obtain information about vitamin D status in a large number of resident subjects.

Serum vitamin D concentration was measured using a competitive chemiluminescence assay (Liaison, DiaSorin, Saluggia, Italy). Quality and reproducibility of data were validated throughout the study period by means of internal quality controls (IQCs) and participation to an external quality assessment (EQA) scheme. Data were finally reported as median and interquartile range (IQR). Vitamin D deficiency was defined as a serum concentration <50 nmol/L (i.e., <20 ng/mL), in accord with recommendations of the International Osteoporosis Foundation (IOF) (11). Seasonality was defined according to the conventional equinoxes and solstices at our latitude (i.e., spring: March 20 to June 20; summer: June 21 to September 22; autumn: September 23 to December 20; winter: January 1 to March 19 and December 21 to December 31). Differences of values were analyzed using Mann-Whitney-Wilcoxon test (for continuous variables) and Pearson's χ^2 test with Yates' correction (for categorical variables), using Analyse.it (Analyse-it Software Ltd, Leeds, UK). The odds ratio (OR) and 95% confidence interval (95% CI) were calculated using MedCalc Version 12.3.0 (MedCalc Software, Mariakerke, Belgium). The study was performed in accordance with the Declaration of Helsinki, under the terms of relevant local legislation and cleared by the Institutional review board of the University Hospital of Parma.

Results

The study population consisted in 11,150 unselected Italian residents (median age 62 years and IQR, 49-73 years; 8,592 women and 2,558 men). Serum vitamin D values were found to be significantly lower in subjects born in winter than in those born in spring and summer (*Table 1*). No significant differences of age and sex distributions were observed in subjects born in winter compared to those born in other seasons. The frequency of vitamin D deficiency (i.e., <50 nmol/L) was found to be significantly lower in subjects born in Spring compared to those born in winter (*Table 1*), with an OR for vitamin D deficiency of 0.89 (95% CI, 0.80-0.99). Interestingly, in multivariate analysis in which serum vitamin D was entered as dependent variable whereas age, sex and mean duration of daylight at birth were entered as independent variables, the concentration of vitamin D was found to be independently associated with sex (beta coefficient, –6.63; P<0.001) and duration of daylight at birth (beta coefficient, 2.52; P=0.001), but not with the age of the patient (beta coefficient, 0.01; P=0.85).

Discussion

Several lines of evidence convincingly attest that the winter season of birth may be associated with both development and severity of a variety of human disorders later in life (4-9). Although most of these associations were explained with a relative vitamin D deficiency occurring during the months with the shortest daily sunlight period (10), no previous study has investigated whether the season of birth may be per se a risk factor for developing vitamin D deficiency in adulthood.

The results of this large, cross-sectional retrospective investigation attest that subjects born in winter have a total vitamin D concentration in adulthood that is significantly lower than those born in seasons with longer daylight periods (i.e., spring and summer) (*Table 1*). Even more importantly, the risk of developing vitamin D deficiency later in life appeared to be 11% higher in subjects born in winter than in those born in spring. A similar trend was also noticed when the winter season of birth was compared with summer birth, although the risk did not reach statistical significance. Interestingly, no difference in either vitamin D serum concentration or vitamin D deficiency was found in subjects born in winter or autumn, and this evidence is in agreement with the fact that these two seasons are characterized by a very similar daylight period in our country.

As previously emphasized, the evidence that the season of birth may have an impact on the burden of vitamin D deficiency later in life has not been previously described, and it is hence challenging to find a reasonable explanation for our findings due to the lack of additional experimental studies on this issue. It has been reported that the duration

Table 1 Age, sex and values of total vitamin D (median and interquartile range) according to the season of birth in an unselected population of Italian residents (n=11,150)

Demographic and laboratory data	Winter birth	Spring birth	P*	Summer birth	P*	Autumn birth	P*
n	2,747	2,867		2,860		2,676	
Mean daylight (h)	10.2 (9.8-10.7)	13.8 (13.0-14.5)	<0.001	13.9 (13.2-14.5)	<0.001	10.4 (9.7-11.0)	0.053
Age (years)	61 [49-73]	62 [49-74]	0.234	61 [48-73]	0.319	62 [50-74]	0.063
Sex (women) (%)	2,169 [79]	2,225 [78]	0.117	2,252 [79]	0.437	2,146 [80]	0.135
Total vitamin D							
Values (nmol/L)	59.2 (35.5-82.9)	62.2 (38.5-85.8)	<0.001	60.7 (38.5-82.9)	0.001	60.7 (38.5-82.9)	0.101
Values <50 nmol/L (%)	1,024 (37.3)	992 (34.6)	0.020	1,019 (35.6)	0.105	974 (36.4)	0.260
OR (95% CI)	–	0.89 (0.80-0.99)	0.037	0.94 (0.84-1.04)	0.200	0.97 (0.86-1.08)	0.502

*, compared to Winter season birth. OR, odds ratio; CI, confidence interval.

of daylight exposure improve endogenous vitamin D production (12). Vitamin D is principally obtained from foods and UV irradiation of the yeast sterol ergosterol. It is hence obvious that lifestyle and environmental factors that reduce exposure to sunlight are leading causes of short-term hypovitaminosis D (13).

Conclusions

Although further research is needed to support our preliminary findings, it seems reasonable to suggest that the duration of daylight at birth may have a still unrecognized long-term impact on vitamin D metabolism later in life, as attested by the existence of a highly significant and independent association between serum vitamin D and daily sunlight hours at birth observed in our investigation.

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None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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