QUANTITATIVE RESEARCH

Suboptimal Vitamin D Levels in Pregnant Women Despite Supplement Use

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ABSTRACT

Objective: Obtaining adequate vitamin D during pregnancy is important for the health of mother and child. Low circulating 25-hydroxyvitamin D (25OHD) concentrations, a measure of vitamin D status, have been reported in pregnant women in several countries; yet, there are few studies of pregnant Canadian women. We measured 25OHD concentrations in a multi-ethnic group of pregnant women living in Vancouver (49°N) and explored the determinants of 25OHD.

Methods: 336 pregnant women (16-47 y) between 20 and 35 weeks gestation provided a blood sample and completed questionnaires.

Results: Mean 25OHD was 67 (95% CI 64-69) nmol/L. Only 1% of women had a 25OHD concentration indicative of severe deficiency (<25 nmol/L). However, 24% and 65% of women were vitamin D insufficient based on cut-offs of 50 and 75 nmol/L, respectively. In multivariate analysis, mean 25OHD concentrations were 12 nmol/L higher in the summer compared to in winter. Women of European (White) ethnicity had a 9-13 nmol/L higher mean 25OHD concentration than women from other ethnic groups. Almost 80% of women took vitamin D-containing supplements containing ≥400 IU/d. However, 24% and 65% of these women had 25OHD <50 and <75 nmol/L, respectively.

Conclusion: Vitamin D insufficiency was not uncommon in this group of pregnant women. Season and ethnicity were determinants of 25OHD but the magnitude of their effect was not large. Most women took vitamin D-containing supplements but this did not provide much protection against insufficiency. Consideration should be given to increasing the amount of vitamin D in prenatal supplements.

Key words: Vitamin D; nutrition and metabolism; pregnancy; Vancouver

La traduction du résumé se trouve à la fin de l'article.

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Vitamin D is important at all life stages, but attaining adequate vitamin D during pregnancy may be especially important for the health of both mother and child. Vitamin D inadequacy during pregnancy has been associated with preeclampsia, the leading cause of maternal morbidity in Canada.[1,2] Poor vitamin D status during pregnancy may also adversely affect calcium homeostasis and skeletal mineralization in the unborn child. Rickets, which still occurs in Canada, is found almost exclusively in breastfed infants born to vitamin D-deficient mothers.[3] In addition, a lack of vitamin D in utero or in early life may increase the risk of type 1 diabetes,[4] asthma,[5] and low bone mass[6] later in life. Circulating 25 hydroxyvitamin D (25OHD) is the best indicator of vitamin D status as it represents vitamin D obtained from both UV skin synthesis and dietary sources.[7,8] The optimal 25OHD concentration in pregnancy is not known with certainty. In 2010, the Institute of Medicine recommended that maintaining a serum 25OHD concentration of approximately 50 nmol/L is desirable in all life-stage groups.[9] In 2007, the Canadian Pediatric Society adopted a 25OHD serum concentration of >75 nmol/L as "sufficient" for pregnant and lactating women, and infants.[10]

Low 25OHD concentrations have been reported in pregnant women in several countries,[11,12] yet there are few studies of pregnant women in Canada. Factors that might predispose Canadian women to poor vitamin D status include living at high latitude, low vitamin D intakes from food, and for some individuals, darker skin pigmentation. Very few Canadian women of reproductive age achieve the Recommended Dietary Allowance of vitamin D intake of 600 IU.[9] However, over 80% of pregnant women consume a multivitamin supplement at some point during pregnancy.[13] It is unclear whether the amount of vitamin D provided in prenatal supplements, typically 400 IU, is sufficient to achieve optimal 25OHD concentrations.

Given the widening spectrum of adverse maternal and child outcomes associated with a lack of vitamin D during pregnancy and the paucity of Canadian data, we measured 25OHD concentrations in an ethnically diverse sample of pregnant women living in Vancouver. We also explored the determinants of 25OHD concentration such as season, ethnicity and skin colour, as well as dietary and supplement intake of vitamin D.

METHODS

Participants

Between February 2009 and February 2010, Vancouver (49°N) women were recruited through BC Women's Hospital and Health Centre, Douglas College prenatal programs, and Community Health

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Centres served by Vancouver Coastal Health. Pregnant women (16-47 y) between 20 and 35 weeks gestation identified for low-risk delivery were eligible to participate in the study. Women were not eligible if they had any co-morbid conditions such as gestational diabetes, cardiac or renal disease, HIV/AIDS, chronic hypertension, autoimmune disease, or conditions associated with vitamin D malabsorption such as celiac disease. The University of British Columbia Children's and Women's Research Ethics Board approved this study and all participants gave informed written consent.

Procedures

Participants completed a health and demographic questionnaire that included questions on pre-pregnancy weight, age, week of pregnancy, smoking status, ethnicity, annual income and educational attainment. In cases where the participants indicated that they belonged to more than one ethnic group, a single ethnic category was assigned using a priority system. If a non-European ethnicity was one of the groups reported, the participant was assigned to the non-European ethnic category. Intake of vitamin D from food sources including fortified foods and supplements in a typical month during pregnancy was estimated using a validated semi-quantitative Food Frequency Questionnaire.[14] A non-fasting blood sample was collected from each woman into an evacuated tube containing heparin as an anti-coagulant. Plasma was separated from whole blood and samples were stored at -80°C.

Skin colour was measured by reflectance colourimetry using a handheld spectrophotometer (Konica Minolta Sensing CM-600d; Tokyo, Japan). This instrument assigns an L* and B* value which represent the relative brightness of colour (ranging from black to white) and degree of pigmentation, respectively.[15] Skin pigmentation is best described by the Individual Typology Angle (ITA°): ITA° = Arc Tangent[(L-50)/b)] x 180/π. The lower the ITA, the darker the skin colour.[16] Skin colour was measured at two sites: the inner upper arm which represents constitutive or genetically inherited skin colour at a non-UV exposed site and the outer forearm which represents both constitutive and facultative (tanning) skin colour.[17]

Laboratory methods

Plasma 25OHD was determined by BC Biomedical Laboratories Ltd (Surrey, BC) using a *DiaSorin* LIAISON® 25-OH Vitamin D TOTAL Assay, a competitive chemiluminescence immunoassay used for the quantitative determination of both $25OHD_2$ and $25OHD_3$ metabolites.[18] BC Biomedical Laboratories Ltd. participates in the Vitamin D External Quality Assessment Scheme, an external quality control program for 25OHD measurement.[19] During the period in which 25OHD was determined for this study (April 2010), all controls were within 8% of the assigned mean value for the method.

Data analyses

Statistical analyses were performed using SPSS Statistics 18.0 for Macintosh (SPSS Inc., Chicago, IL 2010). Plasma 25OHD concentrations were normally distributed based on visual inspection of a histogram and the Shapiro-Wilk Test (p>0.05). We calculated mean 25OHD concentrations and compared results to three commonly used cut-offs for 25OHD. We used 25 nmol/L to define vitamin D deficiency[20] and two cut-offs to define vitamin D insufficiency, 50 and 75 nmol/L.[9,21] Vitamin D deficiency is the concentration of 25OHD below which the risk of osteomalacia increases markedly.

Table 1. Characteristics of Women (n=322-336)

Characteristic	n (%)	Characteristic	n (%)
Age (years)		Vitamin D supplement (IU/d)	
<30	129 (39)	0	25 (7)
≥30	206 (61)	<400	45 (13)
Gestation (weeks)		≥400	266 (79)
<27	113 (34)	Vitamin D intake from food (IU/d)	
≥27	219 (66)	<200	154 (46)
Season*		≥200	182 (54)
Winter	76 (23)	Pre-pregnancy BMI (kg/m²)	
Spring	89 (26)	<25	235 (73)
Summer	92 (27)	25-29.9	64 (20)
Fall	79 (24)	≥30	23 (7)
Constitutive skin colour†		Education	
Very light	76 (23)	<High school	5 (1)
Light	171 (51)	High school	53 (16)
Intermediate	47 (14)	Trade/vocational training	49 (15)
Tanned	29 (9)	University	228 (68)
Brown	10 (3)	Family income per year	
Dark	3 (1)	<$40,000	38 (11)
Ethnicity		$40,000-<80,000	56 (17)
European	155 (46)	$80,000-<120,000	61 (18)
Chinese	66 (20)	≥$120,000	59 (18)
South Asian	30 (9)	Do not know	74 (22)
Other‡	85 (25)	Do not want to say	48 (14)

Note: BMI=Body Mass Index.
* 'Winter' months: December 21 - March 20; 'Spring' months: March 21 - June 20; 'Summer' months: June 21 - September 22; 'Fall' months: September 23 - December 20.
† Individual Typology Angle: Very Light > 55° > Light > 41° > Intermediate > 28° > Tanned > 1°0 > Brown > -30° > Dark.
‡ Latin American 21 (6%); Other 15 (4%); Black 12 (4%); Filipino 10 (3%); Southeast Asian 9 (3%); Korean 6 (2%); Japanese 5 (1%); Iranian and Afghan 4 (1%); Arab 3 (1%).

Vitamin D insufficiency is a lesser form of deficiency, generally not associated with osteomalacia, but may be associated with adverse health outcomes. Univariate comparisons between maternal characteristics by 25OHD concentration were made by ANOVA and χ^2 as appropriate. Multiple regression analysis was used to examine the independent relationship between variables and plasma 25OHD concentration. To estimate the effect of skin colour on 25OHD, we replaced ethnicity in the model with constitutive and facultative skin colour measures.

RESULTS

Of the approximately 725 women approached to participate, 336 agreed, giving a response rate of 46%. Participant characteristics are given in Table 1. The mean age of the women was 31 y (range=16-47 y) and 46% of participants were of European ethnicity. The median (1st, 3rd quartile) vitamin D intake was 640 (524, 816) IU, with 400 (400, 400) IU coming from supplements and 220 (140, 310) IU coming from food. Overall the mean plasma 25OHD concentration was 66.7 (95% CI 64.2-69.1) nmol/L. Only 4 (1%) women had a 25OHD concentration indicative of deficiency (<25 nmol/L). Based on cut-offs of 50 and 75 nmol/L, 24% and 65% of participants were vitamin D insufficient, respectively. Table 2 displays mean 25OHD concentrations and the prevalence of vitamin D insufficiency based on these two cut-offs by pregnancy characteristics. Mean 25OHD was lower in women surveyed in winter compared to in summer; in women of South Asian or Other ethnicity versus European ethnicity; in those consuming <400 IU or no vitamin D supplement than in those consuming ≥400 IU as a supplement; and in those consuming <200 IU vitamin D from food sources. Characteristics associated with having a plasma 25OHD concentration <50 nmol/L were being surveyed in winter versus in fall; being of Asian or Other versus European ethnicity; and con-

Table 2. Plasma 25OHD Concentration and Prevalence of 25OHD Insufficiency by Pregnancy Characteristics

Characteristic	n	Plasma 25OHD (nmol/L)		
		Mean (95% CI)	Prevalence % (95% CI)	
			<50nmol/L	<75nmol/L
All	336	67 (64-69)	24 (19-28)	65 (60-70)
Age (years)				
<30	129	65 (61-70)[a]†	27 (19-35)[a]	70 (62-78)[a]
≥30	206	67 (64-70)[a]	21 (16-27)[a]	63 (56-69)[a]
Gestation (weeks)				
<27	113	65 (60-69)[a]	26 (18-34)[a]	72 (63-80)[a]
≥27	219	68 (65-71)[a]	22 (16-27)[a]	62 (55-68)[a]
Season‡				
Winter	76	59 (55-64)[a]	37 (26-48)[a]	74 (64-84)[a]
Spring	89	67 (63-72)[ab]	19 (11-27)[ab]	62 (52-72)[a]
Summer	92	71 (65-76)[b]	23 (14-31)[ab]	62 (52-72)[a]
Fall	79	68 (63-73)[ab]	16 (8-25)[b]	65 (54-75)[a]
Ethnicity				
European	155	72 (69-76)[a]	14 (9-20)[a]	57 (49-65)[a]
Chinese	66	65 (59-71)[ab]	26 (15-36)[ab]	67 (55-78)[ab]
South Asian	30	60 (51-68)[b]	40 (22-58)[b]	77 (62-92)[ab]
Other§	85	60 (56-64)[b]	33 (23-43)[b]	75 (65-84)[b]
Pre-Pregnancy BMI (kg/m²)				
<25	235	67 (64-70)[a]	22 (16-27)[a]	65 (59-71)[a]
25-29.9	64	69 (63-75)[a]	25 (15-36)[a]	62 (50-74)[a]
≥30	23	64 (55-74)[a]	26 (8-44)[a]	70 (51-88)[a]
Vitamin D Supplement (IU/d)				
0	25	56 (46-65)[a]	36 (17-55)[a]	84 (70-98)[a]
<400	45	59 (53-65)[a]	29 (16-42)[a]	80 (68-92)[a]
≥400	266	69 (66-72)[b]	21 (16-26)[a]	61 (55-67)[b]
Vitamin D From Food (IU/d)				
<200	154	64 (60-67)[a]	30 (23-37)[a]	69 (62-77)[a]
≥200	182	69 (66-72)[b]	18 (13-24)[b]	62 (54-69)[a]

Note: 25OHD=25-hydroxy vitamin D; BMI=Body Mass Index.
† Estimates within a column subgroup not sharing a common superscript letter are significantly different (p<0.05).
‡ Winter: December 21-March 20; Spring: March 21-June 20; Summer: June 21-September 22; Fall: September 23-December 20.
§ Latin American, Black, Filipino, Southeast Asian, Korean, Japanese, Iranian and Afghan, Arab, and other.

suming <200 IU of vitamin D from food versus >200 IU of vitamin D from food. Vitamin D supplement use of <400 IU and being of Other versus European ethnicity were associated with a higher prevalence of having a 25OHD concentration <75 nmol/L.

In multivariate analysis, season, ethnicity, vitamin D intake from both food and supplements and skin colour had a significant impact on 25OHD concentrations (Table 3). Mean 25OHD concentrations were higher in summer than in winter; in women of European (White) ethnicity compared to women of Chinese, South Asian, and Other ethnicity; in those consuming ≥400 IU/d of vitamin D from supplements versus those consuming no supplements; and in those consuming ≥200 IU of vitamin D from food sources versus those consuming less. Darker skin colour at the upper inner arm (UV unexposed) was associated with lower 25OHD concentrations, while darker skin at the forearm (UV exposed) was associated with higher 25OHD.

DISCUSSION

Although vitamin D deficiency was uncommon (1%) in this multiethnic group of pregnant women living in Greater Vancouver, vitamin D insufficiency was common. Between 24% and 65% of women were classified as vitamin D insufficient depending on the cut-off used for 25OHD. Vitamin D insufficiency has been associated with an increased risk of adverse maternal[1] and child health outcomes.[4,6] As expected, plasma 25OHD concentrations were higher in women surveyed in summer versus in winter and in women of European ethnicity compared with women of other ethnic groups. Over 90% of women were taking vitamin D-containing supplements and most were receiving at least 400 IU/day. Although supplement use was associated with higher 25OHD concentrations, it did not appear to provide complete protection against vitamin D insufficiency.

For comparison, data from the recent Canadian Health Measures Survey (CHMS)[22] provide the best population estimates of 25OHD in Canadians. The mean 25OHD in the CHMS of 70 nmol/L for non-pregnant women (20-39 y) is very similar to the mean in our study of 67 nmol/L. However, White (European) women made up a greater proportion of participants in the CHMS than in our study (82% versus 46%). Also, vitamin D supplement use has not yet been reported for the CHMS, but it was unlikely to be as high as in our study (>90%). The vitamin D status of women in our study is somewhat higher than that reported in studies of pregnant women in other regions of Canada. In the Arctic (68°N), for example, the mean plasma 25OHD concentration of pregnant women was 60 nmol/L for Whites (n=33), 52 nmol/L for Native Indians (n=37), and 50 nmol/L for Inuit (n=51).[23] In another study of predominantly White women living in and near St. John's, Newfoundland, the mean 25OHD (47°N) was 69 nmol/L in summer (n=304) and 52 nmol/L in winter (n=289).[24] Latitude, climatic conditions, supplement use and fortified food consumption are potential explanations for observed differences among Canadian studies.

A major source of vitamin D is through skin synthesis by the action of UV light.[25] Anything that limits the amount of UV reaching and penetrating the skin will affect 25OHD concentrations. Time of year[24] and ethnicity[26] are well-described determinants of 25OHD. Although mean 25OHD concentrations were higher in our study in summer than in winter, the difference of only 12 nmol/L is somewhat smaller than reported in other countries but consistent with the recent CHMS data for non-pregnant women.[27] Melanin in skin acts as a natural sunscreen and limits skin vitamin D synthesis and is thought to be the main reason that vitamin D concentrations vary by ethnicity.[28] Markedly lower 25OHD concentrations in darker-skinned versus lighter-skinned ethnic groups have been described in some studies.[11,22,29] In the US, for example, the mean 25OHD for pregnant White women (77 nmol/L) was nearly twice that of Black women (39 nmol/L), and a third higher than Hispanic women (56 nmol/L).[26] Although in our study, ethnicity was a determinant of 25OHD concentration, the effect was not as pronounced. Women of European ethnicity had only a 9-13 nmol/L higher 25OHD concentration than women from other ethnic groups. This may be because the skin colour of Chinese and South Asians is not much darker than Europeans.

Ethnicity is only a proxy measure for skin colour, which varies greatly within ethnic groups. Reflectance colourimetry has been used to provide quantitative measurements of skin colour.[30] Darker unexposed (constitutive) skin colour has been associated with lower 25OHD concentrations in some but not all studies.[17,31] We present the novel finding in pregnant women that darker unexposed skin (lower ITA) is associated with lower 25OHD concentration. We found this association despite having only a very few women who were classified as tanned, brown, or dark (n=13). We also found that darker exposed skin colour, presumably a result of tanning, after correcting for unexposed skin colour was associated with higher 25OHD concentrations. This is not unexpected and has been reported in at least one other study of non-pregnant adults.[17]

Over 90% of women took prenatal supplements containing vitamin D in our study and the majority of these women were receiving at least 400 IU/d of vitamin D. Our findings support those of others that 400 IU/D may not be sufficient to maintain optimal 25OHD in all women during pregnancy.[32] We found that 60% of women in our study who received 400 IU/d or more vitamin D from supplements had 25OHD less than 75 nmol/L. Indeed 20% of these women had plasma 25OHD concentrations less than 50 nmol/L – the concentration recently recommended by the Institute of Medicine. Consideration should be given to increasing the amount of vitamin D in prenatal supplements.

We found no association between pre-pregnancy BMI and 25OHD. Obesity has been associated with lower 25OHD in some studies.[33] Very few women were classified as obese in our study (n=23) and pre-pregnancy weight was self-reported, which can be unreliable. Likewise there was no difference in 25OHD plasma concentrations in women evaluated from 20-27 weeks gestation compared to women evaluated at 28-35 weeks gestation. It might be expected that with the increase in plasma volume that occurs, particularly during the first trimester of pregnancy, 25OHD concentrations might change during pregnancy. This study was limited to women greater than 20 weeks gestation, which limits the conclusions regarding the effect of gestation on plasma concentration of 25OHD. However, in two recent studies, 25OHD was higher in the third compared to the first or second trimester.[11,26] The authors attribute this to longer duration of supplement use.[26]

Strengths of our study include a large sample size, a multi-ethnic population and a complete assessment of the determinants of vitamin D status. However, we do acknowledge a number of limitations. First, we recruited a convenience sample of women and thus our results cannot be generalized to the Canadian population or even to Vancouver. However, the mean age of women in our study was 31 y, which is not markedly different from the average age (29.9 y) of women giving birth in British Columbia in 2007.[34] Although 50% of participants in our study were not of European ethnicity, similar to the demographics of Vancouver, women in our study were generally well educated and of high socio-economic status. Further, recruitment bias may have occurred as women with more healthful behaviours, such as supplement use, may have been more likely to take part in the study than other women. Whether the women in our study have higher or lower plasma 25OHD concentrations than other Canadian pregnant women is not known. However, despite the study participants being well educated and of higher socio-economic status, vitamin D insufficiency in this population was common. Based on those two characteristics, it is possible that rates of vitamin D insufficiency might be even higher in a representative population; however, that could be counterbalanced by there being more women of European ethnicity in a representative sample.

Second, we used cut-offs of 50 and 75 nmol/L to define insufficiency but acknowledge that the evidence base to support these is limited in pregnancy. Maternal 25OHD determines 25OHD concentration at birth with infants having concentrations typically 80% of the mother's.[35] When maternal 25OHD concentration in late pregnancy was above 50 nmol/L, reduced bone mineral content was not seen in offspring at 9 years of age.[6] The higher cut-off of 75 nmol/L is based largely on observational reports of associations between 25OHD and health outcomes in non-pregnant adults.[36,37] More research, particularly prospective clinical trials, are required to establish the minimum 25OHD required during pregnancy to reduce adverse maternal and child outcomes.

Table 3. Multivariable Model for Plasma 25OHD Concentrations

Characteristic	n	ß nmol/L (95% CI)
Age (years)*	335	0.4 (0.0, 0.9)
Gestation (weeks)*		
<27	113	Referent[a]†
≥27	219	4.2 (-0.8, 9.1)[a]
Season*‡		
Winter	76	Referent[a]
Spring	89	8.3 (-0.6, 17.3)[ab]
Summer	92	11.6 (2.7, 20.6)[b]
Fall	79	7.6 (-1.6, 16.8)[ab]
Ethnicity*		
European	155	Referent[a]
Chinese	66	-9.0 (-17.6, -0.4)[b]
South Asian	30	-12.5 (-23.9, -1.0)[b]
Other§	85	-13.0 (-20.7, -5.3)[b]
Pre-Pregnancy BMI (kg/m²)*		
<25	235	Referent[a]
25-29.9	64	1.1 (-6.1, 8.3)[a]
≥30	23	-0.4 (-11.8, 11.1)[a]
Vitamin D Supplement (IU/d)*		
0	25	Referent[a]
<400	45	2.4 (-10.6, 15.5)[a]
≥400	266	13.2 (2.3, 24.1)[b]
Vitamin D Intake From Food (IU/d)*		
<200	154	Referent[a]
≥200	182	6.4 (1.8, 11.1)[b]
ITA°, Per 10° Increase¶**		
Upper inner arm	336	5.6 (2.9, 8.4)
Forearm	336	-5.0 (-8.0, -2.1)

Note: 25OHD=25-hydroxyvitamin D; BMI=Body Mass Index.
* Adjusted for age, gestation, ethnicity, season, pre-pregnancy BMI, vitamin D intake from supplement and food.
† Estimates within a column subgroup not sharing a common superscript letter are significantly different (p<0.05).
‡ Winter: December 21-March 20; Spring: March 21-June 20; Summer: June 21-September 22; Fall: September 23-December 20.
§ Latin American, Black, Filipino, Southeast Asian, Korean, Japanese, Iranian and Afghan, Arab, and other.
¶ ITA° (Individual Typology Angle): Very Light > 55° > Light > 41° > Intermediate > 28° > Tanned > 1°0 > Brown > -30° > Dark.
** Adjusted for age, week of gestation, ITA°, season, pre-pregnancy BMI, vitamin D intake from supplement and food.

In conclusion, vitamin D insufficiency was common in this group of pregnant Vancouver women. Season and ethnicity were determinants of 25OHD but the magnitude of their effect was small. Most women took vitamin D-containing supplements containing at least 400 IU, but this did not ensure protection against vitamin D insufficiency. Consideration should be given to increasing the amount of vitamin D in prenatal supplements.

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RÉSUMÉ

Objectif : Des apports suffisants en vitamine D durant la grossesse sont importants pour la santé de la mère et de l'enfant. Dans plusieurs pays, on rapporte de faibles concentrations en 25-hydroxy-vitamine D (25OHD), une mesure du statut en vitamine D, dans le sang des femmes enceintes, mais il y a eu peu d'études sur le sujet auprès des Canadiennes enceintes. Nous avons mesuré les concentrations en 25OHD au sein d'un groupe multiethnique de femmes enceintes vivant à Vancouver (49 °N) et exploré les déterminants de la concentration en 25OHD.

Méthode : En tout, 336 femmes enceintes (de 16 à 47 ans) entre la 20e et la 35e semaine de gestation ont fourni un échantillon de sang et rempli des questionnaires.

Résultats : La concentration moyenne en 25OHD était de 67 nmol/L (IC de 95 % = 64-69). Seulement 1 % des femmes avaient une concentration en 25OHD indiquant un grave déficit (<25 nmol/L). Cependant, 24 % et 65 % des femmes, respectivement, étaient carencées en vitamine D selon que l'on place le point de coupure à 50 ou à 75 nmol/L. Dans une analyse multivariée, les concentrations moyennes en 25OHD étaient de 12 nmol/L de plus l'été que l'hiver. Les femmes d'origine ethnique européenne (blanche) avaient une concentration moyenne en 25OHD de 9 à 13 nmol/L de plus que les femmes d'autres groupes ethniques. Près de 80 % des femmes prenaient des suppléments contenant ≥400 UI/jour de vitamine D. Cependant, 24 % et 65 % de ces femmes, respectivement, avaient des concentrations en 25OHD de <50 et de <75 nmol/L.

Conclusion : Les carences en vitamine D n'étaient pas rares dans ce groupe de femmes enceintes. La saison et l'ethnicité étaient des déterminants des concentrations en 25OHD, mais l'ampleur de leur effet n'était pas importante. La plupart des femmes prenaient des suppléments contenant de la vitamine D, mais cela ne les protégeait pas beaucoup contre les carences. Il faudrait songer à accroître la quantité de vitamine D dans les suppléments nutritifs prénatals.

Mots clés : vitamine D; nutrition; métabolisme; grossesse; Vancouver