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Vitamin D Deficiency Rate in First-Trimester Pregnant Women at Ho Chi Minh City

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ABSTRACT

Objectives: *Vitamin D deficiency during pregnancy can increase the risk of pre-eclampsia, diabetes and high blood pressure. Therefore, it is needed to determine vitamin D deficiency rate and related factors in pregnant women of the first trimester.*

Methodology: *A cross-sectional study was conducted from November 2015 to March 2016. The study subjects were pregnant women of the first trimester who were randomly and singly selected from those visiting the antenatal care clinic of Hung Vuong Hospital. Vitamin D deficiency is defined as 25(OH)D blood concentration ≤ 20 ng/mL (or 50 nmol/L). We used blood samples routinely taken in the first trimester of pregnancy to quantify 25(OH)D. Other information was collected through on-site interview with pregnant women based on a prepared questionaire.*

Results: *Vitamin D deficiency rate was 31.09 percent on 386 samples. Vitamin D deficiency in pregnant women had a statistically significant correlation with such factors as pregnant women aged 20-25 years versus adolescent group (PR=0.5), non-King group (PR=2.01), poor economic status group (PR=2.60), those with more than two pregnancies (PR=0.45), those with severe morning sickness (PR=1.68), those with weight gain in the first trimester (PR=0.70), those working outdoors (PR=0.58).*

Conclusion: *Healthcare providers need to counsel pregnant women right at the first antenatal care visit to prevent and minimise vitamin D deficiency during pregnancy in order to reduce risks for pregnant women and foetuses.*

Keywords

Pregnant women, First trimester, Vitamin D deficiency.

Rationale and Objectives

Vitamin D is a fat-soluble vitamin rich in milk, fruits, fish oil and supplemented with diet. It is also synthesized within skin cell on sunlight contact. In bio-chemistry, vitamin D is a steroid that can change a lot of bio-functions within the human body, researchers have determined 37 target organs for vitamin D [1] including placenta.

A lot of studies over the world have concluded vitamin D deficiency rate in pregnant women varying in a wide range of 18.9 – 89% [2-5]. Vitamin D deficiency related to such factors as race [6], skin color [6], season [3,7], sunshine time [3,5,8], clothing habit or culture [7], age [8], gender [9], BMI [10] and cardio-vascular diseases [11].

In our country, vitamin D deficiency status is quite high, but it receives inappropriate concern. As per the study of Ho Pham Thuc Lan et al. in 2011, in the districts of Ho Chi Minh city, the rate of vitamin D deficiency in females was two times in males [12]. The cross-sectional study conducted in 2012 by Nguyen Van Tuan in urban and rural areas in the northern Viet Nam also found vitamin D deficiency rate higher in females than in males (30% vs 16%) [13].

Vitamin D deficiency is the risk factor of some diseases like osteoporosis, bone pain, muscular weakness, diabetes, cardio-vascular disease, cancer, and etc. in all women. In addition, during pregnancy, vitamin D deficiency increases the risk of pre-

eclampsia [14], diabetes mellitus, high blood pressure [15].

Vitamin D deficiency in females influences not only their own health, but also foetus in pregnancy. Specifically, vitamin D deficiency in pregnancy can make a child possibly contract asthma, allergic otitis media [16], diabetes [17], acute lower respiratory tract infection [18], and bone mass deficiency [15]. In contrast, if vitamin D is sufficiently supplied, risks may be reduced up to 36 percent for diabetes in pregnancy, high blood pressure and pre-eclampsia in pregnant women [6], it also has impacts on reducing hypocalcemia and rickets in children [19].

Supplement and treatment against vitamin D deficiency are simple and highly effective. Therefore, it is very necessary to help high risk people in preventing and counselling, early detection for supplement and treatment are very vital. Due to high prevalence of vitamin D deficiency in pregnant women by studies in many countries over the world, a study of vitamin D deficiency in our country is of high interest. Some studies on vitamin D deficiency were conducted in Ho Chi Minh City over subjects with type II diabetes mellitus, Parkinson, osteoporosis in more-than-sixty-year-old patients, but there have been no studies on vitamin D deficiency in pregnant women in the south yet. Therefore, we conducted a study of "Vitamin D deficiency rate and related factors in first-trimester pregnant women visiting Hung Vuong Hospital" with research questions: What is the vitamin D deficiency rate in pregnant women of the first trimester? What factors relate to vitamin D deficiency in pregnancy?

Research Objectives

- Principal objectives: To determine vitamin D deficiency rate in first-trimester pregnant women who were visiting Hung Vuong Hospital during the period of November 2015 – March 2016.
- Subordinate objectives: Insight into factors related to vitamin D deficiency in pregnant women of the first trimester.

Study Subjects and Methodology

Study design

Cross-sectional study.

Study population

Target population: Pregnant women

Sampled population: Pregnant women of the first trimester, with foetuses aged between 11.5 weeks and 13 weeks, visited Hung Vuong Hospital for antenatal care, agreed to participate in the study. Their physical and mental health were capable of answering the questionnaire.

Exclusion criteria: Not able to answer the interview due to limits in health and psychology (dumb and deaf, not able to understand language, mental illness). Patients with hyperparathyroidism, liver deficiency, rickets, tuberculosis, Crohn's disease, lupus erythematosus.

Sample size

Calculation of sample size based on a formula to estimate a prevalence rate of disease in a population.

$$n = \frac{Z^2_{1-\alpha/2} \times p \times (1-p)}{d^2}$$

Z = 1.96, P = 0.5 to have the largest simple, d = 0.05, n = 384

Subject-selection approach and data collection

Random and single selection over time. From 07:00 till 16:00 on every Monday, Wednesday and Friday in the period of 6th November 2015 – 1st March 2016, ten pregnant women a day were randomly selected. The first pregnant woman was selected when her consultation procedures were first completed in the day, and then the following subject for interview was determined every thirty minutes after the interview of the antecedent subject finished, the time length of each interview was ten minutes. The random selection was made at seven consultation rooms of the Antenatal Care Clinic. We selected pregnant women who were determined to have pregnancy of 11.5 weeks to 13 weeks via ultrasound scanning in the first trimester at consultation room #1, and then, the following pregnant woman at consultation room #2, and in turn at other consultation rooms, and back to room #1. In case a subject at a room met the inclusion criteria for sampling, but did not agree to participate in the interview, we would call on the next one at the same consultation room until we completed the sample size. If a subject agreed to get involved into the study, she would sign a consent form.

We ourselves made interviews on a pre-designed questionnaire, and examined subjects to look into related factors. And then, we made an additional test of 25(OH)D on the blood sample of volume designated for routine screening tests in the first trimester. A flyer on the role, consequences and treatment of vitamin D deficiency in pregnancy would be distributed to subjects. If vitamin D deficiency was detected, pregnant women would be invited back to the counseling room for further counseling and treatment.

The study was approved by the Department of Obstetrics and Gynecology, Ethics Council of the Ho Chi Minh University of Medicine and Pharmacy and it was accepted by the Hung Vuong Hospital Management for implementation.

Data were input and processed with program SPSS 16.0. The analysis included two steps; Step 1: single variable description and analysis with univariate regression, Step 2: multivariate logistic regression analysis to control confounders. Confidence interval of 95% was applied.

Results

Vitamin D deficiency rate

Diagnosis	Total (N = 386)	Rate (%)	95% CI
Sufficiency	266	68.91	64.03 – 73.50
Deficiency	120	31.09	26.45 – 35.73
Minor	112	29.02	24.53 – 33.82
Major	8	2.07	0.90 – 4.04

Table 1: Levels of vitamin D deficiency.

Our study determined the vitamin D deficiency rate in pregnant women of the first trimester was 31.9%, accounting for one-third of the sample size.

Authors	Places	Vitamin D deficiency rate (%)	Study subjects
Ho Pham Thuc Lan [12]	Viet Nam (2010)	46	Females
Nguyen Van Tuan [13]	Viet Nam (2012)	30	Females
Mukamel [24]	India (2001)	43	Pregnant women
Sachan [25]	Israel (2005)	37	Pregnant women
Farrant HJ [2]	India (2009)	66	Pregnant women
Holmes [21]	England (2009)	96	Women of 12-week pregnancy
Bowyer [20]	Australia (2009)	33	Pregnant women
Xiang [3]	China (2013)	83.6	Women of 12- to 40-week pregnancy
SunminPark [5]	South Korea (2014)	88.9	Women of 12- to 40-week pregnancy
Zhou [4]	China (2014)	18.9	Women of 16- to 40-week pregnancy
Xiao [8]	China (2015)	78.7	Pregnant women of second trimester
Our study	Viet Nam (2016)	31.9	Pregnant women of first three months

Table 2: Vitamin D deficiency in pregnant women by studies.

Analysis of related factors

Characteristics		No vitamin D deficiency (N=266)	Vitamin D deficiency (N=120)	PR*	95% CI	P*
Age group	≤19 years old	3 (37.50)	5 (62.50)	1		
	20 – 25 years old	77 (63.64)	44 (36.36)	0.50	0.26 – 0.92	0.03
	26 – 35 years old	164 (72.89)	61 (27.11)	0.41	0.22 – 0.75	0.01
	> 35 years old	22 (68.75)	10 (31.25)	0.45	0.20 – 1.02	0.06
Ethnicity	Kinh	259 (70.00)	111 (30.00)	1		
Others		7 (43.75)	9 (56.25)	2.01	1.28 – 3.14	0.01
Economic status	Average	212 (69.74)	92 (30.26)	1		
	Poor	2 (25.00)	6 (75.00)	2.60	1.66 – 4.05	0.01
	Good	52 (70.27)	22 (29.73)	0.99	0.69 – 1.45	0.98
Number of pregnancies	One	102 (63.75)	58 (36.25)	1		
	Two	102 (67.55)	49 (32.45)	0.83	0.60 – 1.16	0.28
	More than two	62 (82.67)	13 (17.33)	0.45	0.27 – 0.79	0.01
Pre-pregnancy BMI	Medium	191 (67.49)	92 (32.51)	1		
	Underweight	50 (66.67)	25 (33.33)	0.95	0.68 – 1.333	0.75
	Overweight	25 (89.29)	3 (10.71)	0.31	0.12 – 0.82	0.02
Weight gain in pregnancy	None	59 (63.44)	34 (36.56)	1		
	Reduced	45 (54.22)	38 (45.78)	1.22	0.87 – 1.71	0.28
	Increased	162 (77.14)	48 (22.86)	0.70	0.49 – 0.98	0.04
Morning sickness	No	261 (69.05)	117 (30.95)	1		
	Yes	5 (62.50)	3 (37.50)	1.68	1.14 – 2.52	0.01
Working environment	Indoor	210 (71.67)	83 (28.33)	1		
	Outdoor	56 (60.22)	37 (39.78)	0.58	0.44 – 0.78	0.01
Sunlight contact	No	101 (63.13)	59 (36.88)	1		
	Yes	165 (73.01)	61 (26.99)	0.85	0.64 – 1.13	0.25
Milk drinking habit	No	103 (64.38)	57 (35.63)	1		
	Yes	163 (72.12)	63 (27.88)	0.86	0.64 – 1.56	0.32
Sunscreen use habit	No	256 (70.14)	109 (29.86)	1		
	Yes	10 (47.62)	11 (52.38)	1.36	0.86 – 2.13	0.19

Table 3: Vitamin D deficiency related factors.
(*) Multivariate regression

In order to control confounders, we put factors with $P < 0.25$ by univariate analysis into multivariate regression. There were eleven independent variables in total for further analysis out of which eight factors had statistically significant correlation with vitamin D deficiency in pregnancy as shown above.

Discussion

Table 2 disclosed the vitamin D deficiency rate in pregnant women of our study was at medium level which is nearly equivalent to those of Bowyer's and Shachan's. Vitamin D deficiency is prevalent not only in temperate countries [20], but also in tropical countries like Viet Nam.

Our study results and Ho Pham Thuc Lan's (survey over communities in the south) or Nguyen Van Tuan's (conducted in Ha Noi) showed the vitamin D deficiency rate in Vietnamese women is quite high, this is a reproductive health problem that affects pregnant women and non-pregnant women. This has been reflected in many studies abroad, but it has not been at the health sector's and Vietnamese people's attention yet. It may be explained that the impact of vitamin D deficiency is not directly fatal to human life and its influence on foetus must undergo a long time after birth for being realised.

As compared with Xiao's [8] and Holmes' study [21], our rate is much lower and it is probably because their studies had been conducted in China and England where the time of sunshine in the year is less than that in Viet Nam.

Xiang F's study [3] conducted in China showed the vitamin D deficiency rate is double that of our study. Since Guiyang town is located on Yunnan highlands – Guihou at latitude 26.50 N where the average number of cloudy days is 235.1 and the average number of sunlight hours is 1142.6 only. Maximal ultraviolet intensity may reach level 4 at noon and it is limited in time length. The common ultraviolet level is lower than the average on sunny days. In contrast, Ho Chi Minh City is located in latitudes 10011' – 10038' N and longitudes 106022' – 106054' E.

As per Sunmin Park's study [5], the vitamin D deficiency rate is triple ours, but tantamount to Xiang's. It may be explained that South Korea has climate conditions and sunshine time almost similar to Guiyang, China. As a result, sunshine time also plays an important role in vitamin D deficiency rate in pregnant women.

Pregnant women's average age was 28.45 ± 5.05 years (18 – 44 years). Most of those pregnant women were 26 – 35 years old accounting for 58 percent, the group of pregnant women whose age was under 19 years and above 35 years accounted for a low proportion (2.07 percent and 8.29 percent). This result is similar to that of Xiao [8] and Zhou [4] when they shared our conclusion stating that there was a correlation between age and vitamin D deficiency.

Non-Kinh pregnant women had an increased risk of vitamin D deficiency up to 2.10 times with statistically significant difference PR* = 2.10; 95% CI: 1.28 – 3.14; P < 0.05. Bodnar's study also recorded non-Portuguese white pregnant women had the lower rate of vitamin D deficiency that did non-Portuguese black pregnant women at P < 0.01 (25.8% vs 73.5%) [6]. As per Lucy Bowyer, Islamic pregnant women wearing facial mask had a risk of vitamin D deficiency twenty-one times higher than Islamic pregnant women without facial mask [7].

We found a correlation between vitamin D deficiency and pre-pregnancy BMI in pregnant women. This result is different from Xiang's [3] and Zhou's [22] when they assumed that there was no correlation between pre-pregnancy BMI and vitamin D deficiency risk.

Economic status is a factor which has a statistically significant correlation with vitamin D deficiency. The poor economic status increases the risk of vitamin D deficiency up to 2.6 times that of average economic status. When compared with other studies in the world, our study result is equivalent with that in the US [6] and Qatar [23].

In Bodnar's study [6], the group of pregnant women with average income < US$10000/year had a higher vitamin D deficiency rate than those with income > US$10000/year (P < 0.05). Or in Addulbari's study [23], the group with income QAR5000 - 10000 had more vitamin D deficiency than that with income > QAR10000 (P<0.05).

The pregnant women group of outdoor working has a reduced risk of vitamin D deficiency as compared with the pregnant women group of indoor working. The difference is statistically significant, P<0.05. Our study's result is similar to Abdulbari's [23] and Xiang's [6]. Xiang and Abdulbari explained that since their study subjects worked indoors with fewer outdoor activities and less sunlight contact, the quantity of vitamin D synthesised via skin is not sufficient for pregnant women's needs.

It is so surprised that the vitamin D deficiency rate in multigravida group is much lower than that in primigravida group. Specifically, tertigravida group had a 55-percent reduction in vitamin D deficiency risk as compared with primigravida group, with statistically significant difference at P<0.05. This result is different from Bodnar's [6] in which the vitamin D deficiency rate increased with the number of gestations in pregnant women.

Pregnant women with morning sickness had a double increase in vitamin D deficiency risk versus pregnant women without morning sickness at P<0.05. Morning sickness is a frequent symptom in pregnancy, the pregnant woman has nausea or vomiting at various levels due to gestational hormone increase, leading to dehydration, weight loss, malnutrition and micro-nutrient deficiency as well.

The study showed the pregnant woman group of weight gain accounted for the majority, we found a correlation between weight gain in pregnancy and vitamin D deficiency, specifically the more weight gain pregnant women had, the lower the vitamin D deficiency rate and this difference was statistically significant at P<0.05.

Study restrictions

We estimated the sample size based on a prevalence rate in a population, and therefore, the sample size was not strong enough for the purpose of finding vitamin D deficiency related factors. We determined vitamin D deficiency at the trimester end from 11.5 to 13 weeks, but not for the whole first trimester. Due to medical ethics, we were not able to take blood samples in every week of the first trimester for survey.

Our recommendations

- Women should well prepare their physical status before pregnancy, and change their preventive habit of sunlight contact to facilitate vitamin D absorption in the morning while traveling from home to workplace.
- All pregnant women benefit from vitamin D supplement in pregnancy and post-partum period. The supplement can simply be made with proper sunlight exposure. Healthcare staff should advise pregnant women right at the first visit to minimise vitamin D deficiency in pregnancy in order to reduce risks for pregnant women and foetuses.
- There should be vitamin D specialised drug at obstetrics

hospitals since vitamin D content in a multivitamin drug is very low.

Conclusion

Data from a study over 386 pregnant women of the first trimester attending Hung Vuong Hospital from November 2015 to March 2016 have shown:

- The vitamin D deficiency rate in first-trimester pregnant women is 31.09% (95% CI: 26.45 – 35.73).
- Factors related to vitamin D deficiency in pregnant women of the first trimester are: pregnant women aged 20 – 25 years and 26 – 35 years versus adolescent pregnant women (PR* = 0.5; 95% CI 0.26 – 0.92 and PR* = 0.41; 95% CI 0.22 – 0.75), non-Kinh group (PR* = 2.01; 95% CI 1.28 – 3.14), poor economic status group (PR* = 2.60; 95% CI 1.28 – 3.14), pregnant women with more than two gestations (PR* = 0.45; 95% CI 0.27 – 0.79), pregnant women with morning sickness (PR* = 1.68 ; 95% CI 1.14 – 2.52), weight gain group in the first trimester (PR* = 0.70; 95% CI 0.49 – 0.98), outdoor working group (PR* = 0.58; 95% CI 0.44 – 0.78).

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