Original Article

Prevalence of Vitamin D Deficiency among Pregnant Women at Srinagarind Hospital, Khon Kaen Province, Thailand

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Background: Vitamin D is naturally being synthesized through the skin. However, low levels of vitamin D are commonly encountered in pregnant women. Low vitamin D levels during pregnancy have been observed to be potentially related to some adverse maternal and neonatal outcomes including preeclampsia, gestational diabetes, low birth weight, preterm birth, neonatal hypocalcemia, poor postnatal growth, and bone fragility.

Objective: To determine the prevalence of vitamin D deficiency and associated risk factors among pregnant Thai women.

Materials and Methods: Pregnant Thai women attending the antenatal care clinic at Srinagarind Hospital between August and September 2015 were recruited. Trained interviewers used standardized questionnaires to elicit information of baseline characteristics and factors potentially associated with vitamin D levels. Levels of vitamin D were measured the serum concentrations of 25(OH)D and were classified as deficiency (<20 ng/ml), insufficiency (20 to 34.99 ng/ml), and sufficiency (≥35 ng/ml).

Results: The present study recruited seventy-five pregnant women. The mean age was 29.1 years (SD 6.0, range 13 to 42 years). Forty-three women were found to have vitamin D deficiency (57.3%, 95% confidence interval [CI] 45.4 to 68.7). Vitamin D deficiency was significantly more likely among primigravida women (adjusted odds ratio [OR] 7.26, 95% CI 2.23 to 23.67), pregnant women that are 35 years old or older (adjusted OR 7.59, 95% CI 1.56 to 36.90), and those who had a sunlight exposure of less than 30 minutes per day (adjusted OR 4.26, 95% CI 1.22 to 14.90).

Conclusion: Even with abundant sunshine, vitamin D deficiency in pregnant Thai women was notably high (57.3%). Factors associated with vitamin D deficiency included primigravida pregnancy, advanced age, and limited sunlight exposure.

Keywords: Vitamin D deficiency, Prevalence, Risk factors, Pregnant women

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Vitamin D is an essential fat soluble steroid vitamin, which, 90% to 95%, is derived from exposure of skin to sunlight at ultraviolet B [UVB] wavelengths(1,2). Vitamin D is an important hormone, not only for a healthy skeleton, but also for a healthy immune system(2). Vitamin D status is measured based upon the serum concentration of 25-hydroxyvitamin D [25(OH)D], the major circulating metabolized form of vitamin D(2). Despite being synthesized mainly through skin, low levels of vitamin D are commonly encountered in many populations especially in pregnant women(3-12). This may be secondary to the changing of human lifestyles from mostly outdoor to indoor, often wearing protective clothes and other protectants. Low vitamin D levels during pregnancy have been observed to be potentially related to some adverse maternal and neonatal outcomes including preeclampsia, gestational diabetes, low birth weight, preterm birth, neonatal hypocalcemia, poor postnatal growth, and bone fragility(13,14). Thus, the prevalence of vitamin D deficiency among pregnant women and the associated risks are important topics of inquiry. Despite adequate sunshine in Thailand, the prevalence of vitamin D insufficiency in Thai women is considerably high(3,4). A recent study conducted to determine the levels of vitamin D among pregnant women at delivery, showed that approximately 76% of pregnant women were diagnosed hypovitaminosis D(15). To date, however, there has been limited data regarding the level of vitamin D during pregnancy in Thai women. Accordingly, the present study was conducted to determine the prevalence of vitamin D deficiency and the potential risk factors among pregnant women at Srinagarind Hospital, which is located in the northeastern Thailand.

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Material and Method

Design and study population

This cross-sectional study was conducted in

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Srinagarind Hospital, Faculty of Medicine, Khon Kaen University, Thailand, between August and September 2015. All consecutive pregnant Thai women at their first antenatal care visit during the first and second trimester of gestation were approached to participate in the present study. The inclusion criteria included singleton pregnant women who were not taking any supplemental medication prior to the first antenatal care visit, and having no underlying disease. The study was approved by the Ethics Committee in Human Research, Khon Kaen University. Informed consents were obtained from all participants or their authorized representative.

With a 95% confidence interval [CI] for expected proportion of vitamin D deficiency among pregnant Thai women of 75% and 10% margin of error, minimum sample size needed for this study was 73 pregnant women(16).

Participants were interviewed by trained interviewers who used a standardized questionnaire to elicit information on baseline characteristics i.e., age, gestational age, pre-pregnancy body mass index [BMI], formal education level, occupation, gravidity status, and factors potentially associated with the level of vitamin D including residency areas and amount of time exposed to sunlight per day estimated by subjective evaluation. Pre-pregnancy BMI was categorized into four groups using Asian population categories, as underweight (less than 18.5 kg/m^2), normal (18.5 to 23 kg/m^2), pre-obese (>23 to 27.49 kg/m^2), and obese (27.5 or higher kg/m^2)(17).

Collection of blood samples

After completion of the interviews, blood samples were collected for determining serum 25(OH)D levels. The samples were preserved in -4-degree Celsius freezer. When blood samples required in the present study were completely achieved, serum levels of 25(OH)D were analyzed at one time in the Srinagarind Serology Laboratory Center using an electrochemiluminescence binding assay (Elecsys reagent kit, Cobas®), coefficient variable was 3.7% to 4.5%. The serum levels of 25(OH)D were reported in ng/ml. In the present study, serum 25(OH)D levels were classified into three groups including deficiency level (<20 ng/ml), insufficiency level (20 to 34.99 ng/ml), and sufficiency level (≥35 ng/mL)(4,18).

Statistical analysis

Statistical analysis was carried out via SPSS version 17.0 (SPSS Inc., Chicago, IL, USA). Data are summarized as mean ± SD or number (percentage) when appropriate. Univariate analysis was carried out to identify factors potentially related to vitamin D deficiency, including age, gestational age, pre-pregnancy BMI, formal education level, occupation, residency area, gravidity status, and time of sunlight exposure per day. These variables were then included (if p<0.20) in a stepwise logistic regression analysis to determine which, if any, were independently associated with vitamin D deficiency.

Results

During the study period, 75 pregnant women who met the study inclusion criteria were recruited. The mean age was 29.1 years (SD 6.0, range 13 to 42 years). Of 75 pregnant women, 60 pregnant women (80.0%) were younger than 35 years. Thirty-three pregnant women (44%) were primigravida and 48 pregnant women (64%) had a gestational age of less than 12 weeks. Fifty-four pregnant women (72%) were classified into pre-obese and obese groups (BMI >23 kg/m^2). Thirty-five pregnant women (46.7%) resided in urban areas. Fifty-five pregnant women (72.7%) reported sunlight exposure of less than 30 minutes per day.

Forty-three pregnant women were found to have 25(OH)D levels of less than 20 ng/ml, which was classified as vitamin D deficiency in the present study (57.3%, 95% CI 45.4 to 68.7). The remaining 30 (40.0%) and two (2.7%) pregnant women had 25(OH)D levels within the ranges of 20 to 34.99 ng/ml (vitamin D insufficiency) and 35 or more ng/ml (normal vitamin D level). Table 1 shows the baseline characteristics of the participants stratified by the status of serum vitamin D levels.

Univariate analysis, which included maternal age, gestational age, pre-pregnancy BMI, formal education level, occupation, residency area, gravidity status, and time of sunlight exposure per day was performed. Maternal age, gravidity status, level of formal education, and sunlight exposure time were observed to have a p-value of less than 0.2 and these four variables were then subjected to multivariate analysis using logistic regression. Only maternal age, gravidity status, and sunlight exposure time remained to be significant independent factors predicting an increased risk of vitamin D deficiency (Table 2). Vitamin D deficiency was significantly more likely to be observed among primigravida women (adjusted odds ratio [OR] 7.26, 95% CI 2.23 to 23.67), pregnant women 35 years old or older (adjusted OR 7.59, 95% CI 1.56 to 36.90), and those who had limited sunlight exposure (adjusted OR 4.26, 95% CI 1.22 to 14.90).

Discussion

In the present study, the prevalence of serum vitamin D deficiency and the associated risk factors in pregnant women attending a first visit antenatal care clinic have been systemically evaluated. Prevalence of serum vitamin D deficiency in the present study was notably high (57.3%, 95% CI 45.4 to 68.7). Significant independent variables related to serum vitamin D deficiency were primigravida pregnancy, advanced maternal age, and limited sunlight exposure.

Low levels of serum 25(OH)D, a circulating vitamin D, is commonly observed across various settings including pregnant women. Previous studies reported an exceedingly high prevalence of vitamin D deficiency (25(OH)D <20 ng/ml) among pregnant women with the prevalence ranging from 18.9% to 96.8%[7-9,12]. In addition, approximately 41% to 45% of pregnant women were severely vitamin D deficient (25(OH)D <10 ng/ml)[8,12].

Similar to previous studies, evaluation serum 25(OH)D in Thai pregnant women have reaffirmed the high prevalence of vitamin D deficiency among pregnant women. In the study of Napartivaumnuay et al[19], approximately 25% of pregnant women were noted to have vitamin D deficiency and it was remarkably high among those with gestational diabetes (41.4%). In the study of Charatcharoenwitthaya et al[20], prevalence of vitamin D inadequacy (defined as serum 25(OH)D <30 ng/ml) among Thai pregnant women

Table 1. Baseline characteristics stratified by status of serum vitamin D level

Factors	Total (n = 75), n (%)	Vitamin D status*		
		Deficiency	Insufficiency	Normal
Age (years)				
≥35	15 (20.0)	11	3	1
<35	60 (80.0)	32	27	1
Gestational age				
≥12 weeks	27 (36.0)	15	11	1
<12weeks	48 (64.0)	28	19	1
Pre-pregnancy BMI				
<18.5	7 (9.3)	5	1	1
18.5 to 23	14 (18.7)	6	8	0
>23 to 27.49	46 (61.3)	27	18	1
≥27.5	8 (10.7)	5	3	0
Formal education level				
Elementary education	2 (2.7)	1	1	0
Vocational certificate	17 (22.7)	7	10	0
Secondary education	19 (25.3)	9	9	1
Uneducated	1 (1.3)	1	0	0
College and above	36 (48.0)	25	10	1
Occupation				
Government employee	22 (29.3)	14	7	1
Business man	12 (16.0)	6	6	0
Agriculturist	2 (2.7)	0	2	0
Unemployed	9 (12.0)	5	4	0
Housekeeper	12 (16.0)	7	4	1
Contractor	18 (24.0)	11	7	0
Residency area				
Urban	35 (46.7)	19	14	2
Rural	40 (53.3)	24	16	0
Gravidity				
Primigravida	33 (44.0)	25	8	0
Multigrava	42 (56.0)	18	22	2
Sunlight exposure (per day)				
<30 minutes	55 (73.3)	35	19	1
≥30 minutes	20 (26.7)	8	11	1

BMI = body mass index

* Categorized as deficiency level (<20 ng/mL), insufficiency level (20 to 34.99 ng/mL), and sufficiency level (≥35 ng/mL)

Table 2. Factors predicting vitamin D deficiency

Variables	Number of women	Women with vitamin D deficiency (%)	Univariate analysis *p*-value	Multivariate analysis	
				Adjusted OR (95% CI)	*p*-value
Gravidity			0.004	7.26 (2.23 to 23.67)	0.001
Primigravida	33	25 (75.8)			
Multigravida	42	18 (42.9)			
Age (years)			0.161	7.59 (1.56 to 36.90)	0.012
≥35	15	11 (73.3)			
<35	60	32 (53.3)			
Sunlight exposure (minutes/day)			0.067	4.26 (1.22 to 14.90)	0.023
<30	55	35 (63.6)			
≥30	20	8 (40.0)			
Formal education level			0.042	2.46 (0.80 to 7.52)	0.114
College and above	36	25 (69.4)			
Below college	39	18 (46.2)			
Pre-pregnancy BMI			0.589	Excluded from analyses	
Pre-obese and above (>23)	54	32 (59.3)			
Normal range and lower (≤23)	21	11 (52.4)			
Residency area			0.618	Excluded from analyses	
Urban	35	19 (54.3)			
Rural	40	24 (60.0)			
Gestational age (weeks)			0.815	Excluded from analyses	
≥12	27	15 (55.6)			
<12	48	28 (58.3)			

BMI = body mass index; OR = odds ratio; CI = confidence interval

were 83.3%, 30.9%, and 27.4% for the first, second, and third trimesters. In the most recent study by Pratumvinit et al[15], approximately 76% of pregnant women had serum 25(OH)D of less than 30 ng/ml at delivery. In the present study, approximately 57% of women were noted to have vitamin D deficiency, thus confirmed the notably high prevalence of vitamin D deficiency among Thai pregnant women.

In the present study, primigravida pregnant women were associated with a significantly higher risk of vitamin D deficiency compared with multigravida women (OR 7.26, 95% CI 2.23 to 23.67, $p = 0.001$). An independent increased risk of vitamin D deficiency among primigravida pregnant women observed in the present study was the same as previous studies[21,22]. Serum 25(OH)D concentrations in primigravida were significantly lower than those observed among multigravida pregnant women (3.71±1.88 and 5.2±3.4 ng/ml)[21]. In the study of Al-Faris[22], the rates of vitamin D deficiency among primigravida and multigravida pregnant women were 57.1% and 48.0%. Nevertheless, the actual causes for such findings remain inconclusive.

It has long been acknowledged that the declining capacity of human skin to synthesize vitamin D3 or cholecalciferol occurs with age[1,23]. In addition, elderly pregnant women may stay at home to have more rest and to avoid complications during pregnancy than younger pregnant women. As anticipated, the present study showed that maternal age was noted to be directly associated with the prevalence of vitamin D deficiency. Pregnant women who were 35 years or older were associated with approximately seven times more likely to have vitamin D deficiency compared to younger women (adjusted OR 7.59, 95% CI 1.56 to 36.90).

As vitamin D is synthesized mainly through skin exposure to ultraviolet light, it is therefore not surprising that limited sunlight exposure has previously been identified as one of the major risk factors of vitamin D deficiency[5,12,24-26]. In pregnant women, Song et al[12] reported that the serum concentrations were significant lower in pregnant women with a shorter duration of sunlight exposure (≤0.5 hour per day, 25.3±8.9 nmol/L) than those who had a longer duration of sunlight exposure (>0.5 hour per day, 30.3±9.5 nmol/L). In the study form the Northeastern part of India, sunshine exposure, which was calculated as hours of sun exposure per day, multiplied by the percentage of body surface area [BSA] exposed was noted to be a significant factor predicting vitamin D deficiency. Ninety-three percent of pregnant women with serum levels of 25(OH)D greater than 20 ng/ml had daily exposures greater than 20% of BSA, whereas approximately 66% of those with 25(OH)D levels of less than 20 ng/ml had daily sunlight exposures of less than 20% of BSA (p<0.01)[5]. In the present study, pregnant women who reported to have limited sunlight exposure time (<30 minutes per day) were approximately 4-time more likely to be diagnosed with vitamin D deficiency (adjusted OR 4.26, 95% CI 1.22 to 14.90).

Some limitations of the present study are worthy to note. Firstly, this study had a relatively small sample size resulting in a wide range of 95% CI even though statistical significance had been achieved in some analyses. As a result of the small sample size, the association between vitamin D deficiency and adverse maternal and perinatal outcomes could not be evaluated. Secondly, data were collected for only a two-month period thus, trends or alterations of serum vitamin D level over the different seasons were not possible to determine. Finally, serum vitamin D levels were measured only in the first visit of each participant thus, the alteration of serum vitamin D levels over the course of pregnancy was not evaluated. Despite these limitations, the present study provides an important scientific contribution because there is still limited information regarding the prevalence and risk factors of vitamin D deficiency among pregnant Thai women.

However, further studies should be conducted to identified potential harm of vitamin D deficiency in pregnant women. In addition, pregnant women should be advised to have more sunlight exposure or be prescribed vitamin D supplementation.

In conclusion, even though there is sunshine all year around, vitamin D deficiency in pregnant Thai women was notably high (57.3%, 95% CI 45.4 to 68.7). Women who were at risk of vitamin D deficiency included those who were primigravida, with advanced age, and had limited exposure to sunlight.

What is already known on this topic?

Despite being synthesized mainly through the skin, low levels of vitamin D are common among pregnant women. Previous studies reported that the major risk factor for vitamin D deficiency was a low sunlight exposure time (<30 minutes per day).

What this study adds?

Vitamin D deficiency in pregnant Thai women was high (57.3%, 95% CI 45.4 to 68.7). In the present study, primigravida pregnant women, advanced maternal age, and limited exposure to sunlight were risk factors of vitamin D deficiency.

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Potential conflicts of interest

None.

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ความชุกของการขาดวิตามินดีในหญิงตั้งครรภ์ที่มาฝากครรภ์ที่โรงพยาบาลศรีนครินทร์ จังหวัดขอนแก่น

กุลธิดา ลุสวัสดิ์, สุกรี สุนทราภา, ศรีนารี แก้วฤดี

ภูมิหลัง: ถึงแม้ว่าวิตามินดีส่วนใหญ่จะได้จากการสังเคราะห์จากผิวหนัง ยังพบว่าหญิงตั้งครรภ์มีระดับวิตามินดีที่ต่ำบ่อยครั้ง ระดับวิตามินดีที่ต่ำในระหว่างตั้งครรภ์มีความสัมพันธ์กับการเกิดภาวะครรภ์เป็นพิษ เบาหวานขณะตั้งครรภ์ ทารกน้ำหนักแรกเกิดน้อย การคลอดก่อนกำหนด แคลเซียมต่ำในทารกแรกเกิด ทารกเจริญเติบโตช้า และกระดูกเปราะในทารก

วัตถุประสงค์: เพื่อศึกษาความชุกของภาวะขาดวิตามินดีในหญิงตั้งครรภ์ที่มาฝากครรภ์ที่โรงพยาบาลศรีนครินทร์ จังหวัดขอนแก่น

วัสดุและวิธีการ: เป็นการศึกษาในสตรีตั้งครรภ์เดี่ยวทุกอายุครรภ์ที่มาฝากครรภ์ที่ห้องตรวจฝากครรภ์ โรงพยาบาลศรีนครินทร์ มหาวิทยาลัยขอนแก่น ระหว่างเดือนสิงหาคม พ.ศ. 2558 ถึง กันยายน พ.ศ. 2558 โดยเก็บข้อมูลโดยการสัมภาษณ์ แบบสอบถามมีรายละเอียดเกี่ยวกับลักษณะประชากรพื้นฐานและปัจจัยที่คาดว่ามีผลต่อระดับวิตามินดีในเลือด ระดับวิตามินดีประเมินจากระดับ 25(OH)D ซึ่งจำแนกออกเป็น 3 ระดับ คือ ขาดรุนแรง (น้อยกว่า 20 นก./มล.) ขาดเล็กน้อย (20-34.99 นก./มล.) และเพียงพอ (มากกว่าหรือเท่ากับ 35 นก./มล.)

ผลการศึกษา: ผลการศึกษาในสตรีตั้งครรภ์ 75 คน พบว่าอายุมารดามีค่าเฉลี่ยเท่ากับ 29.1 ปี (ค่าเบี่ยงเบนมาตรฐาน 6.0 ช่วงอายุ 13-42 ปี) สตรีตั้งครรภ์ 43 คน มีระดับวิตามินดีในระดับขาดแคลนในระดับรุนแรง (ร้อยละ 57.3 ช่วงความเชื่อมั่นที่ร้อยละ 95 (95% confidence interval [CI] 45.4-68.7) สตรีตั้งครรภ์ที่มีระดับวิตามินดีขาดแคลนในระดับรุนแรง พบมากในสตรีตั้งครรภ์แรก (adjusted odds ratio [OR] 7.26, 95% CI 2.23-23.67) สตรีตั้งครรภ์ที่อายุมากกว่าหรือเท่ากับ 35 ปี (adjusted OR 7.59, 95% CI 1.56-36.90) และในสตรีตั้งครรภ์ที่ออกแดดน้อยกว่า 30 นาทีต่อวัน (adjusted OR 4.26, 95% CI 1.22-14.90)

สรุป: ถึงแม้ประเทศไทยจะมีแสงแดดที่เพียงพอตลอดทั้งปี สตรีตั้งครรภ์ชาวไทยยังมีความชุกของการขาดวิตามินดีในระดับรุนแรงมาก (ร้อยละ 53) ปัจจัยที่พบว่ามีผลต่อการขาดวิตามินดี คือ การตั้งครรภ์ครั้งแรก สตรีตั้งครรภ์อายุมาก และการเผชิญแสงแดดที่ไม่เพียงพอ