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RESEARCH ARTICLE

Vitamin D Levels and Their Correlation with Predisposing Factors and Estimated Fetal Weight in Third Trimester of Pregnancy: an Observational Study

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Abstract

Vitamin D has a broad impact on the human body, including affecting the bones and the immune system. Vitamin D deficiency in pregnant women is a risk factor in several circumstances, such as preeclampsia, gestational diabetes, premature birth, and low birth weight babies. This study aimed to determine the vitamin D levels and their relationship to predisposing factors and estimated fetal weight in the third trimester of pregnancy. Eighteen pregnant women in their third trimester of pregnancy who received antenatal care in the Obstetric Clinic of Immanuel Hospital Bandung from January to December 2022 were used as subjects of this study. The inclusion criteria are third-trimester pregnant women, healthy, while the exclusion criteria are currently taking drugs that have side effects in pregnancy or having pregnancy disorders. Blood was taken to measure vitamin D levels, fetal weight was estimated with obstetric ultrasound, and the subjects filled in questionnaires about predisposing factors. The results showed ten pregnant women (56%) had vitamin D deficiency below 20 ng/mL in their third-trimester pregnancy. We found non-significant relationships ($p>0.05$) between predisposing factors (daily consumption of vitamin D, sun exposure, maternal age), estimated fetal weight, and vitamin D levels. This study concludes that 56% of pregnant women in their third trimester of pregnancy have vitamin D deficiency with no significant relationship with its predisposing factors and estimated fetal weight.

Keywords: Daily consumption, fetal weight, maternal age, third-trimester pregnant women, vitamin D

Introduction

Vitamin D has a broad impact on the human body, including affecting the bones and the immune system.[1] Vitamin D receptors are present in almost all cells in the body. Vitamin D can enter cells and affect the cell nucleus. Vitamin D also functions as a hormone and vitamin D affects genes in the cell nucleus.[2] A deficiency of vitamin D will cause disturbances in the brain, causing insomnia, sleep apnea, anxiety, and depression.[3]

Vitamin D, which can increase the immune system against viruses, can also reduce symptoms of sinusitis. Vitamin D, which has an anti-inflammatory effect, also helps reduce inflammation in these sufferers. Every immune cell has a vitamin D receptor, which controls cytokine storms and self-defense in autoimmune and allergic diseases.[4] A deficiency of vitamin D will cause muscle cramps, which is related to calcium, which plays a role in muscle contraction.[5] A deficiency of vitamin D dramatically affects bones and teeth. A person deficient in vitamin D and calcium can not reach optimum development for the teeth and bones.[6]

Vitamin D in pregnant women plays a vital role, including maintaining the baby's health in the womb. Previous studies have shown that the incidence of vitamin D deficiency and insufficiency during pregnancy ranges from 27.0% to 91.0% in the United States, 39.0% to 65.0% in Canada, 45.0% to 100.0% in Asia,

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19.0% to 96.0% in Europe, and 25.0% to 87.0% in Australia and New Zealand.[7]

Vitamin D deficiency that occurs at the age of five or when the baby is in the womb can increase the risk of experiencing bone malformations, such as abnormalities in the maxillary bone, and it becomes easy to experience scoliosis, kyphosis, lordosis, flat feet, rickettsia.[6] Without vitamin D, bones become soft (osteomalacia), and osteoporosis can occur.[6,8] Abnormalities in bones and teeth can be prevented by giving pregnant women and nursing mothers sufficient vitamin D. An observational study in Istanbul has proven that vitamin D deficiency was significantly related to daily vitamin intake and clothing style.[9] Other research found that age over 30, parity over 2, BMI, and hyperlipemia are risk factors for vitamin D deficiency in pregnant women.[10] The occurrence of early gestation age was also found to be higher in pregnant women with vitamin D deficiency.[11] But studies about the prevalence of vitamin D deficiency, its predisposing factors, and outcomes at the Obstetric Clinic of Immanuel Hospital Bandung are still limited. Therefore, this study aimed to determine whether there is a vitamin D deficiency with its correlation to predisposing factors and estimated fetal weight in third-trimester pregnant women.

Methods

This research is an analytic observational study with a transversal approach, namely a cross-sectional design. Vitamin D levels in the blood of third-trimester pregnant women were measured by examining a total of 25(OH)D using the ELISA method. The machine used for vitamin D measurement was the Abbott Architect i1000SR Immunoassay System (STEM-AIAEPO-0170-LGZ; Abbott Laboratories; USA). The kit used in the study was ARCHITECT 25-OH Vitamin D 5P02 (G95619R03-B5P02X; Abbott Laboratories, Ireland). Fetal weight is measured using obstetric ultrasonography with an ultrasound (Sonoscope S6, portable color Doppler ultrasound). This research has received ethical approval from the Health Research Ethics Committee at Immanuel Bandung Hospital with number 15/A01/EC/III/2022. This research was conducted at Immanuel Hospital Bandung from January 2022 to December 2022. The subjects of this study are third-trimester pregnant women who received antenatal care at Immanuel Hospital, Bandung. The method of sampling is consecutive sampling. The population of research subjects was obtained from the gynecology polyclinic at Immanuel Hospital with inclusion criteria for third-trimester pregnant women, healthy, and with exclusion criteria (1) currently taking drugs that have side effects in pregnancy (tetracycline, thalidomide, phenytoin), (2) have pregnancy disorders (eclampsia, preeclampsia, thyroid disorders). The sample size is calculated with the cross-sectional formula that resulted in 18 for a minimal sample size.[12]

The research procedures were as follows: (1) the researcher explained to the prospective research subjects the background, objectives, and research procedures, (2) if the prospective research subjects were willing, then the research subjects were asked to sign informed consent, (3) the research subject's blood was taken for examination of vitamin D levels in the Hospital Clinical Pathology Laboratory, (4) research subjects examined fetal weight using obstetric ultrasonography (Sonoscope S6, portable color doppler ultrasound) (5) questionnaire regarding daily consumption of vitamin D and food contains high vitamin D (fish and milk), sun exposure was given to the patients to be filled in, (6) data on the results of an examination of vitamin D levels in the blood of pregnant women, questionnaire about daily consumption of vitamin D and sun exposure, fetal weight were collected, processed, and analyzed with SPSS. The simple linear regression method is used to determine the correlation between predisposing factors, maternal age, and estimated fetal weight and vitamin D levels.

Results

The results showed that out of 18 research subjects, eight people had normal vitamin D levels (>20 ng/ml), and ten other people (56%) had vitamin D deficiency with levels below 20 ng/ml. Recommendations for normal vitamin D levels (cut off) in pregnant women are 20 ng/ml.[13] The result of vitamin D levels is shown in Figure.

Table 1 shows research results of vitamin D levels estimated fetal body weight in 18 pregnant women in the third trimester. Table 2 shows the relationship between predisposing factors (maternal age, daily consumption of vitamin D from fish, supplementation, milk, and sun

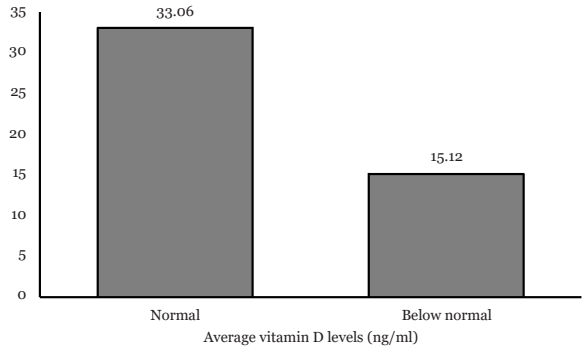

Figure Average Vitamin D Levels in Study Subjects

exposure) and vitamin D levels. The results showed a non-significant relationship between predisposing factors and vitamin D levels.

Discussion

The results showed that out of 18 pregnant women in the third trimester, 10 had vitamin D deficiency with levels below 20 ng/ml. Vitamin D deficiency in pregnant women is a risk factor in several circumstances, such as preeclampsia, gestational diabetes, premature birth, and low birth weight babies.[14] Vitamin D levels in the blood of pregnant women and fetal weight based on statistical tests conducted in this study showed no relationship between vitamin D levels in the blood of pregnant women and fetal weight. It can be seen from the $p>0.05$ value analyzed by the simple linear regression parametric method.

Table 1 Research Results of Vitamin D Levels Estimated Fetal Body Weight in 18 Pregnant Women in the Third Trimester

No.	Vitamin D Levels (ng/ml)	Estimated Fetal Body Weight (grams)
1	34.2	2,504
2	17.5	2,175
3	16.8	2,136
4	27.1	1,884
5	45.8	2,300
6	18.8	1,285
7	12.0	2,700
8	21.7	2,250
9	22.1	2,720
10	18.8	1,468
11	42.8	1,500
12	11.5	2,097
13	11.2	2,800
14	12.3	1,636
15	15.3	2,950
16	45.5	2,100
17	17.0	1,712
18	25.3	2,316

This study also gave some questionnaires to the study subjects to analyze the relationship between maternal age, daily consumption of food and drink containing high vitamin D, vitamin D supplementation, sun exposure, estimated fetal weight based on ultrasound, and vitamin D deficiency. The results found no significant relationship between those factors and vitamin D levels. According to a previous study, high vitamin D levels were found in populations that consume a lot of fish oil, tuna, salmon, and eggs and people exposed to sunlight in the arm and leg area.[15] Vitamin D in pregnancy is also related to the development of the fetus; if there is a deficiency or insufficiency of vitamin D in the mother, it will directly affect the fetus in the womb. During pregnancy, the mother needs 4–5 times the 1,25(OH)2D, calcitriol, and calcium to develop fetal bone.[14] The need for daily vitamin D in pregnant women is the same as the need for vitamin D in non-pregnant women with an age interval of 0–50 years, which is 200 IU/day.[13]

Fetal weight growth is associated with increased maternal calcium mobilization to fetal, especially in bone mineralization. In the growth and development of intrauterine pregnancy, the fetus depends on maternal nutrition, calcium levels, and 25(OH)D in the maternal.[14] Vitamin D deficiency can also be influenced by ethnicity, vitamin D supplementation, body mass index, seasonality, and boundary differences that are used as a reference to determine vitamin D deficiency in certain studies.[1,10,16,17]

Vitamin D deficiency is defined as serum levels of 25-hydroxy vitamin D less than 20 ng/ml, and vitamin D insufficiency is defined as serum levels of 25-hydroxy vitamin D 20–30 ng/ml.[13,18] The best biomarker for diagnosing vitamin D deficiency is measuring 25-hydroxy vitamin D. Vitamin D deficiency can be caused in several cases, such as decreased food intake or absorption and insufficient sun exposure. Sun exposure is the largest source of vitamin D that can be absorbed through the skin by 50–90%.

Table 2 Relationship between Predisposing Factors and Vitamin D Levels

Predisposing Factors	Vitamin D Levels		Total (n=18)	p
	Normal (n=8)	Deficiency (n=10)		
Maternal age (years)				
<30	5	7	12	>0.05
≥30	3	3	6	
Eating fish				
Yes	4	5	9	>0.05
No	4	5	9	
Vitamin D3 supplementation				
Yes	7	5	12	>0.05
No	1	5	6	
Exposure to sunlight for ≥30 minutes				
Yes	8	9	17	>0.05
No	0	1	1	

Therefore, it is tough to maintain vitamin D levels if only from food sources.[19,20] Endogenous synthesis is reduced due to chronic liver disease and kidney failure, as well as increased hepatic catabolism mediated by drugs that can activate vitamin D degradation, such as nifedipine, spironolactone, and clotrimazole.[21]

Previous studies on 3,658 pregnant women showed a correlation between vitamin D levels and fetal weight.[22] Another study with a sample size of 1,491 showed that any increase in vitamin D levels of 10 nmol/l in the umbilical cord would increase the body weight of the fetus by 61 mg at a concentration of vitamin D levels less than 40 nmol/l.[23] The vitamin D3 requirement of pregnant women is 1,000–4,000 IU per day for maximum results.[24]

The strength of this study is it supported other studies that found vitamin D deficiency in pregnant women, especially in the third trimester. Late pregnancy is associated with higher calcium demands, which is associated with vitamin D status. Therefore, vitamin D is needed to ensure optimal fetal skeletal development and maternal and fetal health.

The limitations of this study are (1) the small sample size that might not be able to describe the accurate correlation between daily consumption of vitamin D, sun exposure, maternal age, and estimated fetal weight with vitamin D levels in third-trimester pregnant women; (2) vitamin D levels only examined at a one-time point at third-trimester. If the measurements were also conducted at the first and second trimesters, the results might show vitamin D modulation throughout the pregnancy process; (3) other predisposing factors and outcomes such as low socioeconomic and educational status, covered clothing style, parity, BMI, and lipid profile were not examined in this study. Those factors might correlate with vitamin D levels in pregnant women.

Further studies need to be conducted in larger sample sizes, at several time points (first, second, and third semester), and other risk factors that might be in correlation with vitamin D levels in pregnant women need to be examined.

Conclusions

This study concludes that 56% of pregnant women in their third trimester of pregnancy have vitamin D deficiency. This study also found no correlation between daily vitamin D consumption, sun exposure, maternal age, and estimated fetal weight with vitamin D levels.

Conflict of Interest

The authors declared no conflict of interest.

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