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Original Article

Third trimester maternal 1,25-dihydroxyvitamin D and neonatal birth weight

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Abstract

Background The main cause of neonatal mortality is low birth weight. Active form of vitamin D (1,25-dihydroxyvitamin D) increase the efficiency of calcium and phosphorous absorption in intestinal. Deficiency 1,25-dihydroxyvitamin D in pregnant woman was hipothesized relates with low birth weight in neonate.

Objective To determine the relationship between maternal 1,25-dihydroxyvitamin D level and neonatal birth weight.

Methods This was an observational study with cohort design to 47 women in the third trimester pregnancy. This study was cond ucted on August to December 2014. Subjects were taken from Ibu dan Anak Hospital, Padang, West Sumatera. Maternal blood from antecubital vein was examined for 1,25-dihydroxyvitamin D concentration using enzyme-linked immunosorbent assay (ELISA). Neonatal birth weights were measured right after delivery. Data were analyzed by Pearson's correlation and linear regression tests.

Results A positive correlation was found between maternal 1,25-dihydroxyvitamin D level and neonatal birth weight (R=0.910; R2=0.821; P=0.000). The 1,25-dihydroxyvitamin D level had an 82.1% contribution to the baby's birth weight, while other factors not assessed in this study had less of an effect.

Conclusion There is positive correlation between maternal 1,25-dihydroxyvitamin D levels in the third trimester of pregnancy and neonatal birth weight. **[Paediatr Indones. 2017;57:67-9. doi: http://dx.doi.org/10.14238/pi57.2.2017.67-9]**.

Keywords: *1,25-dihydroxyvitamin D; low birth weight; maternal; neonatal*

Neonates with low birth weight have 40 times higher risk of perinatal and infant death than neonates with normal birth weight.[1] Low birth weight is defined as full term or preterm neonates with birth weight <2,500 grams. Nutritional deficiency also associated with neonatal birth weight.[2] Nutritional intake must be sufficient during pregnancy including vitamin D as a micronutrient. Sufficient vitamin D should be maintained during pregnancy because vitamin D affects fetal growth in the subsequent trimester. Vitamin D deficiency in pregnant women may have negative effects in the mother and fetus, such as pre-eclampsia, gestational diabetes, preterm delivery, fetal growth restriction, and spontaneous abortion.[3]

The two forms of vitamin D usually measured in blood are 25-hydroxyvitamin D [25(OH)D] and 1,25-dihydroxyvitamin D [1,25(OH)2D] as the active metabolite of vitamin D.[4] There was not many study that have examined the association between maternal [1,25(OH)2D] level and neonatal birth weight because

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[1,25(OH)2D] provides no information about vitamin D status and it is often normal or elevated in vitamin D deficiency. However, [1,25(OH)2D] increases the efficiency of calcium and phosphor absorption in intestinal.[5] Furthermore, [1,25(OH)2D] involves in placental cell maintenance, such as proliferation, differentiation, apoptosis, and also plays role in calcium homeostasis in the bones.[3] Deficiency of [1,25(OH)2D] in pregnant women will reduces the calcium absorption that will affect the embryo growth and development.[6] This study was conducted to determine relationship between maternal 1,25-dihydroxyvitamin D level and neonatal birth weight.

Methods

This was an observational study with cohort design that conducted on August to December 2014. The subjects were women in their third trimester of pregnancy that intend to deliver in Ibu dan Anak Hospital, Padang, West Sumatera, Indonesia. The inclusion criteria were pregnant women at >28 weeks of pregnancy, 20-35 year old, had parity more than three times, and agreed to participate in the study. Pregnant women with anemia, diabetes mellitus, kidney disorders, chronic hypertension, signs of clinical infection, twin pregnancy, history of preeclampsia or eclampsia, and did not deliver in Padang were excluded. The subjects were selected by consecutive sampling method.

This study was approved by the Committee of Medical Research Ethics of Dr. M. Djamil Hospital. Subjects were provided written informed consent and interviewed for their characteristics and pregnancy history. Subjects' blood was taken from antecubital vein for measure [1,25(OH)2D] levels. The blood samples were centrifuged at Dr. M. Djamil Hospital to obtain the serum and then brought to Biomedical Laboratory of Medical Faculty of Andalas University for ELISA assay. All subjects were followed up until delivery and the birth weight of the neonate was measured. Normality test was analyzed by Shapiro-Wilk test, followed by Pearson's correlation and linear regression tests.

Results

During the study period, we collected blood samples from 61 women, nine blood samples were excluded from the study because of low hemoglobin (<10 g/dL) (5 samples), leukocytes >17,000/mm3 (3 samples), and glucose level >149 mg/dL (2 samples). At the time of delivery, 5 subjects were also excluded because preterm delivery. Total 47 subjects were participated in this study.

As shown in **Table 1**, the mean concentration of [1,25(OH)2D] was 38.51 (SD 11.68) pg/mL. Two subjects had an extremely low concentration of [1,25(OH)2D] (9.47 pg/mL and 13.97 pg/mL). The mean neonatal birth weight was 2,963 (SD 404.5) grams.

Table 1. Mean 1,25-dihydroxyvitamin D concentration and neonatal birth weight

Variables	Mean (SD)	Range
1,25-dihydroxyvitamin D, pg/mL	38.51 (11.68)	9.47-66.55
Neonatal birth weight, g	2,963 (404.55)	2,200-4,200

Linear regression test revealed a positive correlation between [1,25(OH)2D] concentration and neonatal birth weight (R=0.910; R2=0.827; P=0.000), with a neonatal birth weight regression equation of 1,751.704+31.479 x 1,25-dihydroxyvitamin D. The [1,25(OH)2D] had contribution of 82.7% to neonatal birth weight, while the other 17.3% was contributed from other factors not investigated in this study.

Discussion

In this study, the mean maternal [1,25(OH)2D] concentration was 38.51 pg/mL, which was lower than the normal range in the third trimester pregnancy (60-119 pg/mL).[7] Bouillon *et al.* found the mean concentration of [1,25(OH)2D] in third trimester pregnancy was 97 pg/mL.[8] In other side, Kumar *et al.* found the [1,25(OH)2D] concentration of pregnant women in their third trimester was 39.5 pg/mL.[9] These inconsistent results maybe resulted from the difference of demographics, climate, or other variables that affect the [1,25(OH)2D] concentration, such as urea, creatinine, glucose, or leukocyte concentration. In our study, urea, creatinine, glucose, and leukocyte concentrations were normal in all subjects.

We found a strong correlation between [1,25(OH)2D] concentration and neonatal birth

weight, maternal [1,25(OH)2D] found contributed by 82.7% to neonatal birth weight. The [1,25(OH)2D] plays role in placental cell proliferation, differentiation, apoptosis, and the maintainence of calcium homeostasis in the bones, that affect trophoblast and spiral artery development. Moreover, calcium homeostasis can improve fetal bone growth. So, maternal [1,25(OH)2D] affects neonatal birth weight. To the best of our knowledge, our study was the first to examine the association between maternal [1,25(OH)2D] and neonatal birth weight.[6] A previous study found an elevated neonatal serum [1,25(OH)2D] concentration in very low birth weight infants, but it was hipothesized as a consequence of calcium and phosphor deficiency in the diet. The increase serum [1,25(OH)2D] act as a compensatory mechanism to increase intestinal calcium and phosphor concentration. Deficiency of [1,25(OH)2D] in pregnant women can result in maternal hypocalcemia, neonatal tetany, low birth weight, and rickets.[11] Vitamin D status during pregnancy plays an important role in fetal skeleton development, enamel formation, fetal growth, and development. The recent study showed that [1,25(OH)2D] regulates the secretion of the placental hormones, estradiol and progesterone, and suppresses inflammatory cytokines that can stimulate preeclampsia, premature delivery, and low birth weight.[12] In conclusion, maternal [1,25(OH)2D] concentration in the third trimester of pregnancy has a positive correlation with neonatal birth weight.

Conflict of Interest

None declared.

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