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Original Article

Correlation Between Vitamin D Levels and Anthropometry Status in Neonates

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Abstract

Background : Problems of vitamin D deficiency is now starting to become a concern in the world because 1 million people worldwide have vitamin D deficiency and nearly 50% have vitamin D insufficiency. Vitamin D deficiency is more common in neonates and influenced by maternal status which can increase the risk of low birth weight. The aims of this study was to determine the correlation between vitamin D levels and anthropometric status in neonates.
Methods : This study was a cross sectional design. Sample was neonates at term. Data was obtained from questionnaires, anthropometric measurements and vitamin D levels from blood of neonates in Diponegoro National Hospital and Dr. Kariadi General Hospital, Semarang. The data normality test used the Saphiro-Wilk test. Correlation test between vitamin D levels and anthropometric status using the Pearson test, and test levels of vitamin D with anthropometric indices using the Spearman test.
Results : Median neonatal vitamin D levels were 12.12 (6.09 – 19.52). There was no significant correlation between vitamin D levels and neonatal age, neonatal anthropometric indices, maternal sun exposure and neonatal diet type. This is influenced by several other factors that are consistent with the theory such as neonatal nutrition, genetics, time and length of sun exposure, poor dietary intake.
Conclusion : There was no significant correlation between vitamin D levels and weight, body length, height, anthropometric indices of weight-for-age, weight -for-height, and height-for-age z-score in neonates.

Keywords : vitamin D, anthropometry, neonates

INTRODUCTION

Vitamin D is an important precursor of 1,25-hydroxy vitamin D, a steroid hormone needed for calcium absorption, bone development and growth in children.[1] Based on previous study, vitamin D deficiency is starting to become a global concern due to 1 million people in the world suffering from vitamin D deficiency and nearly 50% of those experiencing vitamin D insufficiency. In Iran shows that 60.2% of mothers experience vitamin D deficiency, and 48.9% of neonates with vitamin D deficiency.[2] Recently, a large study in the United States (US) contained 9% of the population of children under 6 months of vitamin D deficiency and 61% of insufficient vitamin D levels.[3] Whereas in Indonesia based on the study from Soesanti F (2013) there are 75.8% children with vitamin D deficiency and 15% children with vitamin D deficiency.[4]

Vitamin D deficiency is common in pregnant women worldwide. Based on study, low maternal vitamin D status can also have an impact on children's health, including fetal growth after birth.[5] The research shows that vitamin D levels increase infant weight and head circumference at birth, and low vitamin D levels can be a risk factor for overweight and excess waist circumference in school children, which is associated with increased absorption by adipose tissue as well as short body length.[6,7] Study from Satish (2016) suggests that vitamin D deficiency may increase neonatal risk of low birth weight and also affects the length of the baby, head circumference and chest circumference.[7] Vitamin D levels are categorized as deficiency if <20 ng / ml, insufficiency if 21–29 ng / ml and normal if 30–100 ng / ml.[1] Lack of study can be found about correlation between vitamin D levels and anthropometric indices especially in neonates in Indonesia.[8] This study aimed to analyze the correlation between vitamin D levels with weight, length, head circumference of neonates, and nutritional status of weight-for-age z-score (WAZ), weight -for-height z-score (WHZ), and height-for-age z-score (HAZ) in neonates.

METHODS

This study was a cross sectional design with observational analytic on 36 neonates full term. This study was designed to determine the correlation between vitamin D levels and anthropometric status in neonates. The research subjects were full term neonates who met the inclusion and exclusion criteria. The inclusion criteria for this study is defined as full term neonates who were brought to the Pediatric Polyclinic of the Diponegoro National Hospital Semarang and Dr. Kariadi General Hospital in Semarang by parents who agreed to terms of the study as part of informed consent, and the exclusion criteria for this study are premature, congenitally defected and/or infected babies. This study uses independent and dependent variable in this study was vitamin D levels in neonates, and the confounding variables in this study were maternal solar exposure, the type of neonate's diet (breastfeeding/formula/mixed feeding), paternal anthropometry and maternal anthropometry. Samples were taken by consecutive sampling. The research sample was full term neonates. Data collection was carried out using primary and secondary data, namely measurement of body weight, body length, head circumference, nutritional status of weight-for-age (WAZ), weight-for-height (WHZ), and height-for-age (HAZ) z-score.Measurement of infant's weight was done using a calibrated weighing scale. All articles of clothing on the infant were removed, and the infant is then positioned on the weighing scale. The infant's body length was measured using an infantometer placed on a table or flat surface. The infant's head circumference was measured using a measuring tape wrapped around the largest circumference on the head (frontal-occipital), level with the eyebrows.Blood sampling from neonate was done at laboratory of both hospital, and analyzed in GAKY laboratory using microplate reader. Vitamin D levels analyzed based on 25-hydroxy vitamin D levels. Determined as deficiency if <20 ng/ml and insufficiency if <30 ng/ml. Anthropometric indices was obtained by plotting anthropomethric measurement in WHO growth chart.Anthropometric indices below normal if the value <-2 SD. This research protocol has been approved by Faculty of Medicine Diponegoro University Medical and Health Research Ethics Commission No. 423/EC/KEPK/FK-UNDIP/XI/2021. The identity of the research subject is kept confidential and is not published without the subject's permission. Consent of research subjects was requested in the form of written informed consent. Anthropometric measurement was done by trained health practitioner to prevent bias. Sample size was calculated based on the cross sectional formula.

The collected data were analyzed using statistical software version 25 on a computer. In assessing the normality of all data, Saphiro–Wilk test was employed. Correlation test between vitamin D levels and anthropometric status using the Pearson test, and test levels of vitamin D with nutritional status of weight-for-age, weight -for-height, and height-for-age z-score using the Spearman test ($p<0.05$), and vitamin D with confounding variables testusing the partial correlation test and one way ANNOVA test.

RESULTS

In this study, the sampling technique was carried out by consecutive sampling and a total of 36 neonates were assigned as research subjects. The characteristics of study population were shown in Table 1.

TABLE 1
Correlation between vitamin D levels and neonatal anthropometric indices

Anthropometric index	Vitamin D	
	F	%
WAZ		
High	0.274¥	0.187
Normal		
Low		
Very low		
HAZ		
Normal	0.052¥	0.327
Short stature		
Very short stature		
WHZ		
Overweight	0.358¥	0.158
Normal		
Underweight		
Severely underweight		

Notes : ¥Spearman's correlation

TABLE 2
Correlation between vitamin D levels and neonatal anthropometric measurement

Anthropometric measurement		Levels of vitamin D
Body weight	*r*	-0.218‡
	p	0.201
	n	36
Body length	*r*	-0.066¥
	p	0.702
	n	36
Head circumference	*r*	-0.326¥
	p	0.052
	n	36

Notes : ‡Pearson's correlation, ¥Spearman's correlation

Table 2. shows the Spearman's test between vitamin D and WAZ levels, the results obtained are p = 0.274 ¥; r = 0.187. The results of vitamin D levels with HAZ were p = 0.052 ¥; r = 0.327. The levels of vitamin D with WHZ were obtained p = 0.358 ¥; r = 0.158.

The results of the analysis between vitamin D levels and neonatal weight were p=0.201, vitamin D levels with neonatal length was p=0.702, vitamin D levels with neonatal head circumference were p=0.052.

Based on the results of the analysis, it showed that the level of vitamin D and gender was p=0.230, the vitamin D level with the neonatal diet type was p=0.470. Vitamin D levels with maternal sun exposure was p=0.218.

The results of the analysis of neonatal vitamin D levels with maternal sun exposure, neonatal diet type, paternal and maternal anthropometry was not significant.

DISCUSSION

The research subjects who followed this study after elimination based on inclusion and exclusion criteria were 36 full term neonates, male (55,6%) and female (44.6%).This study in table 1 shows the Spearman's test between neonatal vitamin D levels with neonatal weight (p=0.201), neonatal length (p=0.702),and head circumference (p=0.052) was no significant. In table 2, the vitamin D levels with weight-for-age z-score based on pearson's correlation, spearman's correlation (p=0.274), height-for-age z-score (p=0.052), weight-for-height z-score (p=0.358) was no significant. Occurences are influenced by factors such as genetics, maternal and paternal anthropometry, and intake nutrition of neonatal.

In table 3 shows the partial correlation test and one way ANNOVA test between neonatal vitamin D levels with gender, maternal sun exposure, neonatal diet type, paternal and maternal anthropometry was no significant. Among the factors that could influence low vitamin D levels in infants include lack of adequate exposure to sunlight, usage of sunscreen, layered clothing (head coverings), length and weekly frequency of exposure to sunlight, low neonatal breastmilk intake.

Neonatal is the period of newborn babies aged 0–28 days, this period is a very important period both physically (growth and development) and psychologically.[9] So that is one reason for using a sample of neonates. The distribution of vitamin D (25 (OH) D) levels in this study ranged from 6.09 ng/ml – 16.82 ng/ml. Based on the data, it was found that all neonates who were research subjects had vitamin D deficiency.The results of this study were in accordance with research conducted by previous researchers which showed that there were more neonates with vitamin D deficiency than individuals who had normal vitamin D levels.[10] Neonatal vitamin D levels with body weight, body length, head circumference did not have a significant relationship. In a previous study by a 2016 Cochrane Randomized Controlled Trial study, vitamin D levels increased infant

TABLE 3
Correlation between vitamin D levels and confounding variables

Gender		Levels of vitamin D (ng/ml)	p
Male			0.230§
Female			
Neonatal Diet Type	Breast milk	12.37 ± 3.55	0.470¶
	Formula milk	15.47 ± 5.48	
	Mixed	12.00 ± 2.03	
Sun exposure (mother)	Yes	12.96 ± 3.55	0.218§
	No	11.48 ± 3.06	

Notes : §Independent t, ¶One way ANOVA

TABLE 4
Correlation between vitamin D levels and confounding variables

Confounding Variables	Anthropometry	*p*	r	df	Notes
Maternal sun exposure, neonatal diet type, paternal and maternal anthropometry	WAZ	0,165	0,260	28	not significant
	HAZ	0,157	0,265	28	not significant
	WHZ	0,222	0,230	28	not significant

Notes : Correlation partial test

weight at birth and head circumference at birth.Previous study suggests that low vitamin D levels may be a risk factor for overweight and waist circumference in preschool children and other components such as increased plasma glucose concentrations and insulin resistance.[11] Vitamin D may affect lipolysis and adipogenesis in human adipocytes through its role in regulating intracellular calcium concentration, resulting in increased adiposity. Low vitamin D levels are also associated with low body length so that the child looks short, because vitamin D plays a role in bone growth.[6] Low vitamin D levels also result in small head circumference size, if in newborns it is usually influenced by the mother's vitamin D levels.The work of vitamin D during pregnancy is very important for the growth and development of the bones of the baby who is born. In mothers with normal vitamin D levels, the infant head circumference is greater. There is no significant relationship due to various factors, such as changes in neonatal weight every day which are still fluctuating within normal limits. This change can occur due to the influence of input (intake), such as food or drink and output such as defecation. At the age of a few days after birth, body weight will experience a normal decrease, which is about 10% of birth weight. Head circumference is influenced by neonatal nutrition, genetics and brain weight. Body length is due to the linear growth of the neonate which can be influenced by ethnicity, genetics, hormonal, nutrition, and chronic disease. Genetics itself is an anthropometry of father and mother.[12]

Vitamin D levels with the nutritional status of weight for age z-score, weight for height z-score, and height for age z-score did not have a significant relationship. Based on the theory that low vitamin D levels in children produce a greater weight for age z-score value (obese children), this is evidenced by a positive relationship between vitamin D levels and fat mass. Previous studies with multivariate linear methods of weight-for-age, height-for-age z-score, low head circumference z-score when the baby was born to vitamin D deficient mothers. It was also influenced by race, ethnicity, and parental anthropometry. Likewise, with the 2016 Satish study, that vitamin D levels in infants are associated with weight loss at birth, body length, head circumference of children.[13] In addition, neonatal linear growth can be influenced by ethnicity, genetics, hormones, nutrition, and chronic disease. Genetics itself is an anthropometry of father and mother. So that to be able to determine the estimated final height of the child can be seen based on the mid-parenteral height and potential genetic height (mid-parenteral height ±8.5 cm).[14,15] The results of the analysis of vitamin D levels with maternal sun exposure did not have a significant relationship. Latest study states that sun exposure has many health benefits for babies, helping the body to produce vitamin D for calcium absorption, bone growth and development. Drying the baby is best done at 7.00–9.00 in the morning, because it is still safe for the skin, it is good for mothers during pregnancy to bask at 11.00–14.00 for more than 30 minutes a day with an exposure of more than 40% BSA can meet normal vitamin D status.[15] Some of the factors that can influence this include, lack of adequate sun exposure, mothers who use sunscreen, closed clothing (hijab), length of sun exposure, weekly exposure frequency, neonates who lack breast milk intake, pregnant women who consume less food that is contains vitamin D, causing the baby to have low vitamin D levels.[11]

Analysis of vitamin D levels with neonatal diet type did not have a significant relationship. This is contrary to the theory that breast milk contains 0.01 μg/ml of vitamin D.

Based on Ministry of Health Guidelines number 49 of 2014, formula milk contains a maximum of 5 μg / ml (200 IU / L) of vitamin D.[16] This can be influenced by other factors such as the occurrence of Vitamin D deficiency in neonates is caused by mothers with vitamin D deficiency, causing low vitamin D content in breast milk. So that to increase vitamin D levels in infants who are given inadequate exclusive breastfeeding, it is necessary to add vitamin D supplementation 400 IU/ day. Pregnant women need vitamin D supplementation at a dose of 2000 IU/d.[7,17] However, this will be stronger if the diet is adequate because a good diet will affect the neonatal vitamin D levels which can affect calcium absorption, growth and development. bones in neonates. The limitation in this study is that the measurement of vitamin D levels in the sample mother cannot be carried out, biased information that may be obtained because the data collection method uses a questionnaire that is asked of the subject's mother. Some of the subject's mothers had difficulty remembering, especially the length of exposure to sunbathing, the duration of exclusive breastfeeding or formula milk for their babies.

Some limitation from this study are there was no data about maternal status of Vitamin D and dietary history, that both can correlate to vitamin D status of the neonate.

From this study we conclude that there was no significant relationship between neonatal vitamin D levels and neonatal weight, body length, head circumference, weight-for-age, weight-for-height, and height-for-age z-score nutritional status.

REFERENCES

1. Utami S, Chairulfatah A, Rusmil K. Perbandingan kadar vitamin D (25 hidroksivitamin D) pada anak sakit kritis dan nonkritis. *Sari Pediatri*. 2015;16(6). Available from : https://saripediatri.org/index.php/sari-pediatri/article/view/164
2. Abbasian M, Chaman R, Amiri M, Ajami ME, Jafari-koshki T. Vitamin D deficiency in pregnant women and their neonates. *Global Journal of Health Science*. 2016;8(9):83–4. Available from : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5064090/pdf/GJHS-8-83.pdf
3. Choi YJ, Kim MK, Jeong SJ. Vitamin D deficiency in infants aged 1 to 6 months. Korean J Pediatric. 2013;56(5):205–6. Available from : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3668201/pdf/kjped-56-205.pdf
4. Ernawati F, Budiman B. Status vitamin D terkini anak Indonesia usia 2,0–12,9 tahun. *Gizi Indonesia*. 2015;38(1):74. DOI:10.36457/gizindo.v38i1.169
5. Aly H, Hady HA. Vitamin D and the neonate : An Update. *Journal of Clinical Neonatology*.2015;4(1):1. Available from : https://www.jcnonweb.com/temp/JClinNeonatol411-2066747_054427.pdf
6. Fink C, Peters RL, Koplin JJ, Brown J, Allen KJ. Factors affecting vitamin D status in infants. *Children (Basel)*. 2019;6(1):7. Available from : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6351953/pdf/children-06-00007.pdf
7. Gilbert-diamond D, Baylin A, Mora-plazas M, Marin C, Arsenault JE, Hughes MD, *et al*. Vitamin D deficiency and anthropometric indicators of adiposity in school-age children : a prospective study. *Am J Clin Nutr*.2010;1446. Available from : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3131841/pdf/ajcn9261446.pdf
8. Putri NI, Lipoeto NI, Rita RS, Aji4 AS. Hubungan kadar vitamin D pada ibu hamil dengan berat bayi lahir di Kabupaten Tanah Datar dan Kabupaten Solok. *Jurnal Ilmiah Universitas Batanghari Jambi* 2019;19(1):93–4. DOI 10.33087/jiubj.v19i1.546
9. Hafidah E, Ahmad B, Hakim A, Prawirodihardjo L. Faktor determinan status kesehatan bayi neonatal Di RSKDIA Siti Fatimah Makasar. *Kesehatan Masyarakat*. 2012;6. Available from : http://journal.uad.ac.id/index.php/KesMas/article/view/1051/pdf_8
10. Selvarajana S, Gunaseelan V, Kamalanathan S, Anandabaskar N, Xavier A. Systematic review on vitamin D level in apparrently healthy indian population and analysis of its associated factors. *Indian J Endocrinol Methab*. 2017;5:75. Available from : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5628552/pdf/IJEM-21-765.pdf
11. Aji AS, Erwinda E, Yusrawati Y, Malik SG, Lipoeto NI. Vitamin D deficiency status and its related risk factors during early pregnancy : a cross- sectional study of pregnant Minangkabau women. *BMC Pregnancy Childbirth*. 2019;19:7–9. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6532131/pdf/12884_2019_Article_2341.pdf
12. Setiyani A, Sukesi. 2016. Asuhan kebidanan neonatus, bayi, balita, dan anak pra sekolah. In Jakarta: Kemenkes RI; [cited 2020 November 29]. Available from : http://bppsdmk.kemkes.go.id/pusdiksdmk/wp-content/uploads/2017/08/Asuhan-Kebidanan-Neonatus-Bayi-Balita-dan-Apras-Komprehensif.pdf
13. Eckhardt Cara L, Gernand Alison D, Daniel E. Roth3 and LMB. Maternal vitamin D status and infant anthropometry in a US multi-centre cohort study. *Ann Hum Biol* 2016;42(3):2. Available from : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4379132/pdf/nihms618266.pdf

14. IDAI. 2017. Perawakan pendek pada anak dan remaja di Indonesia. In: 1st ed. Jakarta: Endokrinologi Ikatan Dokter Anak Indonesia. p. 1–4.
15. Juniar DA, Rahayuning D, Rahfiludin MZ. Faktor-Faktor yang Berhubungan dengan Status Gizi Bayi Usia 0–6 Bulan (Studi Kasus di Wilayah Kerja Puskesmas Gebang, Kecamatan Gebeng, Kabupaten Purworejo. *J Kesehatan Masyarakat*. 2019;7. Available from : https://ejournal3.undip.ac.id/index.php/jkm/article/view/22973/21010
16. Kementerian Kesehatan RI. 2014. Peraturan Menteri Kesehatan Republik Indonesia Nomor 49 tahun 2014 tentang Standar Mutu Gizi, Pelabelan, dan Periklanan Susu Formula Pertumbuhan dan Formula Pertumbuhan Anak Usia 1–3 Tahun. Jakarta : Kemenkes RI [cited 2020 Desember 25]. Available from : https://janaaha.com/wp-content/uploads/2018/01/PMK-No.-49-ttg-Standar-Mutu-Gizi-Pelabelan-Periklanan-Susu-Formula.pdf
17. Curtis EM, Moon RJ, Harvey NC, Cooper C. Maternal vitamin D supplementation during pregnancy. *Br Med Bull*. 2018;(1):3–4. available from : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6003599/pdf/emss-77970.pdf