

Correlation between vitamin D status in mothers and their neonates in an Iranian population

Nastaran Khosravi (**Corresponding author**): Associate professor, Iran University of Medical Sciences, Tehran, Iran.

khosravi@yahoo.com

Niloofar Khosravi: Neonatologist, Iran University of Medical Sciences, Tehran, Iran.

Shahin Entekhabi: Iran University of Medical Sciences, Tehran, Iran.

Received: 09 Mar 2015 Accepted: 05 Nov 2015

Abstract

Background and Objective: There has been a resurgence of nutritional rickets in children in many developing countries. Furthermore, Vitamin D deficiency is one of the major health problems and unexpectedly has a high prevalence in sunny countries (e.g. Middle East). In order to find out the association between vitamin D deficiencies in mothers and their neonates, we designed this study.

Methods: In a cross-sectional study, 49 pregnant women were recruited from Ali-Asghar children's hospital in Tehran, in 2015. All blood samples were assayed for 25-hydroxyvitamin D3, calcium, phosphorus, parathyroid hormone, alkaline phosphatase and creatinine. Vitamin D deficiency defined as levels of 25(OH) D < 20 ng/ml for mothers and newborns.

Results: The mean \pm SD 25OHD levels of the mothers and their neonates were 26.1 \pm 8.44 ng/mL and 17.23 \pm 10.36 ng/mL, respectively. Serum 25OHD of the mothers and their neonates were significantly correlated ($r=0.446$, $P<0.001$).

Conclusion: We found a significant correlation between vitamin D deficiency in mothers and their neonates. We think it is necessary to reconsider the recommendation of vitamin D supplementation for women during pregnancy.

Keywords: Vitamin D, Neonate, Mother, Iran

Introduction

Vitamin D (Vit D) is one of the most important contributors to calcium (Ca) homeostasis. It is a fat-soluble vitamin formed mostly in human skin by exposure to sunlight, though a small percentage comes directly from the diet (1,2). 25-hydroxyvitamin D3 [25(OH)D] is the main circulating metabolite of vitamin D, and its concentration in serum reflects the vitamin D stores in human (3).

Materno-fetal vitamin D deficiency (VDD) is still an important cause of morbidity in developing countries. 25(OH)D crossing the placenta during the last months of gestation furnishes the main Vit D requirement of the newborn during the first few months of life (4). The Vit D status of breastfed newborns depends mainly on the Vit D stores acquired during intrauterine life because the human milk content of Vit D is very low (5,6).

In this study, we aimed to find out the Vit D sta-

tus in mothers and their neonates and the correlation between serum levels of Vit D in mothers and their neonates and add our results to the last evidence about VDD.

Methods

This study included 49 Iranian women and their full-term neonates who were admitted in the NICU of Ali-Asghar children hospital in Tehran, 2015. The neonates who had odd numbers in the NICU were selected by simple random sampling. All blood samplings were done by a specified person and serum 25-hydroxyvitamin D (25OHD) level was determined in the laboratory of Ali-Asghar children hospital by enzyme-linked immunosorbent assay (ELISA) using Euroimmune kit (Germany). In addition, parathyroid hormone (PTH) calcium (Ca), phosphorus (P), alkaline phosphatase (ALP) and creatinine (Cr) were estimated by chemiluminescence, arsenazo III (color-

Table 1. Biochemical data of the mothers and their neonates' mean \pm SD

Mean of values	Mothers	Neonates
Vitamin D (ng/ml)	26.1 (8.44)	17.23 (10.36)
Calcium (mg/dl)	8.63 (0.49)	9.47 (7.58)
Phosphorus (mg/dl)	5.44 (0.81)	5.23 (0.96)
Alkaline phosphatase (IU/L)	228.77 (64.27)	373.28 (177.16)
Creatinine (mg/dl)	0.43 (0.07)	0.45 (0.17)
Parathyroid hormone (pg/ml)	35.1 (7.43)	42.43 (58.4)

Table 2. Percentage distribution of vitamin D level of mothers and their neonates

25-hydrovitamin D (25OHD) (ng/mL)	Mothers	Neonates
Very severe vitamin D deficiency (< 5)	0%	10.20%
Severe vitamin D deficiency (5 – 10)	0%	16.32%
Vitamin D deficiency (10 – 20)	24.48%	44.89%
Suboptimal vitamin D provision (20 – 30)	46.93%	12.24%
Optimal vitamin D level (30 – 50)	28.57%	16.32%

imetry), photometric method, the German societies for clinical chemistry (DGKC) method, and enzymatic colorimetry, respectively.

Exclusion criteria included: 1) immature neonates 2) history of using Vit D or calcium supplements in mothers 3) history of metabolic diseases related to Vit D and calcium homeostasis among mothers and their neonates, and 4) intensive congenital anomalies in neonates.

We classified serum levels of 25(OH)D into five groups for deficiency status (<5 as very severe, 5-10 as severe, 10-20 as deficiency, 20-30 as suboptimal, and \geq 30 ng/ml as normal).

Statistical Analysis: The biochemical data of the mothers and the neonates were expressed as mean \pm SD. The Student's t-test was used to compare the differences between the means of variables. Pearson correlation was used to investigate

correlation between two variables. In all tests, the level of significance was 0.05. Data were analyzed through SPSS software version 21.

Results

In total, 49 mother-neonate pairs participated in this study. Table 1 presents biochemical data of the mothers and their neonates. The percentage distribution of Vit D level of the mothers and the neonates is presented in Table 2. The mean of calcium, phosphorus, alkaline phosphatase, creatinine, parathyroid hormone levels of the mothers were compared in two groups: 1- the mothers with Vit D deficiency (< 20) 2- the mothers without Vit D deficiency (\geq 20). There were no significant differences between two groups of the mothers. Also, we compared these biochemical levels in two groups of the neonates like their mothers (with and without Vit D deficiency) but there were no significant differences between two groups of the neonates, too. However there was a significant correlation between the newborns' Vit D levels and calcium concentrations ($r=0.345$, $P<0.001$). Furthermore, a significant correlation was observed between maternal and neonatal 25(OH) D concentrations ($r=0.446$, $P<0.001$) (Fig. 1).

Discussion

VDD rickets occurs most commonly during infancy, starting in the early months of life (4) Sub-clinical Vit D deficiency in neonates and their mothers has also been reported (7,8). The prevalence of Vit D deficiency among infants may be as high as 43-70%, depending on the definition of Vit D deficiency and the latitude of the population studied (9-11). Kazemi et al reported a high

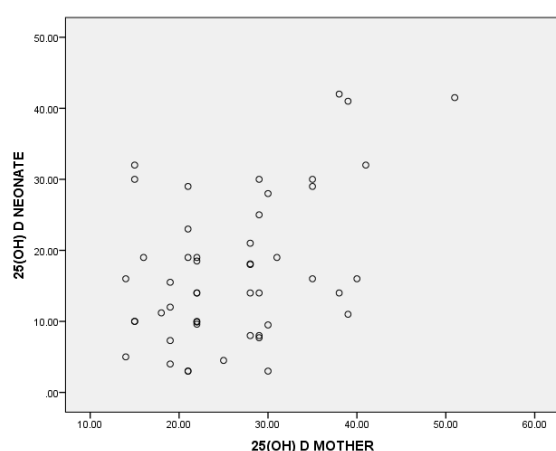


Fig. 1. Correlation between maternal and neonatal 25(OH)D concentrations (ng/mL).

prevalence of physiologically significant hypovitaminosis D among Iranian pregnant women and their newborns (12). Furthermore, there was significant correlation between maternal and cord blood serum concentrations of Vitamin D in several studies (13-21). Molla et al studied Vitamin D status of mothers and their neonates in Kuwait and found out that the Vitamin D of the mothers and neonates are highly correlated ($r = 0.790$, $P < 0.001$) (14). In some other countries of the Middle East, Vitamin D deficiency rickets causes significant morbidity among the children. It is a preventable condition and the cost for prevention is affordable by most of the countries (22-24).

According to the studies (12,25-27) that have been done in Iran about Vitamin D status of the Iranian mothers and their newborns, we expected to find a high rate of Vitamin D deficiency. In this study, 71.41% of the neonates and 24.48% of the mothers had Vitamin D deficiency. In addition, our findings are consistent with some other studies that have shown significant correlation between maternal and neonatal serum concentrations of Vitamin D (13-21). In our study, there was a significant correlation between the newborns' Vitamin D and calcium concentrations in them ($r = 0.345$, $P < 0.001$). This finding is consistent with a study that Hashemi-pour et al conducted (25). Some studies have shown that maternal Vitamin D status may influence placental calcium transfer and neonatal serum calcium concentration as we found (28,29).

Conclusion

We conclude that vitamin D deficiency is common among mothers and newborns in Iran. Therefore, Vitamin D supplements have an important role in pregnant women in decreasing the risk of neonatal Vitamin D deficiency and subsequent complications such as hypocalcemia.

Conflicts of interest: None declared.

References

- Bouillon R, Okamura WH, Norman AW. Structure-function relationships in the vitamin D endocrine system. *Endocr Rev.* 1995;16:200-257.
- Haddad JG. Vitamin D. Solar rays, the Milky Way or both. *N Engl J Med.* 1992;326:1213-1215.
- Gannage-Yared MH, Chemali R, Yaacoub N, Halab. Hypovitaminosis D in a sunny country: relation to lifestyle and bone markers. *J Bone Miner Res.* 2000; 15:1856-1862.
- Hochberg Z, Bereket A, Davenport M, Delemarre-Van de Waal HA, De Schepper J, Levine MA, et al. Consensus Development for the Supplementation of Vitamin D in Childhood and Adolescence. *Horm Res* 2002;58:39-51.
- Fraser DR. Vitamin D. *Lancet.* 1995;345:104-7.
- Reese LE, Chesney RW, De Luca HF. Vitamin D of human milk identification of biologically active form. *Am J Clin Nutr.* 1982;36:122-126.
- Dawodu A, Agarwala M, Hossain M, Jose K, Reem Z. Hypovitaminosis and Vitamin D deficiency in exclusively breast feeding infants and their mothers in summer: a justification for vitamin D supplementation of breast-fed infants. *J. Pediatr.* 2003; 142: 169-73.
- Kreiter SR, Roberts P, Schwartz RP. Nutritional rickets in African American breast-fed infants. *J. Pediatr.* 2000; 137: 153-7.
- Rovner AJ, O'Brien KO. Hypovitaminosis D among healthy children in the United States: a review of the current evidence. *Arch Pediatr Adolesc Med.* 2008; 162(6):513-519.
- Seth A, Marwaha RK, Singla B. Vitamin D nutritional status of exclusively breast fed infants and their mothers. *J Pediatr Endocrinol Metab.* 2009; 22(3):241-246.
- Ziegler EE, Hollis BW, Nelson SE, Jeter JM. Vitamin D deficiency in breastfed infants in Iowa. *Pediatrics.* 2006; 118(2):603-610.
- Kazemi A, Sharifi F, Jafari N, Mousavinasab N. High prevalence of vitamin D deficiency among pregnant women and their newborns in an Iranian population. *J Womens Health (Larchmt).* 2009;18 (6):835-9.
- Maghbooli Zh, Hossein-Nezhad A, Shafaei A. Vitamin D status in mothers and their newborns in Iran. *BMC Preg Childbirth.* 2007; 7:1.
- Molla AM, Al Badawi M, Hammoud MS, Molla AM, Shukkur M, Thalib L, Eliwa MS. Vitamin D status of mothers and their neonates in Kuwait. *Pediatr Int.* 2005;47(6):649-52.
- Brooke OG, Brown IRF, Cleeve HJW, Sood A: Observations on the vitamin D state of pregnant Asian women in London. *Br J Obstet Gynaecol.* 1981; 88:18-26.
- Sachan A, Gupta R, Das V, Agarwal A, Awasth PK, Bhatia V. High prevalence of vitamin D deficiency among pregnant women and their newborns in northern India. *Am J Clin Nutr.* 2005; 81:1060-4.
- Paunier L, Lacourt G, Pilloud P, Schlaeppli P, Sizonenko. PC: 25-HydroxyvitaminD and calcium levels in maternal, cord and infant serum in relation to maternal vitamin D intake. *Helv Paediatr Acta.* 1978; 33:95-103.
- Weiler H, Fitzpatrick-Wong S, Veitch R, Kovacs H, Schellenberg J, McCloy U, Yuen CK. Vitamin D deficiency and whole-body and femur bone mass relative to weight in healthy newborns. *CMAJ.* 2005; 172:757-61.
- Taha SH, Dost SM, Sedrani SH: 25OHD and total Ca: extraordinary low plasma concentrations in Saud: mothers and their neonates. *Res.* 1984; 18: 739-41.
- Sowers M, Crutchfield M, Jannausch M, Updike S, Corton G: A prospective evaluation of bone mineral

- change in pregnancy. *Obstet Gynecol.* 1991; 77: 841-5.
21. Mallet E, Gugi B, Brunelle P, Henocq A, Basuyau JP, Lemeur H. Vitamin D supplementation in pregnancy: a controlled trial of two methods. *Obstet Gynecol.* 1986; 68:300-4.
 22. Elidrassy ATH. Vitamin D deficiency rickets in Saudi Arabia. In: Glorieux FH (ed.). *Rickets*. Nestle Nutritional Workshop Series, Vol. 21. Raven Press Ltd, New York, 1991; 223-31.
 23. Torrence AJ, Foster C, Shope T. The many faces of vitamin D deficiency rickets. *Pediatr Rev.* 2000; 21: 296-302.
 24. Alan DR, Rothberg AD, Pettifor JM, et al. Maternal and infant vitamin D relationship during breast feeding. *J Pediatr.* 2000; 101: 500-3.
 25. Hashemipour S, Larijani B, Adibi H, Javadi E, Sedaghat M, Pajouhi M, et. al. Vitamin D deficiency and causative factors in population of Tehran. *BMC Pub Health.* 2004; 4:38.
 26. Ainy E, Ghazi AA, Aziz F. Changes in calcium, 25(OH) vitamin D3 and other biochemical factors during pregnancy. *J Endocrinal Invest.* 2006; 29 (4): 303-307.
 27. Bassir M, Laborie S, Lapillone A, Claris O, Chapuis MC, Salle BL. Vitamin D deficiency in Iranian mothers and their neonates: a pilot study. *Acta Paediatr.* 2001; 90: 577-579.
 28. Durand D, Braithwaite GD, Barlet JP: The effect of 1-hydroxycholecalciferol on the placental transfer of calcium and phosphate in sheep. *Br J Nutr.* 1983; 49:475-480.
 29. Okonofua F, Menon RK, Houlder S, Thomas M, Robinson D, O'Brien S, Dandona P: Calcium, vitamin D and parathyroid hormone relationships in pregnant Caucasian and Asian women and their neonates. *Ann Clin Biochem.* 1987; 24:22-8.