VITAMIN D DEFICIENCY IN PREGNANT WOMEN AND THEIR NEW BORN

Saima Shabbir,[1] Shazia Sultana,[2] Mehwish Saleem,[1] Faraz Ahmed[1]

ABSTRACT

Background: Vitamin D deficiency may affect the mother and its new born health. **Objective:** To detect the frequency of vitamin D deficiency in pregnant women and their newborn of Karachi at tertiary care hospitals, and correlating maternal vitamin D with cord blood. **Patients and Methods:** This cross-sectional study was conducted on 50 women in labor presenting with a singleton term pregnancy at tertiary centers in Karachi. Data was recorded on a special proforma, maternal blood was taken before delivery and cord blood was taken at delivery. All blood samples were analyzed for 25-hydroxy vitamin D levels. **Results:** The mean vitamin D levels were 24 ng/mL for the mothers and 20 ng/mL for the newborns. Vitamin D sufficiency was noted in 11(22%), insufficiency in 16 (32%), and deficiency in 23 (46%) of the 50 mothers whereas sufficiency and deficiency, were noted in 6 (12%) and 44 (88%) of the newborns respectively. There was a positive correlation between the vitamin D levels in maternal and cord blood (r = 0.03; P0.003). Maternal vitamin D levels were significantly affected by sunlight exposure (P =0.007) and quality of diet (P=0.01). **Conclusion:** Vitamin D deficiency is high among pregnant urban Pakistani women and their newborns. This public health problem needs urgent attention.

Keywords: Vitamin D deficiency, Pregnancy, Newborn.

JSZMC 2015;6(1):778-781

INTRODUCTION

Vitamin D deficiency is associated with osteoporosis and a variety of other illnesses, ranging from depression and severe myopathy to autoimmune disease.[1–3] During pregnancy, mostly in the last trimester, changes in maternal vitamin D and calcium metabolism allow the transfer of up to 250 mg of calcium per day to the fetal skeleton, for a total of 25 to 30 g of calcium.[4] The biologically active metabolite of vitamin D,1,25 dihydroxy-vitamin D, plays a major role in maintaining appropriate blood concentrations of calcium and phosphorous.[5,6] Compared with pre-pregnancy levels, serum levels of 1,25 dihydroxyvitamin D, increase between 50% and 100% during the second trimester and the increase reaches 100% during the third trimester.[7,6] Maternal vitamin D deficiency can therefore result in metabolic bone disease in the mother and disturbed calcium and vitamin D metabolism in the newborn.[7]Studies have shown a high prevalence of vitamin D deficiency among Turkish women and their infants,[8] and among pregnant women and their newborns (as assessed from cord blood) in Greece and Iran.[9,10] An Australian study concluded that insufficient prenatal and postnatal levels of vitamin D were found to place breastfed infants at high risk for vitamin D deficiency and poor bone formation,[11] and a study from India reported widespread vitamin D deficiency among pregnant women and a correlation between maternal and cord blood levels of vitamin D.[12] In Pakistan, a high prevalence of vitamin D deficiency has been reported among breastfed infants and nursing mothers from the upper socioeconomic class,[13,14] but the issue has not been explored for women of lower income levels who are the majority and their newborns. The present study was conducted with women presenting in labor at Karachi, Pakistan, tertiary-care centers. Its objective was to determine the prevalence of vitamin D deficiency among pregnant women and their newborns, and to determine predictors of vitamin D deficiency.

PATIENTS AND METHODS

This cross-sectional study was conducted at the Obstetrics and Gynecology Department (Unit-I) of KVSS SITE hospital and Ziauddin Medical Hospital Karachi. The participants were 50 consecutive eligible women admitted in labor from 1st January, to 30th June 2013. Preterm pregnancy, twin or multiple pregnancies, systemic disease in the mothers, and congenital anomalies in the newborn were exclusion criteria. The Ethical Review Board of the two hospitals approved the study and all participants gave informed consent before they joined the study. Characteristics such as age, height,

1. KVSS, Site Hospital, Karachi. University of Karachi
2. Ziauddin University Hospital Karachi

Correspondence: Dr. Mehwish Saleem, Senior Registrar, Ziauddin University Hospital Karachi.

Received: 14-11-2015 **Accepted:** 20-03-2015

weight, gravidity, level of education, occupation, socioeconomic status, prenatal booking status, regular exposure to sunlight, extent of clothing, supplemental intake of calcium and/or vitamin D, and quality of diet were recorded on a proforma. Economic status was categorized according to monthly family income. The participants were categorized as "booked" if they had 3 or more prenatal visits and "not booked" if they had fewer than 3. They were considered to receive sunlight if they exposed face, arms, and feet daily for at least half an hour in a sunny garden, courtyard, or terrace. Outdoor clothing was classified as "burqa" (a garment and veil covering the body entirely with the exclusion of hands and feet); "burqa with gloves" (only the feet are not covered); and "usual clothing" (that leaves the face, hands, and feet exposed). Diet was assessed by a 3-day recall of their intake of milk, milk products, eggs, and poultry and categorized as "defective" (no intake of any of the listed foods in the last 3 days); "poor" (1 or 2 servings daily on average); "inadequate" (3 to 4 servings daily on average); or "adequate" (5 or more servings daily on average). Maternal and cord blood concentrations of 25-hydroxy vitamin D were assessed. In conformity with well-accepted values maternal concentrations were considered normal if they were 30 ng/mL or greater, insufficient if they were between 21 and 29 ng/mL, and deficient if they were less than 20 ng/mL,[15] and cord blood concentrations of 33 ng/mL were considered normal and less than 33 ng/mL were considered deficient.[16] The neonatal examination included weight, height, and occipitofrontal circumference measurement. All participants found to have vitamin D deficiency were given dietary advice, vitamin D and calcium supplements, and advice regarding exposure to sunlight. They were requested to return 6 weeks later for a mother-and-child visit, during which treatment compliance was assessed, vitamin D levels reassessed, and the infant treated according to standard guidelines.[17] Data entry was done using SPSS software, version 16 (SPSS, Chicago, IL, USA). The chi square test was used to compare vitamin D levels, including between mothers and newborns, and to explore association between vitamin D deficiency and possible predictors of the deficiency. P value< 0.05 was considered significant.

RESULTS

The demographic characteristics of the 50 participants are shown in Table I. Most participants were between 25 and 35 years old (mean± SD, 28.16 ± 4.4 years) and gravida 2 to 4. Just more than half uneducated and 48 out of 50 were housewives. The participants' mean body mass index was 26 ± 2.4. Eight (16%) were categorized as being economically "above average," 24 (48%) as "average," and 18 (36%) as "poor." The mean birth weight was 3.05 ± 0.47 kg, the mean birth height was 42.94 ± 3.28 cm, and the newborns' mean occipitofrontal circumference was 30.66 ± 2.41 cm.

Table I: Demographic characteristics of the study participants.(N=50).

Variable	No. of participants (%)	No. of participants (%) with vitamin D levels b20 ng/mL[a]
Age (years)		
< 25	13(26)	8 (61)
25–35	35 (70)	14 (40)
>35	2 (4)	1 (50)
Gravidity		
1	9(18)	3 (33)
2–4	31(62)	14 (45)
5–6	9(18)	5 (55)
>6	1(2)	1(100)
Education		
Uneducated	28 (56)	7 (25)
Less than secondary	10 (20)	1 (10)
Secondary	6(12)	0
University	6(12)	3 (50)
Socioeconomic status		
Above average	8 (16)	3 (37)
Average	24 (48)	12 (50)
Poor	18 (36)	8 (44)
BMI		
<18.5	0	0
18.5 -24.9	14 (28)	10 (71)
25-29.9	33 (66)	13 (39)
>30	3 (6)	0

Table II: Relationships between maternal and cord blood vitamin D levels

Maternal level (ng/ml)	Cord Level	
	≥33	< 33
~30(n=11)	5(45)	6 (54)
20–29(n=16)	1(6)	15(93)
<20(n=23)	0	23

The mean and modal concentrations were, approximately, 24 ng/mL and 20 ng/mL for maternal blood and 20 ng/mL and 15 ng/mL for cord blood. Vitamin D sufficiency was noted in 11(22%), insufficiency in 16 (32%), and deficiency in 23

(46%) of the 50 mothers whereas sufficiency and deficiency, respectively, were noted in 6 (12%) and 44 (88%) of the newborns. When the mothers were categorized as having vitamin D insufficiency or deficiency were grouped together, they accounted for 78% of the study group. Further, of the 11 mothers with sufficient levels, only 5 have a vitamin D–sufficient newborn; of the 16 with insufficient levels, only 1 has a vitamin D–sufficient newborn; and of the 23 with vitamin D deficiency, none have a vitamin D–sufficient newborn (Table II).

Table III: Possible predictors of vitamin D deficiency

Variable	No. of participants (%)	No. of participants(%) with vitamin D levels <20 ng/mL
Booking status		
Booked	31(62)	15 (48)
Not booked	19(38)	8(42)
Pregnancy Supplementation		
No	10 (20)	4 (40)
Yes	40 (80)	19 (49)
Diet containing calcium/ vitamin D		
Defective	5 (10)	5 (100)
Poor	9(18)	5 (55)
Inadequate	23 (46)	10 (43)
Adequate	13 (26)	3 (23)
Sunlight exposure		
No	10(20)	9(90)
Yes	40 (80)	14 (35)
Outdoor clothing		
Burqa	30 (60)	13 (43)
Burqa+gloves	2(4)	2(100)
Usual clothing	18 (36)	4 (22)

Calculating the correlation coefficient (Cr = 0.03) and performing linear regression made it evident that cord blood vitamin D concentrations increased or decreased according to increases or decreases in maternal levels (P=0.001).

Predictors of vitamin D deficiency are shown in Table III. A diet insufficient in calcium and vitamin D (P=0.01) and a lack of exposure to sunlight (P=0.007) were associated with vitamin D deficiency. No associations were found between vitamin D levels and number of prenatal visits, extent of clothing, or supplemental intake of calcium and/or vitamin D during pregnancy.

DISCUSSION

Limited data are available in Pakistan about breastfeeding mothers and their infants, there are even fewer reports about pregnant women and their newborns. In view of the long-term health hazards that a deficiency in this vitamin entails, a study of vitamin D concentration at the end of pregnancy was therefore necessary.[18,19] Our participants were from all over the city rather than women receiving prenatal care at the center's clinics. The sole basis for the exclusion criteria was the possible effect certain conditions could have on vitamin D level. Although 1, 25-dihydroxyvitamin D is the active metabolite of vitamin D, its level may be normal in the blood even when its precursor, 25-hyroxyvitamin D, is insufficient. The precursor is therefore a much more reliable indicator of vitamin D stores than the active form and its optimal values are associated with good health.[15] Consequently, 25-hydroxyvitamin D levels were measured in this study.The 78% prevalence of vitamin D inadequacy among our participants is very high but similar to rates have been reported for other countries.[10,12,20] The impact of this inadequacy on the future health of these women is evident. It is also evident on the future health of their off-spring (88% of the newborns in this study were vitamin D deficient), particularly since most Pakistani women breastfeed their infants for 1 to 2 years. Like other authors,[10,12] we report a strong correlation between vitamin D levels in maternal and cord blood. This finding reminds us that the fetus is solely dependent on its mother for the supply of this vitamin. The newborns of the 23 participants found to be deficient in vitamin D were also vitamin D deficient; there was only 1 newborn with a normal vitamin D level among the 16 participants with insufficient vitamin D levels; and there were only 5 newborns with normal levels among the 11 participants found to have sufficient levels. This suggests that for normal vitamin D concentrations to be maintained in fetal blood, the normal vitamin D concentration is higher during than before pregnancy.

A high prevalence of vitamin D deficiency should not be expected in a country abundant in sunshine. Important factors for deficiency are a lack of exposure to sunlight and poor diet. Although published evidence indicate that far more sun exposure is needed to achieve good vitamin D levels, our results suggests that the daily exposure of the face, arms, and feet for a half hour is better than no exposure at all; at any rate, we found this brief exposure to be associated with higher vitamin D levels. The lack of association in this study between

vitamin D deficiency and outdoor clothing is explained by its extent in Pakistan as the burqa conceals the entire body, with variations only in the coverage of the face and hands. Dietary sources of vitamin D are known to be few in Pakistan, but poultry and eggs may contain varying amounts of it in addition to calcium, which would explain the association between intake of these foods and vitamin sufficiency. Commercial food is not routinely enriched with vitamin D in Pakistan. Because of the high prevalence of anemia and its attendant mortality in this country, diet supplementation in pregnancy has been primarily focused on hematenic agents. In this study 40 women were given calcium and/or vitamin D supplementation during their pregnancy. However, they did not take the tablets regularly; and this often consisting of calcium only, or of calcium, iron and folate only, the number of women actually taking vitamin D was too low to make a statistical difference. The number of prenatal visits bore no relation-ship to vitamin D levels, perhaps indicating a lack of awareness, on the part of prenatal clinic staff, of the importance of providing pregnant women with vitamin D.

CONCLUSION

These is high prevalence of vitamin D deficiency among pregnant mothers and new borns. Large scale studies throughout Pakistan, as well as interventional studies with vitamin D supplementation for women found to be deficient, should follow this preliminary inquiry. There is also an urgent need to consider enriching food in this country, and providing vitamin D supplementation to all pregnant women who need it. The health of future generations depends on these measures.

REFERENCES

1. Cooper C, Javaid K, Westlake S, Harvey N, Dennison E. Developmental origins of osteoporotic fracture: the role of vitamin D insufficiency. J Nutr 2005;135 (11 Supplement):2728S–34S.
2. Prabhala A, Garg R, Dandona P. Severe Myopathy associated with vitamin D deficiency in western New York. Arch Intern Med 2000;160:1199–203.
3. Mulligan ML, Felton SK, Riek AE, Bernal-Mizrachi C. Implications of vitamin D deficiency in pregnancy and lactation. Am J Obstet Gynecol 2010;202(5):429. e1–9.
4. Specker B. vitamin D requirements during pregnancy. Am J Clin Nutr 2004;80(6 Supplement):1740S–7S.
5. Salle BL, Delvin EE, Lapillonne A, Bishop NJ, Glorieux FH. Perinatal metabolism of vitamin D1, 2, 3. Am Clin Nutr 2000;71(5):1317S–24S.
6. Cross NA, Hillman LS, Allen SH, Krause GF, Vieira NE. Calcium homeostasis and bone metabolism during pregnancy, lactation, and postweaning: a longitudinal study. Am J Clin Nutr 1995;61:514–23.
7. Thandrayen K, Pettifor JM. Maternal vitamin D status: implications for the development of infantile nutritional rickets. Endocrinol Metab Clin NorthA 2010;39(2):303–20.
8. Pehlivan I, Hatun S, Aydoğan M, Babaoğlu K, Gökalp AS. Maternal vitamin D deficiency and vitamin D supplementation in healthy infants. Turk J Pediatr 2003;45(4):315–20.
9. Nicolaidou P, Hatzistamatiou Z, Papadopoulou A, Kaleyias J, Floropoulou E, Lagona E, et al. Low vitamin D status in mother-newborn pairs in Greece. Calcif Tissue Int 2006;78(6):337– 44.
10. Maghbooli Z, Hossein-Nezhad A, Shafaei AR, Karimi F, Larijani B, Madani FS. Vitamin D status in mothers and their newborns in Iran. BMC Pregnancy Childbirth 2007;7:1120-25
11. Thomson K, Morley R, Grover SR, Zacharin MR. Postnatal evaluation of vitamin D and bone health in women who were vitamin D-deficient in pregnancy, and in their infants. Med JAust 2004;181(9):486–8.
12. Sachan A, Gupta R, Das V, Agarwal A, Awasti PK, Bhatia V. High prevalence of vitamin D deficiency among pregnant women and their newborns in northern India. Am J Clin Nutr 2005;81(5):1060–4.
13. Atiq M, Suria A, Nizami SQ, Ahmed I. Vitamin D status of breastfed Pakistani infants. Acta Paediatr 1998;87(7):737–40.
14. Atiq M, Suria A, Nizami SQ, Ahmed I. Maternal vitamin D Deficiency in Pakistan. Acta Obstet Gynecol Scand 1998;77(10):970–3.
15. Vieth R. Vitamin D supplementation, 25-hydroxyvitamin D concentrations, and safety. Am J Clin Nutr 1999;69(5):842–56.
16. Pesce MA, Nicholson JF. Reference ranges for laboratory tests and procedures. In: Kleigman RM, Behrman RE, Jenson HB, Stanton BF, editors. Nelson Textbook of Pediatrics. 17th ed. Philadelphia, PA: Saunders; 2004. p. 2396-26.
17. Greenbaum LA. Rickets and Hypervitaminosis D. In: Kleigman RM, Behrman RE, Jenson HB, Stanton BF, editors. Nelson Textbook of Pediatrics. 18th ed. Philadelphia, PA: Saunders; 2007: p. 253–63.
18. Bischoff HA, Stähelin HB, Dick W, Akos R, Knecht M, Salis C, et al. Effects of vitamin D and calcium supplementation on falls: a randomized controlled trial. J Bone Miner Res 2003;18(2):343–51.
19. Viljakainen HT, Saarnio E, Hytinantti T, Miettinen M, Surcel H, Makitie O, et al. Maternal vitamin D status determines bone variables in the newborn. J Clin Endocrinol Metab 2010;95(4):1749–57.
20. Newhook LA, Sloka S, Grant M, Randell E, Kovacs CS, Twells LK. Vitamin D insufficiency common in newborns, children and pregnant women living in Newfoundland and Labrador. Matern Child Nutr 2009;5(2):186–91.