Original Article

Status of Vitamin D Deficiency in Pregnant Women and Their Infants in Rural Areas of Karachi, Sindh, Pakistan

Neel Kanth[1], Sejal Neel[2], Mehreen Yousaf Rana[3], Mukesh Kumar[4], Damni Advani[5]

[1]Associate Professor, Doctors Plaza Hospital, Clifton Karachi
[2]Medical Officer, Liaquat University of Medical and Health Sciences, Jamshoro
[3]Assistant Professor, Gynae and OBS Department, Ziauddin Hospital, Karachi
[4]Assistant Professor, Pathology in Muhterma Shaheed Benazeer Bhutto Medical College Lyari Karachi
[5] Undergraduate, SMBBMC Lyari, Karachi

Correspondence: *Dr Neel Kanth*
Associate Professor, Doctors Plaza Hospital, Clifton Karachi
Email: drneelkanth@hotmail.com

Abstract

Objective: To determine the vitamin D3 deficiency among pregnant women and its correlation with neonatal vitamin D level in rural areas of Karachi, Sindh, Pakistan.

Methodology: This cross-sectional study was conducted over 18 months from July 2017 to December 2018. Two hundred serum samples including the mother and their newborn were equally collected at the time of natural delivery or C-section and were sent immediately to Hospital diagnostic laboratory for the vitamin D level. All the information was collected via study proforma. Data analysis was done by SPSS version 20.

Results: A total of 84 women were studied, their mean age was 25.34±23.11 years. Vitamin D3 deficiency and insufficiency in pregnant women were found to be 9.5% and 55.9% respectively, while 34.5% of the women had normal Vitamin D3 levels. Among newborns, vitamin D3 deficiency and insufficiency were found to be 11.9% and 53.5%. As per effect modifiers, vitamin D level was non-significant, p-values were quite insignificant. There was a significant positive correlation between maternal and fetal vitamin D level r-value 6.06 (p=0.001).

Conclusion: Maternal vitamin D3 deficiency and insufficiency was highly prevalent, found to be 9.5% and 55.9%. Maternal vitamin D deficiency proved a significant caused of infant vitamin D deficiency as there was a strong positive correlation.

Keywords: Vitamin D3, Deficiency, Insufficiency, Pregnancy, Newborns

Cite this article as: Kanth N, Neel S, Rana MY, Kumar M, Advani D. Status of Vitamin D Deficiency in Pregnant Women and Their Infants in Rural Areas of Karachi, Sindh, Pakistan.J Soc Obstet Gynaecol Pak.2020; Vol 10(3):175-179.

Introduction

Vitamin D3 deficiency (VDD) is identified as a public health problem in many countries of the world, and females during pregnancy have been recognized as a high-risk group. Pakistan being a tropical country, it is believed that vitamin D3 deficiency would not be common in this country. Despite abundant sunlight, vitamin D3 deficiency seems to be highly prevalent in Pakistan. About a billion peoples throughout the world, suffering from the deficiency of vitamin D level or its insufficiency.[1] This estimation is built on serum level of vitamin D level like 30ng/ml.[2] Vitamin D is biologically inactive and metabolized to 25- hydroxycholecalciferol in the liver and then to its active biologically from 1,25-dihydroxycholecalciferol [1,25-di (OH)D3] in the kidney. The efficiency of this process is decreased by melanin therefore more sun exposure is required in country like Pakistan. There is a higher prevalence of vitamin D3 deficiency in Pakistan due to lack of vitamin D3 fortified diet, poor calcium intake, dark colored skin population, and customary clothing (covers hair and neck and usually has a face veil that covers the face). The raised

Authorship Contribution: [1-3]Analysis and interpretation of data, drafting and revision of manuscript, [4] critical review of manuscript, [5]review methodology, [6] participated in the acquisition and data analysis.

Funding Source: none
Conflict of Interest: none

Received: May 21, 2020
Accepted: Oct 14, 2020

incidence of vitamin D3 insufficiency during pregnancy is progressively recognized. The deficiency of vitamin D3 in the pregnancy is the responsible for risk development of rickets among infants and may cause poor growth of fetus and the development of neonates.[3-6] Furthermore, the deficiency of vitamin D during pregnancy may predispose to preeclampsia and gestational diabetes mellitus.[7,8] Most of the children in Pakistan are exclusively breastfed, and several data have observed that the requirement of vitamin D3 cannot be adequately fulfilled with human milk as alone. Vitamin D deficiency among mothers during gestation and non-supplementation in neonates were the likely causes of rickets found seen in the patients in Pakistan.[9] One old survey concluded that many Pakistani pregnant women during term had developed several biochemical irregularities including phosphorus, alkaline phosphate, and calcium.[10] This study aims to determine maternal vitamin D3 level and its association with newborn vitamin D3 level in rural areas of Karachi, Sindh, Pakistan.

Methodology

This cross-sectional study was conducted at Isra University, Al Tibri Medical College Karachi. The study was conducted for 18 months. All the women having age 15 to 45 years with term pregnancy reporting to antenatal wards immediately before childbirth will be included after obtaining the written consent. A total of 200 cases were selected and the results of 168 women and neonates were analyzed and 32 subjects were dropped out of the study due to refusal for blood draw even after written consent. Women having elective preterm labours were excluded from the study. Blood samples of all the included mothers were taken at the time of vaginal delivery or cesarean section and immediately were sent to the Hospital diagnostic laboratory for maternal vitamin d level. Similarly, newborn blood samples were obtained from the cord blood of the infant immediately after the birth to assess the neonatal vitamin d level. Vitamin D3 deficiency was defined as serum 25(OH)D <10 nmol/l. A pre-tested questionnaire was filled regarding their age, socioeconomic status, diet, parity, sun exposure, history of Vitamin D supplement, and body mass index. All the data was collected via study proforma. Data analysis was done by using SPSS version 20. Frequency and percentage were analyzed for the qualitative variables. Mean and standard deviation were analyzed for continuous data. Pearson correlation was applied for the correlation between mother and newborn vitamin D level.

Results

A total of 84 samples of pregnant women and their newborns were assessed regarding vitamin D level and it correlation between them. Maternal mean age was found their mean age was 25.34$\pm$23.11 years. Most of the women were obese and over weight as 34.5% and 48.8% respectively. Most of the women 59.2% had parity 1-2, followed by 26.2% women had parity 3-4 and 14.3% had parity $\geq$5. The majority of the women had gestational age >36 weeks. As per socioeconomic status most of the women 88.1% were poor. Sun exposure history was noted in 47.6% of women. Hijab habits were in 42.9% of women. Vitamin D containing diet was observed in 54.8% of women. The previous history of vitamin D deficiency was found among 41.7% of females. (Table I)

In registered pregnant women, vitamin D3 deficient mothers were 8(9.5%), 47(55.9%) had insufficiency and 29(34.5%) had sufficient amount of Vitamin D3 level in their blood. However, the overall average maternal vitamin D3 level was 26.87$\pm$18.39 as shown in table II.

As neonatal vitamin D status, 10(11.90%) newborns had vitamin D deficiency followed by 45(53.57%) had vitamin D insufficiency and 29(34.52%) had a sufficient level of vitamin D3. The overall average vitamin D level of newborns was 28.51$\pm$27.57 as shown in table II Maternal vitamin D level was statistically insignificant according to age, BMI, gestational age, parity, socioeconomic status, sun exposure, and history of vitamin D diet intake.

There was a positive correlation between the mother's vitamin D level and newborn vitamin D level and the correlation coefficient was 0.84. Newborns of the affected mothers had nearly the same level of deficiency. Figure 1

Table I: Demographic characteristics of women (n=84)		
	N	%
Age		
< 20	07	8.3%
21-30	58	69.0%
31-45	19	22.6%
BMI		
Underweight (< 18.5)	2	2.4%
Normal (18.5-24.9)	12	14.3%
Overweight (25-29.9)	29	34.5%
Obese (≥30)	41	48.8%
Parity		
1-2	50	59.5%
3-4	22	26.2%
≥5	12	14.3%
Gestational age		
≤36	13	15.5%
>36	71	84.5%
Socio-Economic Status		
Poor (<10,000)	74	88.1%
Middle class (10,000 to 20,000)	10	11.9%
Sun exposure		
Yes	40	47.6%
No	44	52.4%
History of Hijab		
Yes	36	42.9%
No	48	57.1%
Vitamin D dependent diet		
Yes	46	54.8%
No	38	45.2%
History of Vitamin D deficiency		
Yes	35	41.7%
No	49	58.3%

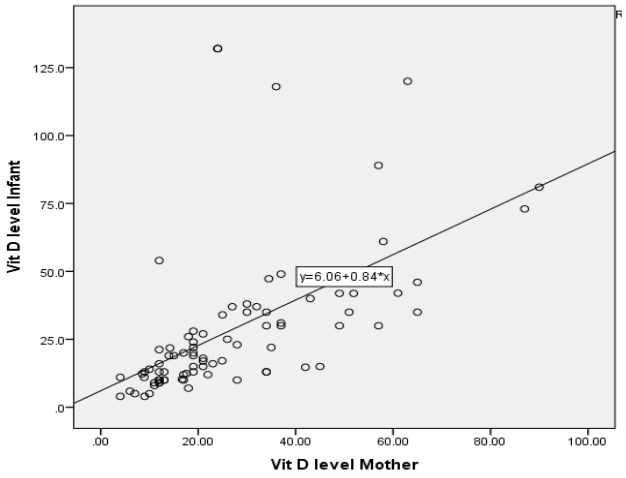

Figure 1. Pearson correlation of maternal and fetal vitamin level (n=84)

Table II: Vitamin D deficiency in pregnant women (n=84)			
Maternal vitamin D level	**Frequency**	**Percent**	**Mean±SD**
Normal/sufficient: 30-100	29	34.5	47.53±15.98
Deficient:<10	08	09.5	7.05±2.16
Insufficient: 10-29	47	56.0	17.49±5.22
Total	84	100.0	26.87±18.39
Infant's Vitamin D level			
Normal/sufficient: 30-100	29	34.50%	55.34±32.29
Deficient:<10	10	11.90%	6.59±2.06
Insufficient: 10-29	45	53.60%	16.08±524
Total	84	100.00%	28.51±27.57

Discussion

High prevalence of vitamin D3 in our country despite of having favorable natural conditions are less outdoor activities, skin pigmentation, customary clothing and no strategy for the protection of food items with vitamin D3. The deficiency of vitamin D3 among pregnant females and their newborn babies is still a big issue of health in developing countries. In this study, there was a positive correlation between maternal and neonatal vitamin D levels. Similarly, Ergur et al[11] reported that vitamin d deficiency during pregnancy is a significant factor for newborn vitamin D deficiency. However, some other studies also found a strong positive correlation between neonatal and maternal vitamin D levels.[12,13]

Greer FR reported that the deficiency of vitamin D level may be the cause of hazards health issues, not only in the mothers but also among their newborns because maternal sufficient vitamin D level is the major source of vitamin D3 among their fetus.[13] Palacios C, and Prentice A reported that several studies had showed higher incidence of deficiency of vitamin D3 in several countries among pregnant women from 4 to 60% and their newborns from 3% to 86%, respectively.[14,15] Our data was comparable to these studies showing 9.5% and 10.9% of pregnant women and newborns of these registered women with Vitamin D3 deficiency respectively. In 2008 and 2010 several studies have reported risk factors that affect the vitamin D3 level and they are limited exposure to the sun, dark toned skin, obesity, living in northern latitudes, extensive cover by clothing, poor status of nutrition, malabsorption, and many medications.[16,17] Our study did not show any effect on the majority of these factors and affecting vitamin D3 levels in mothers. In comparison to this

study, a study conducted in Turkey concluded that the winter season, lower status of education, lower socioeconomic status, and customary clothing are found to be causative factors deficiency of vitamin D3 among mothers.[18,19] Halicioglu et al also demonstrated that the traditional style of covered cloth may be the cause of deficiency of vitamin D3.[20] Several studies have shown lower weight a birth of infants was linked to the low circulating 25(OH)D3 levels of mothers[21] while others have noticed no differences as in this study.[22.23] Global data have documented the relation of maternal vitamin D3 deficiency with serious pregnancy complications including pre-eclampsia, infections, gestational diabetes mellitus, and caesarean section delivery.[24] Howe in a meta-analysis it is observed that there was no moderate or high evidence representing that the supplementation of vitamin D when contrast with controls, improvement in the metabolism of glucose, the adverse outcome of in mothers and in their newborns linked to gestational diabetes among pregnant females.[25] Consistently in a case-control study reported that there was an association between vitamin D concentrations and GDM, as females with lower concentrations of vitamin D have a significantly raised risk of gestational diabetes and adverse outcome of pregnancy as Macrosomia, anemia, amniotic fluid abnormalities, and miscarriage or stillbirth.[26]

Several studies have reported significant associations of maternal vitamin D3 deficiency with low birth weight, stunting, and small gestational age.[27] Exclusive breastfeeding is needed for 1st six months of life as the primary source of neonatal feeding and nutrition, although being aware of the fact that breast milk is the poor source of vitamin D3.[28,29]

Besides supplementation, cultural differences and lifestyle factors should also be underestimated when planning upcoming interventions in lower-income settings. There are several studies available in which several factors associated with maternal vitamin D3 deficiency (VDD) were assessed. Among these, wearing covering clothes for religious and cultural purposes (thereby less use exposure), infrequent outdoor activity, insufficient intake of vitamin D3 rich dietary sources, and having an overweight pre-pregnancy state were found to be high risks of lower vitamin D3 levels among mothers. Other series also confirmed that the aforementioned factors are consistent predictors of vitamin D3 deficiency. Furthermore, likely, the combination of supplementation and food fortification along with lifestyle changes (e.g., safe sun exposure) will provide the best approach to attain sufficient vitamin D3 levels in pregnant women.[30]

Vitamin D3 level in pregnant women of our community is deficient/insufficient at a significant level, and their newborns have also had nearly the same level of deficiency. Vitamin D insufficiency in women did not significantly relate to BMI, socio-economical or education level. There are very few options in the Asian diet to combat this insufficiency, which raise the need for legislation for the fortification of milk with vitamin D. Newborns with vitamin D deficient/insufficient mothers, are subsequently found to have rickets later in life. It has been reported that the likely causes of rickets are deficiency of vitamin D in mothers and non-supplementation of infants. Most of our children in Pakistan are exclusively breastfed, and it has been reported that the adequate intake of vitamin D3 cannot be met with human milk as the sole source of vitamin D. Limited data is available in Pakistan to know the burden of disease in pregnant women and their infants.

Conclusion

Maternal vitamin D3 deficiency and insufficiency was highly prevalent, found to be 9.5% and 55.9%. Maternal vitamin D deficiency proved a significant cause of infant vitamin D deficiency as there was a strong positive correlation. It has been concluded that providing vitamin D3 to women during pregnancy has a positive impact on their infants. So, this question calls for public health attention. Our study highlights the serious need for public health attention towards vitamin D3 deficiencies in pregnant women.

References

1. Krishnamachari KA, Iyengar L. Effect of maternal malnutrition on the bone density of the neonates. Am J Clin Nutr.1975;28(5):482–6.
2. Salle BL, Delvin EE, Lapillonne A. Perinatal metabolism of vitamin D. Am J Clin Nutr 2000; 71 (Suppl):1317S-1324S
3. Wagner CL, Frank R, Greer FR. Prevention of Rickets and Vitamin D Deficiency in Infants, Children, and Adolescents. Pediatrics. 2008; 122:1142–1152.
4. Greer FR. 25-Hydroxyvitamin D: functional outcomes in infants and young children. Am J Clin Nutr. 2008; 88:529–533.
5. Novakovic B, Galati JC, Chen A, Morley R, Craig JM, Saffery R. Maternal vitamin D predominates over genetic factors in determining neonatal circulating vitamin D concentrations. Am J Clin Nutr. 2012; 96:188–195.
6. Leffelaar ER, Vrijkotte TG, Van Eijsden M. Maternal early pregnancy vitamin D status in relation to fetal and neonatal growth: results of the multi-ethnic Amsterdam Born Children and their Development cohort. Br J Nutr. 2010; 104:108–117.

7. Bodnar LM, Catov JM, Simhan HN, Holick MF, Powers RW, Roberts JM. Maternal Vitamin D Deficiency Increases the Risk of Preeclampsia. J Clin Endocrinol Metab. 2007; 92:3517–3522.
8. Niyazoglu M, Hatipoglu E, Aydogan B, Dellal F, Yavuz A, Hacioglu Y, Kaya F, Kumru S. Relation of maternal vitamin D status with gestational diabetes mellitus and perinatal outcome. Afr Health Sci. 2015; 15:523–531.
9. Ahmed, M Atiq, J Iqbal, M Khurshid, P WhittakerVitamin D deficiency rickets in breast-fed infants presenting with hypocalcaemic seizures Article first published online: 21 JAN 2008DOI: 10.1111/j.1651-2227.1995.tb13798.x
10. Rab SM. Occult osteomalacia amongst healthy and pregnant women in Pakistan Lancet. 1976; 2(7997):1211-3.
11. Ergur AT, Berberoglu M, Atasay B, Sıklar Z, Bilir P, Arsan S, Söylemez F, Öcal G. Vitamin D deficiency in Turkish mothers and their neonates and in women of reproductive age. J Clin Res Pediatr Endocrinol. 2009; 1:266–269.
12. Wagner CL, Frank R, Greer FR. Prevention of Rickets and Vitamin D Deficiency in Infants, Children, and Adolescents. Pediatrics. 2008; 122:1142–1152.
13. Greer FR. 25-Hydroxyvitamin D: functional outcomes in infants and young children. Am J Clin Nutr. 2008; 88:529–533.
14. Palacios C, Gonzales L. Is vitamin D deficiency a major global public health problem? J Steroid Biochem Mol Biol. 2014; 144:138–145.
15. Prentice A. Vitamin D deficiency: a global perspective. Nutr Rev. 2008; 66:153–164.
16. Holick MF, Chen TC. Vitamin D deficiency: a worldwide problem with health consequences. Am J Clin Nutr. 2008; 87:1080–1086.
17. Mulligan ML, Felton SK, Riek AE, Bernal-Mizrachi C. Implications of vitamin D deficiency in pregnancy and lactation. Am J Obstet Gynecol. 2010; 202:429.e1–e429.
18. Ergur AT, Berberoglu M, Atasay B, Sıklar Z, Bilir P, Arsan S, Söylemez F, Öcal G. Vitamin D deficiency in Turkish mothers and their neonates and in women of reproductive age. J Clin Res Pediatr Endocrinol. 2009; 1:266–269.
19. Andiran N, Yordam N, Ozön A. Risk factors for vitamin D deficiency in breast-fed newborns and their mothers. Nutrition. 2002;18:47–50.
20. Halicioglu O, Aksit S, Koc F, Akman SA, Albudak E, Yaprak I, Coker I, Colak A, Ozturk C, Gulec ES. Vitamin D deficiency in pregnant women and their neonates in spring time in western Turkey. Paediatr Perinat Epidemiol. 2012; 26:53–60.
21. Leffelaar ER, Vrijkotte TG, Van EM. Maternal early pregnancy vitamin D status in relation to fetal and neonatal growth. Br J Nutr. 2010; 104:108–17.
22. Farrant HJW, Krishnaveni GV, Hill JC, et al. Vitamin D insufficiency is common in Indian mothers but is not associated with gestational diabetes or variation in newborn size. Eur J Clin Nutr. 2009; 63:646–52.
23. Maghbooli Z, Hossein-Nezhad A, Shafaei AR, Karimi F, Madani FS, Larijani B. Vitamin D status in mothers and their newborns in Iran. BMC pregnancy and childbirth. 2007 ;7(1):1-6.
24. Aghajafari, F.; Nagulesapillai, T.; Ronksley, P.E.; Tough, S.C.; O'Beirne, M.; Rabi, D.M. Association between maternal serum 25-hydroxyvitamin D level and pregnancy and neonatal outcomes: Systematic review and meta-analysis of observational studies. Br. Med. J. 2013; 346.
25. Rodrigues MR, Lima SA, Mazeto GM, Calderon IM, Magalhães CG, Ferraz GA, Molina AC, Costa RA, Nogueira VD, Rudge MV. Efficacy of vitamin D supplementation in gestational diabetes mellitus: Systematic review and meta-analysis of randomized trials. PloS one. 2019 Mar 22;14(3):e0213006..
26. Wen J, Hong Q, Zhu L, Xu P, Fu Z, Cui X, You L, Wang X, Wu T, Ding H, Dai Y. Association of maternal serum 25-hydroxyvitamin D concentrations in second and third trimester with risk of gestational diabetes and other pregnancy outcomes. International journal of obesity. 2017 Apr;41(4):489-96.
27. Van der Pligt P, Willcox J, Szymlek-Gay EA, Murray E, Worsley A, Daly RM. Associations of Maternal Vitamin D Deficiency with Pregnancy and Neonatal Complications in Developing Countries: A Systematic Review. Nutrients. 2018; 10(5):640.
28. Takeuchi, A.; Okano, T.; Tsugawa, N.; Tasaka, Y.; Kobayashi, T.; Kodama, S.; Matsuo, T. Effects of ergocalciferol supplementation on the concentration of vitamin D and its metabolites in human milk. J. Nutr. 1989, 119, 1639–1646.
29. Saadi HF, Dawodu A, Afandi BO, Zayed R, Benedict S, Nagelkerke N. Efficacy of daily and monthly high-dose calciferol in vitamin D–deficient nulliparous and lactating women. The American journal of clinical nutrition. 2007 Jun 1;85(6):1565-71.
30. Eggemoen ÅR, Falk RS, Knutsen KV, Lagerløv P, Sletner L, Birkeland KI, Jenum AK. Vitamin D deficiency and supplementation in pregnancy in a multiethnic population-based cohort. BMC pregnancy and childbirth. 2016 ;16(1):1-0.