

Original Research Article

Study of correlation between maternal and cord blood vitamin D3 levels

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ABSTRACT

Background: Vitamin D deficiency during pregnancy and in newborn period is common in this country. Vitamin D status of the mother is known to influence the vitamin D levels in the neonate, however how closely the maternal vitamin D level correlates with the cord blood Vitamin D is not clearly understood. To study the correlation between maternal and neonatal serum Vitamin D3 levels by as indicated by cord blood 25(OH)D levels and find out if there is a significant variation of cord blood 25(OH)D levels in Vitamin D sufficient and insufficient mothers.

Methods: Healthy pregnant women between 18-45 years of age with no known history of chronic disease or long-term medication, consenting for the study were enrolled. Maternal blood sample was collected in peripartum period, cord blood sample was obtained after delivery from the umbilical cord after clamping. Vitamin D3 levels were measured by RIA and paired maternal and cord blood levels were statistically analyzed.

Results: 569 paired samples of maternal and cord blood were analyzed. The mean maternal serum 25(OH)D level was 35.63ng/ml (sd 6.18, range 9.2-39.8) as compared to 13.52ng/ml (sd 3.79, range 7.9-27) for the neonates. 457 of the mothers were found to have sufficient, 101(18%) insufficient and 11(2%) deficient Vitamin D levels as per Endocrinological Society guidelines. In comparison, 535(94%) of the neonates had deficient levels, none of the neonates had sufficient Vitamin D levels, 34(5.99%) had insufficient levels. No significant correlation was found between maternal and neonatal serum vitamin 25(OH)D levels ($r=0.007$, $P=0.85$).

Conclusions: Maternal and Cord blood serum Vitamin D3 levels were found to be poorly correlated in this study.

Keywords: 25(OH)D, Cord-blood, Correlation, Hypovitaminosis-D, Maternal, Vitamin-D3

INTRODUCTION

Vitamin D is a steroid hormone with diverse actions in body ranging from calcium and phosphorus homeostasis to recently uncovered non metabolic actions like those related to cancer, cardiovascular disease, autoimmune disease and infections.¹⁻³ One billion people around the world are estimated to be Vitamin D deficient, ironically while it is called 'sunshine vitamin' its deficiency is widespread in the tropics.⁴ What is especially of concern is the wide prevalence of Vitamin D deficiency (VDD) in pregnant women especially in the Indian subcontinent.⁵

During gestation Vitamin D status of the mother acquires greater importance due to the dependence of the growing fetus on maternal vitamin D. In neonates hypocalcemia, impaired growth, skeletal deformity, decreased bone mineral density, seizures and low birth weight are associated with low vitamin D levels.⁶ Maternal vitamin D status depends on consumption, absorption and metabolism of dietary Vitamin D.^{7,8}

The aim of this study is to correlate the maternal and neonatal serum Vitamin D3 levels by as indicated by cord blood 25(OH)D levels and find out if there is a significant

variation of cord blood 25(OH)D levels in Vitamin D sufficient and insufficient mothers.

METHODS

The study was conducted between July 2014 and June 2015 at a tertiary care hospital in Mumbai, India. Healthy pregnant women between 18-45 years of age with no known history of chronic disease or long-term medication, consenting for the study were enrolled. Maternal blood sample was collected in peripartum period, cord blood sample was obtained after delivery from the umbilical cord after clamping, in sterile tubes. Personal and demographic data was obtained through questionnaire. Infant birth weight, APGAR scores, OFC, length, approximate Gestation age etc was documented.

Inclusion and exclusion criteria

Pregnant women between age of 18 to 45 years with no known morbidity who gave written consent were included in the study. Women with known history of any chronic infection, acute or chronic renal, neurological, gastrointestinal and hematological disease or on any long term medication were excluded from the study. Women with pregnancy related morbidities were however retained in the study.

Sample collection

Samples were collected after obtaining prior consent in the antenatal period from mothers registered with the hospital. Cord blood from placental end was collected for each neonate after clamping of the cord. The paired samples were then stored in -80°C until testing.

Biochemical analysis

Serum 25(OH)D levels were measured with STARTEC SR 300 RIA analyzer (STARTEC Biomedical Systems, AG Germany) using 25(OH)D Iodine-125 RIA after proper standardization in the Endocrine Lab of the hospital.

Data analysis

Analysis of the data was done using SPSS software (Version 20). Continuous variables were analyzed using Students-t test. Correlations were studied using Pearson's Coefficient. A 'p' value of <0.05 taken as statistically significant.

Endocrine Society's practice guideline was followed to label Vitamin D Deficiency (<20ng/ml), Insufficiency (21-29 ng/ml) and Sufficient (>30 ng/ml).⁹

RESULTS

A total of 569 paired samples were collected for the study from eligible maternal and neonatal pairs. 417(73.28%)

of the neonates delivered vaginally; 152(26.71%) by Cesarean section. There were 252(44.2%) males and 317(55.7%) females, 501(88.04%) were term neonates and 68(11.95%) preterm; 465 (81.72%) had normal birth weight (NBW) while 104(18.22%) were low birth weight (LBW). The birth weight of 476(83.65%) neonates were appropriate for gestation (AGA) and 93(16.34%) were small for gestational age (SGA).

A total of 569 paired samples of maternal and cord blood were analyzed for serum 25(OH)D levels in this study. The mean maternal Serum 25(OH)D level was 35.63ng/ml (sd 6.18, range 9.2-39.8) as compared to 13.52ng/ml (sd 3.79, range 7.9-27) for the neonates. 457 of the mothers were found to have sufficient, 101(18%) insufficient and 11(2%) deficient Vitamin D levels as per Endocrinological Society guidelines.⁽⁹⁾ In comparison, none of the neonates had sufficient Vitamin D levels, 34(5.99%) had insufficient and a vast majority 535(94%) had deficient levels. (Table 1).

Table 1: Comparison of maternal and cord blood 25(OH)D levels.

	Maternal 25(OH)D levels	Cord blood 25(OH)D levels
N	569	569
Mean(ng/ml)	35.629	13.529
SD	6.18	3.79
Range (ng/ml)	9.2-39.8	7.9-27
VDS (%)	457 (80%)	0
VDI (%)	101 (18%)	34 (5.99%)
VDD (%)	11 (2%)	535 (94.00%)
r value	0.0077	

*VDS=Vitamin D sufficient, VDI=Vitamin Insufficient, VDD=Vitamin D deficiency.

Table 2: Comparison of VDS maternal and corresponding cord blood 25(OH)D levels.

	Maternal 25(OH)D levels	Cord blood 25(OH)D levels
N	457	457
Mean(ng/ml)	37.93	13.57
SD	3.91	3.85
Range (ng/ml)	30.1-49	7.9-25
VDS (%)*	457	NIL
VDI (%)*	NIL	28(6.126%)
VDD (%)*	NIL	429(93.8%)
r value	0.06	

*VDS=Vitamin D sufficient, VDI=Vitamin Insufficient, VDD=Vitamin D deficiency.

The Pearson correlation coefficient (r) for the association between maternal and neonatal 25(OH)D levels was (r < 0.00777040836098867). The regression equation predicting neonatal 25(OH)D from maternal 25(OH)D

revealed that there is no association between maternal and cord blood ($r=0.8532$)

There were 457 mothers who had sufficient Vitamin D levels, the mean 25(OH)D level of this group was 37.93ng/ml (sd 3.91, range 30.1-49), the corresponding mean cord blood 25(OH)D level was 13.57ng/ml (sd 3.85, range 7.9-25) which was nearly identical to the overall result (Table 2). The correlation was weak ($r=0.06$) and was not significant (p value = 0.20). 34(5.99%) neonates in this group had insufficient levels of Vitamin D and 535(94%) had deficient levels which was similar to the overall results.

Similarly, when the mothers with insufficient levels of Vitamin D were segregated, the mean Vitamin D levels were found to be 27.42ng/ml (sd 2.46, range 21-29), the corresponding cord blood Vitamin D level was 13.47ng/ml (sd 3.58, range 8.7-24.7), which was poorly correlated (r value =0.188) (Table 3). 06(5.94%) of the neonates had Vitamin D insufficiency and 95(94.05%) had deficiency which was again similar to the overall results.

Table 3: Comparison of VDI maternal and corresponding cord blood 25(OH)D levels.

	Maternal 25(OH)D levels	Cord blood 25(OH)D levels
N	101	101
Mean(ng/ml)	27.42	13.47
SD	2.46	3.58
Range (ng/ml)	21-29	8.7-24.7
VDS (%)*	NIL	NIL
VDI (%)*	101	06(5.94%)
VDD (%)*	NIL	95(94.05%)
r value	0.188	

*VDS=Vitamin D sufficient, VDI=Vitamin Insufficient, VDD=Vitamin D deficiency

There were 11 mothers who had Vitamin D deficiency, the mean vitamin D level of this group was 14.57ng/ml(sd 4.64, range 9.2-20), all the neonates in this group were Vitamin D deficient, the mean level was 12.06ng/ml(sd 2.7., range 9.3-17.3) which was significantly less than the other groups. However, the correlation between the maternal and cord blood values were poor ($r=0.063$).

DISCUSSION

In this study no significant correlation was found between maternal and neonatal serum vitamin 25(OH)D levels ($r=0.007$, $P=0.85$) (Figure 1).

In a 2009 Australian study Bowyer et al, found close correlation between maternal and cord blood 25(OH)D levels levels (correlation coefficient = 0.74, $P< 0.001$).¹⁰

These finding is at a variance to this study. The median time between the collection of maternal and neonatal samples was 2.7 months in the study.

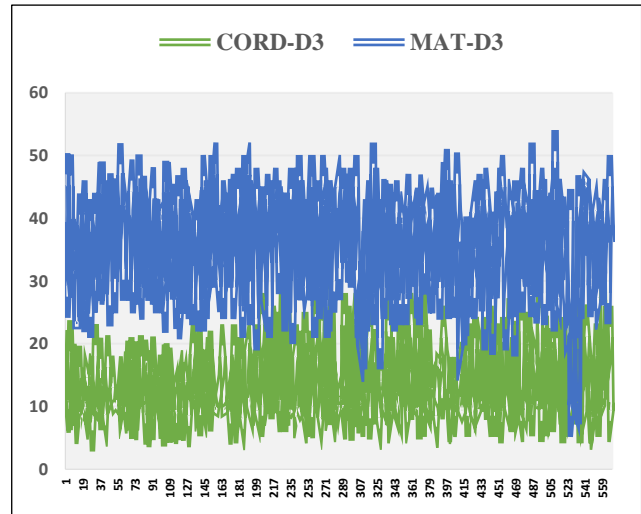


Figure 1: Relationship between cord and maternal 25(OH)D levels.

Sachan et al, in their 2005 study showed a positive correlation between maternal serum 25(OH)D with cord blood 25(OH)D ($r=0.79$, $P <0.001$).⁵ The results do not match with this study, it is possible that a smaller sample size ($n=117$) and the mothers being predominantly Vitamin D deficient may have influenced the results.

Hossain et al, also found positive correlation between maternal and cord blood 25-hydroxy vitamin D3 levels ($r =0.68$; $P < 0.001$).¹¹ The study was small in size ($n=75$).

Authors have compared the earlier studies with the current one in Table 4.

Table 4: Comparative chart showing correlation between maternal vitamin D levels and neonatal vitamin D levels.

	Bowers et al ¹⁰	Sachan et al ⁵	Hossain et al ¹¹	Present study
n	604	207	75	569
P value	<0.001	<0.001	<0.001	0.85
r value	0.74	0.79	0.68	0.007
Inference	SIG	SIG	SIG	NOT SIG

*SIG = Significant

All the three studies mentioned above do not agree with this study. The study by Bowers et al, the possible explanation could be the study population, method of estimation of Vitamin D (Nicholas automated assay), is associated with over estimation of Vitamin D and no history of dietary intake of dairy product and Calcium supplementation was taken. The other two studies were done on small sample size.

Authors also noted that there was an important variance in earlier studies. While Bowyer et al, reported that compared with mothers, fewer neonates were vitamin D deficient (n= 98, 11%) and insufficient (n= 257, 29%). The 25(OH)D levels in the cord blood (median 60 nmol/l, range 17–245 nmol/l) were significantly higher than maternal levels (P<0.001 for difference). Whereas in the study by Sacchan et al, more than 95% of the neonates were found to be Vitamin D3 deficient, out numbering the mothers with hypovitaminosis D. The finding of Hossien et al, was similar, that is more neonates were vitamin D deficient as compared the mothers.

While all the three studies reported close correlation between maternal and cord blood Vitamin D3 levels, the former reported fewer neonates with vitamin D deficiency compared to the mother and the latter two studies concluded the exact opposite. This can be a cause of much confusion. In this study author did not find any correlation between maternal and cord blood vitamin D3 levels.

CONCLUSION

In contrast to earlier studies which had reported a positive correlation, this study found a poor relationship between maternal and cord blood serum Vitamin D3 levels. While further studies with larger number of subjects are required to substantiate our finding, it would be prudent to state that using maternal Vitamin D3 sufficiency as a surrogate for neonatal Vitamin D3 sufficiency or vice versa may not be accurate.

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