Section: Pediatrics

Original Research Article

# AN OBSERVATIONAL STUDY ON CORRELATION OF NEONATAL AND MATERNAL VITAMIN D LEVELS

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ABSTRACT

**Background:** As there are limited studies available on supplementation of mothers with Vitamin D during their pregnancy and the effect of Hypovitaminosis D in mothers on the newborns' Vitamin D status, opinion is still divided as to whether it requires a proper protocol. **Objectives:** To study the prevalence of Vitamin D deficiency in newborns in an urban healthcare setup in Jaipur Golden Hospital, Delhi. To study the correlation of Vitamin D levels in newborns with their mothers.

**Materials and Methods:** An observational Cross Sectional Study conducted over a period of 2 years in Jaipur Golden Hospital. 106 pairs of newborns and mothers were recruited. Serum 25-(OH) Vitamin D levels of newborns and their mothers were taken.

**Results:** Mean Vitamin D levels were 18.58 ±10.65 (maternal) and 16.94 ±9.46 (neonatal) and prevalence of Vitamin D deficiency and insufficiency was 61.32% and 33.96% (newborns) respectively and 56.6% and 28.3% (mothers) respectively. A significant correlation was found between Vitamin D levels of newborns and mothers ($r=0.933$, $p<0.0001$); between maternal Vitamin D levels and sunlight exposure ($p=0.005$) and with antenatal Vitamin D intake ($p=0.0002$) and between maternal Vitamin D level A and birth weight of the baby($r=0.201$, $p=0.03$).

**Conclusion:** A high prevalence of Vitamin D deficiency was found and maternal Vitamin D levels strongly correlated to that of newborns' levels. Antenatal Vitamin D intake along with adequate sunlight exposure was found to be beneficial in terms of Vitamin D status of the mother.

**Keywords**: Vitamin D deficiency, Cord blood Vitamin D, Prevalence, sunlight, antenatal Vitamin D intake.

## INTRODUCTION

Vitamin D deficiency is a common public health problem,[1,2] and the most common nutritional deficiency,[3] in both developing and developed countries.[4] Although India is a tropical country with abundant sunshine; still Vitamin D deficiency is very common in India in all age groups and both sexes across the country. This might be a result of insufficient outdoor activity in urban areas, dark skin colour, poor dietary calcium causing secondary Vitamin D deficiency and environmental pollution accounting for high prevalence of Vitamin D deficiency in the country.[5-8]

During intrauterine development, the fetus accumulates about 30gms of calcium from maternal circulation and it has been estimated that the fetus accumulates up to 250 mg/d calcium during the third trimester,[9] and during lactation, a further 280-400 mg/day calcium is secreted into milk.[10] This results in an increased demand of calcium in mother, so it's important to ensure adequate vitamin D levels for appropriate intestinal absorption of calcium and further for the fetus.

In a population with a high prevalence of vitamin D deficiency and poor dietary calcium intake, the problem is likely to worsen during pregnancy and may cause significant consequences in the newborn.[11]

During pregnancy and lactation, significant changes in maternal vitamin D and calcium metabolism occur to provide the calcium that is needed for fetal bone mineral accretion. During the first trimester, the fetus accumulates 2-3 mg/d in the skeleton; however, this rate of accumulation doubles in the last trimester.[12]

Vitamin D deficiency can cause the following in newborns:

**1) Low Birth Weight:** Studies have reported that the incidence of low birthweight was significantly lower in newborn infants from mothers who received the recommended doses of calcium and vitamin D,[13,2]

**2) Skeletal Development:** Poor skeletal mineralization in-utero that is induced by vitamin D deficiency may manifest as congenital rickets, craniotabes, or osteopenia in newborn infants. Congenital rickets is rare, typically occurring only in infants born to mothers with severe vitamin D deficiency and osteomalacia. In full-term infants, impaired fetal bone ossification correlated with maternal vitamin D deficiency.[14,15]

**3) Childhood Illnesses: a) Asthma:** Vitamin D Signalling pathways and receptor polymorphisms may have effects on Th1,-Th2 imbalance, smooth muscle contraction, airway inflammation, prostaglandin regulation, and airway remodelling, all of which can impact asthma control.[16]

**b) Type I Diabetes Mellitus:** The Diabetes Autoimmunity Study in the Young reported that autoantibodies to islet cells are correlated inversely with maternal dietary vitamin D intake during pregnancy.[17]

In view of the Adverse health outcomes linked to low Vitamin D levels during pregnancy & infancy,[18] we decided to study the Vitamin D levels in mothers and correlate them with the levels in the newborns in our hospital in North Delhi so that enough data could be provided on the prevalence and correlation of Vitamin D deficiency in newborns and their mothers in order to supplement newborns with Vitamin D appropriately and start screening mothers antenatally for Vitamin D levels.

## MATERIALS AND METHODS

This study was conducted in JAIPUR GOLDEN HOSPITAL, Rohini, NewDelhi. The hospital is a 270-bedded Tertiary Care Referral Centre. The Departments of Gynaecology and Paediatrics is well-versed with round the clock Laboratory services, Blood bank, Radiology, Pediatric Surgery and Pediatric sub-speciality Departments. The study was conducted from November 2015 to November 2017. The sample size was calculated based on correlation of Vitamin D levels in newborns and their mothers. With reference to previous studies (145), there was a strong correlation between maternal and newborn Vitamin D levels (r=0.6). Expecting the same, at α-level of 0.05 and power of 90%, the sample size calculated was 25. But we took around 100 patients during the study period.

**Formula used is:**

$$N = \left(\frac{Z_\alpha + Z_\beta}{C(r)}\right) + 3$$

$$C(r) = \frac{1}{2} log_e \frac{1+r}{1-r}$$

Where Zα is value of Z at two sided alpha error of 5% and Zβ is value of Z at power of 90%.

**Inclusion Criteria**

- All term newborns
- All mothers in their final trimester, term gestation, admitted in JGH for delivering their baby either through Normal Vaginal Delivery or through Lower Segmental Caesarean Section

**Exclusion Criteria**

- All preterm babies and mothers with suspicion of preterm labour Term babies with perinatal asphyxia and congenital malformations
- All mothers with h/o
  - Rheumatoid Arthritis
  - Disorders of thyroid, parathyroid or adrenals
  - Hepatic or renal failure
  - Metabolic bone disease
  - Type 1 DM
  - Women on drugs affecting vitamin D levels
  - Malabsorption

**Statistical Analysis**

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD and median, Normality of data was tested by Kalmogorov-Smimov test. If the normality was rejected then non parametric test was used.

**Statistical tests were applied as follows**

1. Quantitative variables were compared using Unpaired t-test/Mann-Whitney Test (when the data sets were not normally distributed) between the two groups and ANOVA/Kruskal Wallis test between more than two groups.
2. Qualitative variables were correlated using Chi-Square test /Fisher's exact test.
3. Spearman rank correlation coefficient was used to correlate Vitamin D of mother with various parameters.

A p-value of <0.05 was considered statistically significant. The data was entered in MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

## RESULTS

A total of the one hundred eighteen newborns and mother pairs were recruited in the study as per inclusion & exclusion criteria during the study period. Serum 25-0OH Vitamin D and ionic calcium levels of all newborns and Vitamin D levels of their mothers were measured. Followings results were obtained.

Newborns and mother pairs recruited (n=118)
Eligible (n=110)
Excluded pairs (n=8) (Perinatal asphyxia in newborn (n=3)) (Type I Diabetes Mellitus in mother (n=2) (Mother on Anti TB Treatment (n=3))

Pt refused to give consent for sample (n=4)
Enrolled = 106 pairs
Outcome measured-106 pairs

**Table 1: Distribution of mothers according to their Vitamin D adequacy**

| Vitamin D adequacy (mother) | Frequency |
|---|---|
| Deficient (<20 ng/ml) | 60 |
| Insufficient (20-29 ng/ml) | 30 |
| Sufficient (>30 ng/ml) | 16 |
| Total | 106 |

**Table 2: Mean neonatal Vitamin D level distribution according to maternal Vitamin D adequacy**

| | Deficient | Insufficient | Sufficient | Total |
|---|---|---|---|---|
| **Deficient** | 54 (90%) | 8 (26.67%) | 3 (18.75%) | 61.32% |
| **Insufficient** | 6 (10 %) | 22 (73.33%) | 8 (50.00%) | 33.96% |
| **Sufficient** | 0 (0%) | 0 (0%) | 5 (31.25%) | 4.72% |
| **Total** | 60 (100.00%) | 30 (100.00%) | 16 (100.00%) | 100.00% |

**Table 3: Distribution of mothers as per their Vitamin D intake antenatally into two groups according to their Vitamin D adequacy**

| | Deficient | Insufficient | Sufficient |
|---|---|---|---|
| **Adequate antenatal intake of Vitamin D** | 0% | 16.67% | 31.25% |
| **Inadequate antenatal intake of Vitamin D** | 100% | 83.3% | 68.75% |

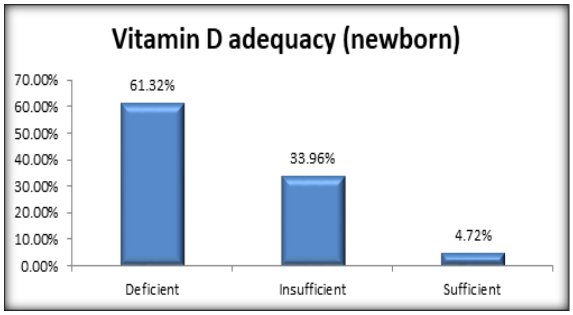


**Figure 1: Distribution of newborns according to their Vitamin D adequacy**

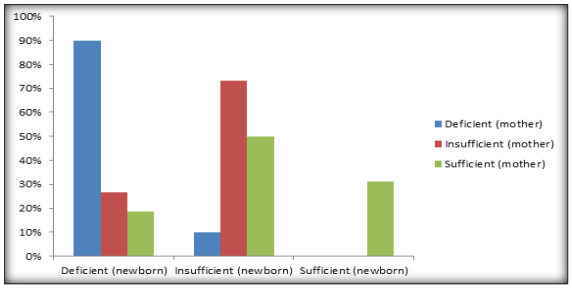


**Figure 2: Distribution of newborns as per their Vitamin D adequacy in 3 groups**

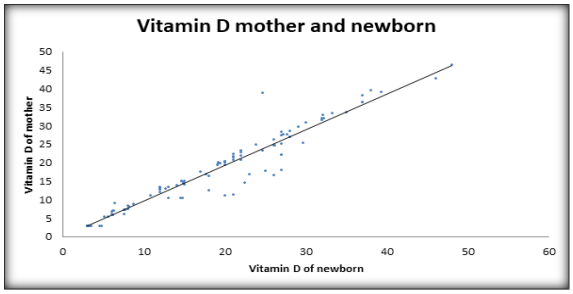


**Figure 3: Correlation of neonatal Vitamin D levels with maternal Vitamin D**

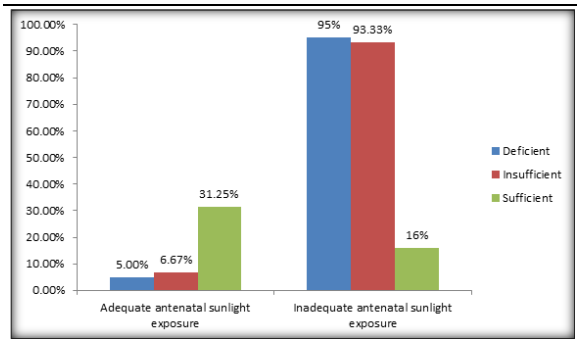


**Figure 4: Mean maternal Vitamin D level distribution according to adequacy of sunlight exposure**

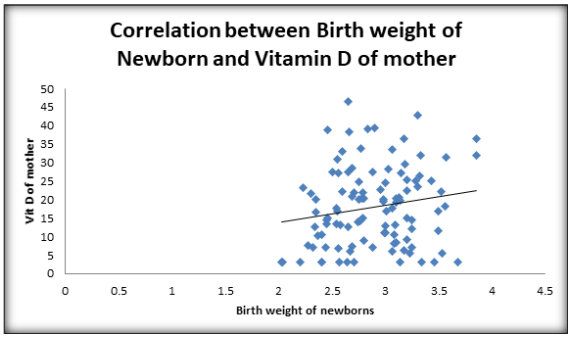


**Figure 5: Correlation of maternal Vitamin D levels with birth weight of newborns**

In the present study, the prevalence of Vitamin D deficiency is reported to be lower than other studies because we have divided our study population into an insufficient and deficient groups exclusively rather than just taking a cut off as the parameter and did the study in an urban population in a tertiary

care centre of New Delhi also, the cutoff for Vitamin D values was different in other studies.

## DISCUSSION

We observed high prevalence of vitamin D deficiency in mothers and their newborns in our hospital. Maternal Vitamin D deficiency was found to be strongly associated with neonatal Vitamin D deficiency. Inadequacy of sunlight exposure and antenatal Vitamin D intake were found to be significant risk factors for maternal Vitamin D deficiency which was further found to be associated with lower birth weight in neonates.

Though India is a tropical country with ample amount of sun light vitamin D supplementation is needed due to dark skin which require higher amount of ultraviolet light to generate adequate Vitamin D, inadequate sun exposure, increasing trend of pollution and due to customs and cultural practices.

**Table 4: Comparison of prevalence of Vitamin D Deficiency in various studies**

| S. No | Year of study | Authors | Prevalence in newborns | Prevalence in mothers | Correlation between neonatal and maternal Vitamin D levels |
|---|---|---|---|---|---|
| 1 | 2017 | Present study | 61.32% | 56.6% | r=0.933, p<0.0001 |
| 2 | 2016 | Shipra Kamal et al | 83.1% | 77.9% | r=0.887, p<0.001 |
| 3 | 2016 | Imene D Ayadi et al | 98% | 97% | r=0.69, p<0.001 |
| 4 | 2015 | Pradeep kumar et al | 98% | 97% | r=0.6, p<0.001 |
| 5 | 2014 | El Rifai et al | 60% | 40% | r=0.7, p<0.0001 |
| 6 | 2007 | Joyce M Lee et al | 81.8% | 75.5% | P<0.001 |
| 7 | 2007 | ZhilaMaghbooli et al | 93.3% | 66.8% | r=0.706, p=0.0001 |
| 8 | 2004 | Sachan et al | 95.7% | 66.7% | r=0.79%, p<0.001 |

Vitamin D supplementation was recommended from as early as 1940s.[20,21,22] At present there are no recommendations for Vitamin D Supplementation in India nor is it a part of any antenatal care programs. The US National Academy of Sciences mentions 4001U as the dietary reference intake of Vitamin D during pregnancy.[19] However, various investigators worldwide are arguing for more standard guidelines for Vitamin D supplementation during pregnancy and lactation. Even after recommendations from many studies and Organizations to supplement vitamin D to all infants we find cases of nutritional deficiency due to lack of supplementation.

Also, IAP recommends a minimum daily intake of 400 IU/day for infants who are exclusively breast fed to be initiated within a few days after birth which is already being practiced in our hospital.

So, we recommend registered for pregnancy and start supplementing them with appropriate dose of Vitamin D in order to avoid Vitamin D deficiency in their newborns and its further implications in both mothers and newborns.

**Vitamin D deficiency in infants can be prevented by the following measures**

a) Supplementing vitamin D to all pregnant and lactating mothers. Supplementing vitamin D to all infants.
b) Exposing pregnant and lactating women and their infants to sufficient amount of sunlight.
c) Public education campaigns voicing importance of vitamin D during pregnancy and infancy through community organizations might be arranged.

## CONCLUSION

The study was conducted in the Jaipur Golden Hospital, Rohini, New Delhi. Out of the total of 118, 106 newborns and mother pairs were recruited into the study as per inclusion and exclusion criteria.

A detailed history including sun exposure, antenatal Vitamin D intake, parity, medical history and obstetric history was taken.

Serum 25(OH) levels were measured in all the pregnant women in third trimester on their admission before delivery and in the cord blood of their newborns at birth.

The data was documented as per the proforma and a master chart was prepared. Statistical analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

Out of 1 06 pairs of mothers and newborns under the study, 65(61.32%) and 36(33.96%) of the newborns were found to have deficient and insufficient Vitamin D levels respectively. 60(56.60%) and 30(28.30%) of the mothers were found to have deficient and insufficient Vitamin D levels respectively. A significant correlation of Vitamin D levels of the newborns and mothers was found to be statistically significant (r-0.933, p-0.0001).

A statistically significant correlation was found between maternal Vitamin D levels and sunlight exposure (p=0.005) and with antenatal Vitamin D intake (p-0.0001).

A statistically significant correlation was also found between maternal Vitamin D level A and birth weight of the babyr-0.201, p-0.039).

No statistically significant correlation was found between maternal Vitamin D levels and sex of the baby, age of the mother and parity, Also there was no correlation between the Vitamin D of the newborns and their ionic calcium levels.

Out of total of 106 mothers, only l0 mothers had adequate sunlight exposure with 96 having inadequate sunlight Exposure and only 10 mothers

had adequate antenatal Vitamin D intake and 96 had inadequate antenatal Vitamin D intake.

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