

Relationship between Maternal Vitamin D Levels and Risk of Low Birth Weight in Term Newborns: A Case Control Study

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Abstract

Introduction: Vitamin D is classically help in the calcium and phosphate homeostasis regulation. It is increasingly being recognized to have a multitude of effects on various cellular levels and signaling system. Vitamin D level of the mother during pregnancy is also assuming great importance as it is expected to have the potential to influence the birth weight.

Objectives: To identify associations between maternal deficiency of vitamin D and risk of low birth weight among term newborns and evaluate the socio-demographic factors associated with it.

Material and Methods: A case control study was carried out in the Neonatal Division, JNMCH, during September 2016 to August 2018. Mothers (n=208) were divided into two groups with newborns birth weight <2.5 kg (cases) and 2.5 kg or more (controls). Maternal socio-demographic history and anthropometric examinations of the newborns were noted in a proforma. Maternal vitamin D levels were estimated. Maternal vitamin D statuses of both groups were compared. Analysis was done by SPSS 25.

Results: Mean vitamin D level in mothers of LBW (Low Birth Weight) new-borns (Cases) 12.375 ± 4.20 ng/mL while in mothers of normal birth weight new-borns (Controls) was 16.987 ± 6.38 ng/mL and there is statistically significant correlation between maternal low vitamin D levels and birth weight of term newborns ($p < 0.01$). Also there is positive correlation between maternal vitamin D status and residence, calcium supplementation, seasonal variation, daily sun exposure and shows no correlation with maternal age, educational qualification, parity of mother, BMI and occupation of mothers.

Conclusions: We found high prevalence of low levels of vitamin D in mothers. Low vitamin D levels were significantly associated with LBW and it was found to be associated with certain modifiable and non-modifiable risk factors. There is a need for recommendation for vitamin D supplementation during pregnancy.

Keywords: Pregnancy; Newborns; Birth weight; Vitamin D status; Socio-demographic status

Introduction

Hypovitaminosis D, especially among pregnant women, is a major public health problem with a very high prevalence ranging from 18% to 84%. The levels depend on the residence and local clothing style [1,2]. Pregnancy in vitamin D deficient mothers poses an extra load reducing maternal 25(OH)D levels even further [3,4]. Maternal vitamin D levels have been shown to positively correlate with birth weight centile as has been shown in studies from various countries [5-7].

In a population that already has a high burden of low levels of vitamin D and poor calcium intake in the diet, the scenario is likely to worsen during pregnancy as the active transplacental transport of calcium to the developing fetus. Low level of vitamin D during pregnancy has important consequences for the newborn including low birth weight [8,9]. SGA (Small for Gestational Age) births are reported

more frequent in pregnancies occurring in the winter with vitamin D deficiency [10].

Vitamin D deficiency is unexpected in India, a tropical country where there is adequate overhead sun for most of the time all of the year. Nevertheless, low level of vitamin D, resulting in severe manifestations, has been observed in India [11]. This paradox may be partly explained by the local social and cultural practices in India that preclude adequate exposure of adolescent girls and young women to sunshine. Recent urbanization that results in poor outdoor activity and greater pollution burden, coupled with other factors, may further aggravate this problem [12,13].

In this study, which was the first investigation in this part of the country, we were intended to compare the maternal low vitamin D levels between LBW and normal birth weight newborns.

Objectives

Primary

To identify associations between maternal low vitamin D levels and risk of LBW among term newborns.

Secondary

To evaluate the socio-demographic factors associated with low vitamin D levels in mothers.

Materials and Methods

This study (a case control study) was conducted in the Neonatal Division department of pediatrics in collaboration with department of Obstetrics & Gynecology and Rajiv Gandhi Centre for Diabetes and Endocrinology, JNMCH, AMU, Aligarh from September 2016 to August 2018. Two hundred eight babies born with gestational age 37-41 weeks with birth weight <2500 g (Cases=104) or >2500 g (Controls=104) were included in the study. Babies with congenital malformations, GA <37 weeks or >42 weeks, mothers with any systemic diseases or on any medications that influence vitamin D metabolisms and refusal to give consent were excluded. The ethical clearance was obtained from Institutional Ethics Committee, JNMCH, Faculty of Medicine, AMU, Aligarh.

Brief Procedure

After taking written informed consent from the parent of the eligible subjects, a detailed history and physical examination was done and the findings were recorded on a pre-designed proforma. Approximately 5 mL of maternal blood was withdrawn for estimation of serum vitamin D level. Total circulating 25(OH)-D was assayed on Access 2 immunoassay system (Beckman Coulter) using chemiluminescence in the laboratory. The levels were classified as deficiency <12 ng/mL, insufficiency:12-20 ng/mL sufficiency >20 ng/mL (Food and Nutrition Board, Ministry of Women and Child Health and Indian academy of Pediatrics) The analysis was done using the SPSS software Version 25.

Observation and Results

Maternal vitamin D status was found to have a positive correlation with birth weight ($p<0.01$), birth length ($p<0.01$), head circumference ($p<0.01$) and chest circumference ($p<0.01$) taking p value significant at a level <0.05 by ANOVA Analysis. This study also shows that there were 54.8% deficient, 38.5% insufficient and only 6.7% sufficient Vitamin D status in mothers of LBW newborns (Cases) while 29.8% deficient, 24% insufficient and 46.2% sufficient Vitamin D status in mothers of normal birth weight newborns (Normal) (Tables 1-4).

Variables	Cases	Controls	p value
1. Maternal Age			
≤ 25 years	60 (51.7%)	56 (48.3%)	0.574
>25 years	43 (47.8%)	47 (52.2%)	
2. Gestational Age			
37th Weeks	40 (50%)	40 (50%)	0.130
38th Weeks	35 (61.4%)	22 (38.6%)	
39th Weeks	16 (38.1%)	26 (61.9%)	
40th Weeks	13 (44.8%)	16 (55.2%)	
3. Education			
Illiterate	4 (33.3%)	8 (66.7%)	0.114
<Secondary	29 (42.6%)	39 (57.4%)	
≥ secondary	71 (55.5%)	57 (44.5%)	
4. Residence			
Rural	34 (42.5%)	46 (57.5%)	0.087
Urban	70 (54.7%)	58 (45.3%)	
5. Occupation			
Housewife	83 (48%)	90 (52%)	0.194
Working	21 (60%)	14 (40%)	
6. Parity			

Primiparous	37 (46.8%)	42 (53.2%)	0.475
Multiparous	67 (51.9%)	62 (48.1%)	
7. Daily Sun Exposure (30 min)			
Yes	38 (48.1%)	41 (51.9%)	0.668
No	66 (51.2%)	63 (48.8%)	
8. Calcium Supplements (4 months)			
Yes	53 (44.5%)	66 (55.5%)	0.068
No	51 (57.3%)	38 (42.7%)	
9. Body Mass index (BMI)			
<30	73 (46.5%)	4 (53.5%)	0.076
≥ 30	31 (60.8%)	20 (39.2%)	
10. Mode of delivery			
NVD	71 (47.7%)	78 (52.3%)	0.282
LSCS	33 (55.9%)	26 (44.1%)	
11. Delivery Season			
Winter (Dec to Feb)	45 (58.4%)	32 (41.6%)	0.064
Spring (Mar to May)	19 (35.8%)	34 (64.2%)	
Summer (Jun to Aug)	13 (44.8%)	16 (55.2%)	
Autumn (Sep to Nov)	27 (55.1%)	22 (44.9%)	

Table 1: Maternal demographic characteristics of cases and controls.

Variables	Total (n=208)	Vitamin D deficient	Vitamin D insufficient	Vitamin D sufficient	p value
1. Birth weight					
<2.5 kg	104 (50%)	57 (54.8%)	40 (38.5%)	7 (6.7%)	p<0.01 (Significant)
≥2.5 kg	104 (50%)	31 (29.8%)	25 (24%)	48 (46.2%)	
2. Birth Length					
≤47 cm	106 (51%)	58 (54.7%)	38 (35.8%)	10 (9.4%)	p<0.01 (Significant)
>47 cm	102 (49%)	30 (29.4%)	27 (26.5%)	45 (44.1%)	
3. Head Circumference					
≤33 cm	161 (77.4%)	75 (46.6%)	55 (34.2%)	31 (19.3%)	p<0.01 (Significant)
>33 cm	47 (22.6%)	13 (27.7%)	10 (21.3%)	24 (51.1%)	
4. Chest Circumference					
≤30 cm	92 (44.4%)	47 (51.1%)	32 (34.8%)	13 (14.1%)	p<0.01 (Significant)
>30 cm	115 (55.6%)	40 (34.8%)	33 (28.7%)	42 (36.5%)	

Table 2: Newborns characteristics in comparison to maternal vitamin D status.

We have also found that out of 104 low birth weight (<2.5 kg) babies, their maternal vitamin D status were following: 54.8% have deficient, 38.5% have insufficient and only 6.7% have sufficient vitamin D status while in normal birth weight (≥2.5 kg) babies, their maternal

vitamin D status were following: 29.8% have deficient, 24% have insufficient and 46.2% have sufficient vitamin D level. Figure 1 showing birth weight trends with vitamin D status.

Groups	Mean Vitamin-D level	Deficiency n (%)	Insufficiency n (%)	Sufficiency n (%)
Mothers of LBW neonates (Cases)	12.375 (SD=4.20)	57 (54.8%)	40 (38.5%)	7 (6.7%)
Mothers of normal birth weight neonates (Controls)	16.987 (SD=6.38)	31 (29.8%)	25 (24%)	48 (46.2%)

Table 3: Maternal vitamin D levels in cases and controls.

Variables	Vitamin D deficiency (N=88)	Vitamin D insufficiency (N=65)	Vitamin D sufficiency (N=55)	p value
Birth weight	2.39 ± 0.232.47	2.47 ± 0.39	2.88 ± 0.43	<0.01
Birth length	47.34 ± 2.0	47.44 ± 2.33	49.15 ± 1.89	<0.01
Head Circumference	31.69 ± 1.60	31.74 ± 1.63	32.73 ± 1.88	<0.01
Chest Circumference	29.96 ± 1.57	30.07 ± 1.67	31.12 ± 1.99	<0.01

Statistically significant p value at <0.05 level by ANOVA Analysis

Table 4: Newborn characteristics association with maternal vitamin D level.

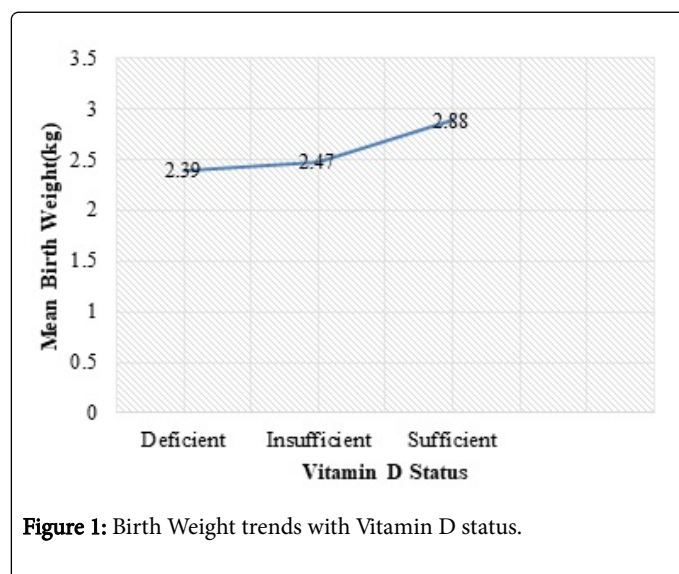


Figure 1: Birth Weight trends with Vitamin D status.

Discussion

Aligarh lies at latitude of 27.88°N and longitude of 78.08°E and 178 m above sea level. There is ample of sunshine throughout the summer days. Yet, the apparently healthy populations including pregnant mothers in this area were found to be deficient in Vitamin D as suggested by unpublished studies conducted in our institution.

Maternal vitamin D status and birth size

Our study showed that mean vitamin D level in mothers of LBW (cases) 12.375 ± 4.20 ng/mL was lower than in mothers of normal birth

weight (controls) newborns 16.987 ± 6.38 ng/mL and this findings was consistent with the study by Khalessi et al. [14] and other studies [5,7]. Maternal vitamin D levels were found to be positively correlated with birth weight (p<0.01). This finding was also seen in the study by Bodner et al. [15] Australian researchers found that mean birth weight was 200 g lower (p <0.01) in babies of vitamin D deficient mothers [6]. Many other studies have also reported an association between infant size and vitamin D status. We have also found a positive correlation of maternal vitamin D status with birth length (p<0.01), head circumference (p<0.01) and chest circumference (<0.01) and this was compatible with studies by Song et al. [16] and Satish et al. [17] was against findings by Khalessi et al. [14].

Maternal vitamin D status in comparison to socio-demographic characteristics

We found a positive correlation between maternal vitamin D status and place of residence (p<0.01), duration of sun exposure (p<0.01), season of the year (p<0.01) and intake of calcium supplement (p<0.01) which was also supported by studies by Prasad et al. [18] and by Dave et al. [19]. Our study found no significant association between maternal vitamin D levels (status) and maternal age, maternal education, occupation or parity. Similar findings were noted by Khalessi et al. [14] but not in the study by Prasad et al. [18].

Like other case control studies, this study too was not free from limitations. Maternal nutritional status and socio-economic status was not evaluated in the questionnaire. In addition, estimation cord blood calcium, PTH and ALP was not done. The status of vitamin D in the newborns could also not be done due to financial constraints. We propose that the given factors may be considered in the future studies. Despite these limitations, the strength of our study lies in the fact that we had taken good number sample size and was adequately powered to

detect a clinically meaningful difference in Vitamin D levels between cases and controls.

Conclusions

We found high prevalence of low vitamin D in mothers. Low vitamin D levels were significantly associated with LBW and low size of the newborns. Vitamin D status was found to be associated with certain modifiable and non-modifiable risk factors. There is a need for recommendation for vitamin D supplementation during pregnancy.

Conflict of Interest

There is no conflict of interest by the authors.

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