Original Article

Association of Maternal Vitamin D Levels with Neonatal Birth Weight

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Objective: To determine Vitamin-D levels of mothers and comparing these levels with birth weight and head circumference of newborns.

Methods: It was a cross sectional analytical study conducted in the Department of Obstetrics and Gynaecology, Central Park Medical College, Lahore. A total of 100 pregnant females admitted for delivery in our hospital and their newborns were included in the study. Maternal blood sample was collected immediately after delivery for measurement of 25-(OH)-vitamin D level. Newborns were physically examined and their birth weight and head circumference was recorded immediately after birth. All the information was recorded on a pre-designed proforma. Newborns were categorized into two groups, neonates with birth weight >2500gm and neonates with birth weight <2500gm. Mothers were categorized according to their Vitamin D status as deficient, insufficient and sufficient. Maternal Vitamin-D status was correlated with neonatal birth weight. SPSS 23.0 was used to analyze the data.

Results: Mean maternal vitamin D level was 22.74 ng/ml . Mean gestational age at delivery was 38 weeks and 6 days. 44% of the mothers had vitamin-D deficiency, 36% had vitamin-D insufficiency, while only a small percentage of 20% had sufficient Vitamin D levels. Mean neonatal birth weight was 2.99 Kg. 14 % of all the newborns had low birth weight(<2500gm). Mean maternal Vitamin D level of low birth weight neonates was significantly lower as compared to the mothers who gave birth to normal weight neonates. Chi square analysis signified the reverse relationship between maternal Vitamin D status and head circumference of the new born (p-value <0.001).

Conclusions: Maternal Vitamin D deficiency could have a negative effect on overall neonatal health outcome by increasing the risk of low birth weight. Awareness programs and Vitamin supplementation should be introduced in antenatal health care to prevent adverse neonatal outcomes.

Keywords: vitamin D, neonate, low birth weight, supplement, head circumference.

Introduction

Vitamin D deficiency is the talk of the town. For a very long time we have been disillusioned into thinking that vitamin D deficiency is not prevalent in our part of the world with the abundance of sunshine. Turns out, we were wrong. According to a recent survey in Pakistan 53.5% of selected population had Vitamin D deficiency[1]. Vitamin D deficiency is highly prevalent throughout the world. Many studies have highlighted the role of micronutrients in determining birth weight and Vitamin D is one of them.[2] These studies found that insufficient levels of maternal Vitamin D can result in low birth weight(LBW) of neonates.[2] Neonatal birth weight depicts the nutritional and health status of the mother. Neonates with low birth weight tend to have higher mortality rate as compared to neonates with normal birth weight.[3] The birth weight of an infant is the weight recorded at the time of birth, measured ideally within the first hour. Normal birth weight (NBW) at delivery of a term neonate is 2500-4200 g. Low birth weight (LBW) of a neonate refers to an absolute weight of less than 2500 g regardless of the gestational age.[4] The neonates with LBW may be small for their gestational age (weighing less than 10th percentile of their gestational age) or may have intrauterine growth restriction (IUGR). Global prevalence of LBW is 15.5%[5] .According to one estimate, 72 % of all the LBW neonates are born in Asia and its prevalence in Pakistan is reported to be 12-25%.[6] Another survey shows that 6% of the total LBW neonates are born in East Asia and Pacific region, 13 % in Sub Sahara and up to 28% in South Asian region.[7]

We designed this study to determine maternal Vitamin D levels among our study population and compare that with the birth weight of their neonates. Identifying the factors responsible for determining birth weight is very important as LBW is associated with mental and physical disabilities of newborns.

Proper supplementation of pregnant females can help us to decrease patient load in health care facilities and financial burden on affected families.

Methods

It was a cross sectional analytical study conducted in the Department of Obstetrics and Gynaecology Central Park Medical College, in a period of 6 months (1 January 2018 to 30 June 2018). The target population was Pregnant females who were admitted for delivery (Both normal vaginal delivery or cesarean section) after 37 completed weeks of gestation ,term neonates with normal birth weight (>2500gm) and term neonates with birth weight <2500gm. A total of 100 mothers and their newborns were studied. An informed consent was taken from all participants and objective of the study was clearly explained to each and every patient separately. Our study was approved from Ethical Committee of Central Park Medical College, Lahore. Mothers with eclampsia, pre-eclampsia, postpartum hemorrhage ,Diabetes Mellitus, any systemic illness, twin pregnancy,history of drug abuse , hematologic disorders and neonates with congenital malformation and infections were excluded from the study. Immediately after delivery, 5 ml of mothers' blood was collected by the health professional on duty, labeled and sent to laboratory for 25-(OH)-Vitamin D (25 Hydroxy Vitamin D) assay. Vitamin D levels were estimated using a two step competitive binding immunoenzymatic assay. The newborns were physically examined and their weight and head circumference was checked and recorded immediately after birth. All the information was recorded on a pre-designed Performa/questionnaire (Annexure I). Validity of questionnaire was checked using Chronbakh α = 0.80. New borns were divided into two groups depending on their birth weight i.e. LBW neonate (<2500 g) and Normal birth weight (NBW) neonates (>2500 g) .Mothers were categorized into Vitamin D Deficient (< 20 ng/ml), Insufficient (20 to < 30 ng/ml) and Sufficient (30 100 ng/ml). All the information recorded in predesigned Performa was correlated with maternal Vitamin D status and neonatal birth weight. SPSS 23.0 was used to analyze the data. Results were expressed using mean, standard deviation and percentages. Tests like Chi Square, ANOVA and T test were used. A p value of <0.05 was considered significant.

Results

In this study mean maternal age was 25.8 years with the highest percentage falling in the age bracket of 20 to 30 years (82%). Only 12% of the mothers were falling in the age group of more than 30 years and 6% of the mothers were less than 20 years of age **(Fig-1)**

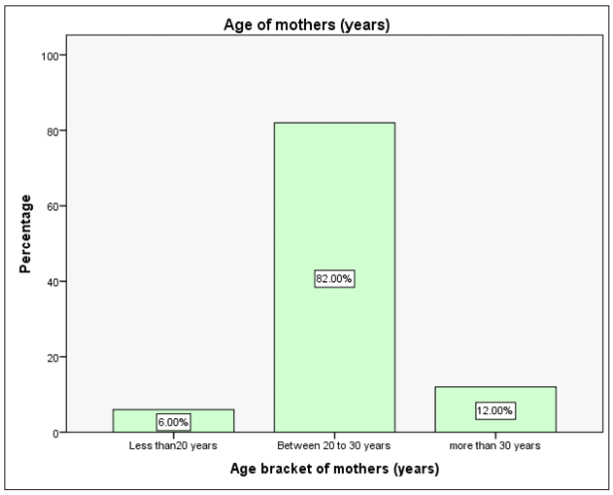

Fig-1: Age bracket of Mothers (in years.

Majority of the neonates were delivered via Caesarean section (65%) and only 35% were born through normal vaginal delivery. Among the participating mothers 31% were primiparous and 69% were multiparous. Majority of the mothers were educated (76%). Mean gestational age was 38 weeks and 6 days(SD±1.24) Mean vitamin D level of all the participating mothers was 22.74 ng/ml(SD±10.15) with a range between 9.70-48.41ng/ml. 81% of the participating mothers had never taken any vitamin D supplementation during their antenatal period. Of all the participants who gave birth to the neonates, 44% had vitamin D deficiency, 36% had vitamin D insufficiency, while only a small percentage of 20% had sufficient Vitamin D levels(Mothers were categorized into Vitamin D Deficient (< 20 ng/ml), Insufficient (20 to < 30 ng/ml) and Sufficient (30 100 ng/ml)). **(Fig-2)**

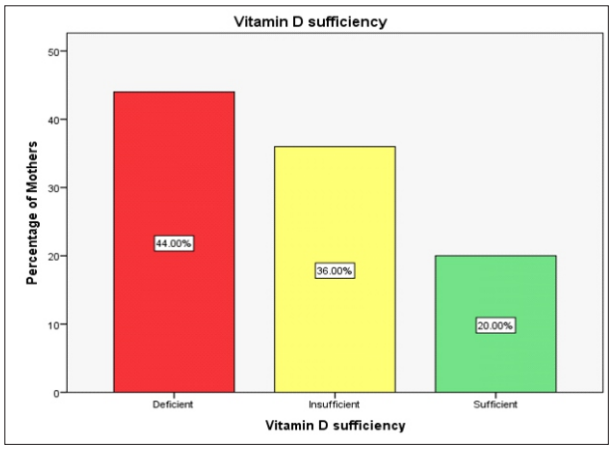

Fig-2: Vitamin-D status of the participating mothers.

Mean Maternal Vitamin D level of mothers with low birth weight neonates was significantly lower as compared to the mothers who gave birth to normal weight neonates. **Table2. Figure 3** (p-value 0.03 ANOVA p-value 0.003 Welch , Brown-Forsythe)

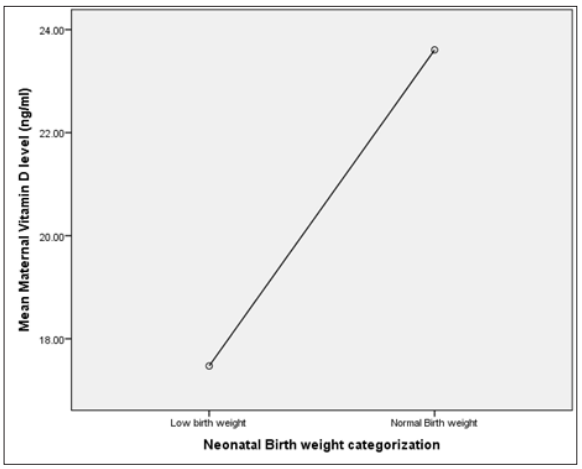

Fig-3: Mean maternal vitamin D level according to birth weight of infants.

There was a significant difference between the mean weight of infants in relation with head circumference and maternal Vitamin D status (p value <0.001) **Table 4**. Among the neonates, 14% were of low birth weight (<2500g) and 86 % were born with a normal weight (>2500g). Nine percent of the LBW neonates were born to mothers with deficient serum Vitamin D levels, 5 percent of the LBW neonates were born to mothers with insufficient vitamin D levels where as none of the mother with sufficient Vitamin D level gave birth to a new born with a weight less than 2500g. Among all the mothers who gave birth to neonates with a normal weight, 35% were Vitamin D deficient, 31% had insufficient Vitamin D levels and 20% had sufficient levels. In our study, 44 of the neonates were born with a head circumference (HC) of 33cm or less and 56 neonates were born with a head circumference (HC) of more than 33cm. Out of all the 44 newborns with HC of ≤33 cm 39 were born to mothers with Vitamin D deficiency and 5 were born to the mothers who had Vitamin D insufficiency. Among the neonates with HC >33 cm, only 2 were born to vitamin D deficient mothers, 36 were born to mothers who had insufficient vitamin D and 18 were born to mothers with sufficient Vitamin D levels. Chi square analysis signifies the reverse relationship between maternal Vitamin D status and head circumference of the new born (p-value <0.001). There was no significant difference between maternal Vitamin D levels in neonates who were born via normal vaginal delivery as compared to those who were born via caesarean section (P value 0.31). I n this study we found no significant relationship between mother's educational status or parity and vitamin D deficiency(p value 0.28 ,p-value 0.08 respectively) (p = 0.25, p = 0.43) respectively.

Table-1: Descriptive statistics of newborns.

Factor	Percentage
Weight of Neonate (kg)	2.00-4.20 (Mean 2.99, Std. Deviation(0.43)
Head circumference (cm)	31.00-37.00 (Mean 33.88 ,Std. Deviation 1.10)
Gender	Male 48%. Female 52%
Percentage of Low birth weight neonates	14%
Percentage of Normal birth weight neonates	86%

Table-2: Descriptive statistics of newborns.

	Mean vitamin-D levels (ng/ml)	Range (ng/ml)	p-value
Mothers with Low birth weight neonates	17.47±5.59	11.40-25.42	0.03
Mothers with Normal Birth weight neonates	23.60±10.48	9.70-48.41	0.03

Table-3: Descriptive statistics of newborns according to birth weight (Percentages).

		Percentage of Low birth weight infants (%)	Percentage of Normal birth weight infants (%)
Age of mother	<20 years	03	03
	21-30 years	10	72
	>30 years	01	11
Mode of delivery	Normal vaginal delivery	02	33
	Caesarean section	12	53
Parity of mother	Primiparous	07	24
	Multiparous	07	62
Head circumference of infants	=33cm	09	38
	>33cm	05	48
Vitamin D status	Deficient	09	35
	Insufficient	105	31
	Sufficient	0	20
Education of mother	Educated	05	18
	Uneducated	09	68
Gender of infants	Male	08	40
	Female	06	46

Table-4: Mean weight of newborns according to different parameters.

		Weight o infants (kg)		
		Mean	SD	P-value
Age of mother	<20 years	2.87	0.69	0.315
	21-30 years	2.94	0.41	
	>30 years	3.1	0.52	
Mode of delivery	Normal vaginal delivery	3.04	0.41	0.16
	Caesarean section	2.91	0.46	
Parity of mother	Primiparous	2.90	0.42	0.41
	Multiparous	2.98	0.46	

Head circumference of infants	=33cm	2.79	0.44	<0.001
	>33cm	3.11	0.40	
Vitamin D status	Deficient	2.76	0.43	<0.001
	Insufficient	3.08	0.42	
	Sufficient	3.1	0.32	
Education of mother	Educated	2.76	0.51	0.17
	Uneducated	3.02	0.41	
Gender of infants	Male	2.93	0.48	0.13
	Female	2.98	0.41	

Discussion

Our study showed that maternal vitamin D was a major determinant in defining birth weight of infants and majority of mothers who were included in our study were vitamin D deficient. Maternal Vitamin D has a direct effect of fetal development by interacting with calcium homeostasis. Vitamin D deficiency has been reported in many areas of South Asia. In a recent study it was found that Vitamin D deficiency was highly prevalent among Pakistani nursing mothers and infants[8] Another study conducted in the Southern region of Pakistan it was found that Pakistani nursing mothers and their newborns were Vitamin D deficient despite living in area with ample sunshine. The authors recommended regular Vitamin D supplementation for mothers as Vitamin D content of breast milk depends upon mothers' status of the vitamin and its deficiency can result in adverse maternal and neonatal outcome.[9] Several Iranian studies have also shown that Vitamin D deficiency is quiet common in that region also especially in rural areas.[6] Poor sun exposure, malnutrition and lack of proper supplementation are major causes responsible for Vitamin D deficiency among women. Breast fed infants born to mothers with low vitamin D levels have an increased risk of infections, increased risk of developing diabetes and decreased immunity.[10] Vitamin D deficient mothers also give birth to neonates with low birth weight who ultimately have a poor health later in their lives.[2]. Small for gestational age babies are more likely to have metabolic abnormalities that have been associated with later development of hypertension and coronary disease including insulin resistance.[10]

Our study clearly indicates that low infant birth weight and decreased head circumference is strongly correlated with maternal Vitamin D status. An Iranian study stated similar findings in which the researchers found a significant correlation between low birth weight of infants along with neonatal head circumference less than 33 cm and maternal Vitamin D deficiency.[2] Bodnar along with his colleagues found a positive correlation between Vitamin D deficiency in white mothers and neonatal low birth weight.[11] A research conducted at University of Michigan, Department of Pediatric Endocrinology showed that the prevalence of low birth weight was higher in neonates born to Vitamin D deficient mothers as compared to those having normal Vitamin levels.[12] Agha jafari along with his coworkers showed a significant association between small for gestational age neonates and maternal vitamin D deficiency.[13]

Improving Vitamin D status of mothers can improve neonatal outcome as it has also been proved that mothers with low Vitamin D levels have decreased expression of vitamin D in their breast milk as well[9]. There is a strong positive correlation between maternal and cord blood levels of Vitamin D, showing dependence of newborns on maternal reserve of 25-hydroxy Vitamin D levels.[14] Low levels Vitamin D in cord blood has also been associated with impaired fetal growth[13] .Vitamin D supplementation has proved to be beneficial during pregnancy as mothers who use Vitamin D supplementation during their second trimester showed lower incidence of preterm risks.[15] In one study it was observed that Vitamin D deficient mothers tend to give birth to small for gestational age babies as compared to the mothers with adequate levels of the vitamin.[16] In a systemic review to see the effect of Vitamin D supplementation during pregnancy on neonatal health outcome it was found that proper supplementation of Vitamin D can increase neonatal weight about 77 grams and can also decrease the incidence of low birth weight[17] . Data from three trials involving 493 women suggest that women who received vitamin D supplementation during pregnancy less frequently had a baby with birth weight <2500gm than those receiving no intervention or placebo(RR 0.40;95% CI 0.24 to 0.67, moderate quality)[18].

Conclusion

Most of the mothers who were included in our study were found to be Vitamin D deficient. Our study revealed that neonatal low birth weight and head circumference less than 33 cm can be related to Vitamin D deficiency among mothers. Vitamin D supplementation in the antenatal period can improve both maternal and neonatal health outcomes.

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