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ORIGINAL ARTICLE

Frequency of Vitamin D Deficiency in Mothers and Neonates at a Tertiary Care Hospital: A Cross-Sectional Study

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ABSTRACT

Objective: To find out the frequency of vitamin D deficiency in neonates and their mothers, admitted in a tertiary care hospital in Karachi.

Study Design: Cross-sectional survey

Place and Duration of Study: Civil Hospital, Karachi from January 2018 to July 2018

Material and Methods: This cross-sectional survey was conducted in pediatric department of Civil Hospital, Karachi from January 2018 to July 2018. All the neonates admitted to the NICU born after 30 week of gestation and weighing more than 1 kg, were included. One ml of serum collected from each mother and baby was sent for detection of serum vitamin D levels. Data was analyzed on SPSS version 22.

Results: A total of 80 neonates were included in the study. The mean age of neonates was 9.93 days. Vitamin D levels were either found to be deficient or insufficient in most of the neonates and their mothers. The mean vitamin D level in neonates was found to be 9.38 ng/dl. Mean vitamin D level of mothers was 12.37 ng/dl.

Conclusion: Status of vitamin D in neonates and their mother was variable. In the present study 42.5% mothers and 33.8 % neonates had insufficient levels of vitamin D, whereas significant number (65% neonates and 50% mothers) had vitamin D deficiency.

Key Words: *Vitamin D deficiency, Vitamin D insufficiency, Pregnant mothers, Neonates*

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INTRODUCTION

In the past few years, status of vitamin D and its potential health outcomes have gained much attention by the researchers.¹ Despite numerous preventive strategies, it has been reported that over one billion children and adults are affected by vitamin D insufficiency and deficiency and persist as a global health issue.^{2,3} It has been marked as one of the most important public health threat for

both developed and developing countries, with the prevalence rate of 30-80%.⁴ One study showed a prevalence of vitamin D deficiency of between 16 and 45% in adults and children.⁵ Most developed countries namely Australia, Canada, United states and UK are also affected from this global health issue.⁶ Whereas, due to socioeconomic, religious and cultural determinants, Asian countries Iran, India, Pakistan and Bangladesh are facing higher prevalence rate of this micronutrient vitamin D

deficiency. There is also widespread public health concern about the high prevalence of vitamin D deficiency during the reproductive periods as it is widely correlated with adverse outcomes in mothers and offsprings.⁷

Direct exposure of skin to ultraviolet B rays and dietary intake are the two most common sources of vitamin D.⁸ Sunlight exposure ranks as the primary source of vitamin D following with dietary sources such as fish, fish oil, liver, egg yolk and other dietary supplements.^{9,10} Vitamin D is also contemplated as hormone due to its structural resemblance and bioactive effects resembling those of steroid hormones. Major metabolic processes namely calcium and phosphate homeostasis and bone metabolism that occur in human body are dependent on this micronutrient. Its sustained deficiency can be the major factor of rickets among children and osteomalacia with fractures and osteoporosis among adults particularly.^{11,7}

Expectants women and their off-springs are the two most vulnerable groups for this micronutrient deficiency and therefore especially are center of research.^{12,13} Vitamin D status throughout the pregnancy is directly linked with health outcomes and its deficiency can lead to accumulated adverse effect for both mothers and babies.¹⁴ Multiple physiological processes make alteration to maternal metabolisms during pregnancy to establish healthy development of the fetus. Previous studies have mentioned a very close relationship among maternal and fetal vitamin D status in the period of pregnancy and highlights its optimal supply in this critical time.¹²

Maternal vitamin D levels is considered as major determining factor for vitamin D concentration during neonate period. Metabolism of vitamin D is greatly modified during the time of pregnancy and it works as a primary source of extraordinary circulating $1, 25(\text{OH})^2\text{D}$.⁹

Vitamin D deficiency in pregnancy can restrict fetal growth and increases the risk of preterm delivery. Premature neonates present more frequently with vitamin D deficiency as compared to term babies.¹³ Adverse pregnancy outcomes like pre-eclampsia, gestational diabetes and premature low birth weight babies are also associated with vitamin D deficiency.^{12,14}

Associations between vitamin D deficiency in mother and child and various childhood health problems makes it an important issue for consideration in maternal and child health and focus must be placed on ensuring sufficient vitamin D levels in mothers during pregnancy and lactation.¹⁵ Studies have reported that vitamin D supplementation during pregnancy improve maternal vitamin D levels. It has also been shown to reduce the risk of preterm, low birth weight and found to be protective against neonatal respiratory infections and sepsis.¹⁴ Neonatal hypokalemic convulsions had also been reported with deficiency of vitamin D.¹⁶

This study was important in our setting because we deal with the patients from lower and middle socio-economic group. These women are mainly deficient in calcium and vitamin D and this study aimed at finding out the frequency of affected mothers and neonates; timely strategies can be planned for prevention of vitamin D deficiency among these mothers and their neonates.

The aim of this study was to find out the frequency of vitamin D deficiency in neonates and their mothers, admitted in a tertiary care hospital, in Karachi.

MATERIAL AND METHODS

This observational study was conducted in neonatal intensive care (NICU) of department of pediatrics, Civil Hospital, Karachi from 1st January to 31st July 2018. Ethical approval of the study was obtained prior to conducting the study from Institutional review board (IRB) of Dow University of Health Sciences, Karachi.

All neonates admitted to the NICU, born after 30 week of gestation and weighing more than 1 kg, were included in this study. Exclusion criteria were babies of less than 1 kilogram, born before 30 weeks of gestation, whose mother was not available for evaluation or mothers who had known vitamin D deficiency either clinical or laboratory proven, mothers receiving vitamin D supplementation therapy and babies older than 28 days of life.

Serum samples were drawn by a trained staff nurse under the supervision of a research team member to ensure the uniformity in collection, immediate processing and laboratory analysis.

One ml of serum was collected from each mother and baby, sent to the Dow Diagnostic Research and Reference Laboratory for detection of serum vitamin D level through chemiluminescent micro-particle immunoassay (CMIA) technique. As per laboratory reference, vitamin D level above 30 ng/dl was considered normal for both mothers and babies. Similarly, level between 10-30 ng/ dl was labelled as insufficient and below 10 ng/dl was considered as vitamin D deficient.

Data was entered on a preformed questionnaire and included the demographic profile of mothers and babies including weight, length, OFC, clinical diagnosis of child and any comorbidity in mother. Data was entered and analyzed on SPSS version 22 by a fully trained research team member. Descriptive analysis was performed to calculate frequency measures and results were presented in the form of pie charts and tables.

RESULTS

A total of 80 neonates were included in the study. Forty-seven neonates (58.7%) were male and 33 (41.3%) were female. The mean age of neonate was 9.93 days, and mean weight and length were 2.49 kg and 47.63 cm respectively. (table 1).

TABLE 1: Demographic Details of Study Participants (n=80)

Characteristics	Number (%)
Gender	
Male	47 (58.70)
Female	33 (41.30)
Day of life	
≤7 days	38 (47.50)
Day 8 to 14	19 (23.75)
Day 15 to 21	14 (17.50)
Day 22 to 28	09 (11.25)
Weight distribution	
1.0-2.0 kg	28 (35.00)
2.1-3.0 kg	35 (43.75)
3.1-4.0kg	16 (20.00)
Above 4.0 kg	01 (01.30)
Length distribution	
35.0 to 50.0 cm	63 (78.80)
51.0 to 60 cm	17 (21.30)
Occipito-frontal circumference	
<30.0 cm	12 (15.00)
30.0 to 34.9 cm	68 (85.00)

Most common reason for admission was diagnosis of early onset sepsis (40%) followed in

order by preterm low birth weight (20%), jaundice and meconium aspiration syndrome (12.5% each). (table 2)

TABLE 2: Distribution of cases according to primary diagnosis

Diagnosis	Number (%)
Early onset sepsis	32(40.00)
Preterm low birth weight	16 (20.00)
Jaundice	10 (12.50)
Meconium aspiration syndrome	10 (12.50)
Meningitis	09 (11.25)
Late onset sepsis	08 (10.00)
Hypoxic ischemic encephalopathy	08 (10.00)
Acute gastroenteritis	06(7.50)
Infant of diabetic mothers	05 (6.25)
Transient tachypnea newborn	04 (5.00)

Stratified analysis was performed on frequencies of vitamin D levels according to their age groups among neonates in table 03. Majority of neonates of age less than 7 days were vitamin D deficient and insufficient. Whereas only one neonate who was vitamin D sufficient lies among age group of 22 to 28 days.

TABLE 3: Vitamin D levels in neonates according to age group (n=80)

Age Groups/ days	Vitamin D Levels		
	Deficient (%)	Insufficient (%)	Sufficient (%)
≤7	25 (66)	13 (34)	0
8-14	13 (68)	06 (32)	0
15-21	09 (64)	05 (36)	0
22-28	05 (56)	03 (33)	1 (11)

Data was also stratified to evaluate frequencies of vitamin D levels according to their weight groups among neonates as shown in table 4. According to this 18, 23 and 10 neonates were vitamin D deficient with respect to their weight groups of 1 to 2 kg, 2.1 to 3 kg and 3.1 to 4 kg respectively, and only one neonate of weight more than 4 kg was vitamin D deficient. Therefore, among all only one neonate with weight between 1 to 2 kg was found to be vitamin D sufficient.

TABLE 4: Vitamin D levels in neonates according to weight groups (n=80)

Weight Groups	Vitamin D Levels		
	Deficient (%)	Insufficient (%)	Sufficient (%)
1 – 2kg	18 (64)	09 (32)	1 (4)
2.1 – 3kg	23 (66)	12 (34)	0
3.1 - 4 kg	10 (63)	06 (37)	0
> 4kg	01 (100)	0	0

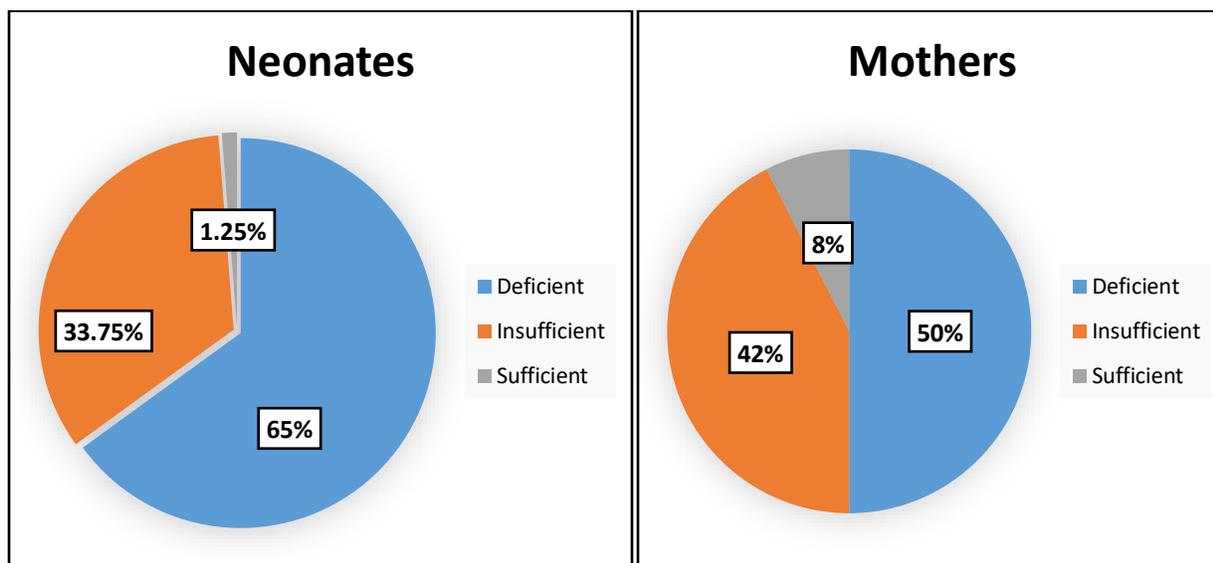
Frequencies of vitamin D levels according to their diagnosis or disease among neonates are mentioned in table 5. This table shows that mostly neonates presented with the diagnosis of early onset sepsis and preterm low birth weight were having Vitamin D deficiency and insufficiency. Jaundice, meconium aspiration syndrome, meningitis, late onset sepsis, hypoxic ischemic encephalopathy and acute gastroenteritis were also found to be present among vitamin D deficient neonates. Only few with the complaint of infants of diabetic mothers and transient tachypnea were found to be vitamin D deficient.

TABLE 5: Vitamin D Levels in neonates according

to Primary Diagnosis (n=80)

Diagnosis	Vitamin D Levels		
	Deficient (%)	Insufficient (%)	Sufficient (%)
Early onset sepsis	21 (66)	11 (34)	0
Preterm low birth weight	10 (63)	5 (31)	1 (6)
Hyperbilirubinemia	7 (70)	3 (30)	0
Meconium Aspiration Syndrome	7 (70)	3 (30)	0
Meningitis	6 (67)	3 (33)	0
Late onset sepsis	5 (63)	3 (37)	0
Hypoxic Ischemic Encephalopathy	5 (63)	3 (37)	0
Acute Gastroenteritis	4 (67)	2 (33)	0
Infant of Diabetic Mothers	3 (60)	2 (40)	0
Transient Tachypnea Newborns	3 (75)	1 (25)	0

Fifty percent of mothers were vitamin D deficient, 42% insufficient while only 8% were having normal levels. In neonates, 65% were deficient 33.75% insufficient and only 1.25% having normal levels. (graph 1)



Graph 1: Vitamin D levels in neonates and mothers

Demographic features of mothers include the mean age 27.88 years (range 18-40 years) and mean weight of 55.83 kg. Comorbidities in mothers included gestational diabetes in 5 case and pregnancy induced hypertension in 1 case.

Vitamin D levels were either found to be deficient or insufficient in most of the neonates and their mothers. Mean vitamin D level for neonates was found to be 9.38 ng/dl (Vitamin D deficient <10 ng/dl). A total of 52 neonates (65%) had deficient vitamin D levels. 33.8% of newborn were found to be vitamin D insufficient (10-30 ng/dl). Whereas only one neonate was having normal vitamin D level i.e. more than 30ng/dl.

The values did not differ much for mothers either. Average vitamin D level of a mother was 12.37 ng/dl that was in insufficient vitamin D category. Out of 80 mothers of studied newborn babies, only 6 mothers were having sufficient vitamin D level of above 30 ng/dl. Thirty-four mothers constituting 42.5 % had insufficient levels (10-30 ng/dl) and half of the mothers, {forty (50%)} were having vitamin D deficiency (levels below 10 ng/dl).

Using the regression modal, the correlation between the babies and mothers' vitamin D levels was found to be 0.231 (which is significant with a p-value of 0.039) and no other co-factor (gender, age of mother, baby's day of life) was significantly related to the baby's vitamin D levels.

DISCUSSION

Vitamin D levels in a neonate correlates strongly with vitamin D levels in maternal blood and therefore maintaining optimal vitamin D levels in pregnancy is of great significance. Vitamin D deficiency has been shown to be a risk factor for several chronic diseases.¹⁷ Mothers, with vitamin D deficiency may deliver low birth weight babies.¹⁹ The bone mass of the newborn may be related to the vitamin D status of the mother.²⁰ Children born to vitamin D deficient mothers show an increased incidence of rickets,⁸ while, maternal vitamin D insufficiency is associated with a deficiency in bone-mineral deposition in children.²¹ Therefore, this study was done to determine the frequency of vitamin D deficiency in mothers and their neonates.

In our study, most of the babies and their mothers were found to have vitamin D deficiency. To be precise, average value for neonate vitamin D level was 9.38 ng/dl and based on laboratory references, 65% newborns were vitamin D deficient and 33.8% had vitamin D insufficiency. While mean vitamin D level of maternal blood was 12.37 ng/dl with 50% of mothers being deficient and 42.5% being insufficient for vitamin D in the body. These results are in accordance with studies in both Pakistan as well as in other countries with similar socio-cultural background.

One local study conducted in a tertiary care hospital, reported that 90% of the pregnant females and their newly born babies were deficient in vitamin D when screened at the time of birth.⁸ Their results were similar to our findings. Another earlier study showed that 69.6% of mothers and 58.2% of neonates were deficient in vitamin D²² which was relatively lower than our results. This study reported mean vitamin D levels of 15.42 ng/dl in neonates and 27.33 ng/dl in mothers. A study from Iran reported vitamin D deficiency in 48% of mothers very similar to our results, and vitamin D insufficiency in 27.5% cases, which was slightly lower compared to our results.¹⁷

Another study from Saudi Arabia on adult females of age 19-40 year visiting a primary health facility reported that all 465 screened females were found to have low vitamin D levels with mean vitamin D level of 18.34 nmol/L with 79.1% falling in the range of deficient vitamin D.²³ The deficiency of vitamin D also appears to be high among young children in other countries, which includes Greece, Canada and England. A study from China reported 65.3% prevalence of vitamin D deficiency among 12 to 24 months old infants, but very few cases (3.7%) with radiographic or clinical rickets.

Many studies have reported a strong association between lower vitamin D levels and occurrence of neonatal sepsis and respiratory tract infections in infancy even later in childhood. In our study most common reason for diagnosis was also neonatal sepsis accounting for 40% of total admissions in babies with vitamin D deficiency.¹⁸

Association of vitamin D with low birth weight¹⁹ and small for gestational age had revealed mixed results in literature.²⁴ In our study preterm low birth

was the second most common reason for admission noticed in newborn babies and studies had reported that low birth weight is one of the factors that increase neonatal mortality even up to 40 times. A study in Iran found that almost 75% of the mothers were either vitamin D deficient or insufficient. They had also found a significant association between lower vitamin D levels and low birth weight in newborns.⁹

Applying regression model in our study we were able to observe the fact that maternal vitamin D level have a strong correlation with neonatal vitamin D level and with each 1ng/ml rise in maternal vitamin D there was an increase of 0.17 ng/ ml rise in vitamin D level in neonates.

This study revealed that vitamin D deficiency was quite frequently noted in mothers and babies in tertiary care obstetric hospitals like our setup. Adequate sun exposure and dietary intake along with supplementation of vitamin D in the form of medicine is needed to improve maternal and neonatal health and to decrease the morbidity and mortality. This study has the limitation of smaller number of participants, in-hospital setting and a single center study. True representation of vitamin D deficiency in society and generalization of result will require larger community- based trials before any firm conclusions can be drawn.

CONCLUSION

Vitamin D status in neonates and their mother was variable. In the present study 42.5% mothers and 33.8 % neonates had insufficient levels of vitamin D, whereas large number (65% neonates and 50% mothers) had vitamin D deficiency. But, due to the single center, convenience based sampling, we are unable to generalize the study results to a larger population so we suggest to have a multicenter regional study to estimate the vitamin D deficiency levels and its related factors in neonate.

RECOMMENDATION

- Vitamin D supplementation should be included in national planning strategies of maternal and child health.
- Vitamin D level of mothers should be assessed during antenatal visits. Dietary counseling and supplementation should be given accordingly.

- All neonates should be given vitamin D supplementation at birth with 400 IU/day.

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