EVALUATION OF VITAMIN D IN MOTHERS AND NEWBORNS AT BIRTH IN SULAIMANI MATERNITY TEACHING HOSPITAL

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ABSTRACT

Background

Deficiencies in vitamin D are frequent worldwide. Approximately 1 billion individuals around the globe are vitamin D deficient (<20ng/ml), and half of the population is insufficient (20-29ng/ml). According to extensive epidemiological studies, vitamin D deficiency is common in women, particularly pregnant and nursing mothers. Vitamin D deficiency during pregnancy is associated with various maternal and fetal health effects..

Objectives

Vitamin D levels in fetuses and newborns are directly related to their mothers' levels during pregnancy. The study aims to assess and compare the vitamin D levels of mothers and their newborn babies. Additionally, we are interested in determining whether there is a link between vitamin D levels and delivery outcomes.

Patients and Methods

One hundred pairs of mothers and newborns enrolled in a cross-sectional study at Maternity Teaching Hospital in Sulaimani. Any newborn baby diagnosed with a congenital abnormality during pregnancy was excluded. Also, any mother that was on anticonvulsant drugs was excluded. Blood samples for vitamin D analysis were taken from the mothers and newborns at birth. In addition, the demographic and medical data of the mothers and newborns were recorded. All evaluations had a p-value of 0.05 as the threshold for statistical significance.

Results

The mothers' and newborns' mean vitamin D were 17.2±13.33 ng/ml and 10.48±9.77 ng/ml, respectively. An examination of the data using statistical methods indicated a connection between the vitamin D found in mothers and the levels found in their newborns (p-value=0.001). Furthermore, higher levels during pregnancy were linked to better Apgar scores (≥7) for their newborn children (p-value=0.03). Maternal vitamin D level was not statistically associated with other birth outcomes; p-value > 0.05.

Conclusion

The results of this study show that vitamin D deficiency in mothers leads to deficiency in their newborns. Except for the Apgar score, no statistically significant relationship was found between maternal vitamin D levels and other birth outcomes.

Keywords: *Vitamin D, Pregnancy, Vitamin D deficiency, Birth weight, Preterm birth, Apgar score.*

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INTRODUCTION

Vitamin D (VD) is a fat-soluble vitamin that aids calcium and phosphorus homeostasis and musculoskeletal wellness [1]. VD is basically of two types: cholecalciferol (vitamin D3) and ergocalciferol (vitamin D2). In order to produce the active form of vitamin D known as 1,25-dihydroxy vitamin D (1,25(OH)2 D), a series of steps must first be completed [2]. Deficiency (<20ng/ml) and insufficiency (20-29ng/ml) in VD are frequent worldwide [3].

Many pieces of research suggest that vitamin D deficiency (VDD) may contribute to various illnesses and ailments [4]. It is accepted that VDD should be avoided during pregnancy to safeguard the fetus's skeletal development; this is because the mother's vitamin D level (VDL) influences the concentrations of 25-hydroxyvitamin D in the fetal and neonatal blood [5]. Circulating 1,25(OH)2 D levels rise early in pregnancy, peak in the third trimester, and return to normal following breastfeeding. Since maternal parathyroid hormone (PTH) levels remain stable throughout pregnancy, the trigger for the 1,25(OH)2 D increase remains unclear. However, it might be regulated by PTH-related protein (PTHrP), which increases in the mother's bloodstream early in pregnancy [6, 7]. In the early stages of pregnancy, 25(OH)D is transferred from the mother to the fetus via the placenta, marking the beginning of the process by which fetal vitamin D reservoirs are formed.

The umbilical cord VDL account for 60%-89% of maternal VD concentration [8]. An analysis of available research indicates that deficiency of VD in pregnancy is widespread in many countries and is associated with insufficient exposure to sunlight and inadequate consumption of vitamin D.

It is suspected that many babies throughout the world have insufficient vitamin D reserves as a result of the high frequency of low VD reserves in mothers [3, 9]. Prenatal vitamin D treatment raised VDLs in cord blood in a meta-analysis of 43 randomized trials. As the half-life of 25(OH)D in serum is around three weeks, almost 93.75% of this vitamin D at birth will be catabolized when the baby is three months old[10]. Preterm delivery, obstetric issues(Preeclampsia, Gestational Diabetes Mellitus), and poor outcomes for the developing skeleton, immune system, and lungs are some clinical problems connected to VDD [11] .A lack ofVD in the mother has been connected to an increased risk of preeclampsia [12] .The association between VDLs and insulin sensitivity was robust in a survey of 741 pregnant women. Women with gestational diabetes are more prone to suffer significant VDD than non-diabetic women [8]. Low birth weight (LBW) infants have been linked to insufficient bone mineralization, which is, in turn, associated with insufficient prenatal and postnatal VDLs [13]. Several cohort studies have linked low 25(OH)D levels during pregnancy or after delivery to a higher likelihood of respiratory infections among neonates and young children [14].

This research aimed to compare and contrast the VDL of mothers and their newborns and examine any possible associations between them. Another goal is to examine the link between a mother's vitamin D status and delivery outcome.

PATIENTS AND METHODS

Study design

The present study is cross-sectional; cases enrolled from Maternity Teaching Hospital in Sulaimani. The blood samples were analyzed in a private laboratory (not available in the public hospitals). The samples were collected over four months, from December 2021 to March 2022.

The study sample included mothers and their newborns. Newborns of both genders are included. However, any newborn baby diagnosed with a congenital abnormality during pregnancy was excluded. Also, any mother that was on anticonvulsant drugs was excluded. A sample of 100 mothers and their newborns was selected by convenience sampling.

Data collection

Data were collected from the mother after the baby was delivered. Maternal age, parity, ethnicity, and residency were recorded. After delivery, the newborn's gender, weight (LBW <2500g, Normal 2500g-4500g) and Apgar score were recorded. The Apgar score was considered normal if it was equal to or more than seven. Mode of delivery (MOD) was classified into Normal Vaginal Delivery and Cesarean Section. Cesarean section reasons were obstructed labour (such as non-progression of labour, failed induction, and cephalopelvic disproportion), fetal distress, pregnancy-related diseases, or elective cesarean section.

Vitamin D analysis

After delivery, 3 ml of blood was collected from each mother. Regarding newborns, the blood samples were

taken from the umbilical cord, about 3ml. The blood samples were put into gel tubes in a water bath after 10-15 minutes; the samples were centrifuged for five minutes at 5000 RPM. Later, an amount of the serum (not less than 250µl) was placed into a sample cup to be read by an automated device (Cobas- 411). After 30min in the device, the results were obtained.

Regarding the analysis results, the deficiency was defined as VD <20ng/ml, insufficiency as 20-29ng/ml, and normal as ≥30ng/ml [15].

Ethical considerations:

Ethical considerations were considered by obtaining approval from the Sulaimani University College of Medicine's Ethical Committee. Written informed consent was obtained from the participants after they were provided with sufficient information about the study's goals. Statistical analysis:

The data collected were analyzed using SPSS, which stands for Statistical Package for the Social Sciences (SPSS version 25.0). Descriptive and inferential statistical tests were used for this purpose. In our statistical tests,p-value of 0.05 as our cutoff for significance.

RESULTS

The average age of the mothers was 31.2±5.65 years old. Concerning the ethnicity of the mothers, 91% of the mothers were Kurds, and 9% were Arabs. Regarding their residency, 47% of the mothers lived in urban areas, and 53% lived in rural areas.

Regarding the past medical history of the mothers, only 7% of the mothers had chronic diseases (Hypertension, Diabetes Mellitus, Thyroid diseases). Regarding parity, 65% of the mothers were multiparous, 23% were grand multiparous, and only 12% were primiparous. 58% of the mothers delivered the baby by C/S and 42% by NVD, (Table 1,2).

Regarding the newborns, 49% were males, and 51% were females. Regarding the newborns' weight, only one weighed less than 2500g. 95% of the newborns had an Apgar score of seven or more, and 10% needed NICU admission, (Table 3).

The mean maternal VDL was 17.2±13.33 ng/ml, and the mean VDL of the newborns was 10.48±9.77 ng/ml. The vitamin D levels of the mothers were as follows; 67% deficient, 18% insufficient, and 15% normal. Regarding the newborns, the levels were 87% deficient, 9% insufficient, and 4% normal, (Figure 1) This study's results show a statistically positive correlation between the mothers' and the newborns' VDLs. (p-value<0.001), (Table 4).

According to the findings of this study, there is a positive correlation between the levels of VD detected in mothers and the Apgar scores of their newborn children. (p-value=0.03), (Table 5) In terms of associations between the mothers' VDLs and the newborns' weight, the results show no association (p-value=0.6), Table 6.

Table 1. Demographic characteristic of the mothers.

	Frequency (N)	Percentage (%)
Age in years		
19-24	14	14.0
25-34	57	57.0
35-43	29	29.0
Total	100	100.0
Ethnicity		
Kurd	91	91.0
Arab	9	9.0
Total	100	100.0
Residency		
Urban	47	47.0
Rural	53	53.0
Total	100	100.0
Occupation		
Unemployed	93	93.0
Employee	7	7.0
Total	**100**	**100.0**

Table 2 .The mothers' obstetric and medical data.

	Frequency (N)	Percentage (%)
Parity		
Primiparous (1)	12	12.0
Multiparous (2-5)	65	65.0
Grand multiparous(>5**)**	23	23.0
Total	100	100.0
Mode of delivery		
NVD	42	42.0
C/S	58	58.0
Total	100	100.0
Chronic disease		
Yes	7	7.0
No	93	93.0
Total	**100**	**100.0**

Table 3. Newborns outcomes.

	Frequency (N)	Percentage (%)
Gender		
Male	49	49.0
Female	51	51.0
Total	100	100.0
Birth weight		
<2500g	2	2.0
2500-4500g	98	98.0
Total	100	100.0
Gestational age (weeks)		
Preterm □37	5	5.0
Term ≥37	95	95.0
Total	100	100.0
Apgar score (5 minutes)		
<7	5	5.0
≥7	95	95.0
Total	100	100.0
NICU admission		
Yes	10	10.0
No	90	90.0
Total	100	100.0

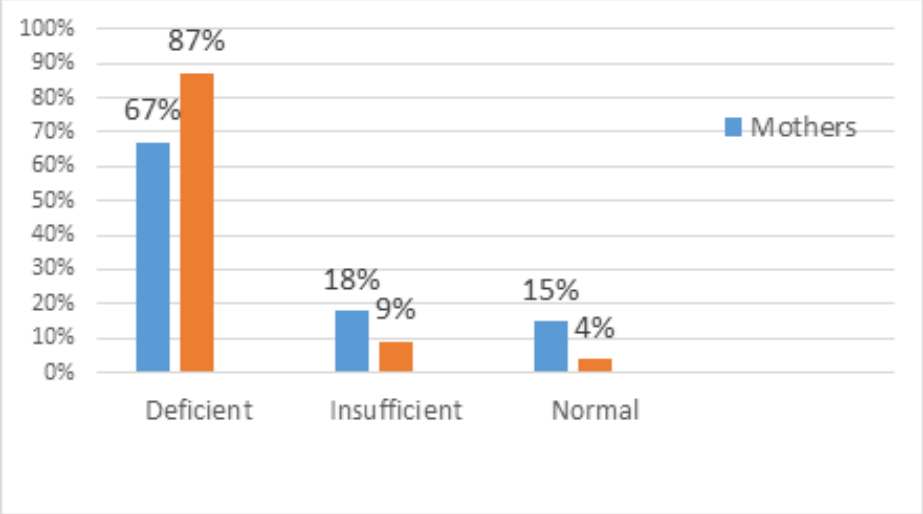

Figure 1. Vitamin D levels of the mothers and newborns.

Table 4 .Association between the mothers' and the newborns' vitamin D levels.

Vitamin D newborns	Vitamin D mothers			Total	p-value
	Deficient	Insufficient	Normal		
Deficient	66 98.5%	15 83.3%	6 40.0%	87	**<0.001**
Insufficient	1 1.5%	3 16.7%	5 33.3%	9	
Normal	0 0.0%	0 0.0%	4 26.7%	4	
Total	**67 100.0%**	**18 100.0%**	**15 100.0%**	**100 100.0%**	

Table 5 .Association between maternal vitamin D levels and Apgar score.

Apgar score (5 minute)	Vitamin D mother			Total	p-value
	Deficient	Insufficient	Normal		
<7	2 3.0%	3 16.7%	0 0.0%	5 5.0%	**0.03**
≥7	65 97.0%	15 83.3%	15 100.0%	95 95.0%	
Total	**67 100.0%**	**18 100.0%**	**15 100.0%**	**100 100.0%**	

Table 6. Association between birth weight and maternal vitamin D levels.

Birth weight	Vitamin D mother			Total	p-value
	Deficient	Insufficient	Normal		
<2500g	2 3.0%	0 0.0%	0 0.0%	2 2.0%	**0.60**
2500g-4500g	65 97.0%	18 100.0%	15 100.0%	98 95.0%	
Total	**67 100.0%**	**18 100.0%**	**18 100.0%**	**100 100.0%**	

DISCUSSION

Vitamin D levels were measured in both the mothers and the newborns, and the mean levels of VD were 17.7±13.35 in the mothers and 10.46±9.79 in the newborns. The findings showed a statistically significant correlation between the mother's VD and the infant. Other studies that have been done by Shor et al. [8], Esmeraldo et al. [16], Elechi et al. [17], and Wang et al. [18] also support the findings in this study. Two studies conducted in Turkey by Ozdemir et al. [19] and Fedakar [20] show a robust positive correlation between the mother's and the newborn's VDL and show that minimal maternal VDL was a significant predictor for deficiency in the newborn. Because the fetus depends on maternal VD and calcium reserves throughout pregnancy, this might be the likely reason for this phenomenon. As a result, the increased risk of vitamin D insufficiency in pregnancy has ramifications for the children of women afflicted by this condition [21].

There has been a lot of study and discussion on how the VDL in pregnant women impacts the developing fetus and newborn baby. VD deficiency has been linked to a higher risk of low birth weight [22]. Statistically, this study found no association between maternal VDLs and LBW; according to Almidani et al. [23], there is no link between VD in the mother and the infant's birth weight. However, the mean VDLs of mothers with newborns of average weight are higher. Even in a multiethnic sample, Eggemeon et al.[24] found no relation between maternal VD and neonatal weight. Furthermore, no relation between maternal VDLs and LBW was found by Shor et al.[8].

In contrast to this result, Khalessi et al. [13] and Miliku et al. [25] found a connection between maternal VDLs and LBW in their study. Three studies in China confirm the linkage between low VDLs in the mother and low birth weight by Wang et al. [18], Chen, Y. H et al. [26], and Chen, G. D et al. [27]. Bone mineralization is facilitated by vitamin D's interaction with the homeostasis of calcium and parathyroid hormone. Vitamin D's extra-skeletal roles in embryonic development have been the subject of recent studies. These roles include adipogenesis, cell proliferation, glucose homeostasis, and immunomodulation [23, 28] .

VDLs in the mother was observed to have strong associations with the Apgar scores of their newborns; higher levels were associated with better Apgar score. Consistent with this result, studies by Kim et al. [29], Boskabadi et al. [30] and Augustin et al. [31] determined that low levels of vitamin D in the mother are linked to a higher risk of birth hypoxia and a lower Apgar score. Furthermore, a study by Hossain et al. [32] conducted in Pakistan revealed that better Apgar scores are connected to vitamin D supplementation, which is necessary to obtain an acceptable concentration. Respiratory distress syndrome (RDS) is premature infants' most prevalent respiratory problem; surfactant deficiency and lung immaturity are essential factors in the development of RDS. Steroids are known to have a positive impact on lung growth and maturation. Active 1,25(OH)2D, the steroid-structured form of 25(OH)D, stimulates lung growth in developing fetuses [33].

The limitations of this study are 1) It is a cross-sectional study, 2) A single blood sample was taken from the mother and the newborn for vitamin D analysis at birth, 3) The sample size is relatively small, 4) The study was conducted in a single hospital where the patient population may be different from other hospitals.

Conclusion: most pregnant women receive vitamin D supplements during pregnancy, vitamin D deficiency in mothers and their newborns is still a prominent health problem. This study's data demonstrate that most mothers' and newborns' vitamin D levels are below the normal value (≥30ng/ml). Furthermore, this study found an association between VDL in mothers and their newborns. and between the VDL in the mother's blood and the Apgar scores of her newborn. In contrast, the findings of this study showed no statistical connection between maternal VDLs and other fetal outcomes.

REFERENCES

1. Kim MJ, Na B, No SJ, Han HS, Jeong EH, Lee W, et al. Nutritional status of vitamin D and the effect of vitamin D supplementation in Korean breast-feed infants. Journal of Korean medical science. 2010;25(1):83-9.

2. Lo T-H, Wu T-Y, Li P-C, Ding D-C. Effect of Vitamin D supplementation during pregnancy on maternal and perinatal outcomes. Ci Ji Yi Xue Za Zhi. 2019;31(4):201-6.

3. Mithal A, Kalra S. Vitamin D supplementation in pregnancy. Indian J Endocrinol Metab. 2014;18(5):593-6.

4. Bhimji KM, Naburi H, Aboud S, Manji K. Vitamin D Status and Associated Factors in Neonates in a Resource Constrained Setting. International Journal of Pediatrics. 2018;2018:9614975.

5. Kiely M, Hemmingway A, O'Callaghan KM. Vitamin D in pregnancy: current perspectives and future directions. Ther Adv Musculoskelet Dis. 2017;9(6):145-54.

6. Curtis EM, Moon RJ, Harvey NC, Cooper C. Maternal vitamin D supplementation during pregnancy. British medical bulletin. 2018;126(1):57-77.

7. Urrutia-Pereira M, Solé D. [Vitamin D deficiency in pregnancy and its impact on the fetus, the newborn and in childhood]. Revista paulista de pediatria : orgao oficial da Sociedade de Pediatria de Sao Paulo. 2015;33(1):104-13.

8. Shor DB, Barzel J, Tauber E, Amital H. The effects of maternal vitamin D on neonatal growth parameters. European journal of paediatrics. 2015;174(9):1169-74.

9. Dawodu A, Tsang RC. Maternal vitamin D status affects breast-feeding infants' milk vitamin D content and vitamin D status. Advances in nutrition (Bethesda, Md). 2012;3(3):353-61.

10. Fink C, Peters RL, Koplin JJ, Brown J, Allen KJ. Factors Affecting Vitamin D Status in Infants. Children (Basel). 2019;6(1):7.

11. Rana S, Lemoine E, Granger JP, Karumanchi SA. Preeclampsia: Pathophysiology, Challenges, and Perspectives. Circulation research. 2019;124(7):1094-112.

12. Fogacci S, Fogacci F, Banach M, Michos ED, Hernandez AV, Lip GYH, et al. Vitamin D supplementation and incident preeclampsia: A systematic review and meta-analysis of randomized clinical trials. Clinical nutrition (Edinburgh, Scotland). 2020;39(6):1742-52.

13. Khalessi N, Kalani M, Araghi M, Farahani Z. The Relationship between Maternal Vitamin D Deficiency and Low Birth Weight Neonates. Journal of Family & reproductive health. 2015;9(3):113-7.

14. Moukarzel S, Ozias M, Kerling E, Christifano D, Wick J, Colombo J, et al. Maternal Vitamin D Status and Infant Infection. Nutrients. 2018;10(2).

15. Chauhan K, Shahrokhi M, Huecker MR. Vitamin D.StatPearls. Treasure Island (FL): StatPearls Publishing,Copyright © 2022, StatPearls Publishing LLC.; 2022.

16. Esmeraldo CUP, Martins MEP, Maia ER, Leite JLA, Ramos JLS, Gonçalves J, Jr., et al. Vitamin D in Term Newborns: Relation with Maternal Concentrations and Birth Weight. Annals of nutrition & metabolism. 2019;75(1):39-46.

17. Elechi HA, Oduwole A, Idris HW, Faruk MB, Alhaji MA. Vitamin D and bone mineral status of newborn-maternal pair delivering at a tertiary hospital in Nigeria. Nigerian journal of clinical practice. 2021;24(3):345-54.

18. Wang Y, Li H, Zheng M, Wu Y, Zeng T, Fu J, et al. Maternal vitamin D deficiency increases the risk of adverse neonatal outcomes in the Chinese population: A prospective cohort study. PloS one. 2018;13(4):e0195700.

19. Özdemir AA, Ercan Gündemir Y, Küçük M, Yıldıran Sarıcı D, Elgörmü Y, Ça Y, et al. Vitamin D Deficiency in Pregnant Women and Their Infants. Journal of clinical research in pediatric endocrinology. 2018;10(1):44-50.

20. Fedakâr A. Vitamin D Deficiency, Prevalence and Treatment in Neonatal Period. Endocrine, metabolic & immune disorders drug targets. 2019;19(6):866-73.

21. Weinert LS, Silveiro SP. Maternal-fetal impact of vitamin D deficiency: a critical review. Maternal and child health journal. 2015;19(1):94-101.

22. Lian RH, Qi PA, Yuan T, Yan PJ, Qiu WW, Wei Y, et al. Systematic review and meta-analysis of vitamin D deficiency in different pregnancies on preterm birth: Deficiency in middle pregnancy might be at risk. Medicine. 2021;100(24):e26303.

23. Almidani E, Barkoumi A, Elsaidawi W, Al Aliyan S, Kattan A, Alhazzani F, et al. Maternal Vitamin D Levels and Its Correlation With Low Birth Weight in Neonates: A Tertiary Care Hospital Experience in Saudi Arabia. Cureus. 2021;13(4):e14528.

24. Eggemoen Å R, Jenum AK, Mdala I, Knutsen KV, Lagerløv P, Sletner L. Vitamin D levels during pregnancy and associations with birth weight and body composition the newborn: a longitudinal multiethnic population-based study. The British journal of nutrition. 2017;117(7):985-93.

25. Miliku K, Vinkhuyzen A, Blanken LM, McGrath JJ, Eyles DW, Burne TH, et al. Maternal vitamin D concentrations during pregnancy, fetal growth patterns, and risks of adverse birth outcomes. The American journal of clinical nutrition. 2016;103(6):1514-22.

26. Chen YH, Fu L, Hao JH, Yu Z, Zhu P, Wang H, et al. Maternal vitamin D deficiency during pregnancy elevates the risks of early gestational age and low birth weight infants in the Chinese population. The journal of clinical endocrinology and metabolism. 2015;100(5):1912-9.

27. Chen GD, Pang TT, Li PS, Zhou ZX, Lin DX, Fan DZ, et al. Early pregnancy vitamin D and the risk of adverse maternal and infant outcomes: a retrospective cohort study. BMC pregnancy and childbirth. 2020;20(1):465.

28. Lee SS, Ling KH, Tusimin M, Subramaniam R, Rahim KF, Loh SP. Interplay between Maternal and Neonatal Vitamin D Deficiency and Vitamin-D-Related Gene Polymorphism with Neonatal Birth Anthropometry. Nutrients. 2022;14(3).

29. Kim I, Kim SS, Song JI, Yoon SH, Park GY, Lee Y-W. Association between vitamin D level at birth and respiratory morbidities in very-low-birth-weight infants. Korean J Pediatr. 2019;62(5):166-72.

30. Boskabadi H, Mamoori G, Khatami SF, Faramarzi R. Serum vitamin D level in preterm infants and its association with premature-related respiratory complications: a case-control study. Electron Physician. 2018;10(1):6208-14.

31. Augustin H, Mulcahy S, Schoenmakers I, Bullarbo M, Glantz A, Winkvist A, et al. Late Pregnancy, Vitamin D Deficiency, is Associated with Doubled Odds of Birth Asphyxia and Emergency Caesarean Section: A Prospective Cohort Study. Maternal and child health journal. 2020;24(11):1412-8.

32. Hossain N, Kanani FH, Ramzan S, Kausar R, Ayaz S, Khanani R, et al. Obstetric and neonatal outcomes of maternal vitamin D supplementation: results of an open-label, randomized controlled trial of antenatal vitamin D supplementation in Pakistani women. The journal of clinical endocrinology and metabolism. 2014;99(7):2448-55.

33. Dogan P, Ozkan H, Koksal N, Bagci O, Varal IG. Vitamin D deficiency and its effect on respiratory distress syndrome in premature infants: results from a prospective study in a tertiary care centre. Afr Health Sci. 2020;20(1):437-43.