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Severe maternal vitamin D deficiency during labor and its correlation with umbilical cord vitamin D level

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Abstract

Background and objective: Prenatal vitamin D insufficiency has been linked to serious negative neonatal outcomes. This study aimed to evaluate the prevalence of vitamin D deficiency in pregnant women and compare maternal and umbilical cord vitamin D levels.
Methods: A cross-sectional study was conducted on 60 women who gave birth vaginally at Maternity Teaching Hospital in Erbil city, Kurdistan region, Iraq from January to December 2021. Total serum 25(OH) vitamin D concentration was measured from each woman during labor and her newborn umbilical cord blood. To determine how strong the link between both levels is, the Pearson (r) correlation coefficient was used.
Results: More than 98% of participants had a significant vitamin D3 deficiency, compared to 88.3% of their newborn children. There was A strong correlation between newborns' and mothers' vitamin D3 levels (r = 0.726, *P* <0.001).Thenewborns' mean D3 levels (15.8 ± 8.3 mmol/l) were not appreciably (*P* = 0.064) greater than their mothers' (13.2±7.0 mmol/l) mean D3 levels. There was a strong, significant correlation between newborns' and mothers' vitamin D3 levels (r = 0.726, *P* <0.001). The majorities of the women were either illiterate or only had primary education, and more than half of them lived in rural areas.
Conclusion: Regarding severe vitamin D3 deficiency, no discernible differences between mothers and their offspring were found, and newborns' vitamin D3 levels correlated strongly and significantly with their newborns.
Keywords: Labor; Preterm delivery; Umbilical cord; Vitamin D deficiency; Illiterate.

Introduction

Over 1 billion people worldwide, representing all racial, ethnic, and age categories, suffer from vitamin D insufficiency, which has become a serious health issue.[1] A important ingredient for human growth is vitamin D. A growing body of evidence shows that a lack of vitamin D during pregnancy increases the likelihood of unfavorable neonatal outcomes like low birth weight and small gestational age. It is also linked to a number of other harmful effects on the health of the progeny.[2,3]
Maternal vitamin D deficiency has been extensively documented on a global scale and a high prevalence of low cord serum 25-hydroxyvitamin D (25(OH) concentrations.[4] Studies have shown links between poor pregnancy outcomes and vitamin D insufficiency. both on fetal development and mother health.[5] Insufficiency is associated with a variety of harmful maternal and neonatal outcomes, such as preeclampsia, hypertension, gestational diabetes mellitus, spontaneous abortion, intrauterine growth restriction, small size for gestational age, and low. birth weight, and premature birth, according to a large body of epidemiological research[6,7]
During pregnancy, maternal and neonatal calcium homeostasis is influenced by the mother's vitamin D status. Through the mother's placenta, vitamin D is transferred

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to the fetus.[8] Although their analysis finds that there are too few low vitamin D concentrations, a Polish investigation found a correlation between maternal vitamin D concentrations and neonatal measures.[9] Almost irrespective of the season, a large proportion of pregnant women and their newborns are susceptible to severe vitamin D deficiency. and low umbilical cord vitamin D levels in mothers were associated with low umbilical cord vitamin D levels.[10]

According to a recent Izmir study, mothers who wore cover-ups and did not take prenatal multivitamins reported no data.[9] Additionally, a lesser variation (by 176 g) in the weight of infants born to American mothers with vitamin D deficiency was discovered.[11] Regarding cord blood, a different study found that neonatal length was reduced (by 0.5 cm) in a group of kids with very low vitamin D concentrations (4.8 ng/ml) in comparison to the usual values.[12] The thresholds for vitamin D deficiency, insufficiency, and sufficiency levels differ across research, and there are few references for umbilical cord 25(OH) D concentrations,[13] studying the relationship between umbilical cord vitamin D level and understanding the impact on mother and baby is crucial given the rising incidence of severe vitamin D deficits in pregnant women.[14] In order to determine the prevalence of vitamin D in pregnant women during labor and to associate the amount with umbilical cord vitamin D level, a hospital-based study was done. Because severe vitamin D insufficiency in pregnant women is on the rise, it is critical to investigate the relationship between umbilical cord vitamin D levels and how it might influence both mother and child.

Methods

This cross-sectional study was conducted on a convenient sample size of sixty women delivered vaginally in the labor room of Maternity Teaching Hospital, Erbil City, Kurdistan region, Iraq from January to December 2021. The study sample includes women not on multivitamins including Vitamin D in pregnancy, delivered vaginally and accepted to participate in the research. Women with multiple pregnancies. Anemic, being hypothyroidism, routinely taking vitamin D supplements. Taking medicine that would affect their vitamin D metabolism, such as antiepileptic agents, glucocorticoids, or antiretroviral drugs was excluded.

Mothers were interviewed directly with researcher; proper history was taken from them. All women were delivered vaginally.

Two blood samples were collected from the mother during labor and the umbilical cord of the newborn. Two milliliters of blood were directly put in a gel tube to detect the serum levels of vitamin D in the laboratory. All the samples of blood were tested for the level of vitamin D at the clinical laboratory in Erbil City.

Vitamin D levels were categorized as per the guidelines of the Institute of Medicine (IOM). The IOM defines 25(OH) D3 serum level of less than 10 ng/mL as a severe deficiency, less than 20 ng/ml as a deficiency, 20-30 ng/ml as insufficiency, and more than 30 ng/ml as sufficient [14]

The instrument used for detection of the level was Cobas E411 Using ECL Electrochemiluminescence. A reagent for ECLIA commercial kit based on electrochemiluminescence methodology from Roche was taken. Elecsys Preci Control Bones 1, 2, and 3 of the low, normal, and high ranges were used.

Method of estimation:

The assay employed a polyclonal 25OHD3 specific ruthenium labeled antibody. It followed a competitive protein binding assay principle in which the binding protein of 25(OH) vitamin D was inactivated during incubation. Twenty serum samples previously analyzed with RIA were used for 25OHD analysis. Before running the samples these three controls with high, low, and normal concentrations of 25(OH) vitamin D provided by the manufacturer were run. The lower detection limit of the assay was 4.0 ng/ml, the upper detection limit was 100 ng/mL and the precision of

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the test was CV=9.9%. Results were determined via a calibrator curve which was instrument-specific and generated by 2-point calibration and a master curve provided via the reagent barcode. The analyzer automatically calculated the 25 (OH) vitamin D concentration of each sample.

Ethical considerations

Ethical approval to conduct the research was approved by the Research Ethics Committee/Hawler Medical University / College of Medicine (No. 5/6/23 -2021). Verbal informed consent to participate in the study was obtained from each woman. An official acceptance letter was obtained from the Erbil Directorate of Health granting permission to conduct this research at the hospital. All participants were assured that confidentiality would be maintained and that their information would only be used for research purposes.

Statistical analysis:

Data were analyzed using the Statistical Package for Social Sciences (SPSS, version 25). Fisher's exact test was used (instead of the Chi-square test) when the expected frequency (value) was less than 5 of more than 20% of the cells of the table. Student's t-test of two independent samples (unpaired t-test) was used to compare the means of the two samples. Pearson (r) correlation coefficient was calculated to assess the strength of correlation. A *P*-value of ≤0.05 was considered as statistically significant.

Results

Sixty women were included in the study after rejecting 21 women who did not meet the inclusion criteria and two women who refused to participate. The average age (SD) of the population under study was 27.1 (6.5) years. The age range was 16 to 41 years, with 26 being the median. 85% of the ladies were under 37 years old when they became pregnant. Women who were multiparous made up the biggest share of the sample according to Table 1.

Table 1 Basic characteristics of the mothers

	No.	(%)
Age (years)		
< 20	7	(11.7)
20-24	16	(26.7)
25-29	14	(23.3)
30-34	15	(25.0)
≥ 35	8	(13.3)
Gestational age (weeks)		
< 37	9	(15.0)
≥ 37	51	(85.0)
Parity		
Nulliparous	21	(35.0)
Multiparous	34	(56.7)
Grand multiparous	5	(8.3)

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As shown in (Table 2), 98.3% of the women had a significant vitamin D3 insufficiency, compared to 88.3% of their newborn children.

Figure 1 shows a strong correlation between newborns' and mothers' vitamin D3 levels (r = 0.726, *P* <0.001).

Table 2 Vitamin D3 status of mothers and newborns

	No.	%
Mother D3 level		
Very deficient	59	98.3
Deficient	1	1.7
Newborn D3 level		
Very deficient	53	88.3
Deficient	7	11.7
Total	60	100

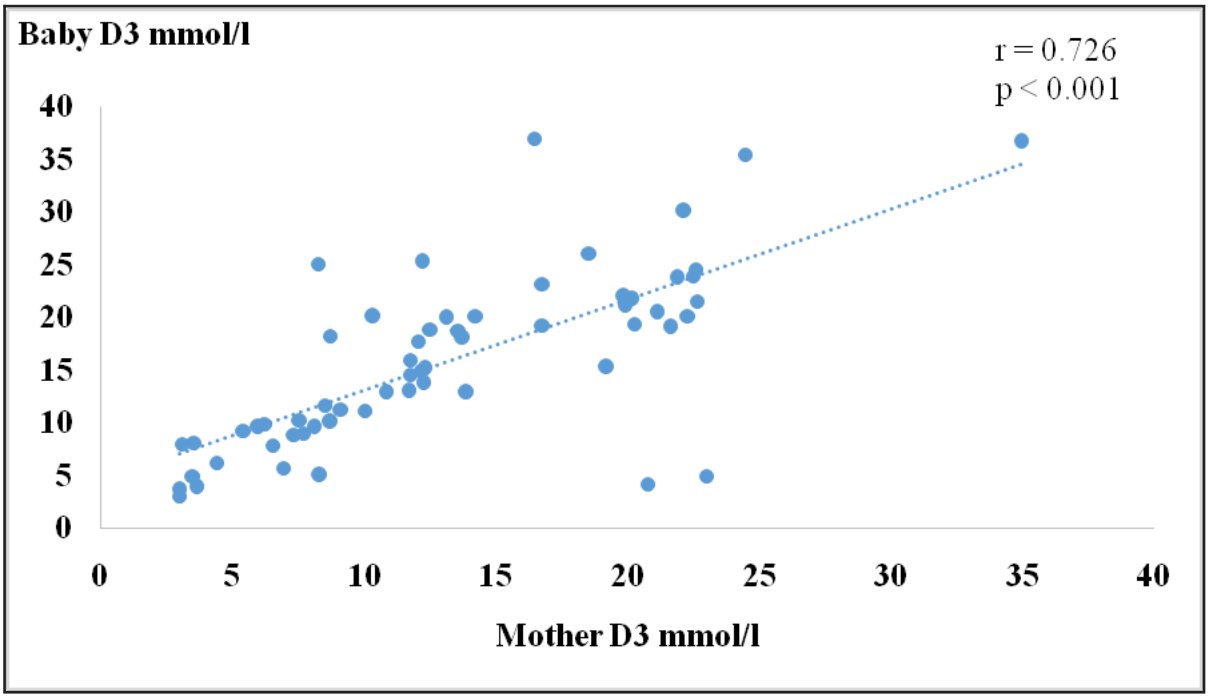

Figure 1 Correlation between mothers' and newborns' vitamin D3 levels

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Table 3 clearly shows that 59 women had a serious 25(OH) vitamin D deficit. 53 of 55 (89.8%) showed significant 25(OH) vitamin D insufficiency in their newborns. Vitamin D3 levels between mothers and their infants did not differ significantly (*P* = 0.117).

According to Figure 2, the neonates' mean 25(OH) vitamin D levels (15.8 mmol/l) were not appreciably (*P* = 0.064) greater than their mothers' (13.2 mmol/l) mean D3 levels.

Table 3 Association between mothers and newborns' degree of vitamin D3 deficiency

	Newborn D3 level			
Mothers D3 level	**Very deficient**	**Deficient**	**Total**	***P-value***
	No. (%)	**No. (%)**	**No. (%)**	
Very deficient	53 (89.8)	6 (10.2)	59 (100.0)	
Deficient	0 (0.0)	1 (100.0)	1 (100.0)	0.117*
Total	53 (88.3)	7 (11.7)	60 (100.0)	

*By Fisher's exact test.

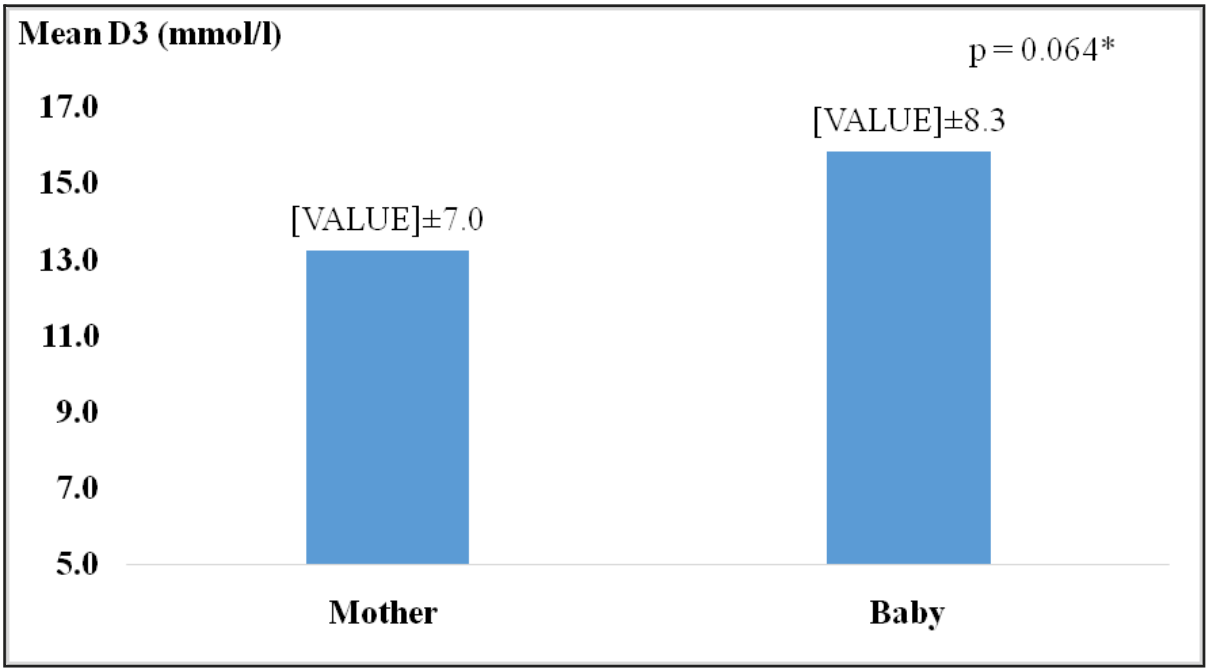

Figure 2 Means of vitamin D3 of mothers and babies
*By t-test of two independent samples.

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Discussion

During pregnancy, maternal 25(OH) vitamin D level influences maternal and neonatal calcium homeostasis. Vitamin D is delivered to the fetus via placental transfer from the mother. [9]

The current study shows that almost all of the women (98.3%) had a deficiency of 25 (OH) vitamin D. The deficiency of vitamin D is prevalent in developed and developing countries.[15] same pattern was observed in other districts in Iraq, with about 95% having a vitamin D deficiency or sufficiency. [16]

China has also a high prevalence of vitamin D insufficiency, with 90.2% in Beijing [17] and 83.6% in Guiyang. [18] Despite its importance, vitamin D level is not optimal throughout the population, particularly pregnant women who require a lot of it. Geographic position, dietary structure, and character of job might be contributing factors. [15]

The current study revealed a positive correlation between maternal serum and umbilical cord blood 25(OH) vitamin D concentrations. A prospective maternal-infant birth cohort study found a high prevalence of low vitamin D status among pregnant women and newborns. [19]

Also, a systematic review summarizing maternal and neonatal vitamin D status globally reported that over half of pregnant women and three-quarters of neonates have serum 25-hydroxyvitamin 25(OH) vitamin D concentrations <50 nmol/L being a deficiency state. [14]

The mother's and newborns' 25(OH) vitamin D levels are positively connected. [20,21] This was consistent with the current study's findings.

On the other hand, the result in this study does not agree with a previous study, which indicated the lack of a relationship between maternal vitamin D concentrations and neonatal measurements in Poland, although their study focused on insufficiently low vitamin D concentrations, which were confirmed in almost 69% of mothers of term infants.[10]

A study conducted by Agarwal et al revealed the same findings although the sample size (n = 20) was much smaller than the current study. [22]

Kanika et al. discovered an alarmingly high frequency of 25(OH) vitamin D deficiency and inadequacy in infants. Notably, despite women claiming regular multivitamin consumption during pregnancy, low vitamin D reserves were observed. [21]

A high number of pregnant women and their newborns are prone to severe vitamin D deficiency, almost regardless of season and there was an association between a low maternal 25 (OH) vitamin D status and umbilical cord level. A recent study from Izmir reported that mothers who had not used multivitamins during pregnancy and had covered dressing styles reported no data. [11]

This study focused on women's severe vitamin D shortage during delivery, the final stage of pregnancy; whereas other published articles were mostly conducted during pregnancies. We investigated the possibility of a link between vitamin D insufficiency and vitamin D levels in newborn umbilical cord blood. Having a relevant indication of neonatal long-term health provides policymakers with data to emphasize vitamin D supplementation in the early stages of pregnancy.

The study's limitations included, firstly, since this was a cross-sectional study, we were unable to ascertain if a control group of moms who utilized supplements during pregnancy exhibited same levels of Vitamin D for themselves and their newborns. Secondly, the study did not investigate changes in vitamin D deficiency related to diet, lifestyle, sunshine exposure, clothing choices, and additional vitamin D supplementation.

Larger, well-designed, prospective studies are required to determine the causal relationship between maternal and newborn vitamin D levels and maternal and newborn outcomes.

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Conclusion

No significant difference was detected between mothers and their babies regarding levels of vitamin D3.There was a strong, significant correlation between newborns' and mothers' vitamin D3 levels.

Competing interests

The authors declare that they have no competing interests.

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