The Egyptian Journal of Hospital Medicine (October 2022) Vol. 89 (2), Page 7037- 7042

# Impact of Vitamin D Status on Pregnant Women and Their Neonates: A Cross-Sectional Study

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## ABSTRACT
**Background:** Vitamin D deficiency or insufficiency is very prevalent, but it is most common in pregnant women and infants, where it is related to a wide range of unfavorable consequences, for example, preeclampsia and premature birth. This study aims to: (1) Evaluate the negative implications of low levels of vitamin D on neonates; (2) Analyze the prevalence of Vitamin-D insufficiency/deficiency amongst mothers and their newborns, as well as the features associated with it.
**Patients and methods**: Between July 2 and October 31, 2021, researchers at Baghdad's "Al-Elwiya teaching hospital" surveyed 100 pregnant Iraqi mothers and their neonates in a cross-sectional study. Age, delivery method, gender, weight, adequate sun exposure, and time in utero were all determined for the mother. Enzyme-Linked Immunosorbent Assay is used to assess Vitamin D in both mothers and infants (ELISA).
**Results:** Among a sample of 100 mothers and their children, researchers discovered that 95% of moms and 86% of newborns had insufficient or deficient Vitamin D. Vitamin D of parents and newborns was found to be different. Infant Vitamin D is favorably associated with maternal Vitamin-D status. Birth weight is strongly associated with maternal Vitamin D. Vitamin D in women was (5.1-19.1) ng/ml whereas in neonates was (9.28-31.22) ng/ml, on average.
**Conclusions**: Vitamin D deficiency or insufficiency is widespread, particularly among mothers, but it is also present in a considerable percentage of babies. There is a link between the mother's Vitamin D level and that of their babies.
**Keywords**: ELISA, pregnant, Vitamin-D, cross-sectional study.

## INTRODUCTION

Pregnancy-related vitamin D insufficiency is a global health concern. Miscarriages, hypertension, intrauterine growth restriction, a greater risk for gestational diabetes, premature delivery, and Children with a low birth weight are among the negative pregnancy consequences that have been linked to vitamin D insufficiency [(1)].

Vitamin D is synthesized by the skin when it is exposed to sunlight; this accounts for the vast majority of vitamin D in the body. Deficiency of vitamin D is unusual in tropical places where the sun is overhead for most or all of the year, such as India, the Middle East, and Africa (particularly Iraq). However, a significant frequency of vitamin D insufficiency in pregnancy, ranging from 26-95%, was documented in nations around the equator despite steady and ample sun exposure [(2)]. Women have traditionally been considered to have a "high risk" for vitamin D insufficiency in sub-Saharan Africa, Asia, and the Middle East. All areas had a high incidence of hypovitaminosis when its level is lesser than 30 ng/ml (75 nmol/L), although South Asia and the Middle East had the highest incidence of values below 10 ng/ml (25 nmol/L) [(3, 4)]. Vitamin D level is affected by several external and internal factors, including but not limited to exposure to sun, season, skin color, clothing type, latitude, diet, and Vitamin-D supplementation. Poor sun exposure, inadequate vitamin D dietary intake, obesity, and poor socioeconomic situations are the most prevalent causes of vitamin D insufficiency [(5, 6)]. Even under ideal circumstances, the amount of Vitamin D gained from dietary sources is less than 10% of what is required by the body. In the summer, a person with lighter skin may create between 10,000 and 20,000 IU of vitamin D3 in only 10 to 15 minutes of sun exposure, whereas a person with darker skin may need as much as 10 times as much sun exposure to get the same result. Factors other than time spent outdoors affect how much ultraviolet radiation (UV) is absorbed by the skin for Vitamin-D synthesis [(6)].

Increased rates of asthma, respiratory-distress-syndrome, food allergy, type-I diabetes, autism, and schizophrenia have all been associated with vitamin D insufficiency in neonates [(7-10)]. The vitamin D status of the mother has a major impact on the vitamin D status of the developing fetus and baby. Maternal vitamin D insufficiency is the primary risk factor for neonatal vitamin D deficiency. The benefits of vitamin D supplementation, as well as what constitutes adequate vitamin D consumption, are up for debate [(11)]. Among pregnant women and their babies, vitamin-D deficiency or insufficiency is common. The current study aimed to determine how common is vitamin-D deficiency among pregnant women and what negative impacts this condition has on babies.

## PATIENTS AND METHODS

We have conducted a cross-sectional research study with convenience sampling of 100 pregnant women



Received: 13/7/2022
Accepted: 16/9/2022

and 100 infants between July 2, 2021, and October 31, 2021, at Al-Elwiya Maternity Teaching Hospital, Baghdad. These women were asked to fill out a survey about themselves and their pregnancies, including questions about their ages, delivery methods, sex, the number of months their babies stayed in the womb, sun exposure, and the total birth weights of their babies. In our questionnaire, we ask for about 20 minutes or more of exposure of the face, upper and lower limb, to sunlight during the day several times a week between 9.00 am and 3.00 pm. Excluded from the trial were women with renal, bone, or gastrointestinal issues or who were taking drugs known to impact Vitamin-D metabolism. All of the moms gave their blessings. Mothers were interviewed and data is culled from medical records accessible to the public. Vein blood samples from women were taken at admission for cross-matching purposes, whereas cord blood samples were taken shortly after delivery.

Serum 25-hydroxyVitamin-D was measured in both mothers and their newborns at a private laboratory because the Enzyme-Linked Immunosorbent Assay (ELISA) method is not available at the hospital. We divided moms and infants into groups according to their Vitamin-D. A deficiency is indicated at 10 ng/ml, an insufficient between 10 and 30 ng/ml, and an adequate from 30 to 100 ng/ml. A digital scale is used to calculate the birth weight of each neonate.

**Ethical approval:**

**The Scientific Committee of Al-Kindy Medical College/ University of Baghdad approved the study. Every patient signed an informed written consent for the acceptance of participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.**

***Statistical Analysis***

Statistical Package for the Social Sciences (SPSS) software version 25 was implemented for data analysis. Results are shown in mean, standard deviation, and range formats. Frequencies and percentages are used to display categorical data.

If necessary, Yate's adjustment or the Fisher Exact test was used with the Pearson Chi-square test (2-test) to determine whether or not a statistically significant difference existed between sets of percentages (qualitative data). There is no connection if r is less than 0.3, a weak correlation if r is between 0.3-0.5, a moderate correlation if r is 0.5-0.7, and a high correlation if r is more than 0.7. P values below 0.05 were deemed statistically significant. P value $\leq$0.05 was considered significant.

**RESULTS**

This study included a total of 100 pregnant women and their newborns. The mean age of participant mothers was 25.23 (SD 5.34) years and the highest proportion of mothers aged <25 years (48%). Regarding infants' gender, there were 55 males versus 45 females with a male-to-female ratio of 1.22:1. Concerning infants' weight; 34 were underweight (9 of them were very LBW), and the remaining 66 were normal weight. The mean gestational age was 35.31 (SD 3.05) weeks, 44% of pregnancies were in a term, and 56% were preterm. More than half of enrolled infants (56%) were delivered through C/S, while normal vaginal delivery was the mode of delivery for the remaining 44%. Sun exposure was reported by 8% of the studied mothers (**Table 1**).

**Table 1: Socio-demographic and reproductive characteristics of participants**

| Participants Characteristics | No. (n= 100) | Percentage (%) |
|---|---|---|
| **Age of Mothers (Years)** | | |
| **< 25** | 48 | 48.0 |
| **25 - 29** | 29 | 29.0 |
| **≥ 30** | 23 | 23.0 |
| **Infants' gender** | | |
| **Male** | 55 | 55.0 |
| **Female** | 44 | 45.0 |
| **Birth Weight** | | |
| **Normal** | 66 | 66.0 |
| **LBW** | 25 | 25.0 |
| **VLBW** | 9 | 9.0 |
| **Gestational Age** | | |
| **Preterm** | 56 | 56.0 |
| **Term** | 44 | 44.0 |
| **Mode of Delivery** | | |
| **NVD** | 44 | 44.0 |
| **C/S** | 56 | 56.0 |
| **Sun Exposure** | | |
| **Yes** | 8 | 8.0 |
| **No** | 92 | 92.0 |

The mean level of vitamin D3 in mothers and neonates were respectively 12.53 (SD 7.39) and 20.51 (SD 11.36) ng/ml. Vitamin D3 was sufficient in 5% of mothers, insufficient in 48%, while 47% of them had vitamin D3 deficiency. In the neonates, vitamin D3 was sufficient in 14%, insufficient in 65%, and deficient in 21%. In this study, there was a statistically significant association (P= 0.001) between maternal vitamin D3 and neonatal vitamin D3 levels, as 95.2% of neonates who were vitamin D3 deficient, their mothers were with vitamin D3 deficiency (**Figure 1** and **Table 2**).

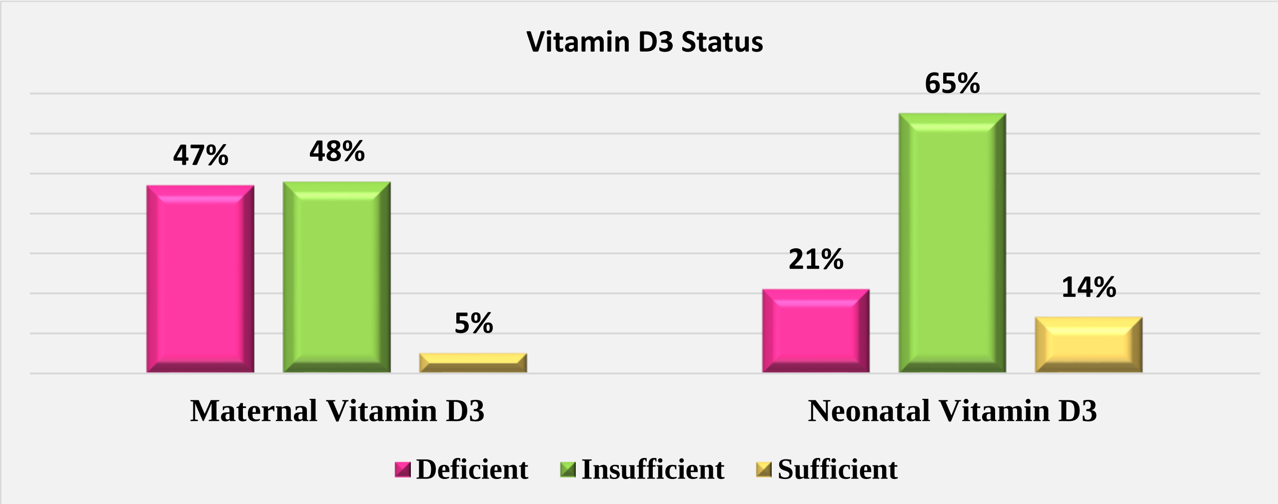


**Figure 1: Maternal and neonatal vitamin D3 levels.**

**Table 2: Distribution of the study sample by maternal and neonatal vitamin D3 levels.**

| Neonatal Vitamin D3 | Maternal Vitamin D3 | | | Total (%) n= 100 | P- Value |
|---|---|---|---|---|---|
| | Deficient (%) n= 47 | Insufficient (%) n= 48 | Sufficient (%) n= 5 | | |
| **Deficient** | 20 (95.2) | 1 (4.8) | 0 (0) | 21 (21.0) | **0.001** |
| **Insufficient** | 24 (36.9) | 41 (63.1) | 0 (0) | 65 (65.0) | |
| **Sufficient** | 3 (21.4) | 6 (42.9) | 5 (35.7) | 14 (14.0) | |

The present study found a statistically significant difference between neonatal vitamin D3 level and gestational age, delivery mode, and sun exposure. The proportion of deficient vitamin D3 was significantly higher among women with preterm pregnancies (96.4%, P= 0.001), women who delivered through cesarean section (92.9%, P= 0.026), and women who didn't expose to sunlight (91.3%, P= 0.001). No significant association (P ≥ 0.05) was found between neonatal vitamin D3 level and maternal age (**Table 3**).

**Table 3: Distribution of study sample by neonatal vitamin D3 level and maternal characteristics.**

| Maternal Characteristics | Neonatal Vitamin D3 | | Total (%) n= 100 | P- Value |
|---|---|---|---|---|
| | Deficient (%) n= 86 | Sufficient (%) n= 14 | | |
| **Age of Mothers (Years)** | | | | |
| **< 25** | 42 (87.5) | 6 (12.5) | 48 (48.0) | **0.114** |
| **25 - 29** | 22 (75.9) | 7 (24.1) | 29 (49.0) | |
| **≥ 30** | 22 (95.7) | 1 (4.3) | 23 (23.0) | |
| **Gestational Age** | | | | |
| **Preterm** | 54 (96.4) | 2 (3.6) | 56 (56.0) | **0.001** |
| **Term** | 32 (72.7) | 12 (27.3) | 44 (44.0) | |
| **Mode of Delivery** | | | | |
| **NVD** | 34 (77.3) | 10 (22.7) | 44 (44.0) | **0.026** |
| **C/S** | 52 (92.9) | 4 (7.1) | 56 (56.0) | |
| **Sun Exposure** | | | | |
| **Yes** | 2 (25.0) | 6 (75.0) | 8 (8.0) | **0.001** |
| **No** | 84 (91.3) | 8 (8.7) | 92 (92.0) | |

In the Pearson correlation analysis, there was a significant, strong, and positive correlation between vitamin D3 levels of mothers and that of neonates (r= 0.755, P= 0.001) (**Figure 2**).

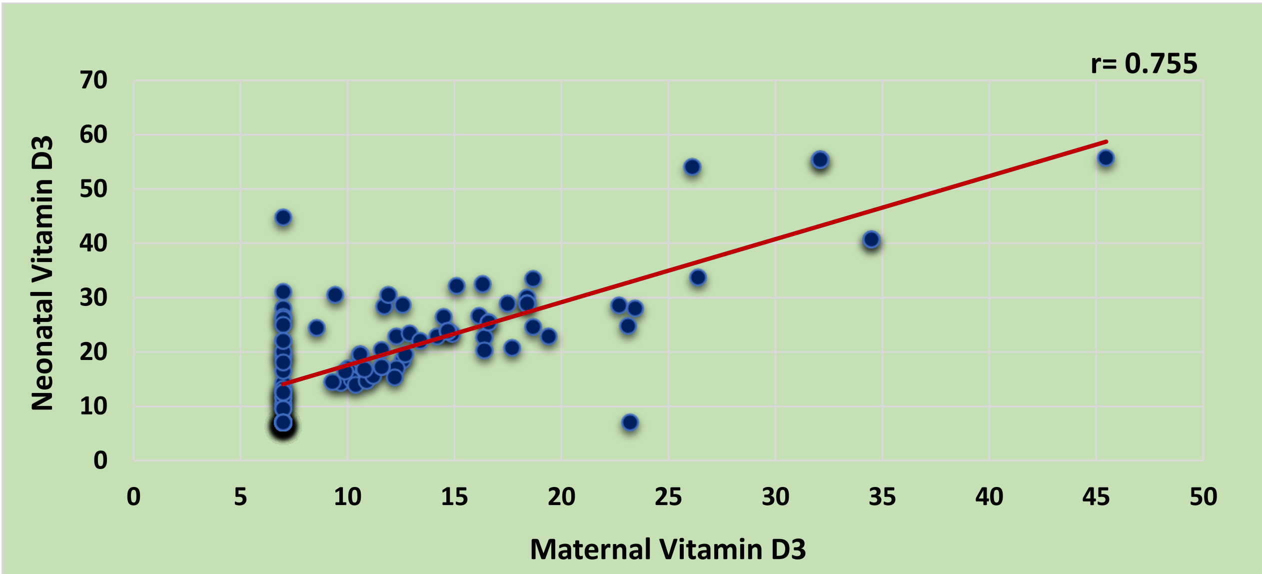


**Figure 2: An investigation of the degree to which maternal and newborn vitamin D3 levels are correlated.**

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**DISCUSSION**

In our study, there were more newborn boys than girls. The majority of mothers had significant vitamin D deficiencies, which is similar to earlier studies [12-16] and other nations, where deficiencies have been reported to affect 81% of expectant mothers in Nepal [17], over 90% in Guizhou, China [18], and Saudi Arabia [19]. Nearly 44% of mothers and babies were found to have the condition, according to a study's pooled findings across African nations [20].

The tendency of Iraqis to avoid exposure to sunlight during summer months due to high temperature, also diet, absent supplement use, cultural and lifestyle factors, and skin pigmentation are possible factors for Vitamin-D insufficiency/deficiency among mothers in the current study. Moreover, many Iraqi women wear an abaya, which may prevent their skin from producing Vitamin D, although research conducted by MNAR in Iraq found no variation in Vitamin D among women of different garment styles [16]. Iraq's severe air pollution problem is another possible contributor [21, 22]. Another plausible rationale is that pregnant women's Vitamin-D stores are decreased because they provide their newborns with Vitamin D. There is a limitation to this study in that questionnaire did not inquire about participants' diet, Vitamin-D supplementation, skin tone, or clothing preference. Even though there is a massive disparity in Vitamin D between moms and neonates, a large number of babies were deficient or insufficient in Vitamin D. Consistent with results of previous worldwide studies, we found a robust positive correlation between neonatal and maternal Vitamin D [22]. Since a healthy infant's birth weight tends to be more than 5 pounds, it stands to reason that Vitamin D in infants would have a positive correlation with their sizes. A considerable percentage of neonates (34%) had a low or extremely low birth weight, which is highly positively correlated with maternal Vitamin D. Moreover, the study found a statistically significantly different in means of Vitamin-D between mothers whose pregnancies were full term and those whose pregnancies were premature. These correlations between maternal and infant Vitamin D are consistent with previous studies and imply a role for maternal Vitamin D in fetal development [23-26]. Researchers observed that Vitamin D in umbilical cord blood is consistently higher than in maternal blood, which is coherent with findings of another research looking at risk factors for hypovitaminosis D in pregnant women and their neonates. Such high levels of Vitamin D in the umbilical cord might be attributed to the placental production of Vitamin D or because of a positive maternal-fetal Vitamin-D gradient. This precaution would ensure that pregnancy and newborn get enough amounts of Vitamin D throughout development. This may be because cord blood has a larger quantity of vitamin-D binding protein (DBP), which might explain why Vitamin-D is higher there [27]. Despite the large prevalence of Vitamin-D insufficiency/deficiency amongst pregnant women sample and their newborns in the current study, up-to-date National guidelines of the Iraqi Health Ministry, which were adapted from the World Health Organization guide, do not recommend Vitamin-D testing or supplementation for pregnant women [28,29].

In the study, there was a statistically significant association between neonatal vitamin D3 level and mode of delivery. The level of vitamin D3 is lower in mothers and neonates who were delivered by cesarean section compared to vaginal birth. This might be due to similar risk factors that increase the chance of delivery by cesarean section with low vitamin d levels, like decreased activity, sedentary lifestyle, obesity, and urbanization that decreases the adequacy of sun exposure. The low level of vitamin d decreases the muscle strength needed during labor, which rises the incidence of cesarean section [30-34].

Sun exposure was inadequate in most mothers with a low level of vitamin D.

Despite plentiful overhead sunlight during most or all of the year in our nation, insufficient sun exposure occurs for a number of reasons. Due to their reduced exposure to sunshine, women who are housebound, work in jobs that prevent them from getting much sun, or don long gowns, robes, or head coverings for religious reasons are at risk for vitamin D insufficiency [35].

In conclusion, many pregnant women and their infants both have vitamin-D deficiency or insufficiency (with a higher prevalence among mothers). Babies' vitamin D was most affected by their mothers and by their birth weight. Those mothers had inadequate sun exposure and more cesarean section incidence.

## RECOMMENDATION

Even though our country the abundant overhead sun for most of the year, vitamin D deficiency is common, so mothers need screening for vitamin D3 levels, and treatment is required to decrease maternal and neonatal complications, but more studies are required about the effect and safety of treatment on the maternal and neonatal outcome.

**Consent for Publication:** I confirm that all authors accept the manuscript for submission.

**Availability of data and material:** Available.

**Competing interests:** None.

**Funding:** No fund.

**Conflicts of Interest:** The authors declare no conflicts of interest regarding the publication of this paper.

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