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A Comparison Between Maternal and Neonatal Serum Level of Vitamin D and Its Relationship with Anthropometric Neonatal Factors

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ABSTRACT

Background & Objective: The aims of present study were to compare the vitamin D concentration in pregnant women and the umbilical cord blood while investigating for a relationship between its level and anthropometric neonatal factors (i.e. birth weight, birth length, and head circumference).

Materials & Methods: The study was performed as a descriptive cross-sectional study on pregnant women who were admitted to the labor ward for delivery. Serum level of 25-hydroxyvitamin D [25(OH) D], was measured and compared in women and the umbilical cord blood. The relationship between 25(OH) D levels and anthropometric neonatal factors including birth weight, birth length and head circumference was evaluated.

Results: A total of 106 pregnant women (53 Iranians and 53 Afghan refugees' women) were evaluated. There was a significant correlation between maternal serum level of 25(OH) D and that of their neonates, both in Iranians and Afghans considering gestational age as a confounding factor (R=0.62, *P*=0.000). Maternal and neonatal 25(OH) D levels were significantly higher in Iranians than Afghans (27.2±11.5 ng/mL VS 21.9±12.7 ng/mL, *P*=0.026 and 26.5±11.2 VS 17.3±11.4, *P*=0.000) respectively. However, neonatal weight and head circumference (HC), were not different in Iranians and Afghans except for neonatal height which was higher in Afghans (*P*=0.015) irrespective of lower amount of neonatal 25(OH) D levels.
The mean cord levels of vitamin D in boys and girls did not show a significant difference. There was no significant correlation between 25(OH) D serum level and pregnant women's level of education, pre-labor rupture of membranes (PROM), past medical history (PMH), taking supplements and smoking.

Conclusion: Maternal and neonatal 25(OH) D levels did not influence neonatal anthropometry.

Keywords: Anthropometry, Head circumference (HC), Neonate, Pregnancy, Vitamin D, Umbilical cord, 25-hydroxyvitamin D [25(OH) D]

Introduction

Vitamin D is a fat soluble vitamin which in harmony with its metabolites has a crucial and vital role in calcium homeostasis and bone metabolism **(1)**. Its precursor is produced in skin under the influence of ultra violet rays and then converts to active forms of vitamin D in liver and kidney. Vitamin D aids the absorption of calcium through the digestive system **(2)**.

Vitamin D deficiency is a global problem. Its incidence in neonates and children is around 15-16% **(3-4)**. In the United States and developed countries, however, it differs in various ethnicities and countries specially places in which maternal deficiency of vitamin D is common **(5)**. During pregnancy, there is a profound change in the metabolism of vitamin D and calcium, which is essential for fetal bone growth and mineralization **(6)**. Increasing the calcium intake in the

intestine, reducing renal excretion and increasing calcium reabsorption from maternal skeletons are among these changes **(7, 8)**. Low concentration of vitamin D in maternal blood has been suggested as a risk factor for poor fetal and neonatal skeletal outcomes. It has been reported that vitamin D deficiency can cause intrauterine growth restriction and rickets in neonates and children **(9-10)** and the main source of its supply depends on maternal resources **(10)**. This deficiency is more severe in most Asian and west Asian countries including Iran and Afghanistan **(11)**.

The aims of the present study were to compare the vitamin D concentration in pregnant women's and the umbilical cord blood in both Iranian and Afghan refugees' women, and finding a relationship between its level and anthropometric neonatal factors (i.e. birth weight, birth length, and head circumference).

Materials and Methods

This was a descriptive cross sectional study performed on 106 pregnant women who had been admitted to the labor ward of Akbarabadi Teaching Hospital in Tehran, Iran, between March 2017 and February 2018.

The main objective was to compare the mean 25-hydroxyvitamin D [25(OH) D] serum levels in pregnant women and their neonates in these two ethnic groups. Also, the relationship between 25(OH) D and neonatal anthropometric indexes were evaluated.

The maternal blood samples were taken in the delivery room and the umbilical cord blood sample was taken after birth in order to measure 25(OH) D, which is the best indicator of vitamin D status. Vitamin D deficiency was considered as 25(OH) D serum level of lower than 10 ng/mL, insufficient vitamin D as 10-30 ng/mL and sufficient as more than 30 ng/mL both for mothers and neonates. Maternal demographic characteristics including age, ethnicity, level of education, gravidity and parity, delivery route, gestational age at delivery, pre-labor rupture of membranes (PROM), history of maternal disorders, smoking, drug abuse and alcohol consumption were recorded. Also, neonatal sex, weight, height, head circumference and Apgar score were evaluated. Data were then analyzed using SPSS software version 22 (SPSS Inc., Chicago, IL., USA). The results for quantitative and qualitative variables were expressed as mean and standard deviation (mean ± SD) and percentages respectively. To compare quantitative variables, t-test and for comparing qualitative variables Chi-square test were used. P-value of less than 0.05 was considered significant.

Results

A total of 53 Iranian and 53 Afghan refugee women were evaluated (n=106). The baseline characteristics of women are shown in Table 1. Serum 25(OH) D concentration were higher in Iranian women than Afghans. Also, umbilical cord 25(OH) D concentration were higher in Iranian neonates (Table 2). However, neonatal anthropometry including birth weight and newborn head circumference (HC), were not different between Iranians and Afghans except for neonatal height which was higher in Afghans (*P*=0.015) irrespective of lower amount of neonatal 25(OH) D umbilical cord levels (Table 3). At the same time, there was a significant correlation between maternal serum level of 25(OH) D and that of their neonates, both in Iranians and Afghans considering gestational age as a confounding factor (*P*=0.000, R=0.62).

The mean cord levels of vitamin D in boys and girls were 20.9±11.7 ng/mL and 22.8±12.7 ng/mL respectively without a significant difference (*P*=0.418).

There was no significant correlation between 25(OH) D level and pregnant women's level of education, PROM, maternal past medical history (PMH), taking supplements and smoking (Table 4).

Table 1. The baseline characteristics of women and neonates

Characteristics		N=106
Age (y) M±SD (min-max)		26.3±6.03 (16-44)
Gravidity M±SD (min-max)		2.04±1.09 (1-6)
Parity M±SD (min-max)		0.9±1.09 (0-5)
Gestational age(w) M±SD (min-max)		38.3±1.98 (29.3-41.3)
Level of education	**illiterate**	18 (17%)
	Less than Diploma	56 (52.8%)
	Diploma	22 (20.8%)
	Bachelor	7(6.6%)
	Missing	3 (3.1%)

Characteristics		N=106
Delivery rout	Cesarean	15 (14.2%)
	Vaginal	91 (85.8%)
PROM		31 (29.2%)
PMH		28 (26.4%)
Taking supplements		96 (90.6%)
Smoking, alcohol		2 (1.9%)
Neonatal sex	Girl	54 (50.9%)
	Boy	52 (49.1%)
Neonatal weight(g) M±SD (min-max)		3098±493 (1650-4500)
Neonatal HC(cm) M±SD (min-max)		34.4±1.5 (30-37)
Neonatal height M±SD (min-max)		49.8±2.5 (45-59)
Apgar min 1 M±SD (min-max)		8.8±0.664 (4-9)
Apgar min 5 M±SD (min-max)		9.9±0.43 (6-10)
Neonatal complications		16 (15.1%)
Maternal 25(OH) D M±SD (min-max)		24.5±12.3 (0.5-67.3)
Neonatal 25(OH) D M±SD (min-max)		21.9±12.2 (0-58.3)
Maternal Vit D deficiency		74 (69.8%)
Neonatal Vit D deficiency		77 (72.7%)
Maternal Vit D	Sufficient	10 (9.4%)
	Insufficient	64 (60.4%)
	Deficient	32 (30.2%)
Neonatal Vit D	Sufficient	20 (18.9%)
	Insufficient	57 (53.8%)
	Deficient	29 (27.4%)

Table 2. Maternal serum and Umbilical cord blood level of vitamin D

Characteristics	Iranian n=53	Afghan n=53	P-value
Maternal 25(OH) D	27.2±11.5	21.9±12.7	0.026*
Umbilical cord 25(OH) D	26.5±11.2	17.3±11.4	0.000*

*: significant

Table 3. Neonatal characteristics of the two groups of Iranians and Afghans

Characteristics	Iranians n=53	Afghans n=53	P-value
Neonatal weight(g) M±SD	3103.02±454.7	3093.4±534.2	0.921
Neonatal HC(cm) M±SD	34.2±1.47	34.59±1.52	0.177
Neonatal height M±SD	49.23±2.14	50.4±2.67	0.015*
Apgar min 1 M±SD	8.77±0.8	8.91±0.49	0.308
Apgar min 5 M±SD	9.87±0.59	9.98±0.13	0.176

*: significant

Table 4. Relationship between maternal 25(OH) D level and her baseline characteristics

Characteristics		Sufficient n=10	Insufficient n=64	Deficient n=32	P-value
Level of Education N=103	Illiterate n=18	3(16.7%)	11(61.1%)	4(22.2)	0.487
	lower than High school diploma n=56	6(10.7%)	35(62.5%)	15(26.8%)	

Characteristics		Sufficient n=10	Insufficient n=64	Deficient n=32	P-value
	High school Diploma n=22	0(0%)	13(59.1%)	9(40.9%)	
	Bachelors n=7	1 (10%)	5(50%)	1(10%)	
PROM N=31		3(9.7%)	20(64.5%)	8(25.8%)	0.816
PMH N=28		2(7.1%)	18(64.3%)	8(28.6%)	0.843
Taking supplements N=96		9(9.4%)	58(60.4%)	29(30.2%)	0.958
Smoking N=2		0(0%)	1(50.0%)	1(50.0%)	0.785

Discussion

In this study, 25(OH) D level was higher in Iranian women and their neonates, however, the neonatal anthropometry was not different between Iranian and Afghan refugee women except for neonatal height which was surprisingly higher in Afghans irrespective of their lower 25(OH) D umbilical cord level. Therefore, maternal and neonatal 25(OH) D levels did not influence neonatal anthropometry and this could be related to other factors, including genetics. However, further studies need to investigate this subject independently. Also, no relationship was reported between maternal characteristics and 25(OH) D level. Furthermore, socio-cultural challenges to natural methods of vitamin D intake deserve attention, as both Iran and Afghanistan benefit from sufficient hours of sunlight.

Different serum levels of vitamin D in various ethnicities has been shown in other studies **(12- 16)**. Also a correlation between neonatal and maternal serum levels of vitamin D has been shown in some studies **(12, 13)**. However, in the study by Jacquemyn (2013), no differences were made by taking supplements and gravidity did not affect vitamin D levels **(12)**. This is in accordance with the present study. It can therefore be questioned whether taking vitamin D supplements during pregnancy should be recommended.

There are some controversies on the effects of maternal serum level of vitamin D on anthropometric characteristics of newborns. In a cohort study on 107 women and their neonates, Við Streym *et al.* **(17)** reported no correlation between anthropometric indexes of neonates and vitamin D level, which is similar to the present study. In contrast, Bowyer *et al.* **(13)**, showed that vitamin D deficiency can influence the neonatal weight which is different with the results of the present study and the study by Við Streym *et al.* **(17)**. Also, Sarma *et al.* **(18)**, reported lower neonatal height and femur length in vitamin D deficient mothers, which is not comparable with the present study and the other mentioned studies **(17, 19)**. A systematic review **(20)**, reported high correlation between maternal and neonatal vitamin D levels, similar to the present study. Therefore despite the fact that vitamin D deficiency is common in mothers and neonates, it is not clear whether prescribing vitamin D supplements during pregnancy can cause any changes in neonatal anthropometric characteristics **(21-23)**. There were also limitations to the present study. For one, participants' nutritional habits were not recorded. This could have led to a better understanding of the potential effects of such habits on this study's results. Also, the Afghan refugee women are expats living in Iran, although their duration of residence in Iran is not known. There could have been cultural or pre and post immigration factors that have led to this study's outcomes. For future studies, these extra information could potentially facilitate a better understanding of the results. Further randomized clinical trials are recommended in order for clearer conclusions to be reached.

Conclusion

Maternal and neonatal 25(OH) D levels did not influence neonatal anthropometry.

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Conflict of Interest

All authors have no conflicts of interest.

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