

VITAMIN D STATUS IN TERM NEWBORNS
AND THEIR MOTHERS

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Abstract

The aim of this study is: 1) To evaluate vitamin D serum levels of full-term newborns and its association with the maternal levels; 2) To evaluate the diet and the intake of multivitamin supplements of women; 3) To analyze seasonal dependence in serum levels of mother-baby pairs. The prospective study was carried out between July 2018 and February 2020 at the University Hospital of Obstetrics and Gynecology "Maichin dom", Sofia. The study included 45 full-term newborns and their mothers. Data collected included maternal health, nutrition, vitamin intake, and anthropometric data of the newborns. The laboratory tests performed: maternal serum 25(OH)D levels taken in the third trimester of pregnancy and umbilical cord levels of 25(OH)D. The results show that the mean birth weight was 3234.22 ± 370.29 g and the mean gestational age was 38.13 ± 0.89 weeks. A 25(OH)D sufficiency was found in 58% of mothers and 67% of newborns. A strong positive correlation between maternal and neonatal 25(OH)D concentrations ($p = 0.007$) was found. A relationship between maternal diet, vitamin supplementation and serum vitamin D levels was observed. The level of 25(OH)D in the umbilical cord in winter is lower than in summer ($p = 0.002$). Due to the essential role of vitamin D for the normal development of the fetus and the infant, a testing for serum levels of vitamin D during pregnancy is recommended.

Key words: vitamin D, pregnancy, full-term newborn

Introduction. Vitamin D is a pleiotropic secondary steroid hormone of great importance for the human health and prophylaxis of various diseases [1]. Pregnant women and newborns are a significantly risky group regarding insufficient 25(OH)D levels [2,3]. The rapid growth of the fetus in the second half of pregnancy reduces maternal vitamin D levels. Balanced maternal nutrition during pregnancy is important to ensure optimal birth outcomes, maternal health and offspring development [4]. Different international scientific organizations recommend that pregnant women take supplemental doses of vitamin D, ranging from 600 to 1000 IU/daily [2,5,6]. The World Health Organization recommends pregnant women to take the amount of 200 IU/daily [7]. The Bulgarian Society of Endocrinology recommends a dose of up to 2000 IU/daily [8]. Vitamin D status is defined by the measurement of serum 25(OH)D concentrations [9]. This is the best available indicator that summarizes the amount of skin synthesis and the total intake. Most guidelines report that 25(OH)D of at least 50 nmol/l is an adequate dose [9,10]. A level of 30 to 50 nmol/l is considered insufficient, while a 25(OH)D < 30 nmol/l as deficient. The aim of this study is to evaluate the relationship between maternal and umbilical cord blood vitamin D concentrations.

Materials and methods. The prospective study was conducted among 45 full-term babies and their mothers at the University Hospital of Obstetrics and Gynecology “Maichin dom”, Sofia, Bulgaria from 1.07.2018 to 29.02.2020. The following criteria of serum 25(OH)D concentrations were used: recommended 25(OH)D level > 50 nmol/l; insufficiency of 30 to 50 nmol/l; deficiency < 30 nmol/l [6,10]. We analyzed maternal and umbilical 25(OH)D levels and formed three groups – 1) normal level, 2) insufficient level, and 3) deficient level group. The study was conducted for a period of eight months during different seasons. The mother-infant cohort was subdivided into two large groups depending on the season of birth. The summer group included 23 women who delivered from July to October 2019, and the winter group consisted of 22 women who delivered from November 2019 to February 2020. Each participant provided a written informed consent declaration. The Ethics Committee of the Medical University of Sofia approved the study protocol.

Data collected. Women included were interviewed for their lifestyle, health and prenatal care. They were surveyed about their education, obstetric diseases, nutrition, vitamin intake, and body mass index. The exclusion criteria were as follows: non-Bulgarian nationality, multiple gestation, chronic diseases before pregnancy, preterm delivery, malformations of the fetus. Anthropometric parameters of the newborn (weight, length, head circumference), the Apgar score and mode of delivery were assessed at birth.

Laboratory tests. Maternal serum 25(OH)D levels were prenatally tested during the last trimester of pregnancy. The umbilical cord samples were taken at birth. All samples were made in the MDL “Cibalab”, Sofia. 25(OH)D concentration was determined via electrochemiluminescence immunoassay.

Statistical analysis. Data were analyzed using SPSS Version 19.0. $P < 0.05$ was considered statistically significant.

Results. We followed 45 mother-newborn pairs in our study. The mean age of mothers was 32.69 ± 5.31 years; 56% were primiparous; 87% had university degree; 96% had professional activity during pregnancy. The deliveries by Cesarean section were 71%. Sixty percent of women had normal pregnancy. The analysis of morbidity showed: 13.3% with different infections, 4% – preeclampsia, 8.9% – gestational diabetes, 13.3% – other disorders (hypothyroidism, thrombophilia, etc.).

The mean 25(OH)D level of mothers was 55.95 ± 22.52 nmol/l. According to their vitamin D level they were divided into three groups (Table 1).

T a b l e 1

Model of maternal nutrition, vitamin intake, and maternal vitamin D level

Maternal nutrition (intake of milk, meat, eggs), <i>n</i> (%)	Regular intake	34 (75.6%)
	Irregular intake	10 (22.2%)
	Vegetarians	1 (2.2%)
Supplementation with multivitamins, <i>n</i> (%)	Regular intake	23 (51.1%)
	Irregular	2 (4.4%)
	None	20 (44.4%)
Single component vitamin D preparations, <i>n</i> (%)	Regular intake	13 (28.9%)
	Irregular intake <1 month	5 (11.1%)
	No	27 (60%)
Pre-pregnancy BMI (kg/m ²), <i>n</i> (%)	Normal	36 (80%)
	Overweight	5 (11.1%)
	Obesity Excessive	4 (8.9%)
BMI at birth (kg/m ²), <i>n</i> (%)	Normal	12 (26.7%)
	Overweight	14 (31.1%)
	Obesity	19 (42.2%)
Maternal 25(OH)D level (nmol/l), <i>n</i> (%)	Normal	70.11 ± 18.1 (58%)
	Insufficiency	41.35 ± 6.30 (31%)
	Deficiency	23.22 ± 3.04 (11%)

The nutrition pattern, multivitamin supplementation and weight gain during pregnancy affect metabolism. Table 1 presents the reported intake from diet, supplements and maternal vitamin D level. Half of the patients took multivitamins during the second and third trimester of pregnancy. The women who received 1000 IU/daily of vitamin D were 28.9%. We analyzed BMI before pregnancy and at birth. A survey of pre-pregnancy BMI found only 8.9% were obese (BMI > 30 kg/m²). Almost 42% of the patients, at the time of delivery were obese. The Mann–Whitney test showed no difference between BMI (both before pregnancy and at birth) and maternal 25(OH)D levels ($p = 0.514$, $p = 0.807$). A relationship between morbidity and maternal levels was not found ($p = 0.398$).

Milk, dairy products, eggs, meat are complete protein foods with a high biologic value and a source of vitamin D. Almost 75% of mothers reported for

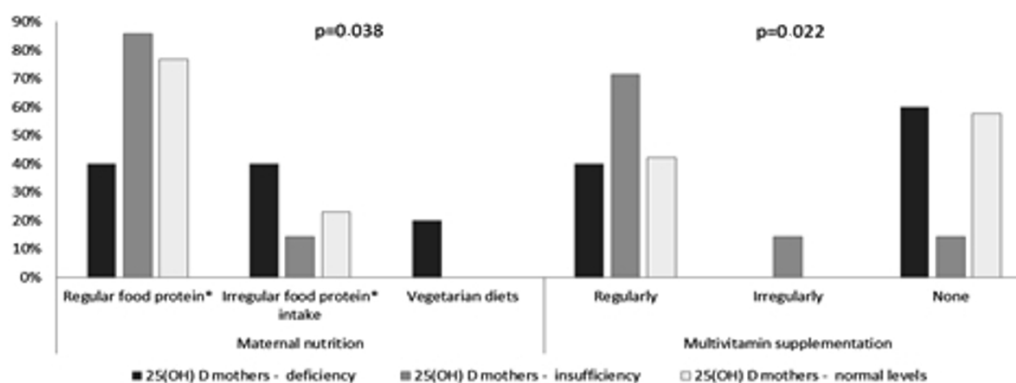


Fig. 1. Association between women's plasma 25(OH)D, nutrition and multivitamin supplementation. *Protein food intake-milk, dairy products, eggs, meat

optimal intake of these foods (Table 1). A statistically significant relationship was found between these parameters (Fig. 1).

Forty-five newborns were included in this prospective study. The number of male infants was 27 (60%). The mean gestational age of the infants was 38.13 ± 0.89 g.w. and the mean birth weight was 3234.22 ± 370.29 g. The mean length was 49.64 ± 1.90 cm and mean head circumference 34.44 ± 1.27 cm. Mean Apgar scores (at 1/5 minutes) were within normal ranges in all newborns. Neonatal somatic development was good in all neonates. The mean vitamin D level was 60.59 ± 24.30 nmol/l for the total group. The newborns were divided into three groups according to maternal levels. Overall, vitamin D deficiency was detected in 11% (20.52 ± 5.64 nmol/l) of the neonates, vitamin D insufficiency – in 22% (41.14 ± 6.24 nmol/l) and normal vitamin D levels in 67% (73.75 ± 17.12 nmol/l). A linear relationship between serum vitamin D in mothers and umbilical cord blood was found ($p = 0.007$) (Fig. 2).

We looked for seasonality in the vitamin D levels in the mother-baby groups. Mean maternal 25(OH)D concentration in the summer group was 54.23 ± 20.83 nmol/l, and for the winter group was 57.75 ± 24.52 nmol/l ($p = 0.608$). In the study group of infants born during the cold months the level of vitamin D was significantly lower than in the infants born during the summer ($p = 0.002$) (Fig. 3).

Discussion. A growing number of studies are devoted to studying the impact of vitamin D levels of pregnant women, the fetus and the newborn [3,4]. We found that 58% of women had sufficient levels of vitamin D. Forty-two percent of mothers in the study showed hypovitaminosis D (< 50 nmol/l). Studies reported from neighbouring countries have shown a prevalence of vitamin D deficiency in pregnant women and infants from 34.6% to 49.5% and from 37.2% to 56.7%, respectively [11,12].

Nutritional status during pregnancy has a significant impact on maternal and neonatal health. We found a statistically significant association between a

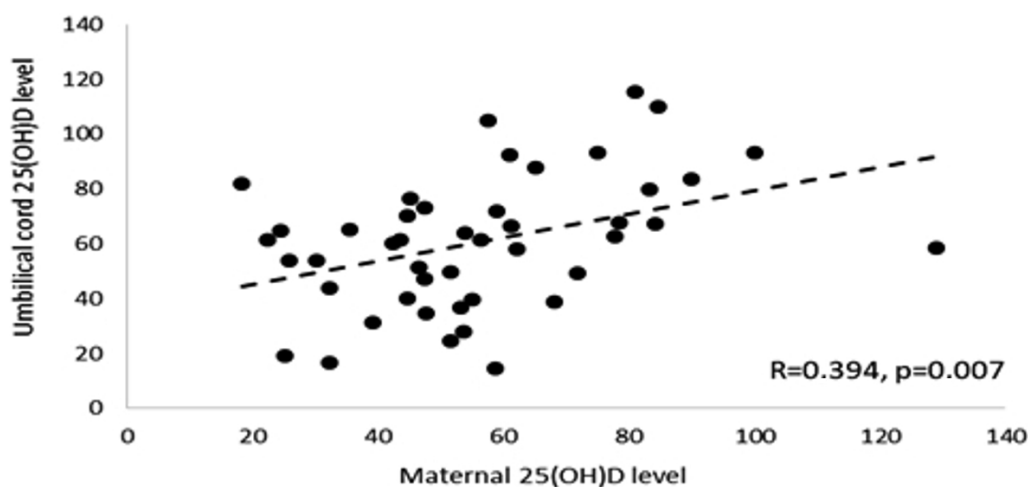


Fig. 2. Correlation of 25(OH)D concentrations in the mothers and umbilical cords in the study group. Level of significance of Pearson's correlation test ($p = 0.007$)

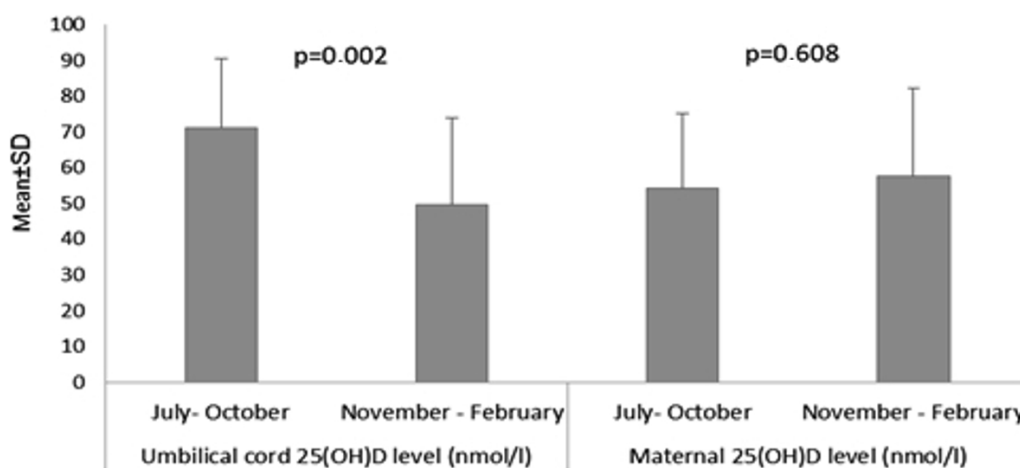


Fig. 3. Seasonal dependence of vitamin D levels in mother-baby pairs

diet naturally high of vitamin D and serum levels in mothers ($p = 0.038$). The intake of vitamin D-containing supplements had a protective role against deficiency. Almost one third of mothers have received single component vitamin D preparations (28.9%). Half of women were on multivitamin supplement intake during pregnancy. Our study showed a statistically significant correlation ($p = 0.022$) between use of multivitamins and maternal 25(OH)D levels. AGHAJAFARI et al. [13] reported a similar significant relationship between maternal reported dietary vitamin D intake and serum 25(OH)D levels. Another interesting finding was the statistically significant correlation between multivitamins and vitamin D intake in the mother and 25(OH)D level of the umbilical cord ($p = 0.040$), respectively,

($p = 0.018$). We did not find an effect of maternal nutrition on the level of vitamin D from the umbilical cord ($p = 0.714$). ÖZDEMİR et al. [12] reported association between maternal vitamin D and daily vitamin intake ($p < 0.001$).

Other authors have shown a positive correlation between maternal and newborns vitamin D levels [11]. Our study confirmed the positive correlation between maternal and umbilical cord levels ($p = 0.007$). We found only 11% newborns with a vitamin D deficiency. Two-thirds of newborns (67%) had normal 25(OH)D levels.

Upon dividing the population in two groups according to the month of birth, we found seasonal variation in umbilical cord vitamin D levels (see Fig. 3). The same dependence was not confirmed in maternal levels. The limitations of our study included the small sample size and the lack of an accurate quantitative analysis of vitamin D intake during pregnancy. Our motivation for this pilot study was to identify vitamin D status in pregnant women and their newborns and to promote screening and vitamin D supplementation.

Conclusion. The neonatal vitamin D level is associated with maternal level. However, several factors affect it, such as maternal nutrition, multivitamin/vitamin D supplementation, and the seasons. In conclusion, 42% of mothers were with hypovitaminosis D. Further studies of larger mother-baby cohorts are needed to give an overall assessment of the vitamin D status in our country.

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