ASSESSMENT OF CORRELATION BETWEEN VITAMIN D LEVEL AND PREVALENCE OF PRETERM BIRTHS IN THE POPULATION OF PREGNANT WOMEN IN POLAND

MARTA BACZYŃSKA-STRZECHA and JAROSŁAW KALINKA

Medical University in Lodz, Łódź, Poland
Department of Perinatology, 1st Chair of Obstetrics and Gynecology

Abstract

Objectives: Aim of this project is determination of the correlation between the level of vitamin D in blood serum and duration of pregnancy in population in central Poland. Material and Methods: 25-Hydroxyvitamin D (25(OH)D) level was determined in blood serum, using enzyme-linked immunosorbent assay (ELISA). Standardized history of each patient was recorded. The history included: general medical history, data regarding the course of pregnancy and information about health-related behavior that could influence vitamin D concentration. Two hundred-and-one Caucasian women at childbirth were qualified into the study. The study group was divided into 2 parts: 100 patients who had a spontaneous premature birth and 101 patients who had birth at full term. Results: Vitamin D deficiency (< 30 ng/ml) was very common for both groups (69.6% of patients in the premature group and 72% – in the control group). Patients who had a premature birth had severe vitamin D deficiency (less than 10 ng/ml) more often than in the control group (34% vs. 14.2%, p = 0.001). Severe vitamin D deficiency increased the risk of premature birth but the association was not statistically significant in the multivariate regression model (odds ratio (OR) = 2.47, 95% confidence interval (CI): 0.86–7.15, p = 0.094). Conclusions: Severe vitamin D deficiency (< 10 ng/ml) may be the factor increasing the risk of preterm birth. Int J Occup Med Environ Health 2017;30(6)

Key words: Pregnancy, Vitamin D, Preterm delivery, Vitamin D deficiency, Preterm birth, Preterm labor

INTRODUCTION

Preterm births are currently the main cause of perinatal mortality and morbidity of neonates, and have a significant influence on their further mental and physical development. Prematurity is not only a huge medical problem but also a social and economic one [1]. There are studies suggesting that vitamin D deficiency in the case of pregnant women and neonates is common in Poland, and associated with poor exposition to sunlight at that geographical latitude (49–55°N) and low dietary consumption of the vitamin by pregnant women [2]. Furthermore, it has recently been considered that abnormal gestational vitamin D level (< 30 ng/ml) has an unfavorable effect both on mother and a fetus [3,4]. Only single reports indicating the effect of vitamin D on duration of pregnancy have been published so far.
This was a case-control study. Caucasian women, of Polish origin, in single pregnancy, giving birth at the Department of Perinatology were qualified into the study. Patients were divided into 2 groups. The test group involved 100 women having spontaneous preterm birth (weeks 22–36.6). The control group involved 101 women having term birth (> 37 weeks). Duration of pregnancy was determined based on the date of the last menstruation, and verified with an ultrasonographic examination performed between week 11 and 13.6 of pregnancy. All patients were included in the study on the day of childbirth after triggering the regular uterine systolic action.

Exclusion criteria were: multiple pregnancy, abnormal result of prenatal screening, anatomical or genetic defects of the fetus, iatrogenic preterm delivery, pre-pregnancy diabetes, severe arterial hypertension present before the pregnancy or pregnancy-induced (blood pressure above 160/110 mm Hg), immunological disorders, maternal severe endocrine diseases (uncompensated hypothyroidism, hyperparathyroidism, parathyroid diseases and adrenal disorders), generalized infection. Additionally, patients with diseases that could affect the vitamin D level – chronic renal failure, condition post surgical procedures of the upper alimentary tract, parathyroid diseases, hepatic problems, uncontrolled thyroid diseases, unspecific inflammatory enteral diseases, were excluded.

Blood was collected from patients on the day of childbirth. 25-Hydroxyvitamin D (25(OH)D) level was assayed at the Immunoendocrinology Department of the Chair of Endocrinology of the Medical University in Lodz. The 25(OH)-Vitamin direct ELISA Kit from Immunodiagnostik produced in Germany was used for the assay. 25-Hydroxyvitamin D level was measured in serum obtained from 5 ml of full blood using the immunoenzymatic method. The immunoenzymatic method – enzyme-linked immunosorbent assay (ELISA) consisted in the use of monoclonal antibodies recognizing 25(OH)D. Concentration of vitamin D was determined quantitatively using
Vitamin D level and preterm birth rate

ORIGINAL PAPER

IOMIEH 2017; 30(6)

E. Włodarczyk, K. Brzyńska, P. Annaś

Mean body mass index (BMI), vocational activity, and living conditions (p > 0.05). Selected characteristics are presented in the Table 1.

The analysis of health-related behavior that could influence vitamin D concentration revealed that the ratio of patients using supplementation of vitamin D, most commonly from the 2nd trimester of pregnancy, was high and similar in both groups (78.1% vs. 83.8%, p = 0.309). Women giving term birth significantly more often used vitamin preparations containing vitamin D throughout their pregnancy (40.8% vs. 26.9%, p = 0.042). Additionally, they significantly more often declared a correct time of daily exposure to sunlight adequate to synthesis of vitamin D (47.5% vs. 25.6%, p = 0.002) (Table 1).

Vitamin D deficiency, that is the level below 30 ng/ml, was found very often in the case of both groups, in as many as 69.6% of patients in the control group and as many as 72% in the study group (p = 0.711).

The analysis of the mean serum vitamin D level in subgroups demonstrated lower levels in the preterm birth group (22.2±16.9 ng/ml) as compared to the term birth group (23.8±11.1 ng/ml) but the difference was not statistically significant (p = 0.103). The minimum level of vitamin D observed in the preterm birth group was 0.32 ng/ml and 1 ng/ml in the term birth group. The maximum level of vitamin D observed in the preterm birth group was 74.6 ng/ml and 41.8 ng/ml in the term birth group.

Women having preterm birth significantly more often had vitamin D level below 10 ng/dl – severe vitamin D deficiency (34% vs. 14.2%, p = 0.001). The percentage of patients with normal vitamin D level was higher for the term birth group than for the preterm birth group but the difference was not statistically significant (30.4% vs. 28%, p = 0.714). Results are presented in the Table 2.

Additionally, the preliminary analysis revealed that the mean vitamin D level in the group of patients giving birth before the 34th week was only 16.49 ng/ml, and was significantly lower than in the group of, the so called, late pre-

RESULTS

One hundred patients who had preterm birth and 101 patients who had term birth finally participated in this study. Both groups were comparable in terms of the mean age, mean body mass index (BMI), vocational activity, and living conditions (p > 0.05). Selected characteristics are presented in the Table 1.

The analysis of health-related behavior that could influence vitamin D concentration revealed that the ratio of patients using supplementation of vitamin D, most commonly from the 2nd trimester of pregnancy, was high and similar in both groups (78.1% vs. 83.8%, p = 0.309). Women giving term birth significantly more often used vitamin preparations containing vitamin D throughout their pregnancy (40.8% vs. 26.9%, p = 0.042). Additionally, they significantly more often declared a correct time of daily exposure to sunlight adequate to synthesis of vitamin D (47.5% vs. 25.6%, p = 0.002) (Table 1).

Vitamin D deficiency, that is the level below 30 ng/ml, was found very often in the case of both groups, in as many as 69.6% of patients in the control group and as many as 72% in the study group (p = 0.711).

The analysis of the mean serum vitamin D level in subgroups demonstrated lower levels in the preterm birth group (22.2±16.9 ng/ml) as compared to the term birth group (23.8±11.1 ng/ml) but the difference was not statistically significant (p = 0.103). The minimum level of vitamin D observed in the preterm birth group was 0.32 ng/ml and 1 ng/ml in the term birth group. The maximum level of vitamin D observed in the preterm birth group was 74.6 ng/ml and 41.8 ng/ml in the term birth group.

Women having preterm birth significantly more often had vitamin D level below 10 ng/dl – severe vitamin D deficiency (34% vs. 14.2%, p = 0.001). The percentage of patients with normal vitamin D level was higher for the term birth group than for the preterm birth group but the difference was not statistically significant (30.4% vs. 28%, p = 0.714). Results are presented in the Table 2.

Additionally, the preliminary analysis revealed that the mean vitamin D level in the group of patients giving birth before the 34th week was only 16.49 ng/ml, and was significantly lower than in the group of, the so called, late pre-

a spectrophotometric method, based on the measurement of color intensity. Concentration of 25(OH)D in samples was determined based on the standard curve. Quality control was performed. Standards, controls and patient samples were incubated together. The results for the patient samples were not valid, if within the same assay one or more values of the quality control sample was outside the acceptable limits (4.8–96 ng/ml). Limit of detection was 1.28 ng/ml.

Vitamin D deficiency was classified as less than 30 ng/ml. Obtained results of serum vitamin D levels were divided into 4 categories. Severe vitamin D deficiency (< 10 ng/ml), moderate deficiency (10–20 ng/ml), suboptimal vitamin D level (20–30 ng/ml), and the level over 30 ng/ml was considered normal.

The calculations were performed using Statistica PL 10.0 software. Quantitative variables were described by the mean (M), standard deviation (SD) and range (min.–max). Four categorical variables percentages (%) are presented. Normality was tested using the Shapiro-Wilk’s test for normality. Differences between 2 independent samples for continuous data were analyzed using Mann-Whitney U test (if the distributions of variables were different from normal) or Student’s t-test (for variables normally distributed). For the categorical variables the statistical analysis was based on Pearson Chi² test or Chi² test with Yates’ adjustment. Variables significant in univariate comparisons (at p < 0.10) were included into the multivariate logistic regression model to identify the set of the independent risk factors of preterm delivery. The odds ratio (OR) with 95% confidence interval (CI) was presented for each potential risk factor. The results were considered statistically significant at p ≤ 0.05.

RESULTS

One hundred patients who had preterm birth and 101 patients who had term birth finally participated in this study. Both groups were comparable in terms of the mean age, mean body mass index (BMI), vocational activity, and living conditions (p > 0.05). Selected characteristics are presented in the Table 1.

The analysis of health-related behavior that could influence vitamin D concentration revealed that the ratio of patients using supplementation of vitamin D, most commonly from the 2nd trimester of pregnancy, was high and similar in both groups (78.1% vs. 83.8%, p = 0.309). Women giving term birth significantly more often used vitamin preparations containing vitamin D throughout their pregnancy (40.8% vs. 26.9%, p = 0.042). Additionally, they significantly more often declared a correct time of daily exposure to sunlight adequate to synthesis of vitamin D (47.5% vs. 25.6%, p = 0.002) (Table 1).

Vitamin D deficiency, that is the level below 30 ng/ml, was found very often in the case of both groups, in as many as 69.6% of patients in the control group and as many as 72% in the study group (p = 0.711).

The analysis of the mean serum vitamin D level in subgroups demonstrated lower levels in the preterm birth group (22.2±16.9 ng/ml) as compared to the term birth group (23.8±11.1 ng/ml) but the difference was not statistically significant (p = 0.103). The minimum level of vitamin D observed in the preterm birth group was 0.32 ng/ml and 1 ng/ml in the term birth group. The maximum level of vitamin D observed in the preterm birth group was 74.6 ng/ml and 41.8 ng/ml in the term birth group.

Women having preterm birth significantly more often had vitamin D level below 10 ng/dl – severe vitamin D deficiency (34% vs. 14.2%, p = 0.001). The percentage of patients with normal vitamin D level was higher for the term birth group than for the preterm birth group but the difference was not statistically significant (30.4% vs. 28%, p = 0.714). Results are presented in the Table 2.

Additionally, the preliminary analysis revealed that the mean vitamin D level in the group of patients giving birth before the 34th week was only 16.49 ng/ml, and was significantly lower than in the group of, the so called, late pre-
infections during pregnancy, premature rupture of membranes (PROM), cervical insufficiency during pregnancy) were selected for creation of the logistic regression model. The univariate logistic regression model demonstrated that the level of vitamin D below 10 ng/ml significantly increased the risk of preterm birth (OR = 2.62, 95% CI: 1.15–5.98, p = 0.023). In the multivariate model, besides the level of vitamin D, factors significant in univariate logistic regression model at the level of p < 0.10 were taken into account. Variables affecting the concentration of vitamin D and statistically significant were not taken into account. The analysis indicated 2 statistically significant independent variables increasing the risk of preterm birth: PROM (OR = 7.25, 95% CI: 3.28–16.05, p < 0.001)

Table 1. Characteristics of the respondents in the study of the correlation between the level of vitamin D in blood serum and duration of pregnancy, Poland, 2013–2015

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Respondents who gave preterm birth (N = 100)</th>
<th>Respondents who gave term birth (N = 101)*</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age [years] (M±SD (min.–max))</td>
<td>31.0±5.0 (19.0–42.0)</td>
<td>29.9±4.5 (19.0–40.0)</td>
<td>0.114</td>
</tr>
<tr>
<td>BMI [kg/m²] (M±SD (min.–max))</td>
<td>26.6±4.6 (18.7–39.3)</td>
<td>27.1±3.3 (18.6–38.8)</td>
<td>0.198</td>
</tr>
<tr>
<td>Body weight [kg] (M±SD (min.–max))</td>
<td>71.7±13.9 (46.0–112.0)</td>
<td>74.6±9.5 (55.0–108.0)</td>
<td>0.019</td>
</tr>
<tr>
<td>Pregnancies [n] (M±SD (min.–max))</td>
<td>2.0±1.2 (1–7)</td>
<td>1.6±0.8 (1–4)</td>
<td>0.007</td>
</tr>
<tr>
<td>Births [n] (M±SD (min.–max))</td>
<td>1.7±1.0 (1–7)</td>
<td>1.4±0.6 (1–4)</td>
<td>0.028</td>
</tr>
<tr>
<td>Caesarean section [n (%)]</td>
<td>51 (51.0)</td>
<td>23 (22.8)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Uterine cervix insufficiency [n (%)]</td>
<td>25 (25.0)</td>
<td>4 (4.0)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>PROM/PPROM [n (%)]</td>
<td>66 (66.0)</td>
<td>24 (24.0)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Hospitalizations** [n (%)]</td>
<td>64 (64.0)</td>
<td>39 (39.0)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Miscarriages [n (%)]</td>
<td>19 (19.0)</td>
<td>9 (8.9)</td>
<td>0.030</td>
</tr>
<tr>
<td>Nicotinism [n (%)]</td>
<td>19 (19.0)</td>
<td>10 (10.1)</td>
<td>0.071</td>
</tr>
<tr>
<td>Infections occurrence** [n (%)]</td>
<td>25 (25.0)</td>
<td>15 (14.9)</td>
<td>0.071</td>
</tr>
<tr>
<td>Vitamin D supplementation [n (%)]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>during pregnancy</td>
<td>78 (78.0)</td>
<td>83 (83.8)</td>
<td>0.309</td>
</tr>
<tr>
<td>throughout pregnancy</td>
<td>26 (26.0)</td>
<td>40 (40.8)</td>
<td>0.042</td>
</tr>
<tr>
<td>Appropriate daily exposure to sunlight** [n (%)]</td>
<td>25 (25.0)</td>
<td>47 (47.5)</td>
<td>0.002</td>
</tr>
</tbody>
</table>

* Some percentages are not calculated from N = 101 because of missing data.
** During pregnancy.
M – mean; SD – standard deviation; min. – minimal value; max – maximal value; BMI – body mass index; PROM – premature rupture of membranes; PPROM – preterm premature rupture of membranes.
Table 2. Vitamin D level in serum of the respondents on the day of childbirth, Poland, 2013–2015*

<table>
<thead>
<tr>
<th>Vitamin D concentration</th>
<th>Respondents who gave preterm birth (N = 100)</th>
<th>Respondents who gave term birth (N = 92)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10 ng/ml (severe deficiency)</td>
<td>34 (34.0)</td>
<td>13 (14.2)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>10–20 ng/ml (moderate deficiency)</td>
<td>17 (17.0)</td>
<td>23 (25.0)</td>
<td>0.17</td>
</tr>
<tr>
<td>20–30 ng/ml (suboptimal level)</td>
<td>21 (21.0)</td>
<td>28 (30.4)</td>
<td>0.13</td>
</tr>
<tr>
<td>&gt; 30 ng/ml (normal level)</td>
<td>28 (28.0)</td>
<td>28 (30.4)</td>
<td>0.71</td>
</tr>
</tbody>
</table>

* Level of statistical significance was set at p ≤ 0.05.

Table 3. Logistic regression model* of demographic, behavioral and clinical characteristics associated with preterm delivery, Poland, 2013–2015

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR (95% CI)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight</td>
<td>0.973 (0.942–1.004)</td>
<td>0.091</td>
</tr>
<tr>
<td>Pregnancies</td>
<td>1.149 (0.246–5.375)</td>
<td>0.860</td>
</tr>
<tr>
<td>Deliveries</td>
<td>1.567 (0.298–8.229)</td>
<td>0.596</td>
</tr>
<tr>
<td>Miscarriages</td>
<td>1.075 (0.105–11.026)</td>
<td>0.951</td>
</tr>
<tr>
<td>Nicotinism</td>
<td>1.962 (0.588–6.539)</td>
<td>0.273</td>
</tr>
<tr>
<td>Infections</td>
<td>2.365 (0.902–6.196)</td>
<td>0.080</td>
</tr>
<tr>
<td>Premature rupture of membranes (PROM)</td>
<td>7.571 (3.372–16.998)</td>
<td>0.001</td>
</tr>
<tr>
<td>Uterine cervix insufficiency</td>
<td>9.409 (2.523–35.092)</td>
<td>0.001</td>
</tr>
<tr>
<td>Vitamin D level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 10 ng/ml</td>
<td>2.543 (0.880–7.351)</td>
<td>0.085</td>
</tr>
<tr>
<td>10–20 ng/ml</td>
<td>0.367 (0.119–1.125)</td>
<td>0.080</td>
</tr>
<tr>
<td>20–30 ng/ml</td>
<td>0.722 (0.269–1.934)</td>
<td>0.517</td>
</tr>
</tbody>
</table>

* Chi² = 69.52, df = 11, p < 0.001 – statistically significant model. OR – odds ratio; CI – confidence interval.

and cervical insufficiency (OR = 9.21, 95% CI: 2.48–34.19, p = 0.001). The vitamin D level below 10 ng/ml also increased the risk of preterm birth, but the result was not statistically significant (OR = 2.47, 95% CI: 0.86–7.15, p = 0.094) (Table 3).

The analysis of data from the group with severe vitamin D deficiency revealed low percentage of patients supplemented vitamin D in this group (65.9% (< 10 ng/ml) vs. 85.1% (> 10 ng/ml), p = 0.005). Additionally, women taking preparations containing vitamin D at a dose of 800–1000 IU were more frequently in the group of patients giving birth on time (21.2% vs. 15.7%, p = 0.33). Furthermore, maximum duration of daily exposure to the sun was shorter in this group (15 ± 34.5 min vs. 44.8 ± 84.2 min, p = 0.019) and lower percentage of patients declared appropriate to synthesize vitamin D time of daily exposure to sunlight unlike the group with vitamin D level > 10 ng/ml (22.5% vs. 41%, p = 0.028) (Table 4).
Currently recommended ones. We found that patients who declared avoiding the sun and not adequate time of daily exposure to sunlight also gave birth prematurely. The further analysis of the group of patients with severe vitamin D deficiency also revealed the correlation between vitamin D level and its supplementation or exposure to sunlight.

Additionally, the analysis of vitamin D levels after dividing patients into groups revealed that the mean level of vitamin D was lower in the group of birth before 34 week of gestation (early preterm birth) than in the group of birth between 34–36.6 week of gestation (late preterm birth). It may be concluded that an earlier birth time correlates with a lower vitamin D level.

Another important finding from our study is the fact that vitamin D below optimal level (> 30 ng/ml) is common among the studied population. The study indicated a very high ratio of patients with diagnosed vitamin D deficiency as much as 70% of the whole studied population. We found a high ratio (up to 80%) of patients using vitamin D-containing preparations during their pregnancy. However, the use of

**DISCUSSION**

In this study we found a significantly higher ratio of patients with severe vitamin D deficiency (< 10 ng/ml) in the group of patients having spontaneous preterm birth as compared to women with term delivery. The model of logistic regression created by us indicates a possible association between severe vitamin D deficiency and occurrence of preterm births (OR = 2.47, p = 0.094); however, the result is not statistically significant and further studies on a larger groups of patients are necessary. In addition, it has been found that the concentration of vitamin D below 15.84 ng/ml significantly increases the risk of preterm birth.

The analysis of healthy-related behavior that may influence vitamin D level also revealed the correlation between vitamin D and preterm birth. In the group of patients who supplemented vitamin D only periodically during their pregnancy, preterm births were more often. Currently, it is recommended to supplement vitamin D in doses of 2000 IU. In the population we analyzed, most patients used supplementation but the doses were below the currently recommended ones. We found that patients who declared avoiding the sun and not adequate time of daily exposure to sunlight also gave birth prematurely. The further analysis of the group of patients with severe vitamin D deficiency also revealed the correlation between vitamin D level and its supplementation or exposure to sunlight.

Additionally, the analysis of vitamin D levels after dividing patients into groups revealed that the mean level of vitamin D was lower in the group of birth before 34 week of gestation (early preterm birth) than in the group of birth between 34–36.6 week of gestation (late preterm birth). It may be concluded that an earlier birth time correlates with a lower vitamin D level.

Another important finding from our study is the fact that vitamin D below optimal level (> 30 ng/ml) is common among the studied population. The study indicated a very high ratio of patients with diagnosed vitamin D deficiency as much as 70% of the whole studied population. We found a high ratio (up to 80%) of patients using vitamin D-containing preparations during their pregnancy. However, the use of
The study indicated that the vitamin D level above 30 ng/ml decreased the risk of preterm birth by 60%. The researchers stressed that demand for microelements, including vitamin D, was different in the case of a twin pregnancy and singleton pregnancy, and standards of recommended supplementation should be different as well [7].

In the study by Thorp et al. [6] on pregnant women with a history of at least one preterm delivery, no effect of abnormal vitamin D level, understood as the concentration below 50 nmol/l (20 ng/ml), on duration of pregnancy was found. The study analyzed 131 patients having preterm birth and 134 having term birth, but the study population was not ethnically homogeneous, as much as 40% of patients were Afro-Americans, and 12% were Latin Americans. A similar distribution was found in the control group. In that study blood was collected twice: in week 16–22 and 25–28, but no level on the day of delivery was measured [6]. In our study, the population was ethnically homogeneous, and vitamin D level was determined at a different point of pregnancy, which could result in different results.

Little is known about maternal vitamin D status in relation to risk of spontaneous preterm birth. There are single reports suggesting an association between vitamin D deficiency and occurrence of preterm births.

Shibata et al. [5] performed their study on a group of pregnant women in 30th week of pregnancy and found a significantly lower vitamin D levels for patients hospitalized because of threatened premature delivery. The vitamin D level in that group was 11.2±3.2 ng/ml and was significantly lower as compared to healthy gravidas, demonstrating the level of 15.6±5.1 ng/ml. The study also demonstrated that pregnant women with abnormal serum vitamin D levels required treatment for threatened premature delivery 0.023-times more often. Authors did not provide any information regarding: efficacy of the treatment for the threatened preterm delivery, how many of the studied patients had preterm birth despite the introduced therapy, and what the vitamin D concentration was in the group of patients in which the treatment proved successful [5].

Bodnar et al. [7] stated that abnormal vitamin D level below 75 nmol/l (30 ng/ml) was associated with the increased risk of preterm delivery in the case of women in twin pregnancy. In that study, blood was collected from all patients at week 24–28 of pregnancy – that is different from our study.

Bartoszewicz et al. [2] also found a high percentage of vitamin D deficiency in the population of Polish pregnant women. In their study on a population of 50 healthy pregnant volunteers living in Warszawa, and having term birth, the optimum vitamin D concentration (30–80 ng/ml) was found in only 30% of participants, and a severe deficiency, defined as the vitamin level below 10 ng/ml, was found in 7.3% of studied pregnant women [2]. In our study, severe deficiency was found in a bigger group of patients: as many as 14% of patients having term birth and as many as 34% of patients having preterm birth.

Little is known about maternal vitamin D status in relation to risk of spontaneous preterm birth. There are single reports suggesting an association between vitamin D deficiency and occurrence of preterm births.

Shibata et al. [5] performed their study on a group of pregnant women in 30th week of pregnancy and found a significantly lower vitamin D levels for patients hospitalized because of threatened premature delivery. The vitamin D level in that group was 11.2±3.2 ng/ml and was significantly lower as compared to healthy gravidas, demonstrating the level of 15.6±5.1 ng/ml. The study also demonstrated that pregnant women with abnormal serum vitamin D levels required treatment for threatened premature delivery 0.023-times more often. Authors did not provide any information regarding: efficacy of the treatment for the threatened preterm delivery, how many of the studied patients had preterm birth despite the introduced therapy, and what the vitamin D concentration was in the group of patients in which the treatment proved successful [5].

Bodnar et al. [7] stated that abnormal vitamin D level below 75 nmol/l (30 ng/ml) was associated with the increased risk of preterm delivery in the case of women in twin pregnancy. In that study, blood was collected from all patients at week 24–28 of pregnancy – that is different from our study.

The study by Hansel et al. [11] demonstrated an association between bacterial vaginosis in the case of pregnant women and deficiency of vitamin D. That study demonstrated that the vitamin D level below 30 ng/ml increased the risk of bacterial vaginosis (BV) 2.87 times, and that was supported by some earlier reports [11]. The study by Bodnar et al. [12] indicated that vitamin D deficiency significantly reduced the risk of BV in the group of black pregnant women, but no association was confirmed in the group of white pregnant women. However, it should be remembered that BV occurred more often in the case of black women, and it was known that black women were at 6-time greater risk of vitamin D deficiency [12].
The effect of vitamin D on duration of pregnancy is explained by its influence on the immunological system. There are studies suggesting the role of vitamin D in the process of placenta implantation and in immunosuppressive processes occurring in the maternal organism [13]. Vitamin D participates in immunological processes and in response of the immunological system to bacterial invasion, which may indirectly influence duration of pregnancy [14]. Cytokines released by maternal and fetal organisms in response to bacterial invasion lead to production of prostaglandins, and then trigger a preterm contractions. Increased amniotic levels of cytokines, including interleukin-1 (II-1), II-6 and tumor necrosis factor α (TNF-α), were found in preterm deliveries [15]. Another factor indicating a possible effect of vitamin D deficiency on occurrence of preterm delivery is increased level of vitamin D binding protein (DBP) in vaginal secretion of women who had preterm birth. Increased DBP level during pregnancy may impair functions of vitamin D metabolites [16]. Moreover, vitamin D participates in production and influences secretion of cathelicidins, being a product of neutrophil degranulation and demonstrating bactericidal properties, as well as influences the activation of inflammation by pro-inflammatory cells [17].

Potential limitations of our report include the following. First limitation of the study is that 25(OH)D levels were obtained only from serum samples taken at the day of delivery. The levels of vitamin D throughout pregnancy were unknown, as was the impact of vitamin D status during first and second trimesters on the duration of pregnancy. Second limitation is the fact that in the studied population only few patients had serum 25(OH)D below 10 ng/ml. The vitamin D level below 10 ng/ml increased the risk of preterm birth in multivariate regression model, but the result was not statistically significant. This result was close to statistical significance, therefore the association between severe vitamin D deficiency and preterm birth needs a further study.

CONCLUSIONS

Considering a common vitamin D deficiency among pregnant women, introduction of a routine determination of serum vitamin D levels should be considered, especially in the case of pregnant women at high risk of preterm birth. Doctors should inform pregnant women that supplementation of vitamin D and proper daily exposure to sunlight are known practices which increase chances of giving birth a healthy child on time.

REFERENCES


This work is available in Open Access model and licensed under a Creative Commons Attribution-NonCommercial 3.0 Poland License – http://creativecommons.org/licenses/by-nc/3.0/pl/deed.en.