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Vitamin D Levels in Pregnant Women with Metabolic Syndrome in the First Trimester of Pregnancy

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The purpose of the study was to determine the level of vitamin D in pregnant women with metabolic syndrome and compare it in pregnant women without this syndrome.

Materials and methods. 120 pregnant women were examined in the first trimester, of whom 60 women were diagnosed with metabolic syndrome before pregnancy (main group) and 60 patients without metabolic syndrome (control group). Anthropometric measurements were performed and an oral glucose tolerance test and fasting lipid profile (triglycerides, high-density lipoprotein cholesterol and low-density lipoprotein cholesterol) were determined. Total 25-hydroxyvitamin D in blood serum was analyzed by electrochemiluminescence immunoassay. Statistical analysis was carried out in Microsoft System Excel 2016 (SPSS). The t-test, Pearson's chi-square were used, Spearman's correlation coefficient was calculated.

Results and discussion. In patients of the main group, the body mass index was by 23.30% higher (p=0.041) than in the control group. In patients with metabolic syndrome, compared with the control group, an increase in low-density lipoprotein cholesterol by 41.4% (p=0.001) and a decrease in high-density lipoprotein cholesterol by 44.0% (p=0.053) were detected. In winter, 38.3% were received; in summer – 20.0%. Vitamin D deficiency in the main group was detected in 70.0%, in the control group – 51.7% (p>0.05), 25-hydroxyvitamin D deficiency in the main group (30.0%) was less than in the control group (48.3%, p<0.05). According to the data obtained, vitamin D deficiency in pregnant women of the main and control groups was higher in winter and lower in summer. There was a direct, weak relationship between vitamin D concentration and body mass index in the main (r=0.175, p>0.05) and control group (r=0.290, p>0.05), as well as a weak, multidirectional correlation with triglycerides (r= 0.109, p>0.05), with low-density lipoprotein cholesterol (r=0.126, p>0.05) with high-density lipoprotein cholesterol (r=-0.107, p>0.05).

We studied the relationship between vitamin D deficiency and such indicators as body mass index, triglycerides, low-density lipoprotein cholesterol and high-density lipoprotein cholesterol and revealed a weak statistically insignificant correlation. On the contrary, the results of the Chinese study indicate the presence of a correlation that was stronger in the overweight and obese groups. However, this relationship has not been confirmed by all authors, which corresponds to our results showing a weak relationship between body mass index and vitamin D levels.

Conclusion. Despite living in one of sunny and warm cities, a high prevalence of low vitamin D levels among pregnant women in the first trimester was revealed – 60.8%. We do not rule out that low vitamin D levels were also associated with metabolic syndrome.

Keywords: metabolic syndrome, pregnancy, vitamin D, anthropometric parameters, lipid profile, seasons.

Introduction. In recent years, more and more attention has been paid to the role of vitamin D during pregnancy. Data were obtained on the relationship of vitamin D deficiency during pregnancy with insulin resistance, with gestational diabetes mellitus and abnormalities of the fetal immune system [1, 2]. Data were obtained on the relationship of vitamin D deficiency with all components of metabolic syndrome (MS) [3]. The study reported an association between vitamin D deficiency during pregnancy and adverse outcomes for both maternal health and fetal development [4]. The correlation of the unfavorable status of vitamin D in the mother with pregnancy complications, such as preeclampsia, premature birth, the birth of small children who do not correspond to gestational age [5, 6], and respiratory tract infections in children [7] is reported. According to a report published in 2012, the status of vitamin D and, consequently, the prevalence of vitamin D deficiency in pregnant women living in Switzerland remain largely unknown [8]. Even if most of the reported determinants of vitamin D deficiency are similar to the determinants registered for the general population, some determinants seem to remain country-specific [9].

Literature data indicate a growing prevalence of MS in women, which has reached a large scale in many countries of the world, in particular, the prevalence of MS in pregnant women varied from 3% to 42% in various studies, depending on the presence of pre-existing components of the syndrome, age and region [10-12]. Metabolic changes before pregnancy are the determining cause of complications during pregnancy, after pregnancy, in the postpartum period, as well as the causes of adverse perinatal outcomes. Women who are overweight before pregnancy increase the risk of pregnancy complications; obesity turns out to be an independent risk factor for cesarean section, hypertension caused by pregnancy, premature birth, restriction of intrauterine growth, birth defects, development, macrosomia, intrauterine fetal death, etc. [13]. Pregnancy also creates an environment similar to MS, including insulin resistance, elevated blood sugar, triglycerides, and blood pressure; it is also seen as a potential risk accelerator for cardiovascular disease and diabetes. The appearance of MS indicators during pregnancy can also harm the fetus [14]. It is noted that in mothers with MS, infants have an increased likelihood of developing MS in the late lactation period. The enhancement of these effects may not be limited to the first generation of offspring, and metabolic problems may persist in subsequent generations [15].

Thus, understanding the status of vitamin D in the early stages of pregnancy can help determine the future management strategy of pregnant women.

The purpose of the study was to determine the level of vitamin D in pregnant women with metabolic syndrome and compare it in pregnant women without this syndrome.

Materials and methods. The research was conducted in the period from February 7, 2018 to February 17, 2020 in the public legal entity of the Research Institute of Obstetrics and Gynecology in Baku. The study involved 120 pregnant women, of whom 60 women were diagnosed with MS before pregnancy (the main group) and 60 patients did not suffer from MS (the control group). The criteria for inclusion in the study were: I trimester of gestation, single pregnancy, over the age of 18 years, actual residence in Baku and the suburbs for at least 6 months before pregnancy; women suffering from MS before pregnancy. Exclusion criteria were multiple pregnancies, HIV infection, a history of parathyroid, kidney or liver diseases, chronic malabsorption syndromes or granule-forming disorders, age under 18 years, known (or suspected) drug or alcohol abuse, patients with acute or chronic diseases, patients who received vitamin D or calcium supplements in previous 3 months. Informed consent was obtained from the patients. Anamnesis was collected from all participants of the study, socio-demographic information was collected, as well as data related to pregnancy and lifestyle. Thus, the following indicators were recorded: age; first or repeated pregnancy; parity (first-time, second-time), professional activity; body mass index (BMI) upon admission. The season of treatment of pregnant women: winter (December 22 – March 18), spring (March 24 – June 11), summer (July 1 – September 19), autumn (October 10 – December 20). Sun exposure was taken into account as the average number of days a week spent outdoors for at least 1 hour from 10 to 16 hours over the past 6 months; the use of sun protection products (for example, the use of sunscreen, wearing long-sleeved clothing, trousers, hats (never, sometimes, always), consumption of fish (herring, salmon, mackerel, sardines or tuna) at least once a week (yes, no) and taking vitamin supplements containing vitamin D (yes, no). The dosage, adherence to treatment and the start of admission were not recorded. Anthropometric measurements were carried out in all women. The biochemical analysis included a standard oral glucose tolerance test and an empty stomach lipid profile. The oral glucose tolerance test (OGTT) was performed according to the procedure described by the World Health Organization [16].

A 10 ml blood sample was taken during a routine blood collection from a vein. Indicators of lipid metabolism triglycerides (TG), cholesterol of high-density lipoproteins (HDL-C) and low-density lipoproteins (LDL-C) were determined using Human test kits (Germany) on an automatic biochemical analyzer Roche Diagnostics Cobas Integra 800 (Switzerland).

After centrifugation and serum extraction, total 25-hydroxyvitamin D (25(OH)D) was analyzed using electrochemoluminescent immunoassay on a Roche Cobas® analyzer (Roche Diagnostics, Basel, Switzerland). Detection range: 3.0–70.0 ng/ml for 25(OH) D; above 15 ng/ml, coefficient of variation between assays: 11.5% and coefficient within the assay: 6.5% [17]. Women with a concentration of 25(OH)D in serum strictly below 20 ng/ml were considered deficient in vitamin D in accordance with the recommendations of the Endocrine Society [1]. Women with a concentration of 25(OH)D in serum above 20 ng/ml were considered non-deficient (including both insufficient (from 20 to 30 ng/ml) and sufficient (above 30 ng/ml)) by definition of the Endocrine Society [1].

All experiments were conducted in accordance with the Council of Europe Convention "On the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine Application of Biological and Medicine Achievements (ETS No. 164)" dated 04.04.1997, and the Helsinki Declaration of the World Medical Association (2008). Each study patient signed an informed consent to participate in the study and all measures to ensure anonymity of patients were taken.

Statistical analysis was carried out in Microsoft System Excel 2016 using statistical software SPSS (USA). The differences between the groups were compared using an independent two-sample t-test and Pearson's chi-square test. The Spearman correlation coefficient is calculated. The value of $p<0.05$ was considered statistically significant.

Research results. The age of 120 patients included in the study ranged from 18 to 43 years, the average age was 28.1 ± 4.08 years. According to the age groups of 18-28 years, 29-35 and 36-43 years, the patients were distributed as follows 64 (53.3%), 46 (38.3%) and 10 (8.3%), respectively. The first and second pregnancies were in 41 (34.2%) and 79 (65.8%), respectively. Of the 120 pregnant women examined, 76 (63.3%) were primiparous, 44 (36.7%) were repeat-bearing women. 32 (26.7%) were engaged in professional work related to mental work, 7 (5.8%) were engaged in physical work, 81 (67.5%) patients were housewives. The weight of patients at admission averaged 81.3 ± 1.3 kg, height – 163.3 ± 0.6 cm, BMI – 30.5 ± 0.5 kg/m^2, while BMI within the normal range (18-25 kg/m^2) was observed in 19 (15.8%), overweight (25-30 kg/m^2) – in 34 (28.3%) patients, obesity of the I degree (30-35 kg/m^2) – in 41 (34.2%), obesity of the II degree (35-40 kg/m^2) – in 21 (17.5%), and obesity of the III degree (>40 kg/m^2) – in 5 (4.2%) patients. Systolic blood pressure (SBP) and diastolic (DBP) averaged 124.3 ± 1.9 mmHg (90/180 mmHg) and 80.1 ± 1.3 mmHg (60/120 mmHg), respectively. The concentration of TG averaged 1.9 ± 0.1 mmol/l (0.8–4.8 mmol/L), LDL-C – 2.9 ± 0.1 mmol/L (1.6–4.8 mmol/L) and HDL-C – 1.2 ± 0.1 mmol/L (0.6–2.2 mmol/L). The largest number of patients were admitted in winter – 38 (31.7%), the smallest – in spring – 23 (19.2%), in summer and autumn – 25 (20.8%) and 34 (28.2%), respectively. **Table 1** shows the general characteristics of the patients of the research groups.

The results presented in **Table 1** showed that both groups were comparable in age and did not differ statistically (p=0.788, t=0.27). At the same time, patients with MS in the age group of 36–43 years were by 33.0% more likely (p<0.05). Pre-pregnant patients in the main group were by 48.2% less common than in the control group (p<0.05), while repeat pregnancies in the main group were by 28.3% more (p<0.05). There were no differences in the parity of pregnant women in the main and control groups. In the main group of women, mental labor was by 39.9% less (p<0.05), and physical

Table 1 – Characteristics of the studied patients in the first trimester of pregnancy

Indicator	Main group (n=60)	Control group (n=60)	p
Age, years	28.9 ± 3.91 [19; 43]	27.38 ± 4.08 [18; 39]	0.788
Age groups: 18–28 years old, n (%) 29–35 36–43	 29 (48.3) 25 (41.7) 6 (10.0)	 35 (58.3) 21 (35.0) 4 (6.7)	 >0.05 >0.05 <0.05
First pregnancy, n (%) Repeated	14 (23.3) 46 (76.7)	27 (45.0) 33 (55.0)	<0.05 <0.05
Primiparous Repeat births	38 (63.3) 22 (36.7)	38 (63.3) 22 (36.7)	-
Labor activity, n (%) Housewives Engaged in mental labor Physical labor	 12 (20.0) 5 (8.3) 43 (71.7)	 20 (33.3) 2 (3.3) 38 (63.3)	 <0.05 <0.01 >0.05
Weight at the time of the study, kg	91.73 ± 5.87 [67; 110]	70.89 ± 10.14 [48; 103]	0.078
Height, cm	163.22 ± 4.64 [150; 180]	163.45 ± 5.39 [148; 178]	0.974
BMI at the time of the pregnancy study (kg/m^2)	34.50 ± 2.46 [27.9; 42.6]	26.46 ± 3.02 [18.9; 39.2]	0.041
BMI: 18–25 kg/m^2, n (%) 25–30 kg/m^2 30–35 35–40 >40	- 1 (1.7) 35 (58.3) 19 (31.7) 5 (8.3)	19 (31.7) 33 (55.0) 6 (10.0) 2 (3.3) -	0.001 0.001 0.001 0.001 0.001
SBP, mmHg <130, n (%) 130–150 150–170 >170	135.5 ± 16.40 [100; 180] 20 (33.3) 30 (50.0) 8 (13.3) 2 (3.3)	113.0 ± 12.27 [90; 150] 51 (85.0) 9 (15.0) - -	0.274 <0.001 <0.001 <0.001 -
DBP, mmHg Up to 85, n (%) 85–90 90–110 >110	86.2 ± 11.92 [60; 120] 25 (41.7) 16 (26.7) 18 (30.0) 1 (1.7)	73.75 ± 8.25 [60; 100] 51 (85.0) 7 (11.7) 2 (3.3) -	0.392 <0.001 <0.001 <0.001 <0.001
Glucose, mmol/l	5.21 ± 0.51 [3.9; 7.2]	4.63 ± 0.31 [3.9; 6.1]	0.333
TG, mmol/L	2.53 ± 0.49 [1.2; 4.8]	1.27 ± 0.20 [0.8; 2.7]	0.019
LDL-C, mmol/L	3.65 ± 0.40 [2.4; 4.8]	2.14 ± 0.23 [1.6; 3.8]	0.001
HDL-C, mmol/L	0.89 ± 0.16 [0.6; 2.0]	1.59 ± 0.32 [0.7; 2.2]	0.053
Time of year, n (%) Winter Spring Summer Autumn	 23 (38.3) 12 (20.0) 12 (20.0) 13 (21.7)	 15 (25.0) 11 (18.3) 13 (21.7) 21 (35.0)	 <0.05 <0.05

labor was by 60.2% more ($p<0.01$) than in the control group. In both groups, there were no statistical differences in relation to housewives. The average weight of patients in the main group was by 22.7% higher than in the control group ($p=0.078$, $t=1.78$), and the height of the patients did not differ much ($p=0.974$, $t=0.03$). In patients of the main group, BMI was by 23.30% ($p=0.041$, $t=2.06$) higher than this indicator in the control group. As can be seen from the **Table 1**, BMI within normal limits was not observed in the main group, whereas in the control group, normal BMI was detected in 19 patients ($\chi^2=62.28$; $p<0.001$).

Overweight patients were more common in the control group, which was by 96.1% higher compared to the main group ($\chi^2=31.49$; $p<0.001$). Obesity of the I and II degrees was more often noted by patients of the main group, which was higher by 82.8% ($\chi^2=15.70$; $p<0.001$) and 89.6% ($\chi^2=55.12$; $p<0.001$), respectively, compared with the control group. Obesity of the III degree was observed only in the main group in 8.3% of cases ($\chi^2=101.54$; $p<0.001$). The values of SBP and DBP in the study groups did not differ significantly, although in patients with MS, the level of these indicators was on average by 16.1% higher ($p=0.274$, $t=1.10$) and by 14.4% higher ($p=0.392$, $t=0.86$), respectively. The SBP indicator is less than 130 mmHg in the main group compared with the control group where it was significantly less ($\chi^2=33.15$; $p<0.001$). At the same time, 50.0% of patients in the main group had SBP in the range of 130–150 mmHg ($\chi^2=16.75$; $p<0.001$). The level was in the range of 150–170 mmHg and above 170 mmHg. It was observed only in patients of the main group – $\chi^2=91.76$ ($p<0.001$) and $\chi^2=112.26$ ($p<0.001$), respectively. The value of DBP up to 85 mmHg in the main group was by 50.9% less common than in the control group ($\chi^2=24.26$; $p<0.001$). The value of DBP in the range of 85–90 mmHg in the group of patients with MS was by 56.2% more common ($\chi^2=46.68$; $p<0.001$) and in the range of 90–110 mmHg – by 89.0% ($\chi^2=57.42$; $p<0.001$). The DBP index of more than 110 mmHg was observed only in 1 patient with MS ($\chi^2=116.1$; $p<0.001$). Glucose levels in both groups were within normal limits and there was no significant difference ($p=0.333$, $t=0.97$). Comparison of the average concentration of TG in the blood of patients of the main and control groups showed its increase in the main group by 49.8% ($p=0.019$, $t=2.38$). In patients with MS, in comparison with the control group, an increase in LDL-C and a decrease in HDL-C were detected by 41.4% ($p=0.001$, $t=3.27$) and by 44.0% ($p=0.053$, $t=1.96$), respectively. The largest number of patients of the main and control groups were admitted in winter – 38.3% and in autumn – 35.0%, respectively ($p<0.05$).

The analysis of vitamin D content showed that its average concentration in the total sample (n=120) was 16.5 ± 0.6 ng/ml, varying in the range of 6.25–28.7 ng/ml. In the main group, vitamin D levels ranged from 9.74 to 28.7 ng/ml, which averaged 17.20 ± 3.76 ng/ml. In the control group, the average vitamin D level was 15.76 ± 3.77 ng/ml (6.25–25.4 ng/ml). When comparing the level of vitamin D in patients of the main group with the control group, there was no statistically significant difference – $p=0.787$ ($t=0.27$).

We also analyzed the 25(OH)D deficit shares in the blood serum of the patients of the study groups (**Figure**).

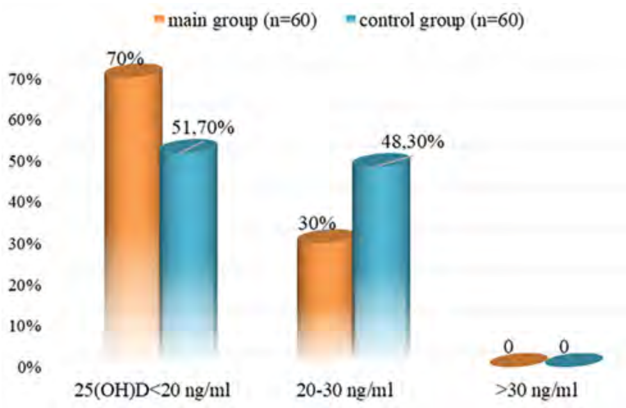

Figure – The frequency of vitamin D deficiency and insufficiency in the study groups

Vitamin D deficiency in the main group was detected in 42 patients, which compared with the control group (n=31) was more frequent by 26.1% ($p>0.05$), and deficiency of 25(OH)D in the main group (n=18) was less than in the control group (n=29) by 37.9% ($p<0.05$). In both groups, the concentration of 25(OH) D >30 ng/ml was not observed.

From the data given in **Table 2** indicators show the absence of significant differences in vitamin D content between the main and control groups, depending on the season. The study showed that the highest concentration of vitamin D was observed in

Table 2 – Concentration of vitamin D in pregnant women of both groups compared depending on the season of the year

Season	n	Main group (n=60)	n	Control group (n=60)	t	p
Winter	23	15.56 ± 4.02 [9.74; 23.6]	15	13.49 ± 5.0 [6.25; 20.6]	0.32	0.758
Spring	12	16.73 ± 2.52 [12.3; 20.7]	11	16.2 ± 2.13 [13.0; 18.9]	0.16	0.877
Summer	12	18.67 ± 3.77 [10.6; 28.7]	13	17.52 ± 2.02 [14.9; 20.4]	0.27	0.792
Autumn	13	16.65 ± 3.45 [12.8; 21.6]	21	16.65 ± 4.87 [8.6; 25.4]	0.00	1.00

patients of both groups in summer, and the minimum – in winter. When comparing the maximum and minimum concentrations of vitamin D in the main (p=0.585, t=0.56) and in the control (p=0.476, t=0.75) group, no statistically significant differences were found.

In the course of the study, the frequency of occurrence of deficiency and insufficiency of concentration of 25(OH)D was analyzed in patients of both groups by season (**Table 3**).

Table 3 – Frequency of vitamin D deficiency and insufficiency in the study groups in different seasons of the year

Season	Concentration of 25(OH)D, ng/ml	n	Main group n (%)	n	Control group n (%)	X^2	P
Winter	<20	23	17 (73.9)	15	9 (60.0)	4.37	0.037
	20–30		6 (26.1)		6 (40.0)		
Spring	<20	12	9 (75.0)	11	6 (54.5)	1.059	0.304
	20–30		3 (25.0)		5 (45.5)		
Summer	<20	12	7 (58.3)	13	4 (30.8)	0.322	0.571
	20–30		5 (41.7)		9 (69.2)		
Autumn	<20	13	9 (15.0)	21	12 (57.1)	2.242	0.135
	20–30		4 (30.8)		9 (42.9)		

As follows from **Table 3**, the dependence of the frequency of vitamin D deficiency and insufficiency in the winter season is statistically significant. According to the data obtained, vitamin D deficiency in pregnant women of the main and control groups was higher in winter and lower in summer. The correlation analysis showed a direct, weak relationship of vitamin D concentration with BMI both in the main group (r=0.175, p>0.05) and in the control group (r=0.290, p>0.05). Also, a weak, multidirectional correlation was determined between the level of vitamin D and TG (r=0.109, p>0.05; control – r=-0.039, p>0.05), 25(OH) D – LDL-C (r=0.126, p>0.05; control – r=0.396, p>0.05), 25(OH)D – HC-HDL (r=-0.107, p>0.05; control – r=-0.023, p>0.05).

Discussion. Numerous reports show that in recent years the number of overweight and obese people has increased, which lead to many systemic disorders, including MS [17, 18]. In this study, we presented the results of the analysis of vitamin D content in 120 pregnant women with and without MS living in the city. Pregnant women with MS in the first trimester had a significantly increased BMI (p<0.001). The results obtained are comparable with the literature data [2, 3]. It has been established that the prevalence of vitamin D deficiency is high during pregnancy and is a serious problem. Vitamin deficiency in the main group was observed in 70.0% of cases, in the control group – in 51.7% of cases. The study showed that there was no sufficient concentration of vitamin D in patients with MS. Also, an adequate level was not detected in pregnant women of the control group. However, in a study by F. R. Perez et al. [19] it was noted that 35.9% of pregnant women in the first trimester had an adequate level of 25(OH)D in blood serum (≥30 ng/ml). At the same time, it should be noted that pregnant women did not suffer from MS in the study.

Our results revealed a high incidence of vitamin D deficiency in 120 pregnant women living in Baku (60.8%), and in pregnant women with MS hypovitaminosis 25(OH)D was found in 70.0%, in pregnant women without this pathology – in 51.7% of cases. N. B. I. Bukary et al. [20] reported that 90% of the studied pregnant women in the first trimester suffered from hypovitaminosis D. There are several possible reasons for the decrease in the level of 25(OH)D in serum: not only low consumption of foods rich in vitamin D, but also certain external factors that contribute to preventing exposure to sunlight on the body, which provides 90% of the need for vitamin D [21]. Our results are comparable to the data of B. C. Cakır, F. Demirel [22], who reported that the level of vitamin D during pregnancy in summer is higher than in winter. It is known that the main source of vitamin D is sunlight. According to the literature data, it is expected that in the sunny period we will detect less vitamin D deficiency. The results obtained confirm this. Despite the fact that the patients we examined lived in a city with a high level of sun exposure, vitamin D deficiency was high in the first trimester, which was probably due to being outdoors for less than one hour a day and refusing to take vitamin D supplements before pregnancy.

It should be noted that changes in the concentration of 25(OH)D, the main marker of vitamin D status, are poorly characterized throughout pregnancy, and the data are contradictory, partly due to the significant seasonal influence present in many studies, with assumptions of an increase [23, 24], a decrease [25] and no changes during pregnancy [26]. At the same time, all researchers pay attention to the need to accurately determine this variable and include the status of vitamin D during pregnancy in the analysis of studies.

We studied the relationship between vitamin D deficiency and such indicators as BMI, TG, LDL-C and HDL-C and revealed a weak statistically insignificant correlation. On the contrary, the results of the Chinese study indicate the presence of a correlation that was stronger in the overweight and obese groups [27]. However, this relationship has not been confirmed by all authors [28, 29], which corresponds to our results showing a weak relationship between BMI and vitamin D levels.

Conclusion. Despite living in one of sunny and warm cities, a high prevalence of low vitamin D levels among pregnant women in the first trimester was revealed – 60.8%. We do not exclude that low vitamin D levels were also associated with metabolic syndrome.

Perspectives of further research. It is planned to further study the use of vitamin D at various stages of pregnancy, which will help determine the future management strategy of pregnant women.

References

1. Holick MF, Binkley NC, Bischoff-Ferrari HA, Gordon CM, Hanley DA, Heaney RP, et al. Guidelines for preventing and treating vitamin D deficiency and insufficiency revisited. *J Clin Endocrinol Metab*. 2012;97:1153-8. PMID: 22442274. doi: 10.1210/jc.2011-2601
2. Chen H-Y, Zhang H-P, Yang J, Huang Z-Q, Xu H-X, Jin J, et al. The relationship between maternal vitamin D deficiency and glycolipid metabolism and adverse pregnancy outcome. *Clin Endocrinol*. 2020;93(6):713-720. PMID: 32713029. PMCID: PMC7754337. doi: 10.1111/cen.14298
3. Awad AB, Alappat L, Valerio M. Vitamin D and metabolicsyndrome risk factors: Evidence and mechanisms. *Crit Rev Food Sci Nutr*. 2012;52(2):103-12. PMID: 22059957. doi: 10.1080/10408391003785458
4. Wagner CL, Hollis BW, Kotsa K, Fakhoury H, Karras SN. Vitamin D administration during pregnancy as prevention for pregnancy, neonatal and postnatal complications. *Rev Endocr Metab Disord*. 2017;18:307-22. PMID: 28214921. doi: 10.1007/s11154-017-9414-3
5. Zhou S-S, Tao Y-H, Huang K, Zhu B-B, Tao F-B. Vitamin D and risk of preterm birth: up-to-date meta-analysis of randomized controlled trials and observational studies. *J Obstet Gynaecol Res*. 2017;43:247-56. PMID: 28150405. doi: 10.1111/jog.13239
6. De-Regil LM, Palacios C, Lombardo LK, Peña-Rosas JP. Vitamin D supplementation for women during pregnancy. *Cochrane Database Syst Rev*. 2016;2016:CD008873. PMCID: PMC8627255. doi: 10.1002/14651858.CD008873.pub3
7. Łuczyńska A, Logan C, Nieters A, Elgizouli M, Schöttker B, Brenner H, et al. Cord blood 25(OH)D levels and the subsequent risk of lower respiratory tract infections in early childhood: the Ulm birth cohort. *Eur J Epidemiol*. 2014;29:585-94. PMID: 24859820. doi: 10.1007/s10654-014-9918-z
8. Cabaset S, Krieger JP, Richard A, Elgizouli M, Nieters A, Rohrmann S, et al. Vitamin D status and its determinants in healthy pregnant women living in Switzerland in the first trimester of pregnancy. *BMC Pregnancy Childbirth*. 2019;19;10. PMID: 30621626. PMCID: PMC6323787. doi: 10.1186/s12884-018-2150-1
9. Hilger J, Friedel A, Herr R, Rausch T, Roos F, Wahl DA, et al. A systematic review of vitamin D status in populations worldwide. *Br J Nutr*. 2014;111:23-45. PMID: 23930771. doi: 10.1017/S0007114513001840
10. Tavares HP, Arantes MA, Tavares SBMP, Abbade JF, dos Santos DCDM, de Mattos Paranhos Calderon I, et al. Metabolic Syndrome and Pregnancy, Its Prevalence, Obstetrical and Newborns Complications. *Open J Obstet Gynecol*. 2015;5:618-625. doi: 10.4236/ojog.2015.511087
11. Papysheva OV, Kotaysh GA, Orazmuradov AA, Arakelyan GA, Savenkova YV. Oslozhnenyya beremennosty u zhenshchyn s metabolycheskym syndromom [Pregnancy complications in women with metabolic syndrome.] *Akusherstvo y gynekologyya: novosty, mnenyya, obuchenye*. 2018;6(3):18-22. [Russian]. doi: 10.24411/2303-9698-2018-13902
12. Kytykova OYu, Antonyuk MV, Kantur TA, Novgorodtseva TP, Denysenko YuK. Rasprostranennost y byomarkery metabolycheskogo syndroma [Prevalence and biomarkers in metabolic syndrome.] *Ozhyrenye y metabolyzm.* 2021;18(3):302-312. [Russian]. doi: 10.14341/omet12704
13. Mohsenzadeh-ledari F, Taghizadeh Z, Motaghi Z, Keramat A, Moosazadeh M, Najafi A. Appropriate Interventions for Pregnant Women with Indicators of Metabolic Syndrome on Pregnancy Outcomes: A Systematic Review. *Int J Prev Med.* 2019;10:2. PMID: 30774836. PMCID: PMC6360852. doi: 10.4103/ijpvm.IJPVM_46_18
14. Bhowmik B, Afsana F, Siddiquee T, Munir SB, Sheikh F, Wright E, et al. Comparison of the prevalence of metabolic syndrome and its association with diabetes and cardiovascular disease in the rural population of Bangladesh using the modified National Cholesterol Education Program Expert Panel Adult Treatment Panel III and International Diabetes Federation definitions. *J Diabetes Investig*. 2015;6:280-8. PMID: 25969712. PMCID: PMC4420559. doi: 10.1111/jdi.12268
15. Hou R-L, Jin W-Y, Chen X-Y, Jin Y, Wang X-M, Shao J, et al. Cord blood C-peptide, insulin, HbA1c, and lipids levels in small-and large-for-gestational-age newborns. *Med Sci Monit.* 2014;20:2097-105. PMID: 25357084. PMCID: PMC4226317. doi: 10.12659/MSM.890929
16. World Health Organization. Diagnostic criteria and classification of hyperglycaemia first detected in pregnancy: a World Health Organization guideline. *Diabetes Res Clin Pract*. 2014;103:341-63. PMID: 24847517. doi: 10.1016/j.diabres.2013.10.012

17. Schienkiewitz A, Mensink GBM, Kuhnert R, Lange C. Overweight and obesity among adults in Germany. *J Health Monit*. 2017;2:20-27. doi: 10.17886/RKI-GBE-2017-038
18. World Health Organization. Obesity and Overweight Factsheet from the WHO. Available from: http://www.thehealthwell.info/node/82914
19. Pérez-López FR, Fernández-Alonso AM, Ferrando-Marco P, González-Salmerón MD, Dionis-Sánchez EC, Fiol-Ruiz G, et al. First trimester serum 25-hydroxyvitamin D status and factors related to lower levels in gravids living in the Spanish Mediterranean coast. *Reprod Sci*. 2011;18(8):730-736. PMID: 21285449. doi: 10.1933719110396720
20. Bukhary NBI, Isa ZM, Shamsuddin K, Lin KG, Mahdy ZA, Hassan H, et al. Risk factors for antenatal hypovitaminosis D in an urban district in Malaysia. *BMC Pregnancy Childbirth*. 2016; 16(1):156. PMID: 27411716. PMCID: PMC4944244. doi: 10.1186/s12884-016-0939-3
21. Aji AS, Erwinda E, Yusrawati Y, Malik SG. Vitamin D deficiency status and its related risk factors during early pregnancy: a cross-sectional study of pregnant Minangkabau women, Indonesia. *BMC Pregnancy Childbirth*. 2019;19:183. PMID: 31117971. PMCID: PMC6532131. doi: 10.1186/s12884-019-2341-4
22. Cakır BC, Demirel F. Effects of seasonal variation and maternal clothing style on vitamin D levels of mothers and their infants. *Turk J Pediatr*. 2014;56:475-81.
23. Lundqvist A, Sandstrom H, Stenlund H, Johansson I, Hultdin J. Vitamin D status during pregnancy: a longitudinal study in Swedish women from early pregnancy to seven months postpartum. *PLoS One*. 2016;11(3):e0150385. PMID: 26938997. PMCID: PMC4777524. doi: 10.1371/journal.pone.0150385
24. Milman N, Hvas AM, Bergholt T. Vitamin D status during normal pregnancy and postpartum. A longitudinal study in 141 Danish women. *J Perinat Med.* 2011;40(1):57-61. PMID: 22098305. doi: 10.1515/JPM.2011.120
25. Zhang JY, Lucey AJ, Horgan R, Kenny LC, Kiely M. Impact of pregnancy on vitamin D status: a longitudinal study. *Br J Nutr*. 2014;112(7):1081-7. PMID: 25159824. doi: 10.1017/S0007114514001883
26. Gustafsson MK, Romundstad PR, Stafne SN, Helvik AS, Stunes AK, Morkved S, et al. Alterations in the vitamin D endocrine system during pregnancy: a longitudinal study of 855 healthy Norwegian women. *PLoS One*. 2018;13(4):e0195041. PMID: 29641551. PMCID: PMC5895009. doi: 10.1371/journal.pone.0195041
27. Shao B, Mo M, Xin X, Jiang W, Wu J, Huang M, et al. The Interaction between Prepregnancy BMI and Gestational Vitamin D Deficiency on the Risk of Gestational Diabetes Mellitus Subtypes with Elevated Fasting Blood Glucose. *Clin Nutr Edinb Scotl*. 2020;39:2265-2273. PMID: 31669001. doi: 10.1016/j.clnu.2019.10.015
28. Lee SH, Kim SM, Park HS, Choi KM, Cho GJ, Ko BJ, et al. Serum 25-Hydroxyvitamin D levels, obesity and the metabolic syndrome among Korean children. *Nutr Metab Cardiovasc Dis*. 2013;22:1-7. PMID: 22762845. doi: 10.1016/j.numecd.2012.04.013
29. Wieder-Huszla S, Jurczak A, Szkup M, Barczak K, Dołęgowska B, Schneider-Matyka D. et al. Relationships between Vitamin D3 and Metabolic Syndrome. *Int J Environ Res Public Health*. 2019;16(2):175. PMID: 30634516. PMCID: PMC6352038. doi: 10.3390/ijerph16020175

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РІВЕНЬ ВІТАМІНУ D У ВАГІТНИХ ЖІНОК ІЗ МЕТАБОЛІЧНИМ СИНДРОМОМ У ПЕРШОМУ ТРИМЕСТРІ ВАГІТНОСТІ

Ахундова Е. М.

Резюме. *Мета* дослідження - визначити рівень вітаміну D у вагітних з метаболічним синдромом, та порівняти його у вагітних без цього синдрому.

Матеріал та методи. Обстежено 120 вагітних жінок у І триместрі, з яких у 60 жінок до вагітності було діагностовано метаболічний синдром (основна група), та 60 пацієнтів без цього синдрому (контрольна група). Проведено антропометричні вимірювання та визначено пероральний тест на толерантність до глюкози та ліпідний профіль натще (тригліцериди-ТГ, холестерин ліпопротеїнів високої щільності-ХС-ЛПВЩ та низької щільності-ХС-ЛПНЩ). Загальний 25-гідроксивітамін D (25(OH)D) у сироватці крові аналізували методом електрохімолюмінесцентного імуноаналізу. Статистичний аналіз проводився у Microsoft System Excel 2016 (SPSS). Використані t-критерій, хі-квадрат Пірсона, розрахований коефіцієнт кореляції Спірмена.

Результати. У пацієнток основної групи індекс маси тіла (ІМТ) на 23,30% (p=0,041) був вищим, ніж у групі контролю. У пацієнтів з метаболічним синдромом порівняно з групою контролю виявлялося підвищення ХС-ЛПНЩ на 41,4% (p=0,001) та зниження ХС-ЛПВЩ на 44,0% (p=0,053). Взимку надійшло – 38,3%, улітку – 20,0%. Дефіцит вітаміну D в основній групі виявлено у 70,0%, у групі контролю (51,7%, p>0,05), недостатність 25(OH)D в основній групі (30,0%) зустрічалася менше, ніж у контрольній групі (48,3%, p<0,05). Згідно з отриманими даними, дефіцит вітаміну D у вагітних жінок основної та контрольної групи був вищим взимку і нижчим влітку. Виявлено прямий, слабкий зв’язок концентрації вітаміну D

з ІМТ в основній (r=0,175, p>0,05) та в групі контролю (r=0,290, p>0,05), а також слабка різноспрямована кореляція з ТГ (r= 0,109, p>0,05), з ХС-ЛПНЩ (r=0,126, p>0,05) з ХС-ЛПВЩ (r=-0,107, p>0,05).

Висновок. Незважаючи на проживання в одному із сонячних та теплих міст, виявлено високу поширеність низького рівня вітаміну D серед вагітних жінок у І триместрі – 60,8%. Не виключаємо, що низький рівень вітаміну D був пов'язаний з метаболічним синдромом.

Ключові слова: метаболічний синдром, вагітність, вітамін D, антропометричні показники, ліпідний профіль, сезони року.

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A – Work concept and design, B – Data collection and analysis,
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