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Research Article

Vitamin D status in pregnant women with gestational diabetes mellitus at Minia Maternity and Children University Hospital: a cross-sectional study

Ameer Ahmed Abdalla [1], Ahmed Kotb Ahmed[1], Heba Reda Mohamed[1], Mustafa Rabiee Ali Esmail[1]

[1]Obstetrics and Gynecology Department, Faculty of Medicine- Minia University, Egypt

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Abstract

Background: Gestational diabetes mellitus (GDM) is described as varying degrees of glucose intolerance that occur within pregnancy. The worldwide prevalence of GDM accounts for 4 to 28 percent, depending on the ethnic composition of the population and the diagnostic procedures used. The aim of the study was to assess the serum concentration of vitamin D in pregnant women with GDM. **Methods:** This cross-sectional study involved a group of pregnant women with GDM cases and a group of apparently non-diabetic pregnant women (control group). The duration of the study ranged from 6-12 months. Serum vitamin D levels were measured in both groups. **Result:** Pregnant women with GDM had significantly decreased serum vitamin D than the control group. Among pregnant women with GDM, 40% had deficient serum vitamin D (<10 ng/ml), and 55.6% had insufficient value (10–30 ng/ml). The deficient serum vitamin D was significantly higher in pregnant women with GDM, but insufficient vitamin D was statistically nonsignificant, while sufficient serum vitamin D was significantly higher in healthy pregnant women. There was no statistically significant difference between pregnant women with GDM and the control group regarding the demographic data and lifestyle except for the statistically significant association between lower income and decreased serum concentration of vitamin D. **Conclusion:** Pregnant women with GDM have reduced serum concentration of vitamin D. This finding might help with GDM prediction.

Keywords: Gestational diabetes mellitus, diabetic pregnant women, Vitamin D

Introduction

Gestational diabetes mellitus (GDM) is characterized as varying degrees of glucose intolerance that occurs or is detected within pregnancy [1]. The worldwide prevalence of GDM accounts for 4 to 28 percent, depending on ethnicity and the techniques used to diagnose it [2]. According to 2015 research on GDM prevalence and demographic factors, 8.8 percent of Minia city women had GDM [3].

GDM is linked to an elevated risk of a variety of problems in pregnant women and their fetuses during pregnancy and later after birth. GDM consequences include preeclampsia, an increased rate of cesarean delivery, and a higher risk to develop type 2 diabetes mellitus (T2DM) later after delivery. On the other hand, macrosomia, congenital abnormalities, birth trauma, breathing trouble, hypoglycemia, and jaundice are all examples of infant problems [2].

Vitamin D, also termed calciferol, is a prohormone that plays a crucial role in calcium and phosphorus balance and promotes the healthy condition of the bones. Humans obtain vitamin D from their diets or through direct exposure to sunshine and ultraviolet radiation type B. Vitamin D is also essential for neuromuscular function [4]. It has two primary functional forms: ergocalciferol (D2) and cholecalciferol (D3) [4]. The pleiotropic activities of vitamin D and their therapeutic importance have become clearer. It is worth noting that there are 2776 vitamin D receptor (VDRs) binding sites in the human genome [5].

Vitamin D is essential for glucose regulation. It has a double action; the presence of certain VDRs on pancreatic beta-cells, and the expression of the enzyme 1-alpha- hydroxylase in pancreatic beta-cells, which stimulates the transformation of 25-hydroxy vitamin D to 1, 25-dihydroxy vitamin D [6].

A vitamin D response element was found in the human insulin gene promoter, as well as the presence of VDR in skeletal muscle. 1, 25-dihydroxy vitamin D rapidly accelerates transcription of the human insulin receptor gene [7], promotes peroxisome proliferator activator receptor-δ, which enhances insulin receptor expression, and promotes insulin-mediated glucose transport in vitro [8].

This research aims to study the vitamin D status in pregnant women with GDM at Minia Maternity and Children University Hospital.

Patient and Methods

This cross-sectional study was conducted on 45 pregnant women with GDM and 45 non-diabetic pregnant women (control group) after approval of the local research and ethical committee in the obstetrics and gynecology department at Minia University. The samples were collected from pregnant women who were seeking antenatal visits at Minia Maternity and Children University Hospital. The participating women were informed about the nature and objective of the study and then consented to participate in this study.

The inclusion criteria were pregnant women aged from 25 to 37 years old, while the exclusion criteria included women having type 1 or type 2 DM, patients with kidney disease, liver disease, thyroid disorders, or other endocrine/chronic diseases, and women on vitamin D supplements.

A questionnaire was filled by a personal interview. The questionnaire was designed to match the study's needs. The questions included age, education, socioeconomic status, employment, family income, family history of DM or GDM, physical activity, number of daily diets, blood glucose monitoring, and BMI measurements.

Venous blood samples (3ml) were taken from the participants by the investigator himself. About 2 ml were added into an EDTA tube to determine HbA1c. The remaining 1 ml was added into a plain tube to allow blood clotting. Then serum samples were obtained by centrifugation (3000 rpm/10 minutes) at room temperature to assay serum vitamin D. All samples were kept in ice to be then analyzed. 1ml of the serum was aliquoted and stored at the Minia University laboratory at minus 20°C until vitamin D was analyzed by ELISA Kits [7].

Oral glucose tolerance test (OGTT): At time zero (baseline), a blood sample was collected. The participants were then given a specific dose of glucose solution (75 g) orally. The participants were instructed to drink the solution within 5 minutes according to the recommendation of the World Health Organization. After that, the patient stayed without physical activity. Blood was then drawn again after 2 hours. For simple diabetes screening, the most important samples to be collected are the 0 and 2-hour samples.

GDM was diagnosed using two hours of 75 g OGTT at 24 to 28 weeks of gestation. The cut-off values were FBG level > 92 mg/dl and two hours of 75 g OGTT>140 mg/dl [9].

Statistical analysis:

Data were collected, reviewed, and coded. The statistical analysis was done with the Statistic Package for Social Science, Version 22 (SPSS 22). Numerical data were presented as mean ± standard deviations, while categorical data were presented as numbers and percentages. For comparing the data of both groups, the independent student t-test was used for the numerical data, and the Chi-square test was used for the categorical data. P-values were considered significant if less than 0.05.

Results

There was no statistically significant difference between pregnant women with GDM and the control group as regards age, education, employment, and financial income (Table 1). There was a statistically significant higher family history of GDM and DM in pregnant women with GDM than in women of the control group (Table 2).

Pregnant women with GDM had significantly lower serum concentrations of vitamin D than the control group. Among pregnant women with GDM, 40% had deficient serum vitamin D (<10 ng/ml), and 55.6% had insufficient value (10–30 ng/ml). Deficient vitamin D levels were significantly higher in pregnant women with GDM, but insufficient vitamin D was statistically nonsignificant, while sufficient serum vitamin D was significantly higher in healthy pregnant women (Table 3). A significant negative correlation between BMI and vitamin D serum levels was found among the studied pregnant women (Table 4).

Table (1): Demographic data of women in both groups

		Gestational diabetes group	Control group	t/x^2	P-value	Sig.
		No.= 45	No.= 45			
Age (years)	**Mean ± SD**	30.156 ± 5.134	29.378 ± 5.386	0.701•	0.485	NS
	Range	21 - 38	21 - 38			
Education	**Uneducated**	12 (26.67%)	11 (24.44%)	1.841*	0.606	NS
	Prep School	10 (22.22%)	6 (13.33%)			
	Secondary School	18 (40.00%)	20 (44.44%)			
	University	5 (11.11%)	8 (17.78%)			
Employment	**Yes**	11 (24.44%)	14 (31.11%)	0.498*	0.480	NS
	No	34 (75.56%)	31 (68.89%)			
Income (pound/month)	**<1000**	0 (0.00%)	3 (6.67%)	5.218*	0.074	NS
	1000 to 2000	16 (35.56%)	9 (20.00%)			
	> 2000	29 (64.44%)	33 (73.33%)			

• Independent student t-test, *: Chi-square test NS: Non-significant (>0.05)

Table (2): Family history of GDM and DM for both groups

		Gestational diabetes group	Control group	x^2	P-value	Sig.
		No.= 45	**No.= 45**			
Family history of GDM	**Yes**	26 (57.78%)	16 (35.56%)	4.464*	0.035	S
	No	19 (42.22%)	29 (64.44%)			
Family history of DM	**Yes**	33 (73.33%)	22 (48.89%)	5.657*	0.017	S
	No	12 (26.67%)	23 (51.11%)			

*: Chi-square test S: significant (<0.05)

Table (3): Vitamin D levels in women of both groups

		Gestational diabetes group	Control group	t/x^2	P-value	Sig.
		No.= 45	**No.= 45**			
Vitamin D (mg/dl)	**Mean ± SD**	15.513 ± 8.328	24.673 ± 6.261	-5.897•	<0.0001	HS
	Range	6.4 –31	11 - 33			
Category of vitamin D level	**Deficient (<10 ng/ml)**	18 (40.00%)	1 (2.22%)	19.281*	<0.0001	HS
	Insufficient (10–30 ng/ml)	25 (55.56%)	33 (73.33%)	3.103*	0.078	NS
	Sufficient (> 30 ng/ml)	2 (4.44%)	11 (24.44%)	7.283*	0.007	HS

• Independent student t-test, *: Chi-square test
NS: Non-significant (>0.05), HS: highly significant (<0.001)

Table (4): Correlation of vitamin D serum level with clinical and laboratory data of the studied pregnant women

Variables	Vitamin D serum level		Sig.
	r	P-value	
Age	-0.142	0.182	NS
BMI	-0.28	0.008	HS
Systolic blood pressure	-0.043	0.687	NS
Diastolic blood pressure	0.001	0.991	NS

NS: Non-significant (>0.05), HS: highly significant (<0.001)

Discussion

GDM is described as glucose intolerance of varying degrees that begins or is first noticed during pregnancy. Maternal age, a history of GDM or a family history of type 2 diabetes, obesity or overweight, previous fetal mortality or delivery of a macrosomic newborn, and ethnicity are the most common risk factors for GDM. [10].

This study was conducted on 45 pregnant women with GDM and 45 healthy pregnant women (control group). The duration of the study ranged from 6-12 months. There was no statistically significant difference between pregnant women with GDM and the control group as regards age, education, employment, and financial income.

Our results were in agreement with the study of Xia et al. (2019) as they reported that among their participants, women with GDM and women in the control group showed no statistically significant difference as regards age and education [11]. Similarly, Al - Shafei et al. (2021) revealed no significant difference in their study between women with GDM and women in the control group regarding age, level of education, and residence [12].

The current study showed a significantly higher family history of GDM and DM in pregnant women with GDM than the control group. Our results were in line with the study of Arnold et al. (2015), as they reported that women with a family history of DM or hypertension are more susceptible to developing GDM, in contrast to the women in the control group [13]. Similarly, Xia et al. (2019) demonstrated that GDM cases, compared with non-GDM controls, had a higher prevalence of a family history of DM [11].

The present study showed that pregnant women with GDM had significantly decreased serum vitamin D than the control group. Among pregnant women with GDM, 40% had deficient vitamin D levels (<10 ng/ml), and 55.6% had insufficient value (10–30 ng/ml).

Our results agreed with the study of Hu et al. (2018). They demonstrated in their meta-analysis, which included 29 observational studies with a total of 28,982 participants, 4,634 women were diagnosed with GDM. They found that when vitamin D in pregnant women decreased, the incidence of GDM increased by 39% (pooled OR: 1.39, 95% CI: 1.20-1.60) with moderate heterogeneity (I2=50.2%; P=0.001). Furthermore, the level of 25 hydroxy vitamin D in women with GDM was substantially lower than in controls, with a pooled impact of -4.79 nmol/L (95% CI: -6.43, -3.15) [14].

In another meta-analysis conducted by Milajerdi et al. (2021), a total of 29 prospective and nested case-control studies, with data from 27 of those studies being suitable for the meta-analysis. Individuals with low serum vitamin D concentrations had a 26% higher chance to develop GDM than those with normal serum levels of vitamin D (OR= 1.26; 95% CI= 1.13-1.41) [10].

In another study conducted by Salakos et al. (2021), they showed that pregnant women with deficient serum concentration of vitamin D (<20 ng/mL) had a significantly higher risk for GDM (OR=1.42, 95% CI=1.06-1.91; P=0.021) [15].

Whereas in the study by Rodriguez et al. (2015), about 31.8% of women had vitamin D insufficiency (20–29.99 ng/ml), and 19.7% of women had vitamin D deficiency (<20 ng/ml). After adjusting for other factors, there was no link between maternal 25 hydroxy vitamin D levels and the risk of GDM or premature birth [16].

Our results showed that there is no statistically significant difference between pregnant women with GDM and women in the control group as regards the demographic data and lifestyle except for the statistically significant association between the lower income and the decreased serum concentration of vitamin D. There is a significant negative correlation between BMI and serum levels of vitamin D in the studied pregnant women.

Our results were supported by a study by Nassar & Alzaharna (2021), as they reported that the Pearson correlation test revealed a substantial negative association between serum concentration of vitamin D and the following variables: BMI, glucose, OGTT, HbA1c, and Homeostatic Model Assessment for Insulin Resistance (HOMA-IR) [17].

In the study of Pleskačová et al. (2015), they reported statistically significant differences between pregnant women with GDM and controls regarding 25 hydroxy vitamin D levels, both with and without adjustment for BMI [18].

Lacroix et al. (2014) revealed that decreased serum concentration of vitamin D was linked to increased insulin resistance as assessed by HOMA-IR (r = - 0.08; P=0.03), and the relationship remained significant after suitable adjustments (P=0.03). On the other hand, BMI adjustment slightly decreased the significance values for relationships with HOMA-IR (P=0.06) [19].

However, Xia et al. (2019) found no significant effect modification by race/ethnicity, BMI before gestation, maternal age, physical activity, parity, or diabetes family history [11].

Conclusion

Pregnant women with GDM have reduced serum concentration of vitamin D. This finding might help with GDM prediction. Further multicentric research on a large scale is needed.

References

1. Gashlan HM, Noureldeen AF, Elsherif HA, Tareq O. Vitamin D and insulin resistance in gestational diabetes mellitus. Journal of Diabetes and Endocrinology. 2017;8(3):17-25.
2. Guariguata L, Linnenkamp U, Beagley J, Whiting D, Cho N. Global estimates of the prevalence of hyperglycaemia in pregnancy. Diabetes Res Clin Pract. 2014;103(2):176-85.
3. Ghada M.El Sagheer ,Lamia Hamdi , prevalence and risk factors for GDM according diabetes in pregnancy study group India in comparison to international association of diabetes and pregnancy study group in El mimia , Egypt.2015.
4. Jain A, Chaurasia R, Sengar NS, Singh M, Mahor S, Narain S. Analysis of vitamin D level among asymptomatic and critically ill COVID-19 patients and its correlation with inflammatory markers. Scientific reports. 2020;10(1):1-8.
5. Ramagopalan SV, Heger A, Berlanga AJ, Maugeri NJ, Lincoln MR, Burrell A, et al. A ChIP-seq defined genome-wide map of vitamin D receptor binding: associations with disease and evolution. Genome Res. 2010;20(10):1352-60. doi: 10.1101/gr.107920.110.
6. Bland R, Markovic D, Hills CE, Hughes SV, Chan SL, Squires PE, et al. Expression of 25-hydroxyvitamin D3-1α-hydroxylase in pancreatic islets. The Journal of steroid biochemistry and molecular biology. 2004;89:121-5.
7. Holick, M. F. Vitamin D status: measurement, interpretation, and clinical application. Annals of epidemiology, 2009;19(2), 73-78.
8. Maestro B, Campion J, Davila N, Calle C. Stimulation by 1, 25-dihydroxyvitamin D3 of insulin receptor expression and insulin responsiveness for glucose transport in U-937 human promonocytic cells. Endocr J. 2000;47(4):383-91
9. Alfadhli, E. M. Gestational diabetes mellitus. Saudi medical journal, 2015;36(4), 399-406.
10. Milajerdi, A., Abbasi, F., Mousavi, S. M., & Esmaillzadeh, A. Maternal vitamin D status and risk of gestational diabetes mellitus: A systematic review and meta-analysis of prospective cohort studies. Clinical Nutrition, 2021;40(5), 2576-2586.
11. Xia, J., Song, Y., Rawal, S., Wu, J., Hinkle, S. N., Tsai, M. Y., & Zhang, C. Vitamin D status during pregnancy and the risk of gestational diabetes mellitus: A longitudinal study in a multiracial cohort. Diabetes, Obesity and Metabolism, 2019;21(8), 1895-1905.
12. Al‐Shafei, A. I., Rayis, D. A., Mohieldein, A. H., El‐Gendy, O. A., & Adam, I. Maternal early pregnancy serum level of 25‐Hydroxyvitamin D and risk of gestational diabetes

mellitus. International Journal of Gynecology & Obstetrics. 2021;152(3), 382-385.
13. Arnold, D. L., Enquobahrie, D. A., Qiu, C., Huang, J., Grote, N., VanderStoep, A., & Williams, M. A. Early pregnancy maternal vitamin D concentrations and risk of gestational diabetes mellitus. Paediatric and perinatal epidemiology. 2015;29(3), 200-210.
14. Hu, L., Zhang, Y., Wang, X., You, L., Xu, P., Cui, X., ... & Wen, J. Maternal vitamin D status and risk of gestational diabetes: a meta-analysis. Cellular Physiology and Biochemistry. 2018;45(1), 291-300.
15. Salakos, E., Rabeony, T., Courbebaisse, M., Taieb, J., Tsatsaris, V., Guibourdenche, J and Benachi, A. Relationship between vitamin D status in the first trimester of pregnancy and gestational diabetes mellitus-A nested case–control study. Clinical Nutrition. 2021;40(1), 79-86.
16. Rodriguez, A., García ‐ Esteban, R., Basterretxea, M., Lertxundi, A., Rodríguez ‐ Bernal, C., Iniguez, C., ... & Morales, E. Associations of maternal circulating 25 ‐ hydroxyvitamin D3 concentration with pregnancy and birth outcomes. BJOG: An International Journal of Obstetrics & Gynaecology, 2015;122(12), 1695-1704.
17. Nassar, Z., & Alzaharna, M. Maternal Vitamin D Status in Gestational Diabetes Mellitus Women. 2021
18. Pleskačová, A., Bartáková, V., Pácal, L., Kuricová, K., Bělobrádková, J., Tomandl, J., & Kaňková, K. Vitamin D status in women with gestational diabetes mellitus during pregnancy and postpartum. BioMed research international, (2015), 1-7.
19. Lacroix, M., Battista, M. C., Doyon, M., Houde, G., Menard, J., Ardilouze, J. L., . . . Perron, P. Lower vitamin D levels at first trimester are associated with higher risk of developing gestational diabetes mellitus. [Research Support, NonU.S. Gov't].Acta Diabetologica, 2014;51(4), 609-616.