Maternal Vitamin D Status in Gestational Diabetes Mellitus
Sedigheh Soheilykhah, Mahdieh Mojibian, Maryam Rashidi, Soodabeh Rahimi-Saghand and Fatemeh Jafari

*Nutr Clin Pract* 2010 25: 524
DOI: 10.1177/0884536610379851

The online version of this article can be found at:
http://ncp.sagepub.com/content/25/5/524

Published by:
SAGE
http://www.sagepublications.com

On behalf of:

The American Society for Parenteral & Enteral Nutrition

Additional services and information for *Nutrition in Clinical Practice* can be found at:

Email Alerts: http://ncp.sagepub.com/cgi/alerts
Subscriptions: http://ncp.sagepub.com/subscriptions
Reprints: http://www.sagepub.com/journalsReprints.nav
Permissions: http://www.sagepub.com/journalsPermissions.nav

>> Version of Record - Oct 20, 2010

What is This?
Gestational diabetes mellitus (GDM) is known as glucose intolerance, with its onset or first recognition during pregnancy. The results of some studies suggested that vitamin D could play a role in the pathogenesis of type 2 diabetes by affecting insulin sensitivity or β-cell function. For example, both animal and human studies have shown that vitamin D deficiency is related to insulin resistance and impaired secretion of insulin; in addition, this effect was reversible by vitamin D administration. Moreover, some studies detected specific receptors for vitamin D in pancreatic β cells, suggesting a role for 1,25-dihydroxy vitamin D in the regulation of insulin secretion. 

There are additional studies that have shown that vitamin D deficiency is prevalent in pregnant women. For example, Bodnar et al demonstrated that vitamin D deficiency was present in 29.2% of black women and 5% of white women residing in the northern United States.

In a study of 126 healthy volunteers with normal glucose tolerance, there was a significant positive correlation between serum 25-hydroxy vitamin D concentrations (a measure of vitamin D status) and insulin sensitivity, as well as a significant negative correlation between serum 25-hydroxy vitamin D and measures of pancreatic β-cell function. People with subnormal serum concentrations of 25-hydroxy vitamin D had a greater prevalence of components of the metabolic syndrome than did those with normal levels (30% vs 11%, P < .01). As data are not sufficient regarding the relationship between GDM and vitamin D deficiency, we aimed to investigate the relationship between vitamin D concentrations and GDM.

Materials and Methods

A case-control study was performed at the Department of Yazd Diabetes Research Center from June 2007 to February 2009 in Iran. Exclusion criteria included, women with pregestational diabetes, multiple pregnancies, fetal abnormality, chronic disease, hypertension, and history of consumption of anticonvulsant drugs. All subjects gave written informed consent for participation in the study, which was approved by the local ethics committee.

Pregnant women were screened for GDM at 24–28 weeks of gestation using a 50-g oral glucose challenge test (OGCT; Carpenter and Coustan criteria). However, when risk factors such as positive family history of diabetes, age
greater than 30 years, obesity (body mass index [BMI] >30 kg/m²), previous history of GDM, and history of macrosomia were present, the OGCT was done at the 14th and 18th week of gestation.

Patients with an abnormal response (postload glucose concentrations of 130 mg/dL or higher) underwent a standard 100-g, 3-hour oral glucose tolerance test (OGTT). Women were diagnosed with GDM if at least 2 of 4 diagnostic criteria were met (fasting plasma glucose ≥95 mg/dL, 1-, 2-, and 3-hour plasma glucose levels of ≥180 mg/dL, ≥155 mg/dL, ≥140 mg/dL, respectively).10,11 By consecutive patient selection, we enrolled 54 women with GDM, 39 women with 1 abnormal OGTT value on the 3-hour OGTT (impaired glucose tolerance test) according to American Diabetes Association criteria (ADA 2004), and 111 healthy pregnant women with normal serum GTT levels as the control group. From the subjects’ medical records, we obtained general information including maternal age, height, prepregnancy weight, reproductive and medical histories, and prepregnancy BMI (kg/m²); these data were included in the analysis of the data as covariates. We also calculated maternal BMI at the time of sample collection. Normal pregnant women were matched with the GDM and IGT group according to age, gestational age, and BMI before pregnancy.

Maternal fasting plasma samples collected in 10-mL vacutainer tubes were kept frozen at −80°C. Serum glucose was measured by using an enzymatic in vitro test, and 25-hydroxy vitamin D₃ was analyzed by a human ELISA kit (Immuno Diagnostic System, UK), with intrassay coefficient of variation (CV) of 2.6% intraassay CV of 2.3%.

Statistical Analysis

All statistical analyses were performed using SPSS for Windows, version 11.50. Data of continuous variables were expressed as mean ± standard deviation, and because vitamin D₃ levels were not normally distributed, the results were presented as medians (interquartile range). Serum 25-hydroxy vitamin D₃ levels were compared between the 3 groups using the Kruskal-Wallis test. For the assessment of correlation between variables of the 3 groups, Pearson correlation was used. We used a regression model to estimate odds ratio (OR) and 95% confidence interval (CI). Statistical significance was set at P < .05.

Serum levels of 25-hydroxy vitamin D₃ were classified into 3 groups for deficiency status (<20 ng/mL as deficient, 20-29 ng/mL as insufficient, and >30 ng/mL as sufficient).

Results

Two hundred four pregnant women participated in this study (54 GDM, 39 IGT, 111 normal GTT). The mean gestational age of the participants was 22.03 ± 8.54 weeks, and the mean maternal age in the 3 groups was 27.39 ± 5.08 years.

As shown in Table 1, there was a significant difference between vitamin D₃ levels in the 3 groups studied (P = .001). Moreover, this difference was seen between GDM and control (P = .03) and IGT and control groups (P = .0001).

Women with GDM had a 2.66-fold (95% CI, 1.26-5.6) increased risk of 25-hydroxy vitamin D₃ deficiency (<15 ng/mL) compared with the control group. When deficient status was considered less than 20 ng/mL, women with GDM had a 2.02-fold (95% CI, 0.88-4.6) increased risk of vitamin D deficiency.

With regard to the serum 25-hydroxy vitamin D₃ levels, deficient status (<20 ng/mL) was present in 78.4% of patients, insufficient status (20-29 ng/mL) was present in 10.3% of patients, and sufficient status (>30 ng/mL) was present in 11.3% of all women studied (Table 2).

The serum levels of 25-hydroxy vitamin D₃ had no significant correlation with age (r = 0.05, P = .6), parity (r = 0.07, P = .2), BMI (r = −0.08, P = .24), or fasting blood glucose level (r = −0.06, P = .4).

Discussion

Our finding showed serum levels of 25-hydroxy vitamin D₃ were significantly lower in GDM and IGT groups compared...
with the control group; in addition, women with GDM had a 2.66-fold increased risk of deficient status (25-hydroxy vitamin D₃ level <15 ng/mL) compared with the control group.

It is hypothesized that vitamin D plays a role in the secretion, and possibly the action, of insulin.¹² There are some proposed mechanisms that describe the association between vitamin D deficiency and GDM risk. Vitamin D may directly or indirectly regulate β-cell function and secretion by binding its circulating active form, 1,25-hydroxy vitamin D, to a β-cell vitamin D receptor as well as regulating the balance between the extracellular and intracellular β-cell calcium pools.¹³,¹⁴ In addition, vitamin D can enhance insulin sensitivity by stimulating expression of the receptors of insulin and increasing insulin response for glucose transport.¹⁵

There are no sufficient data to describe the relationship between GDM and vitamin D deficiency. Our findings are in line with those of Maghbooli et al¹⁶ in which serum concentrations of 25-hydroxy vitamin D levels during 24–28 weeks of gestation were significantly lower in GDM women than in groups with normal levels of vitamin D.¹⁶ Clifton-Bligh et al¹⁷ showed that maternal serum 25-hydroxy vitamin D concentrations were significantly and inversely associated with fasting serum glucose levels. Nevertheless, some studies could not show any relation between hypovitaminosis D and GDM. Farrant et al¹⁸ in the United Kingdom showed that, in total, 66% of women had hypovitaminosis D (serum 25-hydroxy vitamin D concentrations <50 nmol/L), and 31% had levels below 28 nmol/L. There was no significant association between maternal serum vitamin D levels and GDM.¹⁸ Also, another study performed in India showed no significant association between serum 25-hydroxy vitamin D concentrations (30 weeks of gestation) and GDM risk.¹⁹

A large cohort study found that after adjustment for the covariates (including BMI, maternal age, race/ethnicity, and first-degree family history of type 2 diabetes), serum vitamin D deficiency was associated with a 2.66-fold (OR, 2.66; 95% CI, 1.01-7.02) increase in GDM risk.¹⁹ Our findings also demonstrated that women with GDM had a 2.02-fold increased risk of deficient vitamin D status (serum 25-hydroxy vitamin D₃ level <20 ng/mL) compared with the mean level of the control group.

Table 2. Frequency (and Group Percentage) of Different Serum Levels of 25-Hydroxy Vitamin D₃ According to Their Groups

<table>
<thead>
<tr>
<th>Vitamin D₃ Level, ng/mL</th>
<th>GDM</th>
<th>Non-GDM</th>
<th>IGT</th>
<th>Total</th>
<th>P Value *</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td>45  (83.3)</td>
<td>79  (71.2)</td>
<td>36  (92.3)</td>
<td>160  (78.4)</td>
<td>.007</td>
</tr>
<tr>
<td>20-29</td>
<td>1   (1.9)</td>
<td>17  (15.3)</td>
<td>3   (7.7)</td>
<td>21   (10.3)</td>
<td></td>
</tr>
<tr>
<td>&gt;30</td>
<td>8   (14.8)</td>
<td>15  (13.5)</td>
<td>0   (0)</td>
<td>23   (11.3)</td>
<td></td>
</tr>
</tbody>
</table>

GDM, gestation diabetes mellitus; IGT, impaired glucose tolerance. *P value between 3 groups.

Our study has limitations. First, we measured serum 25-hydroxy vitamin D₃ levels only once in 24–28 weeks of gestation. Second, because our study is cross-sectional, we need further cohort studies with serial measurements of serum 25-hydroxy vitamin D₃ concentrations in the first trimester and should evaluate the risk of GDM in women with vitamin D deficiency.

Conclusion

Our results suggested that rates of vitamin D deficiency are higher among women with IGT/GDM, and the relationship between vitamin D status and glucose tolerance in pregnancy needs further study.

References


