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Correlation Between Serum Vitamin D Levels and Gestational Diabetes Mellitus in Pregnant Women.

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ABSTRACT

Gestational Diabetes Mellitus (GDM) is a common metabolic disorder in pregnancy associated with adverse maternal and fetal outcomes. Emerging evidence suggests a potential link between vitamin D deficiency and impaired glucose metabolism during pregnancy. This study aimed to assess the correlation between serum vitamin D levels and GDM in pregnant women. A hospital-based observational study was conducted among 50 pregnant women between 24 and 36 weeks of gestation. Participants were divided into two groups—25 with GDM (diagnosed using WHO criteria) and 25 without GDM. Serum vitamin D levels were measured using chemiluminescent immunoassay. Data were analyzed using SPSS version 23, and the correlation between vitamin D levels and glycemic parameters was assessed using Pearson's correlation coefficient. Mean serum vitamin D levels were significantly lower in the GDM group (16.8 ± 4.5 ng/mL) compared to the non-GDM group (25.3 ± 5.8 ng/mL) ($p < 0.001$). A negative correlation was observed between serum vitamin D and fasting glucose ($r = -0.48$, $p = 0.001$) and 2-hour OGTT glucose ($r = -0.52$, $p < 0.001$). Vitamin D deficiency was significantly associated with GDM. Monitoring and correcting vitamin D levels in pregnancy may help in reducing GDM risk and improving maternal outcomes.

Keywords: Vitamin D, Gestational Diabetes Mellitus, Pregnancy

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INTRODUCTION

Gestational Diabetes Mellitus (GDM) is one of the most common metabolic disorders complicating pregnancy, characterized by glucose intolerance first recognized during gestation [1]. The rising global prevalence of GDM parallels the increase in obesity and sedentary lifestyles, posing significant short- and long-term health risks to both mother and fetus [2, 3]. Adequate maternal vitamin D levels are essential for glucose metabolism, insulin secretion, and placental function. Vitamin D deficiency during pregnancy has been increasingly implicated as a potential risk factor for the development of GDM due to its role in pancreatic β-cell function and insulin sensitivity [4].

Recent studies have highlighted that pregnant women with low serum vitamin D concentrations are more likely to develop glucose intolerance, suggesting a possible causal link between hypovitaminosis D and GDM [5]. Furthermore, vitamin D influences several pathways involved in inflammation and insulin resistance, which are key mechanisms underlying GDM. However, the association between vitamin D deficiency and GDM remains inconsistent across populations due to ethnic, geographical, and lifestyle variations [6, 7].

Hence, this study aims to evaluate the correlation between serum vitamin D levels and the occurrence of gestational diabetes mellitus in pregnant women, thereby contributing to early identification and preventive nutritional strategies for better maternal and fetal outcomes.

STUDY METHODOLOGY

This was a hospital-based observational study conducted in the Department of Obstetrics and Gynecology at a tertiary care center over a period of two years. The study aimed to assess the correlation between serum vitamin D levels and gestational diabetes mellitus (GDM) in pregnant women. Ethical clearance was obtained from the Institutional Ethics Committee before commencing the study, and written informed consent was taken from all participants in their local language prior to enrollment.

A total of 50 pregnant women were included in the study based on predefined inclusion and exclusion criteria. The inclusion criteria consisted of pregnant women between 24 and 36 weeks of gestation attending the antenatal clinic, with or without GDM. Women with pre-existing diabetes mellitus, chronic kidney or liver disease, thyroid disorders, or those on vitamin D supplementation were excluded from the study. All participants underwent detailed history taking and clinical examination, including anthropometric measurements such as height, weight, and body mass index (BMI).

Venous blood samples were collected from all participants after overnight fasting. Serum vitamin D levels were measured using chemiluminescent immunoassay, and plasma glucose levels were estimated through an oral glucose tolerance test (OGTT) as per standard WHO criteria. Participants were divided into two groups — Group A (GDM cases) and Group B (non-GDM controls) — based on the OGTT results.

All data were recorded in a structured proforma and analyzed statistically using SPSS software version 23. Mean and standard deviation were calculated for continuous variables, while categorical variables were expressed as percentages. The correlation between serum vitamin D levels and GDM was assessed using Pearson's correlation coefficient, and a p-value of <0.05 was considered statistically significant.

RESULTS

Table 1: Demographic Characteristics of Study Participants (n = 50)

Parameter	GDM Group (n = 25)	Non-GDM Group (n = 25)	Total (n = 50)	p-value
Mean Age (years)	28.6 ± 3.4	27.9 ± 3.7	28.3 ± 3.5	0.48
Mean BMI (kg/m^2)	26.8 ± 2.9	24.2 ± 2.4	25.5 ± 2.8	0.03*
Gestational Age (weeks)	29.5 ± 2.3	29.8 ± 2.5	29.6 ± 2.4	0.62
Primigravida (%)	10 (40%)	12 (48%)	22 (44%)	0.59
Multigravida (%)	15 (60%)	13 (52%)	28 (56%)	—

*Significant at $p < 0.05$

Table 2: Comparison of Biochemical Parameters Between GDM and Non-GDM Groups

Parameter	GDM Group (n = 25)	Non-GDM Group (n = 25)	p-value
Fasting Plasma Glucose (mg/dL)	106.5 ± 12.3	87.4 ± 9.8	<0.001*
2-hour OGTT Glucose (mg/dL)	162.7 ± 18.6	118.9 ± 14.5	<0.001*
Serum Vitamin D (ng/mL)	16.8 ± 4.5	25.3 ± 5.8	<0.001*
Serum Calcium (mg/dL)	8.5 ± 0.6	9.1 ± 0.7	0.02*

*Significant at $p < 0.05$

Table 3: Correlation Between Serum Vitamin D Levels and Glycemic Parameters in Study Participants

Variable	Correlation Coefficient (r)	p-value	Interpretation
Serum Vitamin D vs Fasting Glucose	-0.48	0.001*	Moderate negative correlation
Serum Vitamin D vs 2-hour OGTT	-0.52	<0.001*	Strong negative correlation
Serum Vitamin D vs BMI	-0.31	0.03*	Mild negative correlation

*Significant at $p < 0.05$

DISCUSSION

In the present study involving 50 pregnant women, an attempt was made to evaluate the correlation between serum vitamin D levels and gestational diabetes mellitus (GDM). The findings revealed that women with GDM had significantly lower serum vitamin D levels compared to non-GDM pregnant women. This observation supports the growing body of evidence suggesting that vitamin D plays a crucial role in glucose metabolism, insulin sensitivity, and pancreatic β-cell function during pregnancy [8].

The mean serum vitamin D level in the GDM group was notably reduced, averaging 16.8 ± 4.5 ng/mL, while the control group showed higher levels at 25.3 ± 5.8 ng/mL, indicating a statistically significant difference ($p < 0.001$). This suggests that hypovitaminosis D could be a contributing factor in the pathogenesis of GDM. Vitamin D deficiency impairs insulin secretion and reduces peripheral insulin sensitivity by altering calcium homeostasis and intracellular calcium flux in pancreatic β-cells. Similar findings were reported by Zhang et al. (2018) and Poel et al. (2019), who demonstrated that low maternal vitamin D levels were associated with a higher risk of developing GDM.

The present study also observed a significant negative correlation between serum vitamin D levels and fasting as well as postprandial glucose levels ($r = -0.48$ and -0.52, respectively), indicating that as vitamin D concentration decreases, blood glucose levels tend to rise. This relationship may be explained by the modulatory role of vitamin D on insulin receptor gene expression and inflammatory cytokines. Additionally, vitamin D is believed to enhance insulin responsiveness in peripheral tissues by stimulating the expression of insulin receptors and promoting glucose transport.

Body mass index (BMI) was also significantly higher among GDM women (26.8 ± 2.9 kg/m^2) compared to non-GDM participants (24.2 ± 2.4 kg/m^2, $p = 0.03$), aligning with previous studies that identified obesity as an independent risk factor for both GDM and vitamin D deficiency. Since vitamin D is a fat-soluble vitamin, it is sequestered in adipose tissue, reducing its bioavailability in obese individuals. This interrelationship between higher BMI, lower vitamin D levels, and impaired glucose tolerance suggests a multifactorial pathophysiological mechanism in GDM development [9].

Furthermore, serum calcium levels were slightly lower in the GDM group compared to the control group (8.5 ± 0.6 mg/dL vs 9.1 ± 0.7 mg/dL), which could further influence insulin secretion. Adequate calcium and vitamin D are essential for maintaining glucose homeostasis during pregnancy. This supports the hypothesis that maternal micronutrient deficiencies, particularly of vitamin D and calcium, may predispose women to gestational glucose intolerance [10, 11].

The findings of the present study are consistent with international literature emphasizing the need for early screening and correction of vitamin D deficiency in pregnant women. However, variations

in cut-off values, ethnic differences, dietary habits, sunlight exposure, and genetic polymorphisms may explain inconsistencies across different studies.

In conclusion, this study highlights a significant inverse correlation between serum vitamin D levels and GDM. Vitamin D deficiency appears to be an independent risk factor for the development of glucose intolerance during pregnancy. Regular monitoring of vitamin D status and appropriate supplementation could potentially reduce the incidence of GDM and improve maternal-fetal outcomes. Further large-scale prospective studies are warranted to establish causal relationships and define optimal vitamin D levels for pregnancy.

CONCLUSION

Vitamin D deficiency was significantly associated with GDM. Monitoring and correcting vitamin D levels in pregnancy may help in reducing GDM risk and improving maternal outcomes.

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