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ORIGINAL RESEARCH

Investigating Vitamin D Status: A Key Factor in Gestational Diabetes among Pregnant Women

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ABSTRACT

Background: Vitamin D deficiency within the general population suggests the emergence of glucose intolerance. The relationship between insufficient vitamin D levels and gestational diabetes mellitus remains a subject of ongoing discussion.
Objectives: The investigation looked into the connection between vitamin D levels and the chances of developing gestational diabetes mellitus.
Methodology: This cross-sectional analytic study includes 262 pregnant women who attended the Gestational Diabetes Center and Antenatal Counseling Center at the Maternity Teaching Hospital in Sulaimani City. The study used convenience sampling, and the data was collected from November 1st, 2021, to October 1st, 2022. The study used a specific questionnaire divided into four sections: demographics, medical, and obstetric. Simultaneously, the Roche Elecsys vitamin D3 assay determined serum vitamin D status.
Results: Women with gestational diabetes mellitus had a significantly higher prevalence of vitamin D inadequate levels (p =0.000), Significant variance in residency (p =0.000), education (p =0.000), body mass index (p =0.038), age at marriage (p =0.023), history of using the contraceptive pill (p-value =0.000), parity (p =0.001), and gravidity (p =0.014) were additionally identified between the two groups of gestational diabetes mellitus and non-gestational diabetes mellitus.
Conclusion: Women with gestational diabetes mellitus had higher rates of vitamin D deficiency than those without, but the differences were not statistically significant.

Keywords: Serum Vit D level; women with GDM.

INTRODUCTION

Diabetes Mellitus (GDM) is a carbohydrate intolerance that develops or develops during pregnancy. Whether or not insulin is used to treat a medical condition or if the condition persists after pregnancy, the term applies. GDM has harmed the mother's pregnancy and the fetus, newborn, and children-adult offspring of a diabetic mother (1).

The most common diabetes-related pregnancy complication is hyperglycemia, which increases the risk of preeclampsia, preterm birth, and cesarean section. In the years following pregnancy, GDM increases the risk of type 2 diabetes mellitus (T2DM). Obesity, cardiovascular morbidity, and recurrent GDM are other maternal consequences of metabolic syndrome. Maternal complications of delivering a macrocosmic or large gestational age (LGA) fetus include increased cesarean delivery rate, bleeding after delivery, birth trauma, and shoulder dystocia (2).

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The global incidence is estimated to be 7%. However, the incidence of GDM has risen in recent decades and is expected to increase further due to a spike in the associated risk factors [3].

As mentioned previously, it is crucial to study GDM because it affects both pregnant women and babies during and after birth. Many researchers are investigating the adverse consequences of inadequate levels of vitamin D in pregnant women and fetuses and the effects of non-classical vitamin D action [4].

Vitamin D is classified as a fat-soluble vitamin with well-known anti-rachitic properties. Its primary function is to regulate calcium levels and support bone metabolism. Scientists posit that the role of vitamin D in the body extends beyond the control of calcium and phosphorus homeostasis. This function includes enhancing insulin production and function, responding to inflammatory and immune triggers, and regulating cell growth and differentiation [5].

Adequate vitamin D intake is essential for the proper development of the fetal skeleton during pregnancy. In addition to its traditional role, vitamin D has been found to significantly improve insulin function, regulate the immune system, and support lung growth. Research has shown that a deficiency in vitamin D could potentially lead to adverse pregnancy outcomes, including an increased likelihood of preeclampsia and gestational diabetes in the mother, as well as a higher risk of the fetus being born small for gestational age.

Vitamin D deficiency is a risk factor for the development of glucose intolerance and diabetes mellitus in the general population. The link between low vitamin D levels and gestational diabetes mellitus, on the other hand, remains debatable [6].

The prevalence of both diabetes and gestational diabetes has recently increased. This is partly due to obesity, lack of exercise, and unhealthy eating habits. A lack of vitamin D is linked to insulin insufficiency, potentially raising the risk of gestational diabetes. However, studies on the subject have presented contradictory results. The current study examines the possible link between vitamin D deficiencies and gestational diabetes in Sulaimani City.

AIMS OF THE STUDY

The investigation looked into the connection between vitamin D levels and the chances of developing gestational diabetes mellitus.

METHODOLOGY

Research Approach and Design

A cross-sectional analytic study investigated the association between vitamin D status and gestational diabetes in pregnant women, both with and without the condition, who visited the GDM Centre and Antenatal Counseling Center at the Maternity Teaching Hospital in Sulaimani City.

All women who attended both centers were assessed for inclusion in the study during the data collection process, and eligible attendees were recruited.

Population and Sample

Purposive (non-probability) sampling is used to select samples in this study. All women who registered in the Gestational Diabetic Center and Antenatal Counselling Center of Maternity Teaching Hospital in Sulaimani City during the study were investigated to be included in the study. A researcher interviewed those who fulfilled the requirements for inclusion and exclusion. The following figure shows the steps taken to get the final group of samples Within the case and control groups.

The study included 262 cases (100 with GDM and 162 without GDM). The criteria for inclusion and exclusion were the same for both groups, except that one group had GDM and the other did not. In the study group, 100 cases were excluded from the sample. This is due to several reasons: 26 of the serums were expired, 55 samples did not consent to get their Vitamin D tested, and 19 samples had a history of liver and renal diseases. Likewise, in the

control group, 28 cases had been dropped from the sample because 7 cases were confirmed with GDM during the study and were thus excluded. Nine samples did not consent to getting a Vitamin D test, and 12 used Vitamin D supplements.

Study Criteria

Inclusion criteria included Women under the age of 39 who are pregnant with a single and have previously been diagnosed with GDM. Pregnant women with a BMI greater than 40 kg/m2, a history of diabetes mellitus and gestational diabetes, hypertension, polycystic ovarian syndrome (PCOS), and a family history of diabetes were excluded. Those who had taken vitamin D supplements in the previous six months, as well as those with a Macrosomic baby and a history of polyhydramnios

Body Mass Index determination

Data related to anthropometric measurements (height and weight) were obtained from medical records. BMI is a reliable measure of relative weight adjusted for height to estimate obesity and its relative risk. Obesity was assessed using BMI. BMI was calculated as an index of general obesity using Quettlet's equation (weight (kg) divided by squared height (m) [7].

According to the WHO BMI classification, the patients were divided into four groups: low weight (18 kg/m2), standard (18.5-25.0 kg/m2), overweight (25.0-29.9 kg/m2), and obese (30 kg/m2) [8].

Data Collection

All women who attended the GDM Center and Antenatal Counseling Center at the Maternity Teaching Hospital were reviewed when gathering data, and the questionnaire was filled out for those who met the inclusion criteria in the study. The time spent in data collection was 11 months, from November 1st, 2021, to October 1st, 2022. The researcher collected the data through direct interviews and recorded it in the prepared questionnaire. Each form was coded, and each interview took about 15 minutes. Then, the researcher took the blood sample, which was transferred to the icebox until the end of the working day (the workday starts from 09 am to 12 pm).

Gynaecologists and endocrine specialists previously confirmed GDM at the GDM Center. OGTT is used to diagnose GDM. Gestational diabetes mellitus (GDM) is determined by identifying a plasma glucose concentration that meets or exceeds the specific thresholds established by IADPSG. These thresholds are set at 92 mg/dl or higher for fasting glucose, 180 mg/dl or higher for glucose levels one hour after a glucose load, and 153 mg/dl or higher for glucose levels two hours after the load. This diagnosis is made following the administration of a 75 g oral glucose tolerance test (OGTT) [9].

All samples submerged in liquid were placed inside a tube to separate the liquid and solid components. The extracted liquid portion, known as serum, was separated from the rest using a centrifuge of 3000 revolutions per minute for 15 minutes. The obtained serum was then preserved at a temperature of -20°C in a specialized tube for chemical tests to be measured later. Every hundred samples were tested for 25 hydroxyvitamin D3 at the same time.

The study realized that 25(OH.)D is stable at room temperature for 4 hours, 24 hours at 2-8 o C, seven days at 20 o C, and three months at -80 o C. Vitamin D does not need to be stored or refrigerated, according to the study; Serum and plasma samples can be utilized to measure vitamin D levels [10].

The questionnaire contained the following items:

1. Socio-demographic characteristics: age, socioeconomic status, height and weight,
2. Obstetric history: Age at marriage, Gestational age, Gravida, Para
3. Serum vitamin D status.

Quantitative Estimation of 25-HydroxyVitamin D3 (ng/ml)

The immunoassay technique has been utilized to measure the 25(OH)D level in human serum and plasma in a controlled setting. To determine the adequacy of vitamin D3 in adults, the Elecsys vitamin

D3 (25-OH) assay is employed. The competition principle is employed to execute this assay, and the total time taken for the procedure is 18 minutes. Here's a breakdown of the steps involved:

1. Initially, the 25(OH)D3 present in the sample (35 microliters) competes with biotin-labelled Vitamin D in R2 (biotin-vitamin D/polyclonal 25(OH)D3-specific ruthenium labelled antibody). The amount of the resulting complex (biotin-vitamin D/polyclonal 25(OH)D3-specific ruthenium labelled antibody) formed in the sample is determined by the concentration of the analyte.
2. In the second step, streptavidin-coated micro particles are introduced, causing the complex to bind to the solid phase through the biotin-streptavidin interaction.
3. The reaction mixture is then transferred into the measuring cell, where magnetically recorded micro particles adhere to the surface of the electrode. The use of Pro Cell helps eliminate any unbound substances.
4. A photomultiplier can then detect the emission of chemiluminescent light after applying a voltage to the electrode.
5. Finally, the results are calculated using a two-point calibration curve and a master curve from the reagent barcode.

These steps ensure an accurate assessment of vitamin D3 levels in adults using the immunoassay technique.

Reagent – Working Solution

One vial of Streptavidin Coated Micro particles (Clear Cap) contains 6.5mL of a solution with a concentration of 0.72 mg/mL of streptavidin-coated micro particles. The solution also includes preservatives. The R1 reaction buffer (grey cap) is supplied in an 8 mL volume and contains approximately 220 mmol/L of acetate buffer with a pH of 3.9. It also includes human albumin at a concentration of 2 g/L and preservatives. Additionally, there is a 9 mL solution of polyclonal anti-25(OH).) D3 antibody (sheep) labelled with a ruthenium complex at a 1.5 mg/L concentration. The solution also includes biotinylated 25-OH vitamin D at a 0.15 mg/L concentration. The pH of the solution is 6.5, and it is prepared in phosphate buffer. Preservatives are also included in this solution.

Calculation:

The analyzer automatically calculates each sample's analyte concentration (ng/ml or nmol/L). Conversion factors: nmol/L× 0.40=ng/ml ng/ml. 2.50 = nmol/L.

Criteria for Vitamin D Status:

Vitamin D levels are categorized as deficient, insufficient, and optimal. A serum vitamin D level below 20 ng/mL is classified as deficient; a level above 20 ng/mL but below 30 ng/mL is considered insufficient; and a level exceeding 30 ng/mL is deemed optimal [11].

Ethical Consideration:

Concerning the confidentiality and anonymity of study participants, the study protocol was presented to the College of Medicine/Sulaimani University's Scientific and Ethics Committee. The protocol was approved after the members of the ethical committee reviewed it. The approval came from a directory of gestational diabetic centers. All study participants gave verbal consent. Furthermore, the confidentiality of all personal information was ensured throughout the study to ensure the participants' anonymity.

Subject Welfare:

Using code for the subjects instead of the name in the Excel sheet (the name was confidential). Only the researcher accesses the raw data.

Statistical analysis:

All patient pieces of information were recorded using the Statistical Package for Social Science (SPSS) version 22 software and Microsoft Excel (2016). When possible, the results are presented as frequencies, percentages, and mean SD (SD = standard deviation). For continuous data, use an independent samples t-test with binary data; for

categorical data, use an F-test with classified and constant information.

T-test: It is used to find the relationship between vitamin D levels and other categorical or continuous data,

F-test determines the causal connection between vitamin D levels and another variable.

The degree of statistical significance was considered p≤0.05, and any significant value of three decimal digits was considered <0.001. The p-value of 0.05 is considered insignificant and highly significant at p-value ≤ 0.000.

RESULTS

The socioeconomic backgrounds of pregnant women who have or have not GDM are shown in Table 1. The GDM group had the highest proportion of samples aged 30 to 39, accounting for 56.0% of all participants. In contrast, the non-GDM group had 41.9% of this age group. The largest proportion of the study samples in the non-GDM group (54.3%) were aged between 20 and 29 years. This evidence shows that GDM group participants were older than non-GDM group participants. Furthermore, the mean in the non-GDM group and the standard deviation of their age distribution were (28.35.03) and (30.15.03) in the GDM group, respectively. The age difference between groups was insignificant in statistical terms (p=0.139).

Based on the BMI tool used to calculate ideal body weight, the majority of individuals in both the GDM (47.0%) and non-GDM (43.2%) groups were classified as overweight. The underweight category had the smallest percentage (1%) in the GDM group, whereas 6.5% of participants in the non-GDM group fell into the underweight category. Furthermore, in the GDM group, the BMI has a mean of 26.80 with a standard deviation of 4.62, while in the non-GDM group, the BMI has a mean of 26.59 with a standard deviation of 4.72. There were slight differences found between means of BMI between groups, which were statistically significant (p=0.038).

Most respondents in the GDM group (75.0%) and non-GDM group (79.6%) were non-employed. No statistical differences in occupation were found between the two groups (p=0.381).

The highest proportion of the samples in both groups had graduated from secondary school, 36% and 53.1% in the GDM and non-GDM groups, respectively. Regarding higher education, in the GDM group, 32% and 27.2% in the non-GDM group had postgraduate degrees. The findings show that statistically significant variations are present between the groups regarding the educational level (p=0.000).

As shown in Table 1, 63% of the total participation in the GDM group and 95.7% of the total involvement in the non-GDM were living in urban places, and the minority were from rural areas (4.0%, 1.2%) in the GDM and non- GDM group, respectively. The findings show that statistically significant variations regarding residency are present between the groups (p=0.000). The majority of the samples in both groups practiced a fully covered dress style, 68% and 63.6% in the GDM and non-GDM groups. There were no statistically significant distinctions between GDM and non-GDM women in dress style groups (p=0.465).

Table (1): Differences between GDM and non-GDM groups according to socio-demographic characteristics

Variables	Items	GDM group Frequency (%) (n=100)	Non-GDM group Frequency (%)(n=162)	P-value F-test
Age	Less than 20 years	3 (3%)	6 (3.70%)	**0.139**
	20- 29 years	41(41%)	88(54.32%)	
	30- 39 years	56(56%)	68(41.97%)	
	Mean ± S.D	30.10 ± 4.95	28.33±5.03	
Body massindex	Underweight	1(1%)	11(6.8%)	**0.038**
	Normal	34(34%)	43(26.5%)	
	Overweight	47(47%)	70(43.2%)	
	Obese	11(11%)	32(19.8%)	
	Morbid obese	7(7%)	6(3.7%)	
Education	Illiterate	5(5%)	1(0.6%)	**0.000**
	Primary schoolgraduate	26 (26%)	30(18.5%)	***HS.**
	Secondary schoolgraduate	36(36%)	86(53.1%)	
	High education	33(33%)	45(27.8%)	
Residency	Urban	63(63%)	155(95.7%)	**0.000**
	Suburban	37(37%)	7(4.3%)	**HS***
Occupation	Employee	25(25%)	33(20.4%)	**0.381**
	Non-Employee	**75(75%)**	**129(79.6%)**	

* Highly Significant

Table 2 presents the obstetric history of participants with and without GDM. The data reveals that a majority of individuals in both groups, comprising 65.% in the GDM group and 74.7% in the non-GDM group, got married between the ages of 20 and 29. Additionally, the gestational age range of 20-29 weeks has the highest proportion of GDM (54.0%) and non-GDM (56.2%) samples. Furthermore, in the GDM group, the gestational age's mean and standard deviation are (29.47, 4.70) and (29.89, 4.18) in the non-GDM group, respectively. There were no statistical differences between groups (0.085) regarding gestational age. The study's findings revealed that in the GDM group, just 23.0% of the total participation had been primigravida, and this ratio was 37.7% in the non-GDM group. Statistical variation was found between groups in terms of gravidity (p=0.014).

Regarding para, 68.0% of participants with GDM and 85.2% of clients without GDM were primiparous, whereas 32.0% of those with GDM and 14.8% of those without GDM were multiparous. There are significant differences in parity (p=0.001) between the GDM and non-GDM sets.

Table (2): Differences in GDM and non-GDM groups based on obstetric history

Variables	Items	GDM group Frequency (%)(n=100)	Non-GDM group Frequency (%) (n=162)	P-value
Gestational age	Less than 20 Weeks	3(3%)	0(0%)	**0.085**
	20- 29 Weeks	54(54%)	91(56.2%)	
	30- 39 Weeks	43(43%)	71(43.8%)	
	Mean ± S.D	29.47 ± 4.70	29.89 ± 4.18	
Gravida	Primigravida	23(23%)	61(37.7%)	**0.014**
	Multigravida	77(77%)	101(62.3%)	
Para	Primiparous	68(68%)	138(85.2%)	**0.001**
	Multipara	**32(32%)**	**24(14.8%)**	

According to the findings in Table 3, there is no evidence of any significant variations in serum vitamin D levels between the GDM and non-GDM groups (p-value=0.263). However, it is worth noting that a higher percentage of individuals in the GDM group (77%) had vitamin D deficiency than those in the non-GDM group (68.5%). Interestingly, the rates of vitamin D sufficiency were comparable in both groups.

Table (3): Comparison between the Vitamin D status of the GDM group and non-GDM group

Vitamin D class	G.D.M. group (n=100) Frequency (%)	Non-GDM group (n=162) Frequency (%)	P-value
Deficient (20 ng/mL)	77 (77%)	111 (68.5%)	**0.263**
Insufficient (20-30 ng/mL)	13 (13%)	33 (20.4%)	
Sufficient (30 ng/mL)	**10 (10%)**	**18 (11.1%)**	

DISCUSSION:

This study aimed to examine the correlation between vitamin D levels and the likelihood of developing gestational diabetes mellitus (GDM) in pregnant women residing in Sulaimani City. The study compares the vitamin D levels in pregnant women with and without GDM to determine if there exists a connection between vitamin D levels and the risk of developing GDM. The risk of GDM and vitamin D deficiency may be heightened by certain socio-demographic traits and obstetric and medical histories, which can impact individuals through diverse processes. Altogether, two hundred sixty-two expectant mothers were chosen to participate in the study; 100 participants were identified with GDM, and 162 were not. The majority (54%) of individuals in the GDM group are in the 30 to 39 age range; nonetheless, Over fifty percent of the non-GDM women are between 20 and 29. This demonstrates that this study's women with GDM were older than non-GDM women. This study discovered statistical differences in BMI between pregnant women with and without GDM. The findings revealed that a higher proportion of the non-GDM group was obese when compared to the GDM group. Obesity, a BMI over 29.9 kg/m2, is a significant risk indicator for GDM. Furthermore, this relationship appears to differ by race and ethnicity. Obese Latina and Asian women are twice as likely as African-American and Caucasian women to develop GDM [12].

The impact of maternal BMI on GDM, as well as the possibility of adverse pregnancy outcomes, was investigated in a prospective cohort study. They noticed an increase the prevalence of GDM as BMI increased [13].

Researchers in this study examined the serum 25-hydroxyvitamin D levels in women with and without GDM. The results showed no significant variations in vitamin D levels between the two groups. However, it was observed that women with GDM had a higher prevalence of vitamin D deficiency compared to those without GDM. Moreover, dietary sources such as vitamin D2 from vegetables and vitamin D3 from fish can help fulfill the body's vitamin D requirements [14].

The literature does not provide a conclusive connection between vitamin D levels and GDM. Hamarashid & Mohammed looked into the relationship between vitamin D status and the risk of GDM [15]. Although many women were given vitamin D and calcium supplements in early pregnancy, They found that 66% of pregnant women were deficient in vitamin D. Despite this, no differences in GDM incidence were found between the GDM and non-GDM groups. Furthermore, the researchers discovered a significant variation in vitamin D levels, with 30-minute glucose concentrations being inversely related to serum levels of vitamin D in women with vitamin D deficiency.

In a case-control study involving 54 women with gestational diabetes mellitus (GDM) and 39 women with impaired glucose tolerance (IGT), it was observed that serum vitamin D concentrations were significantly lower in the GDM group during weeks 24-28 compared to the control group. The control group consisted of 111 women without GDM. The study revealed that 83% of the GDM patients had hypervitaminosis D, while 71% of the non-GDM individuals lacked vitamin D [16].

Taking vitamin D supplements during pregnancy may increase insulin sensitivity and may be beneficial for women with gestational diabetes, according to a few studies on pregnant women. However, more research, including well-designed clinical trials, is needed to fully understand the relationship between vitamin D and gestational diabetes [17].

The studies' findings all point to an increased rate of vitamin D deficiency in pregnant women. South Asian women have fewer serum vitamin D concentrations than white Caucasians, whether born in South Asia or immigrated to Europe or the United States [18].

In a population study in Saudi Arabia, the serum vitamin D was even lower and reached a mean of 2.59 ng/mL in older people [19].

There are limited studies on the treatment of GDM and no studies on preventing it. A single study investigated the effectiveness of vitamin D supplementation in treating GDM. Twelve women with abnormal GTT tests participated in the study and were given intravenous and oral vitamin D doses. Their OGTT was repeated after supplementation, and their insulin and glucose levels were measured.

The study found that giving vitamin D through an IV lowered blood glucose levels compared to the starting point. The researchers observed that insulin levels decreased after IV and oral vitamin D treatment. This suggests that vitamin D may lower fasting blood glucose and glycated hemoglobin levels by increasing glucose absorption by cells or improving insulin function.

A study in Iran observed the effects of vitamin D supplementation during pregnancy. The researchers recruited 120 first-trimester pregnant women and measured their blood glucose, insulin, and vitamin D levels. The women were then randomly assigned to one of three groups that received varying daily doses of vitamin D. Blood samples were retaken after pregnancy to measure the same parameters. The results showed that the group that received the most vitamin D experienced the greatest increase in vitamin D levels while experiencing the smallest increase in insulin levels, indicating a dose-response relationship [20].

Vitamin D could serve a role in gestational diabetes control of glucose by increasing the number of insulin receptors in peripheral tissues, which aids in glucose uptake. This process is calcium-dependent,

and vitamin D levels can indirectly influence glucose transport in tissues by regulating intracellular calcium [21].

The Royal College of Obstetricians and Gynaecologists (RCOG) stated that pregnant women can safely take daily vitamin D supplements and should be provided with ten micrograms (400 units) per day, as recommended by national guidelines. It is also essential for pregnant women to eat a healthy balanced diet to ensure they receive adequate nutrition [22].

The primary health care centers in Sulaimani City do not recommend vitamin D screening and supplementation for pregnant women. The same public health policy should be implemented in light of this region's substantial vitamin D deficiency. Iraq has a high average number of sunny days per year. Arizona had the most sunny days per year, approximately 4015 hours; in Iraq, this number is 3250. This abundance of sunlight did not protect its inhabitants from hypovitaminosis. D. UVB exposure is essential for the skin's synthesis of vitamin D. Several factors, including tradition and religion, force people to cover most of their bodies, and outdoor activities are not popular in this region. Exposing skin to direct sunlight is the most effective way to increase vitamin D levels, particularly in countries with abundant sunshine, such as Iraq, and it has no toxicity due to the skin's self-regulatory system. Most people, however, avoid the sun due to the heat [23].

A bathing suit to 1 minimal erythema dose (MED) is equivalent to consuming 10.000 to 25,000 IU of vitamin D2. In these cases, fat malabsorption lamps emitting UVB radiation are the most effective treatment for vitamin D deficiency [24].

Because high UVB is considered a crucial factor in sunburn and skin cancer development, determining the highest UVB time frames for getting vitamin D from the sun is critical. Furthermore, there is no information on UVB time in Sulaimani City.

However, the maximum UVB time in Riyadh was recorded between 10:30 am and 2:00 pm during summer. Given this, the best time for the sun is between 8:30 am and 12:00 pm [25].

Several studies compared the level of vitamin D3 creation from oral supplementation versus sun exposure. It has been reported that exposing the entire body to sunlight for 10-15 minutes in the middle of the summer is equivalent to taking 15,000 IU of vitamin D3. According to this discovery, exposing hands, face, and arm (approximately 15% of body surface area) is equivalent to producing 1000 IU of D3 [26].

More research is required to verify that vitamin D deficiency affects gestational diabetes risk differently in obese and lean women [27] mentioned in the study that limited research suggests that taking vitamin D supplements during pregnancy can boost insulin sensitivity, which may have a threshold effect. Even if adequate vitamin D levels do not prevent gestational diabetes, women who have it may benefit from supplementation. Observational studies may suggest a connection, but thorough randomized controlled trials are necessary to fully understand the link between vitamin D and gestational diabetes throughout pregnancy.

CONCLUSIONS:

The study's findings revealed no relationship between vitamin D levels and the possibility of developing GDM. Vitamin D deficiency was much more common in women with GDM. The correlation between insufficient serum vitamin D levels and the likelihood of developing GDM is multifaceted, necessitating additional research to gain a comprehensive understanding.

Strength and Limitations:

To minimize complications during pregnancy, it is crucial to tackle vitamin D deficiency through pre-conception counseling. Healthcare planners and professionals must comprehensively understand the connection between vitamin D deficiency and gestational diabetes to ensure adequate healthcare planning. The study was not a common topic; it was

novel for the participants and even health care staff and challenging for the researcher. It faced some barriers and difficulties mentioned as follows:

1. Matching the control and case groups was difficult due to the exclusion criteria and age groups.
2. Some of the patients were not cooperative.
3. The main concern of this study that limited us involved finance and the ability to review previous studies through Internet access. This is due to our lack of a personal account, which enabled us to reach our earlier studies. In addition, most studies are purchased online, which we had a limited budget for and could not afford.

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