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## THE EFFECT OF VITAMIN D SUPPLEMENTATION ON GESTATIONAL DIABETES


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**ABSTRACT**

*Introduction: In view of the growing prevalence of gestational diabetes mellitus (GDM), a great deal of study has been done to determine the link between vitamin insufficiency and GDM. All the same, Pakistan has not generated many clinical research studies.*

*Objective: The goal of this study is to determine how vitamin D supplementation impacts the GDM and vitamin D insufficiency in pregnant women.*

*Method: During patients' prenatal checks at the hospital, information was gathered from them using a self-made questionnaire. Serum vitamin D testing was done on patients aged 18 to 40 who were diagnosed with gestational diabetes between the 24th and 28th week of pregnancy. Group A and B were formed from 106 GDM patients who were vitamin D insufficient.Group B, the control group, received no therapy for six weeks while Group A received an interventional dosage of vitamin D (50,000 IU) twice at two-week intervals. Group A received only two doses totaling fifty thousand units of dosage. The two groups' serum FBS, HbA1c, and vitamin D levels were compared.*

*Findings: Following the intervention, there was a significant drop in HbA1c (5.764), a rise in Vit D (23.70 ng/mL), and a change in FBS (97.55 mg/dL),Results: According to descriptive data. Significant differences were verified by a Mann-Whitney U test, which rejected the null hypothesis for all variables ($p < 0.05$).*

*Conclusion: The group that received the intervention showed better results than the control group, including better glycemic control and higher levels of vitamin D. These results highlight the intervention's potential effectiveness in managing gestational diabetes and highlight how important it is to optimal mother health.*



***Keywords:*** *Gestational Diabetes Mellitus, Glycated Hemoglobin, Oral glucose tolerance test, homeostasis model assessment-estimated insulin resistance*


## INTRODUCTION

Gestational diabetes mellitus (GDM) is a type of diabetes that has its onset during pregnancy, and because of this it can cause a number of health problems in both the mother and the fetus. As a result of increased incidences of obesity and reduced physical activity, GDM is now a major area of concern in maternal medicine owing to its growing incidence globally. Pregnancy is a unique physiological situation that involves intricate alterations to the immune system, blood circulation, and nutritional requirements (Thrailkill et al., 2017). Gestational diabetes mellitus is a

disease of decreased glucose tolerance that presents in many ways throughout pregnancy or the gestation period. Women's hormone levels fluctuate dramatically during the gestational period, and they also require different nutrition at different times. The health of women and newborns may be adversely affected if these demands are not met. Vitamin D levels rise as a result of the fetus's quick development. A vitamin D deficit can impact bone health, bone density, and the associated immune response if pregnant women at this point do not take supplements (Egan & Dunne, 2019).

Moreover, Secosteroid hormone vitamin D is involved in bone formation by maintaining calcium, magnesium, and phosphorus homeostasis. It also regulates immune system function, neurological function, cardiovascular function, and insulin secretion, which controls blood sugar levels. Since diabetes can result from insulin resistance, vitamin D monitoring is essential in this regard (Arshad et al., 2021). Over the last few years, there has been a rise in vitamin D deficiency across various nations, racial groupings, and age categories—such as women who are of reproductive age—in particular (Shah et al., 2021).Deficit factors include sun protection use, cosmetics, low vitamin D intake, intestinal malabsorption, failure of the kidney and liver, certain lifestyle choices like smoking, obesity, using certain medications, and inflammation (Arshad et al., 2022; Anwar et al., 2021).

Furthermore, considering fetal development, the Institute of Medicine (IOU) and European Calcified Curtis et al. (2018) recommend 600 IU daily for pregnant women.Vitamin D levels should be greater than 30 ng/ml to be regarded as normal; inadequate, between 21 and 29 ng/ml; deficient, less than 20 ng/ml; and severely deficient, less than 10 ng/ml, according to Flood-Nicholas et al. (2015)(Haq et al., 2021).Gestational diabetes mellitus (GDM) is present in 14.2% of pregnant women worldwide, depending on the ethnic composition of the population and the GDM diagnostic tests utilized (Jamilian et al., 2019).

Pregnancy reduces beta-cell function in women with GDM more than it does in pregnant women without the disease. Reduced beta cell adaptation may result from this, which may compromise glycemic control and induce insulin resistance (Fowler et al., 2007). Except from those who are younger than 25 years old, do not have a family history of type 2 diabetes, do not have poor obstetric outcomes, and do not belong to racial/ethnic groups where type 2 diabetes is highly prevalent, women with a gestation period between 24 and 28 weeks should be screened for gestational diabetes mellitus (GDM), according to the Recommended Dietary Allowance (RDA).Two conditions are needed to diagnose GDM, according to Seshadri (2004): a random blood glucose level of at least 200 mg/dl (11.1 mmol/L) and a fasting blood glucose level of at least 126 mg/dl (7.0 mmol/L) (Seshadri , 2004).

Type 2 diabetes is becoming more common in concert with GDM. Because obesity raises the risk of type 2 diabetes, the incidence of GDM is increasing (Cheung, 2009). Women who run the risk of type 2 diabetes may also develop GDM. Morbidity and death in both are caused by GDM-related health impacts on the mother and progeny (Getahun et al., 2010). Among the short-term risk consequences linked to gestational diabetes mellitus in pregnancy are preeclampsia, hypertension, urinary tract infections, and preterm births. According to longitudinal research, Type 2 diabetes will strike 70% of women with GDM within the next ten years (Fowler, 2007). Gestational diabetes mellitus (GDM) is 35–80% more likely to strike women who have previously had the disease (Ben-Haroush et al., 2004).

Untreated hyperglycemia can lead to various health complications by increasing the fetus's need to produce insulin (Pridjian& Benjamin, 2010). Only 12% of pregnancies result in fetal macrosomia and higher birth weight, but 20% of newborns whose moms have GDM have these conditions (Chen, 2009). These babies are more susceptible to hypoglycemia, jaundice, polycythemia, hypocalcemia, hypomagnesemia, and respiratory distress syndrome developing. As adults, these babies run a greater chance of developing type 2 diabetes, impaired glucose tolerance, and cardiovascular disease. When they are 20–24 years old, they have a 45% probability of having T2D, but the odds are 9% for children whose moms had diabetes after becoming pregnant (Cheung, 2009).

Maintaining maternal blood glucose levels, especially postprandial levels, within the ideal

range is the primary goal of managing gestational diabetes mellitus (GDM) successfully (Lohse et al., 2011). According to Wojcik et al. (2015) and Nobles et al. (2015), the development of GDM is thought to include the placenta producing more insulin-resistant hormones, which lowers insulin sensitivity throughout pregnancy. This bolsters the evidence base supporting the use of medical nutrition therapy to treat GDM (Djelti et al., 2015). Whether it is found as vitamin D2 or D3, its principal job is to support the preservation of strong bones. Normally, sun exposure and food supply humans with the required amount of vitamin D. Vitamin D synthesis occurs cutaneously in response to factors such skin 7-dehydrocholesterol content, melanin pigmentation, and the solar zenith angle, which is controlled by latitude, season, and time of day. Furthermore, new research has shown how previtamin D3 production is affected by altitude. Using simulated sunlamps in specific circumstances to boost vitamin D production has shown possible benefits for some individuals with intestinal malabsorption or those who reside in northern latitudes and may be elderly or ill. Worldwide prevalence of vitamin D deficiency is mostly caused by a lack of knowledge about the vital role sunlight plays in achieving vitamin D needs (Chen et al., 2010).

Surprisingly, a global population of around nine hundred million suffer from vitamin D paucity, which is known to be an emerging health concern (Holick 2010). Present research suggests that vitamin D receptors are found in several tissues, including muscles, and pancreatic beta cells important for blood glucose homeostasis (Jain et al., 2015). According to Kramer et al. (2014) and Maghbooli et al. (2008), these receptors essential for consistent insulin synthesis and release by the pancreatic beta cells, directly act on the endocrine pancreas. It is therefore logical that low vitamin D levels are associated with changes in blood glucose and insulin, and a decrease in insulin sensitivity in tissues of interest (Shahgeibi et al., 2016).

Essential nutritional factors required for proper functioning of the body is vitamin D, this study points more concentration on Type 2 Diabetic patients who are Vitamin D deficiency and it has been researches and discovered that taking vitamin D have a positive impact in improving insulin sensitivity and secretion of the patients. Related to that, gestational diabetes mellitus (GDM) was identified to be developed by pregnancy-induced insulin resistance and consequently, decreased insulin synthesis as a compressed form of glycemia regulation. Sunlight is the most major form by which some parts of the body produce Vitamin D(Muthukrishnan & Dhruv, 2015). However, this process is not free from influences of several factors, such as season, latitude, climate type, level of melanin and skin colour (Web, 2006).

Food can also contain the substances upon which the activation of the vitamin occurs to form cholecalciferol and ergocalciferol. Liver converts vitamin D produced in the body in addition to vitamin D consumed in the diets to 25-hydroxyvitamin D (25(OH)D). The most precise approach of identifying a person's vitamin D status is to measure the serum 25(OH)D concentrations. 1,25(OH)2D is the metabolically active form of vitamin D and is synthesized in the kidney through parathormine stimulated further hydroxylation of 25(OH)D. A literature review revealed that published research has shown that pregnancy causes an increase of 1,25(OH)2D levels, but these concentrations are still appreciably elevated compared with postpartum or nonpregnant persons; indeed, in the third trimester, the concentration is almost twice that of the norm. (Barrett & McElduff, 2010;Shin et al, 2010).

Several studies have demonstrated that supplementation with vitamin D can be helpful to prevent GDM and that the levels of vitamin D should be raised among women, and in case of pregnant women with low levels of vitamin D, the vitamin D supplements should be delivered. Like any other review studies, the analysis brings out the correlation between GDM risk and vitamin D insufficiency. Concerning the causative relationship between a previous vitamin D deficiency and the development of GDM, the pathways by which this takes place remains unknown. These are leading to severe conditions affecting different racial populations Hence, randomised, placebo-controlled, clinical trial of vitamin D supplementation is needed to identify the desirable level of vitamin D and evaluate the effect of dietary supplementation on GDM risk, if any(Alzaim & Wood, 2018).

However, by considering the discussed studies, the current research aims to examine if taking vitamin

D supplements during pregnancy can help improve blood sugar control in women with GDM, providing a safe way to support the health of both mothers and their babies.

## HYPOTHESIS

**Research hypothesis:**

**$H0_1$**: Vitamin D supplementation effects Gestational Diabetes.

**Null hypothesis:**

**$H_0$** : Vitamin D supplementation does not effect Gestational Diabetes.

**Research Question**

What are the effects of Vitamin D supplementation on GDM?

## MATERIALS AND METHODS

The study aims to determine how gestational diabetes pregnant women who take vitamin D supplements fare. Pregnant women with gestational diabetes were selected from Obstetrics and Gynecology Department, Fatima Memorial Hospital, Lahore. The study employed a quasi-experimental design. Probability sampling technique was used to ensure the validity of the research design.

**Inclusion Criteria**

In this study on vitamin D supplementation on gestational diabetes mellitus, the target population in this study is pregnant women with GDM but who will display homogeneity in health and demographic status so as to enable accurate generalization. Samples for this study will comprise pregnant mothers who had their vitamin-D levels assessed and confirmed to be deficient in it when diagnosed with gestational diabetes mellitus (GDM), a condition that interferes with the body's ability to regulate blood sugar during pregnancy. Furthermore, in order to assess the period when GDM is most likely to be diagnosed only women in their 24th to 28th weeks of pregnancy were chosen. That period is essential because it coincides with the time when GDM screening and diagnosis take place. To this end, the study also established age criteria whereby included women were between 18 and 40 years.

**Exclusion Criteria**

However, pregnant women with other comorbid conditions were omitted in this study such as; cancer and chronic kidney diseases. Cohort chronic diseases may affect glucose metabolism and general health, and therefore may confound the relationship between vitamin D supplementation and GDM. For example, cancer patients may have a somewhat more convoluted metabolism and as some of the offered treatments include chemotherapy, their blood glucose levels could change drastically. Moreover, women with chronic kidney disease present changes in vitamin D metabolism as well as insulin resistance as the kidney has the ability to convert Vitamin D into its active form.

**Sample Size Estimation**

According to a recent study conducted in Pakistan the prevalence rate is 9.47% (Inamet al., 2022).A sample of size 106 (53 in each group) individuals has been calculated using 10% level of significance, 90% confidence interval,10% margin of error and 80% power of the test.

Following quantities were used in sample size calculation:

level of significance $= \alpha = 10\%$

Confidence interval $= 90\%$

Margin of error $= d = 10\%$

Prevalence of GDM $= 0.947\%$

Standard Normal Randon variate $= z_{1-\alpha/2} = 1.645$

Power of the test $= 80\% = z_{1-\beta} = 0.84$

Formula used for sample size calculation is as follows:

$$n = 2\left(\frac{z_{1-\alpha/2} + z_{1-\beta}}{d_0}\right)^2 p(1-p)$$

106 (53 in each group)

**Treatment plan**

| GROUPS | PARTICIPANTS |
|---|---|
| **INTERVENTIONAL GROUP** (A) | (n=53) VITAMIN D DEFICIENT AND GDM PATIENTS (Were given a dose of50,000 IU/d) |
| **CONTROL GROUP** (B) | (n=53) VITAMIN D DEFICIENT AND GDM PATIENTS (No vitamin D supplementation) |

**Data Collection Method**

The data were gathered by measuring the vitamin D and HB1AC serum FBS levels. After getting their permission, patients who consented to take part in the study were told its goal. Following that, the patients were instructed to take 50,000 IU of recommended Vitamin D tablets every two weeks. Over the trial, two dosages were given. In order to measure pertinent factors, fasting blood samples were taken at baseline and six weeks following the treatment.

**Data Collection Method**

Throughout the trial period, the lab tests were tracked to see how each patient's GDM and vitamin D related.

- Fasting blood sugar levels
- HbA1c
- Serum Vitamin D levels

**RESULTS**

**Table 1 Descriptive statistics of Interventional Group**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Age | 53 | 16 | 39 | 29.13 | 4.193 |
| Weight(kg) | 53 | 45 | 89 | 67.06 | 7.422 |
| Height(cm) | 53 | 67 | 180 | 163.58 | 14.452 |
| BMI | 53 | 16.0 | 30.1 | 24.499 | 2.1115 |
| Gestational week | 53 | 24 | 32 | 27.36 | 2.379 |
| HbA1c at baseline | 53 | 5.4 | 7.0 | 5.934 | .3198 |
| HbA1c after 6 weeks | 53 | 5.2 | 6.4 | 5.660 | .2699 |
| FBS at baseline (mg/dL) | 53 | 95 | 130 | 105.55 | 7.871 |
| FBS after 6 weeks (mg/dL) | 53 | 81 | 110 | 89.58 | 6.629 |
| Vit D after 6 weeks (ng/mL) | 53 | 24 | 41 | 31.89 | 3.766 |
| Vit D at baseline (ng/mL) | 53 | 7 | 28 | 15.79 | 4.688 |
| Valid N (listwise) | 53 | | | | |

Despite having an average age of 29.13 years, the 53 participants in the intervention group's descriptive statistics indicate that the cohort is relatively youthful, with participants ranging in age

from 16 to 39 years. 163.58 cm is the average height, and 67.06 kg is the average weight. With a mean BMI of 24.499, these statistics together yield a body composition that is within the normal range. Pregnant subjects in the study were indicated by the mean gestational week of 27.36.

Notably, the baseline HbA1c levels—a gauge of long-term blood sugar control—drop marginally to 5.660 following six weeks of intervention. This could benefit the control of blood sugar levels. Furthermore, after six weeks, there was a reduction in fasting blood sugar (FBS) levels from 105.55 mg/dL at baseline to 89.58 mg/dL, indicating improved short-term blood sugar control. Additionally, the mean vitamin D level increased from 15.79ng/mL at baseline to 31.89ng/mL after six weeks, suggesting a good response to the intervention.

All these findings point to the intervention's positive effects on health, particularly in the areas of vitamin D and glycemic control. Therefore, it is crucial to assess these results in the context of the study's limitations and account for any confounding factors. Statistical tests can be used to assess the significance of observed changes and support the validity of the conclusions drawn from the descriptive statistics. The discussion and analysis that follows should align with the objectives of the research as well as the larger corpus of scholarly literature on the subject.

**Table 2 Descriptive statistics of control Group**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Age | 53 | 19 | 37 | 28.72 | 4.235 |
| Weight(kg) | 53 | 52 | 94 | 69.48 | 8.078 |
| Height(cm) | 53 | 152 | 175 | 164.02 | 5.458 |
| BMI | 53 | 19.0 | 36.7 | 25.877 | 3.3455 |
| Gestational week | 53 | 24 | 38 | 27.21 | 2.699 |
| HbA1c at baseline | 53 | 5.3 | 7.1 | 5.957 | .3866 |
| HbA1c after 6 weeks | 53 | 5.3 | 7.2 | 5.868 | .3941 |
| FBS at baseline (mg/dL) | 53 | 92 | 160 | 108.68 | 15.439 |
| FBS after 6 weeks (mg/dL) | 53 | 80 | 140 | 105.51 | 11.613 |
| Vit D at baseline (ng/mL) | 53 | 9 | 29 | 15.43 | 4.971 |
| Vit D after 6 weeks (ng/mL) | 53 | 8 | 29 | 15.51 | 5.180 |
| Valid N (listwise) | 53 | | | | |

**Descriptive statistics of control Group**

Characteristics and health-related parameters of the 53 members of the control group are revealed via descriptive statistics. The control group's age range is 19–37 years old, with an average of 28.72 years old. The control group members have a mean BMI of 25.877, 164.02 cm of height, and 69.48 kg of weight. These numbers show that the sample is representative and varied since they are within usual ranges.

The average gestational week was 27.21 for the pregnant individuals in the study. An examination of the initial values reveals an average of 5.957, which after six weeks marginally drops to 5.868. Over time, this suggests a minor improvement in blood sugar management. Fasting blood sugar (FBS) averages were 108.68 mg/dL at baseline and 105.51 mg/dL after 6 weeks. Though small, the decline implies that short-term blood sugar levels may have stabilized over the intervention period. The baseline and 6-week averages of vitamin D for the control group are 15.43 and 15.51 ng/mL, respectively. There is not much fluctuation in these values. This uniformity can imply that the intervention had little effect on the people's vitamin D levels.

Compared to the interventional group, the control group's results reveal some baseline similarities and minimal differences throughout the course of the 6-week period. Finding these trends in the context of the overall research objectives and accounting for any confounding factors is crucial. Statistical studies could shed more light on the relevance of observed trends and improve our comprehension of how the intervention affected the control group's health indicators.

**Table 3 (a)Case Processing Summary ofHbA1c after 6 weeks**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| HbA1c after 6 weeks | 106 | 100.0% | 0 | 0.0% | 106 | 100.0% |

**Table 3 (b) Descriptive ofHbA1c after 6 weeks**

| | | | Statistic | Std. Error |
|---|---|---|---|---|
| HbA1c after 6 weeks | Mean | | 5.764 | .0342 |
| | 95% Confidence Interval for Mean | Lower Bound | 5.696 | |
| | | Upper Bound | 5.832 | |
| | 5% Trimmed Mean | | 5.734 | |
| | Median | | 5.700 | |
| | Variance | | .124 | |
| | Std. Deviation | | .3519 | |
| | Minimum | | 5.2 | |
| | Maximum | | 7.2 | |
| | Range | | 2.0 | |
| | Interquartile Range | | .4 | |
| | Skewness | | 1.509 | .235 |
| | Kurtosis | | 3.648 | .465 |

**Table 3 (c) Tests of Normality for HbA1c after 6 weeks**

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | Df | Sig. | Statistic | Df | Sig. |
| HbA1c after 6 weeks | .142 | 106 | .000 | .885 | 106 | .000 |

a. Lilliefors Significance Correction

**4.2Kolmogorov-Smirnov test:**

**4.2.1 HbA1c after 6 weeks:**

The Kolmogorov-Smirnov (KS) test was employed in a sample of 106 cases to assess whether the distribution of HbA1c levels after a 6-week intervention was normal. With a significance level (p-value) of 0.000, the test yielded a statistical result of 0.142. This low p-value may suggest a statistically significant deviation from a normal distribution. According to the null hypothesis of the KS test, the sample distribution is the same as a normal distribution. We reject the null hypothesis because of the rather low p-value, and we draw the conclusion that the distribution of HbA1c after six weeks is noticeably non-normal.

The Shapiro-Wilk test, which examines normality as well, lends support to this view. The null hypothesis is further disproved with a p-value of 0.000 and a Shapiro-Wilk score of 0.885. The 6-week-old HbA1c distribution in this group is not usual, as evidenced by the consistency of the test results. The descriptive statistics show a positive

skewness of 1.509, which indicates a rightward skewness in the distribution. This demonstrates the distribution's tail on the right side and its leftmost concentration of values. The kurtosis score of 3.648 indicates that the distribution is more peaked and has thicker tails than a normal distribution. The distribution of HbA1c levels after six weeks in this sample, as indicated by the skewness and kurtosis values, KS and Shapiro-Wilk test findings, and heavier tails, all seem to be significantly non-normal.

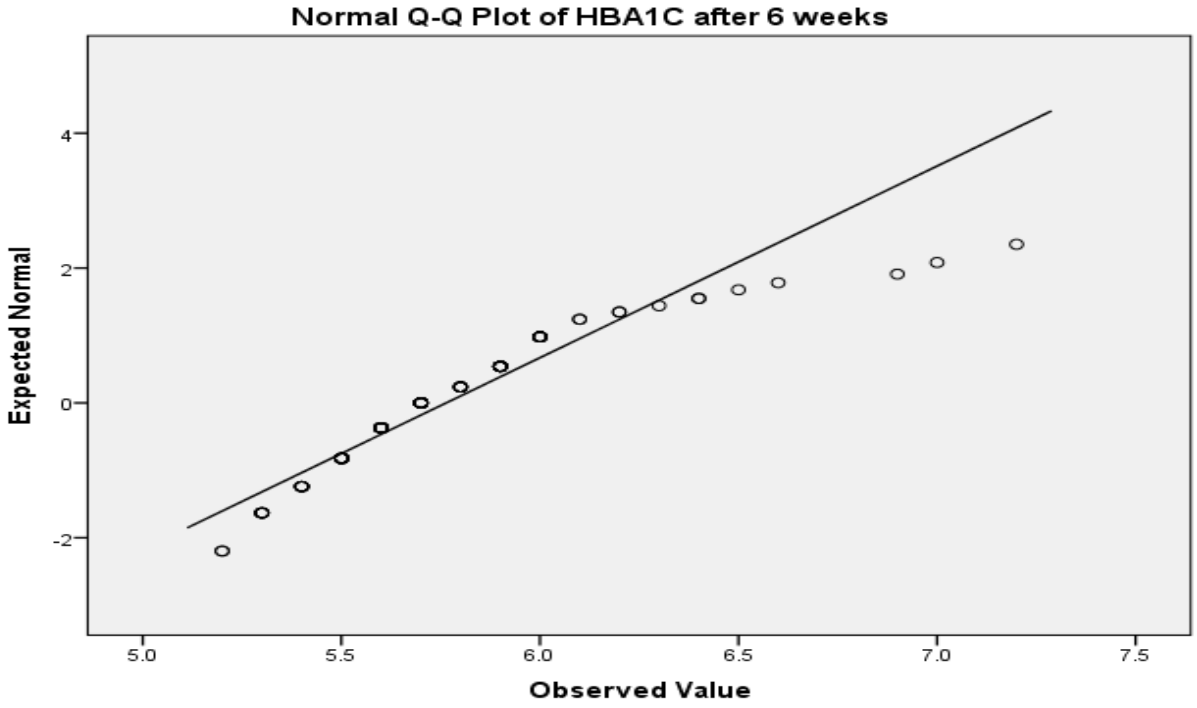


**Figure 1 (a)Normal Q-Q Plot of HbA1c after 6 weeks**

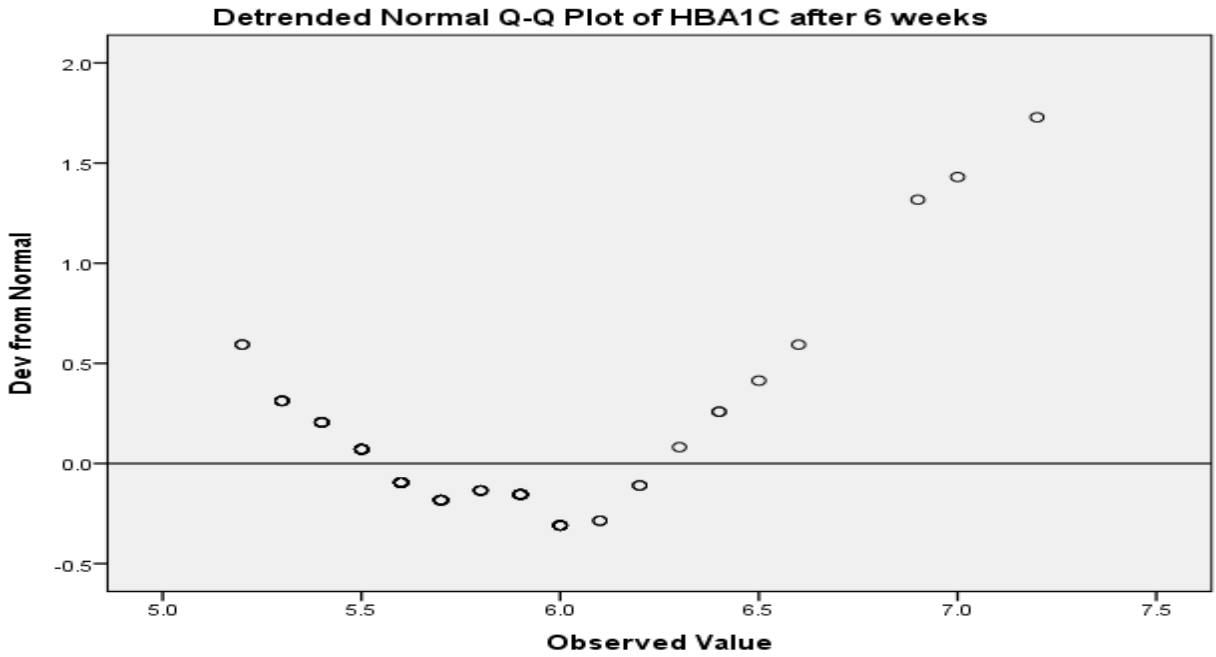


**Figure 1 (b) Detrended Normal Q-Q Plot of HbA1c**

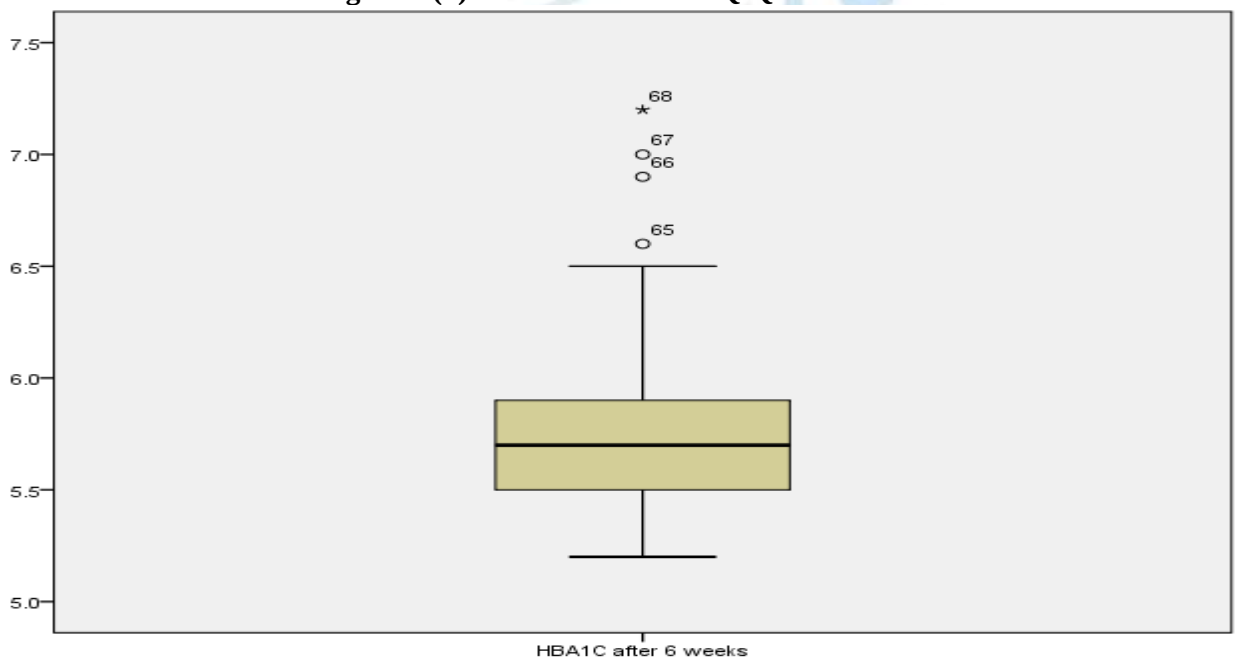


**Figure 1 (c)**

**FBS results after 6 weeks in Figure 1 (a,b,c)**

To find out if the distribution of fasting blood sugar (FBS) levels after six weeks of intervention followed a typical pattern, the Kolmogorov-Smirnov (KS) test was performed on 106 patients. The KS test yielded a statistic of 0.096 and a significance level (p-value) of 0.017. Given that the p-value is less than the commonly used limit of 0.05, it indicates a statistically significant divergence from a normal distribution.

This suggests that the distribution shape of the FBS levels after six weeks is practically different from what would be expected from a normal distribution of the data. A normal distribution is bell-shaped

and symmetrical, yet it may also exhibit kurtosis, skewness, or other irregularities.

The Shapiro-Wilk test, which evaluates normality as well, concurs with this outcome. The Shapiro-Wilk test yielded a statistic of 0.925 with a significance level of 0.000 after using Lilliefors Significance Correction, confirming the deviation from normalcy. The hypothesis that the distribution is right-skewed, with the tail of the right side being longer than the left, is supported by the descriptive statistics' positive skewness (1.059). Based on the kurtosis value of 1.372, the distribution looks more peaked and has substantially heavier tails than a normal distribution. In summary, after six weeks, the distribution of FBS levels in this sample is clearly non-normal, as indicated by the findings of the KS and Shapiro-Wilk tests as well as the descriptive statistics.

**Table 4 (a)Case Processing Summary for FBS after 6 weeks**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| FBS after 6 weeks (mg/dL) | 106 | 100.0% | 0 | 0.0% | 106 | 100.0% |

**Table 4. (b)Descriptive for FBS after 6 weeks**

| | | | Statistic | Std. Error |
|---|---|---|---|---|
| FBS after 6 weeks (mg/dL) | Mean | | 97.55 | 1.200 |
| | 95% Confidence Interval for Mean | Lower Bound | 95.17 | |
| | | Upper Bound | 99.93 | |
| | 5% Trimmed Mean | | 96.60 | |
| | Median | | 95.00 | |
| | Variance | | 152.555 | |
| | Std. Deviation | | 12.351 | |
| | Minimum | | 80 | |
| | Maximum | | 140 | |
| | Range | | 60 | |
| | Interquartile Range | | 16 | |
| | Skewness | | 1.059 | .235 |
| | Kurtosis | | 1.372 | .465 |

**Table 4. (c)Tests of Normality for FBS after 6 weeks**

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | Df | Sig. | Statistic | Df | Sig. |
| FBS after 6 weeks (mg/dL) | .096 | 106 | .017 | .925 | 106 | .000 |

a. Lilliefors Significance Correction

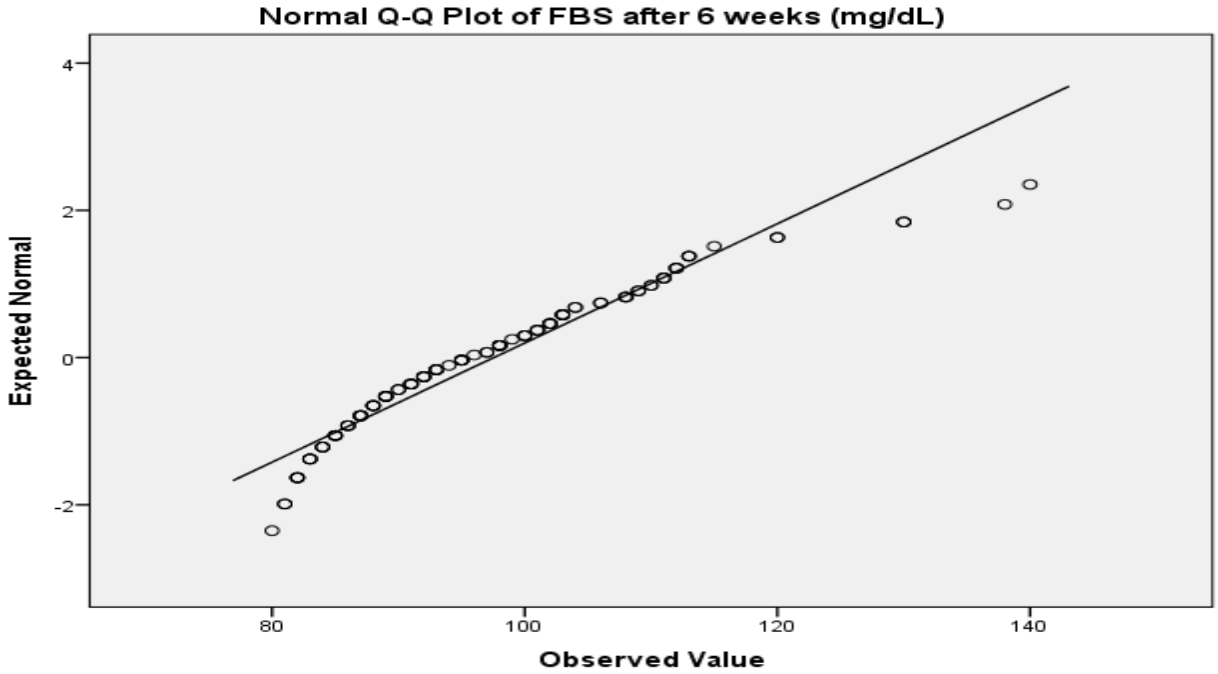


**Figure 2 (a)Normal Q-Q Plot of FBS after 6 weeks(mg/dL)**

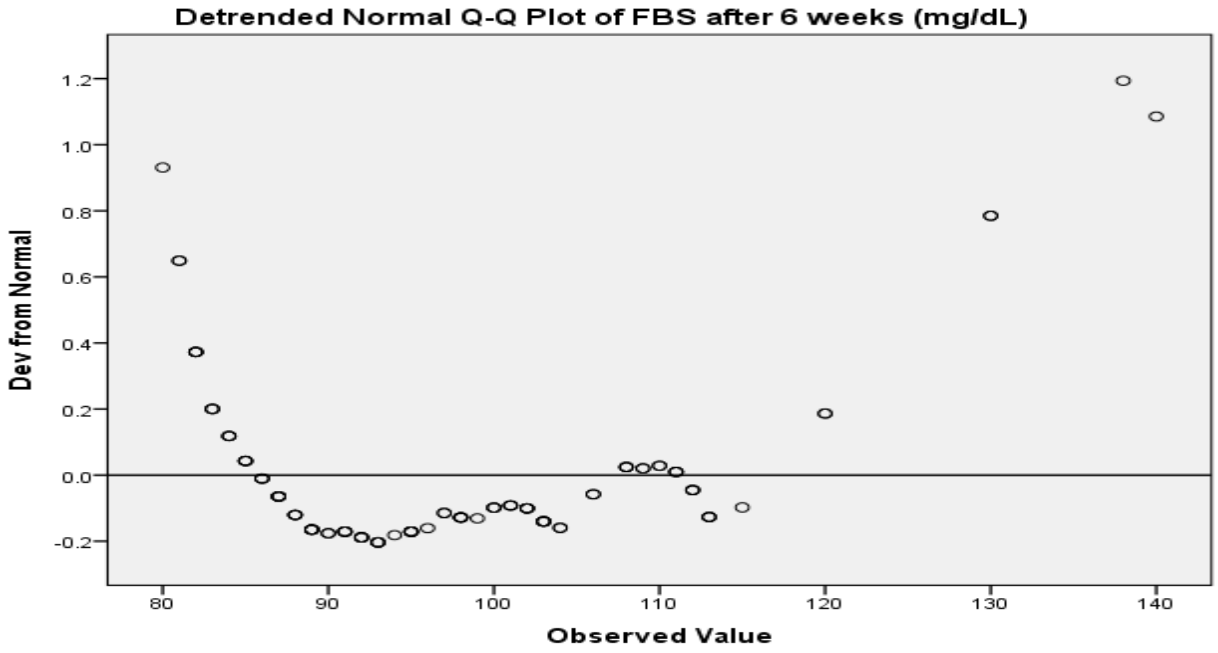


**Figure 2 (b)DetrendedNormal Q-Q Plot of FBS after 6 weeks(mg/dL)**

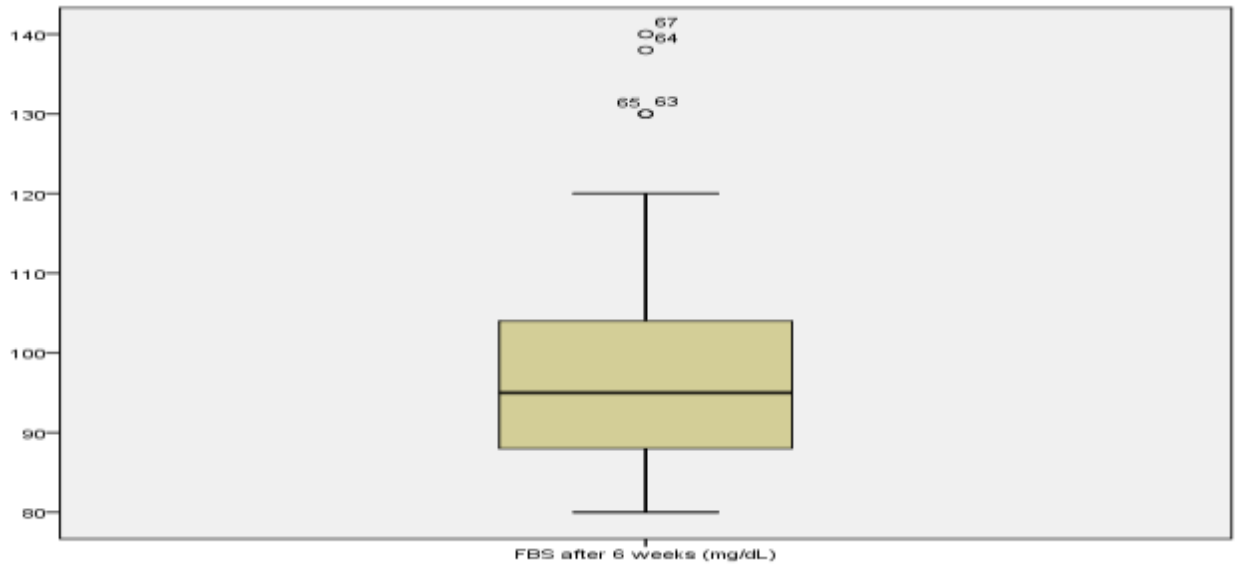


**Figure 2 (c)**

**Vitamin D after 6 weeks in Table 4 (a,b,c) and Figure 2 (a,b,c)**

The KS test shows that there were 106 valid instances with no missing data for the variable "Vitamin D after 6 weeks (ng/mL)," which includes the whole sample. An overview of the distribution of vitamin D levels was obtained by computing descriptive statistics after a 6-week intervention.

The average vitamin D level six weeks later was 23.70 ng/mL, with a 95% confidence interval of 21.89 to 25.50. The median was 25.00 ng/mL and the 5% trimmed mean, which is less susceptible to extreme readings, was 23.67 ng/mL. The standard deviation was 9.381 and the variance was 88.003. The lowest and highest results, 8 ng/mL and 41 ng/mL, respectively, were separated by 33 units. The spread of the middle 50% of the data was shown by the interquartile range, which is a statistical dispersion measure of 18 units. The distribution appears to be slightly skewed to the left, as indicated by the skewness value of -0.146, and has a flatter peak and lighter tails than the normal distribution, as indicated by the kurtosis value of -1.371.

Tests for normalcy, such as the Shapiro-Wilk and Kolmogorov-Smirnov tests, were performed to determine whether the distribution of vitamin D levels at six weeks is normal. Following Lilliefors Significance Correction, the Shapiro-Wilk test gave a statistic of 0.923 with a p-value of 0.000, while the Kolmogorov-Smirnov test yielded a statistic of 0.123 with a level (p-value) of 0.000. The sample distribution of vitamin D levels after six weeks deviates significantly from a normal distribution, according to both assays, which indicate a significant deviation from normalcy.

**Table 5 (a)Case Processing Summary for Vit D after 6 weeks**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Vit D after 6 weeks (ng/mL) | 106 | 100.0% | 0 | 0.0% | 106 | 100.0% |

**Table 5 (b)Descriptive for Vit D after 6 weeks**

| | | | Statistic | Std. Error |
|---|---|---|---|---|
| Vit D after 6 weeks (ng/mL) | Mean | | 23.70 | .911 |
| | | Lower Bound | 21.89 | |

| | | | |
|---|---|---|---|
| 95% Confidence Interval for Mean | Upper Bound | 25.50 | |
| 5% Trimmed Mean | | 23.67 | |
| Median | | 25.00 | |
| Variance | | 88.003 | |
| Std. Deviation | | 9.381 | |
| Minimum | | 8 | |
| Maximum | | 41 | |
| Range | | 33 | |
| Interquartile Range | | 18 | |
| Skewness | | -.146 | .235 |
| Kurtosis | | -1.371 | .465 |

**Table 5 (c)Tests of Normality for Vit D after 6 weeks**

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | Df | Sig. | Statistic | Df | Sig. |
| Vit D after 6 weeks (ng/mL) | .123 | 106 | .000 | .923 | 106 | .000 |

a. Lilliefors Significance Correction

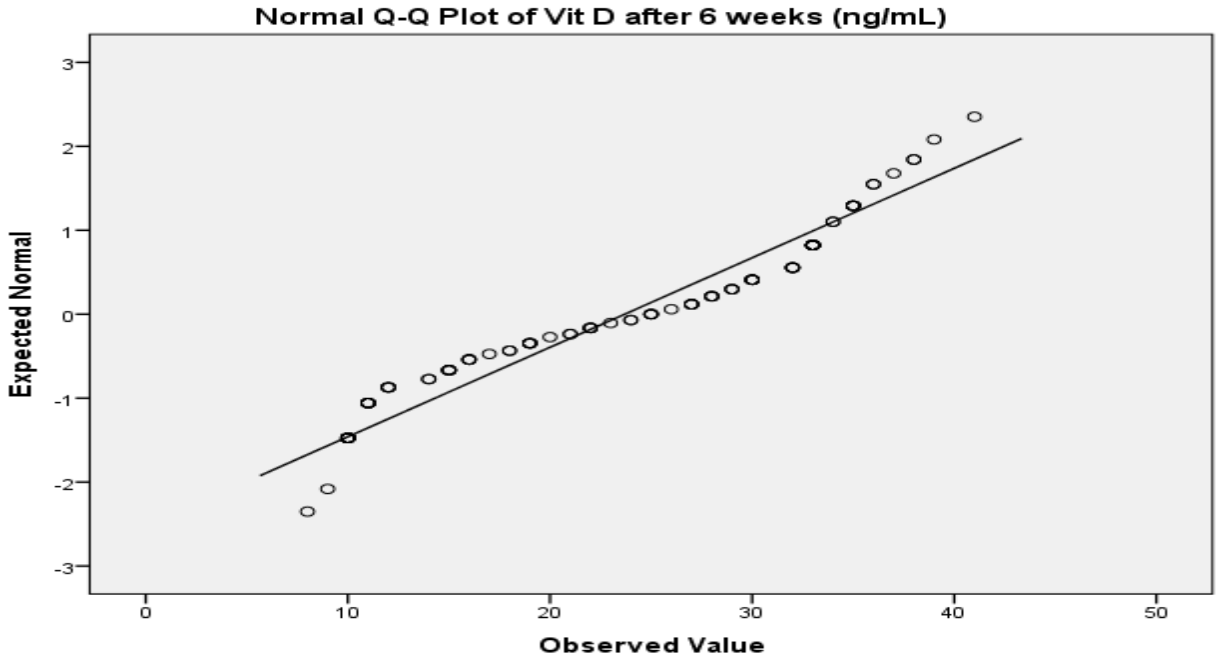


**Figure 3 (a)Normal Q-Q Plot of Vit D after 6 weeks(mg/dL)**

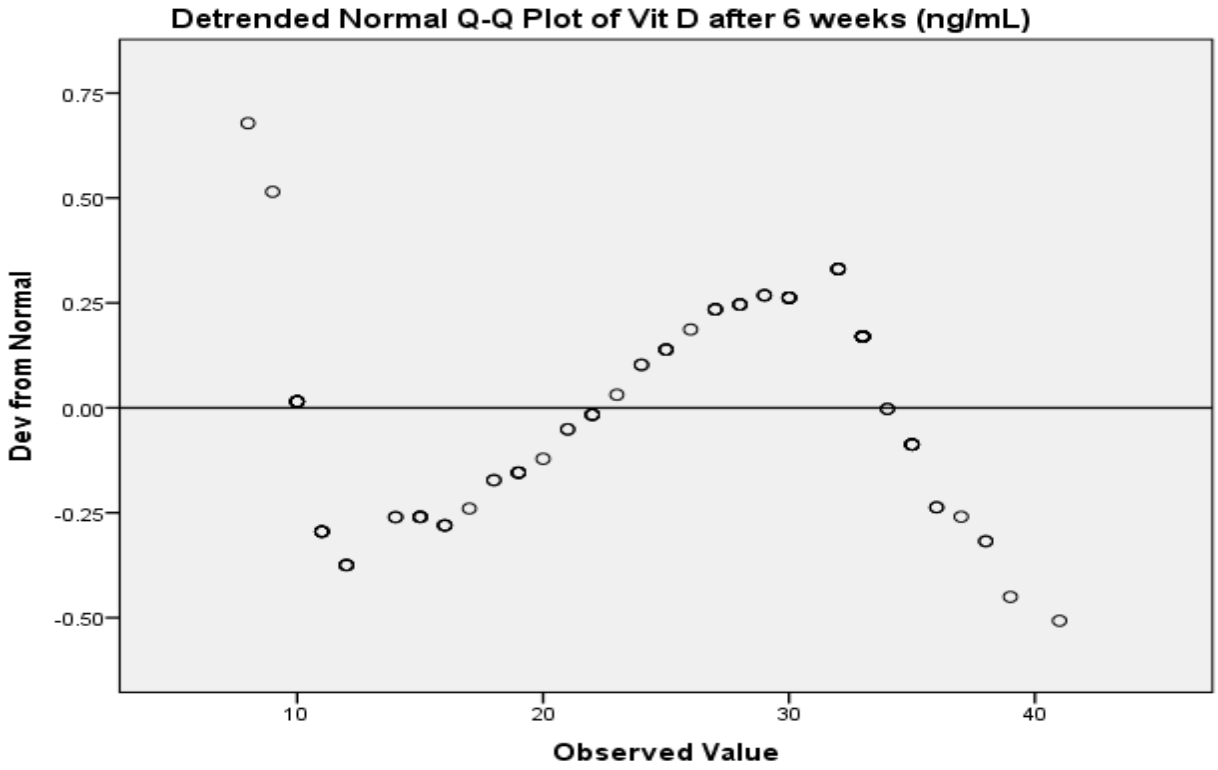


**Figure 3 (b) DetrendedNormal Q-Q Plot of vit D after 6 weeks(mg/dL)**

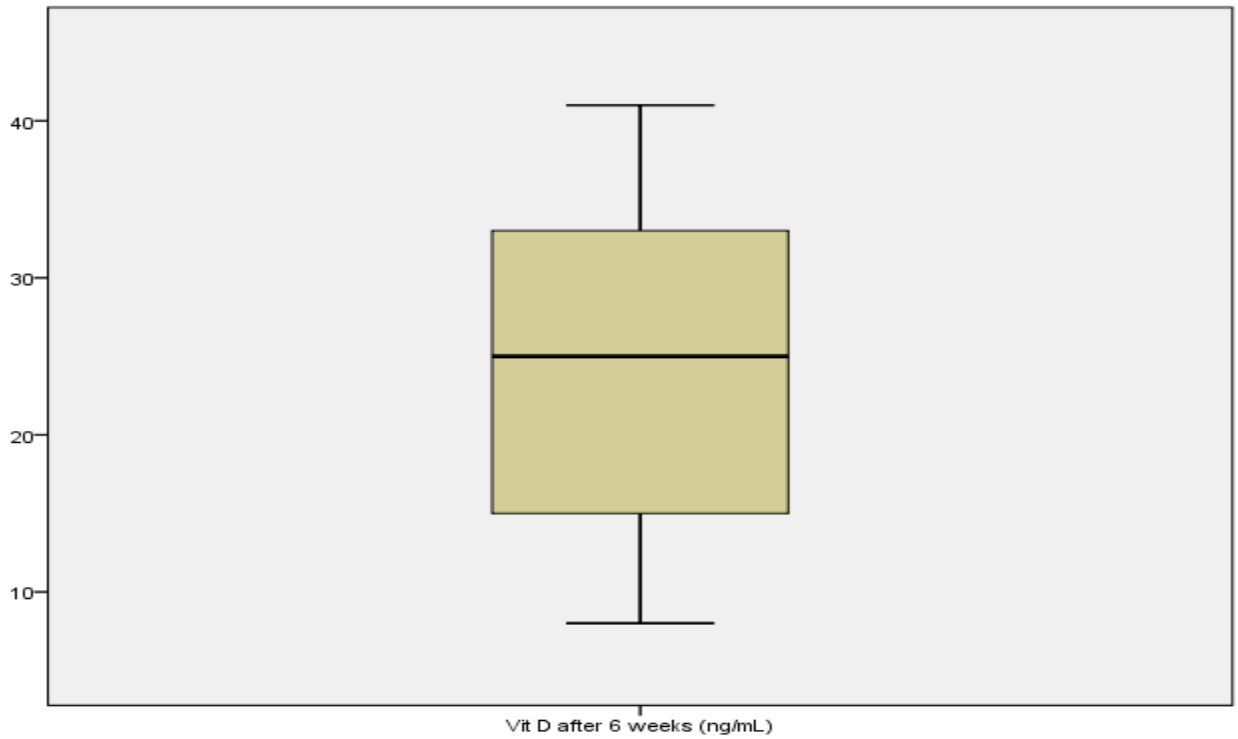


**Figure 3 (c)**

**Results in Table 5 (a,b,c) and Figure 3 (a,b,c)**
Taking the descriptive statistics and normality tests together, we conclude that this sample is noticeably non-normal, with lighter tails and significantly leftward skewness. Since the data are not normal, we use additional statistical methods including the Mann-Whitney U test.

**Mann-Whitney U test:**
After six weeks, the distribution of three separate variables—HbA1c, FBS (mg/dL), and Vit D (ng/dL)—among different groups was examined using the Mann-Whitney U test. For every test, the null hypothesis proposed that the variable distributions were the same for all the categories of the Group variable. In each of the three instances, the findings pointed to a substantial divergence from the null hypothesis. The Mann-Whitney U test yielded a p-value of.003 for HbA1c after 6 weeks, which was below the predetermined significance level of.05. As a result, the null hypothesis was disproved, indicating that the distribution of HbA1c among the designated groups differs statistically.
The Mann-Whitney U test for FBS after six weeks also produced a p-value of.000, which is once more below the significance level of.05. The null hypothesis was rejected because of this finding, suggesting that there are notable differences in the FBS distribution between the specified groups. A similar trend was evident in the Vit D six weeks later, with a p-value of.000 from the Mann-Whitney U test. As this result was less significant than.05., the null hypothesis was rejected. In conclusion, the study provides strong proof that, after six weeks, the distributions of HbA1c, FBS, and Vit D varied significantly between the groups of the Group variable.

**Table 6 (a) HbA1c after 6 weeks**
**Hypothesis test summary**

| | Null Hypothesis | Test | Sig. | Decision |
|---|---|---|---|---|
| 1 | After six weeks, all Group categories have the same HbA1c distribution | Mann Whitney U test for independent samples | .003 | Dismiss the null hypothesis |

**Asymptotic significances are displayed. .05 is the significance level**

**Table 6 (b) FBS after 6 weeks**
**Hypothesis test summary**

| | Null Hypothesis | Test | Sig. | Decision |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | After six weeks, the FBS distribution (mg/dL) is consistent all Group categories | Mann Whitney U test for independent samples | .000 | Dismiss the null hypothesis |

**Asymptotic significances are displayed. .05 is the significance level**

**Table 6 (c )Vit D after 6 weeks**
**Hypothesis test summary**

| | Null Hypothesis | Test | Sig. | Decision |
|---|---|---|---|---|
| 1 | After six weeks, all Group categories have the same Vit D distribution (ng/dL) | Mann Whitney U test for independent samples | .000 | Dismiss the null hypothesis |

**Asymptotic significances are displayed. .05 is the significance level**

**Discussion**

Numerous research has examined the relationship between vitamin D and gestational diabetes (GDM) (Hu et al., 2018; Szymczak-Pajor et al., 2020), focusing in particular on the vitamin's involvement in beta cell activity and insulin sensitivity. This work identified a substantial correlation in GDM between serum FBS, HbA1c, and vitamin D.

A randomized, double-blind, placebo-controlled clinical trial included 54 GDM women and conducted in Iran assessed the effects of vitamin D supplementation on metabolic profiles. Good results, such lower glycemia and cholesterol concentrations, brought attention to possible benefits (Asemi et al., 2014). In contrast, a study that administered moms 50,000 IU of vitamin D every two weeks found that the incidence of GDM significantly decreased and that their vitamin D status improved without any adverse effects (Mojibian et al., 2015). A different study done in Kashan, Iran, showed that when vitamin D supplementation was utilized during gestational diabetes mellitus, mother polyhydramniosis and infant hyperbilirubinemia decreased (Asemi et al., 2014).

Adding to the corpus of earlier research, our work emphasizes the potential effects of vitamin D supplementation in GDM. A double-blind clinical trial that demonstrated lower fasting blood glucose, lower HbA1c, and greater levels of 25-hydroxyvitamin D in the vitamin D group than in the placebo group emphasized the effect of vitamin D on metabolic parameters (Yazdchi et al., 2016). Supplementing with vitamin D raised metabolic markers but had little effect on HOMA-IR or insulin levels, claim Jahanjoo et al. (2018). Another study showed that by controlling glucose tests in high-risk individuals, daily 5000 IU of vitamin D may help prevent gestational diabetes mellitus (Shahgheibi et al., 2016).

To reduce bias, this study excluded additional conditions that are linked to higher levels of insulin resistance. Determining the ideal vitamin D dosage to avoid substantial insulin resistance during pregnancy is still a difficulty. A thorough understanding of the genesis of GDM requires more study that considers variables including inflammation and beta cell activity. Robust clinical outcomes combined with improved understanding of the molecular and genetic levels may help lower

the incidence and consequences of GDM (Ojo et al., 2019).

## CONCLUSION

Detailed analysis of descriptive statistics was necessary to comprehend the pre- and post-intervention features of the intervention and control groups as well as the effect of vitamin D on gestational diabetes. Notably, the intervention group's mean HbA1c levels and FBS dropped after six weeks, suggesting that the vitamin D intervention had improved glycemic management. The descriptive data demonstrated these positive trends. Moreover, an increase in the average The Kolmogorov-Smirnov (KS) test was used in the study to investigate the distributional features of the variables more thoroughly. This statistical method demonstrated how well the observed data agreed with a theoretical distribution. The KS test results confirmed the data's non-normality, bolstering the case for non-parametric research. A potential improvement in the individuals' vitamin D status was indicated by their vitamin D levels.

We next determined the significance of differences between the intervention and control groups using the potent non-parametric Mann-Whitney U test. The test results, which corroborated the findings of the KS test and descriptive test, showed statistically significant variations in the distributions of HbA1c, FBS, and vitamin D after six weeks. There is proof to support the hypothesis that vitamin D supplementation is essential for glycemic and vitamin D status in people with gestational diabetes as the null hypothesis for each of the three variables was rejected.

The results of the KS test, Mann-Whitney U test, and descriptive statistics taken together suggest that vitamin D may be helpful in reducing the risk of gestational diabetes. These findings open new research directions and potential therapeutic applications in the management of gestational diabetes by offering significant new information regarding therapies intended to improve metabolic outcomes during pregnancy.

## LIMITATIONS

When interpreting the research's conclusions, it is important to take into account a number of its shortcomings. First, the study's narrow emphasis on a particular region or demographic group contributes to its limited generalizability and may limit the results' relevance to a larger population. Second, statistical power may be weakened by the relatively small sample size, making it more difficult to identify tiny effects. Furthermore, it's possible that the brief intervention's duration limited the observation of long-term impacts, which calls for caution when drawing conclusions about persistent influence. The absence of a thorough consideration of potential confounding variables raised concerns about internal validity. Potential downsides included self-reporting bias, the influence of exclusion criteria, and racial factors. The limitations of the study are also exacerbated by its dependence on retrospective data and its scant examination of drug interactions. To guide future research in this field and to gain a comprehensive understanding of the research conclusions, it is imperative to acknowledge and solve these limitations. More sophisticated diagnostic evaluations, like serum insulin resistance tests and the Homoeostatic Model Assessment of Insulin Resistance (HOMA-IR), were absent from my study.

## RECOMMENDATIONS

1. A number of suggestions are made to improve future research and therapeutic applications in light of the study's findings and limitations.
2. First off, a more comprehensive understanding of the possible impacts of vitamin D supplementation would be possible with bigger and more diversified sample sizes across a range of demographics.
3. Extended intervention durations in longitudinal studies may help to better capture long-lasting effects on gestational outcomes. More robust internal validity would result from addressing relevant confounders such socioeconomic status, lifestyle factors, and comorbidities.
4. Future research should examine the ideal amount and length of vitamin D supplementation, taking into account individual differences and the stages of pregnancy. A more thorough approach would also look at any possible interactions or synergies between vitamin D and other pertinent therapies, drugs, or lifestyle changes.

5. Collaboration between various research sites and populations can improve the generalizability of results, supporting the development of evidence-based clinical guidelines.For a more thorough analysis, I advise adding more advanced diagnostic tests to subsequent research, such as serum insulin resistance testing and the Homoeostatic Model Assessment of Insulin Resistance (HOMA-IR).
6. Ultimately, further studies should explore the underlying genetic and molecular mechanisms to clarify the methods by which vitamin D affects gestational diabetes mellitus (GDM). These suggestions seek to improve methodological rigor, study design, and our comprehension of the complex link between vitamin D and GDM.

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