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Research Article

Differences between Factors affecting Vitamin D in Diabetic Patients in Benghazi

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Abstract

Vitamin D is a steroid hormone that is ingested through food, but the majority of it is produced in the skin or diet and transformed by the liver into 25 (OH) vitamin D and the kidney into 1.25 dihydroxyvitamin D the (active metabolite) that is responsible for intestinal absorption of calcium and bone mineralization. In addition to rickets and osteomalacia, autoimmune diseases have also been linked to low vitamin D level. Diabetes mellitus is common disease in low and middle-income countries and has been growing at faster rate. Besides, link between diabetes and vitamin D has been showed as results of many studies. However, vitamin D is a widely known for its role in improving pancreatic cell function and insulin sensitivity, its mechanism is especially via the promotion of the expression of insulin receptors and enabling peroxisome proliferator-a activated response-δ which promotes glucose uptake in peripheral tissues, almost like antidiabetic drug pioglitazone mechanism of action.

Keywords: Diabetes mellitus, Mechanism of vitamin d in diabetes, Vitamin D

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Introduction

Diabetes mellitus (DM) is one of the most common diseases in low- and middle-income countries and has been growing at the fastest rate worldwide over the last decade [1]. In 2017, it was estimated that 451 million people worldwide had diabetes and this number is expected to rise to 693 million by 2045[2]. Recently, DM has been found to be associated with vitamin D deficiency [3, 4].

High blood glucose levels can damage the body's organs on long term especially if it is uncontrolled [5].

Damage to both large and small blood vessels can result in heart attacks and strokes as well as affecting kidney, eyes, feet and nerves are potential long-term effects [6].

Vitamin D is a steroid hormone that is ingested through food, but the majority of it is produced in the skin or diet and transformed by the liver into 25 (OH) vitamin D and the kidney into 1.25 dihydroxyvitamin D the (active metabolite) that is responsible for intestinal absorption of calcium and bone mineralization. In addition to rickets and osteomalacia, autoimmune diseases have also been linked to low

vitamin D level [7].

However, vitamin D is a widely known for its role in improving pancreatic cell function and insulin sensitivity, its mechanism is especially via the promotion of the expression of insulin receptors and enabling peroxisome proliferator-a activated response-δ [8] which promotes glucose uptake in peripheral tissues, almost like antidiabetic drug pioglitazone mechanism of action. It also stimulates insulin secretion via vitamin D receptors activation within the cell of pancreas [9]. Therefore, vitamin D has been found to lower fasting glucose and HbA 1c level in patients [10, 11].

Compared to people with optimal vitamin D levels, those with vitamin D deficiency showed a 48-perenct reduction in insulin secretion. As a result, vitamin D is thought to stimulate the pancreas to produce insulin. Low vitamin D levels are also linked to beta-cell dysfunction and insulin resistance. Hemoglobin A1c (HbA1c) levels significantly decrease when vitamin D deficiency is corrected. Lack of vitamin D was linked to metabolic syndrome, increased insulin resistance, and decreased insulin production [12]. The test for 25- hydroxyvitamin D is the most reliable way to determine how much vitamin s is present in the body.

The objective of the current paper was to showed differences between factors affecting vitamin D in the diabetic patients in Benghazi and the prevalence of vitamin D deficiency in diabetes mellitus patients. This could establish the importance of treatments to treat vitamin D deficiency in diabetics, reducing complications and enhancing patient outcomes.

Study Design

Prospective study- Cross-sectional research design was used to collect the data from randomly selected cases of diabetes mellitus, after Ethics Committee approval. One hundred patients of both sex and age range (20-65 years and over) were taken from the diabetic polyclinic in Sayidi Husayn in Benghazi between March 2023 to August 2023.

Complete history of any medical or surgical problems from the patients was taken (history of onset of symptoms, duration of disease and family history of diabetes and if patients developed any complication) in addition to history of drug that increase blood glucose levels like corticosteroids, antidepressant and lithium and beta 2 receptors stimulants and oral contraceptive and if patients taken vitamin D supplement.

Quantitative determination of serum 25-OHD was performed using an enzyme linked immunosorbent assay (ELISA). Vitamin D deficiency was defined as a level of vitamin 25-OHD less than 30ng/ml, and level below 12 ng/ml is considered as very severe deficiency for both men and women.

Data Analysis

The Profile of Patients was described using descriptive statistics, namely frequency and percentage, because the data values are independent, randomly selected from two normal populations and had equal variances in each group. One way to determine if the unknown population means of two groups are equal or not is to apply the two independent sample t-test.

Data were analyzed using the Statistical Package for Social Science (SPSS), Version 28 based on the following statistical methods. Descriptive statistics were done to compute frequencies and percentages, as well as mean and standard deviation.

Chi square was used to assess the association between symptoms, age and vitamin D levels. P-value lower than 0.05 were regarded as significant**.**

Results

Profile of patients

To describe the backgrounds of the survey respondents. A quick profile of the survey participants, including their gender, age, vitamin D status, HBA1C, and fasting blood glucose levels, is shown in the following table. Detailed features of the survey patients are addressed below:

Table 1 and Figure 1 state that 67 out of 100 (67%) patients participating in the survey were Females and 33 out of 100 (23%) Males, which means that two-thirds of the study sample of patients participating in the survey were females. Our study showed that the highest percentage of 32% (n = 32) of the study population aged 35-49 years was followed by patients aged 50-64 years with 31% (n = 31), while lowest parentage was 14% (n = 14) for patients aged between 20-34 years.

Variables	Classification	Numbers of patients	Percentage
Gender	Female	**67**	67.0
	Male	**33**	33.0
	Total	**100**	100.0%
Age	20-34	**14**	14.0
	35-49	**32**	32.0
	50-64	**31**	31.0
	65+	**23**	23.0
	Total	100	100.0%
Vitamin D	Severe deficiency	**9**	9.0
	Deficient	42	42.0
	Insufficient	**28**	28.0
	Sufficient	**21**	21.0
	Total	100	100.0%
HbA1C	Controlled	25	25.0
	Uncontrolled	75	75.0
	Total	100	100.0%
Fasting blood glucose	Controlled	23	23.0
	Uncontrolled	77	77.0
	Total	**100**	

Table 1: Description of the samples according to the background of patients.

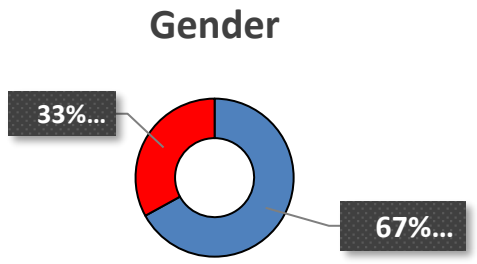

Figure 1: Represent the sample according to gender.

Figure 2: Represent the sample according to fasting blood glucose.

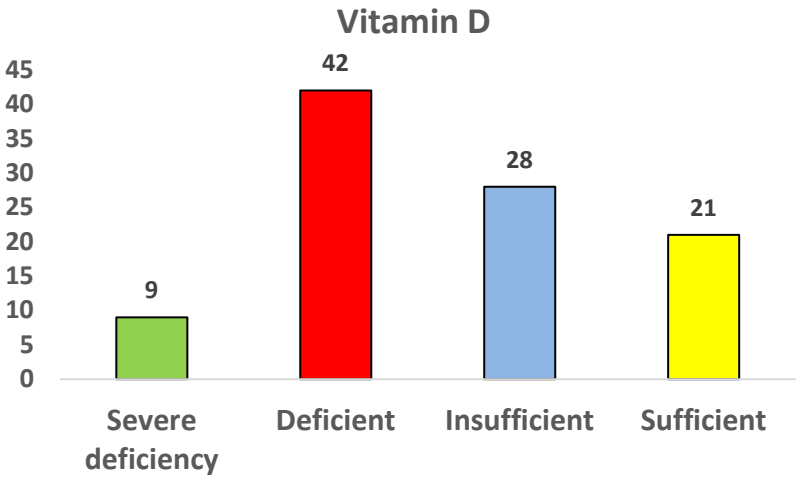

Figure 3: Represent the sample according to Level of Vitamin D.

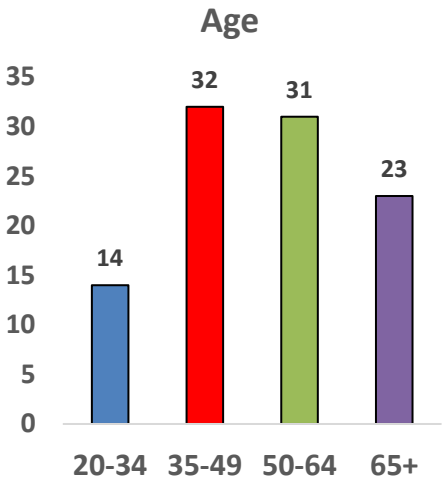

Figure 4: Represent the sample according to age.

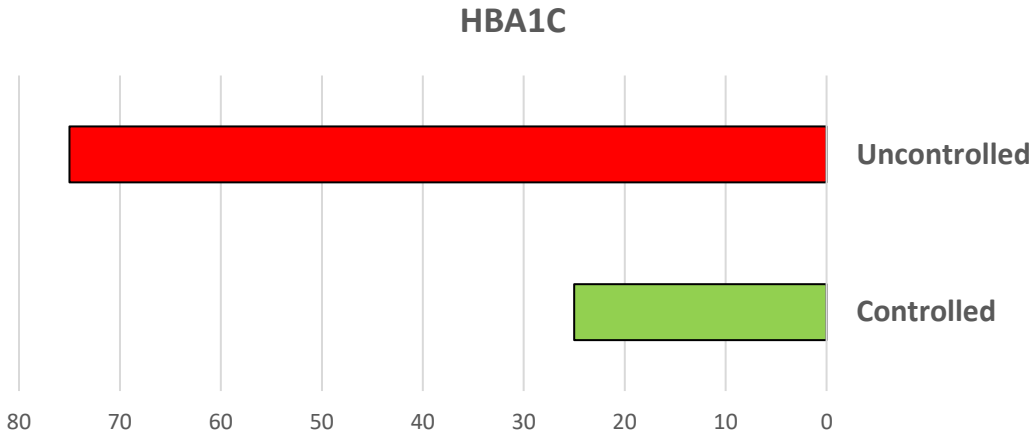

Figure 5: Represent the sample according to HbA1C.

Regarding the level of vitamin D, 42% (n = 42) patients have deficient vitamin D, and 28% (n = 28) patients have insufficient vitamin D, followed by 21% (n = 21) for patients with sufficient vitamin D, whereas the lowest percentage (9%) is for severe deficiency patients. In terms of HBA1C, of the 100 patients in the study 25% (n = 25) were Controlled and 75% (n = 75) had Uncontrolled. In regarding to Fasting blood glucose 77% (n = 77) of the patients were Uncontrolled, whereas 23% (n = 23) Uncontrolled, as shown in table 1.

Statistical Testing

The previous part focused on the descriptive characteristics of the patients. This section continues with the Statistical Testing and a discussion of the test results of the hypotheses as proposed.

Testing of Normality

There are two broad classifications of statistical tests used in data analysis, namely: parametric and non-parametric. The use of parametric tests is said to be appropriate when the variables distributed normally Conversely, non-parametric tests must appropriate (Bereson and Levine (1992) and Siegel and Castellan (1988) [13].

Variable	Kolmogorov-Smirnov		
Vitamin D	Statistic	df	Sig.
	0.053	100	0.200

Table 2: Test of normality.

The above Table 2 shows the Kolmogorov-Smirnov test. In our case, since we have only one dependent related to Vitamin D, the Kolmogorov-Smirnov is used. From the above table, the p-value > 0.05 We can accept the null hypothesis and conclude that the data comes from a normal distribution. It is obvious that parametric techniques are more suitable used in this work.

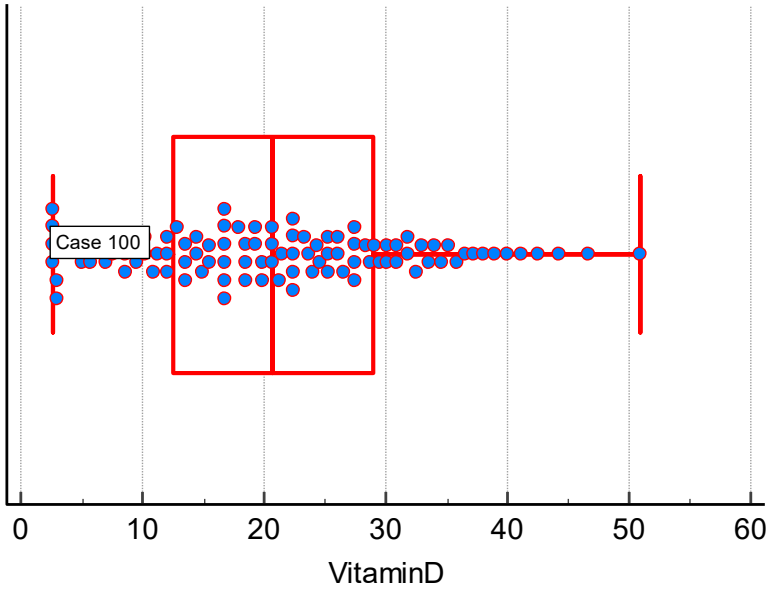

Figure 6: Shows Scatter-plot of score of the respondent's sample related to Vitamin D.

Figure 6 shows that depicts the normal shape with the median located in the middle of the box plot to obtain more reliable information about the overall distribution. We will use statistical tests to ascertain the shape of the distribution.

Testing the Hypotheses

This study aimed to test the following hypothesis

Finding of the First hypothesis

The first hypothesis in this aspect refer to a significant different of Vitamin D through gender, the test is showing the following:

H_0: There is an insignificant difference in Vitamin D between male and female patients
H_1: There is a significant difference in Vitamin D between male and female patients

	Group	N	Mean	Std. Deviation	t-test for Equality of Means	t-test	df	Sig. (2-tailed)	Decision
Gender	Male	67	19.36	10.84	Equal variances assumed	-2.37	62.23	0.02	Reject H_0
	Female	33	24.94	11.15					

Table 3: Difference Vitamin D between male and female patients.

Table 3 represent the result of independent-sample t-test was conducted to compare the Vitamin D for Male and female. There was statistically significant difference ($t_{98} = -2.37 < 0.05$) in the score mean for Female (μ = 24.94, S.D = 10.841) was higher than and group Male (μ = 19.36, S.D = 11.145). The magnitudes of the difference in the mean (Mean difference = -5.58.95% CI -10.19 to - 0.95) was significant hence , H_1 was supported.

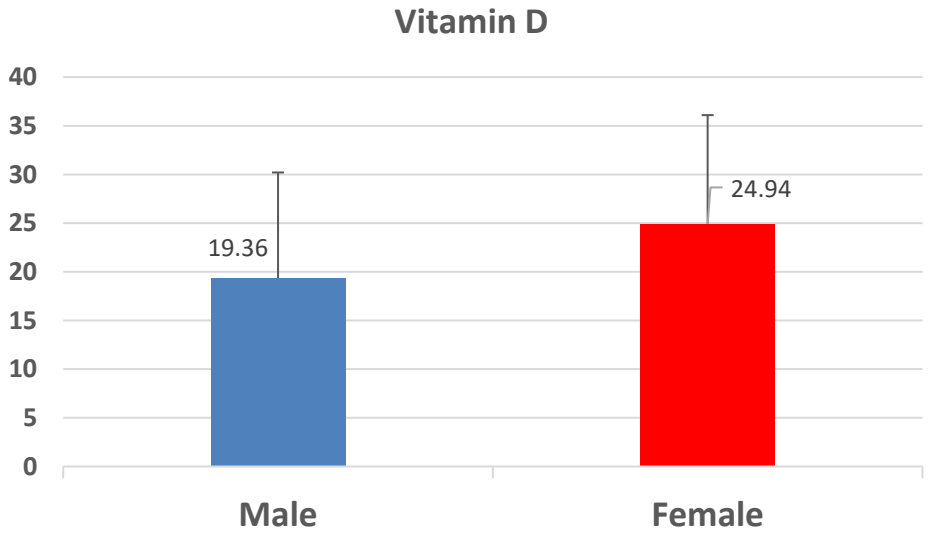

Figure 7: Shows bar chart of score of the respondent's sample related to Vitamin D.

Finding of the second hypothesis

The second hypothesis in this aspect refer to a significant different of Vitamin D through HBA1C, the test is showing the following:

H_1: There is a significant difference in Vitamin D a cross HBA1C

	Group	N	Mean	Std. Deviation	t-test for Equality of Means	t-test	df	Sig. (2-tailed)	Decision
Gender	Controlled	25	19.10	12.37	Equal variances assumed	-0.81	98	0.42	**accept H_0**
	Uncontrolled	75	21.36	12.00					

Table 4: Difference Vitamin D according to HBA1C.

Table 4 represent the result of independent-sample t-test was conducted to compare the Vitamin D for Controlled and Uncontrolled. There was insignificant difference ($t_{98} = -0.81 > 0.05$) in the score mean for Uncontrolled μ = 21.36, S.D = 12) was higher than and group Controlled (μ = 19.10, S.D = 12.37). The magnitudes of the difference in the mean (Mean difference = -2.255% CI -7.79 to 3.28) was insignificant hence, H_1 was not supported.

Finding of the third hypothesis

The third hypothesis in this aspect refer to a significant different of vitamin D through fasting blood glucose, the test is showing the following:

H_0: There is an insignificant difference in Vitamin D a cross Fasting blood glucose
H_1: There is a significant difference in Vitamin D a cross Fasting blood glucose

	Group	N	Mean	Std. Deviation	t-test for Equality of Means	t-test	df	Sig. (2-tailed)	Decision
Gender	Controlled	23	23.5	12.8	Equal variances assumed	1.21	98	0.23	**accept H_0**
	Uncontrolled	77	20.0	11.8					

Table 5: Difference Vitamin D according to fasting blood glucose.

Table 5 represents the result of independent-sample t-test was conducted to compare the Vitamin D for controlled and uncontrolled. There was insignificant difference ($t_{98} = 1.21 > 0.05$) in the score mean for controlled (μ = 23.5, S.D = 12.8) was higher than and group uncontrolled (μ = 20., S.D = 11.8). The magnitudes of the difference in the mean (Mean difference = 3.45% CI -2.23 to 9.12) was insignificant hence, H_1 was not supported.

Discussion

This study was conducted in Benghazi city and included Libyan subjects who visited diabetic clinics, which considered as one of the most important clinics in our country. The entire participant in the study had diabetic mellitus.

Vitamin D deficiency is a global problem worldwide. It is estimated that more than one billion people in the world have vitamin D deficiency or insufficiency [14].

In Libya, studies on vitamin D status in 2019 identified vitamin D deficiency is common, especially in women of childbearing age and older age [15]. It has been also demonstrated that vitamin D has immunomodulatory effects. Vitamin D deficiency has been linked to a number of immunomodulatory diseases, including rheumatoid arthritis, multiple sclerosis, systemic lupus erythematous, and inflammatory bowel disease [16]. A vitamin D deficiency is also thought to be connected to type 1 diabetes [17].

Since human T and B cells express VDR, vitamin D is hypothesized to alter the Th1/Th2 cytokine profile. Furthermore, it is believed that vitamin D influences the immune system by preventing the proliferation of lymphocytes [18] according to a different study, 1,25(OH)2D also inhibited the expression of Fas in human islet cells, which is regulated by cytokines [19].

In our study showed that the highest percentage of 32% (n = 32) of the study population was 35-49 years was followed by patients aged 50-64 years with 31% (n = 31), while the lowest percentage was 14% (n = 14) for patients aged 65 or more this is in accordance with another study which demonstrated that a total of 116 participants' information was used for analysis. Almost three-fourths of the participants were over 45 years old. There was not much difference among the male and female T2DM patients across different categories. Obesity was observed in most (75.86%) of the study sample. A good number of the T2DM patients were graduates (66.98%) [20].

In another study done in Benghazi 2019 on vitamin d deficiency in this study Out of (100) patients, 83 returned the filled questionnaire with a response rate of 83%. Regarding the age, it ranged between 20 and 65 years. The mean age among all participants was 48 years. The highest percentage (43.4%) of the study subjects was between 35-49 years old, while the lowest percentage (10.8 %) of the study subjects was 65+ years old [21].

Furthermore, our results showed that highest percentages of study sample was female 67% this is in accordance with study done on Japanese population of the 1256 participants, 571 (45.5%) were women and 742 (59.1%) had a family history of type 2 diabetes. The mean age of participants was 61.3 years. The mean serum 25-hydroxyvitamin D concentration at baseline was 20.9 ng/mL (52.2 nmol/L); 548 (43.6%) participants had concentrations below 20 ng/mL (50 nmol/L) [22].

In contrast another study showed that of the total 50 cases in group I, 31 (62%) were male and 19 (38%) were female and in group II, 10 (50%) were male and 10 (50%) were female [23].

Furthermore, in our paper about 79% of patients have vitamin d deficiency this is in accordance with study a total of 54 studies with 38 016 study participants were included in the study. The pooled prevalence of VDD among patients with T2DM was found to be 64.2% (95% CI 60.6% to 67.8%) with a substantial level of heterogeneity (I^2=98.2%; p<0.001). Results of the subgroup analysis indicated that the pooled prevalence of VDD among patients with T2DM was highest (70.9%) in African nations and lowest (57.1%) in Middle East countries. Being female (pooled OR (POR) 1.60, 95% CI 1.29 to 1.97), having poor glycemic control (POR 2.50; 95% CI 1.74 to 3.59) [24]. In addition another study showed that the mean age was 49.17 ± 12.72. One hundred and eleven (74%) of them had vitamin D levels <30 ng/dL. Mean vitamin D levels were 24.24 ± 11.20. Mean HbA1c was 10.96 ± 1.78, 9.66 ± 1.37, and 7.05 ± 0.65, among patients having their vitamin D levels ranging <20, 20-30, and >30 ng/dL, respectively, showing p value < 0.001. Mean BMI was 29.90 ± 2.18, of 111 of them who had vitamin D levels <30 ng/dL, 74 of them had BMI (18.5-22.9), 20 had BMI (23-24.9) and 17 of them had BMI >25 this study found that the higher the HbA1c levels, the lower was the vitamin D levels suggesting a good correlation between poor glycemic control and low vitamin D levels [25].

Additionally, study showed the prevalence (%) of vitamin D deficiency, insufficiency and sufficiency was 68.6, 25.9 and 5.5, respectively. Mean age (p=0.004), systolic (p=0.05) and diastolic (p=0.04) blood pressure, weight (p=0.03), BMI (p=0.04) and FBG (p=0.02) were significantly higher in subjects with vitamin D deficiency as compared with those with vitamin D insufficiency and sufficiency. Unadjusted mean values of FBG were significantly decreased in fourth (p=0.02) and fifth quintiles (p=0.030) of 25(OH)D levels as compared with second quintile. Furthermore, after adjusting for age and family income FBG levels were significantly increased in first quintile (compared with fourth (p=0.012) and fifth (p=0.018) quintiles) and second quintile (compared with fourth (p=0.003) and fifth (p=0.004) quintiles) of 25(OH)D levels, respectively [26].

Vit D receptors (VDRs) are found in pancreatic beta cells, which also express 1-hydroxylase (encoded by CYP27B1), and the human insulin gene promoter contains a vitamin D response element. In addition, vitamin D regulates T-cell responses and may protect beta cells from immune attack [27].

Conclusion

vitamin D status appears to play a role in the onset and management of diabetes mellitus. As lower vitamin D levels are associated with higher blood glucose values. Most studies conducted to discuss the effects of vitamin D on glucose metabolism supported the hypothesis that appropriate vitamin D supplementation may improve the metabolic regulation of glucose levels in type 1 diabetes.

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