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Serum Vitamin D Among Patients withType 2 Diabetes Mellitus

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Research Article

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ABSTRACT

Vitamin D supplements are a beneficial health issue to benefit from insulin therapy. In those with T2DM, serum vit-D was checked and resuscitated. Serum vit-D was evaluated with its rich content. Serum vit D levels were statistically significantly lower in T2DM patients than in the control group. It was found to be significant in terms of the relationship between fasting blood sugar and vit-D and HbA1C. Vit-D in sugar will be used as a benefit from vit-D in patients with blood T2DM patients. The mean±SD vit-D level was 19.22±9.23 for the whole population with a fasting blood glucose level of 110 mg/dl or less, and 12.21±6.15 for people with a fasting blood glucose level above 130 mg/dl, and p<0.001. The relationship between vit-D level and fasting blood sugar is statistically significant with negative pearson correlation coefficient. Vit-D mean±SD 20.46±8.56 for the entire population with an HbA1C level equal to or lower than 6.5%, and 12.84±6% for individuals with a fasting blood glucose level above 6.5%, is 26 and p<0.001. The strong relationship between vit-D and fasting blood glucose and HbA1C is due to the fact that vit-D tends to specifically stimulate insulin production in β-pancreatic cells via the nuclear vit-D receptor (VDR) and that vit-D minimizes inflammation. Vit-D supplements are a beneficial health challenge to benefit from insulin therapy. Serum vit-D was checked in patients with T2DM. The serum has been evaluated with its rich content of vit-D. Serum vit-D levels were statistically significantly lower in T2DM patients compared to the control group. It was found to be significant in terms of the relationship between fasting blood sugar and vit-D and HbA1C. Vit-D in sugar will be used as a benefit from vit-D in blood T2DM patients.

Keywords: Vitamin D, Serum, Type 2 Diabetes Mellitus, Human.

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Introduction

Diabetes mellitus (DM) is an important chronic disease that occurs when the pancreas cannot produce enough insulin. It is a condition in which the body cannot adequately use the insulin it produces. It is the hormone insulin that regulates blood sugar. As a result of increased glucose or hyperglycemia, a typical effect of uncontrolled diabetes, many systems in the human body deteriorate over time. It is known that nerves and vessels are actually damaged [1]. DM is a heterogeneous disease characterized by hyperglycemia. There are two main types of diabetes patients. Type 1 diabetic (T1DM) is distinguished from other types of diabetes by the acute lack of insulin secretion. The other is Type 2 diabetic (T2DM), the cause is a mix of insulin resistance. Diabetes difficulties are becoming more regular and increasing rapidly in T2DM patients [2]. Lifestyle and genetic factors are the main causes of T2DM. People can control some factors such as obesity and diet, but other factors such as genetics, age and female gender are beyond personal control [3].

Although the effect of this is accepted, it is known that T2DM is caused by the body's insufficient use of insulin. T2DM accounts for the majority of the world's diabetic population [1]. Although the symptoms of T2DM are similar to those of T1DM, this type of diabetes has only been seen in adults, but is now increasing in children [4].

Briefly, T2DM is defined by insulin resistance, high glucose levels, and a relative absence of insulin. In general, symptoms that should be considered first include increased hunger, thirst, weight loss, urination, feeling tired, and sores [1]. In the first years, many people have no symptoms and are diagnosed in routine tests [5]. Various health problems related to T2DM are: Cushing's syndrome, acromegaly, hyperthyroidism, it is effective in some types of cancer. In addition, cancer patients have a higher risk of death if they have diabetes [6]. T2DM has a role in testosterone deficiency in men [7].

The type of fat in the diet is important, trans fatty acids or saturated fats increase the risk, but monounsaturated and polyunsaturated fats reduce the risk [3].

Both types of diabetes (WHO) defined their symptoms as a single glucose increase. In the fasting state, plasma glucose is equal to or greater than 126mg/dl. Random blood glucose greater than 200 mg/dl. Glycosed hemoglobin (HbA1C) ≥6.5% is another way to diagnose diabetes [5]. The degree of diagnosis of diabetes depends on the relationship between glucose tolerance test results, fasting glucose or HbA1C. Random or fasting blood glucose is preferred over the glucose tolerance test (GTT). This is because (FBS and RBS) is more accessible and easier for individuals. HbA1C has focal points where fasting is not required and the result is more stable than (FBS and RBS).

However, this is a disadvantage as the test is more expensive than blood glucose measurement[8].

T2DM is defined by the high glucose level in the blood associated with insulin resistance and proportional insulin deficiency. Both types of diabetes may be widely recognized depending on the conditions present [9]. The onset of T2DM can be delayed or prevented by adequate diet and normal exercise [10]. It is known that bad lifestyles such as being overweight, malnutrition, physical inactivity, stress and urbanization, which are important factors in the development of obesity and T2DM, are effective. The risk of diabetes can be reduced by more than half with drastic lifestyle actions [11].

The advantage of physical activity arises regardless of the individual's initial weight or subsequent weight loss [12]. With a high level of physical activity, the risk of DM can be reduced by approximately 28% [13]. Evidence to serve dietary changes alone is limited [14]. Some evidence for an eating routine includes high amounts of green vegetables, and some are important data for limiting the intake of the sweet drink[15]. There is indeed an association between increased consumption of sugar-sweetened fruit juice and diabetes, although there is no evidence of an association with 100% fruit juice [16].

In 2019, a study discovered evidence of the advantage of dietary fiber [17]. A healthy diet and exercise play a very important role in diabetes[8]. Better results are obtained with more exercise[18]. Exercise improves glucose control, lowers blood lipid levels, and decreases body fat content [14]. Lowering HbA1C and insulin resistance are positively affected when aerobic exercise is performed [19]. This type of eating routine of calorie restriction is widely recommended for weight loss. In addition, other recommendations include a diet containing vegetables, fruits, reduced saturated fat and low-fat dairy products [20]. DM is popular in both the developing and developed population and remains so around the world [21].

There are several forms of vit-D. Vit-D3 and vit-D2, also known as cholecalciferol and ergocalciferol, are the two main forms of vit-D. forms such as vit-D1 (a mixture of lumisterol and ergocalciferol compounds), vit-D4 (22-dihydroxyergocalciferol) and vit-D5 (cytocalciferol). In 1931, vit-D2 was chemically characterized. In 1935, the chemical formation of vit-D3 (7-dehydrocholesterol) was identified as the product of UV radiation. It is a diverse chemical form of vit-D in steroids that breaks one of the steroid ring bonds. The main structural difference between vit-D2 and vit-D3 is that vit-D2 has a double bond between carbon 22 and carbon 23 in the side chain, furthermore it contains a methyl group at carbon [22].

Wrong or excessive dietary factors are a factor in the risk of developing T2DM. Excessive use of sugar is associated with increased risk [23]. Processed carbohydrates play a key role in increasing the risk when consumed excessively [24]. Vit-D becomes active by eating foods containing vit-D and taking sunlight naturally. Vit-D is effective on skeletal health, cardiovascular disease, T2DM and various other diseases. As many studies have shown, patients with T2DM have been reported to have low serum vit-D [2]. In the liver, ergocalciferol and cholecalciferol hydroxylate molecules are converted to 25-hydroxy [25(OH)D2 and 25(OH)D3], the main metabolite of vit-D [25]. 25(OH)D hydrosylate to 1,25-dihydroxy vit-D [1.25(OH)2D2 and 1,25(OH)2D3] in the kidney and this active form binds to the vit-D receptor and its biological activities improve [1]. The protective role of vit-D in T2DM is known, and induction of the insulin receptor gene is known. The relationship of 25(OH)D with β-cell function and insulin resistance in T2DM patients has been expressed in many studies.1,25(OH) 2D The active form of vit-D increases the insulin sensitivity (IS) of insulin target tissues. It increases the biosynthetic limit of β-cells. It aids in transformation. In this process, it converts from proinsulin to insulin, reduces fat and increases muscle mass. Thus, it improves insulin sensitivity (IS) [26]. However, the basic mechanism for how 25(OH)D affects the evolution and development of T2DM is not entirely clear in middle-aged subjects. Ranges of vit-D in human body; deficiency is <20 ng/ml, insufficient between 20 to 29 ng/ml, normal 30 to100ng/ml, toxic>100 ng/ml [27].

Vit-D2 is usually found in fungi, while vit-D3 is found in animal sources [28]. Form vit-D2 ergosterol by UV irradiation. The calcitriol form of the vit-D receptor is the most potent natural ligand that mediates most of the physiological effects of the vitamin [29]. It modulates the response of organs to microbial pathogens by activating the innate immune system [30].

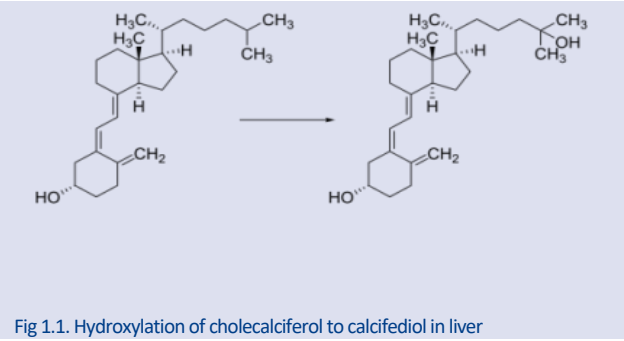

Fig 1.1. Hydroxylation of cholecalciferol to calcifediol in liver

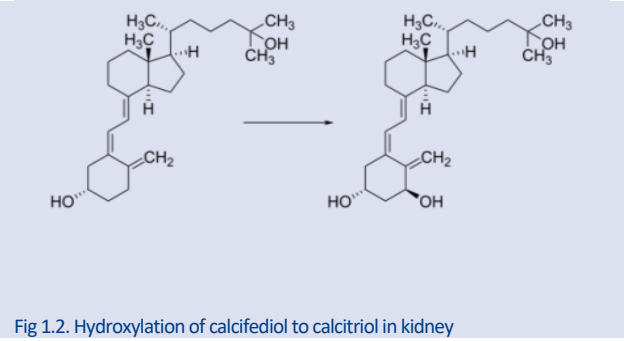

Fig 1.2. Hydroxylation of calcifediol to calcitriol in kidney

Generally, 25(OH)D serum concentration is used to evaluate the vit-D form. It is converted to 25(OH)D giving an accurate picture of vit-D status in serum. The serum level of 1.25(OH)D is characteristically not used to assess vit-D form as it is also controlled by certain hormones in the human body [31].

Vit-D deficiency is mainly due to insufficient exposure to sunlight [30]. Insufficient dietary intake of vit-D may

cause its deficiency [32]. This deficiency affects bone mineralization and causes bone diseases, including rickets, in children. It may also contribute to an increased risk of osteomalacia and osteoporosis in adults [26,32]. Weakness of the muscles increases the risk of falling, as well as the risk of fractures in adults. There are one billion people in the world who are either deficient or deficient in vit-D [26]. People who appear to be overweight or obese are at increased risk for vit-D deficiency [33]. Clothing that conceals a significant portion of human skin is associated with a lower vit-D value and an increased popularity of hypovitaminosis D [34]. In countries far from the equator, the amount and intensity of sunlight varies more seasonally [35].

Vit-D tends to specifically stimulate insulin production in β-pancreatic cells via the nuclear vit-D receptor (VDR). This method helps in minimizing vit-D inflammation. It is an important process in inducing insulin resistance [2,7]. Treatment of vit-D deficiency depends on the degree of deficiency. The lower the concentration of serum 25(OH)D prior to treatment, the higher the dose required to rapidly achieve an appropriate serum vit-D level [26].

The aim of the study is to emphasize the experimental results and to emphasize the necessity of periodically measuring the Vit D value in T2DM patients as a result of this significant increase in the HbA1C value in T2DM patients. In this context, studies related to the fact that vit-D, Ca and Mg are responsible for increasing intestinal absorption and that it is very important to measure Ca and Mg values periodically in T2DM patients with Vit D deficiency are to follow up with contributing experimental results.

Materials and Method

Individuals visiting the endocrine and diabetes unit of the teaching hospital and the emergency teaching hospital and appropriate sampling techniques were used. There were 70 diabetes patients in the study.The following cases were excluded in this sampling process. Those with chronic liver disease, those with chronic kidney disease, those with thyroid disease, patients using folic acid and multivitamin (A–Z) or vit-B12 and iron, patients taking Ca and Mg supplements, patients using insulin, pregnant women, inflammatory conditions and T2DM patients . Diabetics and control group the results obtained in this study were compared. He was fasted overnight for testing before blood samples were taken. The study group was selected between the ages of 35 and 75. Informed consent was obtained from each participant before starting the study. Required ethical permission was obtained and all procedures and questionnaires were studied in accordance with the procedure. Patients are equal to or less than 5 years according to the duration of diabetes. Selected from people over 5 years. Patients were evaluated according to their smoking habits. BMI for each participant was determined by dividing weight in kilograms (kg) by height in meters squared. BMI from 18.5 to 24.9 kg/m2 was considered normal weight. A BMI of 25 to 29.9 kg/m2 was considered overweight. BMI equal to or greater than 30kg/m^2 was considered obese. BMI uses heights and weights to assess the fall of an adult who is underweight, healthy weight, overweight or obese. BMI= weight(kg)/height^2m^2[36]. Diabetes status (Glycemic control): Glycated Hemoglobin was measured for all diabetic patient:HbA1c less than 6.5% was considered good control. HbA1c equal to, or more than 6.5% was considered fair control.

Lipid Profile Status

Total serum cholesterol and lipids were performed according to the guidelines of the national cholesterol education program. Total serum cholesterol below 200 mg/dl was considered normal. Total serum cholesterol equal to or greater than 200 mg/dl was considered as hypercholesterolemia. S.TG lower than 150 mg/dl was considered normal. S.TG equal and above 150 mg/dl was considered high. S.HDL-C below 40 mg/dl was considered low level. S.HDL-C between 40 and 60 mg/dl was accepted as normal level. S.HDL-C more than 60 mg/dl was considered high level. S.LDL-C of less than 130 mg/dl was considered optimal. Equal to S.LDL-C and greater than 130 mg/dl were considered as a high risk factor. Serum vit-D<10ng/ml was considered deficient. Serum vit-D was considered insufficient between 10 and 30 ng/dl. Serum vit-D >30ng/ml was accepted as the normal range.

Collection and Processing of Blood Sample

Participants who attended the morning endocrine and diabetes unit from T2DM patients diagnosed according to the WHO protocol fasted for 12 to 14 hours. Vinous blood samples (6 ml) were taken between 8:30 and 11:30 in the morning from the antecubital vein using a vacutainer. 2 ml were immediately collected into a vacuum tube containing K3 EDTA as anticoagulant for HbA1c estimation. The remaining 4 ml were collected in vacutainer system gel separator tubes. Serum was separated from whole blood after coagulation using centrifugation (HITACHI centrifuge, model O5P-21) for 8 min at 6000rpm. Serum glucose was immediately processed to measure total cholesterol, triglycerides, HDL, LDL and vit-D.

Biochemical Analysis

Most of the tests were performed by the cobas c 311 and cobas6000 devices for laboratory analyze, and here we review all these tests.The sugar level is detected by using glucose HK Gen.3 300 tests Roche(Hitachi) cobas c311,cobas c501/502 with reference no. 04404483 190.The cholesterol level is detected by using cholesterol gen.2 400 tests roche (hitachi) cobas c311, cobas c501/502 with reference no. 03039773 190.The triglyceride level is detected by using triglyceride. 250 tests roche (hitachi) cobas c311, cobas c 501/502 with reference no. 20767107 322.The HDL level is detected by using tests roche (hitachi) cobas c311, cobas c 501/502 with reference no. 07528566 190.The LDL level is detected

by using tests roche (hitachi) cobas c311, cobas c 501/502 with reference no.07005717 190.The detection of serum vit-D3 is performed by using vit-D3 total 25-hydroxy vit-D3 kit (roche) with reference number 05894913 190 and modular analytics cobas e 601, cobas e 602 and E170 cobas e 411.Determination of HbA1c level was done by (HPLC D10) auto analyzer device [37, 38, 39, 40].

Statistical Analysis

Statistical package version (23) for the social sciences program was used in the analysis of our data. The t-test was used to compare the ratios. A p value of ≤0.05 is considered statistically significant, while a p value of 0.01 is considered statistically highly significant. One-way anova was used for comparison between more than two groups. The correlation coefficient between study parameters was determined using the pearson correlation.

Results And Discussion

General Characteristic of Studied Participants for Frequency Distribution

In this study, 70 T2DM patients and 25 healthy controls were compared. Research participants were 46 men and 49 women. The study included 79 subjects, 83.2% of whom were non-smokers and 73.7% of 70 subjects who did not exercise, whereas 16 smokers were 16.8% and 25 physically active 26.3%. 17.9% of 17 people are aged 40 or younger and 82.1% of 78 people are older than 40. Diabetes duration of 33.7% of 32 patients is 5 years or less, 40% of 38 patients have diabetes duration of more than 5 years. 16.8% of 16 patients are less than 25kg/m2, 32.6% of 31 patients are with 25 between 29.9kg/m2 and 50.6% of 48 people are over 30kg/m2 (Table 3.1).

Table 3.1. General characteristic of studied participants for frequency distribution

Subject characteristics (n=95)		Frequency Distribution	
		Frequency (n)	Percentage (%)
Subject categorizes	Control	25	26.3
	Diabetic	70	73.7
Age (years)	≤40 years	17	17.9
	>40 years	78	82.1
Gender	Male	46	48.4
	Female	49	51.6
BMI	<25kg/m^2	16	16.8
	25-29.9 kg/m^2	31	32.6
	>30 kg/m^2	48	50.6
Duration of diabetes (years)	≤5 years	32	33.7
	>5 years	38	40.0
	No Duration(control)	25	26.3
Family history of diabetes	Positive	61	64.2
	Negative	34	35.8
Exercise	Yes	25	26.3
	No	70	73.7
Smoking	Yes	16	16.8
	No	79	83.2

General Characteristics of Biochemical Indicators for Frequency Distribution

The biochemical indicators for this study were: 37.9% of 36 subjects had glucose less than or equal to 110 mg/dl, and 62.1% of 59 subjects had glucose greater than 110 mg/dl. 34.7% of 33 people had an HbA1c below 6.5% and 65.3% of 62 people had an HbA1c equal to or more than 6.5%. 34.7% of 33 subjects had vit-D less than 10 ng/ml, 53.7% of 51 subjects had between 10 and 29.9, and 11.6% of 11 subjects had equal or more than 30ng/ml. 27.4% of 26 subjects had less than or equal to 1.7 mg/dl and 72.5% of 69 subjects had more than 1.7 mg/dl. 22.1% of 21 subjects were less than 9 mg/dl and 77.9% of 74 subjects were equal to or more than 9 mg/dl. 68.4% of 65 people had cholesterol less than 200 mg/dl and 31.6% of 30 people had 200 mg/dl or more. It is more than 150 mg/dl. The HDL value of 32 people was 33.7% lower than 40mg/dl and 66.3% equal and more than 40mg/dl in 63 people. LDL value of 71 people is 74.7% lower than 130mg/dl and 25.3% of 41 people have equal or more than 130mg/dl (Table 3.2).

Table 3.2. General characteristics of biochemical indicators for frequency distribution

Biochemical indicators		Frequency Distribution	
		Frequency (n)	Percentage (%)
Glucose	≤110 mg/dl	36	37.9
	>110 mg/dl	59	62.1
HbA1c (%)	<6.5 %	33	34.7
	>=6.5 %	62	65.3
Vitamin D	<10 ng/ml	33	34.7
	10-29.9 ng/ml	51	53.7
	>=30 ng/ml	11	11.6
Cholesterol (mg/dl)	<200	65	68.4
	>=200	30	31.6
Triglyceride	≤150 mg/dl	34	35.8
	>150 mg/dl	61	64.2
HDL		32	33.7
	<40 mg/dl	63	66.3
	≥40 mg/dl		
LDL		71	74.7
	<130 mg/dl	41	25.3
	>=130 mg/dl		

Patients and Subjects Characteristics according to Control, and Diabetic Patients

In this table, we compare all the characteristics according to the control and diabetes patients. The mean±SD for control age was 42.48 ±8.11 and 52.12 ±9.09 for diabetic patients, p<0.001. 11 (44.0%) of the controls were male, 14 (56.0%) were female, 35 (50.0%) of the diabetic patients were male and 35 (50.0%) were female, and the p value was not significant. The mean±SD of the control BMI were 26.90±4.09 and 30.52±4.56 for diabetic patients with p<0.01. 20 (80.0%) of the controls had a positive family history of diabetes, 5 (20.0%) had a negative family history, 41 (58.6%) had a positive family history, and 29 (41.4%) had a negative diabetes history p<0.05. . 32 of the patients (45.7%) had diabetes duration

of 5 years or less, 38 (54.3%) had diabetes duration of more than 5 years. Nine of the controls (36.0%) were physically active and 16 of the controls (64.0%) were physically inactive, 16 of the patients (22.9%) were physically active, and 54 (77.1%) of the patients were physically active without making any sense. not active. Of the controls, 5 (20.0%) were smokers and 20 (80.0%) were non-smokers, 11 (15.7%) of the diabetic patients were smokers and 59 (84.3%) were non-smokers. The mean±SD of glucose was 93.48±8.48 for controls and 176.64±59.90 for diabetic patients, p<0.001. The mean±SD of HbA1c was 5.28±0.19 for controls and 8.81±1.71 for diabetic patients, with p<0.001. The mean±SD of vit-D was 21.09±8.54 for controls and 13.48±6.77 for diabetic patients, with p<0.001. The mean±SD of cholesterol was 176.16±27.63 for controls and 178.44±41.61 for diabetic patients, and the p-value was not significant. The mean±SD of triglycerate was 133.84±57.70 for controls and 203.24±80.88 for diabetic patients, p<0.001. The mean±SD of HDL was 47.00±8.10 for controls and 42.3±8.59 for diabetic patients, p<0.01. The mean±SD of LDL was 109.16±25.10 for controls and 100.65±39.40 for diabetic patients and was not significant in the p-value (Table 3.3).

Table 3.3. Patients and subjects characteristics according to control, and diabetic patients

Subjects, characteristics (n=95)		Frequency Distribution or Mean±SD		p-value
		Controls (n=25)	Diabetic (n=70)	
Age (years)		42.48 ±8.11	52.12 ±9.09	<0.001
Gender	Male	11(44.0%)	35(50.0%)	NS
	Female	14(56.0%)	35(50.0%)	
BMI (kg/m$^{2)}$		26.90±4.09	30.52±4.56	<0.01
Family history of diabetes	Positive	20(80.0%)	41(58.6%)	<0.05
	Negative	5(20.0%)	29(41.4%)	
Duration of diabetes	≤5 years	No Diabetic	32(45.7%)	
	>5 years		38(54.3%)	
Exercise	Yes	9(36.0%)	16(22.9%)	NS
	No	16(64.0%)	54(77.1%)	
Smoking	Yes	5(20.0%)	11(15.7%)	NS
	No	20(80.0%)	59(84.3%)	
Glucose (mg/dl)		93.48±8.48	176.64±59.90	<0.001
HbA1c (%)		5.28±0.19	8.81±1.71	<0.001
Vit.D (ng/ml)		21.09±8.54	13.48±6.77	<0.001
Cholesterol (mg/dl)		176.16±27.63	178.44±41.61	NS
Triglyceride (mg/dl)		133.84±57.70	203.24±80.88	<0.001
HDL (mg/dl)		47.00±8.10	42.3±8.59	<0.01
LDL (mg/dl)		109.16±25.10	100.65±39.40	NS

NS: Statistically No significant. p-value<0.05 is considered significant, p-value> 0.05 is considered No significant. Independent t-test and Chi-square was performed for statistical analysis.

Vitamin D Level in T2dm Patients, and Healthy Subjects in Relations with Age Group

The vit-D mean±SD of T2DM patients aged 40 years or less was 14.39±3.20, and the vit-D mean±SD of T2DM patients older than 40 years was 13.43±6.94, which was not significant. The vit-D mean±SD of healthy individuals aged 40 and over was 17.99±8.65, and the vit-D mean±SD of healthy individuals older than 40 years was 24.46±7.34 non-significant p-value (Table 3.4).

Table 3.4. Vit- D level in T2DM patients, and healthy subjects in relations with age group

Parameter	Diabetic (n=70) Mean ±SD			Controls (n=25) Mean ±SD		
	<=40 year (n=4)	>40 year (n=66)	p-value	<=40 year (n=13)	40 year (n=12)	p-value
Vit.D	14.39±3.20	13.43±6.94	NS	17.99±8.65	24.46±7.34	NS

NS : Statistically No Significant

Vitamin D level in T2DM patients, and healthy subjects in relations with BMI group.

In the comparison between the vit-D of a T2DM patient and a healthy subject in the BMI group, the mean±SD of vit-D was 19.03±10.98, and the mean±SD for T2DM patients with a BMI of less than 25 kg/m2. Vit-D mean±SD for T2DM patients with a BMI between 25-29.9kg/m2 is 14.41±6.66 and for T2DM patients with a BMI equal to and above 30 kg/m2, the mean±SD of vit-D is 11.84±5.51 and p<0.05 is. In healthy individuals with a BMI less than 25 kg/m2, vit-D mean±SD is 26.79±7.86, in healthy individuals with a BMI between 25-29.9kg/m2, vit-D mean±SD is 18.86 is . In healthy individuals with equal BMI and greater than 30kg/m2, vit-D was 18.86±2.83 and mean±SD was 16.90±7.58 and p<0.05 (Table 3.5).

Table 3.5.Vit-D level in T2DM patients, and healthy subjects in relations with BMI group

Parameter	Diabetic (n=70) Mean ±SD			
	<25 kg/m^2 (n=6)	25-29.9 kg/m^{2}n (n=28)	>=30 kg/m^2 (n=36)	p-value
Vit.D	19.03±10.98	14.41±6.66	11.84±5.51	<0.05
Parameter	**Controls (n=25) Mean ±SD**			
	<25 kg/m^2 (n=10)	25-29.9 kg/m^2 (n=3)	>=30 kg/m^2 (n=12)	p-value
Vit.D	26.79±7.86	18.86±2.83	16.90±7.58	<0.05

NS : Statistically No Significant

Vitamin D level in T2DM Patients, and Healthy Subjects in Relations with Gender Group

Between the vit-D of T2DM patients and healthy subjects in the gender group, the mean±SD of vit-D for T2DM patients was 14.90±5.71 for male and 12.07±7.51 for female, and the p-value was not significant. For males, the mean±SD of vit-D for healthy subjects was 22.72±10.37 and for females 19.81±6.93, which was not significant in the p-value (Table 3.6).

Table 3.6. Vit-D level in T2DM patients, and healthy subjects in relations with gender group

Parameter	Diabetic (n=70)Mean ±SD			Controls (n=25)Mean ±SD		
	Male (n=35)	Female (n=35)	p-value	Male (n=11)	Female (n=14)	p-value
Vit. D	14.90±5 .71	12.07±7 .51	N S	22.72±10 .37	19.81±6 .93	N S

NS : Statistically No Significant

Vitamin D Level in T2dm Patients, and Healthy Subjects in Relations with Physical Activity Group

Between vit-D of T2DM patients and healthy subjects in the physical activity group, mean±SD of vit-D for T2DM patients was 14.87±6.32 for active subjects and 13.08±6 for inactive subjects, It is 91 and there is no significant difference. For active people, mean±SD of vit-D was 21.92±9.33 in healthy subjects and 20.63±8.35 for inactive subjects, which was not significant in p-value (Table 3.7).

Table 3.7.Vit-D'nin level in T2DM patients, and healthy subjects in relations with physical activity group

Parameter	Diabetic (n=70)Mean ±SD			Controls (n=25)Mean ±SD		
	Yes (n=16)	No (n=54)	p-value	Yes (n=9)	No (n=16)	p-value
Vit.D	14.87±6.32	13.08±6.91	NS	21.92±9.33	20.63±8.35	NS

NS : Statistically No Significant

Vit- D Level in T2DM Patients, and Healthy Subjects in Relations with Smoking Group

For T2DM patients, the mean±SD of vit-D was 13.79±5.10 for smokers and 13.43±7.08 for non-smokers, which was not significant in p. For smokers, mean±SD of vit-D was 25.37±8.96 in healthy subjects and 20.02±8.32 in non-smokers, and the p-value was not significant (Table 3.8).

Table 3.8.Vit-D'nin level in T2DM patients, and healthy subjects in relations with smoking group

Parameter	Diabetic (n=70)Mean ±SD			Controls (n=25)Mean ±SD		
	Yes (n=11)	No (n=59)	p-value	Yes (n=4)	No (n=18)	p-value
Vit.D	13.79±5.10	13.43±7.08	NS	25.37±8.96	20.02±8.32	NS

NS : Statistically No Significant

Vitamin D Level in T2DM Patients, and Healthy Subjects in Relations with Family History Group

Mean±SD of vit-D for T2DM patients with negative family history was 14.50±7.36 and 12.05±5.66 for positive family history, and there was no significant difference. p-value. The mean±SD of vit-D was 21.00±7.95 for healthy subjects for negative family history and 21.46±11.70 for positive family history, the p-value was not significant (Table 3.9).

Table3.9.Vit-D'nin level in T2DM patients, and healthy subjects in relations with family history group

Parameter	Diabetic (n=70)Mean ±SD			Controls (n=25)Mean ±SD		
	Negative (n=41)	Positive (n=29)	p-value	Negative (n=20)	Positive (n=5)	p-value
Vit.D	14.50±7.36	12.05±5.66	NS	21.00±7.95	21.46±11.70	NS

Vitamin D Level in T2DM Patients in Relations with Duration Group

The mean±SD of vit-D for equal and less than five years for T2DM patients was 13.81±7.54 and 13.21±615 for more than five years. not significant in p-value (Table 3.10).

Table3.10.Vit-D'nin level in T2DM patients in relations with duration group

Parameter	Diabetic (n=70)Mean ±SD		
	<=5 year (n=32)	>5 year (n=38)	p-value
Vit.D	13.81±7.54	13.21±6.15	NS

NS : Statistically No Significant

Vitamin D Level in T2DM Patients, and Healthy Subjects in Relations with Cholesterol

For T2DM patients with cholesterol less than 200mg/dl, the mean±SD of vit-D is 14.49±7.22, and the p value of 11.68±5.57 is not significant if the cholesterol value is greater than or equal to 200mg/dl. The mean±SD of vit-D is 19.61±8.44 in healthy individuals with a cholesterol value of less than 200mg/dl, and 27.02±6.65 in individuals with a cholesterol value equal to or greater than 200mg/dl (Table3.11).

Table 3.11. Vit-D'nin level in T2DM patients, and healthy subjects in relations with cholesterol

Parameter	Diabetic (n=70)Mean ±SD			Controls (n=25)Mean ±SD		
	Serum total cholesterol level<200 (n=45)	Serum total cholesterol level>=200 (n=25)	p-value	Serum total cholesterol level<200 (n=20)	Serum total cholesterol level>=200 (n=5)	p-value
Vit.D	14.49±7.22	11.68±5.57	NS	19.61±8.44	27.02±6.65	NS

NS : Statistically No Significant

Vitamin D Level in T2DM Patients, and Healthy Subjects in Relations with Triglyceride Group

The mean±SD of vit-D for T2DM patients with vit-D is 14.84±7.67 for T2DM patients with triglyceride level less than 150mg/dl and the value is equal to or greater than 150mg/dl for patients with high triglyceride level being 13.02±6.45 and not significant in the p-value. In healthy subjects with a triglyceride value less than 150 mg/dl, the mean±SD of vit-D is 18.82±7.57 and for individuals with a triglyceride value equal to or greater than 150 mg/dl, it is 25.13±9.11 and in terms of p is not significant (Table 3.12).

Table3.12. Vit-D'nin level in T2DM patients, and healthy subjects in relations with triglyceride group

Parameter	Diabetic (n=70)Mean ±SD			Controls (n=25)Mean ±SD		
	Serum total Triglyceride level<150(n=18)	Serum total Triglyceride level>=150(n=52)	p-value	Serum total Triglyceride level<150(n=16)	Serum total Triglyceride level>=150(n=9)	p-value
Vit.D	14.84±7.67	13.02±6.45	NS	18.82±7.57	25.13±9.11	NS

NS : Statistically No Significant

Vitamin D Level in T2DM Patients, and Healthy Subjects in Relations with HDL Group

The mean±SD of vit-D for T2DM patients with vit-D and HDL less than 40mg/dl for T2DM patients and 40mg/dl for patients with HDL is 13.18±6.81 while it was 13.68±6.83 and it was not significant in the p-value. The mean±SD of vit-D is 21.50±8.78 in healthy individuals with HDL value less than 40mg/dl, and 21.02±8.71 in individuals with HDL value equal to or greater than 40mg/dl. and p is not significant (Table 3.13).

Table3.13. Vit-D'nin level in T2DM patients, and healthy subjects in relations with HDL group

Parameter	Diabetic (n=70)Mean ±SD			Controls (n=25)Mean ±SD		
	Serum HDL Level<40(n=28)	Serum HDL Level>=40(n=42)	p-value	Serum HDL Level<40(n=4)	Serum HDL Level>=40(n=21)	p-value
Vit.D	13.18±6.81	13.68±6.83	NS	21.50±8.78	21.02±8.71	NS

NS : Statistically No Significant

Vitamin D level in T2DM Patients, and Healthy Subjects in Relations with LDL Group

Vit-D of T2DM patients and 12.39±6.00 p if the mean ±SD of vit-D for T2DM patients with LDL value less than 130 mg/dl is 13.89±7.05 and LDL value is greater than or equal to 130mg/dl value is not significant. In healthy individuals with LDL value below 130 mg/dl, mean±SD of vit-D is 21.51±7.90 and in individuals with LDL value equal to or more than 130 mg/dl, 19.42±11,71 and there is no significant difference (Table 3.14).

Table 3.14. Vit-D level in T2DM patients, and healthy subjects in relations with LDL group

Parameter	Diabetic (n=70)Mean ±SD			Controls (n=25)Mean ±SD		
	Serum LDL Level<130(n=51)	Serum LDL Level>=130(n=19)	p-value	Serum LDL Level<130(n=20)	Serum LDL Level>=130(n=5)	p-value
Vit.D	13.89±7.05	12.39±6.00	NS	21.51±7.90	19.42±11.71	NS

NS : Statistically No Significant

Vitamin D Level in whole Study Population in Relations with Fasting Blood Glucose Level Group

The mean±SD of vit-D for the entire study population with vit-D level equal to or lower than 110mg/dl and fasting blood glucose was 19.22±9.23, and fasting blood glucose above 130mg/dl. persons with p<0.001 and 12.21±6.15 (Table 3.15).

Table 3.15. Vit-D'nin level in whole study population in relations with fasting blood glucose level group

Parameter	Whole study population (n=92)Mean ±SD		
	Fasting blood glucose level <=110 g/dl(n=36)	Fasting blood glucose level >110 mg/dl(n=59)	p-value
Vit.D	19.22±9.23	12.21±6.15	<0.001

NS : Statistically No Significant

Vitamin D Level in whole Study Population in Relations with HbA1C Level Group

The vit-D mean±SD is 20.46±8.56 for the entire population with a vit- D level and an HbA1C level equal to or less than 6.5% in the entire study population and a blood glucose level above 6.5% for fasting subjects p<0.001 and 12.84±6.26 (Table 3.16).

Table3.16. Vitamin D level in whole study population in relations with HbA1C level group

Parameter	Whole study population (n=92) Mean ±SD		
	HbA1C level<6.5 (n=33)	HbA1C level>=6.5(n=62)	p-value
Vit.D	20.46±8.56	12.84±6.26	<0.001

NS : Statistically No Significant

Correlation Between Vitamin D and other Parameters in the Study Population

According to the pearson correlation coefficient (r), results in the entire study population showed that there was no negative significant correlation between vit-D level [age group, cholesteroll, and LDL level (r=-0.105, p=0.313) each. (r=-0.109, p=0.292), (r=-0.091, p=0.383)], vit-D level had a negative and low significant correlation with triglyceride (r=-0.209, p<0.05), vit-D level, [had a negative high significant correlation with BMI, fasting blood glucose and HbA1C (r=-0.308, p<0.01), (r=-0.334, p<0.01)),(r=-0.380, p<0.001), respectively, vit-D level did not have a positive and significant relationship with HDL (r=0.100, p=0.336) (Table 3.20).

Table 3.20. Correlation between vitamin D and other parameters in the study population

Parameter	(r)	p-value
Age (year)	-0.105	0.313
BMI(Kg/m^2)	-0.308**	<0.01
Cholesterol	-0.109	0.292
Triglycerides	-0.209*	<0.05
HDL	0.100	0.336
LDL	-0.091	0.383
FBS	-0.334**	<0.01
HbA1c	-0.380**	<0.001

T2DM is a metabolic problem that occurs by reducing insulin secretion from pancreatic β-cells, hyperglycemia and insulin resistance. The increase in the prevalence of diabetes is mostly linked to poor lifestyle habits and obesity. Obesity is the main health problem mostly associated with T2DM and causes increased mortality and morbidity. The disclosure of T2DM levels represents a worldwide health problem. Even as changes in diet, obesity levels and physical activity underlying genetic hazard factors turn out to be fueling this epidemic, other environmental variables may be compelling in curing T2DM. T2DM is known to be a worldwide health problem. Other environmental variables may be compelling in curing T2DM, even if changes in diet, obesity levels, and physical activity underlying genetic hazard factors in this disease turn out to be fueling this epidemic [4]. The data in our study confirmed that there was no significant relationship between the patient and control group and each group (age, gender, activity, smoking, family history, duration) in relation to vit-D. Similar observations have been reported in similar studies [2,4]. Body mass index (BMI) is known as the body weight divided by the square of height and is properly expressed in kg/m2. In this study, the pearson correlation coefficient (r) was negative between the patient's vit-D (BMI) group. and the decrease in vit-D value was shown with the increase in BMI value due to control. Similar observations have been reported in similar studies [4]. In our study, the data confirmed that there was no statistically significant relationship between vit-D and cholesterol, triglycerate, LDL, and HDL levels, and that there was a positive pearson correlation coefficient (r) between HDL level and vit-D level. There is a negative pearson correlation coefficient (r) between the vit-D of the patient and control, but the vit-D of the patient and control and (cholesterol, triglycerate, LDL) level. Similar observations have been reported in similar studies [2]. The mean±SD vit-D level was 19.22±9.23 for the whole population with a fasting blood glucose level of 110 mg/dl or less, and 12.21±6.15 for people with a fasting blood glucose level above 130 mg/dl, and p<0.001. The relationship between vit-D level and fasting blood sugar is statistically significant with negative pearson correlation coefficient. Similar observations are also observed in similar studies [1,4]. Vit-D mean±SD 20.46±8.56 for the entire population with an HbA1C level equal to or lower than 6.5%, and 12.84±6% for individuals with a fasting blood glucose level above 6.5%, is 26 and p<0.001. The relationship between vit-D level and fasting blood sugar is statistically significant with negative pearson correlation coefficient. Similar observations have been reported in similar studies [1,4]. The strong relationship between vit-D and fasting blood glucose and HbA1C is due to the fact that vit-D tends to specifically stimulate insulin production in β-pancreatic cells via the nuclear vit-D receptor (VDR) and that vit-D minimizes inflammation. This is an important process in inducing insulin resistance [2,4].

Conclusion

T2DM is a complex metabolic disease that has turned into an important health problem. Vit-D deficiency is a major health problem worldwide, currently associated with chronic diseases such as diabetes mellitus and cardiovascular disease. The role of vit-D in insulin resistance is important and the T2DM patient should measure the vit-D value periodically.

Conflicts of interest

The authors report no conflict of interest.

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