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Prevalence Patterns of Several Demographical Characteristics and vitamin D Status among Diabetes and Non-diabetes Patients in Najaf, Iraqi

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ABSTRACT

Vitamin D is a fat-soluble vitamin that plays a vital role in various physiological functions, including the regulation of calcium and phosphate balance, bone metabolism, and immune function. Recent research has linked vitamin D deficiency to numerous chronic diseases, including diabetes mellitus. In particular, type 2 diabetes mellitus (T2DM) has been associated with low serum vitamin D levels, potentially due to its role in insulin secretion and sensitivity. This study aims to evaluate the prevalence of vitamin D deficiency in diabetic patients and compare it with non-diabetic individuals in the Iraqi population and analyze its association with demographic, lifestyle, and clinical characteristics .This study is a cross-sectional study, it involved 72 subjects (45 with diabetes and 27 without diabetes) and conducted at Al-Seder teaching Hospital- Diabetic center. They aged between 18-70 years old and collected during time between the start of September to the end of December 2024 from Najaf Governorate, Iraq. Demographic and clinical data (Blood pressure, BMI, dyslipidemia, hypertension, smoking, physical activity and antidiabetic therapy) were abstracted from patient medical records using a structured data‑collection sheet. Blood sample was collected for each subject to test vitamin D by MINI VIDAS method which is a compact automated immunoassay system based on Enzyme linked Fluorescent Assay (ELFA) principles. Statistical analysis was performed by using SPSS version 18, Using Frequency, Percentage, chisquare test and Independent T-test. The results showed that Vitamin D deficiency was more frequent in DM than non‑DM patients (80% vs 33.3%, p=0.005). DM patients showed higher inactivity (81.8% vs 19.2% active), more hypertension (55.6% vs 11.1%) and dyslipidemia (51.1% vs 33.3%) and in conclusion Vitamin D deficiency is common among DM patients and clusters with adverse demographic and clinical characteristics (physical inactivity, obesity, hypertension, and dyslipidemia).

Keywords: Vitamin D deficiency, diabetes mellitus, demographics, lifestyle, Najaf, Iraq.

I. INTRODUCTION

Vitamin D, is an essential fat-soluble vitamin that plays a critical role in muscular function and haemostasis of phosphorus and calcium. Vitamin D is a pre-hormone have important role in many systems like, extra-skeletal, cardiovascular and regulation of blood pressure, inflammation, proliferation cell and improve the body sensitivity for insulin [1]. The active form of vitamin D, calcitriol, acts as a hormone that supports various physiological functions, including muscle performance, cell growth, and inflammation control. Beyond skeletal health, recent research highlights its involvement in modulating immune responses, which

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has implications for autoimmune diseases, cardiovascular health, and chronic conditions [2]. Globally, vitamin D deficiency has become a significant public health concern, with over one billion people estimated to have insufficient levels. This deficiency is particularly common in the Middle East, including Iraq, due to factors such as limited sun exposure, traditional clothing, and dietary habits. Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycaemia due to defects in insulin secretion, insulin action, or both. Emerging evidence suggests that vitamin D deficiency may play a role in the development and progression of diabetes mellitus. Vitamin D influences insulin secretion and sensitivity through its receptor, which is expressed in pancreatic beta cells. Adequate levels of vitamin D are essential for maintaining intracellular calcium concentrations, a key factor in insulin release. Furthermore, vitamin D's anti-inflammatory properties may mitigate chronic inflammation, a significant contributor to insulin resistance and beta cell dysfunction in type 2 diabetes [3]. Observational studies have found a higher prevalence of vitamin D deficiency among individuals with diabetes compared to non-diabetic populations. For instance, a systematic review and meta-analysis reported that low serum vitamin D levels were associated with an increased risk of type 2 diabetes [4].

Vitamin D levels indirectly influence insulin secretion by regulating calcium flux through the cell membrane and intracellular calcium [5]. It has also been proposed that the pancreatic tissue and various cell-type immune systems express VDR [6]. According to past studies, VDR gene polymorphisms influence the activity of the VDR protein [7]. The genetic polymorphisms in the VDR, which altered calcium metabolism, adipocyte function, insulin release, and cytokine production, had a substantial impact on the development of type 2 diabetes mellitus. A strong association between vitamin D3 and insulin resistance was found in a previous cross-sectional study of five periods in the NHANES (National Health and Nutrition Examination Survey) database. Subgroup analyses, however, showed that this correlation varied between people and races [8].

II. METHODS AND MATERIAL

Study design: A cross sectional comparative study, sample size calculated as

$N=Z^2 P (1-P)/d^2$

This study involved 72 subjects (45 with diabetes and 27 without diabetes) was conducted at Al-Seder Teaching Hospital- Diabetic center. Collected during time between the start of September to the end of December 2024 from Najaf Governorate, Iraq. Inclusion criteria: adults aged 18-70 years attending the diabetes Center during study periods with available records for comorbidities and lifestyle data. Exclusion criteria: Thyroid and parathyroid disease, advance chronic kidney or liver disease, malabsorption syndromes, age > 70 years and participants take vitamin D supplement. Demographic and clinical data (Blood pressure, BMI, dyslipidemia, hypertension, smoking, physical activity and antidiabetic therapy) were abstracted from patient medical records using a structured data‑collection sheet. Blood sample was collected for each subject to test vitamin D by MINI VIDAS method which is a compact automated immunoassay system based on Enzyme linked Fluorescent Assay (ELFA) principles. According to serum level of vitamin D, these subjects were categorized into 3 groups: (< 10 ng/ml as deficient group, 10-30 ng/ml as insufficient group and 30-100 ng/ml as sufficient group).

For all participants weight and height were calculated by using a sensitive balance after removing excessive things (e.g. shoes, bags, coats and jackets). After that the BMI is calculated by using this equation: BMI= weight (Kg)/ height (m^2). According to their body mass index, the participants were divided into four categories: Underweight (BMI< 18.5 kg/m^2), Normal (18.5-24.9 kg/m^2), Overweight (25-29.9 kg/m^2) and Obese (≥30 kg/m^2).

Statistical analysis

The data analysis was performed using Microsoft Excel 2019. Microsoft Excel was used for editing, sorting, and coding. Using Frequency, Percentage & chi-square test and Independent T-test and P value was considered as a significant at <0.05.

III.RESULTS AND DISCUSSION

Distribution of study population according to presence of Diabetes mellitus

The results of the study showed, that about from72 participants, 45 are diabetic (62.5%), while 27 are non-diabetic (37.5%), as in table 1.

TABLE 1: Distribution of study population according to presence of Diabetes mellitus.

		Drug for DM			
		Frequency	Percent	Valid Percent	Cumulative Percent
Drugs	**Insulin**	**11**	**24.4**	**24.4**	**24.4**
	oral hypoglycemic drug	**34**	**75.6**	**75.6**	**100.0**
	Total	**45**	**100.0**	**100.0**	

Levels of Vitamin D3 in the study population

The study showed a significant difference in vitamin D3 levels between individuals with and without diabetes. Among the participants with diabetes, 80% were deficient in vitamin D3, while only 6.6% had sufficient levels of vitamin D3.In the non-diabetic group, only 33.3% were deficient in vitamin D3, while only 29.6% had sufficient levels as in table 2.

TABLE 2: Levels of Vitamin D3 in the study population

		Vitamin D status			Total	P value
		Sufficient	Insufficient	Deficient		
With DM	Count	3	6	36	45	0.005
	Percent	6.6 %	13.3 %	80%	100 %	
Without DM	Count	8	10	9	27	
	Percent	29.6%	37%	33.3 %	100 %	
Total	Count	11	16	45	72	
	Percent	100 %	100 %	100 %	100 %	

Distribution of study population according to physical activity

The results of the present study showed that, diabetics patients are more likely to be physically inactive, about 36 (81.8%) of them appearing to be inactive, compared to 8(18.2%) who appear active. While in non-diabetes group, 5 (19.2%) inactive and 21 (80.8%) are active. This large difference suggests a strong relationship between physical inactivity and diabetes, as vitamin D3 and physical inactivity may contribute to an increased risk of diabetes.

TABLE 3: Distribution of diabetes and non-diabetes according to physical activity

Presence of Diabetic * physical activity Crosstabulation					
			Physical activity		Total
			active	inactie	
Presence of Diabetic	Yes	Count	8	36	44
		Percentage%	18.2%	81.8%	100.0%
		% of Total	11.4%	51.4%	62.9%
	No	Count	21	5	26
		Percentage %	80.8%	19.2%	100.0%
		% of Total	30.0%	7.1%	37.1%
	Total	Count	29	41	70
		%	41.4%	58.6%	100.0%

Distribution of study population according to lifestyle

The lifestyle is one of the most important factors, so and according to the results of the present study about 68.2% of diabetics had unhealthy lifestyle, compared to 3.8% of non-diabetics. This significant difference suggests that lifestyle plays a role in the development of diabetes as in table 4.

Table 4: Distribution of diabetes and non-diabetes according to life style.

Presence of Diabetic * life style Crosstabulation			
	life style		Total
	Healthy	Unhealthy	

Presence of Diabetic	Yes	Count	14	30	44
		Percentage %	31.8%	68.2%	100.0%
		% of Total	20.0%	42.9%	62.9%
	No	Count	25	1	26
		Percentage %	96.2%	3.8%	100.0%
		% of Total	35.7%	1.4%	37.1%
Total		Count	39	31	70
		%	55.7%	44.3%	100.0%

Distribution of study population according to body mass index

The result of study showed most of diabetes patient are normal weight (51.1%) followed by overweight (31.1%) then obese & underweight (11.1%, 6.7%) respectively. While in non-diabetes participants most of them are normal (20.2%) followed by obese, underweight & overweight (7.2%, 4.4%, 2.9%) respectively.

Table 5: Distribution of diabetic & non-diabetic according to body mass index

Presence of Diabetic * BMI Crosstabulation			BMI				Total
			obese	overweight	Normal	underweight	
Presence of Diabetic	Yes	Count	5	14	23	3	45
		Percentage %	11.1 %	31.1 %	51.1 %	6.7%	100 .0%
		% of Total	7.2%	20.3 %	33.3 %	4.3%	65. 2%
	No	Count	5	2	14	3	24
		Percentage %	20.8 %	8.3%	58.3 %	12.5 %	100 .0%
		% of Total	7.2%	2.9%	20.3 %	4.3%	34. 8%
Total		Count	10	16	37	6	69
		%	14.5 %	23.2 %	53.6 %	8.7%	100 .0%

The presence different symptoms in study population

The result of study showed that most of patients are suffered from muscle pain, followed by bone pain and then other symptoms, while in nondiabetic most participants suffered from fatigue followed by bone pain and then other symptoms as in figure 1.

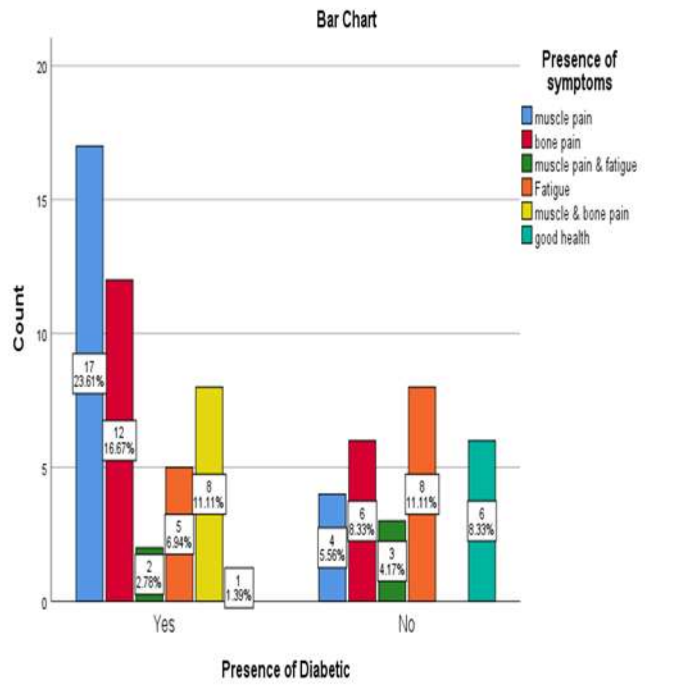

Figure 1: Distribution of different symptoms in study population.

Prevalence of dyslipidemia in the study population

The result of study showed, that about (51.1%) diabetic patients had dyslipidemia, while (48.9%) were not. In non-diabetic about (66.7%) had no dyslipidemia and (33.3%) had dyslipidemia as in table 6.

Table 6: prevalence of dyslipidemia in diabetic and non- diabetic population

Presence of Diabetic * dyslipidemia Crosstabulation			Dyslipidemia		Total
			Yes	No	
Presence of Diabetic	Yes	Count	23	22	45
		%	51.1%	48.9%	100.0%
		% of Total	31.9%	30.6%	62.5%
	No	Count	9	18	27
		%	33.3%	66.7%	100.0%

	% of Total	12.5%	25.0%	37.5%
Total	Count	32	40	72
	%	44.4%	55.6%	100.0%

The present study showed that, there was a strong relationship between vitamin D3 deficiency and diabetes (DM). Many of mechanisms could explain how vitamin D3 affects the risk and development of diabetes. These mechanisms involve insulin secretion, insulin sensitivity, inflammation, oxidative stress, and pancreatic β-cell function. Vitamin D3 plays an important role in how pancreatic β-cells function and how sensitive the body is to insulin. Research suggests that lower vitamin D3 levels are linked to higher insulin resistance and reduced insulin production, both of which contribute to type 2 diabetes. One of the most well-established roles of vitamin D3 in glucose metabolism is its effect on pancreatic β-cell function. Pancreatic β-cells, which are responsible for insulin production and secretion, express vitamin D receptors (VDRs) and enzymes required for vitamin D3 activation [9].

Insulin secretion is a calcium-dependent process. Vitamin D3 regulates intracellular calcium levels in pancreatic β-cells, which is crucial for proper insulin release [10]. Vitamin D3 deficiency disrupts this calcium balance, leading to reduced insulin secretion and impaired glucose regulation [11]. Vitamin D3 influences the expression of the insulin gene by interacting with vitamin D response elements (VDREs) in pancreatic β-cells [12]. A deficiency in vitamin D3 reduces insulin gene transcription, leading to insufficient insulin production and poor glycemic control. These findings suggest that vitamin D3 deficiency may contribute to β-cell dysfunction. Beyond insulin secretion, vitamin D3 plays a direct role in enhancing insulin sensitivity in peripheral tissues, particularly in skeletal muscle, liver, and adipose tissue. Insulin sensitivity is critical for maintaining glucose homeostasis, and its impairment leads to insulin resistance, a key feature of type 2 diabetes (T2DM). Vitamin D3 upregulates insulin receptor expression on muscle and adipose cells, allowing for better glucose uptake. In individuals with low vitamin D3 levels, insulin receptors become less responsive to insulin, leading to higher blood glucose levels and increased insulin resistance.

Studies have shown that vitamin D3 supplementation improves insulin sensitivity, particularly in vitamin D3-deficient individuals [13].

The glucose transporter GLUT-4 is responsible for moving glucose into cells in response to insulin. Vitamin D3 enhances GLUT-4 translocation to the cell membrane, improving glucose uptake and reducing hyperglycemia [14]. A deficiency in vitamin D3 impairs GLUT-4 activation, leading to reduced glucose utilization and increased insulin resistance.

A study by Pittas (2010) showed that low levels of vitamin D3 were associated with an increased risk of type 2 diabetes. It was suggested that taking vitamin D3 supplements may help reduce this risk [15]. Also, Foroughi (2008) studied a European cohort for five years and found that people with higher levels of vitamin D3 had a significantly lower risk of insulin resistance and diabetes [16]. This is consistent with our study, where we found that participants with diabetes had a significantly higher prevalence of vitamin D3 deficiency (73.3%) compared to non-diabetics (37.0%). Data from the National Health and Nutrition Examination Survey (NHANES) also showed that lower vitamin D3 levels were strongly associated with higher fasting glucose levels and reduced insulin sensitivity (Scragg et al., 2004). Vitamin D3 may be help insulin secretion by regulating calcium levels in pancreatic β-cells [17].

Animal studies have shown that rodents with vitamin D3 deficiency had impaired insulin secretion, but their condition improved when given vitamin D3 supplement [18]. Also, Chiu in (2004) found that people with higher vitamin D3 levels had better insulin sensitivity, while those with lower levels showed greater insulin resistance [19].

The mechanism behind this involves vitamin D3's role in increasing insulin receptors and enhancing the activity of GLUT-4 (a glucose transporter) in muscle and fat tissue, which helps improve glucose absorption (Mitri, et al. 2011). A study by Boucher in 2011, found that vitamin D3 deficiency is linked to higher levels of inflammatory markers like TNF-α and IL-6, both of which contribute to insulin resistance and β-cell dysfunction [20].

Additionally, the study showed that diabetics are more likely to have symptoms associated with vitamin D3 deficiency, such as bone and muscle pain, fatigue and lethargy. These symptoms may be occurred due to inflammation. Chronic low-grade inflammation is a key driver of insulin resistance and diabetes progression. Several studies suggest that It has also been reported that body fat content is inversely related to serum 25D concentration, and that this associations is stronger than those between 25D and BMI and body weight [21]. One of the possible mechanisms that explain these results that obese individuals expose less skin to the sun less often than non-obese individuals, resulting in reduced synthesis of vitamin D, which has anti-inflammatory properties, and its deficiency may contribute to a pro-inflammatory state that exacerbates insulin resistance. Vitamin D3 inhibits the production of pro-inflammatory cytokines, including TNF-α, IL-6, and IL-1β, which are elevated in diabetics and contribute to insulin resistance. In the present study, diabetics with vitamin D3 deficiency exhibited higher rates of musculoskeletal symptoms (muscle pain, bone pain, and fatigue), which could be linked to increased systemic inflammation due to vitamin D3 deficiency. Vitamin D3 modulates immune system function by preventing the overactivation of macrophages, which produce inflammatory molecules that disrupt insulin signaling. The individuals with higher vitamin D3 levels exhibit lower markers of systemic inflammation, which correlates with improved insulin sensitivity and glycemic control.

Vitamin D3 appears to be more common in overweight diabetics, suggesting a possible link between low levels of vitamin D3, obesity, and impaired glucose metabolism. Since D3 plays a role in regulating insulin and inflammation, its deficiency in obese people may contribute to an increased risk of developing the disease and its complications. These findings suggest low levels of vitamin D3 in diabetic patients may be effect with other lifestyle and metabolic factors in insulin resistance and diabetes risk. There is an association between increasing BMI and lower serum 25hydroxyvitamin D (25D) concentrations. Many of studies found that obesity may be associated with lower 25D concentrations, high parathyroid hormone (PTH) concentrations and low 1,25D concentrations [22].

IV.CONCLUSION

This study supports that Vitamin D deficiency is common among diabetic patients in Najaf and is associated with unfavorable demographics and clinical profiles. Clinical pathways in DM care should consider routine vitamin D screening and targeted correction alongside lifestyle

Ethical Considerations. The study protocol adhered to the ethical principles of the Declaration of Helsinki and was approved by the institutional review board of the Faculty of Pharmacy, University of Kufa. (No:83 at 28/8/2024).

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