

# Vitamin D Effects on Glycated Haemoglobin (HbA1c) Level, and Their Correlation to Age

<sup>1</sup>Esraa mohiddin a. gadah, <sup>2</sup>Daniyah salmeen s. baduqayl, <sup>3</sup>Ahlam Omar a. albisaisi, <sup>4</sup>Sara mohammedalbager m. Aljifri

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**Abstract:** Background: HbA1c is considered an indicator of average blood glucose concentrations during the preceding 2 to 3 months and, thus, a long-term marker of glucose homeostasis. Abnormalities may be a result of changes in insulin secretion and insulin-stimulated uptake of glucose in muscle and fat tissue.

**Objective:** Vitamin D deficiency is associated with a greater risk of developing type 2 diabetes mellitus (T2DM). Studies looking at the effect of vitamin D replacement on glycaemic control in type 2 diabetics are few and conflicting. So our objective come which was to test whether vitamin D level has any effect on HbA1c level concerning diabetes, and whether there are any changes in this correlation with age different.

**Methodology:** Participants were 299 diabetic patients divided to three groups according to their age 1) children which form almost 70% of participants; 2) adolescents which were 30% 3) adults which were only 1% of participants in this study. The data were recruited through outpatient departments of “King Abdul Aziz University Hospital in Jeddah Saudi Arabia. Fasting venous blood samples were collected by phlebotomy to perform HbA1c analyses by high-pressure liquid chromatography. Serum (s-25(OH) D) was measured using high-pressure liquid chromatography tandem mass spectrometry.

**Results:** the most effected among this population with vitamin D deficiency is the diabetic children 70% of children population showed good glycemic control. And 76% of adolescents with vitamin D deficiency also were in a good controlled (HbA1c  $\leq$  7 %) category.

**Conclusion:** this study revealed that vitamin D deficiency was higher in diabetic children compared to healthy controls. It will be of interest for future studies to investigate whether vitamin D supplementation will improve glycemic control and inflammation status in vitamin D deficient diabetic children.

**Keywords:** Vitamin D, Glycated Hemoglobin (HbA1c) level, high-pressure liquid chromatography.

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## 1. INTRODUCTION

Vitamin D assumes a to play significant part in calcium metabolism, and vitamin D level may be connected with a scope of serious diseases, including tumors , cardiovascular illness, and sort 2 diabetes. Despite the fact that the hidden organic instruments are inadequately comprehended, the relationship of low serum 25-hydroxyvitamin D3 [25(OH) D3] focuses with sort 2 diabetes may be interceded through consequences for glucose homeostasis and, specifically, an immediate impact of vitamin D on the b-cell capacity, and along these lines insulin discharge. A few studies have recommended that low vitamin D status likewise adds to insulin resistance. Low vitamin D status is connected with markers of impeded glucose metabolism, for example, glycosylated hemoglobin (HbA1c) (4,5). Be that as it may, the greater part of these studies concentrated on heterogeneous gatherings of moderately aged subjects.

Lately studies have exhibited relationships between's low vitamin D levels and the advancement of sort 2 diabetes while others give comparable discoveries yet on the inverse range where more elevated amounts of vitamin D are connected with diminished rate of sort 2 diabetes. Moreover, past exploration distinguished vitamin D receptors in the  $\beta$  cells of the pancreas and connected vitamin D to insulin emission regulation. Vitamin D insufficiency is basic all inclusive, incorporating into sunny nations like our nation. In any case, the quantity of studies taking a gander at the impact of Vitamin D substitution on glycemic parameters is constrained.

This study aimed to investigate the relation of vitamin D with metabolic parameters in patients with diabetes and the effects of vitamin D on glucose metabolism, showing in (HbA1c) control.

## 2. METHODOLOGY

Study designed as, randomized, retrospective research design.

Participants were 299 diabetic patients divided to three groups according to their age 1) children which form almost 70% of participants; 2) adolescents which were 30% 3) adults which were only 1% of participants in this study. All participants performed the baseline test to show the vitamin D level and HbA1c. The results were recruited through outpatient departments of “King Abdul Aziz University Hospital in Jeddah Saudi Arabia. The participants were asked to fast and arrive before breakfast to undergo blood sampling and a thorough clinical examination. Fasting venous blood samples were collected by phlebotomy to perform HbA1c analyses by high-pressure liquid chromatography. Serum (s-25(OH) D) was measured using high-pressure liquid chromatography tandem mass spectrometry, Waters triple quadruple mass spectrometer instruments.

### Analysis process:

Finally SPSS 16.0 (SPSS version 16.0, SPSS Inc. Chicago, IL, USA) package was used in statistical analysis of collected data.

For the better assessment through SPSS, the participants were divided into three groups depending on their age first group are children groups which are under 12 years, second group were adolescent and they are between the age of 12 up to 18 years old. And the third group was the Adults and those are who is above 19 years. And we had to categorize the HbA1c into categories that include good glycemic control (HbA1c  $\leq 7\%$ ), moderate glycemic control (HbA1c 7.1 - 9 %), poor glycemic control (HbA1c  $> 9\%$ ). and this study has divided the participants into three groups too according to their vitamin D levels in their bodies. and these groups are first (Vitamin D deficiency), who is their level of vitamin D less than 30 nmol/L,. second group (insufficient Vitamin D level), those who is having the level of vitamin D between the ranges of 30-49 nmol/L, Patients, who had the level of vitamin D  $\geq 50$  nmol/L, were included in third group sufficient (Vitamin D level in blood).

### HbA1c in diagnosis:

*HbA1c can indicate people with prediabetes or diabetes as follows:*

HbA1c	mmol/mol	%
Normal	Below 42 mmol/mol	Below 7.0%
Prediabetes	42 to 47 mmol/mol	7.0% to 9%
Diabetes	48 mmol/mol or over	9% or over

## 3. RESULTS

Epidemiological and in-vitro studies have found evidence for an association between Vitamin D and diabetes. Vitamin D receptors are found on pancreatic beta-cells, suggesting they have a role in glycaemic control. Vitamin D analogues inhibit inflammatory cytokines involved in destruction of Beta-cells. This study aimed to assess the relationship between Vitamin D and glycaemic control, as measured by HbA1C, in a Type 1 (T1) diabetic. HbA1C values were recorded for each patient from diagnosis to recruitment and combined to determine monthly HbA1C variation in the study population. In this study 299 participants were included the majority of them were children 68.9%, the second majority of participants adolescent which is 30.1, and the third which is the least participant in this study are Adults which is only 3 adult participants. Table 1 is presenting complete information about the distribution of selected participants on the basis of age groups at the time of diagnosis and evaluation.

**Table 1: Age distribution among participants**

		Age			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Adolescent	90	30.1	30.1	30.1
	Adult	3	1.0	1.0	31.1
	Children	206	68.9	68.9	100.0
	Total	299	100.0	100.0	

To discuss the finding of this study we have demonstrated the Vitamin D amount among participants depending on their age (Table 2), to see how they are correlated to each others, this shows that among Adolescents which 90 participants out of 299 of the whole study population, 67(74.4%) of them suffering Vitamin D deficiency which is relatively high among of Adolescents participants, and only 5 (5.6%) of them having a sufficient amount of Vitamin D in their bodies.

among the children population which form the largest group in this study, we found that 73.3% suffering from vitamin D deficiency and only 8.7% who is having a sufficient amount of Vitamin D, and that's unfortunately a really bad sign among the children who they need more vitamin D to be able to have a sufficient growth rhythm.

In contrast we found 74% of the selected participants among all different age groups are affected by Vitamin D deficiency, it means 219 patients out of 299 having very low amount of vitamin D.

**Table 2: Vitamin D amount level correlated to the Age of participants**

			Vitamin D amount			Total
			Deficiency	Insufficient	Sufficient	
<b>Age Adolescent</b>	<b>Count</b>		67	18	5	90
	<b>% within Age</b>		74.4%	20.0%	5.6%	100.0%
	<b>% within Vit D</b>		30.6%	31.6%	21.7%	30.1%
	<b>% of Total</b>		22.4%	6.0%	1.7%	30.1%
<b>Adult</b>	<b>Count</b>		1	2	0	3
	<b>% within Age</b>		33.3%	66.7%	0.0%	100.0%
	<b>% within Vit D</b>		0.5%	3.5%	0.0%	1.0%
	<b>% of Total</b>		0.3%	0.7%	0.0%	1.0%
<b>Children</b>	<b>Count</b>		151	37	18	206
	<b>% within Age</b>		73.3%	18.0%	8.7%	100.0%
	<b>% within Vit D</b>		68.9%	64.9%	78.3%	68.9%
	<b>% of Total</b>		50.5%	12.4%	6.0%	68.9%
<b>Total</b>	<b>Count</b>		219	57	23	299
	<b>% within Age</b>		73.2%	19.1%	7.7%	100.0%
	<b>% within Vit D</b>		100.0%	100.0%	100.0%	100.0%
	<b>% of Total</b>		73.2%	19.1%	7.7%	100.0%

And concerning the Vitamin D effect and relation with HbA1c level we have found the following (Table 3), 46% of those having Vitamin D deficiency are measured as a good glycemic control ( $HbA1c \leq 7\%$ ), which means almost they are normal patients among the population of this study are having vitamin D deficiency which could give us an impression about the effect of vitamin D on HbA1c which is a measure of diabetes. so we can also say that those who are showing good prognosis to diabetes are the most who are suffering Vitamin D deficiency. however only 5% of those having good glycemic control are showing sufficient amount of vitamin D level in their body which is significantly low percentage comparing to those having vitamin D deficiency from the same group.

**Table 3: vitamin D amount and its effect on HbA1c**

			Vitamin D amount			Total
			Deficiency	Insufficient	Sufficient	
<b>HbA1c-control.</b>	<b>Good</b>	<b>Count</b>	138	42	15	195
		<b>% within HbA1c</b>	70.8%	21.5%	7.7%	100.0%
		<b>% within Vit D</b>	63.0%	73.7%	65.2%	65.2%
		<b>% of Total</b>	46.2%	14.0%	5.0%	65.2%
	<b>Moderate</b>	<b>Count</b>	59	7	4	70
		<b>% within HbA1c</b>	84.3%	10.0%	5.7%	100.0%
		<b>% within Vit D</b>	26.9%	12.3%	17.4%	23.4%
		<b>% of Total</b>	19.7%	2.3%	1.3%	23.4%
	<b>Poor</b>	<b>Count</b>	22	8	4	34
		<b>% within HbA1c</b>	64.7%	23.5%	11.8%	100.0%
		<b>% within Vit D</b>	10.0%	14.0%	17.4%	11.4%
		<b>% of Total</b>	7.4%	2.7%	1.3%	11.4%
<b>Total</b>	<b>Count</b>	219	57	23	299	
	<b>% within HbA1c</b>	73.2%	19.1%	7.7%	100.0%	
	<b>% within Vit_D</b>	100.0%	100.0%	100.0%	100.0%	
	<b>% of Total</b>	73.2%	19.1%	7.7%	100.0%	

In contrast we can say that the most effected population with vitamin D deficiency is the diabetic children 70% of children population showed good glycemic control. The same thing in adolescent's participants those who are suffering from Vitamin D deficiency showed to be normal or prediabetic patients.

#### 4. DISCUSSION

There are significant differences in HbA1c levels in T1DM compared to controls and also significant negative correlation between HbA1c levels T1DM and levels of vitamin D. High HbA1c levels indicate poor glycemic control. A study in the United States had normal high HbA1c levels ( $9.3 \pm 1.9\%$ ) in T1DM with vitamin D deficiency. Vitamin D status is one of the components connected with glycemic control in children and teenagers with T1DM. VDR (Vitamin D Receptor) found on pancreatic beta cells, recommending its part in glycemic control. Vitamin D represses incendiary cytokine that is included in beta cell pulverization. Research by Magee and partners analyzed the relationship between vitamin D and glycemic control, measured by HbA1 in type 1 diabetes in the pediatric population *marra et al (2009)*.

But in this present study we have found there are also correlation between vitamin D deficiency and diabetic patients, and Indeed, animal and human studies support the notion that adequate vitamin-D supplementation may decrease the incidence of type-1 and possibly also of type-2 diabetes mellitus and may improve the metabolic control in the diabetes state. However, the exact mechanisms by which vitamin-D and calcium supplementation exerts their beneficial effects are not clear and need further investigation.

#### 5. CONCLUSION

Vitamin D sufficiency may provide protection against T1DM, Therefore, our data suggest an inverse association between the serum concentration of 25(OH) D3 and the odds of newly diagnosed type 1 diabetes, thereby suggesting a protective role of vitamin D against the development of the disease, as suggested previously in different studies. HbA1c is considered an indicator of average blood glucose concentrations during the preceding 2 to 3 months and, thus, a long-term marker of glucose homeostasis. Abnormalities may be a result of changes in insulin secretion and insulin-stimulated uptake of glucose in muscle and fat tissue. In vitro studies and laboratory animal studies suggest possible mechanisms for the effects of the active form of vitamin D.

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