



## Exploring the Interrelationship of Fasting Triglycerides Glucose Index with Vitamin D in type 2 Diabetes Mellitus with Hypothyroidism

Ashni SJ 1, Dr.G.Anuradha\*

1 M.Sc. Human Nutrition Student, Department of Biochemistry, Chettinad Academy of Research and Education, Kelambakkam, CHRI, Chengalpattu district, Tamil Nadu-603103, India,.

\*Professor, Department of Biochemistry, Chettinad Academy of Research and Education, CHRI, Kelambakkam, Chengalpattu district, Tamil Nadu-603103, India,

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### KEYWORDS

Fasting triglycerides glucose index, vitamin D, type 2 diabetes mellitus, hypothyroidism.

### ABSTRACT:

**Introduction:** Thyroid dysfunction in Type 2 Diabetes Mellitus is a pervasive health condition found in the adult population at large. Recent studies have highlighted the need for increased attention to the interplay between these two diseases, as they can affect each other. Therefore, this study aimed to investigate the effect of fasting triglycerides glucose index, a marker of insulin resistance with vitamin D in type 2 diabetes mellitus with hypothyroid dysfunction.

**Objectives:** Primary objective to determine the fasting triglycerides glucose index in diabetes mellitus with hypothyroidism dysfunction. To find the correlation between fasting triglycerides glucose index with vitamin D in type 2 diabetes mellitus with hypothyroid population.

**Methods:** A cross-sectional study was done between December 2023 and February 2024 at Chettinad Hospital and Research Institute, located in Kelambakkam, India. A total of 200 subjects between 35 to 70 years belonging to both genders were included in the study. Participants were categorized into two groups: Group 1 includes 100 patients with type 2 diabetes and hypothyroidism, and the other 100 is control group.

**Results:** The study shows significant negative correlation between fasting triglycerides glucose index and Vitamin D (P value - 0.02) in type 2 diabetes with hypothyroidism. ROC curve comparing Vitamin D with type 2 diabetes mellitus with hypothyroid shows AUC of 0.873 implying good accuracy.

**Conclusions:** The present study exhibited strong relationship between insulin resistance and Vitamin D among type 2 diabetes mellitus with hypothyroidism. Prompt therapeutic intervention with Vitamin D supplements in type 2 diabetes mellitus patients will for sure alleviate the complications and thereby considerably bring down the morbidity.

### 1. Introduction

Diabetes mellitus complicated by thyroid dysfunction are becoming more prevalent among adults. Both conditions have systematic effects on the body and can lead to metabolic disorders. Consequently, the coexistence of them should haul up furthermore health complications [1, 20]. Diabetes is a persistent health

condition arising from inadequate insulin synthesis by the pancreas or ineffective utilization of the produced insulin in the body. Insulin, a crucial hormone, is responsible for regulating blood glucose levels. Uncontrolled diabetes often results in hyperglycemia, characterized by elevated blood glucose or sugar levels, causing notable harm to various bodily systems,



particularly the nerves and blood vessels, over an extended period [2].

The most prevailing form is type 2 diabetes, typically observed in adults, because of resistance to insulin. Over the past thirty years, type 2 diabetes is notably more prevailing worldwide. Globally, approximately 422 million individuals are affected by diabetes, with the majority residing in low- and middle-income countries. Furthermore, around 1.5 million deaths annually can be directly linked to diabetes. The incidence and prevalence of diabetes have consistently risen in the past few decades [2]. According to the American Diabetes Association (ADA), HbA1c levels over  $>6.51\%$ , Fasting blood glucose levels over  $>126$  mg/dL, postprandial blood glucose levels over  $>200$  mg/dL are considered diagnostic of diabetes [3].

Hypothyroidism develops when the thyroid gland fails to produce enough thyroid hormone, or when there is insufficient stimulation from the hypothalamus or pituitary gland [4]. According to the American thyroid Association (ATA) Hypothyroidism can occur in the form of subclinical (TSH level 4.5-10 mIU/l) and overt hypothyroidism (TSH  $>10$  mIU/l) [5] and the occurrence of hypothyroidism fluctuates based on the global supply status of iodine [6]. Hypothyroidism is more widespread than hyperthyroidism, with a prevalence of approximately 4-5% in the developed world. [7] The occurrence of unidentified subclinical and that of clinical hyperthyroidism was 0.9% and 0.1%, respectively [8]. Therefore, the present study was conducted on hypothyroidism in type 2 diabetes mellitus.

A lack of vitamin D is a widespread health issue with over one billion individuals worldwide experiencing either deficiency or insufficiency of vitamin D [10, 11]. Vitamin D has a significant role in regulating the immune system, and this modulation may influence the thyroid gland by means of its immune-mediated mechanisms.

Vitamin D deficiency (VDD) is related to an enhanced risk of progressing to type 2 diabetes mellitus (T2DM), primarily due to insulin resistance (IR). Our objective is to investigate the correlation between Vitamin D deficiency and the triglyceride-glucose (TyG) index, a

strong measure of insulin resistance, in individuals with Type 2 Diabetes mellitus [12].

The connection between low vitamin D levels and the onset of autoimmune thyroid disease remains uncertain [13]. Research indicates an inverse relationship between serum TSH and vitamin D levels among individuals with hypothyroidism. Similarly, various autoimmune thyroid diseases have shown a correlation with vitamin D deficiency [14, 15].

Furthermore, vitamin D deficiency is associated with cardiovascular risk factors such as obesity, high blood pressure, abnormal lipid levels, insulin resistance (IR), and type 2 diabetes mellitus [16, 17]. However, there has been relatively limited research conducted on the correlation between vitamin D and hypothyroidism [14]. Hence, this study is to explore the impact of the fasting triglycerides glucose index on vitamin D levels among patients diagnosed with type 2 diabetes mellitus and hypothyroid dysfunction.

## 1. Objectives

To determine the fasting triglycerides glucose index in diabetes mellitus with hypothyroidism dysfunction. To find the correlation between fasting triglycerides glucose index with vitamin D in type 2 diabetes mellitus with hypothyroid population.

## 2. Methods

It was an age and sex matched cross sectional study. It was done among individuals who comes for diabetic clinic at Chettinad Hospital and Research Institute, Kelambakkam. This study was started after the Institutional human ethical committee gave approval. A total of 200 subjects 100 were cases with type 2 diabetes and hypothyroidism and 100 were control who were willing to give voluntary consent were included in the study. It includes both genders between the ages of 35 to 70 years.

### Exclusion criteria

Those suffering from systemic disorders hypertension, chronic kidney diseases (CKD), Rheumatoid arthritis, pregnant and lactating women, those who consume alcohol were excluded from the study.



## Data collection

Demographic details were obtained with the help of a semi-structured questionnaire. Anthropometric measurements like height and weight were measured through standard procedure and BMI was calculated using the formula (weight in kg/height in m<sup>2</sup>). 5ml of fasting blood sample collected and measured for HbA1c, fasting and postprandial blood glucose levels, vitamin D, serum-free T3, serum-free T4, TSH, and lipid profile levels are analyzed using automated Siemens chemistry analyzer. Fasting triglycerides glucose index was calculated using the formula:  $\ln [\text{fasting triglycerides (mg/dL)} \times \text{fasting plasma glucose (mg/dL)} / 2]$ .

## Statistical analysis

Data analysis was performed using SPSS version 29 software. Descriptive statistics, including mean and standard deviation, were computed. A p-value below 0.05 was regarded as statistically significant. The independent t-test was employed to determine the significance between the groups. To compare the Fasting triglycerides glucose index with Vitamin D in type 2 diabetes and hypothyroid patients in both genders, Pearson's correlation analysis was used.

## 3. Results

Correlation between fasting triglycerides glucose index and vitamin D with type 2 diabetes with hypothyroidism presented in table 1 and found to be statistically significant. By independent t test, BMI compared between case and control in table 2 and not significant. Age wise comparison of fasting triglyceride glucose index between case and control given in table 3 and found to be statistically significant. Age wise comparison of Vitamin D in table 4 and found to be statistically significant.

Table 1: Correlation between fasting triglycerides glucose index and vitamin D with type 2 diabetic, hypothyroid

Variables	Type 2 diabetic and hypothyroid (N=100)		
	Mean $\pm$ SD	P value	r value
Fasting triglycerides glucose index	5.22 $\pm$ 0.17	0.02*	-0.227
Vitamin D	8.03 $\pm$ 2.01	0.02*	-0.227

\*P value less than 0.05 level is significantly correlate.

Table 2: Independent t test Association between BMI with type 2 diabetic, hypothyroid and non- type 2 diabetic, hypothyroid patients.

BMI	Type 2 diabetic and hypothyroid (N=100)			Control (N=100)		
	Mean $\pm$ SD	t value	P value	Mean $\pm$ SD	t value	P value
	25.95 $\pm$ 3.69	1.325	0.187	25.30 $\pm$ 3.13	1.324	0.187

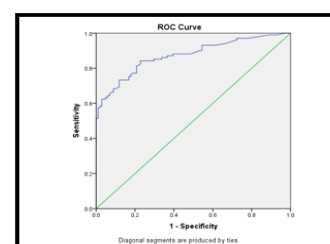
Table 3: Independent t test Association between case and control in different age groups.

Fasting triglycerides glucose index	Age group	Type 2 diabetic and hypothyroid (N=100)			Non- type 2 diabetic and hypothyroid (N=100)		
		Mean $\pm$ SD	t value	P value	Mean $\pm$ SD	t value	P value
	35-45	5.21 $\pm$ 0.19	21.499	0.00*	4.45 $\pm$ 0.17	21.242	0.00
	46-55	5.27 $\pm$ 0.16	14.81	0.00*	4.49 $\pm$ 0.172	14.933	0.00
	56-65	5.25 $\pm$ 0.77	17.044	0.00*	4.61 $\pm$ 0.089	17.418	0.00
	>65	5.25 $\pm$ 0.77	13.139	0.00*	4.64 $\pm$ 0.093	12.418	0.00

Table 4: Independent t test Association between age group and vitamin D with type 2 diabetic, hypothyroid and non- type 2 diabetic, hypothyroid patients.

Vitamin D	Age group	Type 2 diabetic and hypothyroid (N=100)			Non- type 2 diabetic and hypothyroid (N=100)		
		Mean $\pm$ SD	t value	P value	Mean $\pm$ SD	t value	P value
	35-45	8.11 $\pm$ 2.22	-7.042	0.00*	18.28 $\pm$ 9.69	- 7.984	0.00
	46-55	8.80 $\pm$ 1.95	-4.177	0.00*	19.05 $\pm$ 9.95	- 5.193	0.00
	56-65	7.64 $\pm$ 1.97	-6.637	0.00*	16.78 $\pm$ 6.38	-3.741	0.00
	>65	7.99 $\pm$ 1.66	-5.635	0.00*	24.05 $\pm$ 8.52	-4.166	0.00

Figure 1: ROC curve – Vitamin D with type 2 diabetic, hypothyroid and non- type 2 diabetic, hypothyroid patients.



Area Under the Curve

Area	Std. Error <sup>a</sup>	Asymptotic Sig. <sup>b</sup>	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
0.873	.025	.000	.824	.922

Figure 1 shows AUC of 0.873 implying significant accuracy of the test.

## Discussion

The pervasiveness of type 2 diabetes mellitus may escalate strikingly from 171 million to 366 million by 2030 [18]. It is a complex disease with several causes in which insulin resistance contributes a strong role [19].

The current research aimed to investigate the impact of the fasting triglycerides glucose index in conjunction with Vitamin D levels among individuals with type 2



diabetes mellitus and hypothyroidism. The study revealed a noteworthy correlation between fasting triglycerides glucose index and Vitamin D, consistent with the findings reported by Roshan Kumar Mahat et al. [20].

There was a high significant association with fasting triglycerides glucose index and Vitamin D in type 2 diabetes mellitus with hypothyroid individuals.

Therefore, the findings of this study suggest that fasting triglycerides glucose index could serve as a more effective predictor for detecting vitamin D deficiency early on, potentially aiding in the reduction of metabolic disorders such as diabetes mellitus and hypothyroidism. Additionally, utilizing this predictor could help in lowering mortality and morbidity rates more effectively.

Moreover, the results of the study can be employed for the benefit of dietitians, doctors, and other healthcare professionals.

### Limitation

The research was conducted with a limited sample size, which could have impacted the precision of the findings. A larger sample size would have provided increased accuracy in analysing the results of this study and allowed for more detailed examination.

### Conclusion

The results of this research suggest a notable association between the fasting triglycerides glucose index and Vitamin D among individuals with type 2 diabetes mellitus and hypothyroidism within the Kelambakkam population.

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### Conflict of interest

The authors declare that they do not have any competing interests or conflicts of interest.

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