

Evaluating the Relationship between HbA1C Levels, Lipid Profile, and TSH Levels in Subjects with Type 2 Diabetes

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Conflict of interest: Nil

Abstract:

Background: Previous literature established a link between diabetic status and thyroid dysfunction with data reporting a higher incidence of thyroid dysfunction in subjects with type 2 diabetes compared to type 1 diabetes. However, the literature data establishing this correlation are scarce.

Aims: The present study assessed the levels of HbA1c (glycosylated hemoglobin) and TSH (thyroid stimulating hormone) in the subjects with type 2 diabetes and to assess the correlation between HbA1c levels and thyroid hormone levels and in HbA1c levels and lipid type in type 2 diabetics.

Methods: The present retrospective study assessed 200 subjects from both male and female genders with type 2 diabetes mellitus. In all the subjects, laboratory data were retrieved for biochemical tests along with demographic data from the records of the institute. The data extracted were statistically analyzed to get the results.

Results: The study results showed normal levels of T4 and TSH in study subjects with respective values of 14.1 pmol/L and 4.5 mIU/L respectively and an increased value of HbA1c with 8.4% in the study subjects. A non-significant relationship was seen in HbA1c and thyroxin with $p=0.83$ and a weak positive correlation in TSH and HbA1c with $p=0.02$. A weak positive correlation was also seen among HbA1c and low-density lipoprotein and total cholesterol with respective p -values of 0.002 and 0.001.

Conclusion: The present study concludes that an increase in blood glucose levels can stimulate the anterior pituitary for increased TSH secretion. However, no direct correlation exists between the rate of thyroxin secretion and increased glycemic index. Also, a weak correlation exists between some lipid markers and blood glucose levels.

Keywords: Glycosylated hemoglobin, diabetes mellitus, thyroid dysfunction, thyroid stimulating hormone, type 2 diabetes

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Introduction

Diabetes mellitus represents a group of metabolic disorders identified with hyperglycemia seen secondary to defects in insulin utilization, insulin production, or both processes. Recent literature data depicts that nearly 170 million of the World's population had diabetes in the year 2000 and this is expected to increase to 366 million by the end of year 2030. [1] Duration of hyperglycemia is directly related to the occurrence of chronic complications in diabetics, and these complications are usually seen in the second decade after the development of diabetes mellitus. In India, diabetes mellitus is highly prevalent in all regions with more accumulation in the urban areas compared to the rural areas. [2]

One of the most common endocrine dysfunctions seen in India is diabetes mellitus which also affects a large population globally, and is commonly seen in diabetic subjects affected with type 2 diabetes

mellitus. Thyroid dysfunction is more common in the female gender and is seen in elderly females. [3]

Previous literature data assessing subjects with both type 2 and type 1 diabetes reported that thyroid dysfunction is seen in nearly 13% of subjects globally. It is also shown that thyroid disorder is seen in almost 11% of subjects affected with diabetes. [4] It was also reported that thyroid dysfunction is more prevalent in subjects with type 1 diabetes mellitus compared to subjects with type 2 diabetes mellitus with nearly 1/3rd of subjects with type diabetes reported with thyroid dysfunction and almost 25% of females having type 1 diabetes mellitus developing thyroid dysfunction in their postpartum period. Also, some literature data reports equal existence of thyroid disorders in type 2 and type 1 diabetes subjects. [5]

The most prevalent type of thyroid disease is hypothyroidism showing high prevalence. Hypothyroidism is usually shown to present similar clinical features in diabetic and non-diabetic subjects including an increase in insulin resistance and a decrease in blood glucose levels. [6] In some subjects, abnormal thyroid function shows a correlation to diabetes which is represented by renal disorders and very low blood glucose levels. Diabetes has also been linked to insufficient replacement of thyroid hormone in older subjects with hypothyroidism. [7]

Controlling and maintaining the blood glucose levels and keeping them within normal limits can halt the development of complications in diabetics, [8] The present study aimed to assess the levels of HbA1c in subjects with diabetes and to establish a correlation between HbA1c, thyroid hormone, and various lipid types to evaluate the significance of this correlation in preventing the worsening of risk of mortality related to cardiovascular diseases.

Materials and Methods

The present retrospective clinical study aimed to assess the levels of HbA1c in subjects with diabetes and to establish a correlation between HbA1c, thyroid hormone, and various lipid types to evaluate the significance of this correlation in preventing the worsening of the risk of mortality related to cardiovascular diseases. The study was done at Department of General Medicine, Shri Shankaracharya Institute of Medical Sciences, Bhilai, Chhattisgarh. The study included a total of 200 subjects with confirmed diagnoses of type 2 diabetes mellitus from both genders. Based on their age, these subjects were divided into three groups of age 30-50 years, 51-70 years, and above 70 years including 18 subjects, 112 subjects, and 70 subjects respectively. The study included 53% (n=106) females and 47% (n=94).

The inclusion criteria for the study were subjects having confirmed diagnosis of type 2 diabetes

mellitus, from both genders, from all the age groups, and with complete data and reports needed for the study. The exclusion criteria for the study were subjects with incomplete records needed for the study and subjects with type 1 diabetes mellitus. The data for the study were collected for any subject from both genders and any age group that was admitted to the institute at any point in time.

After getting approval from the Ethical Institutional Committee, the data needed for the study were gathered from the records of the institute from various departments and the laboratory for the tests being done. Demographic data for the study participants were also gathered from institutional data along with outcomes and clinical events. All the data were listed to form the results.

The data collected were statistically analyzed using the SPSS software version 21.0 (IBM Corp., NY, USA) and the Pearson correlation test. The data were expressed as frequency and percentage and mean and standard deviation. The significance level was taken at $p < 0.05$.

Results

The present retrospective clinical study aimed to assess the levels of HbA1c in subjects with diabetes and to establish a correlation between HbA1c, thyroid hormone, and various lipid types to evaluate the significance of this correlation in preventing the worsening of the risk of mortality related to cardiovascular diseases. The study included 200 subjects with a confirmed diagnosis of type 2 diabetes mellitus from both genders. Based on their age, these subjects were divided into three groups of age 30-50 years, 51-70 years, and above 70 years including 18 subjects, 112 subjects, and 70 subjects respectively. The study included 53% (n=106) females and 47% (n=94) male subjects. The demographic data of study participants are listed in Table 1.

Table 1: Demographic characteristics of the study subjects

S. No	Characteristics	Number (n)	Percentage (%)
1.	Gender		
a)	Males	94	47
b)	Females	106	53
2.	Age range		
a)	30-50	18	9
b)	51-70	112	56
c)	>70	35	35

On assessing the values of various parameters in the study subjects, it was seen that the values of LDL (low-density lipoproteins), HDL (high-density lipoproteins), Triglycerides, and total cholesterol in

study participants were 2.1 ± 0.7 , 1.2 ± 0.5 , 1.5 ± 1.2 , and 4.3 ± 1.3 mmol/L respectively and these parameters were within their reference values that were < 2.60 , > 1.55 , < 1.70 , and < 5.18 mmol/L

respectively. The mean value of HbA1c was $8.2 \pm 2.4\%$, for TSH was 4.3 ± 4.2 pmol/L, and for T4 was 14.2 ± 3.3 mIU/L respectively in study subjects, whereas, their reference values were 4.4-6.4%, 0.35-

4.94 pmol/L, and 9-19 mIU/L respectively depicting the mean values to be higher than the reference range as shown in Table 2.

Table 2: The mean values and reference values of various parameters in the study subjects

S. No	Parameter	Reference values	Mean \pm S. D
1.	LDL (mmol/L)	<2.60	2.1 \pm 0.7
2.	HDL (mmol/L)	>1.55	1.2 \pm 0.5
3.	Triglycerides (mmol/L)	<1.70	1.5 \pm 1.2
4.	Total cholesterol (mmol/L)	<5.18	4.3 \pm 1.3
5.	HbA1c (%)	4.4-6.4	8.2 \pm 2.4
6.	TSH (pmol/L)	0.35-4.94	4.3 \pm 4.2
7.	T4 (mIU/L)	9-19	14.2 \pm 3.3

A negative correlation in T4 and HbA1c with $p=0.83$ and $r=0.016$. However, a positive and significant correlation was seen in TSH and HbA1c levels on the Pearson correlation test with $p=0.02$ and $r=0.214$. On assessing the correlation between LDL levels and HbA1c, the results were positive significantly with $p=0.002$ and $r=2.95$. The study results also depicted a significantly positive correlation between cholesterol levels and HbA1c with $p=0.001$ and $r=0.23$.

The study results also showed a significantly negative correlation between cholesterol levels and age with $p=0.000$ and $r=0.335$. Also, a similar negative significant correlation was seen in age and LDL (low-density lipoprotein) levels with $p=0.001$ and $r=0.366$.

Discussion

The assessment of the HbA1c levels is vital in diabetic subjects for monitoring diabetes and blood sugar levels. Also, the results of the present study showed that in subjects with diabetes mellitus, the levels of blood sugar are raised compared to the normal non-diabetic subjects. These results were consistent with the studies of Saha et al [9] in 2012 and Vikhe et al [10] in 2012 where authors reported that levels of HbA1c are higher in diabetic subjects and have a vital role in diabetes monitoring.

Deranged lipid metabolism developing from high blood glucose levels and persistent hyperglycemia have caused various cardiovascular complications in subjects with diabetes. This can be supported by the results of the present study where a correlation has been shown in levels of LDL, total cholesterol, and HbA1c levels in subjects with diabetes mellitus. This was in agreement with the study of Khan HA et al [11] in 2007 where authors reported a direct correlation of HbA1c levels to levels of LDL and cholesterol.

Previously existing literature data showed that type 2 diabetes mellitus does not affect the levels of T4 hormone. Hence, normal T4 levels are usually seen in subjects with type 2 diabetes mellitus when matched to the existing and accepted reference

values depicting that oral hypoglycemics taken for type 2 diabetes mellitus can affect the thyroid hormone values which can be the reason for normal T4 levels seen in diabetics as reported by the study of Cappelli C et al [12] in 2009. However, the results from the present study showed no change in the TSH levels in the study participants which was in contrast to the study by Cappelli C et al¹² in 2009 where the author attributed these variations secondary to medications taken for diabetes mellitus.

Also, the correlation results in the present study reported that a positive correlation exists between the levels of TSH and levels of HbA1c in subjects with type 2 diabetes mellitus. These results were comparable to the study by Udiong CE et al [13] in 2007 where authors also reported a significant correlation in levels of TSH and HbA1c levels. The study results showed no correlation between levels of T4 hormone and levels of HbA1c in subjects with diabetes mellitus. These results were similar to the studies of Saha HR et al [9] in 2012 where authors also reported no association among levels of T4 hormone and HbA1c in subjects with type 2 diabetes mellitus.

A literature study by Volpato S et al [14] in 2001 reported that levels of LDL and cholesterol decrease with the increase in the age of the subjects which is also seen in the results of the present study where higher LDL and cholesterol levels are seen with increasing age. However, the present study depicted a positive and strong correlation between levels of triglycerides and cholesterol.

Conclusions

The present study concludes that an increase in blood glucose levels can stimulate the anterior pituitary for increased TSH secretion. However, no direct correlation exists between the rate of thyroxin secretion and increased glycemic index. Also, a weak correlation exists between some lipid markers and blood glucose levels. The present study suggested that levels of blood glucose should be strictly maintained in subjects with diabetes in the reference values suggested to avoid the chronic

complications arising from diabetes. Also, the thyroid hormone profile and lipid profile should be regularly checked in all the subjects with diabetes every 3 months as suggested by various guidelines.

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