



A Study of Thyroid Dysfunction and Its Associated Risk Factors among Type 2 Diabetes Mellitus Patients

Dr. C.Sathishkumar¹, Dr. C.Gunasundari², Dr.M.S.Gayathri.M.S³,
Dr.J.Vinodha⁴

¹Assistant Professor, Government Villupuram Medical College, Villupuram, Tamilnadu.

²Assistant Professor, Government Stanley Medical College, Chennai, Tamilnadu.

³Assistant Professor, Government Stanley Medical College, Chennai, Tamilnadu.

⁴Assistant Professor, Government Stanley Medical College, Chennai, Tamilnadu.

Date of Submission: 10-11-2020

Date of Acceptance: 24-11-2020

ABSTRACT: Thyroid diseases and diabetes mellitus are the two most common endocrine disorders encountered in clinical practice. Both these disorders have been shown to mutually influence each other and relationships between both conditions have long been reported. Thyroid hormones play a vital role in the regulation of carbohydrate metabolism and pancreatic function, and on the other hand, diabetes mellitus affects thyroid hormone levels to variable extents. Thyroid disease must be screened annually in diabetic patients to detect asymptomatic thyroid dysfunction. Diabetes mellitus and thyroid dysfunction can be found to exist together where thyroid disease can affect glucose metabolism and the untreated thyroid dysfunction can affect the control of diabetes.

Objectives: The present study was intended to explore thyroid dysfunction and its associated risk factors among patients with type 2 diabetes mellitus.

Materials and Methods: A cross-sectional study was conducted among patients with type 2 diabetes on treatment for 3 years with age group of more than 30 to 50 years and 100 patients taken up for the study attending the outpatient department of Karpaga Vinayaga Institute of Medical Sciences, Madhuranthagam. The assessment parameters for this study based on their life style factors and biochemical analysis such as FBS, PPBS, HbA1C, Lipid profile, Renal function test, Thyroid profile (ELISA).

Statistical Analysis: The data were analyzed by using standard Mean deviation student's T test and Univariate analysis. In all cases, $p < 0.05$ was considered as statistically significant.

Results: From the assessment status of diabetics, males have uncontrolled diabetes when compared to females and p value is < 0.05 and it was statistically significant.

Assessment of thyroid dysfunction in diabetics showed that males with thyroid dysfunction in the age group of 30-40 years are less when compared to females in the same age group. P value is < 0.05 and is statistically significant. But incidence of thyroid dysfunction in type 2 DM is higher in the age group of 41-50 years in both genders when compared to age group of 30-40 years. Correlation between thyroid dysfunction and diabetes in males and females among various age groups showed that thyroid dysfunction in females is greater even if they have controlled diabetes when compared to males. But thyroid dysfunction in males with uncontrolled diabetes is higher than females with uncontrolled diabetes. Incidence of thyroid dysfunction in females is higher even if they have controlled diabetes. This may be linked with their reproductive age and p value is < 0.05 and it is statistically significant. Comparison of incidence of renal failure in diabetics shows 8% of the males have renal failure and 4% of females have renal failure, indicates greater incidence of renal failure among males. Incidence of hypertriglyceridemia (triglycerides) is higher in males when compared to females and p value is < 0.05 and it is statistically significant. Incidence of hypercholesterolemia (total cholesterol) is higher in females than males in the age group of 41-50 years and p value is < 0.05 and it is statistically significant. Co-incidence of thyroid dysfunction with hyperlipidemia is higher in male diabetic patients when compared to female diabetics.

Conclusion: Assessment of Thyroid profile in the present study showed that thyroid dysfunction is greater in females even if they had controlled diabetes when compared to males. Thyroid dysfunction is higher in uncontrolled diabetic males when compared to females with uncontrolled diabetes. It seems that incidence of thyroid dysfunction is more in females even if they had



controlled diabetes. This may be associated with their reproductive age. The present study showed that the prevalence of thyroid dysfunction among Indian diabetic patients attending an outpatient clinic was 12.3%. Co-incidence of thyroid dysfunction with hyperlipidemia and renal failure is higher in male diabetics when compared to female diabetics. Hence it is concluded that thyroid dysfunction is positively associated with hyperlipidemia and renal dysfunction in type 2 DM. Regular evaluation of thyroid profile, lipid, profile and renal parameters is highly beneficial in type 2 DM patients and regular treatment of thyroid dysfunction with hyperlipidemia may reduce the risk of development of cardiovascular and renal complications in type 2 DM patients. Further research is needed to elucidate the exact molecular mechanism behind the link between hyperlipidemia and thyroid hormone dysfunction in type 2 DM and the life style modification also to be assessed.

Key words: Thyroid dysfunction, type 2 DM. Thyroid hormones, Hyperlipidemia, renal parameters

I. INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder that results in hyperglycemia (high blood glucose levels) due to being ineffective at using the insulin it has formed; also known as insulin resistance and or being unable to synthesize enough insulin. The occurrence has been steadily increasing throughout the world. DM is becoming a fast epidemic in some countries of the world with great number of people affected. This would expect to be double in the next decade due to increase in ageing population. It is also one of the leading cause of death worldwide.^[1]

Patients with type 2 DM are more vulnerable to various forms of complications both short- and long-term, which often lead to their death in young age. This tendency of increased morbidity and mortality is seen in patients with type 2 DM because of its insidious onset and late recognition, especially in resource-poor developing countries like Africa.^[2] In 2014, the International Diabetes Federation estimated that 387 million people around the world had DM, and by 2035 this number is likely to rise to 592 million. Factors such as inactive lifestyle, dietary modifications, ethnicity, and obesity have led to a remarkable increase in the occurrence of DM, particularly in the twenty-first century.^[3]

Diabetes mellitus (DM) is almost certainly one of the oldest diseases known to man. It was first reported in Egyptian manuscript about 3000

years ago.^[4] In 1936, the difference between type 1 and type 2 DM was clearly made. Type 2 DM was first described earlier as a factor of metabolic syndrome.^[5] Type 2 DM (formerly known as non-insulin dependent DM) is the most common form of DM characterized by hyperglycemia, insulin resistance, and relative insulin deficiency.^[6] Type 2 DM results from a combination of genetic, environmental and behavioural hazard factors.^[7]

In type 2 diabetes mellitus (T2DM) the primary defects observed are insulin resistance and abnormal insulin secretion by pancreatic beta-cells. DM is a common metabolic disorder considered by absolute or relative deficiencies in insulin secretion and/or insulin action associated with chronic hyperglycemia and conflict of carbohydrate, lipid and protein metabolism.

The thyroid gland is significantly concerned in metabolism of lipid and carbohydrate, role in adipogenesis and thermogenesis, regulation of body weight.^[8] Thyroid dysfunction may also interfere in control of diabetes. Hyperthyroidism is characteristically associated with deteriorating glycemic control and amplified insulin requirements. There is primary increased hepatic gluconeogenesis, rapid gastrointestinal glucose absorption, and probably increased insulin resistance. Indeed, thyrotoxicosis may unmask latent diabetes.⁸ The most common thyroid disorder is hypothyroidism. The association of thyroid disorder with diabetes is more frequent in diabetics who have deranged metabolic control. Thyroid hormones also influence the glycosylated haemoglobin levels.^[9]

In practice, there are several implications for patients with both diabetes and hyperthyroidism. First, in hyperthyroid patients, the diagnosis of glucose intolerance needs to be considered cautiously, since the hyperglycemia may improve with treatment of thyrotoxicosis. Second, underlying hyperthyroidism must be considered in diabetic patients with unexplained worsening hyperglycemia. Third, clinician need to anticipate potential deterioration in glycemic control and initiate the treatment accordingly in patients with diabetes and hyperthyroidism to lower the blood glucose level which will result in euthyroidism restoration.^[10]

Although wide-ranging changes in carbohydrate metabolism are seen in hypothyroidism, clinical manifestation of these abnormalities is seldom conspicuous. However, the condensed rate of insulin degradation may inferior



the exogenous insulin condition. More importantly, hypothyroidism is accompanied by a variety of abnormalities in plasma lipid metabolism, including elevated triglyceride and low-density lipoprotein (LDL) cholesterol concentrations.^[11] Even subclinical hypothyroidism can exacerbate the coexisting dyslipidemia commonly found in type 2 diabetes and further increase the risk of cardiovascular diseases. Lipid abnormalities can be reversed by replacement of sufficient thyroxine in patients with hypothyroidism.

Prevalence of thyroid dysfunction is higher in type 2 diabetes patients compared to normal population. Diabetes mellitus and thyroid dysfunction are the most common endocrine diseases seen among the adult population ^[11] while insulin or thyroid hormones metabolism can result in functional abnormalities of one another. The strong link between diabetes and thyroid diseases encouraged the American Diabetes Association (ADA) to propose that patients with diabetes must be checked periodically for thyroid dysfunction.^[12] Thyroid hormones may influence glucose level through a variety of actions on intermediary metabolism. Excess thyroid hormones promote hyperglycaemia by increasing insulin clearance, intestinal glucose absorption, and glycogenolysis and gluconeogenesis. Also, hyperthyroidism is associated with increased hepatic glucose output, reduced insulin action and increased lipolysis¹³ (Potenza et al., 2009). Accordingly, diabetic patients with overt hyperthyroidism may experience poor glycaemic control and indeed hyperthyroidism has been known to induce diabetic ketoacidosis in patients with diabetes.^[14] Thyroid disease must be screened every year in diabetic patients to detect asymptomatic thyroid dysfunction.^[15]

At the same time, patients with thyroid dysfunction may require to be tested for the prospect of abnormal glucose metabolism, since extreme thyroid hormones cause increased glucose production in the liver, rapid absorption of glucose through the intestine and increased insulin resistance.^[16] There are many risk factors known to be associated with thyroid dysfunction in the general population, including age, gender, BMI, family history of thyroid disease, smoking, and pregnancy. Incidence of hyperthyroidism and hypothyroidism increases with age, especially beyond 30 years, and it has been established that female gender is 10–20 times more likely to have this medical problem than males.^[17] Morbidly

accounting for 19.5% obese individuals show a high prevalence of overt and subclinical hypothyroidism.^[18] Risk factors for thyroid dysfunction among diabetic patients are similar to what have been reported in non-diabetics, although they will vary with the type of thyroid dysfunction., while hypothyroidism among diabetic patients is more prevalent among women^[18] and the older population.^[19]

Thus, the present study was intended to explore thyroid dysfunction and associated risk factors among type 2 diabetes mellitus patients in Tamil Nadu.

Aim: To evaluate thyroid profile, lipid profile, and renal parameters in type 2 Diabetes mellitus

Objectives: To assess the risk factors like thyroid profile, lipid profile and renal parameters for cardiovascular disease and renal disease in type 2 diabetes mellitus among male and female patients .To compare the serum levels of thyroid profile, lipid profile and renal parameters between controlled and uncontrolled diabetes patients.

II. MATERIAL AND METHODS

A cross-sectional study was carried out during the period of February 2016 to June 2017 among Type 2 diabetes patients on treatment for 3 years with age group of more than 30 to 50 years . 100 patients were taken for the study attending the outpatient department of Karpaga Vinayaga Institute of Medical Science for regular health checkup who have no known significant medical illness which can affect the outcome of the study.

This study was ethically approved by the institutional ethical committee. Age and Body mass index was quantified by bioelectrical impedance analysis. Blood samples for TSH, T4, T3, total cholesterol (TC), triglycerides (TGL), HDL-C, LDL-C, levels along with a written consent were taken from every patient. Fasting Serum sample from cases as well as control group was obtained to determine the following investigations. Thyroid function tests were measured by (Avantor Performance Materials, India) kit using Enzyme linked Immunosorbent assay (ELISA). Normal range of thyroid tests was TSH: 0.39–6.16 (μIU/ml), Free T4: 0.8–2.0 (ng/dl) and FT3: 1.4–4.2 (pg/ml). Patients with TSH levels >6.2 (μIU/ml) with normal FT4 & FT3 values were accepted to have SCH. Total cholesterol (130–250 mg/dl), triglycerides (60–170 mg/dl), HDL – cholesterol (male: 35–80 mg/dl; female: 42–88 mg/dl) VLDL (20–40 mg/dl), LDL (80–150 mg/dl). Blood sugar fasting (70–110 mg/dl) and post prandial (upto 130 mg/dl) and renal



function test such as urea (15- 40 mg/dl), creatinine (male: 0.9-1.4 mg/dl; female 0.8-1.2 mg/dl) was investigated by GOD/POD method, enzymatic method respectively. HBA1C (5- 7%) Immunoturbidimetry method was used for investigation.

The subjects were studied in terms of their thyroid dysfunction and its risk factors among type 2 diabetes. The study parameter used were: Age (30-50 years), Gender (males and females), Physical activity and exercise wise: low, moderate, high, Socioeconomic condition, Body mass index (BMI), Alcohol intake, Blood pressure.

Exclusion criteria: Type I diabetes mellitus patients, Patients on medications affecting thyroid function, Total and hemi thyroidectomy individuals, Gestational diabetes mellitus, Corticosteroid therapy, Diabetic keto acidosis, Neurodegenerative diseases, Cerebrovascular diseases, Tuberculosis, Cancer.

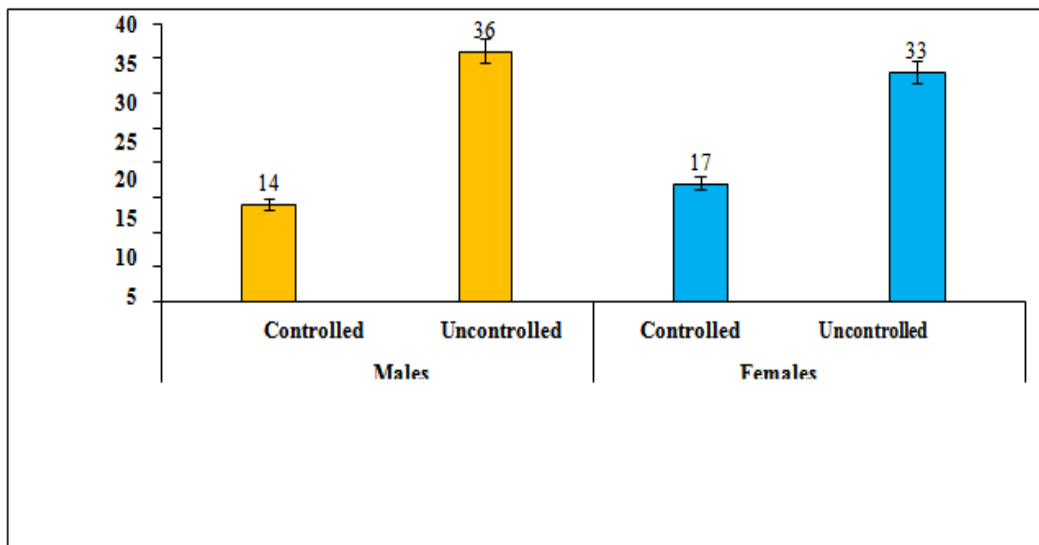
III. STATISTICAL ANALYSIS

This study was done to evaluate serum thyroid profile, lipid profile and renal parameters in type 2 diabetes mellitus patients and was done in total number of 100 subjects of which 50 patients were males and 50 patients were females. The data were analyzed by using standard Mean deviation, student's T test, % graph to compare the levels of various biochemical parameters in age-categorized male and female patients. Univariate analysis was performed to evaluate the gender, age and Thyroid dysfunction with glycemic control. p-value of <0.05 was considered as statistically significant.

IV. IV. RESULTS

The results obtained in the study as represented in figure 1-8 revealed significance of thyroid dysfunction and its risk factors among type 2 diabetes mellitus patients. Comparison assessment of males and females thyroid dysfunction and its associated risk factors.

FIG. 1. ASSESSMENT OF STATUS OF DIABETES MELLITUS IN STUDY GROUP



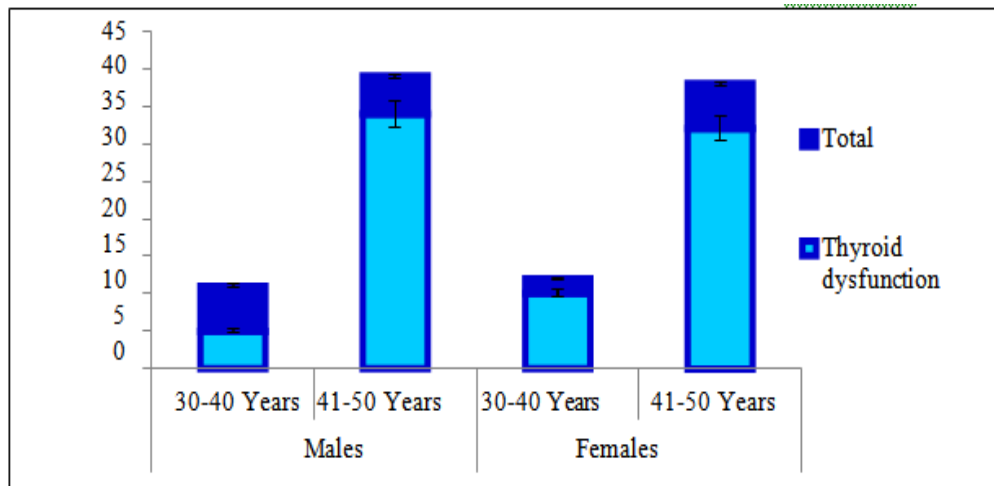
Gender	Status	Number of Patients
Males	Controlled	14
	Uncontrolled	36
Females	Controlled	17
	Uncontrolled	33



Fig.1.Represents the assessment of status of diabetes in males and females among various age groups. P value <0.05 is considered as statistically significant. Each bar represents controlled and uncontrolled diabetes among male and female through HbA1c levels. First column bar: Males with HbA1c 6.0 – 7.0; Second column bar: Males with HbA1c>7.0; Thirdcolumnbar:Femaleswith

HbA1c6.0–7.0;Fourthcolumnbar:Femaleswith HbA1c >7.0 Cases. Total number of cases: 50 (Males), 50 (Females). Each bar represents the assessment of status of diabetes in males and females among various age groups. P valueis<0.05 and it is statistically significant. From this assessment it is clear that uncontrolled diabetes is more in males when compared to females.

FIG.2DYSFUNCTION IN DIABETIC PATIENTS AMONG VARIOUS AGE GROUP



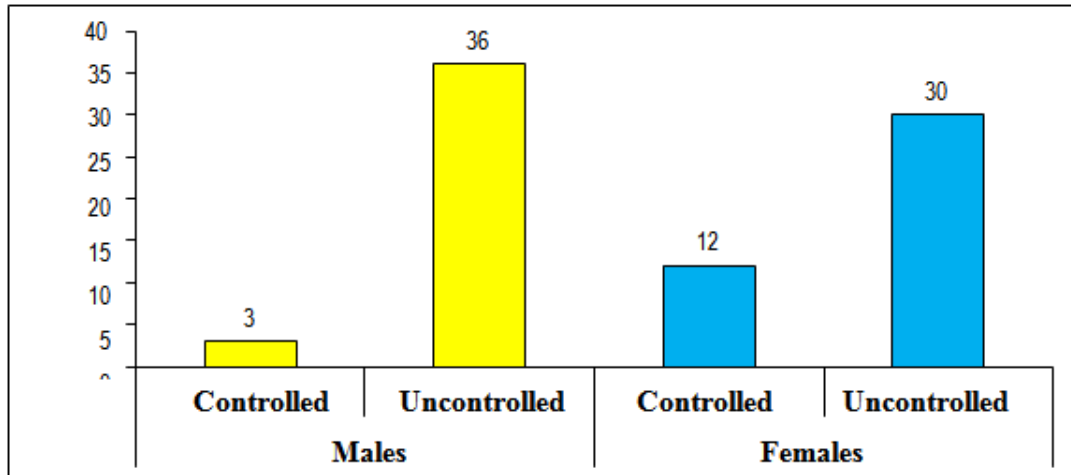
Gender	Age	Number of Patients with thyroid dysfunction	Total
Males	30-40 Years	5	11
	41-50 Years	34	39
Females	30-40 Years	10	12
	41-50 Years	32	38

Fig.2 Represents the assessment of thyroid dysfunction in diabetic males and females among various age groups. P value is <0.05 and it is statistically significant. Total number of individuals: 50 (males), 50 (females).Each stacked bar represents thyroid dysfunction in diabetic individual. From this assessment, the number of males with thyroid dysfunction at the age of 30-40 years are less when compared to females in the

same age group.P value is <0.05 and is statistically significant.The second stacked bar of this assessment shows that there is no much difference in both genders at the age group of 41-50 years with thyroid dysfunction in diabetic patients. But there is higher incidence of thyroid dysfunction in type 2 DM in the age group of 41-50 years in both genders when compared to age group of 30-40 years.



FIG. 3. CORRELATION BETWEEN THYROID DYSFUNCTION AND DIABETES BASED ON HBA1c



	Status	DM+Thyroid dysfunction
Males	Controlled	3
	Uncontrolled	36
Females	Controlled	12
	Uncontrolled	30

Figure : 3 Represents correlation between thyroid dysfunction and diabetes in males and females among various age groups. P value is <0.05 and it is statistically significant. Each bar represents controlled and uncontrolled diabetes among thyroid dysfunction in males and females. First column bar: Males have with thyroid dysfunction among controlled diabetes. Second column bar : Males with thyroid dysfunction among uncontrolled diabetes. Third column bar : Represents Females with thyroid dysfunction among controlled diabetes. Forth column bar :

Shows Females with thyroid dysfunction among uncontrolled diabetes .Total number of individuals: 50 (Males), 50 (Females). From this assessment, it is observed that thyroid dysfunction in females is greater even if they have controlled diabetes when compared to males. But thyroid dysfunction in males with uncontrolled diabetes is higher than females with uncontrolled diabetes. There is more incidence of thyroid dysfunction in females even if they have controlled diabetes.. This may be linked with their reproductive age.

FIG. 4. INCIDENCE OF RENAL FAILURE IN DIABETIC PATIENTS

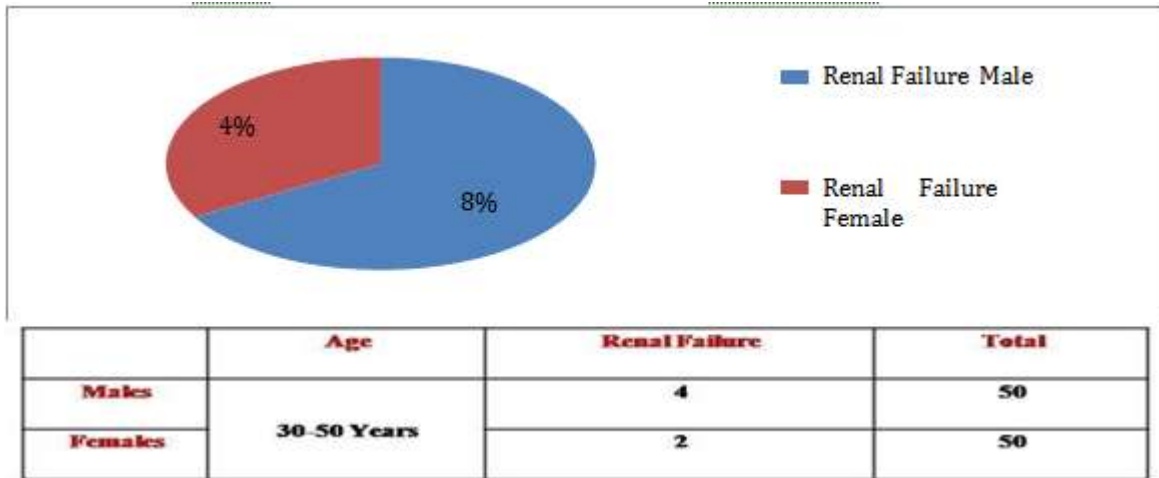


Figure. 4. Incidence of renal failure in diabetic patients. Total number of individuals: 50 (Males), 50 (Females). Pie chart is a representative of the incidence of renal failure in both diabetic males and females among 30-50 years age group. Comparison

of incidence of renal failure in diabetic patients shows 8% of the males have renal failure and 4% of females have renal failure, indicates greater incidence of renal failure among males .

FIG. 5. CO-INCIDENCE OF THYROID DYSFUNCTION AND RENAL FAILURE IN DIABETIC PATIENTS

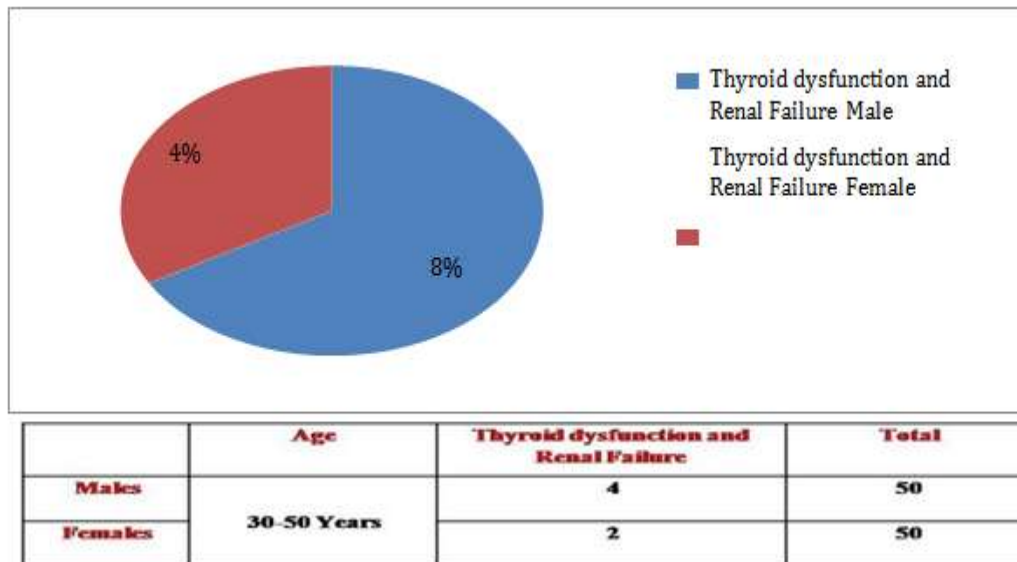
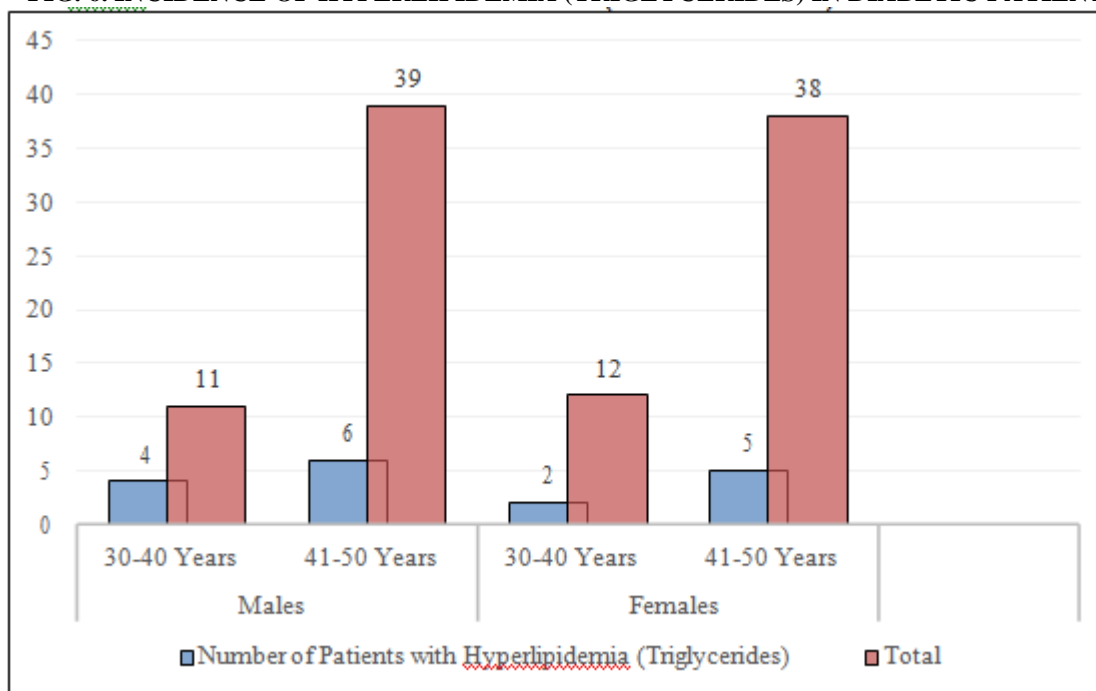


Figure. 5. Incidence of thyroid dysfunction and renal failure in diabetic individuals 50 (Males), 50 (Females). Pie chart is a representative of the incidence of thyroid dysfunction and renal failure

in diabetic males and females among 30-50 years age group. Comparison of co-incidence of thyroid dysfunction and renal failure is about 8% in males which is greater than females .



FIG. 6. INCIDENCE OF HYPERLIPIDEMIA (TRIGLYCERIDES) IN DIABETIC PATIENTS



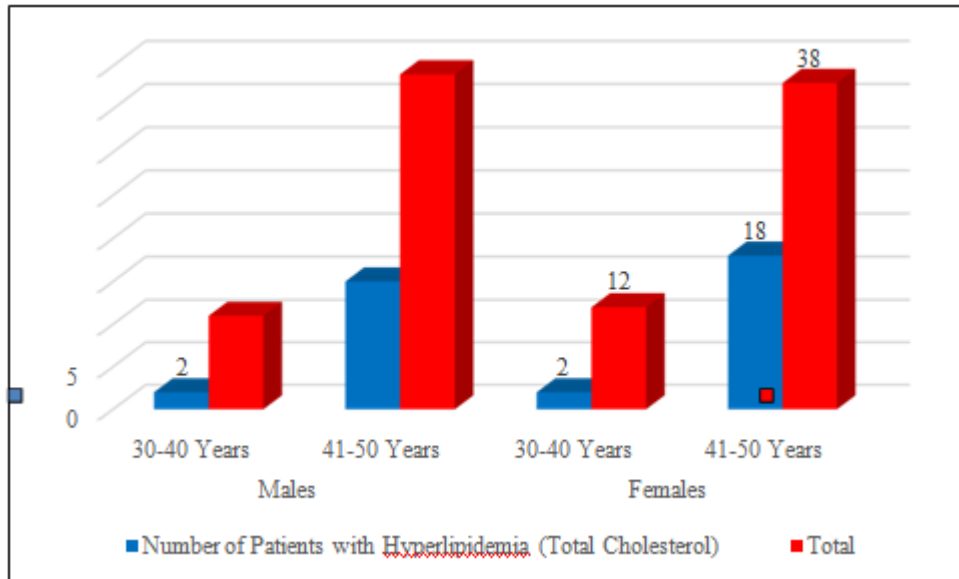
	Age	Number of Patients with Hyperlipidemia (Triglycerides)	Total
Males	30-40 Years	4	11
	41-50 Years	6	39
Females	30-40 Years	2	12
	41-50 Years	5	38

Figure 6 . Incidence of hypertriglyceridemia (triglycerides) in diabetic patients. Total number of individuals: 50 (Males), 50 (Females). This stacked bar diagram is a representative of the incidence of hypertriglyceridemia (triglycerides) in both diabetic males and females. P value is <0.05 and it is statistically significant. Each bar represents incidence of hypertriglyceridemia (triglycerides) in both diabetic males and females. First column bar: Represents 4 Males at the age of 30-40 years are

having hypertriglyceridemia (triglycerides). Second column bar: Represents 6 Males at the age of 41-50 years are with hypertriglyceridemia. Third column bar shows 2 Females at the age of 30-40 years having hypertriglyceridemia . Fourth column bar shows 5 Females at the age of 41-50 years are having hypertriglyceridemia . From this assessment it is observed that incidence of hypertriglyceridemia is higher in males when compared to females.



FIG. 7. INCIDENCE OF HYPERLIPIDEMIA (TOTAL CHOLESTEROL) IN DIABETIC INDIVIDUALS



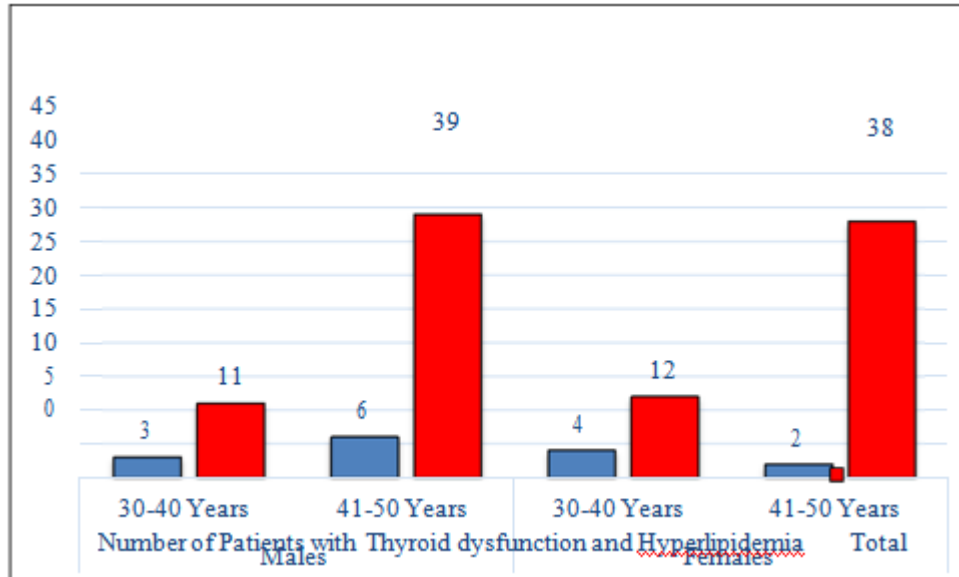
	Age	Number of Patients with Hyper-lipidemia (Total cholesterol)	Total
Males	30-40 Years	2	11
	41-50 Years	15	39
Females	30-40 Years	2	12
	41-50 Years	18	38

Figure: 7 Incidence of hypercholesterolemia (total cholesterol) in diabetic individuals. Total number of individuals: 50 (Males), 50 (Females). This stacked bar diagram is a representative of the incidence of hypercholesterolemia (total cholesterol) in both diabetic males and females. P value is <0.05 and it is statistically significant. Each bar represents incidence of hypercholesterolemia (total cholesterol) in both diabetic males and females. First column bar:

Represents 2 Males at the age of 30-40 years having hypercholesterolemia (total cholesterol). Second column bar represents 15 males at the age of 41-50 years are with hypercholesterolemia Third column bar shows 2 females with hypercholesterolemia . Fourth column bar: Represents 18 females at the age of 41-50 years are with hypercholesterolemia. So it is observed that incidence of hypercholesterolemia is higher in females than males in the age group of 41-50 years



FIG. 8. CO-INCIDENCE OF THYROID DYSFUNCTION WITH HYPERLIPIDEMIA IN DIABETIC PATIENTS



	Age	Number of Patients with Thyroid dysfunction and Hyperlipidemia	Total
Males	30-40 Years	3	11
	41-50 Years	6	39
Females	30-40 Years	4	12
	41-50 Years	2	38

Figure : 8 Co-incidence of thyroid dysfunction with hyperlipidemia in diabetic individuals. Total number of individuals: 50 (Males), 50 (Females). This stacked bar diagram is a representative of the co-incidence of thyroid dysfunction with hyperlipidemia in both diabetic males and females. $p < 0.05$ is considered as statistically significant. Each bar represents co-incidence of thyroid dysfunction with hyperlipidemia in diabetic males and females. It is observed that the Co-incidence of thyroid dysfunction with hyperlipidemia is higher in male diabetic patients when compared to female diabetics.

V. DISCUSSION

In our study, we reported a higher prevalence of thyroid dysfunction among both gender of diabetic patients. In a study by Perros et al.[20] the prevalence of thyroid dysfunction was

10.9% in females and 6.9% in males [20]. NHANES III study reported that the prevalence of subclinical hypothyroidism was 3.4% in males and 5.8% in females.[21] In addition, a study in 420 adult females with T2D randomly selected from participants in the community-based Fremantle Diabetes Study showed that the prevalence of subclinical hypothyroidism was 8.6%.[22] Finally, a recent study revealed the prevalence of subclinical hypothyroidism was 5.2% in males and 8.4% in females with T2D.[23] Our study results showed that male diabetic patients had poorer glycemic control with higher HbA1c level when compared to females. The FBS levels were slightly higher in males when compared to females. The levels of TGs were higher in males than females. Total cholesterol was slightly higher in females than males. Also the levels of renal parameters like urea and creatinine were increased



in diabetic males when compared to diabetic females since there is poor glycemic control in males.

In the present study we also observed that thyroid dysfunction in females is greater even if they had controlled diabetes when compared to males. But thyroid dysfunction in males with uncontrolled diabetes is higher than females with uncontrolled diabetes. There is more incidence of thyroid dysfunction in females even if they had controlled diabetes.. This may be linked with their reproductive age. It is observed that the Co-incidence of thyroid dysfunction with hyperlipidemia and renal failure is higher in male diabetic patients when compared to female diabetics. Higher levels of FBS, TG , TC, similar to other studies. [24,25] The cause of dyslipidemia in type 2 diabetes mellitus may be due to impaired liver apolipoprotein production which in turn regulates the enzymatic activity of lipoprotein lipase and cholesterol ester transportprotein. [26]

In the present study we found that diabetic patients with thyroid disorders had derangement in lipid profile, with respect to TGL and total cholesterol levels. The existing literature data regarding the association between hyperlipidemia and thyroid dysfunction supports the present study. While dyslipidemia is a reported complication of overt hypothyroidism in diabetic , [27, 28] subclinical hypothyroidism does not seem to be dyslipidemia (increased TGL) has been observed in type 2 diabetics, suggesting their increased susceptibility to vascular disease. [36] It is likely that the combination of thyroid dysfunction, hyperglycemia, dyslipidemia,

Insulin resistance and hypertension as in metabolic syndrome produces an enhanced atherogenic environment within the circulation.

VI. CONCLUSION

In the presence study, the serum levels of FBS, PPBS , HbA1c, Thyroid profile, urea, Creatinine and lipid profile were evaluated in type 2 Diabetes mellitus patients of both gender in the age group of 30-50 years. Our study results showed poor glycemic control with higher HbA1c levels in male diabetic patients when compared to females. Assessment of Thyroid profile showed thyroid dysfunction is greater in females even if they had controlled diabetes when compared to males. Thyroid dysfunction is higher in males with uncontrolled diabetes when compared to females with uncontrolled diabetes. It seems that more incidence of thyroid dysfunction in females even if they had controlled diabetes.. This may be

associated with dyslipidemia. A study by Chubb et al. did not find any significant relationship between subclinical hypothyroidism and the presence of dyslipidemia. Also, in large studies of subclinical hypothyroidism and coronary heart disease. [29,30] there was no association with raised serum cholesterol. The levels of HbA1c were higher in male patients when compared to females. Diabetes confers markedly increased risk of cardiovascular complications among both males and females. [31] However, women with diabetes are more susceptible to increased cardiovascular mortality. [32] They are subject to more adverse changes in coagulation, vascular function and cardiovascular risk factors than diabetic men. Serum TGL increases with poor glycemic control among males unlike females. The results of lipid profile showed that male diabetic patients had higher levels of TGL cholesterol, which is in agreement with earlier reports. [33,34] This may be attributed to the effects of sex hormones on body fat distribution, leading to differences in altered lipoproteins. [35]

Glucose lowering is essential for the prevention of micro vascular complication, and improvement in cholesterol is central to reducing cardiovascular disease in these patients. [25] A significant correlation

associated with their reproductive age. The present study showed that the prevalence of thyroid dysfunction among Indian diabetic patients attending an outpatient clinic was 12.3%. The levels of urea and creatinine were raised in diabetic males when compared to diabetic females since there is poor glycemic control in males indicating higher incidence of renal failure in diabetic males. The levels of TGL were higher in diabetic males when compared to females. It is observed that the Co-incidence of thyroid dysfunction with hyperlipidemia and renal failure is higher in male uncontrolled diabetic patients when compared to female diabetics. Hence, it is concluded that thyroid dysfunction is positively associated with hyperlipidemia and renal dysfunction in type 2 diabetes mellitus. So the estimation of serum thyroid profile , lipid profile and renal parameters is highly beneficial in type 2 diabetes mellitus patients to assess the cardiovascular and renal complications.

Regular treatment and follow up of thyroid dysfunction with hyperlipidemia may prevent or decrease the development of cardiovascular and renal complications in type 2



diabetes mellitus. . Further research is needed to elucidate the exact molecular mechanism behind the link between hyperlipidemia and thyroid dysfunction in type2 DM and the life style modification also to be assessed.

REFERENCES:

- [1]. Faghilimnai S, Hashemipour M, Kelishadi B. Lipid profile of children with type 1 diabetes compared to controls. *ARYA J*. 2006;2(1):36–38.
- [2]. Azevedo M, Alla S. Diabetes in sub-saharan Africa: kenya, mali, mozambique, Nigeria, South Africa and zambia. *Int J Diabetes Dev Ctries* 2008Oct;28(4):101-
- [3]. Zimmet P, Alberti KG, Shaw J. Global and societal implications of the diabetes epidemic. *Nature*. 2001;414 (6865):782–787.
- [4]. Ahmed AM. History of diabetes mellitus. *Saudi Med J* 2002 Apr;23(4):373-378.
- [5]. Patlak M. New weapons to combat an ancient disease: treating diabetes. *FASEB J* 2002 Dec;16(14):1853.
- [6]. Maitra A, Abbas AK. Endocrine system. In: Kumar V, Fausto N, Abbas AK (eds). *Robbins and Cotran Pathologic basis of disease (7th ed)* 2005. Philadelphia, Saunders; 1156-1226
- [7]. Chen L, Magliano DJ, Zimmet PZ. The worldwide epidemiology of type 2 diabetes mellitus--present and future perspectives. *Nat Rev Endocrinol*. 2011 Nov 8;8(4):228-36.
- [8]. Michalaki MA, Vagenakis AG, Leonardou AS, Argentou MN, Habeos IG, Makri MG, et al. Thyroid function in humans with morbid obesity. *Thyroid*. 2006;16(1):73–8. 10.1089/thy.2006.16.73 [PubMed]
- [9]. Vibha Uppal, Chitranjan Vij, Gurdeep Kaur Bedi, Anil Vij, Basu Dev Banerjee, Thyroid Disorders in Patients of Type 2 Diabetes Mellitus In- dian *J Clin Biochem*. 2013 Oct; 28(4): 336–341.
- [10]. Patricia Wu, MD Feb 2000, Thyroid Disease and Diabetes, original article.
- [11]. L. H. Duntas, J. Orgiazzi, and G. Brabant, “The interface between thyroid and diabetes mellitus,” *Clinical Endocrinology*, vol. 75, no. 1, pp. 1–9, 2011.
- [12]. American Diabetes Association, “Standards of medical care in diabetes—2013,” *Diabetes Care*, vol. 36, no. 1, pp. S11–S66, 2013.
- [13]. Potenza M, Via MA, Yanagisawa RT. Excess thyroid hormone and carbohydrate metabolism. *EndocrPract* 2009; 15: 254–62.
- [14]. Naeije R, Golstein J, Clumeck N, Meinhold H, Wenzel KW, Vanhaelst L. A low T3 syndrome in diabetic ketoacidosis. *Clin Endocrinol (Oxf)*. 1978; 8: 467-472
- [15]. R. S. Gray, W. J. Irvine, and B. F. Clarke, “Screening for thyroid dysfunction in diabetics,” *British Medical Journal*, vol. 2, no. 6202, p. 1439, 1979
- [16]. J. L. Johnson, “Diabetes control in thyroid disease,” *Diabetes Spectrum*, vol. 19, no. 3, pp. 148–153, 2006.
- [17]. R. W. V. Flynn, T. M. MacDonald, A. D. Morris, R. T. Jung, and G. P. Leese, “The thyroid epidemiology, audit, and research study: thyroid dysfunction in the general population,” *Journal of Clinical Endocrinology and Metabolism*, vol. 89, no. 8, pp. 3879–3884, 2004.
- [18]. G. E. Umpierrez, K. A. Latif, M. B. Murphy et al., “Thyroid dysfunction in patients with type 1 diabetes: a longitudinal study,” *Diabetes Care*, vol. 26, no. 4, pp. 1181–1185, 2003.
- [19]. S. A. P. Chubb, W. A. Davis, and T. M. E. Davis, “Interactions among thyroid function, insulin sensitivity, and serum lipid concentrations: the Fremantle diabetes study,” *Journal of Clinical Endocrinology and Metabolism*, vol. 90, no. 9, pp. 5317–5320, 2005.
- [20]. Cleland SJ, Fisher BM, Colhoun HM, Sattar N, Petrie JR. Insulin resistance in type 1 diabetes: what is ‘double diabetes’ and what are the risks? *Diabetologia*. 2013;56(7):1462–70
- [21]. Lundberg PR et al *Clin Chem* 28, 1241 (1982) J.G. Hollowell, N. W. Staehling, W. Dana Flanders et al., “Serum TSH, T4, and thyroid antibodies in the United States population (1988 to 1994): National Health and Nutrition Examination Survey (NHANES III),” *Journal of Clinical Endocrinology and Metabolism*, vol. 87, no. 2, pp. 489–499, 2002
- [22]. S. A. P. Chubb, W. A. Davis, and T. M. E. Davis, “Interactions among thyroid function, insulin sensitivity, and serum lipid concentrations: the Fremantle diabetes study,” *Journal of Clinical Endocrinology and Metabolism*, vol. 90, no. 9, pp. 5317–5320, 2005
- [23]. Chen HS, Wu TE, Jap TS, Lu RA, Wang ML, Chen RL, Lin HD. Subclinical hypothyroidism is a risk factor for nephropathy and cardiovascular diseases in



- Type 2 diabetic patients. *Diabet Med* 2007;24(12):1336-1344.
- [24]. Ladeia AM, Adan L, Couto-Silva AC, Hiltner A, Guimaraes AC. Lipid profile correlates with glycemic control in young patients with type 1 diabetes mellitus. *Prev Cardiol.* 2006;9(2):82-8.
- [25]. Eshaghian S, Horwich TB, Fonarow GC. An unexpected inverse relationship between HbA1c levels and mortality in patients with diabetes and advanced systolic heart failure. *Am Heart J.* 2006;151(1):91.
- [26]. Goldberg IJ. Lipoprotein lipase and lipolysis: central roles in lipoprotein metabolism and atherogenesis. *J Lipid Res.* 1996;37(4):693-707.
- [27]. Staub JJ, Althaus BU, Engler H, Ryff AS, Trabucco P, Marquardt K, Burckhardt D, et al. Spectrum of subclinical and overt hypothyroidism: effect on thyrotropin, prolactin, and thyroid reserve, and metabolic impact on peripheral target tissues. *Am J Med* 1992;92(6):631-642
- [28]. Johnston J, McLelland A, O'Reilly DS. The relationship between serum cholesterol and serum thyroid hormones in male patients with suspected hypothyroidism. *Ann Clin Biochem* 1993;30 (Pt 3):256-259.
- [34]. Esteghamati A, Abbasi M, Nakhjavani M, Yousefizadeh A, Basa AP, Afshar H. Prevalence of diabetes and other cardiovascular risk factors in an Iranian population with acute coronary syndrome. *Cardiovasc Diabetol.* 2006;5:15.
- [35]. Sibley SD, Thomas W, de Boer I, Brunzell JD, Steffes MW. Gender and elevated albumin excretion in the Diabetes Control and Complications trial/Epidemiology of Diabetes Interventions and Complications (DCCT/EDIC) cohort: role of central obesity. *Am J Kidney Dis.* 2006;47(2):223
- [29]. Tunbridge WM, Evered DC, Hall R, Appleton D, Brewis M, Clark F, Evans JG, et al. Lipid profiles and cardiovascular disease in the Whickham area with particular reference to thyroid failure. *Clin Endocrinol (Oxf)* 1977;7(6):495-508.
- [30]. Imaizumi M, Akahoshi M, Ichimaru S, Nakashima E, Hida A, Soda M, Usa T, et al. Risk for ischemic heart disease and all-cause mortality in subclinical hypothyroidism. *J Clin Endocrinol Metab* 2004;89(7):3365-3370.
- [31]. Haffner SM, Lehto S, Ronnema T, Pyorala K, Laakso M. Mortality from coronary heart disease in subjects with type 2 diabetes and in nondiabetic subjects with and without prior myocardial infarction. *N Engl J Med.* 1998;339(4):229-34.
- [32]. Gu K, Cowie CC, Harris MI. Diabetes and decline in heart disease mortality in US adults. *JAMA.* 1999;281(14):1291-7.
- [33]. Hanefeld M, Fischer S, Julius U, Schulze J, Schwanebeck U, Schmechel H, et al. Risk Factors for myocardial infarction and death in newly detected NIDDM: the Diabetes intervention study, 11-year follow-up. *Diabetologia.* 1996;39(12):1577-83.