CHAPTER V
DISCUSSION
DM is an important health problem affecting major populations worldwide. Epidemiological studies and clinical trials strongly support the notion that hyperglycemia is the principal cause of diabetes complications. Controlled blood glucose is the effective key for prevention of disease and improving the quality of life for patients with diabetes.\(^{164,165,166}\)

A recent study by the world health organization estimated that the worldwide prevalence of diabetes in 2002 was 170 million, with the number predicted to grow to 366 million or more by 2030. The adoption of sedentary lifestyle, consumption of non traditional foods and a genetic predisposition to the disease are thought to be the major underlying causes of the epidemic.\(^{73}\) Despite great studies that have been made in the understanding and management of diabetes, the disease and its related complications are increasing unmitigated. In some studies influence of endocrine and non endocrine organs other than pancreas on diabetes is documented.\(^{94}\)

Udiong et.al. reported that physiological and biochemical relationship between insulin and thyroid hormones influence on the metabolism of carbohydrate, lipids and proteins. Such records indicate that iodothyronines are insulin antagonists with high levels being diabetogenic, while absence of iodothyronines inhibits the development of diabetes.\(^{79,167,168}\) Thyroid dysfunction acts as a great obstacle in controlling blood sugar in diabetics. Hypothyroidism can decrease the amount of insulin required in diabetics and hyperthyroidism can deteriorate glucose control.\(^{169,170}\) Lipoprotein abnormalities
are also observed in diabetes and contribute significantly to its complications. But still there is a misconception that such abnormalities are always secondary to poor glycemic control and focus most of the attention on the management of hyperglycemia. As a result, the treatment of dyslipidemia was often neglected. Lipid abnormalities associated with T1DM predispose to atherosclerosis, but in contrast to T2DM, these abnormalities can often be reversed by appropriate glycemic control.\(^{171,172}\) This is somewhat surprising, given that these complications are the important cause of morbidity and mortality associated with both type 1 and type 2 diabetes with two to threefold increased incidence in men and an up to six fold increase in women compared to age-matched, non diabetic individuals.\(^{173,174,175}\)

Since thyroid hormone and lipid abnormalities are associated with diabetes, the present study is an attempt to estimate thyroid hormones and lipid profile parameters in diabetic and non diabetic groups.

### 5.1. Diabetes with Hypothyroid and Hyperthyroid

Thyroid disease is common in general population and the prevalence studies reveals that diabetes patients have higher prevalence of thyroid disorders compared with normal population\(^{165, 176}\). It is well known that patient with one organ specific autoimmune diseases are at risk of developing other auto immune disorders. Like type 1 diabetic patients have higher tendency to develop thyroid disorders, but number of reports have also indicated a higher than normal prevalence of thyroid disorder in type 2 diabetes patients with hypothyroidism being the most common.\(^{54,177}\)

Among the people of Bastar region both the endocrinopathies i.e. diabetes and thyroid dysfunction are profound. Due to illiteracy and very low socioeconomic condition people of this region are not much aware of nutrient intake. They mostly take rice, goiterogenic food and consume liquor on regular basis. Environmentally also Bastar region is affected
from severe and prolonged iodine deficiency, which can be seen in the form of thyroid dysfunction in the population.\textsuperscript{(10,16)}

In present study older women of higher mean age (62yrs, 52yrs, 45 yrs, 48yrs) in Table 2, 3, 6, 7; (figure 4 a) were found affected from type 2 diabetes mellitus with thyroid dysfunction and showed subclinical condition. This is in support with an Australian study \textsuperscript{(96)} where type 2 diabetes mellitus women with known thyroid disease commonly show subclinical hypothyroidism. The Colorado study show the prevalence of thyroid dysfunction is common in elderly females reaching upto 60 years of age.\textsuperscript{(92)} We observed females of mean age (37, 42, 38, 38) in Table 4, 5, 8, 9; (figure 4 b) as thyroid dysfunction without diabetes. Perros et.al. reports the frequency of thyroid dysfunction in T2DM equals that of T1DM because of older age group.\textsuperscript{(94)} The prevalence varies according to the studied population. The Whickman survey in North England showed prevalence of overt thyrotoxicosis in 2% females and 0.2% males.\textsuperscript{(64)}

Our studied patients of group diabetes, diabetes with hypothyroid and diabetes with hyperthyroid had poor diabetic control as evidence by high mean values of fasting and post parandial blood glucose levels in Table 1, 2, 6; when compared to the mean values of fasting and post parandial blood glucose levels in thyroid dysfunction patients without diabetes i.e. Table 5, 9. There was a significant difference observed in (Table 1B, 5B) fasting sugar and post parandial mean values between diabetic hypothyroid and hypothyroid groups (\textit{f} diff: 93.75) (\textit{pp} diff: 162), diabetes and hypothyroid group (\textit{f} diff: 71.9) (\textit{pp} diff: 185.2) and no significant difference in fasting sugar and post parandial sugar mean values of diabetic hypothyroid and diabetes, controls and hypothyroid (\textit{f} diff: 2.5) (\textit{pp} diff: 0.4).

Similarly, fasting sugar and post parandial sugar means showed a significant difference in (Table 2B, 6B) diabetic hyperthyroid and hyperthyroid groups (\textit{f} diff: 110.65) (\textit{pp} diff:
97.65), diabetic hyperthyroid and diabetes (f diff: 35.7) (pp diff: 54.5), diabetes and hyperthyroidism (f diff: 74.95) (pp diff: 152.15). No significant difference was observed in the mean of controls and hyperthyroid (f diff: 2.5) (pp diff: 0.4).

Mouradian M. suggested hypothyroidism may influence glucose metabolism by reducing hepatic glucose output, gluconeogenesis which finally disposes to hypoglycaemia.\(^{(178)}\)

The statement is accepted in present work as hypothyroid group showed significantly decreased fasting and post parandial glucose levels. On the contrary one case report by Johnson JL\(^{(176)}\) showed that blood glucose levels remains unaffected by hypothyroidism as insulin sensitivity is not altered. In fact, in patients utilizing insulin there may be a decrease in insulin requirements from reduced insulin degradation therefore glucose remains stable in hypothyroid condition. Subclinical condition was observed in both the groups of hypothyroid and diabetic hypothyroid.\(^{(54)}\) Celani P et.al. reported high frequency of thyroid function abnormalities in poorly controlled diabetes. These abnormalities were mostly subclinical and reverted to normal with improvement in blood glucose control in most of the patients.\(^{(179)}\) Co-existing diabetes may affect the treatment in thyroid dysfunction patients.\(^{(180)}\) A recent study in elderly patients on thyroxin treatment showed the presence of diabetes was independently associated with inadequate thyroid hormone replacement.\(^{(181)}\)

Maratou E et.al. reported insulin resistance which obviously leads to high glucose levels in both subclinical and overt hypothyroidism in fasting and post parandial state.\(^{(135)}\)

Some previous studies\(^{(134,182)}\) also observed hyperglycemia in those patients with overt hypothyroidism, due to impaired glucose disposal in peripheral tissues. Present finding strongly support the study by Maratou E et.al. which is known to be the first report showing that patients with subclinical hypothyroidism have hyperglycemia. However the insulin resistance observed does not seem to be clinically relevant in terms of significant
hyperglycaemia, possibly due to a compensatory decrease in hepatic glucose output.\textsuperscript{(183, 184) Kim SR et.al.} presented an interesting observation suggesting that the lower the thyroid hormone levels in plasma, the lower the sensitivity to insulin, resulting hyperglycaemia. This could explain the elevated glucose levels found in patients with overt and subclinical features.\textsuperscript{(185) Potenza M.} reported excess thyroid hormones promote hyperglycaemia by facilitating glucose intestinal absorption, enhancing glycogenolysis and gluconeogenesis.\textsuperscript{(122) Ober K. et.al.} showed that hyperthyroidism cause insulin resistance and gradually unmask impaired glucose tolerance and undiagnosed diabetes patients.\textsuperscript{(186) The current study agree with Potenza M.} by showing uncontrolled glucose levels in diabetic hyperthyroid group. 

Due to common signs and symptoms of thyroid disorders and diabetes, thyroid disorder remains undiagnosed some times. Studies revealed uncontrolled diabetes either type 1 or type 2 may induce a low T3 so that total T3 and free T3 will decrease and reverse T3 will increase but TSH and T4 will stay normal.\textsuperscript{(187) Present studies showed mean values of TSH and all thyroid hormones within reference range in diabetic group with unknown thyroid dysfunction (Table 1), while diabetes with known hypothyroidism group showed subclinical condition with mean value of increased TSH and all thyroid hormones were in normal limit (Table 2). Similarly subclinical condition was mainly observed in diabetes patients with known hyperthyroidism and this is characterized by increased mean values of thyroid hormones and decreased TSH. 

There is a significant difference observed between TSH mean value of diabetic hypothyroid group with controls (diff: 19.14) and diabetic (diff: 17.78) groups. Also, TSH mean value was observed significantly different between hypothyroid and controls (diff: 18.39) and diabetic (diff: 16.98) groups, (Table 33B). This shows that, in the
studied groups diabetes does not put any impact on thyroid stimulating hormone. The statement is again satisfied when no significant difference was observed in TSH mean values between diabetic hypothyroid and hypothyroid (diff: 0.8), diabetic and non diabetic (diff: 1.36) (Table 33B).

Present study is in agreement with Saiful Islam et.al. who stated that TSH levels were not significantly different between the diabetic and control group (also seen in our study), which indicates euthyroidism in diabetic patients.\(^{(188)}\) With the advent of sensitive assays for TSH measurements subclinical hypothyroidism will increasingly be diagnosed in healthy individuals. Despite a considerable amount of research the significance of these subclinical states remain unsettled. The implications of subclinical hypothyroidism in the patients with diabetes will depend upon its likelihood of progression to overt disease.\(^{(110,189)}\)

No significant difference was observed in mean values of T3 and T4 (Table 37B, 41B) between following groups: normal and diabetic (diff: 0.07) (diff: 0.50), diabetic and diabetic hypothyroid (diff: 0.37) (diff: 1.29), diabetic hypothyroid and hypothyroid (diff: 0.01) (diff: 0.7). T4 value differs significantly between diabetic and hypothyroid (diff: 1.99) group.

In a study by Saunders et.al. altered thyroid hormones were reported in T1DM and were significantly different with control groups, which after insulin treatment rose in these patients.\(^{(190)}\) A study by Saiful Islam et.al. reported low serum T3 levels but normal T4 and TSH in diabetic patients.\(^{(188)}\) Hereby studied results showed the normal level of thyroid hormones in various groups, and again supporting the subclinical condition of thyroid disorder. The abnormal thyroid hormone levels may be the outcome of various medications diabetes patients were receiving. Simultaneously, literature reveals that oral hypoglycemic agents such as phenylthioureas are known to suppress the levels of T4 and
FT4, while raising the levels of TSH. It is also known that insulin is an anabolic hormone which enhances the level of FT4 while suppress the level of T3 by inhibiting hepatic conversion of T4 to T3.\(^{(177)}\) This may be the true reason in present study that TSH levels were found elevated in diabetic hypothyroid group due to medications but no changes were observed in the same group for mean values of T4.

No significant difference was observed in the mean values of FT3 between diabetic, diabetic hypothyroid, hypothyroid, controls (Table 45B). On the other hand FT4 mean values was found to be significantly different between hypothyroid and diabetic hypothyroid (diff: 4.1) and between diabetic and diabetic hypothyroid (diff: 3.52) groups. Low FT4 values of diabetic hypothyroid group in present study agree with the study of Johnson et.al \(^{(176)}\) showed the suppressed levels due to oral hypoglycemic agents. Haarburger D in his study reports as a high serum TSH concentration with normal serum FT4 and FT3 concentrations are confirmation of subclinical hypothyroidism.\(^{(191)}\) The availability of highly sensitive immunoassay for serum TSH provides advance in diagnosis of thyroid disease. It is the most reliable and sensitive screening test for thyroid dysfunction and allows both hypothyroidism and hyperthyroidism to be diagnosed with certainty. Additionally, subclinical thyroid dysfunction can only be diagnosed by an abnormal TSH because the serum T3 and T4 are normal and by definition the patients are usually asymptomatic. Subclinical hypothyroidism can elevate serum LDL cholesterol and worsen preexisting dyslipidemia, further increasing risk of atherosclerosis, cardiac arrhythmias and exacerbate angina. Since diabetic patients are at high risk for cardiovascular diseases, the diagnosis and treatment of subclinical thyroid disease is important.\(^{(165)}\)

A significant decrease was observed in mean values of TSH with high T4, FT4 and normal T3, FT3, among diabetic hyperthyroid and hyperthyroid groups. All the thyroid
hormones between diabetic and non diabetic were found within reference range (Table 1, 6, 9, 10).

It is known that a suppressed serum TSH concentration is the earliest biochemical manifestation of hyperthyroidism. Subclinical hyperthyroidism is characterized by suppressed serum TSH concentration with normal thyroid hormones. Diabetes mellitus influences the assessment of thyrotoxicosis by falsely decreasing the blood levels of T4 and T3 during severely uncontrolled hyperglycemia. Some laboratory interprets low TSH with high FT4 due to T4 ingestion, ectopic thyroid tissue or iodine induced or subclinical hyperthyroidism; while normal FT3 may be because of non thyroidal illness. Monlka F. Bayer reported transiently low or high TSH tended to be associated with normal FT4 and prolonged subnormal TSH with subnormal FT4. By contrast, subnormal TSH plus elevated FT4 were encountered in cases of subclinical hyperthyroidism. Poorly controlled diabetes with or without its complications may produce changes in thyroid function tests that occur in non thyroidal illnesses. Typical changes include a low serum T3 due to impaired extra thyroidal T4 to T3conversion, a low serum T4 due to decreased protein binding, and an inappropriately low serum TSH concentration.

No significant difference was observed in the mean value of TSH between hyperthyroid and diabetic hyperthyroid patients (diff: 0.01) rest all the groups show significantly different TSH mean values (Table 34B). T3 and FT3 mean values were observed insignificant among all groups (Table 38B, 46B). T4 and FT4 were commonly significant differed between diabetic hyperthyroid and controls, diabetes groups; hyperthyroid with normal and diabetes groups (Table 42B, 50B).

Most of the guidelines advocate measuring of TSH and thyroid antibodies at diagnosis of diabetes. TSH is known to be the most sensitive means of detecting thyroid
dysfunction and sensitive third generation assays are readily available in most modern laboratories. A normal TSH concentration has a high negative predictive value for excluding thyroid disease, and changes in TSH concentrations usually precede changes in free thyroid hormone levels in the development of thyroid failure. However TSH alone may be inappropriate in specific clinical situations such as in pituitary disease or in monitoring patients with known thyroid disease. Estimation of FT4 with TSH will be necessary in these instances and may need to be repeated to distinguish true thyroid dysfunction from non thyroidal illness.\(^{(110)}\)

### 5.2. Diabetic and Thyroid Dysfunction with Dyslipidemia

The physiological and biochemical interrelationship between insulin and iodothyronines have been recorded on the metabolism of carbohydrates, proteins and lipid\(^{(167,197)}\). Such records indicate that iodothyronines are insulin antagonist with high levels being diabetogenic while absence of the hormone inhibits the development of diabetes.\(^{(197)}\) Moreover, thyroid hormones have significant effects on the synthesis, mobilization and metabolism of lipids.\(^{(198,199)}\) Although there have been several large cross-sectional studies examining the association between thyroid dysfunction and metabolic abnormalities, few have studied type 2 diabetes.\(^{(200)}\) In a study by Bakker et.al. no association of TSH with insulin sensitivity was reported but there were significant positive associations of TSH with LDL-C, TC, and non-HDL-C and an inverse association with HDL-C.\(^{(201)}\) Similar interactions have been demonstrated in diabetic patients and together these studies suggest a modifying influence of insulin sensitivity on the effects of hypothyroidism on lipid profile.\(^{(110)}\)

In the present study significantly high glucose levels (fasting & post parandial) were observed in diabetic hypothyroid with dyslipidemia and diabetic hyperthyroid with dyslipidemia (Table 3, 7); fasting sugar mean values of these groups differ significantly
from hypothyroid with dyslipidemia (diff: 119), diabetic (diff: 42.65) and controls (diff: 112.05), (Table 3B). Similar pattern of significant difference was observed in diabetic hyperthyroid with dyslipidemia group (Table: 4B). Mean values of post parandial sugar does not differ significantly between diabetes and diabetic hypothyroid with dyslipidemia (diff: 28.3), hypothyroid with dyslipidemia and controls (diff: 0.29), (Table: 7B); diabetes and diabetic hyperthyroid with dyslipidemia (diff: 36.55), normal and hypothyroid with dyslipidemia (diff: 1.40) (Table: 8B).

T2DM is associated with multiple metabolic derangements that result in the excessive production of reactive oxygen species and oxidative stress. Lowenstein and Giugliani suggested a variety of potential mechanisms for the initiation of endothelial dysfunction in T2DM, including the effects of hyperglycemia, advanced glycation end products (AGE) and dyslipidemia. Abnormal lipid metabolism often presents in patients with NIDDM. Resistance to insulin likely underlies the changes that occur in lipid parameters of NIDDM, and usually it is associated with higher concentrations of TC and TG, and lower concentrations of HDL-C.

In the present study lipid profile parameters were found within the normal range in diabetes group when compared to controls (Table 1). Mean values of TC, Tg, HDL, LDL, VLDL and TC/HDL ratio in diabetic group were observed within the normal limit but simultaneously significant difference was also observed in various parameters between diabetic group and diabetic hypothyroid, hypothyroid, normal (Table 9B, 13B, 17B, 21B, 25B, 29B). Although Tg does not significantly differ between hypothyroid and diabetic group (diff: 2.57) (Table 13B); TC/HDL ratio does not differ between diabetic and hypothyroid (diff: 0.53), controls (diff: 0.06) (Table 29B); HDL does not differ between diabetic and hypothyroid (diff: 2.9), diabetic hypothyroid (diff: 2) (Table 17B).
The same tedious picture of TC, Tg, HDL, LDL, VLDL, ratio was observed among diabetic, diabetic hyperthyroid, hyperthyroid and control groups i.e. the parameters were normal or slightly high (Table 1, 6, 9, 10) but with a significant difference when compared to controls. This may be due to the medications prescribed these days which along with controlling hyperglycemia also controls the altered lipid profile.

Dyslipidemia is common in patients with T2DM and is held to be responsible for considerable CVD-related morbidity and mortality. At the level of the adipocyte, impaired insulin action leads to increased rates of intracellular hydrolysis of triglycerides. The rise in nonesterified fatty acids (NEFA) provides substrate for the liver that, in the presence of impaired insulin action and relative insulin deficiency, is associated with complex alterations in plasma lipids. Patients with T2DM are at high risk from complications associated with atherosclerosis and should therefore receive preventive interventions. KREINTZ in a review included, the lipid-lowering arm of the Anglo-Scandinavian Cardiac Outcomes Trial (ASCOT) was halted because of a significant reduction in cardiovascular events compared with placebo. Surprisingly an analysis of subgroups failed to show significance among the diabetic population, although the sample size, shortened follow-up period and higher drop-in statin use among diabetics on placebo may have affected results. The Collaborative Atorvastatin Diabetes Study (CARDS), involving 2800 patients with Type 2 diabetes, was halted 2 years early in June 2003 because patients allocated atorvastatin had significant reductions in MI, stroke and surgical procedures compared with those receiving placebo. The UK prospective diabetes study (UKPDS) demonstrated that the appearance and progression of certain microvascular complications of T2DM could be reduced by treatment directed at hyperglycaemia. By the appropriate use of statins in patients with Type 2 diabetes can control lipid profile and significantly reduce
cardiovascular morbidity and mortality. Various studies (primary prevention with gemfibrozil: Helsinki Heart Study; secondary prevention with simvastatin and pravastatin: Scandinavian Simvastatin Survival Study and Cholesterol and Recurrent Events [CARE], respectively) have demonstrated that lipid-lowering therapy in type 2 diabetes is effective in decreasing the number of cardiac events. (210)

Thyroid function significantly affects lipoprotein metabolism as well as some cardiovascular risk factors. Nutrient intake in the food consumed by individuals were calculated according to Nutritive Value of Indian Foods and then compared with recommended dietary allowances to know the inadequacy in diet and nutrients were found lower than recommended allowance, protein intake was also not closer. (11,211) Oxidative stress is also affected by thyroid dysfunction with controversial outcomes in various studies. Furthermore endothelial and cardiac functions as well as atherosclerosis have been positively associated with thyroid hormone levels. (69)

Increased mean values of TSH were seen in diabetic hypothyroid with dyslipidemia and hypothyroid with dyslipidemia group while T3, T4, FT3, FT4 were seen within reference range (Table 3,4). Thyroid hormones (T3, T4, FT4) mean values were elevated in diabetic hyperthyroid with dyslipidemia and hyperthyroid with dyslipidemia group with a significant decrease in TSH and normal FT3, when compared to controls (Table 7, 8). Mean values of TSH in hypothyroid with dyslipidemia differ significantly from diabetes (diff: 16.95) and controls (diff: 18.31); similarly diabetic hypothyroid with dyslipidemia differ significantly from diabetes (diff: 13.98) and controls (diff: 15.34) (Table: 35B). T3 mean values differ significantly in controls and diabetic hypothyroid with dyslipidemia (diff: 0.54), diabetes and diabetic hypothyroid with dyslipidemia (diff: 0.47) (Table 39 B). Mean values of FT3 and T4 does not differ in any of the studied dyslipidemic groups (Table 43B, 47B). FT4 is significantly differ between diabetic hypothyroid with
dyslipidemia and hypothyroid with dyslipidemia (diff: 4.42), diabetes group (diff: 4.21), and control (diff: 3.87) (Table 51B). Above mentioned results showed the subclinical conditions in hypothyroid patients with and without diabetes.

Insulin resistance in many studies is found correlated with thyroid function.\(^{212,213,214,215}\) TSH is positively associated with fasting and post parandial insulin concentration and negatively with insulin sensitivity.\(^{213}\) Moreover, low normal FT4 levels are significantly associated with increased insulin resistance.\(^{216}\) Oxidative stress is also affected by thyroid function with studies however showing controversial outcomes.\(^{216,217}\)

Subclinical hypothyroidism is associated with increased levels of TC and LDL-C\(^{218,219}\), additionally some studies have shown that subclinical hypothyroidism dyslipidemia may also be accompanied by increased Tg and decreased HDL-C levels. In the present study elevated levels of TC, Tg, LDL-C, VLDL-C and TC/HDL ratio with normal HDL-C were observed in diabetic hypothyroid with dyslipidemia (Table 3) and hypothyroid with dyslipidemia (Table 4) when compared to diabetes (Table1) and controls (Table 10). TC and LDL-C were not significantly different between hypothyroid with dyslipidemia and diabetic hypothyroid with dyslipidemia( diff: 16.1) (diff: 12) (Table 11B, 23B ) , they also show no difference among diabetic and control groups like Tg (diff: 10.6), VLDL-C (diff: 3.12), TC/HDL ratio (diff: 0.03) (Table 11B, 15B, 23B, 27B, 31B).

Dyslipidemia is well recognized association of hypothyroidism and typically consists raised levels of TC, LDL-C and reduced levels of HDL-C.\(^{220}\) Such lipid abnormalities are partly reversible with thyroxine treatment in patients with co-existence diabetes.\(^{221}\) Several studies have reported inter dependent associations between thyroid status, dyslipidemia and insulin resistance. In euthyroid persons low normal thyroid hormone levels were associated with hyperlipidemia and insulin resistance.\(^{110}\) Furthermore, hypothyroidism is associated with endothelial dysfunction as determined by increased
arterial intima media thickness or impairment in flow mediated endothelial dependent vasodilation.\(^{(222)}\) A study in healthy euthyroid men showed positive correlations between TSH, endothelial dysfunction and insulin resistance lending further support to the three way relationship between thyroid status, insulin resistance and cardiovascular disease risk.\(^{(110,213)}\)

Iqbal et.al. reported patients with high TSH had significantly higher levels of TC, LDL-C whereas Tg, HDL-C did not differ significantly compared with euthyroid. Similarly results from the fifth Tromso study showed increased levels of LDL-C in subclinical hypothyroid patients.\(^{(69)}\) There is some controversy regarding the presence or the severity of subclinical hypothyroidism induced dyslipidemia. Indeed there have been studies indicating no significant difference in lipid profile between subclinical hypothyroid patients and controls.\(^{(223,224,225)}\) Data from NHANES III revealed increased level of TC in subclinical hypothyroid patients vs controls. However when adjusted for age, race, sex and the use of lipid lowering drugs no difference was observed between subclinical hypothyroid and controls regarding lipid profile.\(^{(226,227,228,229)}\)

Regardless with the above conclusions, our study showed alterations in lipid profile and significant differences among the groups of subclinical hypothyroidism with and without diabetes when compared to controls. In a study association between lipid, thyroid dysfunction and insulin resistance has been observed. The analysis from the subgroup of Fremantle Diabetes Study (FDS) showed that the association of TSH levels and lipid profile is significant mainly in the presence of insulin resistance.\(^{(201)}\)

Thyroid autoimmunity may also play an important role in elevation of lipoprotein levels. It has been reported that euthyroid males and postmenopausal females with evidence of thyroid autoimmunity have increased lipoprotein levels. On the other hand a study compared the levels of lipoproteins of euthyroid subjects with thyroid autoimmunity with
those of age and sex matched controls no significant difference was observed in the values of lipid parameters including lipoproteins. Furthermore, the presence of thyroid autoimmunity has not been shown to influence serum lipid parameters in subclinical hypothyroid subjects.\(^{(230)}\)

Diabetic hyperthyroid with dyslipidemia and hyperthyroid with dyslipidemia groups show a significant increase in thyroid hormone levels (T3, T4, FT4) and decreased TSH levels when compared to controls (Table 7, 8, 10). TC, Tg and LDL-C were significantly increased in diabetic hyperthyroid with dyslipidemia and HDL-C, VLDL-C, TC/HDL ratio remain unaltered. Hyperthyroid with dyslipidemia show decreased Tg and increased TC/HDL ratio when compared to controls.

In a study by Canaris et.al showed that the incidence of hyperthyroidism is lower compared with hypothyroidism in general population and so on a decreased prevalence of hyperthyroidism is evident in dyslipidemic patients.\(^{(92)}\)

In contrast to our results Kung AW et.al., and Aviram M et al. reported that despite the increased, levels of Tg, TC tends to decrease in patients with clinical or subclinical hyperthyroidism. This is due to increased LDL receptor gene expression resulting in enhanced LDL receptor mediated catabolism of LDL-C particles. Also they reported decreased HDL-C levels, due to increased CETP mediate transfer of cholesteryl esters from HDL-C to VLDL-C and increased HL mediated catabolism of HDL and Tg’s remain unchanged.\(^{(231, 232)}\)

Hyperthyroid is associated with increased hepatic glucose output and increased lipolysis. Accordingly diabetic patients with overt hypothyroidism may experience poor glycemic control and is known to add diabetic ketoacidosis, CVD risk in patients with diabetes.\(^{(233)}\)

Prominent cardiovascular features such as tachycardia, arrhythmias, congestive cardiac failure and systolic hypertension are well recognized manifestations of
thyrotoxicosis. Studies have reported increased mortality in patients with subclinical and overt hyperthyroidism, defined as suppressed TSH in the presence of normal thyroid hormone levels. Lee et.al. reported that individuals with subclinical hyperthyroidism are more likely to develop atrial fibrillation than euthyroid persons, whereas 10-15% of patients of overt hyperthyroidism show atrial fibrillation. Cardiovascular mortality in hyperthyroidism is linked to older age, cardiac arrhythmias or pre-existing organic heart disease.

The coexistence of both diabetes and thyroid disorders have been shown associated with increased morbidity and mortality. Presently studied patients had poor diabetic control as evidence by high blood glucose levels and altered thyroid hormones accounts for more worsened condition. Hypothyroid patients showed a hyperlipidemic profile while in hyperthyroid patients lipid profile remain unchanged. There is a little agreement on thyroid disease screening strategies in routine diabetes care. The increased frequency of thyroid dysfunction in diabetes calls for a systematic routine approach for thyroid testing. The study is regionally also important because no such work has been conducted so far in the tribal area of Bastar.