



ASSESSMENT OF SERUM TOTAL TESTOSTERONE LEVEL AND LIPID PROFILE AMONG SUDANESE MALES WITH TYPE TWO DIABETES MELLITUS IN KHARTOUM STATE- SUDAN.

Myada L. H. Alaraki¹, Elhashimi E. Hassan², Elmutuz H. I. Elssaig³ and Abdalla E. Ali^{4*}

^{1,2,3,4}Clinical Biochemistry Department, Faculty of Medical Laboratory Science, Alzaiem Alazhari University (AAU), Sudan.

*Author for Correspondence: Dr. Abdalla E. Ali

Clinical Biochemistry Department, Faculty of Medical Laboratory Science, Alzaiem Alazhari University (AAU), Sudan.

Article Received on 10/09/2016

Article Revised on 30/09/2016

Article Accepted on 20/10/2016

ABSTRACT

Background: Testosterone plays a significant role in glucose homeostasis and lipid metabolism. The objective of the study was conducted to assess serum total Testosterone levels among Sudanese males with type two diabetes mellitus and comparison with apparently healthy control. **Methods:** Descriptive cross sectional study, Fifty males with type two diabetes mellitus were selected as a test group was compared with a control group apparently healthy 50 volunteers. The analysed variables were age, serum levels of total Testosterone, lipid profile estimated, BMI was measured. **Results:** There was a significant decrease in mean of serum levels of total Testosterone in males with type two diabetes mellitus (1.99 ± 1.29) while (3.47 ± 1.94) in control groups respectively ($P < 0.001$). In this study the prevalence of low serum total testosterone was 66% in patients with type two diabetes mellitus. There was a significant increase in the mean of serum levels of total Testosterone in good glycemic controlled males (2.68 ± 1.43) while (1.67 ± 1.10) in non-glycemic controlled groups respectively ($P = 0.009$). The results indicated significant correlations between serum total Testosterone with serum levels of Triglyceride, HDL cholesterol, and insignificant correlations between serum total Testosterone with serum levels of Cholesterol, LDL cholesterol. The results indicated a significant correlation between the mean of serum total Testosterone & the age in type two diabetic patients ($P = 0.037$), also indicate insignificant correlation between the mean of serum total Testosterone & BMI. **Conclusions:** It concluded that, the serum total Testosterone levels are significantly altered in Sudanese males with type two diabetes mellitus.

KEYWORDS: Testosterone, lipid profile, HbA1c, Sudanese males, Diabetes Mellitus.

1. INTRODUCTION

An inverse relationship exists between testosterone levels and insulin concentrations in healthy men, Biochemical evidence indicates that testosterone is involved in promoting glucose utilization by stimulating glucose uptake, glycolysis.^[1] There has been an alarming increase, of epidemic proportions, in both obesity and diabetes in the general population with increased cardiovascular risk associated with type 2 diabetes mellitus (T2DM).^[2]

The relationship between testosterone and diabetes in men is an important issue. It's not clear whether one causes the other, Research shows that men with low testosterone are more likely to develop type 2 diabetes. Testosterone enhances the body's response to insulin, so it's possible that low testosterone can cause a poor response to insulin and diabetes is a disease in which the body does not produce or properly use insulin.

In men with low plasma testosterone, the probability of diabetes mellitus is increased. Prospective studies have shown that men with higher testosterone levels had a 42% lower risk of type 2 diabetes.^[3]

previous study done in Jordan found correlation of testosterone level and different variable was found, age ($p = 0.005$), BMI ($p = 0.004$), dyslipidemia ($p = 0.493$), HbA1c ($p = 0.009$).^[4]

In U.K Kapoor *et al.*^[44] in 2007 studied the Clinical and Biochemical Assessment of Hypogonadism in Men With Type 2 Diabetes, were enrolled in the study a low Testosterone level, total Testosterone significantly and negatively correlated with BMI ($r = -0.247$; $P < 0.001$). Total Testosterone was significantly associated with A1C ($r = -0.16$; $P = 0.04$), total Testosterone was significantly lower in men with A1C $> 6.5\%$.^[5]

The previous study evaluate the relationship between Diabetes Mellitus (DM) and serum levels of free (FT) and total (TT) Testosterone diabetic and nondiabetic, were paired according to age. TT serum levels were subnormal in 34% of diabetics and in 23% of nondiabetics.^[6]

Dhindsa *et al.*^[7] In 2004 described the frequent occurrence of hypogonadotropic hypogonadism in T2DM, they investigated the prevalence of hypogonadism in type 2 Diabetes and found that Thirty-three percent of patients were hypogonadal, LH and FSH levels were significantly lower in the hypogonadal group compared with patients with normal testosterone levels.^[7]

The relation of lipid and lipoprotein levels to androgen level and diabetic status was assessed. Men with diabetes had significantly lower plasma levels of total Testosterone (14.7 nmol/L compared with 17.4 nmol/L) than nondiabetic men. They also had significantly lower high-density lipoprotein (HDL) cholesterol and significantly higher triglyceride levels. The total Testosterone level was positively correlated with the HDL cholesterol level ($P = 0.009$) and negatively correlated with the Triglyceride level ($P = 0.0001$).^[8]

3. MATERIALS AND METHODS

3.1. Study Population: This was descriptive cross sectional, the study samples was comprised 50 Sudanese males with type two diabetes mellitus, in contrast, 50 healthy volunteers are involved as control group. Both groups are age matched. Exclusion criteria were Sudanese males Patients suffering from any Hypogonadism or chronic diseases. dyslipidemia were excluded from our study.

3.2. Exclusion Criteria

Sudanese males with: A known history of hypogonadism, panhypopituitarism, or chronic debilitating disease such as renal failure, cirrhosis and dyslipidemia were excluded from our study or those who were on testosterone supplementation were excluded from the study.

3.3. Biochemical measurements

Blood was taken from each participant by standard procedures, serum for total testosterone, total cholesterol, triglyceride, HDL and blood container contain EDTA anticoagulant for HbA1c estimation. Total testosterone was measured by Microplate Enzyme Immunoassay, total cholesterol, triglycerides, HDL were measured by spectrophotometry, and HbA1c was measured by Chromatographic – spectrophotometric method.

3.4. Data analysis

Statistical Package for Social Science (SPSS version 17) computer software was used for data analysis. We used

independent T-test and correlation test (significance levels was set at $P < 0.05$). Data were presented inform of tables and figures.

3.5. Ethical consideration: The protocol for the research project was approved by a suitably constituted ethics committee of the faculty of Medical laboratory Science, Alzaiem Alazhari University (AAU), Sudan .The individual induced on this study must be notify well about the objectives and the need of this study and must accept to donate the blood sample before the start of collection process.

4. RESULTS

Fifty patients with type two diabetes mellitus were participate in this study as a test group and 50 healthy volunteers as a control group. The Age of the test group was matched with control group.

In this study the prevalence of low serum total Testosterone was 66% in diabetic patients.

Comparison between Age, BMI, serum level of total Testosterone, total Cholesterol, Triglyceride, HDL cholesterol and LDL cholesterol in diabetic patients and control: BMI, Total Cholesterol, HDL cholesterol and LDL cholesterol were insignificant different in test and control group.

The serum Total Testosterone levels were significant lower in male with type two diabetes as compared to control group ($p < 0.001$) and the Triglyceride levels were higher in male with type two diabetes as compared to control group ($p = 0.001$) Table(4.1).

Effect of glycemic control of diabetes mellitus on Serum Total testosterone level: The percent of Diabetic patients with good glycemic control was 16% and Non glycemic control was 68% figure(4.2).

The serum level of total Testosterone was significant higher in patients with glycemic control in contrast with non glycemic controlled diabetic patients ($P = 0.009$) Table(4.2).

Relationship between age, BMI, serum total Cholesterol, Triglyceride, HDL cholesterol, LDL cholesterol and serum total Testosterone level.

There was a significant correlation between Age, Triglyceride and HDL cholesterol with serum total Testosterone level.

There was no correlation between BMI, serum total cholesterol and LDL cholesterol with serum total testosterone level Figure (4.4) (4.5) (4.6) (4.7) (4.8) (4.9).

Table (4.1): shows the Baseline characteristics and Biochemical measures of the test group and the control group.

Parameter	Test group N = 50 (Mean±SD)	control group N = 50 (Mean±SD)	P value
Age (years)	49.6 ± 7.86 (30 – 59)	46.9 ± 8.69 (32 – 59)	0.112
BMI (Kg/m ²)	24.9 ± 3.6 (18.1 – 34.2)	26.3 ± 3.6 (20.8 – 34.3)	0.055
Serum total testosterone	1.99 ± 1.29 (0.1 – 6.1)	3.47 ± 1.94 (0.6 – 12)	< 0.001
s.total Cholesterol (mg/dl)	191.2 ± 42.4 (120 – 346)	177.7 ± 27.1 (125 – 232)	0.062
s.Triglyceride (mg/dl)	167.4 ± 56.2 (77 – 334)	134.8 ± 39.4 (81 – 294)	0.001
HDL (mg/dl)	55.8 ± 12.5 (32 – 88)	53.2 ± 14.4 (34 – 88)	0.339
LDL (mg/dl)	101.9 ± 32.6 (50 – 233)	97.7 ± 24.2 (55 – 161)	0.467

- The table shows the mean ± SD, minimum and maximum values, probability (p value).
- T-test used for the comparison.
- P- Value < 0.05 considered significant.

Table (4.2): shows the comparison of the means of the serum total testosterone between glycemic control and non glycemic control among test group.

	Glycemic control N = 16	Non glycemic control N = 34	P value
Serum total testosterone	2.68 ± 1.43 (0.6 – 6.1)	1.67 ± 1.10 (0.1 – 3.9)	0.009

- The table shows the number of cases, the mean ± SD, minimum and maximum values, probability (p value).
- T-test used for the comparison.
- P- Value < 0.05 considered significant.

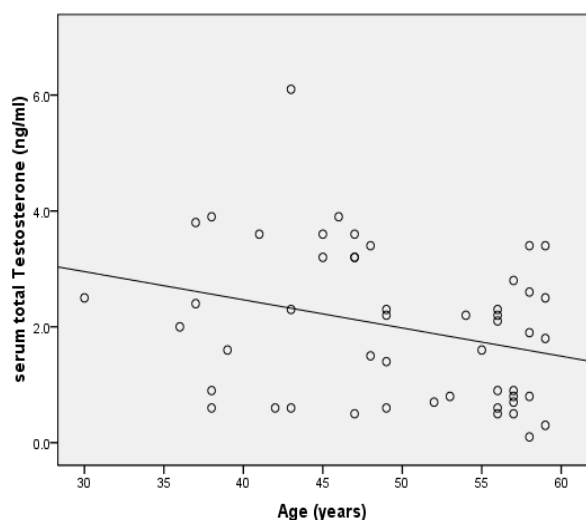


Figure (4.4): Ascotter plot shows the relationship between Serum Total Testosterone (ng/ml) & the age (years). ($r = -0.295$, $P = 0.037$)

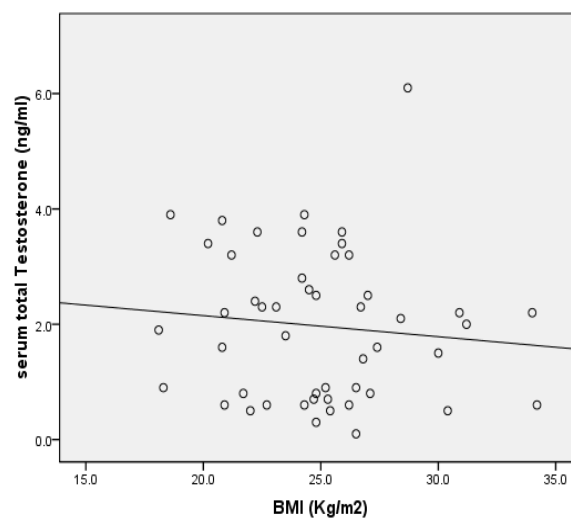


Figure (4.5): Ascotter plot shows the relationship between Serum Total Testosterone (ng/ml) & BMI (Kg/m²). ($r = -0.098$, $P = 0.499$)

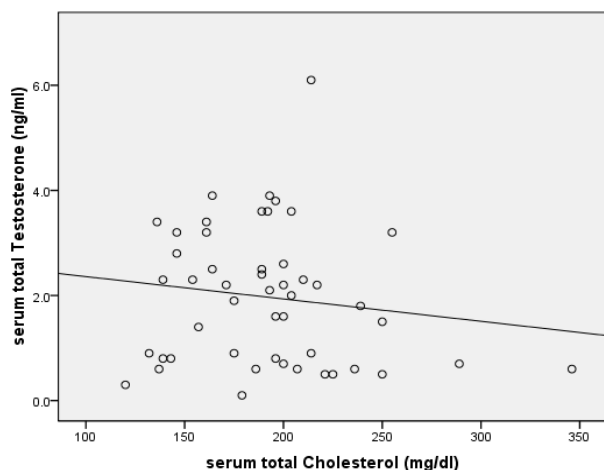


Figure (4.6): Ascotter plot shows the relationship between serum total Testosterone (ng/ml) & serum total Cholesterol (mg/dl).
($r = -0.154$, $P = 0.287$)

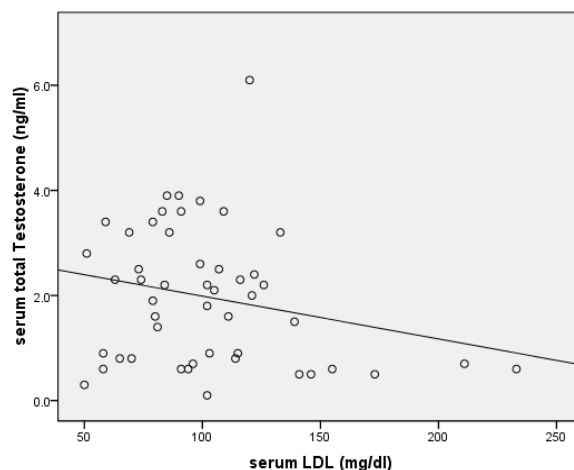


Figure (4.9): Ascotter plot shows the relationship between serum total Testosterone (ng/ml) & serum LDL cholesterol (mg/dl).
($r = -0.239$, $P = 0.095$)

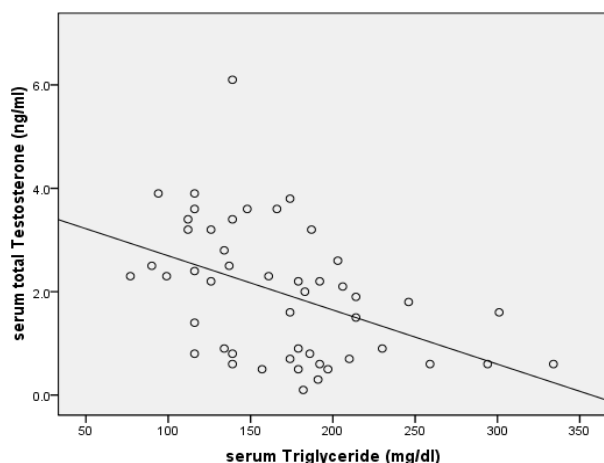


Figure (4.7): Ascotter plot shows the relationship between serum total Testosterone (ng/ml) & serum Triglyceride (mg/dl).
($r = -0.466$, $P = 0.001$)

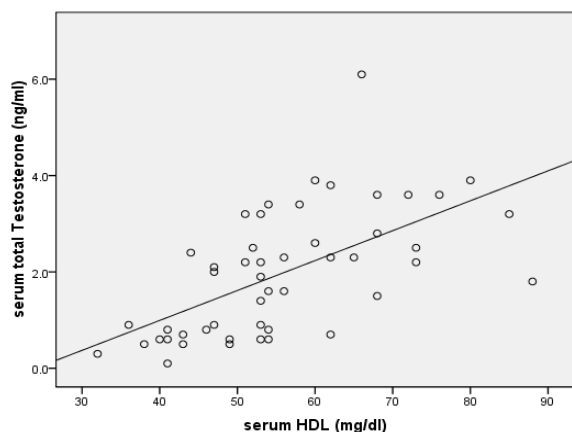


Figure (4.8): Ascotter plot shows the relationship between serum total Testosterone (ng/ml) & serum HDL cholesterol (mg/dl).
($r = 0.601$, $P < 0.001$)

5. DISCUSSION

Testosterone is the principal sex hormone in men. It has become apparent that testosterone plays a significant role in glucose homeostasis and lipid metabolism. T2DM may be one of the commonest causes of hypogonadism – a lack of function in the testes, which adversely affects testosterone production. The present study found that 66% of patients with T2DM between 30 and 59 years who participated in this recent study had a total Testosterone level of < 2.5 ng/ml. there is an inverse relationship between testosterone levels and diabetes in this group of patients. These agree with several cross-sectional studies and systemic analyses from various countries which reported that T2DM is associated with low serum Total Testosterone level. Al hayek *et al* in 2013 found that 36.5% of patients with diabetes had low serum testosterone level,^[4] Kapoor *et al* in 2007 found that 20% (71 men) had low total Testosterone level^[5], Dhindsa *et al*, in 2004 found that 43.7% had low total Testosterone.^[7]

Men with diabetes have lower Testosterone levels compared to men without a history of diabetes, our findings showed a significant decrease of the mean serum total Testosterone among patients with T2DM compared with control group ($p < 0.0001$). This finding has been substantiated by a meta-analysis by Ding *et al*^[9] & meta-analysis of 28 cross-sectional by Corona *et al*.^[10] & Ernani L.*et al*^[6] and Elizabeth Barrett-Connor.^[8] Who reported that there was a significant decrease of the mean of serum total Testosterone.

Our finding was not consistent with the findings revealed by Doustmohammadian S, *et al*^[11] who reported that the mean Serum total Testosterone had no difference between Men with diabetes and control groups.

Our findings showed a significant increase of the mean serum total Testosterone among diabetic patients with

good glycemic control (HbA1c < 7.5%) compared with Non glycemic controlled patients (HbA1c > 7.5%) ($p=0.009$). This finding has been substantiated by Kapoor *et al*^[5] while it is in contrast with those by Ernani L.*et al*^[6] they did not find an association between the serum Testosterone level and HbA1c concentration. Both cross-sectional and longitudinal studies have indicated decreased Testosterone levels in the older population compared to the younger.^{[12], [13], [14]}

Our study found a significant association between total Testosterone and age ($P = 0.037$). With a highest prevalence of low total Testosterone in men aged between 50 and 59 years.

Many studies have addressed the relationship between BMI and low serum Testosterone of patients with T2DM. The outcomes of these studies are controversial. Some studies have shown a significant association between BMI and serum total Testosterone level.^{[15], [16]} In contrast, there was a study that reported no relationship between total Testosterone and BMI.^[17] However, the present study observed insignificant correlation between BMI and serum total Testosterone levels. Our findings showed a significant increase of mean Serum Triglyceride among patients with T2DM compared with control group ($p=0.001$). Testosterone level was positively correlated with the HDL cholesterol level ($P < 0.001$) and negatively correlated with the Triglyceride level ($P = 0.001$). This finding has been substantiated by Elizabeth Barrett-Connor.^[8] Who reported that the total Testosterone level was positively correlated with the HDL cholesterol level and negatively correlated with the Triglyceride level.^[8]

CONCLUSION

This study concluded that there was a significant decrease in the levels of serum total Testosterone in Sudanese patients with type two diabetes mellitus compared to control group and the serum total Testosterone level affected by the age, glycemic control, serum Triglyceride level, serum HDL cholesterol level.

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