



## "A COMPARATIVE STUDY OF THE RELATIONSHIP BETWEEN SERUM TESTOSTERONE LEVELS AND METABOLIC PARAMETERS IN MEN WITH AND WITHOUT DIABETES"

### Endocrinology

**Dr. Kshitij Arora**

Post graduate, Department Of General Medicine, M R Medical College Kalaburagi, Karnataka

**Dr. Sachin Patil**

Post graduate, Department Of General Medicine, M R Medical College Kalaburagi, Karnataka

### ABSTRACT

**Introduction** Diabetes is one of the largest global health emergencies of this century, ranking among the 10 leading causes of mortality with Prevalence of 9.3%. Testosterone is key male sex hormone that plays an important role in the development and maintenance of secondary sexual characteristics. This study aimed to compare serum testosterone levels in diabetic and non-diabetic males and compare the relationship between serum testosterone levels and various metabolic parameters. **Materials & Methods** A cross sectional study conducted at our hospital for 18 months. A total of 200 males (100 diabetic & 100 non-diabetic) visiting the medicine OPD were included. Blood samples were collected to measure serum testosterone levels and metabolic parameters were measured using standard methods. Data was analyzed using appropriate inferential statistics, independent t-tests. **Results** The mean age of diabetics was 52.14 years and non-diabetics were 52.61 years. The results showed significant difference in serum testosterone levels between the diabetics and non-diabetics, with the diabetics having lower levels. Additionally, it revealed negative correlations between age, BMI, WHR, FBS and total cholesterol with serum testosterone. Age, WHR, FBS and total cholesterol were statistically significant, whereas BMI was statistically not significant. However, creatinine showed positive correlation but was statically non-significant. **Conclusion** The serum testosterone levels were low in diabetic people when compared to non-diabetics. The metabolic parameters like Age, WHR, FBS and Total Cholesterol showed negative correlation with serum testosterone levels.

### KEYWORDS

#### INTRODUCTION

Diabetes Mellitus (DM) is one of the largest global health emergencies of this century, ranking among the 10 leading causes of mortality<sup>1</sup>. Prevalence of DM in India is 9.3%<sup>2</sup>. According to the World Health Organization (WHO), Non Communicable Diseases (NCDs) accounted for 74% of deaths globally in 2019, of which, diabetes resulted in 1.6 million deaths, thus becoming the ninth leading cause of death globally<sup>1</sup>.

Testosterone is a key male sex hormone that plays an important role in the development and maintenance of secondary sexual characteristics, as well as overall health and well-being. Men with type 2 diabetes mellitus have low testosterone levels, but this concept has not received much attention because of the fact that both type 2 diabetes and hypotestosteronaemia are associated with aging. There is evidence that hypotestosteronaemia should be an element in the definition of metabolic syndrome, since low levels of testosterone are associated with or predict the development of metabolic syndrome and of diabetes mellitus<sup>3</sup>.

Recent studies have shown that a low serum testosterone level is strongly associated with an increased likelihood of the metabolic syndrome (MES) in both Caucasian and Asian men<sup>4</sup>. This study aimed to compare serum testosterone levels in diabetic and non-diabetic males and compare the relationship between serum testosterone levels and age, various metabolic parameters including body mass index (BMI), total cholesterol, waist-hip ratio (WHR), fasting blood sugar (FBS) and Serum Creatinine.

#### AIMS AND OBJECTIVES

- To compare serum testosterone levels in diabetic and non-diabetic males.
- To find out the relationship between serum testosterone levels with age and various metabolic parameters including body mass index (BMI), total cholesterol, waist-hip ratio (WHR), fasting blood sugar (FBS) and Serum Creatinine.

#### METHODOLOGY

A cross sectional study was conducted at our hospital from 1<sup>st</sup> March 2021 to 31<sup>st</sup> August 2022 (18 Months). Ethical clearance was taken from the Institutional Ethical Committee. A total of 200 patients attending the Medicine OPD were recruited in the study among which 100 were Diabetic and another 100 were non-diabetic. Those patients who were diagnosed with hypogonadism, liver failure, renal failure and those with any history of acute illness, alcohol consumption or smoking and those under sex hormone replacement therapy or any medication (e.g., diuretic, statins) that could have an influence on lipid

metabolism, blood pressure, blood glucose, or body composition were excluded from the study. Basic demographic details were noted. 8 AM Blood samples were collected to measure serum testosterone levels and metabolic parameters were measured using standard methods.

Data was collected using pre-designed and pretested questioner and was entered in the Excel spread sheet, analyzed using appropriate inferential statistics like independent t-tests, Pearson's correlation was used for comparison. For statistical significance, a  $p$ -value  $< 0.05$  was considered significant.

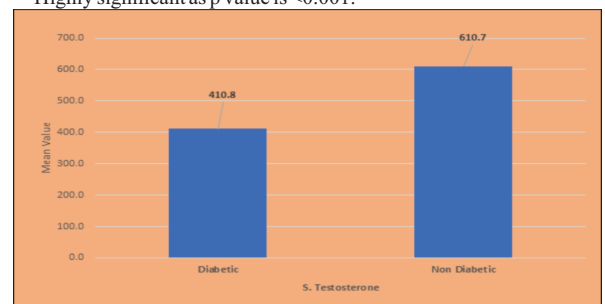
#### RESULTS

The results showed that there was a significant difference in serum testosterone levels between the diabetic and non-diabetic groups, with the diabetic group having lower levels (Table 1).

**Table 1. Comparison between Serum Testosterone with diabetic and non-diabetic groups.**

PARAMETER	Group	N	Mean	Std. Deviation	Std. Error Mean	P VALUE
S. Testosterone	Diabetic	100	410.84	189.09	18.90	<0.001* *
	Non Diabetic	100	610.68	107.53	10.75	

\*\*Highly significant as  $p$  value is  $< 0.001$ .



**Figure**

The significance of other parameters with diabetic and non-diabetic groups is shown in table 2. It was seen that the mean age of diabetic group was 52.14±9.44 years and that of non-diabetic group was 52.61±8.45 years.

The mean Body Mass Index in diabetic group was 26.25±8.55 and in non-diabetic group it was 23.97±3.37.

The mean Waist-hip ratio (WHR) was  $0.96 \pm 0.05$  in diabetic group and was  $0.91 \pm 0.15$  in non-diabetic group.

The mean total cholesterol value in diabetic group was  $196.37 \pm 15.32$  and that of non-diabetic group was  $175.91 \pm 43.61$

The mean FBS levels in diabetic group was  $150.8 \pm 61.38$  and that of non-diabetic group was  $107.2 \pm 15.43$ .

Among all the mean values which were measured in diabetic and non-diabetic groups, BMI, mean WHR, Total cholesterol and FBS were found to be statistically significant, whereas the mean age was statistically not significant.

**Table1. Comparison Between Various Parameters With Diabetic And Non-Diabetic Groups**

Parameters	Group	N	Mean	Std. Deviation	Std. Error Mean	P Value
Age	Diabetic	100	52.14	9.44	0.94	0.7
	Non Diabetic	100	52.61	8.45	0.84	
BMI	Diabetic	100	26.25	8.55	0.85	0.01*
	Non Diabetic	100	23.97	3.37	0.33	
WHR	Diabetic	100	0.96	0.05	0.01	0.005*
	Non Diabetic	100	0.91	0.15	0.01	
T. Cholesterol	Diabetic	100	196.37	15.32	1.53	<0.001**
	Non Diabetic	100	175.91	43.61	4.36	
FBS	Diabetic	100	150.8	61.38	6.13	<0.001**
	Non Diabetic	100	107.2	15.43	1.54	

\*Significant as p value is <0.05

\*\*Highly significant as p value is <0.001.

Additionally, the results revealed negative correlations between age, BMI, mean WHR, FBS and total cholesterol with serum testosterone. Among which age, WHR, FBS and total cholesterol were statistically significant with p value <0.05, whereas BMI was statistically not significant. Serum Creatinine showed positive correlation but was statically non-significant (table 2).

**Table2. Correlation Between Serum Testosterone And Other Parameters**

Parameters	Serum Testosterone	
	Pearson's Correlation	P Value
AGE	-.214	0.002**
BMI	-0.079	0.26
WHR	-.215	0.002**
FBS	-.194	0.006**
CREATININE	0.029	0.68
Total Cholesterol	.156	0.02*

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

## DISCUSSION

The aim of our study was to assess and compare serum testosterone levels in diabetic and non-diabetic males, it was seen that the levels were significantly low in diabetic group when compared to non-diabetic group.

In our study it was seen that the total serum testosterone level in diabetic group was  $410.84 \pm 189.09$  ng/ml whereas in non-diabetic group it was  $610.68 \pm 107.53$  ng/ml which was significantly higher.

Similarly in a study conducted by Kundu D et al the mean serum testosterone of diabetic and non diabetic group was  $351.1 \pm 126.6$  ng/ml and  $588.8 \pm 234.4$  ng/ml which was also statistically significant<sup>5</sup>.

Ding et al. conducted a meta-analysis which included 3825 men and confirmed that there was higher prevalence of lower level of serum testosterone in type 2 Diabetic men<sup>6</sup>.

In a study conducted by Khalid TM it was observed that, mean serum testosterone level among cases (diabetic) was  $345.28 \pm 150.514$  ng/dl and that of in control group (non diabetic) was  $660.56 \pm 104.09$  ng/dl.

The levels were significantly low among diabetic patients as compared to healthy controls<sup>5</sup>.

Corona et al. conducted a recent meta-analysis, which included 1822 diabetic men and 10009 non diabetic controls. He found out that serum total testosterone level was lower in men with diabetes mellitus than non-diabetic controls<sup>7</sup>.

In the present study, the BMI in diabetic group was found to be  $26.25 \pm 8.55$  kg/m<sup>2</sup> and in non-diabetic group it was  $23.97 \pm 3.37$  kg/m<sup>2</sup> and it was statistically significant. In a study conducted by Kundu D et al showed that BMI of diabetic group was  $25.98 \pm 2.62$  kg/m<sup>2</sup>, which was significantly higher than that of control group with BMI  $24.08 \pm 3.18$  kg/m<sup>2</sup>.<sup>4</sup>

In another study which was done by Trivedi J et al showed that BMI of diabetic group was  $25.93 \pm 3.36$  kg/m<sup>2</sup>, which was significantly higher than that of control group with BMI  $24.10 \pm 3.31$  kg/m<sup>2</sup>.<sup>8</sup>

In our study, when the mean of Waist-Hip Ratio was measured, it was  $0.96 \pm 0.05$  in diabetic group and was  $0.91 \pm 0.15$  in non-diabetic group, which was statistically significant. When compared with a study done by Mattack N et al the WHR of control group was  $0.88 \pm 0.05$  and that of diabetic group was  $0.94 \pm 0.05$ , it also showed statistical significance<sup>9</sup>.

In this study, the mean total cholesterol value in non-diabetic group was  $175.91 \pm 43.61$  mg/dl and that of diabetic group was  $196.37 \pm 15.32$  mg/dl, which was statistically significant. whereas in a study which was conducted by Khalid TM et al showed that there was no statistical significance between the total cholesterol levels of diabetics ( $199.32 \pm 33.59$  mg/dl) and that of non-diabetics ( $196 \pm 15.09$  mg/dl)<sup>1</sup>.

In the current study the mean Fasting blood sugar levels in diabetic group was  $150.8 \pm 61.38$  mg/dl and that of non-diabetic group was  $107.2 \pm 15.43$  mg/dl, which was found to be statistically significant. In a study which was conducted by Mattack N, Devi R, Kutum T, Patgiri D, showed that the Fasting blood sugar level in control group was  $89.17 \pm 12.92$  mg/dl and that of diabetic group was  $180.35 \pm 77.24$  mg/dl and also was statistically significant<sup>9</sup>.

## CONCLUSION

This present study showed that there is a significant reduction in serum testosterone levels in type 2 diabetes mellitus patients when compared to non-diabetic study subjects. Low testosterone level can be one of the predictive markers for determining insulin resistance and other metabolic conditions.

This might highlight the requirement of urgent implementation of screening programs, in order to detect testosterone deficiency in all type 2 diabetes mellitus male patients at an earliest stage and to supplement testosterone accordingly. Testosterone administration may, help in treating the conditions by decreasing resistance to insulin, increasing iron absorption, and reducing BMI.

It is recommended that further research with a considerably larger population and other clinical parameters may aid in establishing testosterone level as a marker in early diagnosis and treatment.

## REFERENCES

- Pradeepa R, Mohan V. Epidemiology of type 2 diabetes in India. Indian journal of ophthalmology. 2021 Nov;69(11):2932.
- Mathur P, Leburu S, Kulothungan V. Prevalence, awareness, treatment and control of diabetes in India from the countrywide National NCD Monitoring Survey. Frontiers in Public Health. 2022 Mar 14;10:205.
- Khalid TM, Ali MA. Study of testosterone levels in men among diabetes mellitus. Journal of Cardiovascular Disease Research. 2022;13(5):2598-605.
- Cheung KK, Luk AO, So WY, Ma RC, Kong AP, Chow FC, Chan JC. Testosterone level in men with type 2 diabetes mellitus and related metabolic effects: A review of current evidence. Journal of diabetes investigation. 2015 Mar;6(2):112-23.
- Kundu D, Ghosh E, Roy SS, Basu S. Serum testosterone levels in type 2 diabetes mellitus. Int J Med Res Rev. 2018;6(08):409-13.
- Ding EL, Song Y, Malik VS, et al. Sex differences of endogenous sex hormones and risk of type 2 diabetes: a systematic review and meta-analysis. JAMA. 2006 Mar 15; 295(11):1288-99
- Corona, G., Monami, M., Rastrelli, G., Aversa, A., Lenzi, A., Forti, G., Mannucci, E. and Maggi, M. (2011), Type 2 diabetes mellitus and testosterone: a meta-analysis study. International Journal of Andrology; 24 October 2010 34:528-540. <https://doi.org/10.1111/j.1365-2605.2010.01117.x>
- Trivedi J, Kapoor S, R. Variation in Serum Total Testosterone Levels in Men with Type 2 Diabetes Mellitus. Journal of Clinical & Diagnostic Research. 2019 Jun 1;13(6).
- Mattack N, Devi R, Kutum T, Patgiri D. The evaluation of serum levels of testosterone in type 2 diabetic men and its relation with lipid profile. Journal of clinical and diagnostic research: JCDR. 2015 Jan;9(1):BC04.