

# Serum Testosterone Concentrations In Type 2 Diabetic Males & its Relation to Sexual Asthenia & Waist Circumference

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## ABSTRACT

**Aim:** To study association of low serum testosterone in type 2 diabetic males & its relation to sexual asthenia & waist circumference.

**Place and duration of study:** This study was conducted between June 2016 to Dec 2019, patients presented at Endocrine Clinic at Hameed Latif Hospital Lahore.

**Methodology:** This cross-sectional/observational study was consists of 50 male patients with more than 10 years history of diabetes were included to see association of Serum Testosterone with both: waist circumference & symptoms of sexual asthenia using ADAM Score. Weight, BP Waist circumference, total testosterone & HbA1C was measured. Association of sexual asthenia, waist circumference & low testosterone were assessed. Participants were divided into 3 groups on basis of 2 symptoms: group A with decreased sexual drive, group B with less strong erections group c with both symptoms. Any patient having free testosterone <9.2 nmol/L was labelled as testosterone deficient.

**Results:** Nominal variables were recorded as frequency/percentages and continuous data were expressed as mean±SD the participants were divide in 2 major groups; Group 1: non obese diabetics (18%), the mean age of participants was 52.6±6.2, waist circumference <88cm (mean±SD 80.89±3.91 weight (kg) 92.21±5.57, systolic BP (mean±SD) 146.22±8.4mmHg, diastolic BP (mean±SD) 85.45±6.9mmHg, (20%) had decreased sex drive, (28% had less strong erections and none of them had both symptoms: 6% had A1C 7.5-9 (mean±SD 7.7±0.26), 4% had A1C range 9.1-10.9 (mean±SD 9.1±0), 8% had A1C range 11-13 (mean±SD 11.5±0.25), while total testosterone (9nmole/L (mean±SD 8.96±0.16). Group 2 was divide into 2 sub-goups; Group 2A: Moderately obese diabetics; (38%), the mean age of was 54.9±4.0, waist circumference 93.16±4.52 weight (kg) 92.21±5.57, systolic BP (mean±SD) 152.73±8.51, diastolic BP (mean± SD) 92.84±6.04, 40% had decreased sex drive, 28% had less strong erections and 53% had both symptoms): 10% had A1c 7.5-9% (mean±SD 7.7±0.26), 12% had 9.1-10.9% (mean±SD 9.1±0), & 16% had 11-13% (mean±SD 11.5±0.25, total testosterone was 8.78±0.27. Group 2B:

**Conclusion:** Total testosterone was lower in type 2 diabetics with inadequate control. Periodic evaluation of serum testosterone in type 2 diabetics with sexual asthenia is advised as deficient testosterone can be adequately treated with supplementation to elevate the quality of life.

**Keywords:** Low testosterone, Sexual asthenia, HbA<sub>1</sub>C, Waist circumference, T2DM, Obesity

## INTRODUCTION

Testosterone concentrations progressively decrease as the men become older in contrast to abrupt fall in feminine hormone at menopause in female gender. Diabetes is also one of the cause of Testosterone deficiency especially in those with impaired libido & sex performance. Low testosterone also leads to lassitude, low mood, insulin resistance, high blood pressure and hyperlipidemia.<sup>1,2</sup> Low testosterone is inversely related to abdominal fat. The studies show that either or any combination of abdominal fat, metabolic syndrome, weight gain or T2DM predict or enhance age related decline in testosterone levels.<sup>3-5</sup> Also, it has been observed that progressive decline in total testosterone in diabetics is inversely related to insulin resistance. So modalities of treatment that increase insulin sensitivity in turn result in elevated serum testosterone.<sup>6</sup>

There is an interesting two-way relationship amid visceral obesity and serum testosterone. A. high visceral obesity activates aromatase enzyme. This enzyme transform testosterone to estradiol.<sup>7</sup> High estradiol then

through negative feed back leads to suppressed level of GnRH from hypothalamus & as a result pituitary FSH & LH are suppressed. This in turn results in both (a) decreased testosterone secretion by Leydig cells and (b). Decreased spermatogenesis in the seminiferous tubules. This is called "Hypogonadotropic Hypogonadism"<sup>8</sup> B. Proinflammatory cytokines, insulin, and leptin secreted by adipose tissue suppress hypothalamo-pituitary gonadal axis at multiple sites<sup>9,10</sup>.

A. Low testosterone alternatively increases visceral fat, through release of inflammatory cytokines via mechanisms involving muscle<sup>11</sup>, liver<sup>12</sup> and bone.<sup>13</sup> Low level of SHBG also cause insulin resistance. So this vicious circle of visceral fat and low testosterone goes on leading to more and more sexual asthenia with visceral fat & abdominal obesity in metabolic syndrome. Owing to high incidence of testosterone deficiency, the Endocrine Society Clinical Practical Guidelines recommend serial measurements of serum testosterone in diabetic men.

2. Till now, relationship of serum testosterone with poor controlled diabetes has never been studied in Pakistan. Our aim is to relate level of low testosterone with HbA<sub>1</sub>c in patients who presented with sexual asthenia.

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**PATIENTS & METHODS**

This study was conducted between June 2016 to Dec 2019 on patients presented at Endocrine Clinic at Hameed Latif Hospital Lahore, 50 male patients with more than 10 years history of diabetes and having symptoms of sexual asthenia were included in the study. Those with type 1 DM, Cushing, Depression, CKD, & patients with H/O Major cardiac events or CVA, patients on both or any of these drugs spironolactone & statins were excluded from the study. The patients fulfilling the ADAM score for sexual asthenia were enrolled after written informed consent. Following columns were filled in the study proforma of each patient. Anthropometric measurements, weight (Kg), waist circumference (cm) was measured at the level of tip of ilac crest when the patient was standing with his arms bent on the chest at tidal expiration. BP was recorded while patient was sitting by electronic device while sphygmomanometer at cubital fossa, all these were filled in study proforma and this proforma was kept in record. Patients were instructed to get blood samples from Agha khan lab for both.

- i) Total testosterone early in morning after an overnight fast &
- ii) HbA1c

The lower limit of the normal total testosterone (TT) was considered 9.2nmol/L<sup>14</sup> (264ng/dL). Any patient total testosterone <9.2 nmol/L was labelled as testosterone deficient.

**RESULTS**

According to waist circumference, the participants were categorized as Group 1 Non -Obese diabetics (waist circumference <88cm) 18% & group 2 obese diabetics 2 (a): waist circumference 89-100cm (38%); 2(b): waist circumference >100cm (44%). 24% had HbA1C 7.5-9%; 32% had A1C 9-10.9%), 44% had A1C of 11-13%. The testosterone level ranged between 8.96-8.58 between groups. There was significant difference in weight, waist circumference, blood pressures both systolic and diastolic , mean total testosterone, &mean HbA1C between non obese diabetics versus obese diabetics (both moderate & morbid obese). However, men with waist circumference >100 had poorly controlled diabetes and low mean total testosterone highlighting the dual pathology of low testosterone in obese diabetics. (1ng/dL value equivalent in nmol/L = 0.0347, 264ng/dl= 9.2nmole/L). Anthropometric measurements of studied subjects (Table 1).

**Statistical analysis:** Data for continuous variables were presented as means±SDs and categorical factors are reported as percentages. The participants' characteristics waist circumference HbA1C, & serum testosterone concentrations were analyzed using independent- sample t tests for continuous variables and chi-square tests for categorical variables. A P<0.05 was considered significant. All statistical analyses were conducted using SPSS.

Table 1: Data of Studied Population A. Demographics: (Values are expressed as no, % ages & mean ± SD)

	Group 1-non obese		Group 2-obese diabetics	
	Waist circ <88cm		Waist circ 88-100cm a-Mild-Moderate Obese	Waist circ.>100cm b.Morbidly obese
Number (%)	9(18%)		19(38%)	22(44%)
Diastolic BP	85.45±6.9		92.84±6.04	99.18±7.24
Systolic BP	146.22±8.4		152.73±8.51	161.64±8.49
Age (yrs)	52.6±6.2		54.9±4.0	57.5±6.9
Waist circ	80.89±3.91		93.16±4.52	107.90±4.10
Weight (kg)	84.33±3.67		92.21±5.57	102.67±10.27
<b>B. ADAM SCORE</b>				
a. Decreased sex drive 10 (20%)	2 (20)		4(40)	4(40)
b. Less strong erections 25 (50%)	7(28)		7(28)	11(44)
c. Both a & b 15 (30%)	0		8(53.33)	7(46.67)
<b>C. Lab parameters:</b>				
A1C (%)	mean±SD (%)			
7.5-9 (24%)	7.7±0.26 (6%)		8.2±0.49 (10%)	8.8±0.09(8%)
9.1-10.9 (32%)	9.1±0 (4%)		(6)10.17±0.64 (12%)	10.25±0.47(16%)
11-13 (44%)	11.5±0.25 (8%)		(8)12.15±0.65 (16%)	12.22±0.61(20%)
Total testosterone (nmole/L)	8.96±0.16		8.78±0.27	8.58±0.32

**DISCUSSION**

Our study revealed the association of waist circumference, age, duration of diabetes with symptoms of asthenia and its relation with control of diabetes i.e. A1C and serum free testosterone. This is the first of its type in our population & not studied so far in Asia. We studied the difference between various presentations of sexual asthenia i.e. decreased sex drive, less spontaneous erections and their association between duration of diabetes and HbA1c, the higher the A1C, the more advanced is sexual asthenia .also the value of testosterone was relating to obesity, the group

with waist circumference <88 has more testosterone than those with high waist circumference, highlighting the value of testosterone with abdominal obesity, 20% of non-obese diabetics had decreased sex drive as compared to obese diabetics where the 40% had decreased sex drive. The Hypogonadism in males (HIM) study was a U.S. based cross-sectional study by Sandeep et al to see the incidence of low testosterone in men aged 45 years in their study non diabetics were included as controls our study is comparable to HIM study but we studied only diabetics with primary concern on waist. The prevalence of low free testosterone concentrations in normal weight, over-weight

and obese nondiabetic men was 26%, 29% and 40%. The mean free testosterone concentration of non-obese diabetic men was significantly lower than that of obese diabetic men. Free testosterone level were inversely related to age & BMI. The co-occurrence of diabetes in obese is associated with four fold decrease in serum testosterone<sup>15</sup>. In our scenario, we compared total testosterone in non-obese diabetics versus obese diabetics. The prevalence of Low total testosterone in non-obese, moderately obese and morbidly obese diabetics was  $8.96 \pm 0.16$ ,  $8.78 \pm 0.27$ ,  $8.58 \pm 0.32$  respectively.

According to NHANES 2003–2004 data, 31% of all adult men in U.S. are obese. This has clinical, public health implications.<sup>16</sup> Morbidly obese has low testosterone esp. with co-existent Type II diabetes<sup>15</sup>.

Although our study was not aimed to answer about the etiology of low free testosterone in obese type 2 diabetic men, many studies done elsewhere have answered this dilemma<sup>17</sup> The probable reasons for low testosterone in obesity is either or both: decreased insulin sensitivity & hypogonadotropic hypogonadism.<sup>18</sup> It is relevant that prevalence of hypogonadotropic hypogonadism is >50% in patients aged 18-35 years.<sup>19</sup> As low testosterone concentrations are inversely related to visceral adiposity and because of high prevalence of overweight in younger generation, it is would be imperative to conduct a survey to evaluate young obese individuals with testosterone deficiency through a validated questionnaire<sup>20</sup>. There are a few limitations to our study, we cannot comment on the frequency of symptomatic hypogonadism as we did not have a quantitative questionnaire for erectile dysfunction and symptoms of hypogonadism. Another limitation of our study is that Random sampling for serum testosterone were analyzed. Fasting free serum testosterone if done would have given a more reliable data for comparison because an oral glucose load of 75g can lower total testosterone concentrations by 25%.<sup>21</sup> However, no significant difference in total testosterone was observed if blood samples is drawn between 8AM- 12Noon<sup>22</sup>.

## CONCLUSION

It is concluded, the prevalence of low testosterone is 40% in type II diabetic men if obese and older than 45 years Thus, both obesity and diabetes appear to exert independent effects on the prevalence of low free testosterone concentrations. In light of these findings free testosterone should be measured in obese diabetics and those with symptoms of sexual asthenia.

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