

# Serum Testosterone Levels in Type 2 Diabetes Mellitus Patients

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Received: 6 December 2017 Accepted: 2 January 2018 Published: 15 January 2018

## Abstract

**Introduction:** There is a high prevalence of low serum testosterone in type 2 diabetes mellitus patients. In this study, we tried to determine the level of serum testosterone in type 2 diabetes mellitus patients. **Methods:** A total of 241 patients were taken in the study. Out of this, 121 patients had type 2 diabetes mellitus and 120 were normal. For diagnosis of diabetes HbA1c level of  $\geq 6.5$  was taken. Serum testosterone levels were measured in all the participants.

**Results:** The mean age of the participants was  $46.95 \pm 6.89$  in diabetic patients and  $45.86 \pm 5.45$  in the controls. The mean serum testosterone levels in the diabetes population was  $312 \pm 14.6$  ng/dl and in the control population was  $678 \pm 17.5$  ng/dl. On applying chi square test, the p value was calculated to be 0.02. This shows the difference is statistically significant.

**Conclusion:** Type 2 diabetes mellitus is associated with low levels of serum testosterone levels.

## Index terms—

## 1 I. Introduction

It is estimated that 285 million people worldwide are affected by diabetes mellitus. By 2030, around 438 million people will be affected by diabetes mellitus. About 66% of this population is in low to middle income countries (1). As compared to western population, Asian population has a much higher tendency to develop diabetes. This occurs at a younger age, at lower degrees of obesity and a much higher rate given for the same amount of weight compared to Western population (2).

Total testosterone is largely determined by circulating sex hormone binding globulin. In normal As shown in the table above, the baseline characteristics of all the participants are showed in the

## 2 II. Materials and Methods

A total of 121 patients were taken in the study who consistently attended the diabetes clinic from May 2017 to May 2018 were taken in the study. 120. For diagnosis of diabetes HbA1c level of  $\geq 6.5$  was taken. Serum testosterone levels were measured in all the participants. All calculations were done statistically. P value of  $<0.05$  was considered to be statistically significant. Many studies have reported that there is a high prevalence of low serum testosterone in men with type 2 diabetes mellitus (3, 4, and 5). Some studies have also showed a correlation between reduced total testosterone and insulin resistance and then subsequent development of diabetes mellitus (6,7). The symptoms of low serum testosterone are loss of libido, erectile dysfunction, reduced muscle mass, low energy, increased adiposity (8,9).  $40 \pm 6.7$ . Average height was  $168 \pm 5.3$  cm in the diabetic patients and  $170 \pm 4.2$  cm in the normal population. Average weight was  $73 \pm 6.5$  kgs in the diabetic patients and  $69 \pm 7.4$  in the normal population. 66 patients with diabetes never smoked while 72 participants in the normal population were non-smokers. The number of former smokers in the diabetic patients and normal population was 12 and 10 respectively. Current smokers are 43/121 in the diabetic patients and 38/120 in the normal population. 39 patients in the diabetic population were hypertensives and 118 were normotensives. 2 patients were hypertensive in the normal population and 92 were normotensive. 17 patients had dyslipidaemia and 104 did not have dyslipidaemia in the diabetic population. 14 participants had dyslipidaemia and 106 participants did not have dyslipidaemia in the normal population. Mean duration of diabetes was  $5.6 \pm 1.67$ . Mean HbA1c was  $7.8 \pm 0.8$  in the diabetic population and  $4.7 \pm 0.3$  in the normal population. Serum testosterone level in the diabetic population was  $312 \pm 14.6$  ng/dl. In the normal population, it was  $678 \pm 17.5$  ng/dl. After applying

student t test, the p value was calculated to be 0.02. This is less than 0.05 which shows that the difference in the two group is significant and not due to chance.

### 3 III. Results

### 4 IV. Discussion

Many studies have shown that about 25% of patients with type 2 diabetes mellitus have low serum testosterone levels. About 4% have subnormal testosterone concentrations with high FSH and H (10). Some studies have also shown that low serum testosterone is associated with diabetes related sexual dysfunction.

A study from Australia showed that 43% of type 2 diabetes patients have total testosterone levels less than 70 (11). A study from United Kingdom showed that 355 men with type 2 diabetes mellitus have total testosterone levels of less than 8 and 25% had symptoms of hypogonadism associated with 8-12 total testosterone (12). 33.2% type 2 diabetes patients had hypogonadism in a study in Egypt (13). A study from Brazil also showed that free testosterone and total testosterone levels were low in type 2 diabetes patients (14). The Endocrine society also recommends measuring the levels of testosterone of patients with type 2 diabetes on a regular basis (15,16). Many cross-sectional and longitudinal studies have showed that with the increase in age the level of total testosterone reduces in men (17,18,19).

Many studies have also showed a co-relation between BMI and low serum testosterone levels in type 2 diabetes mellitus. However, these studies are controversial. Some studies have showed that the association between BMI and serum testosterone is significant (20,21). On the contrary, there is also a study that has showed no co-relation between BMI and low testosterone (22).

There are many limitations of this study. It is a cross-sectional study and so we could not find the trend of the serum testosterone levels in the participants. From our study and conclusion, we can strongly say that an early universal screening program can help in diagnosis of low serum testosterone levels and testosterone supplementation can be started accordingly. We recommend that all patients of type 2 diabetes mellitus undergo screening for serum testosterone. A hormonal baseline can also be established for comparison in future follow-ups.

### 5 V. Conclusion

Type 2 diabetes mellitus is associated with low levels of serum testosterone levels in our study population with a p value significance of 0.02.

men, 54% testosterone is bound to albumin and other proteins, 44% is bound to sex hormone binding globulin and 2% is in unbound state. Some studies believe that low levels of serum testosterone are associated with of hypogonadotropic hypogonadism or not. The study by Ali et al showed that in patients with diabetic

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	Diabetic Patients	Normal Population
Age (yrs)	42 $\pm$ 5.7	40 $\pm$ 6.7
Height (cm)	168 $\pm$ 5.3	170 $\pm$ 4.2
Weight (kg)	73 $\pm$ 6.5	69 $\pm$ 7.4
Smoking : Never	66	72
Smoking : Former	12	10
Smoking: Current	43	38
Hypertension: Yes	39	2
Hypertension: No	118	92
Dyslipidaemia : Yes	17	14
Dyslipidaemia: No	104	106
Duration of Diabetes	5.6 $\pm$ 1.67	
Mean HbA1c	7.8 $\pm$ 0.8	4.7 $\pm$ 0.3

Figure 2: Table 1 :

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	Type 2 Diabetes	Control	P Value
Serum Testosterone Levels (Ng/Dl)	312 $\pm$ 14.6	678 $\pm$ 17.5	0.02

Figure 3: Table 2 :



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[Hypogonadism et al. (2003)] , Diabetes Hypogonadism , M Betancourt-Albrecht , G R Cunningham . *Int J Impot Res* 2003 Aug: 15. p. . (Suppl 4)

[Clarke et al. (2008)] , S Clarke , J D Zajac , G Jerums . *J. Clin Endocrinol Metab* 2008 May: 93. (5) p. .

[Clarke et al. (2008)] , S Clarke , J D Zajac , G Jerums . *J Clin Endocrinol Metab* 2008 May: 93. (5) p. .

[Soriguer et al. (2012)] , F Soriguer , E Rubio-Martín , D Fernández , S Valdés , E García-Escobar , G M Martín-Núñez , I Esteva , M C Almaraz , G Rojo-Martínez . *Eur J Clin Invest* 2012 Jan: 42. (1) p. .

[Soriguer et al. (2012)] , F Soriguer , E Rubio-Martín , D Fernández , S Valdés , E García-Escobar , G M Martín-Núñez , I Esteva , M C Almaraz , G Rojo-Martínez . *Eur J Clin Invest* 2012 Jan: 42. (1) p. .

[Dandona and Rosenberg (2010)] ‘A practical guide to male hypogonadism in the primary care setting’. P Dandona , M T Rosenberg . *Int J Clin Pract* 2010 May: 64. (6) p. .

[Dandona and Rosenberg (2010)] ‘A practical guide to male hypogonadism in the primary care setting’. P Dandona , M T Rosenberg . *Int J Clin Pract* 2010 May: 64. (6) p. .

[Chan et al. (2009)] J C Chan , V Malik , W Jia , T Kadowaki , C S Yajnik , K H Yoon , Fbjama Hu . *Diabetes in Asia: epidemiology, risk factors*, 2009 May 27. p. .

[Rezvani M. R., Saadatjou S. A., Sorouri S., Hassanpour Fard M. J. Res Health Sci (ed.) (2012)] *Comparison of serum free testosterone, luteinizing hormone and follicle stimulating hormone levels in diabetics and non-diabetics men -a case -control study*, Rezvani M. R., Saadatjou S. A., Sorouri S., Hassanpour Fard M. J. Res Health Sci (ed.) 2012 Dec. 13 p. .

[Rhoden et al. ()] *Diabetes mellitus is associated with subnormal serum levels of free testosterone in men*, E L Rhoden , E P Ribeiro , C Teloken , Cabju Souto , Int . 2005 Oct: 96. p. .

[Tamler and Deveney (2010)] ‘Hypogonadism, erectile dysfunction, and type 2 diabetes mellitus: what the clinician needs to know’. R Tamler , T Deveney . *Postgrad Med* 2010 Nov: 122. (6) p. .

[Tripathy et al. ()] ‘Hypogonadotropic hypogonadism in erectile dysfunction associated with type 2 diabetes mellitus: a common defect?’. D Tripathy , S Dhindsa , R Garg , A Khaishagi , T Syed , P Dandona . *Metab Syndr Relat Disord* 2003 Mar: 1. (1) p. .

[International Diabetes Federation. IDF Diabetes Atlas. Epidemiology and Mobidity. International Diabetes Federation ()] *International Diabetes Federation. IDF Diabetes Atlas. Epidemiology and Mobidity. International Diabetes Federation*, 2011. (Last accessed on)

[Kapoor et al. (2007)] D Kapoor , H Aldred , S Clark , K S Channer , T H Jones . *correlations with bioavailable testosterone and visceral adiposity*, 2007 Apr: 30. p. .

[Grossmann et al.] *Low testosterone levels are common and associated with insulin resistance in men with diabetes*, M Grossmann , M C Thomas , S Panagiotopoulos , K Sharpe , R J Macisaac .

[Grossmann et al.] *Low testosterone levels are common and associated with insulin resistance in men with diabetes*, M Grossmann , M C Thomas , S Panagiotopoulos , K Sharpe , R J Macisaac .

[Grossmann et al. (2008)] ‘Low testosterone levels are common and associated with insulin resistance in men with diabetes’. M Grossmann , M C Thomas , S Panagiotopoulos , K Sharpe , R J Macisaac , S Clarke , J D Zajac , G Jerums . *J. Clin Endocrinol Metab* 2008 May: 93. (5) p. .

[Köhler et al. (2008)] *Prevalence of androgen deficiency in men with erectile dysfunction*, T S Köhler , J Kim , K Feia , J Bodie , N Johnson , A Makhoulf , Monga Murology . 2008 Apr: 71. p. .

[Ghazi et al. (2012)] ‘Serum testosterone levels in diabetic men with and without erectile dysfunction’. S Ghazi , W Zohdy , Y Elkhia , R Shamloul . *Andrologia* 2012 Dec. (6) p. .

[Bastounis et al. ()] ‘Sex hormone changes in morbidly obese patients after vertical banded gastroplasty’. E A Bastounis , A J Karayiannakis , K Syrigos , A Zbar , G G Makri , D Alexiou . *Eur Surg Res* 1998. (1) p. .

[Testosterone] *SHBG and risk of type 2 diabetes in the second evaluation of the Pizarra cohort study*, Testosterone

[Testosterone] *SHBG and risk of type 2 diabetes in the second evaluation of the Pizarra cohort study*, Testosterone

[Bhasin et al. (2006)] ‘Testosterone therapy in adult men with androgen deficiency syndromes: an endocrine society clinical practice guideline’. S Bhasin , G R Cunningham , F J Hayes , A M Matsumoto , P J Snyder , R S Swerdloff , V M Montori . *J Clin Endocrinol Metab* 2006 Jun. (6) p. .

[Saboor Aftab S. A., Kumar S., Barber T. M (2013)] ‘The role of obesity and type 2 diabetes mellitus in the development of male obesity-associated secondary hypogonadism’. *Clin Endocrinol (Oxf)* Saboor Aftab S. A., Kumar S., Barber T. M (ed.) 2013 Mar. 78 (3) p. .

[Dandona and Dhindsa ()] ‘Update: Hypogonadotropic hypogonadism in type 2 diabetes and obesity’. P Dandona , S J Dhindsa . *Clin Endocrinol Metab* 2011 Sep: 96. (9) p. .

[Zhang et al. ()] X W Zhang , Z H Liu , X W Hu , Y Q Yuan , W J Bai , X F Wang , H Shen , Y P Zhao . *related quality of life in late onset hypogonadism patients in Chinese population*, 2012 Nov: 125 (21. p. .