

# SERUM TESTOSTERONE LEVEL AND ITS ASSOCIATION WITH BMI: A CROSS-SECTIONAL COMPARATIVE STUDY AMONG MALE CKD PATIENTS AND HEALTHY INDIVIDUALS

ANSARY EAF<sup>1</sup>, ISLAM MN<sup>2</sup>, KADER MA<sup>3</sup>, UZZAL OK<sup>4</sup>, MASOOD S<sup>5</sup>, JAHAN F<sup>6</sup>, CHOWDHURY MN<sup>7</sup>

## Abstract

**Introduction:** Chronic kidney disease (CKD) is a significant problem that affects all other vital organs and systems. Endocrine dysfunction is not uncommon as well.

Early identification of patients with chronic kidney disease (CKD) may help implement interventions to decrease progression and eventual morbidity and mortality.

**Aim of the study:** This study aimed to evaluate the serum testosterone level of adult males with different stages of CKD and its association with body mass index and comparison with age-matched healthy individuals.

**Methods:** This cross-sectional study was conducted in the Department of Nephrology, Dhaka Medical College Hospital, Dhaka, Bangladesh. All CKD patients were designated as group 'A' with 90 cases; the healthy control group were grouped as group 'B' with 88 cases.

**Result:** In this study, the majority 40(44.4%) of patients had glomerulonephritis, 24(26.8%) had DM and 11(12.2%) had HTN. The mean BMI was found to be 20.85±2.7 kg/m<sup>2</sup>. More than two-thirds (66.7%) of patients had normal (3.2-14.6 ng/ml) Serum testosterone, and their mean Serum testosterone was found at 4.29±1.9 ng/ml. Negative Spearman's rank correlation ( $r=-0.893$ ;  $p=0.001$ ) was observed between different stages of CKD and S. Testosterone of CKD patients. A positive Pearson correlation existed ( $r=0.517$ ;  $p=0.001$ ) between BMI and S. Testosterone of CKD patients.

**Conclusion:** A significant positive correlation existed between BMI and serum testosterone of CKD patients.

**Keywords:** Serum Testosterone, Body Mass Index (BMI) and Chronic Kidney Disease (CKD).

DOI: <https://doi.org/10.3329/jdmc.v31i1.65470>

J Dhaka Med Coll. 2022; 31(1): 66-70

## Introduction

Endocrine abnormalities are a common feature of chronic renal insufficiency.<sup>1</sup> The altered metabolic milieu in CKD affects the secretion of hormones and the response of target tissues,

causing endocrine dysfunctions.<sup>12</sup> As many as 50 to 70% of CKD stage-5 men have been reported to be hypogonadal based on low concentrations of testosterone.<sup>2,9</sup> Alterations of sex steroid production and metabolism

1. Dr. Eusha Ahmad Fidalillah Ansary, Associate Professor, Department of Nephrology, Uttara Adhunik Medical College, Dhaka.
2. Dr. Md. Nazrul Islam, Professor, Department of Nephrology, Dhaka Medical College, Dhaka.
3. Dr. M A Kader, Professor, Department of Medicine, Medical College for Women and Hospital, Dhaka.
4. Dr. Obaidul Kadir Uzzal, Assistant Registrar, Department of Medicine, Jashore Medical College, Jashore.
5. Dr. Shahriar Masood, Assistant Professor, Department of Physiology, Jahurul Islam Medical College, Kishoreganj.
6. Dr. Ferdous Jahan, Medical Officer, Department of Nephrology, Bangabandhu Sheikh Mujib Medical University, Dhaka.
7. Dr. Md. Nizamuddin Chowdhury, Professor, Senior and Chief Consultant, Department of Nephrology, BRB Hospital, Dhaka.

**Correspondence:** Dr Eusha Ahmad Fidalillah Ansary, Associate Professor and Head, Department of Nephrology, Uttara Adhunik Medical College, Dhaka. E-mail: [eushaansary@gmail.com](mailto:eushaansary@gmail.com)

**Received:** 15-12-2021

**Revision:** 03-02-2022

**Accepted:** 01-04-2022

leading to primary hypogonadism and disturbances of the hypothalamic-pituitary axis are already seen when moderate reductions in the GFR arise.<sup>16</sup> These disorders are not normalized with the initiation of maintenance dialysis treatment; instead, they often progress.<sup>7</sup> Humoral factors, which accumulate in uremia and other comorbid conditions that frequently accompany CKD, and medications, may contribute to suppressed sex hormone levels.<sup>9</sup> There is an increased prevalence of hypogonadism and its potential consequences, but limited data are available on the influence of endogenous testosterone and replacement therapy in CKD patients.<sup>13</sup> Chronic kidney disease (CKD) patients have accelerated atherosclerosis<sup>8</sup>, and CKD patients are considered to be at a significantly increased cardiovascular risk.<sup>13</sup> In addition to sexual dysfunction, testosterone deficiency is also associated with the loss of muscle mass<sup>15</sup> since it actively induces muscle protein synthesis.<sup>3</sup> Lower body mass index is a risk factor for cardiovascular mortality in ESRD.<sup>14</sup> In another study, it was found that comparatively lower BMI in CKD patients.<sup>17</sup> Most previous studies investigating testosterone abnormalities and renal disease have concentrated on patients with end-stage renal disease (ESRD), and little is known about the problem's pervasiveness in patients in the pre-dialysis phase. We, therefore, designed this single-centre study to see the serum testosterone level of adult male patients with different stages of CKD and its association with body mass index and comparison with age-matched healthy individuals.

### Methods

This Cross-sectional study was conducted on 178 subjects, among them 90 patients with different stages of CKD and 88 age-matched healthy individuals at the Department of Nephrology, Dhaka Medical College Hospital, Dhaka, from July 2014 to June 2015. CKD patients of stages 3, 4, and 5 (with estimated glomerular filtration rate (eGFR) 30-59 ml/min, 15-29 ml/min, <15 ml/min without dialysis),

according to MDRD formula respectively, and stage 5D on maintenance hemodialysis were included. Patients having a critical illness, taking spironolactone, glucocorticoids, finasteride, cyclophosphamide, cyclosporin A and tacrolimus, aged <20 or >60, were excluded from this study. Diagnosis of CKD was confirmed by history, clinical examination, biochemical findings and imaging. All CKD patients were designated as group 'A' (total no. 90), healthy control group were grouped as group 'B' (total no. 88). BMI and serum testosterone of the CKD patients (group A) was compared with that of the healthy control group (group B).

### Data processing and data analysis

Statistical analyses were conducted using the Statistical Package for Social Sciences version 16.0 for Windows (SPSS Inc., Chicago, Illinois, USA). The mean values were calculated for continuous variables. The quantitative observations were indicated by frequencies and percentages shown with cross-tabulation. Student t-test was used for continuous variables for two groups. For the significance of the difference Spearman correlation coefficient test was done between the stage of CKD and S. Testosterone of CKD patients. In addition, Pearson's correlation coefficient was used to test the relationship between two continuous variables. P values <0.05 was considered statistically significant.

### Result

Majority 40(44.4%) patients had glomerulonephritis, 24(26.8%) had DM and 11(12.2%) had HTN as etiology of CKD. It was observed that 22.2% patients of CKD stage 3, 24.4% of CKD stage 4, 25.4% of CKD stage 5 and 27.8% of CKD stage 5D. Mean S. testosterone was found 4.29±1.9 ng/ml in CKD patients (group A) and 9.15±1.2 ng/ml in healthy subjects (group B). The mean S. testosterone difference was statistically significant (p<0.05) between two groups (Table I).

**Table I**

*Distribution of S. Testosterone between CKD patients and healthy subjects (n=178)*

| S. Testosterone (ng/ml) | Group A(CKD)(n=90) |      | Group B(Healthy)(n=88) |       | P value            |
|-------------------------|--------------------|------|------------------------|-------|--------------------|
|                         | N                  | %    | N                      | %     |                    |
| <3.2                    | 30                 | 33.3 | 0                      | 0.0   |                    |
| 3.2-14.6 (normal)       | 60                 | 66.7 | 88                     | 100.0 |                    |
| Mean±SD                 | 4.29               | ±1.9 | 9.15                   | ±1.2  | 0.001 <sup>s</sup> |

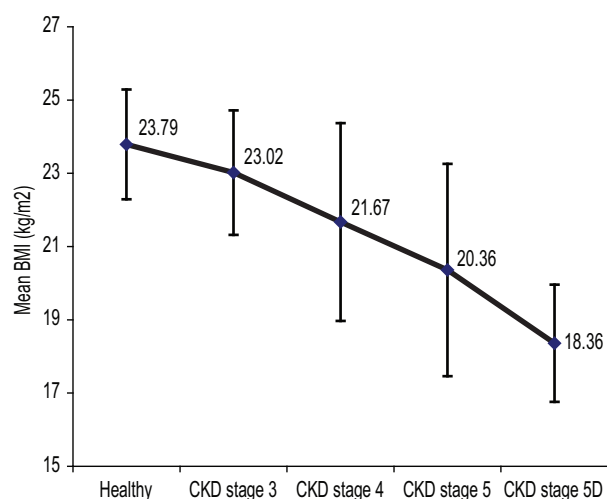
**Table II**

*Distribution of the study population by BMI (kg/m<sup>2</sup>) with CKD patients and healthy subjects (n=178)*

| BMI (kg/m <sup>2</sup> ) | Group-A(CKD)(n=90) |      | Group-B(Healthy)(n=88) |      | p-value            |
|--------------------------|--------------------|------|------------------------|------|--------------------|
|                          | N                  | %    | N                      | %    |                    |
| <18.5 (Under weight)     | 22                 | 24.4 | -                      | -    |                    |
| 18.5-22.9 (Normal)       | 51                 | 56.7 | 29                     | 33.0 |                    |
| 23-24.9 (Over weight)    | 11                 | 12.2 | 39                     | 44.3 |                    |
| 25-29.9 (Obese)          | 6                  | 6.7  | 20                     | 22.7 |                    |
| Mean±SD                  | 20.85              | ±2.7 | 23.79                  | ±1.5 | 0.001 <sup>s</sup> |

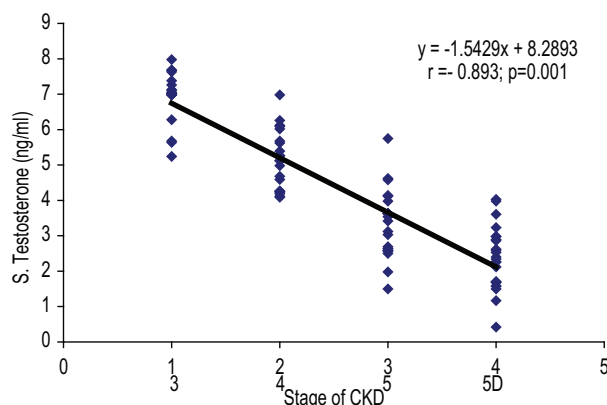
The mean BMI was found 20.85±2.7 kg/m<sup>2</sup> in CKD patients (group A) 23.79±1.5 kg/m<sup>2</sup> in healthy subjects (group B). The mean BMI difference was statistically significant (p<0.001) between two groups (Table II).

Figure 1 showed the relation of mean BMI (kg/m<sup>2</sup>) with different stages of CKD and healthy subjects.



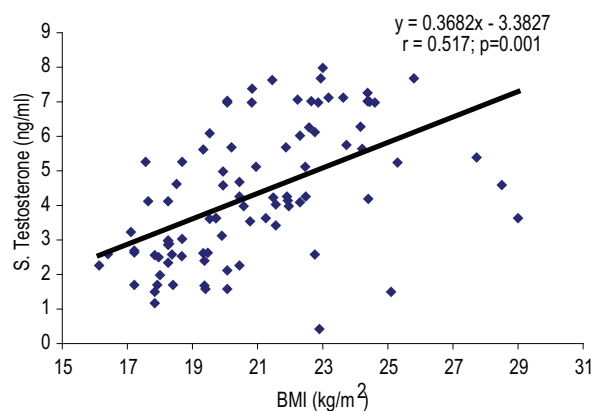
**Fig.-1:** Line diagram showing relation of mean BMI (kg/m<sup>2</sup>) with different stages of CKD and healthy subjects (n=178)

Figure 2 showed the negative Spearman’s rank correlation (r=-0.893; p=0.001) between different stages of CKD and S. Testosterone of CKD patients.



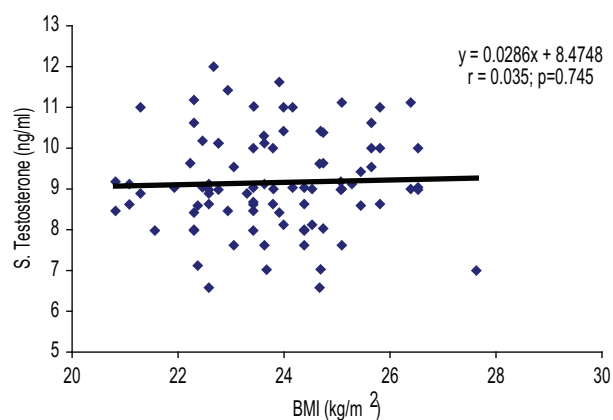
**Fig.-2:** Scatter diagram showing negative Spearman’s rank correlation (r=-0.893; p=0.001) between different stages of CKD and S. Testosterone of CKD patients.

Figure 3 showed the positive Pearson correlation (r=0.517; p=0.001) between BMI and S. Testosterone of CKD patients.



**Fig.-3:** Scatter diagram showing positive Pearson correlation ( $r=0.517$ ;  $p=0.001$ ) between BMI and S. Testosterone of CKD patients.

Figure 4 showed no Pearson correlation ( $r=0.035$ ;  $p=0.745$ ) between BMI and S. Testosterone of healthy subjects.



**Fig.-4:** Scatter diagram showing no Pearson correlation ( $r=0.035$ ;  $p=0.745$ ) between BMI and S. Testosterone of healthy subjects.

## Discussion

This cross-sectional study was carried out among chronic kidney disease (CKD) patients to evaluate serum testosterone levels in males and their association with body mass index (BMI).

For this purpose, a total of 90 diagnosed cases of an adult male with different stages of CKD (CKD stage 3, 4, 5 and 5D) patients and age-matched 88 healthy individuals were included as per inclusion and exclusion criteria.

In this current study, it was observed that the majority of 40(44.4%) patients had glomerulo-

nephritis, 24(26.8%) had DM, and 11(12.2%) had HTN as an aetiology of CKD. It was also observed that 22.2% of patients had CKD stage 3, 24.4% had stage 4, 25.4% had stage 5, and 27.8% had stage 5D. Similarly, evidence showed as many as 40 to 60% of CKD stage-5 men had been reported to be hypogonadal based on low concentrations of total and free testosterone.<sup>5</sup> In this current study, it was observed that in group A (CKD), the majority, 51(56.7%), were normal BMI (18.5-22.9 kg/m<sup>2</sup>). The mean BMI was found to be 20.85±2.7 kg/m<sup>2</sup>. In group B (Healthy), the majority of 39(44.3%) subjects were overweight (23.-24.9 kg/m<sup>2</sup>). The mean BMI was found to be 23.79±1.5 kg/m<sup>2</sup>. The mean BMI difference between the two groups was statistically significant ( $p<0.001$ ). Lower body mass index is a risk factor for cardiovascular mortality in ESRD.<sup>14</sup> In another study, it was found comparatively lower BMI in CKD patients, where the mean BMI was 26.34±3.91 kg/m<sup>2</sup> and 27.77±2.91 kg/m<sup>2</sup> in CKD patients and the control group, respectively.<sup>17</sup>

In this series, it was observed that in group A (CKD), 60(66.7%) patients had normal (3.2-14.6 ng/ml) S. testosterone and their mean S. testosterone was found to be 4.29±1.9 ng/ml. In group B (Healthy), all subjects had normal (3.2-14.6 ng/ml) S. testosterone and their mean S. testosterone was found to be 9.15±1.2 ng/ml. The difference in mean S. testosterone was statistically significant ( $p<0.05$ ) between the two groups. Similarly, it was found that the mean serum total testosterone was 8.81±3.43 nmol/l in CKD patients and 15.17±5.59 in the control group, and the difference was statistically significant ( $p<0.005$ ) between the two groups.<sup>17</sup> In another study, it was found that the mean (±SD) testosterone concentration for all patients was 13.9 (±6.5) (median 13.2; range 0.5–37.0) nmol/l. Mean (±SD) testosterone concentrations were 15.5 (±5.1) (range 5.7– 27.1 nmol/l) in the transplant group; 13.0 (±6.9) (range 0.5– 35.5 nmol/l) in the dialysis group; and 14.2 (±6.4) (range 0.6–37 nmol/l) in the low-clearance group.<sup>2</sup>

This present study shows a negative Spearman's rank correlation ( $r=-0.893$ ;  $p=0.001$ ) between

the Stage of CKD and S. Testosterone of CKD patients. Similarly, it was reported that there was a significant negative correlation between free testosterone in both ESRD patients and control groups, with a significant difference in testosterone between these two groups.<sup>17</sup> Another recent evidence showed that CKD patients had more cardiovascular risk factors (CVRF) than transplant patients and that their concomitant testosterone levels were low.<sup>6</sup> In this series, a positive Pearson correlation ( $r=0.517$ ;  $p=0.001$ ) between BMI and S. Testosterone of CKD patients was observed, similar to recent evidence.<sup>17</sup> In this current study, no Pearson correlation ( $r=0.035$ ;  $p=0.745$ ) between BMI and S. Testosterone of healthy males was observed, and similar findings were also observed in a recent study.<sup>5</sup>

### Conclusion:

In this study, a significant negative correlation existed between CKD and serum testosterone stages, and a positive correlation existed between BMI and serum testosterone of CKD patients. Future studies are also needed to determine the potential adverse effects of low serum testosterone levels in patients with chronic kidney disease and to determine whether the therapeutic intervention of low serum testosterone in males with chronic kidney disease.

### References:

1. Alice, S, Anton, L and Walter, H 2002, 'Sexual hormone abnormalities in male patients with renal failure', *Nephrol Dial Transplant*, vol. 17, pp. 368-371.
2. Albaaj, F, Sivalingham, M, Haynes, P, McKinnon, G, Foley, RN, Donoghue, DJO, & Kalra, PA 2006, 'Prevalence of hypogonadism in male patients with renal failure', *Postgrad Med J*, vol. 82, pp. 693-6.
3. Brodsky, IG, Balagopal, P & Nair, KS 1996, 'Effects of testosterone replacement on muscle mass and muscle protein synthesis in hypogonadal men: A clinical research center study', *J Clin Endocrinol Metab*. Vol. 81, pp. 3469-3475
4. Carrero, JJ, Barany, P, Yilmaz, MI, Sonmez, A, Heimbürger O & Qureshi, AR, Ozgurtas, T, Yenicesu, M, Lindholm, B, and Stenvinkel, P 2012, 'Testosterone deficiency is a cause of anaemia and reduced responsiveness to erythropoiesis-stimulating agents in men with chronic kidney disease', *Nephrol Dial Transplant*, vol. 27, pp. 709-715.
5. Carrero, JJ, Qureshi, AR, Nakashima, A, Arver, S, Parini, P, & Lindholm, B 2011, 'Prevalence and clinical implications of testosterone deficiency in men with end-stage renal disease', *Nephrol Dial Transplant*, vol. 26, no. 1, pp.184-90.
6. Colak, H, Sert, I, Kurtulmus, Y, Karac, C, Toz, H & Kursat, S 2014, 'The Relation between Serum Testosterone Levels and Cardiovascular Risk Factors in Patients with Kidney Transplantation and Chronic Kidney Disease', *Saudi J Kidney Dis Transpl*. Vol. 25, no. 5, pp. 951-9.
7. de Vries, CP, Gooren, LJ & Oe, PL 1984, 'Haemodialysis and testicular function', *Int J Androl* vol. 7, pp. 97-103.
8. Foley, RN, Parfrey, PS & Sarnak, MJ 1998, 'Clinical epidemiology of cardiovascular disease in chronic renal failure', *Am J Kidney Dis*. Vol. 32, Suppl. 5, pp. 112-9.
9. Gomez, F, de la Cueva, R, Wauters, JP & Lemarchand-Beraud, T 1980, 'Endocrine abnormalities in patients undergoing long-term hemodialysis', *The role of prolactin. Am J Med* vol. 68, pp. 522-530.
10. Go, AS, Chertow, GM, Fan, D, McCulloch, CE & Hsu, CY 2004, 'Chronic kidney disease and the risks of death, cardiovascular events, and hospitalization', *N Engl J Med*. vol. 351, pp. 1296-1305
11. Gungor, O, Kircelli, F, Carrero, JJ, Asci, G, Toz, H, & Tatar, E 2010, 'Endogenous testosterone and mortality in male hemodialysis patients: Is it the result of aging?', *Clin J Am Soc Nephrol*, vol. 5, pp. 2018-2023.
12. Handelsman, DJ 1985, 'Hypothalamic-pituitary gonadal dysfunction in renal failure, dialysis and renal transplantation', *Endocr Rev* vol. 6, pp. 151-182.
13. Johansen, KL 2004, 'Testosterone metabolism and replacement therapy in patients with end-stage renal disease', *Semin Dial*, vol. 17, pp. 202-8
14. Kopple, JD, Zhu, X, Lew, NL & Lowrie, EG 1999, 'Body weight-for-height relationships predict mortality in maintenance hemodialysis patients', *Kidney Int*. vol. 56, pp. 1136-1148.
15. Miller, KK 2009, 'Androgen deficiency: Effects on body composition', *Pituitary*. Vol. 12, no. 2, pp. 116-24.
16. Richardson, JR & Weinstein, MB 1970, 'Erythropoietic response of dialyzed patients to testosterone administration', *Ann Intern Med*. Vol. 73, pp. 403-407
17. Zainab, A, Al-Shamma, A, Hasan, K & Zahraw, S 2014, 'Postprandial hypertriglyceridemia and androgen dysfunction relationship in men with end stage renal disease', *Journal of Biology, Agriculture and Healthcare*, Vol. 4, No. 16, pp. 142-7.