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Assessment Of Serum Testosterone Levels In Men With Controlled And Poorly Controlled Type 2 Diabetes Mellitus In Erbil City

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Abstract

Background: Type 2 Diabetes Mellitus (T2DM) is a common condition marked by insulin resistance and high blood sugar. It can cause many health problems, including hormone issues, nerve damage, kidney disease, and heart problems. One of the less recognized complications is low testosterone, which can affect quality of life and increase the risk of heart disease. **Methodology**: This study is a cross-sectional survey carried out at Bahirka Hospital and the Diabetic Center in Erbil, Kurdistan, between April 2024 and June 2025. Information was collected using a structured questionnaire, and blood tests were done to measure testosterone levels. A small pilot study with 5 patients was first done to check feasibility, but those cases were excluded from the final results. The study included 100 men aged 40–70 years with type 2 diabetes for more than one year. Patients with other conditions or treatments that could affect testosterone were excluded. In the final analysis, 50 men had poorly controlled diabetes and 50 had controlled diabetes. **Results:** The mean age of controlled type 2 diabetic patients was 57.4 ± 1.2 years, slightly higher than poorly controlled patients at 54.8 ± 1.1 years. Mean BMI was also higher in poorly controlled patients (33.2 ± 0.8) compared to controlled cases (29.1 ± 0.7). Overall, 80% of participants were overweight or obese, with 46% overweight, 34% obese, and only 20% having normal BMI. Poorly controlled patients had significantly more cases of severely low (10%) and low testosterone (34%) compared to the controlled group. Normal testosterone was more frequent in controlled cases (60% vs. 36%), as were borderline levels (34% vs. 20%). A significant association was found between low testosterone and poor glycemic control ($P < 0.05$). **Conclusion**: This study found a significant link between poor glycemic control and reduced testosterone levels in men with type 2 diabetes, with poorly controlled patients showing lower testosterone, higher BMI, and slightly younger age.

Keywords: Body Mass Index, Glycemic Control, Hypogonadism, Insulin Resistance, Obesity, Testosterone Levels, Type 2 Diabetes Mellitus.

Introduction

Insulin resistance and persistently elevated blood sugar levels are hallmarks of Type 2 Diabetes Mellitus (T2DM), a metabolic disease. Numerous consequences are linked to it, such as endocrine dysfunction, neuropathy, nephropathy, and cardiovascular disease. [1] A comorbidity of type 2 diabetes that is becoming more well acknowledged is testosterone insufficiency, which may lower quality of life and raise the risk of cardiovascular events in those who have it. [2] Diabetes outcomes are significantly influenced by glucose management, with poorly managed diabetes being associated with increased oxidative stress, hormone dysregulation, and systemic inflammation. [3] Men with type 2 diabetes may have lower testosterone levels than people without the disease, according to earlier research, and this loss may be exacerbated by poorer glycemic control. [4] In hypogonadal males with type 2 diabetes, studies have also indicated that testosterone replacement treatment may help with glycemic management and insulin resistance. [5] Furthermore, a complicated interaction between metabolic health and androgen status has been shown to exist between testosterone levels, insulin sensitivity, and mitochondrial

function. [6] Additionally, reduced testosterone levels have been associated with a higher incidence of type 2 diabetes in males, highlighting the need of comprehending hormonal alterations in diabetic populations. [7] It hasn't been sufficiently investigated, nevertheless, how much testosterone levels vary between men with well-controlled and poorly-controlled diabetes. Since diabetes mellitus is rapidly spreading and the morbidity linked to it is more incapacitating than the disease itself, the association between sex hormones and Type 2 diabetes mellitus (T2DM) is a major issue in the medical community. T2DM affects millions of individuals worldwide, yet many more go undiagnosed. [8] By 2030, the global prevalence of diabetes mellitus among adults (ages 20 to 79) is predicted to rise from 6.4% in 2010 to 7.7%. [9] A convincing indication of the link between low serum testosterone and type 2 diabetes. In the Western world and Asia, compared to Africa, hypogonadism is more prevalent in men with diabetes than in men without the disease, despite being caused by a number of different processes. This may be because there is a dearth of information about this problem among men in sub-Saharan Africa. [10-12]

The aim is to assess and compare testosterone levels in men with controlled and poorly controlled T2DM.

The objectives of this study were to determine the serum testosterone levels in men with type 2 diabetes mellitus (T2DM), classify participants into controlled and poorly controlled groups based on HbA1c levels, and compare testosterone levels between these groups. Additionally, the study aimed to evaluate potential correlations between testosterone levels and glycemic control indicators such as HbA1c and fasting glucose levels, as well as to assess the clinical implications of testosterone variations in diabetic men.

Methodology

This study is a cross- sectional, observational study, taking a snapshot information about most of the data and requesting a serum testosterone level for all patients to achieve the purpose of the study. The study was performed in the outpatient clinic of the endocrinology of Bahirka Hospital to enroll controlled cases as well as the Diabetic center to enroll poorly controlled cases of Erbil city, both of which are tertiary health care facilities in Erbil/ Kurdistan/ Iraq, The researcher collected data through a self-administered, purpose structured, and peer reviewed questionnaire designed for patients from Apr. 2024 to Jun 2025. Before the start of the study, the questionnaire was checked, and a pilot study was performed for 5 cases to ensure feasibility and make final arrangements and adjustments; these cases were not included in the study. Inclusion Criteria were patients all males aged 40-70 years, diagnosed with type 2 DM for more than one year of duration, not being on testosterone replacement therapy, and having no history of hypogonadism or pituitary disorders. On the other hand, criteria for exclusion were any patient with known endocrine disorders affecting testosterone levels, or use medications that alter testosterone levels (e.g., corticosteroids, anti-androgens), or have severe renal or hepatic impairment**.** A sample size of approximately 50 was calculated using Epi-Info software, considering a population size of 1000 type 2 diabetic patients, with an expected frequency of 50%, a 95% confidence interval, and a 5% acceptable margin of error. A total of 50 patients were included in the study. Another 50 controlled patients were enrolled in the study for comparison; the number will allow for a comprehensive description and analysis of data. After obtaining every participant's approval, and the scientific and Ethical Committee of the Kurdistan Higher Council of Medical specialties approval, convenient data were collected by direct face-to-face interviews of the patients using a structured questionnaire and by reviewing the patients laboratory test results (Serum Testosterone Level), The data that had been collected were analyzed using appropriate statistical methods to describe frequencies and proportions of different variables. Independent t-tests were used to compare testosterone levels between the two groups. Descriptive statistics were used to summarize the sociodemographic and other characteristics of the participants. SPSS version 26 was used for this purpose. The small sample size from a single site (limited generalizability), potential unmeasured confounding factors, and cross sectional (no cause-effect) are the study's limitations. It does not evaluate symptoms of low testosterone, only measures testosterone, and does not include women or younger males. Additionally, only total testosterone may be assessed, which leaves out more precise hormonal information.

Result

The mean age group in controlled type 2 diabetic cases was 57.4 years ± 1.2 SD, higher than the mean age of poorly controlled type 2 diabetes cases, which was 54.8 years ± 1.1 SD. Details are shown in Figure 1.

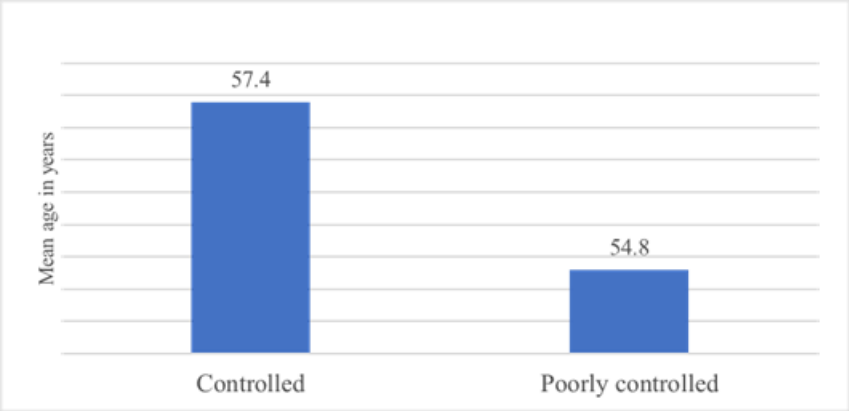

Figure 1: Mean age in controlled vs poorly controlled type 2 DM

The mean BMI of controlled type 2 diabetes patients was 29.1 ± 0.7 SD, whereas the mean BMI of poorly controlled type 2 diabetes patients was 33.2 ± 0.8 SD. Details are shown in Figure 2.

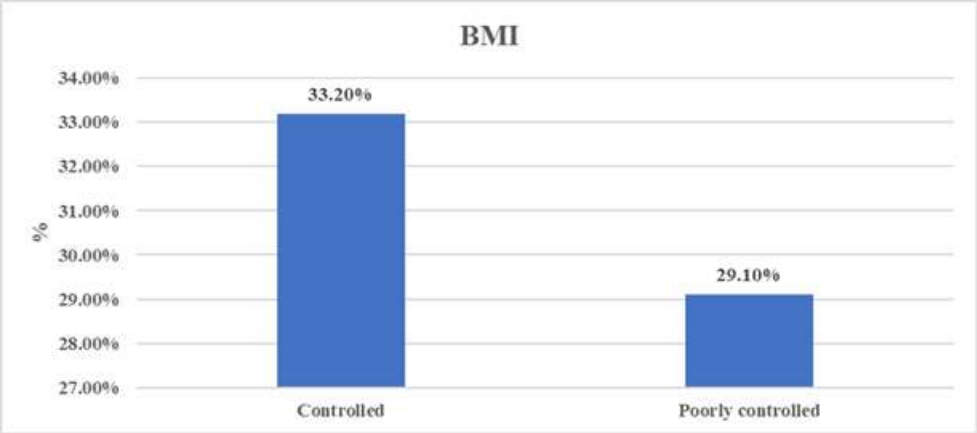

Figure 2: Mean BMI of controlled vs poorly controlled type 2 DM.

Among the 100 participants, the majority (80%) were either overweight or obese. Specifically, 46% were overweight and 34% were obese (33% in Class I and 1% in Class II). Only 20% had a normal BMI, while none were underweight or in Obesity Class III. This indicates a high prevalence of excess body weight, which may contribute to increased health risks such as cardiovascular disease and poor stroke outcomes. Details are shown in Table 1.

Table 1: Body Mass Index (BMI) classification of patient

BMI (kg/m²)	Number	Percent
Underweight (< 18.5)	0	0
Normal weight (18.5 – 24.9)	20	20
Overweight (25.0 – 29.9)	46	46
Obesity Class I (30.0 – 34.9)	33	33
Obesity Class II (35.0 – 39.9)	1	1
Obesity Class III (≥ 40.0)	0	0
Total	100	100

The mean HBA1C of controlled patients was 6.30% ± 1.3 SD which is much lower than the mean HBA1C of poorly controlled 8,70% ± 1.9 SD. Details are shown in Figure 3.

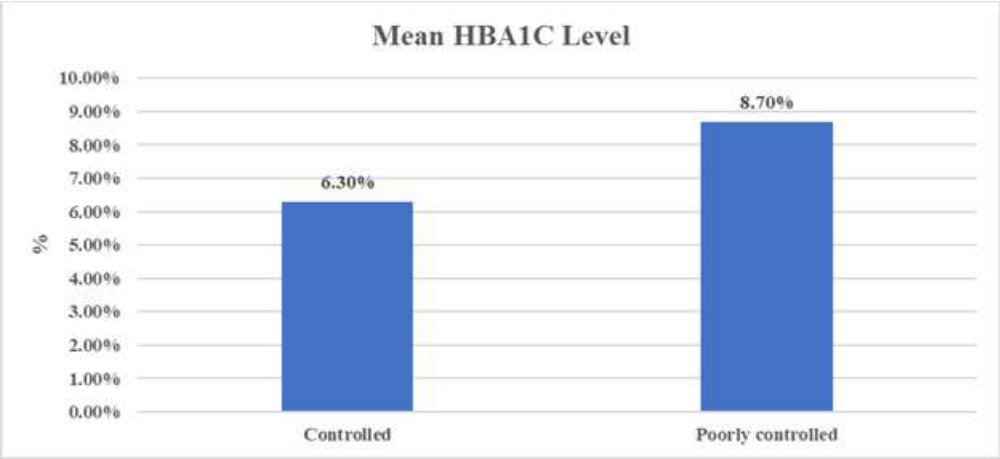

Figure 3: Mean HBA1C of controlled vs poorly controlled type 2 DM.

Among the 50 poorly controlled type 2 diabetic patients, 12 (24%) had mildly poor control with HbA1c levels ranging from 7.0% to 8.0%, 19 patients (38%) showed moderately poor control with HbA1c between 8.1% and 9.0%, and another 19 patients (38%) were classified as severely poorly controlled with HbA1c levels above 9.0%. details are shown in Table 2.

Table 2: Distribution of poorly controlled T2DM patients by HbA1c levels.

HBA1C level	**Number**	**Percentage**
Mildly Poor Control (7.0% – 8.0%)	12	24
Moderately Poor Control (8.1% – 9.0%)	19	38
Severely Poor Control> 9.0%	19	38
Total	50	100

The mean testosterone level of controlled T2DM patients was 4.25 ng/ml ± 0.22 SD. while the mean testosterone level of poorly controlled T2DM patients was 3.17ng/ml ± 0.17SD.

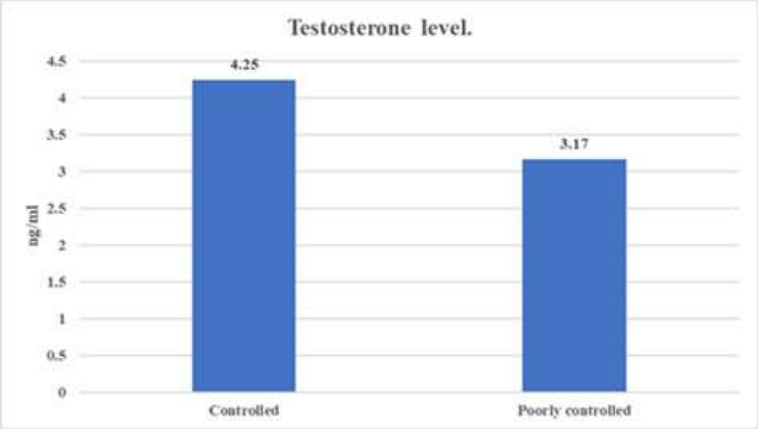

Figure 4: Mean testosterone level in controlled vs poorly controlled type 2 DM.

The mean testosterone level was significantly higher in the controlled group (4.25 ± 0.22) compared to the poorly controlled group (3.17 ± 0.17), with a statistically significant difference (P = 0.007). Details are shown in Table 3.

Table 3: Association between testosterone level and T2 DM control status

Variables	Mean ± SD	P.value
Testosterone level in controlled no = 50	4.25 ± 0.22	0.007
Testosterone level in poorly controlled no = 50	3.17 ± 0.17	
Total no =100	3.71 ± 0.20	

A significantly higher proportion of poorly controlled patients had severely low (10.0%, P = 0.0001) and low testosterone levels (34.0%, P = 0.0003) compared to the controlled group. Conversely, normal testosterone levels were more common in the controlled group (60.0% vs. 36.0%, P = 0.034). Borderline levels were also more frequent in the controlled group (34.0% vs. 20.0%, P = 0.031). No cases had high testosterone levels in either group. There was a statistically significant association between testosterone levels and glycemic control status. Poorly controlled diabetic patients were more likely to have lower testosterone levels, while normal and borderline levels were more prevalent among controlled patients, indicating a potential link between testosterone deficiency and poor glycemic control (P < 0.05 across all categories). Details are shown in table 4.

Table 4: Comparison of Serum Testosterone Levels Between Controlled and Poorly Controlled T2DM Patients"

Category	Controlled No (%)	Poorly controlled No (%)	P value
Severely Low (< 2.0 ng/mL)	0 (0.0)	5 (10.0)	0.0001
Low (2.0 – 2.99 ng/mL)	3 (6.0)	17 (34.0)	0.0003
Borderline (3.0 – 3.99 ng/mL)	17 (34)	10 (20.0)	0.031
Normal Range (4.0-10.0ng/ml)	30 (60.0)	18 (36.0)	0.034
High > (10.0 ng/mL)	0 (0.0)	0 (0.0)	0.0
Total	50 (100.0)	50 (100.0)	

Discussion

The current study examined the link between males with type 2 diabetes mellitus (T2DM) and their blood testosterone levels. It found a direct correlation between lower testosterone levels and poor glycemic management. According to an increasing body of research, men with poorly managed type 2 diabetes are more likely to have hypogonadism than men with appropriate glycemic control[13,14,15] Low testosterone levels may worsen insulin resistance and increase visceral adiposity, further impairing metabolic control, while chronic hyperglycemia and insulin resistance may impair the function of the hypothalamic-pituitary-gonadal (HPG) axis and promote testicular dysfunction. These two conditions are linked by complex and probably reciprocal pathophysiological mechanisms.In this study, the average age of men with controlled type 2 diabetes was 57.4 years, while those with poorly controlled diabetes were slightly younger, at 54.8 years. This small age difference shows that age alone does not determine blood sugar control other factors like how long the person has had diabetes, treatment adherence, and other health problems also play a role. These results are similar to a Saudi Arabian study that found the average age of male diabetes patients was 57 years, confirming that type 2 diabetes mostly affects people in their late middle age.

In the present study, the mean age of participants with controlled type 2 diabetes mellitus (T2DM) was 57.4 years, while those with poorly controlled T2DM had a slightly lower mean age of 54.8 years. This age difference suggests that glycemic control may not be only dependent on age but could also be affected by other factors such as disease duration, adherence to treatment, and presence of comorbidities, these findings are in line with a study conducted in Saudi Arabia by Tourmani et al. 2020, which reported a mean age of 57 years among

male patients with T2DM, supporting the observation that type 2 diabetes mainly affects individuals in their late middle age. The similarity in age distribution across studies supports the fact that T2DM is highly prevalent among older adults, which is due to age-related decease in insulin sensitivity, accumulation of risk factors, and progressive β-cell dysfunction.[17]

In the present study, the mean body mass index (BMI) of controlled type 2 diabetic patients was 29.1 kg/m², while that of poorly controlled type 2 diabetic patients was 33.2 kg/m². This difference supports the association between higher BMI and poor glycemic control. The findings are similar with several studies conducted across the Middle East, highlighting the high prevalence of overweight and obesity among individuals with type 2 diabetes like North Africa [18] (MENA) region reported an average BMI of 31.1 kg/m² among patients with type 2 diabetes, with poor glycemic control (HbA1c ≥8.0%) being significantly more common among those with higher BMI levels (Khunti et al., 2017). Similarly, a study conducted in Al-Ahsa, Saudi Arabia [19] reported a mean BMI of 31.7 ± 6.9 kg/m² among T2DM patients, with obesity correlating positively with higher HbA1c levels and insulin resistance (Alharbi et al., 2022). These results were in alignment with our findings, especially among poorly controlled patients, suggesting that the observed BMI–glycemic control relationship in our study reflects regional findings.

In comparison with studies conducted in other countries, the findings of our study show that the mean testosterone levels in both controlled and poorly controlled type 2 diabetic (T2DM) patients are generally higher. Specifically, our study reported a mean testosterone level of 4.25 ng/mL (± 0.22) in controlled T2DM patients and 3.17 ng/mL (± 0.17) in poorly controlled patients. In contrast, an Iranian[20] study from Isfahan reported a much lower mean level of 4.81 nmol/L (approximately 1.39 ng/mL), suggesting a more pronounced hypogonadism among their participants. Similarly, studies from Saudi Arabia [21] indicated that a substantial proportion of T2DM patients had testosterone levels below 8–12 nmol/L (2.3–3.5 ng/mL), particularly among those with poor glycemic control. The higher mean levels observed in our study, especially among controlled patients, may reflect better overall health status, lower obesity rates, or differences in study population characteristics such as age, duration of diabetes, or medication use.

Conclusion

According to the current study, poor glycemic management was strongly associated with decreased testosterone levels in males with type 2 diabetes mellitus (T2DM). BMIs were higher, testosterone levels were significantly lower, and patients with poorly treated diabetes were slightly younger than those with controlled diabetes.

Recommendations

Weight control, lifestyle education, routine testosterone tests, and individualized treatment programs are crucial for improving the metabolic and hormonal health of men with type 2 diabetes, particularly those with poor control.

Conflict of interest: None.

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