

A Study on Effects of Diabetes Mellitus on Sexual Hormones in Males and Females**Pamarthi Laharika¹, Raghavendra Sherikar², Sanakkayala Sreelatha³, Peddapalegani Palavardhan⁴, D Raja Shree⁵**¹2nd MBBS Student, Mallareddy Medical College for Women, Hyderabad²Professor, Department of Physiology, Mallareddy Medical College for Women, Hyderabad³Dean, Mallareddy Medical College for Women, Hyderabad⁴Statistician, Department of Community Medicine, Mallareddy Medical College for Women, Hyderabad⁵Professor & Hod, Department of Physiology, Mallareddy Medical College for Women, Hyderabad

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Abstract**Introduction:** Diabetes mellitus (DM) is a growing global epidemic, with 537 million people affected worldwide, and projected to reach 784 million by 2045. India, a major contributor, has a diabetes prevalence of 11.4%. This study aimed to investigate the correlation between sexual hormones and DM to better understand its impact.**Methods:** A cross-sectional study was conducted at Mallareddy Medical College between for women between December 2023 and February 2024. Adults aged 20-40 with prediabetes or diabetes were included, excluding pregnant women, PCOS patients, and those on hormonal medications. Blood samples were analyzed for HbA1c, testosterone, estradiol, and progesterone. Statistical analysis used Pearson/Spearman correlations.**Results:** The study included 100 participants, with a mean age of 35 for males and 33 for females. No significant correlation was found between HbA1c and testosterone in males ($r = 0.068$, $p = 0.639$), or estrogen ($r = -0.002$, $p = 0.988$) and progesterone ($r = 0.48$, $p = 0.741$) in females.**Conclusion:** The study concluded that sexual functions in diabetic patients may not be significantly influenced by testosterone, estrogen, or progesterone levels. Other factors, like neuropathy, likely contribute to sexual dysfunction. Healthcare professionals should consider the complex relationship between diabetes and sexual hormones. Further research on newly diagnosed patients is recommended.**Keywords:** Diabetes Mellitus, Sexual Hormones, Testosterone, Sexual Dysfunction, Neuropathy

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Introduction

Diabetes Mellitus (DM), a ticking time bomb silently wreaking havoc on millions. Over the last few decades, the prevalence of DM has progressively increased, reaching epidemic proportions on a global scale. The International Diabetes Federation (IDF) estimates that 537 million individuals (ages 20 to 79) worldwide. As per the current statistics, predicted to be 784 million by 2045 [1] The World Health Organization (WHO) reports that noncommunicable diseases (NCDs) accounted for 74% of mortalities worldwide in 2019; diabetes was the tenth most common cause of death worldwide in 2019 with 1.6 million deaths [2]. It is estimated that 592 million people will pass away from diabetes by the year 2035 [3]. As per the 2019 IDF report, China (116.4 million), India (77.0 million), and the United States of America (31.0 million) have the highest diabetes prevalence rates.

By 2030 and 2045, with the biggest diabetes burdens remaining in China and India [4].

India being the home country of diabetes inhabiting 101 million. Out of 113,043 people 79,506 from rural and 33,537 from urban areas participated in the ICMR INDIAB study. The weighted prevalence of prediabetes was 15.3 percent, while the overall weighted prevalence of diabetes was 11.4%. [5] People in urban areas had a greater prevalence of diabetes than in rural areas. [6] DM is a multifaceted metabolic disorder characterized by persistent hyperglycemia due to defects in insulin secretion, action, or both. Insulin, a hormone produced by the pancreas, plays a central role in regulating blood sugar levels by facilitating the uptake of glucose into cells for energy production and storage. When this intricate regulatory system malfunctions, it leads to the dysregulation of glucose metabolism, resulting in DM.

Over the past two decades, numerous studies have explored the effects of diabetes on sexuality, highlighting its adverse impact on sexual function. Diabetes disrupts the production, regulation, and function of sexual hormones, contributing to various sexual health issues in men and women, with evolving treatment approaches informed by recent research.

Poorly controlled diabetes in men lowers testosterone levels, leading to erectile dysfunction, reduced libido, and oligospermia, caused by Leydig cell dysfunction from vascular issues, inflammation, and insulin resistance. In women, diabetes disrupts hormonal balance, causing menstrual irregularities like oligomenorrhea or amenorrhea and increasing the risk of polycystic ovarian syndrome (PCOS) with insulin resistance and ovulatory dysfunction. Hence, this study was conducted to understand the correlation between DM & sexual hormones in males and females.

Methods

It was a cross-section study conducted in the department of Physiology, Mallareddy Medical College for women. Study protocol was approved by the institutional Ethics committee. Informed consent was obtained from the study members. The research was carried between December 2023 to February 2024.

The study included adults aged 20 to 40 years who were either prediabetic or diabetic, female with consistent menstrual cycles for the past six months. Pregnant women, polycystic ovarian syndrome (PCOS) female, those on medication that could alter serum testosterone or estrogen levels, those on oral contraceptive pills, anaemic individuals and non-cooperative individuals were not considered.

The study was explained to the members in the local language. The doubts were addressed by the study members. Findings were recorded in the study proforma. Then by following universal precautions, 5 ml blood sample was collected in EDTA tubes. It was divided and one portion was used for HBA1C test and the rest to estimate total testosterone (TT), estradiol (E2) and progesterone (P4).

Statistical analysis

Normality test was done using shapiro wilk test. Pearson correlation / spearman rank correlation was used to find the relation between the variables. A p value <0.05 was considered to be statistically significant. Results are represented in mean \pm standard deviations.

Results

A total of 100 members were included in the study with gender ratio of 1. The mean age was 35 and 33 years, respectively to male and female. Men having

mean HbA1c of 8.7 and females having mean HbA1c of 8.8. There was no significant correlation of TT level with HbA1C; $r=0.068$ ($-1 < r < +1$) and $p=0.639$ ($-0.5 < p < +0.5$). There's significant correlation of HbA1c with RBS ($r=0.767$) and estimated average glucose ($r=0.894$). Mean testosterone levels of the patients is 275.98 ng/dL. We identified no significant associations of total testosterone with the duration of diabetes, HbA1c, diabetic complications, erectile dysfunction or sexual quality of life. In 50 diabetic and prediabetic females, no significant correlation was found between HbA1c levels and estrogen ($r=-0.002$, $p=0.988$) or progesterone ($r=0.48$, $p=0.741$).

Discussion

Previously published findings by Tomar et al. [7] who observed normal total testosterone in a group of 50 T1DM males with the average age of 42.8 years. Biswas et al. [31] investigated a group of 93 T1DM patients with the age mean of 45.5 years and 121 healthy controls (age mean 40.3). They found no significant change in the testosterone level between T1DM and controls and no correlation of the testosterone level with erectile function.

Van Dam et al. [8] examined 52 T1DM patients (mean age 36.6) without microvascular complications alongside 53 age- and BMI-matched controls. They found similar total testosterone levels between T1DM patients and healthy controls. Our findings corroborate and expand upon these earlier results in younger DM patients. Consistent with prior research, there was no significant correlation between testosterone levels and either sexual quality of life or dysfunction in T1DM patients.

In contrast, Grossmann et al. [9] reported lower total testosterone levels in a cohort of 68 T1DM males (mean age of 45 years). This discrepancy could be attributed to higher BMI (mean 27 kg/m²) in their group. The association between testosterone and BMI is well documented in T2DM [10, 11] and it was also observed in T1DM in other studies. [12, 13]

David Lionardi and colleagues [14] conducted a study investigating the correlation between blood glucose and estradiol levels in reproductive-age women. The study included twenty participants under the age of 50, divided into two groups: 40–45 years old and 46–50 years old. Their findings revealed no significant correlation between type 2 diabetes and estradiol hormone levels in either age group. Consequently, the study concluded that age is not the primary determinant of fluctuations in blood sugar levels, and there is no correlation between type 2 diabetes and estradiol hormone levels.

Suganthy K et al. [15] conducted a study involving 120 adult women who had normal and regular menstrual cycles ranging from 3 to 7 days within a 28 to 35-day cycle. Their research revealed that there was no significant correlation observed between estradiol levels and blood glucose levels.

Barbara Widom et al. [16] examined the hormonal mechanisms underlying the variability in glycemic control during the different phases of the menstrual cycle in women with insulin-dependent diabetes mellitus. It revealed no significant correlation between progesterone levels and HbA1c.

A study was done by Soren et al. [17] on sexual function and pituitary hormonal axis. The study revealed that there was no significant correlation observed between sexual dysfunction and the duration of the disease. Additionally, there were no discernible differences noted in the serum concentrations of luteinizing hormone, follicle stimulating hormone, prolactin, testosterone, and estradiol-17beta between patients exhibiting normal and reduced sexual function. It is concluded that increased serum concentrations of testosterone, or oestradiol 17beta do not accompany sexual

dysfunction, and that other factors are likely to be responsible for the high prevalence of dysfunction with short-term diabetes who do not have neuropathy.

Enzlin [18] from Belgium has reported also that SD in type 1 diabetic women did not correlate with age, BMI, duration of diabetes, glycemic control, using medication, menopausal status or complications. Similarly, Marzieh [19] examined 200 diabetes patients, 100 males and 100 females, findings of this study showed that SD prevalence and the glycemic control did not correlate with the frequency of SD in the study population. Adnan's research [20] revealed diminished levels of follicle stimulating hormone, luteinizing hormone, testosterone, progesterone, and estradiol among both male and female patients with type 2 diabetes. This deficiency is linked to obesity and increased insulin resistance, resulting in further decline in hormone production.

Conclusion

The study results indicated that sexual functions in diabetic patients may not be significantly influenced by sexual hormones such as testosterone in males, and estrogen and progesterone in females. Sexual complications were not solely linked to serum concentrations of these hormones. Other factors, such as neuropathy, may play a role. Previous studies have shown potential connections between diabetes and sexual dysfunction, including erectile dysfunction, decreased libido, and menstrual irregularities, though the clinical significance varied among individuals. Healthcare

professionals were urged to recognize the complex relationship between diabetes and sexual hormones. Future research should focus on newly diagnosed patients and further explore these mechanisms.

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