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# Evaluation of the relationship between perirenal fat thickness and severity of erectile dysfunction: A prospective study

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## Abstract

**Objective**: To investigate whether perirenal fat thickness (PRFT) is associated with erectile dysfunction (ED).

**Materials and Methods**: Male patients aged 30-70 years who applied to the urology outpatient clinic due to ED were prospectively evaluated in this study. Patients having the similar age without ED complaints were included in the control group. Age, body mass index (BMI), fasting blood glucose (FBG), lipid profile, total testosterone and HB1Ac levels of the patients were recorded. Patients presenting with ED were asked to fill the International Index of Erectile Function (IIEF-5) form. According to the total IIEF scores, ED patients were divided into 4 groups as severe, modarate, mild-moderate and mild. PRFT of all patients was measured by ultrasonography. Baseline demographic, biochemical and PRFT values were compared between groups.

**Results**: The patients were divided into 2 groups as ED (Group 1, n:61) and control (Group 2, n:61). The mean age was 50.5 ± 10.6 years (min-max 30-70), mean BMI and mean PRFT values were also found as 24.6 ± 4.1 kg/m2 (min-max 17.6-35.1) and 4.6 ± 2.2 mm (min-max 1.5-12), respectively.

While no statistically significant difference was observed between the two groups in terms of mean age, FBG, high-density lipoprotein (HDL), triglyceride, HBA1c values, BMI, total testosterone, total cholesterol, low-density lipoprotein (LDL), the mean PRFT was found to be statistically higher in Group 1 ($p<0.001$). According to the results of the correlation analysis, severity of ED, IIEF total score, duration of ED, BMI, FBG and HBA1c were significantly correlated with PRFT.

**Conclusion**: PRFT is a simple measurement that can be used to predict the severity of ED.

**Keywords:** Erectile dysfunction; IIEF-5; Perirenal fat thickness; Relationship

## 1. Introduction

Erectile dysfunction (ED) is defined the inability to achieve or maintain penile rigidity that would allow for satisfactory sexual performance [1]. ED is seen in more than half of the male population between the ages of 40 and 70 [2]. The prevalence of ED increases in the patients with advanced age, sedentary lifestyle and obesity. The most common causes of underlying organic pathology in ED is impaired arterial blood flow to erectile tissues. Factors that can cause ED include advanced age, diabetes mellitus, dyslipidemia, cardiovascular diseases (CVD), hypertension, metabolic syndrome, sedentary lifestyle and smoking.

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It is known that increase in visceral fat tissue caused by sedentary lifestyle and obesity contributes to the development of ED, which shares a common pathogenesis with CVD [3]. In clinical practice measurement of waist circumference (WC) and body-mass index (BMI) are commonly used to assess the increase in visceral fat tissue. Apart from these measurements, central obesity indexes such as centrality index (CI), visceral adiposity index (VAI) waist-hip ratio (WHR) and abdominal volume index (AVI) are also used to evaluate the degree of obesity that is closely related to ED [4-6].

Perirenal fat thickness (PRFT), which is known as ectopic visceral fat deposit and can be measured by ultrasonography, has also been thought to be a marker of visceral obesity [7]. Perirenal adipose tissue reflects the cardiovascular risk profile, with both its direct adverse effect on the kidney and dynamic hormone synthesis (e.g., adiponectin)[8]. It directly increases the glomerular hydrostatic pressure and activates the renin-angiotensin-aldosterone system. Indirectly, it creates a negative cardiometabolic effect in the body with its humoral effects through neural and especially adiponectin synthesis. Increase in PRFT is associated with diabetes mellitus, chronic kidney disease, CVD and obesity [9-13].

In our study, we have aimed to investigate whether PRFT is associated with ED, which is a reflection of cardiac and metabolic risks in male patients.

## 2. Material and methods

The ethics committee approval for the study (dated 06/04/2022 and numbered 2022-7) was obtained from the ethics committee of Mardin Artuklu University. Sixty-one male patients aged 30-70 years who applied to the urology outpatient clinic of Nusaybin State Hospital due to ED between April 2022-September 2022 were assigned to ED patients and age-adjusted 61 male patients without complaints of ED were included as the control group in this prospective study. Age, comorbidity, BMI, FBG, lipid profile, total testosterone and HB1Ac levels of all patients were recorded. The onset time of ED was recorded in patients presenting with ED, and they were asked to fill out the International Index of Erectile Function (IIEF-5) form reflecting their erectile function status within the previous month. According to the total IIEF-5 scores (5-25), patients with ED were divided into groups of severe (5-7), moderate (8-11), mild-moderate (12-16) and mild (17-21) ED.

Patients with a history of smoking, alcohol or substance use, pyelonephritis, psychiatric disease, those receiving any treatment that may affect ED (ie. hormone replacement therapy, GnRH agonist), cancer patients and who had undergone penile surgery were excluded from the study.

PRFT of all patients was calculated by ultrasonography. Measurements were made on the right mid-clavicular line on the right lateral wall of the abdomen with the patient in the supine position. Fat tissue was found between the renal capsule and the right lobe of the liver. The length of fat tissue was measured when an optimal image was obtained (Figure 1)[14].

The recorded biochemical parameters and PRFT values were compared between both groups.


**Figure 1** Ultrasonographic measurement of PRFT

### 2.1. Statistical analysis

Statistical analysis was performed with IBM SPSS V21 (IBM Corp., Armonk, NY, USA). The normality of the distribution was examined by the Kolmogorov-Smirnov test Continuous variables were expressed as means ± standard deviations (SD), minimum-maximum values and compared with Student's t-test. Categorical variables were reported as numbers (percentages). Pearson's and Spearman's correlation analysis were used to assess the relationship of the parameters with PRFT. The G-Power 3.1.9.4 statistical power analysis program was performed to calculate the sample size of the study. A two-tailed $p<0.05$ was considered statistically significant.

## 3. Results

Based on the results of the power analysis (two-way correlation, type-1 error rate (α)=0.05, power of the study (1-β)=0.80, and effect size=0.52), an adequate number of patients were included in each group (n=61). Mean age (50.5 ± 10.6 years), mean BMI (24.6 ± 4.1 kg/m2), and PRFT (4.6 ± 2.2 mm) values of 122 patients were recorded (Table 1). Sixty-one patients with ED were assigned to the mild (n=10; 8.2%), mild-moderate (n=21; 17.2%), moderate (n=9; 7.4%), and severe (n=21; 17.2%) ED groups. The mean duration of ED was 12.1 ± 9.5 months.

The patients were allocated to the ED (Group 1, n:61) and control (Group 2, n:61) groups. There was no statistically significant difference between the two groups in terms of mean age, FBG, BMI, total testosterone, total cholesterol, HBA1c, LDL, HDL and triglyceride levels. The mean PRFT value was 6.1 ± 2.4 mm in the ED, and 3.2 ± 0.7 mm in the control group. The mean PRFT value was found to be statistically higher in the ED group ($p<0.001$) (Table 1).

**Table 1** Comparison of the data between the patients with and without ED

| Parameters, (mean ± SD) | All patients (n=122) | ED group(n=61) | Control group (n=61) | p value |
|---|---|---|---|---|
| Age (year) | 50.5 ± 10.6 | 50.6 ± 10.7 | 50.3 ± 10.6 | 0.893 |
| BMI (kg/m2) | 24.6 ± 4.1 | 24.9 ± 4.5 | 24.3 ± 3.6 | 0.423 |
| Total testosterone (mg/dL) | 419 ± 126.6 | 434.7 ± 110.4 | 403.2 ± 140.0 | 0.170 |
| Total cholesterol(mg/dL) | 168.4 ± 38.3 | 166.2 ± 39.1 | 170.7 ± 37.7 | 0.520 |
| HDL(mg/dL) | 38.7 ± 8.8 | *37.6 ± 6.8* | 39.9 ± 10.4 | 0.149 |
| LDL(mg/dL) | 94.6 ± 36.6 | 89.6 ± 37.8 | 99.6 ± 35.0 | 0.133 |
| Triglyceride (mg/dL) | 210.8 ± 133 | 222.4 ± 148.9 | 199.1 ± 114.9 | 0.335 |
| Fastin blood glucose (mg/dL) | 114.9 ± 29.2 | 113.7 ± 27.4 | 116.1 ± 31.1 | 0.649 |
| HBA1C | 5.7 ± 0.9 | 5.8 ± 0.8 | 5.6 ± 1.0 | 0.361 |
| PRFT (mm) | 4.6 ± 2.2 | 6.1 ± 2.4 | 3.2 ± 0.7 | <0.001 |

ED : Erectile dysfunction, BMI: Body mass index HDL: High density lipoprotein LDL: Low density lipoprotein PRFT: Perirenal fat thickness

**Table 2** Correlation analysis of the parameters associated with PRFT

| Parameters | R coefficient | P value |
|---|---|---|
| Severity of ED * | +0.825 | <0.001 |
| IIEF total score* | - 0.733 | <0.001 |
| BMI** | + 0.574 | <0.001 |
| Fasting blood glucose** | +0.320 | <0.001 |
| HB1Ac** | +0.312 | <0.001 |
| Duration of ED * | +0.742 | <0.001 |

ED: Erectile dysfunction, IIEF: International Index of Erectile Function BMI: Body Mass Index; * Spearman correlation analysis was used; **Pearson correlation analysis was used.

According to the correlation analysis, FBG and HBA1c were weak and positively (correlation coefficient and p-values=+0.320, <0.001; +0.312, <0.001, respectively), BMI was moderate and positively (correlation coefficient and p-value= +0.574, <0.001), duration of ED was strong and positively (correlation coefficient and p-value= +0.742, <0.001), IIEF-5 total score was strong and negatively (correlation coefficient and p-value= -0.733, <0.001), and severity of ED was fairly strong and positively (correlation coefficient and p-value= +0.825, <0.001) correlated with PRFT-related parameters (Table 2). Age, total testosterone, total cholesterol, HDL, LDL and triglyceride parameters were not significantly correlated with PRFT.

## 4. Discussion

Erectile dysfunction and CVD share common risk factors which include atherosclerosis, endothelial dysfunction and inflammation [15]. Changes in visceral adipose tissue mass play a role in the pathogenesis of atherosclerosis. Perirenal adipose tissue, like other visceral ectopic adipose tissue stores, triggers inflammation by contributing to adipokine production [16]. Based on this information, it can be thought that the development of ED in men is associated with perirenal adipose tissue. In our study, we investigated this relationship and found a strong relationship between PRFT and ED, especially severity of ED.

Perirenal fat tissue has the similar histology with visceral adipose tissue. However, Gerota's fascia is located anatomically in the retroperitoneum between the perirenal fat and the peritoneum. Visceral fat is intraperitoneal. Histologically, paranephric fat is white adipose tissue, and perinephric adipose tissue is a mixture of white and brown adipose tissue [11]. Perirenal fat tissue takes an active role especially in adipokine synthesis. In practice, ultrasonography, computed-tomography or magnetic-resonance imaging can be used to visualize these layers. We used ultrasonography in our study because it is cheaper, does not emit ionizing radiation and can be performed in a short time.

We only measured PRFT in our study, while both perirenal and pararenal fat thickness has been measured in various works such as the study performed by Pergola et al (17). The mean PRFT of the patients in our study was 4.6 ± 2.2 mm, which is less than the mean thickness (25 ±8.1 mm) reported in the above-mentioned study [17]. Mean PRFT of our study population was found to be comparable with studies that were measured only PRFT using a similar methodology. For example, the mean PRFT of the obese group was 7.1 ± 2.3 mm and the control group was 3.3 ± 0.9 mm in the study of Grima et al. [14]. Similarly, in the study published by Sahin et al. performed on patients with polycystic ovary syndrome (PCOS), the mean PRFT was found to be 4.3 ± 2.3 mm in the control group and 6.1 ± 2.9 mm in the PCOS group [18].

Perirenal fat thickness is an easily measured anthropometric parameter that can be used to identify and classify visceral adipose tissue. There are many anthropometric measurements besides PRFT. The most known and used ones are the measurements of BMI and WC. Mamtani et al. concluded that among central obesity indexes such as AVI, WC, WHR, BMI and CI, WC was the most valuable predictor for Type 2 DM [6]. Correlations of these measurements with each other have also been shown. Indeed, Kawasaki et al. found that visceral fat area and WC measured by computed-tomography were significantly correlated with PRFT measured by ultrasonography. They emphasized that PRFT >10 mm was associated with increased visceral fat deposition [7].

In our study, lipid and FBG levels were comparable between groups with and without ED. According to the results of the study by D'Marco et al including 103 patients with chronic kidney disease, increased PRFT values were detected in the group with higher fasting plasma glucose and triglyceride levels than in the group with relatively lower levels [9]. We could not find any study directly investigating the relationship between PRFT and ED in the literature. However, PRFT has been shown to be associated with many diseases with underlying endothelial damage. In their study including 42 overweight and obese patients, Pergelo et al. found that para and perirenal ultrasonographic fat thickness (PUFT) was associated with mean blood pressure. They demonstrated a significant correlation between WC measurement, which is a marker of central fat storage, and PUFT which indicates that visceral fat stores increase with accumulation of abdominal fat [17]. Ricci et al. performed a study on 284 obese patients including, 126 patients who had undergone sleeve gastrectomy. In this patient group, the mean PRFT of hypertensive patients was found to be significantly higher compared to non-hypertensive patients. In addition, in the patient group who had undergone bariatric surgery, PRFT decreased significantly after the operation. According to the correlation analysis, PRFT was found to be associated with insulinemia, insulin resistance and HBA1c values [12].

According to a study performed by Lamacchia O et al. on CKD patients, perirenal fat thickness was found to be a predictor for chronic renal failure [10]. The relationship between PRFT and carotid intimal medial thickness (IMT),

which is thought to be a marker of atherosclerosis, was investigated in the HIV-infected patient group. According to the results, PRFT also predicted IMT [14].

In our study, only PRFT was found to be relatively higher in the group with ED. All other biochemical parameters were comparable between groups. Amato et al. developed a so-called visceral adiposity index (VAI) by adding HDL and triglyceride values to WC and BMI in 2010. This newly developed formula has been used to assess the relationship between metabolic syndrome and CVD [19]. Akdemir et al. investigated the relationship between VAI and ED and found that VAI was significantly higher in patients with ED ($p<0.001$). In their study, BMI values were found to be similar between the ED and control groups, like the results of our study [4]. Similarly, Dursun et al. evaluated the relationship between VAI and ED in 95 patients with and 82 patients without ED. The mean VAI values were found to be significantly different between the ED and control groups ($p<0.001$) [5]. The research subject of future studies may be to show whether or not some metabolic factors are associated with PRFT and its increased predictive value, as in VAI.

The limitations of this study include its relatively small sample size, and failure to use any anthropometric measurements other than PRFT and BMI in the evaluation. In addition, we could not perform regression analysis because the control group had age-adjusted patients and they had similar baseline characteristics except for erectile dysfunction. On the other hand, we think that our study will lead to different methodological studies and contribute to the literature.

## 5. Conclusion

PRFT, which can be measured by ultrasonography, is a simple measurement that can be used to predict the severity of ED. Further and larger population studies with better methodology are needed to support our study and for its use in daily practice.

## Compliance with ethical standards

### *Disclosure of conflict of interest*

The authors report no conflict of interest to disclose.

### *Statement of ethical approval*

The ethics committee approval for the study (dated 06/04/2022 and numbered 2022-7) was obtained from the ethics committee of Mardin Artuklu University.

### *Statement of informed consent*

Informed consent was obtained from all individual participants included in the study.

### *Author Contributions*

Plan, design: OE; Material, methods and data collection: OE, AG; Data analysis and comments: OE, AG; Writing and corrections: OE, AG.

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