Obesity is an independent risk factor for low serum testosterone in adult males

Mohamad Habous MD, Alaa Tealab MD, Mohamed Ali MD, Amir Abdel Raheem MD, David Ralph MD, Saleh Binsaleh MD

Mohamad Habous is a urologist with Elaj Medical Group, Jedda Saudi Arabia, Alaa Tealab is a urologist with the Urology Department, Zagazig University, Egypt, Mohamed Ali is a urologist in the Urology Department at Tudor Bilharz Institute, Giza, Egypt, Amr Abdel, Raheem and David Ralph are urologists at the St. Peter’s Andrology Centre, London, United Kingdom, and Saleh Binsaleh is a urologist in the Division of Urology, Department of Surgery, Faculty of Medicine, King Saud University, Riyadh, Saudi Arabia. Correspondence should be directed to binsaleh@ksu.edu.sa

Abstract

Objectives: Obesity and increased weight are recognized risk factors of hypogonadism. This study looked into the relation between body mass index (BMI) and serum testosterone level.

Patients and Methods: This was a prospective study of 664 patients. All patients had BMI calculation and serum Testosterone measurement. Patients with any other possible cause for hypogonadism were excluded from the study.

Results: Statistical analysis of the results showed an inverse correlation between the BMI and serum testosterone.

Conclusion: Increasing BMI is an independent risk factor in lowering serum testosterone.

Keywords: Hypogonadism, Metabolic Syndrome, Lifestyle medicine

This article has been peer reviewed.
Competing interests: None declared.
This study was supported by a grant from the College of Medicine Research Center, Deanship of Scientific Research, King Saud University, Riyadh, Saudi Arabia.
Introduction
Obesity has reached epidemic proportions globally, with more than 1 billion adults overweight - at least 300 million of them are clinically obese - and is a major contributor to the global burden of chronic disease and disability.\textsuperscript{1} It is the most visible, yet most neglected, public-health problem that threatens to overwhelm both developed and developing countries.\textsuperscript{2,3} Obesity is a complex condition, with serious social and psychological dimensions, affecting virtually all ages and socioeconomic groups.\textsuperscript{4} Obesity has been shown to decrease life expectancy by 7 years at the age of 40 years.\textsuperscript{5}

Objectives
To study the relation between the increase in body mass index BMI (overweight and obesity), as a single independent risk factor for low testosterone.

Materials and Methods

Inclusion criteria: From October 2008 to March 2009, 664 patients were selected from the patients attending the Urology and Andrology clinics. Only patients aged 18 to 50 years were selected in order to avoid testosterone age related changes.\textsuperscript{7,8}

Exclusion criteria: Any factor that may alter serum testosterone levels including: history of recent (last 6 months) intake of medications affecting serum sex hormones (e.g. opiates, ketoconazole, spironolactone and GnRH agonists); and history of undescended testes, mumps orchitis, chemotherapy, radiation therapy, primary testicular failure, Klinefelter syndrome, hemochromatosis, pituitary and/or hypothalamic dysfunction or diabetes.\textsuperscript{9,10,11,12}

The BMI was calculated according to World Health Organization criteria by calculating the weight in kilograms divided by the square of the height in meters (kg/m\textsuperscript{2}); decimal fractions were approximated.

Testosterone was measured using Roche Elecsys Testosterone Kit. Blood samples were collected between 9 and 11 am to avoid the diurnal variation in testosterone level. The reference range for the normal adult male was between 280-800 ng/dl according to the manufacturer.

Statistical analysis: Results were expressed as means ± standard deviation (SD). Comparison between the mean values of the 3 groups was done using one way analysis of variance (ANOVA) with post-hoc using Tukey Kramer test. Correlation between testosterone and BMI was performed using Spearman’s rank correlation coefficient. SPSS computer program (version 14 windows) was used for data analysis. P value less than 0.01 was considered highly significant.

Results
From October 2008 to March 2009, 664 patients fulfilled the selection criteria and were included in the study. The mean patient age was 33 years (Figure 1).

Table 1: Descriptive Statistics of age, BMI, and Testosterone

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>BMI</th>
<th>Testosterone</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>664</td>
<td>664</td>
<td>664</td>
</tr>
<tr>
<td>Minimum</td>
<td>18.00</td>
<td>17.00</td>
<td>95.00</td>
</tr>
<tr>
<td>Maximum</td>
<td>50.00</td>
<td>57.00</td>
<td>1052.00</td>
</tr>
<tr>
<td>Mean</td>
<td>33.42</td>
<td>28.59</td>
<td>450.23</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>7.72</td>
<td>5.71</td>
<td>160.90</td>
</tr>
<tr>
<td>Std. Error</td>
<td>0.30</td>
<td>0.22</td>
<td>6.24</td>
</tr>
</tbody>
</table>
Obesity is an independent risk factor for low serum testosterone in adult males

The most frequent patient complaints were LUTS (26%), sexual dysfunction (23%), urolithiasis (14%), UTI (12%), infertility (8%), premarital check up (7%), others (10%).

The BMI was calculated during the first visit; the mean (range) BMI was 28 (17-57). The patients were further subdivided into 3 categories according to the BMI (< 25, 25-30, and > 30) as shown in Table 2 and Figure 2.

The mean (range) serum Testosterone level was 429 (95-1052) ng/dl. Analysis of the results showed an inverse correlation between the BMI and serum testosterone levels. The mean serum testosterone level was significantly different between the 3 groups being highest in patients with normal BMI (<25) and lowest in obese patients (BMI > 30) as shown in Table 3 and Figure 3.

### Table 2: Mean value of BMI in different studied groups

<table>
<thead>
<tr>
<th></th>
<th>Normal (≤ 25) [n= 186]</th>
<th>Overweight (25-30) [n= 214]</th>
<th>Obese (≥ 30) [n= 264]</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>22.35 ± 1.66</td>
<td>27.13 ± 1.44*</td>
<td>34.18 ± 4.24*</td>
<td>*p&lt; 0.01 vs normals</td>
</tr>
</tbody>
</table>

p< 0.01 = highly significant.

### Table 3: Mean value of testosterone in different studied groups

<table>
<thead>
<tr>
<th></th>
<th>Normal (≤ 25) [n= 186]</th>
<th>Overweight (25-30) [n= 214]</th>
<th>Obese (≥ 30) [n= 264]</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testosterone</td>
<td>550.35 ± 160.28</td>
<td>458.18 ± 147.43*</td>
<td>373.25 ± 128.44*</td>
<td>*p&lt; 0.01 vs normals</td>
</tr>
</tbody>
</table>

p< 0.01 = highly significant.

Figure 2: BMI values in different BMI subgroups. Box plots represent median, quartiles and range of BMI.

Figure 3: Testosterone values in different BMI subgroups. Box plots represent median, quartiles and range of testosterone.
There is an inverse correlation between body mass index and testosterone level in all studied patients ($r = -0.467$, $p< 0.01$), and this is very evident as shown in Figure 4.

**Discussion & statistical analysis**

Low serum testosterone levels are associated with increased morbidity and mortality in middle-aged and older men. This includes impairment cognitive function, general health and sexual functions. Older age, lower testosterone levels, erectile dysfunction and cardiovascular disease are interrelated.13,14

Several studies demonstrate the correlation between obesity and low serum testosterone, but most of them studied this correlation in association with other risk factors for hypogonadism.15–22

In men, circulating levels of testosterone increase at the time of puberty and peak in early adulthood. This is followed by a steady decline in testosterone levels with increasing age. In cross-sectional and longitudinal studies of men aged 40 years and above, testosterone concentrations are shown to fall with increasing age. In the Massachusetts Male Aging Study of 1709 men, aged 40–70 years at baseline, total testosterone declined cross-sectionally by 0.8% per year of age.23

In this study, the effect of age as a risk factor for testosterone decline was minimal as the mean age of the participants was 33 years.

Some studies showed pathogenetic mechanisms linking hypogonadism with obesity and insulin resistance.24 Other investigators also found that Testosterone levels are reduced due to obesity, the metabolic syndrome and Type 2 Diabetes, and concluded that low testosterone levels are independent risk factors for these conditions.25

But in this study, we excluded diabetic patients and patients with metabolic syndrome. The only risk factor studied was increasing body mass index in order to evaluate its effect upon serum testosterone levels independent of other known risk factors studied by other investigators.

**Conclusion**

Obesity and overweight expressed as increasing BMI is independent risk factor in low serum testosterone in adult men.

**References**

Obesity is an independent risk factor for low serum testosterone in adult males