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

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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.[1] It is the most visible, yet most neglected, public-health problem that threatens to overwhelm both developed and developing countries.[2,3] Obesity is a complex condition, with serious social and psychological dimensions, affecting virtually all ages and socioeconomic groups.[4] Obesity has been shown to decrease life expectancy by 7 years at the age of 40 years.[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 testesterone.

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.[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. [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/m2); 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).

Figure 1.

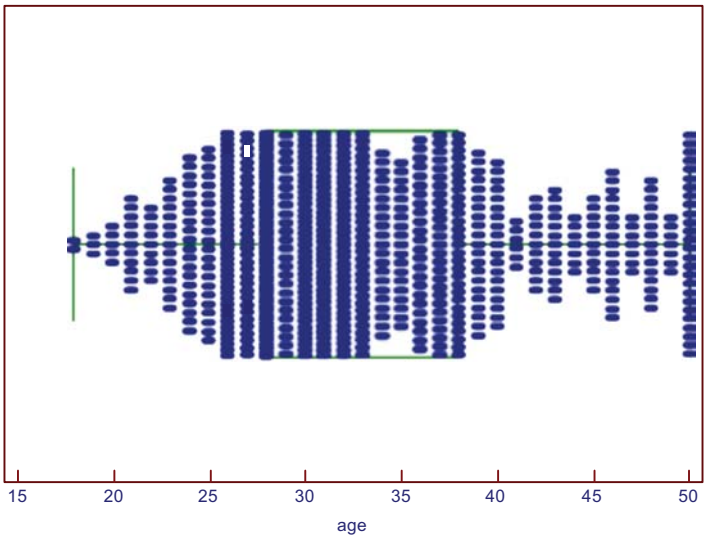

Table 1: Descriptive Statistics of age, BMI, and Testosterone

	Age	BMI	Testosterone
N	664	664	664
Minimum	18.00	17.00	95.00
Maximum	50.00	57.00	1052.00
Mean	33.42	28.59	450.23
Std. Deviation	7.72	5.71	160.90
Std. Error	0.30	0.22	6.24

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

Normal (< 25) [n= 186]	Overweight (25-30) [n= 214]	Obese (≥ 30) [n= 264]	P value
22.35 ± 1.66	27.13 ± 1.44*	34.18 ± 4.24*#	*p< 0.01 vs normals #p< 0.01 vs over-weight

p< 0.01 = highly significant.

Table 3: Mean value of testosterone in different studied groups

Normal (< 25) [n= 186]	Overweight (25-30) [n= 214]	Obese (≥ 30) [n= 264]	P value
550.35 ± 160.28	458.18 ± 147.43*	373.25 ± 128.44*#	*p< 0.01 vs normals #p< 0.01 vs over-weight

p< 0.01 = highly significant.

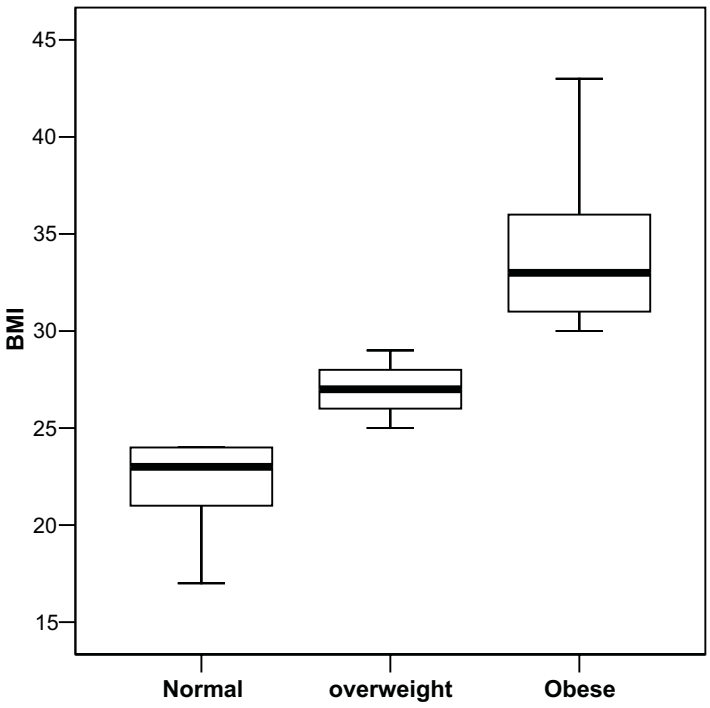

Figure 2: BMI values in different BMI subgroups. Box plots represent median, quartiles and range of BMI.

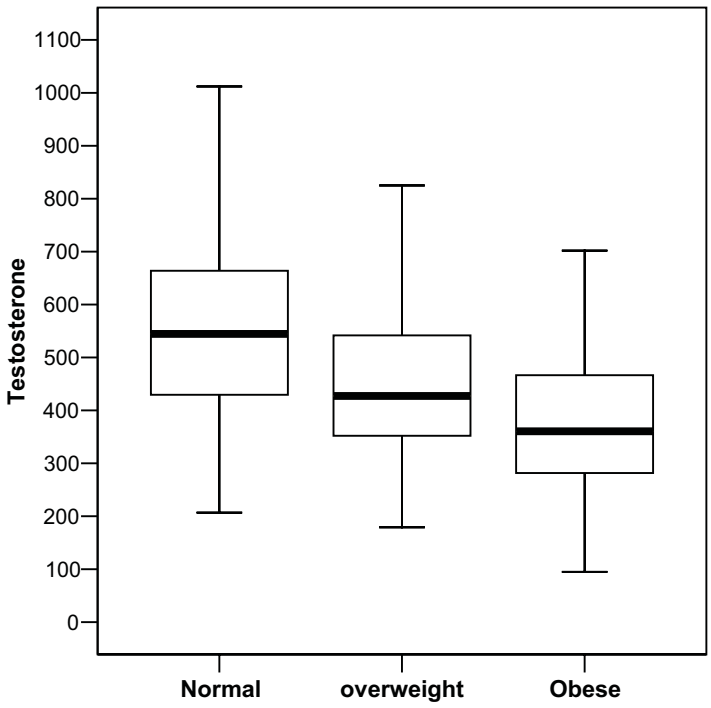

Figure 3: Testosterone values in different BMI subgroups. Box plots represent median, quartiles and range of testosterone

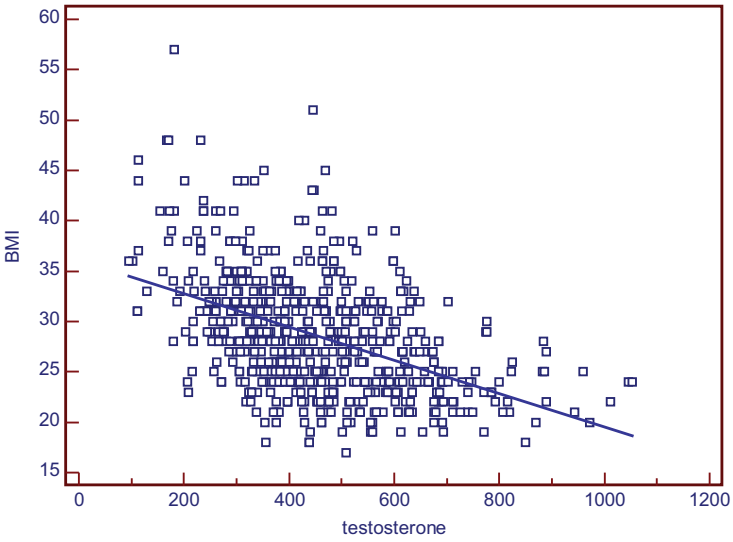

Figure 4: Correlation between body mass index and testosterone level in all studied patients (r= -0.467, p< 0.01).

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

1. World Health Organization, WHO, Global Strategy on Diet, Physical Activity and Health,2003 http://www.who.int/dietphysicalactivity/publications/facts/obesity/en
2. WHO. Obesity: Preventing and managing the global epidemic. WHO Technical Report Series Number 894. WHO: Geneva, 2000.
3. Flegal KM, Carroll MD, Ogden CL, Johnson CL. Prevalence and trend in obesity among US adults, 1999–2000. JAMA 2002; 288: 1723–1727.
4. James WTP, Rigby N, Leach R. The obesity epidemic, metabolic Syndrome and future prevention strategies. Eur J Cardiovasc Prev Rehabil 2004; 11: 3–8.
5. Peeters A, Bartender JJ, Willekens F, Mackenbach JP, Al Mamun A, Nonneux L. NEDCOM, the Netherlands epidemiology and demographic compression on morbidity research group. Obesity in adulthood and its consequences for life expectancy: a life-table analysis. Ann Intern Med 2003; 138: 24–32.
6. World Health Organization, WHO, Fact sheet N°311 September 2006 Obesity and overweight http://www.who.int/mediacentre/factsheets/fs311/en/index.html
7. Kaufman JM, Vermeulen A. The decline of androgen levels in elderly men and its clinical and therapeutic implications. Endocr Rev 2005; 26: 833-876.
8. Gapstur SM, Gann PH, Kopp P, Colangelo L, Longcope C, Liu K. Serum androgen concentrations in young men: a longitudinal analysis of associations with age, obesity, and race. The CARDIA male hormone study. Cancer Epidemiol Biomarkers Prev 2002; 11(10 Part 1): 1041–1047.
9. Andre B. Araujo, Gretchen R. Esche, Varant Kupelian, Amy B. O'Donnell, Thomas G. Travison, Rachel E. Williams, Richard V. Clark and John B. Prevalence of Symptomatic Androgen Deficiency in Men. The Journal of Clinical Endocrinology & Metabolism Vol. 92, No. 11 4241-4247.

10. Snyder PJ. Causes of primary of hypogonadism in males. http://www.uptodate.com/patients/content/topic.do?topicKey=~eL_hWzgiC9MgqX
11. Snyder PJ. Causes of secondary hypogonadism in males. http://www.uptodate.com/patients/content/topic.do?topicKey=~6ZnI AcJrzRkJXZ
12. Kapoor D, Aldred H, Clark S, Channer KS, Jones TH. Clinical and biochemical assessment of hypogonadism in men with type 2 diabetes: correlations with bioavailable testosterone and visceral adiposity. Diabetes Care. 2007 Apr;30(4):911-7
13. Kloner RA. Erectile dysfunction as a predictor of cardiovascular disease. Int J Impot Res 2008; 20: 460-465.
14. Thompson IM, Tangen CM, Goodman PJ, Probstfield JL, Moinpour CM, Coltman CA. Erectile dysfunction and subsequent cardiovascular disease. JAMA 2005; 294: 2996-3002.
15. Svartberg J, Midtby M, Bonaa KH, Sundsfjord J, Joakimsen RM, Jorde R. The associations of age, lifestyle factors and chronic disease with testosterone in men: the Tromso study. Eur J Endocrinol 2003; 149: 145-152.
16. Allan CA, Strauss BJ, McLachlan RI. Body composition, metabolic syndrome and testosterone in ageing men. Int J Impot Res 2007; 19: 448–457.
17. Allen NE, Appleby PN, Davey GK, Key TJ. Lifestyle and nutritional determinants of bioavailable androgens and related hormones in British men. Cancer Causes Control 2002; 13: 353–363.
18. Gapstur SM, Gann PH, Kopp P, Colangelo L, Longcope C, Liu K. Serum androgen concentrations in young men: a longitudinal analysis of associations with age, obesity, and race. The CARDIA male hormone study. Cancer Epidemiol Biomarkers Prev 2002; 11(10 Part 1): 1041–1047.
19. Jensen TK, Andersson AM, Jorgensen N, Andersen AG, Carlsen E, Petersen JH et al. Body mass index in relation to semen quality and reproductive hormones among 1,558 Danish men. Fertil Steril 2004; 82: 863–870.
20. K Esposito, F Giugliano, M Ciotola, M De Sio, M D'Armiento and D Giugliano. Obesity and sexual dysfunction,male and female. International Journal of Impotence Research (2008) 20, 358–365.
21. Svartberg J. Epidemiology: testosterone and the metabolic syndrome. Int J Impot Res 2007; 19: 124–128.
22. Allan CA, Strauss BJ, McLachlan RI. Body composition, metabolic syndrome and testosterone in ageing men. Int J Impot Res 2007; 19: 448–457.
23. Feldman HA, Longcope C, Derby CA, Johannes CB, Araujo AB, Coviello AD et al. Age trends in the level of serum testosterone and other hormones in middle-aged men: longitudinal results from the Massachusetts Male Aging Study. J Clin Endocrinol Metab 2002; 87: 589-598.
24. Sandeep Dhindsa, Sathyavani Prabhakar, Manak Sethi, Arindam Bandyopadhyay, Ajay Chaudhuri and Paresh Dandona. Frequent Occurrence of Hypogonadotropic Hypogonadism in Type 2 Diabetes. The Journal of Clinical Endocrinology & Metabolism Vol. 89, No. 11 5462-5468.
25. B.B. Yeap, Are Declining Testosterone Levels A Major Risk Factor for Ill-Health in Aging Men? Int J Impot Res. 2009;21(1):24- 36.