Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2024; Vol 13: Issue 7
Open Access

Body Fat, Testosterone, and Lipids: New Insights from Local Healthy Male

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Cite this paper as: Fasiha Fatima, Ubaid Ur Rehman, Sabeela Noor, Faiza Alam, Madiha Soban, Amina Raza (2024). Body Fat, Testosterone, and Lipids: New Insights from Local Healthy Male. *Frontiers in Health Informatics, 13 (7) 1010- 1015*

ABSTRACT:

OBJECTIVE: Obesity is currently a worldwide public health concern. Obesity and low testosterone levels are related, although the reasons for this are complex and multi-faceted. This study aims to assess the impact of body fat composition on serum testosterone and lipid profile in healthy adult males.

METHODOLOGY: This cross-sectional study classified 90 healthy adult males into three groups based on their body mass index (BMI) following WHO criteria. Detailed history, clinical examination, and BMI calculations were performed, while serum analysis was performed for testosterone, cholesterol, triglycerides, and high-density lipoproteins. SPSS Version 20 software for statistical analysis was used.

RESULTS: We observed that serum testosterone was significantly lower in individuals having high BMI (p value<0.001). It also exhibited a significantly negative correlation with weight (r= -0.491, p=0.00) and BMI (r= -0.599, p<0.001), whereas there was a notably positive correlation (r=0.234, p=0.026) with HDL cholesterol.

CONCLUSION: Our findings suggested that higher BMI may cause a decline in serum testosterone levels and might also affect serum lipid profile.

KEYWORDS: Testosterone, Obesity, Body Mass Index, Lipid profile, Metabolic Syndrome

INTRODUCTION

Obesity has emerged as a global public health issue. Elevated adipose tissue accumulation in the body results from heightened calorie consumption or reduced physical exertion, a preventable medical disease[1]. Obesity is defined by the World Health Organization (WHO) as having an excessive body weight about one's height. Pakistan, a developing nation, is struggling with this problem and its occurrence is steadily rising [2]. Obesity or being overweight not only raises the likelihood of negative cardiovascular outcomes, type 2 diabetes mellitus, and malignancies but also correlates with several endocrine disorders in both men and women [3].

The connection between obesity and testosterone insufficiency is intricate and influenced by several factors [4]. Testosterone is believed to decrease body fat by inhibiting the enzymatic activity of lipoprotein lipase [5] and glyceraldehyde 3-phosphate dehydrogenase, important enzymes in fat metabolism [6]. Numerous epidemiological studies

have established an inverse relationship between adiposity and reduced testosterone levels in healthy men [7] & [8]. Abdominal obesity may also factor in the decrease of testosterone levels in the bloodstream [9]. Additionally, testosterone is accountable for modifying blood lipid levels [10]. The effect of increased body fat has given the initiative to research this study in a group of adult males to evaluate the link between testosterone, body mass index (BMI), and lipid profile.

METHODOLOGY

A cross-sectional comparative study in which ninety healthy adult males (ages 20-40 years) were recruited and divided based on their BMI recommended by WHO into three groups; normal weight, overweight, and obese [11]. The study was conducted at the Karachi Institute of Medical Sciences, Malir Cantt, Karachi after obtaining ethical approval (7/24/IRB/KIMS). The subjects were chosen after a thorough medical examination and written consent was taken from all the participants. Subjects were healthy adults, without any significant history of smoking, alcoholism, and other co-morbidities. Using Open Epi Version 3 software, the sample size was determined to be n=80, which needs a significant outcome. With a 95% confidence interval, 80% power, and a 5.5% obesity frequency, the sample size was determined [12]. The hip and waist circumference were measured according to the protocol as described earlier [13]. The waist-to-hip ratio was obtained by dividing the hip circumference by the waist circumference. Weight was divided by height squared (kg/m2) to determine BMI [14].

A fasting blood sample was drawn to measure free testosterone, cholesterol, triglycerides, LDL-cholesterol, and HDL-cholesterol. Collected blood was allowed to clot in a tube and then clotted blood in the test tube was centrifuged at 508 for three minutes and serum was separated and stored at -20 ^{0}C until analysis.

ELISA was used to assess serum free testosterone (DIA source Immunoassay S.A., Belgium).

Spectrophotometry measured HDL-C, cholesterol, and triglycerides using the CHOD-PAP and GPO methods. The kits were commercially available from Merck, France. Friedwald Formula was used for calculating low-density lipoprotein (LDL-C) [15].

Continuous variables were descriptively analyzed using SPSS 20 (SPSS Inc., Chicago, IL, USA). The mean ± standard deviation (SD) was used to calculate data on continuous variables, such as biophysical parameters (age, weight, BMI, waist-hip ratio) and biochemical parameters (serum-free testosterone, cholesterol, triglycerides, and HDL-cholesterol). To compute statistical comparisons, one-way analysis of variance (ANOVA) was used for continuous/quantitative variables. The relationship between testosterone and triglycerides, age, weight, BMI, cholesterol, HDL-C, and LDL-C was determined using Pearson's correlation coefficient (r). Every statistical analysis carried out was deemed significant if p-value<0.05.

RESULTS

The characteristics of the research subjects are displayed in Table 1. The mean ages of all three groups were comparable on average, so no significant difference was observed among the groups. As expected, weight ($p<0.001$) and BMI ($p<0.001$) in overweight and obese were statistically significant as compared to the control group respectively. It was discovered that overweight and obese people had significantly lower serum testosterone levels ($p<0.001$). The overweight and obese group had significantly lower HDL-C levels than the control group
($p=0.07$), but there was no difference in the LDL-C, triglycerides, or cholesterol levels.

Serum testosterone showed a positive correlation with HDL-C ($r=0.234$, $p=0.0260$) and a significant negative correlation with weight ($r=-0.491$, $p<0.001$) and BMI ($r=-0.599$, $p<0.001$), respectively.

Table 1: Characteristics of Study Subjects

	Normal weight (n=30)	Overweight (n=30)	Obese (n=30)	p-value
Age(years)	33.63 ± 4.5	32.57 ± 4.63	32.63± 4.54	0.60
Weight(kg)	66.96 ± 9.67	74 ± 13.72	84.23 ± 14.26	<0.01*
BMI (kg/m$^{2)}$	22.58± 1.60	27.53 ± 1.79	33.31± 3.45	<0.01*
WHR	0.93 ± 0.12	0.93± 0.07	0.91± 3.62	0.74
Testosterone(pg/ml)	11.87 ± 4.86	8.74 ± 3.62	5.21 ± 2.73	<0.01*
Cholesterol (mg/dl)	177.30± 41.9	182.77±51	182.17 ± 53.15	0.89
Triglycerides (mg/dl)	139.17±50.26	158.8±59.3	157.50± 70.38	0.37
LDL-C(mg/dl)	100.93± 41.22	104.50±42.9	111.83± 55.65	0.65
HDL –C(mg/dl)	42.37 ± 12.52	38.80±10.76	36.37± 6.30	0.07*

Figure 1: Correlation Of Serum Testosterone With a) Age, b) Weight, c) Waist-Hip Ratio (WHR) and d) Body Mass Index (BMI)

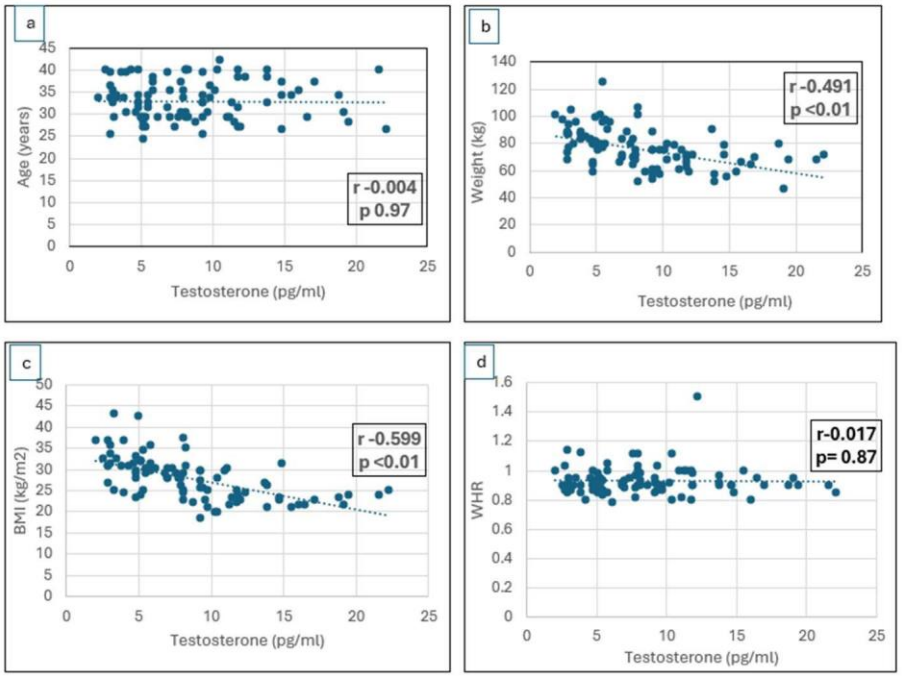
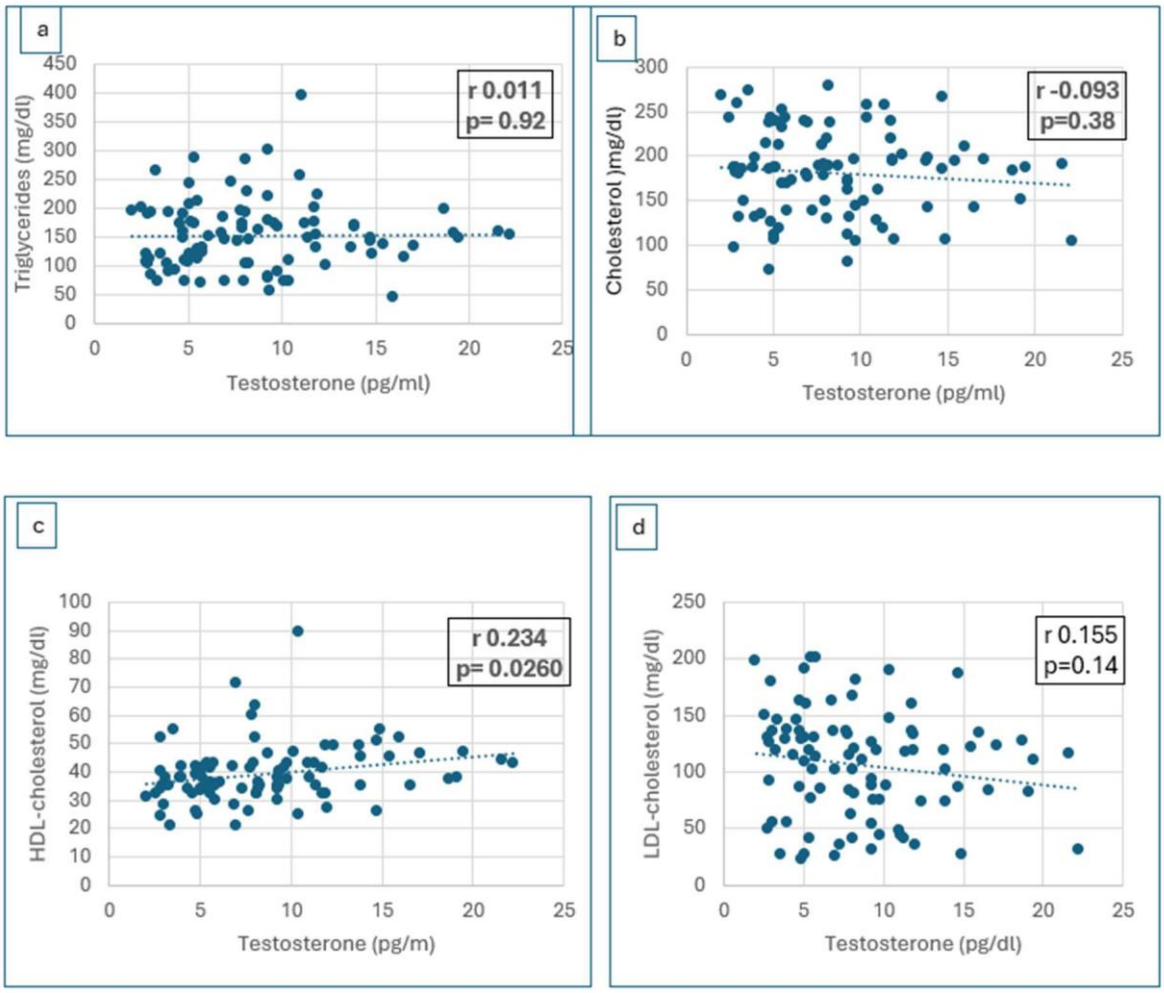


Figure 2: Correlation Of Serum Testosterone With a) Triglycerides, b) Cholesterol c) HDL-Cholesterol and d) LDL-Cholesterol



DISCUSSION

One of the biggest threats to global health today is obesity. Obesity is not only responsible for several co-morbidities like metabolic syndrome, cardiovascular disease, and insulin resistance but is also linked with the decline of testosterone. In developed countries, obesity is the primary cause of testosterone insufficiency, affecting 52.4% of men with levels below 300 ng/dL [16]. There is an intricate and two-way relationship observed between obesity and testosterone deficiency. The present study was planned to assess whether serum testosterone was associated with different levels of obesity and their effect on serum lipid profile.

In the current study, we observed that serum testosterone was found to be significantly decreased as the level of obesity increased which is in line with a previous study that showed that testosterone deprivation treatment may lead to an increase in visceral, abdominal subcutaneous, and total fat in people diagnosed with prostate cancer [17]. Another study has shown that the addition of testosterone may reduce the amount of fat located under the skin in the abdomen and thighs of men who have low testosterone levels and a large waist circumference which is in contrast with our study. Similar findings were also reported by Gucenmez et al., which show a slightly less close relationship between testosterone and waist circumference [18]. A further investigation used quantitative computerized tomography to find an augmentation in subcutaneous fat among hypogonadal males. The research suggested that androgens may hinder

adipogenesis and promote the breakdown of fats [19]. We noted a negative correlation between weight and testosterone, consistent with prior research indicating that weight loss enhances both total and free testosterone levels, while also improving various obesity-related conditions such as type 2 diabetes, metabolic syndrome, and osteoarthritis [20]. In adolescent and adult men, the increase in adipose tissue is more often linked to reduced testosterone levels. This, rather than direct effects on testicular function, is thought to be caused by possible effects on gonadotropin production at the hypothalamic-pituitary level [21]. We also determined that serum testosterone positively correlates with HDL cholesterol, which is in line with previous research [22] but not with Zhang et al., [23]. The exact mechanism by which testosterone affects serum lipid levels remains uncertain. Testosterone may have a role in altering scavenger receptor B1 (SR B1) and hepatic lipase. This enzyme breaks down phospholipids on the surface of HDL cholesterol and aids in the process of reverse cholesterol transfer [24]. It is noteworthy that hypogonadism in younger populations may be influenced by low HDL-C, potentially leading to cardiovascular disease events in later life, and that the effects of testosterone on HDL-C manifest in relatively younger cohorts. This research reveals additional evidence indicating that low levels of testosterone may serve as an early warning for potential metabolic risk, particularly in men who are younger or in middle age.

CONCLUSION

Despite these efforts to date, the impact of obesity on testosterone reduction remains ambiguous. The current investigation demonstrated an inverse correlation between BMI and serum testosterone levels. A favorable correlation was identified between serum testosterone and HDL-cholesterol levels. Consequently, extensive research is required to elucidate the link between blood testosterone and lipid profile.

Our study has several potential limitations including the one that we did not analyze sex hormone binding globulin (SHBG) even though it may influence serum testosterone status, and our study was based in one center.

Conflict of Interest: There is no conflict of interest to declare.

Sources of Funding: None

Authors Contribution: Conception and design Fasiha Fatima, Obaid ur Rehman and Sabeela Noor; collection and assembly of data Faiza Alam, Sabeela Noor, and Madiha Soban; Analysis and interpretation Obaid ur Rehman and Amina Raza; Drafting of article Fasiha Fatima, Amina Raza, and Madiha Soban, critical revision of the article for important intellectual content Sabeela Noor and Faiza Alam, statistical expertise Fasiha Fatima and Faiza Alam; and final approval of article Fasiha Fatima.

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