

A Study of the Correlation of Obesity with Sex Hormones in Young Male Adults

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Abstract

Background: Epidemiological studies support a bidirectional relationship between serum testosterone and obesity as well as between testosterone and the metabolic syndrome. Low serum total testosterone predicts the development of central obesity and accumulation of intra-abdominal fat. Also low total and free testosterone and sex hormone binding globulin (SHBG) levels are associated with an increased risk of developing the metabolic syndrome, independent of age and obesity.

Method: A cross sectional study was conducted on 100 male medical students (age 18 to 24 yrs). Blood samples were collected and investigated for serum testosterone level. Anthropometric measurements-BMI, Waist circumference and waist to hip ratio (WHR) were done.

Results: 57 subjects out of 100 subjects with BMI <25 and serum testosterone level near to higher end of normal range and 43 subjects with BMI >25 and serum testosterone level near to lower end of normal range. 26 subjects with WHR <90 and serum testosterone level near to higher end of normal range and 74 subjects with WHR >90 and serum testosterone level near to lower end of normal range.

Conclusion: Serum testosterone level increase with decrease in BMI and WHR. serum testosterone level decrease with increase in BMI and WHR. Hence Sex hormone (Androgen) level is inversely related with obesity.

Keywords: Testosterone, BMI, WHR, Anthropometric indices.

Introduction

With the improvement in socioeconomic conditions, the obesity arises as a major health issue since early age. Obesity is proinflammatory state resulting in increased release and secretion of proinflammatory cytokines and adipokines, free fatty acids and estrogens from adipose tissue^{1,2}. These increases are important risk factors that

may contribute to the development of metabolic syndrome and type 2 diabetes as well as androgen deficiency. Visceral fat is an active secretory tissue producing inflammatory cytokines and adipokines, biochemical modulators and other pro inflammatory factors including interleukins (IL)-6, IL-1 β , plasminogen activator inhibitor-1, tumor necrosis factor (TNF)- α , angiotensin, vascular endothelial growth factor and serum amyloid-A. These factors contribute to systemic and peripheral vascular inflammation and dysfunction. Aromatase the enzyme that converts testosterone to estradiol, is mainly located in adipose tissue. Obesity associated with elevated estrogen in men activate hypothalamic-pituitary gonadal axis. Treatment with aromatase inhibitors reverse the hypogonadotropic hypogonadism associated with obesity. Men with obesity and insulin

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resistance showed attenuated Leydig cell responsiveness to exogenous gonadotropin stimulation^{1,3}.

In general androgens promote protein synthesis and growth in tissues having androgen receptors leading to anabolic effects⁴.

Androgenically it leads to sexual differentiation and maturation along with development of secondary sexual characteristics. Testosterone is produced mainly by testes in male human beings. Sex steroids are involved in the metabolism, accumulation and distribution of adipose tissues. It is well known that the receptors of sex hormones are located in adipose tissues. Therefore their actions could be direct. But sex hormones carry out their functions in adipose tissues by both the ways genomic as well as non-genomic mechanism^{5,6}.

Leptin and lipoprotein lipase are two key proteins in the visceral adipose tissues that are regulated by sex hormones.

Another way of action through receptors located on plasma membrane and second messenger system. This involves activation of cyclic AMP cascade. This activate hormone sensitive lipase that lead to lipolysis. Through diacylglycerol pathway there is activation of protein kinase-C that is involved in control of preadipocyte proliferation and differentiation. Imbalance between these two mechanisms may lead to obesity⁷.

Material and Method

The present study was conducted in the dept of physiology M.L.B. Medical College Jhansi. The participants in the study were male medical students of M.L.B. Medical College Jhansi. The cross sectional study carried out on 100 male medical students with age ranges from 18 to 24 years. Working proforma was in the form of a questionnaire containing name, age, sex, history of physical illness, exercise, addiction, drug history, personal and family history of diabetes mellitus, hypertension and cardiovascular disease. The consent of ethical committee was taken.

Aim: The aim of this study was to established, the correlation between obesity and sex hormone (testosterone).

Objective: To study the early age health issue due to obesity in young male adults.

Inclusion Criteria: The subjects suffering from

long term stress due to study and examination and willing to participate in the study.

Exclusion Criteria: The subjects with chronic disease, endocrinopathies, taking any form of testosterone altering drugs, alcohol, smoking were excluded.

Procedure: Anthropometric indices were measured and calculated. Blood samples were sent to lab for serum testosterone estimation.

The subjects were divided into four groups in two categories based on BMI and WHR.

Category-1: Based on BMI

Group-A subjects with BMI < 25, Group –B subjects with BMI > 25.

Category-2: Based on WHR

Group-C subjects with WHR < 0.90, Group-D subjects with WHR > 0.90.

Anthropometric Indices:

Weight: Measured in Kilograms to near 0.5 kilograms on portable machine with subjects in light clothing and without shoes.

Height: Measured in centimeters to near 0.1 cm with subjects standing against wall without shoes, heels together buttocks, shoulder and head touching the wall.

BMI: Calculated by formula (Weight in Kg/Height in meter square).

Waist circumference- measured in centimeters to near 0.1 cm at the level of umbilicus at the end of expiration while breathing silently with a plastic measuring tape.

Hip circumference- measured in centimeters near to 0.1 cm at the level of greater trochanter with plastic measuring tape.

WHR: Calculated as (waist circumference/Hip circumference).

Serum Testosterone: Investigated by department of pathology by ELISA method.

Study Design: Cross sectional study.

Sample Size: 100 by random sampling method.

Statistics: To study the correlation between the variables in data the Pearson’s coefficient correlation method was applied.

Observation: The essential data was collected, arranged and analyzed. Modality used for obtaining the correlation between serum testosterone and obesity (BMI and WHR) is Pearson’s Correlation Coefficient as shown in the following table:

Table 1: Correlations

	Pearson’s Coefficient	Serum Testosterone	BMI	WHR
Serum Testosterone	Pearson’s Coefficient	1	-0.387	-0.200
	Significance (two tailed)	-	0.000	0.046
	N (subjects)	100	100	100
BMI	Pearson’s Coefficient	-0.387	1	0.201
	Significance (two tailed)	0.000	-	0.045
	N (subjects)	100	100	100
WHR	Pearson’s Coefficient	-0.200	0.201	1
	Significance (two tailed)	0.046	0.045	-
	N (subjects)	100	100	100

Correlation of serum testosterone with BMI is negatively related ($r=-0.387$, $p 0.001$) significantly. Serum testosterone and WHR are also related negatively ($r=-0.200$, $p 0.047$) (Table-1).

The data was also analyzed and studied by Z-Test, where $IZI < 1.96$ is insignificant and > 1.96 is significant as follows:

Table 2: Comparison

BMI	N	Mean+/-SD	IZI
<25	57	21+/-2.3	15.4894
>25	43	26.81+/-1.435	

The IZI value for BMI is found (15.4894) significant. (Table -2)

Table 3: Comparison

Waist Circumference	N	Mean+/- SD	IZI
<90	46	81.1522+/-7.93856	11.7962
>90	54	97.11111+/-4.9855	

For waist circumference the IZI value in Z-Test is observed as (11.7962) (Table-3). This value again shows a significant relation.

Discussion

As per data analysis based on Pearson’s correlation coefficient and Z-Test serum testosterone level is related negatively.

Men with very low testosterone are also more likely to become obese. Fat cells metabolize testosterone to estrogen, lowering testosterone level. Also obesity reduces level of sex hormone binding globulin (SHBG), a protein that carries testosterone in blood. Some other factors also causes reduce testosterone level in blood like –smoking, thyroid related issues, high cholesterol, stress or anxiety, alcohol consumption, diabetes, high BP

Men with diabetes are more likely to have low testosterone. And men with low testosterone are more likely to later develop diabetes. Testosterone helps the body tissue take up more blood sugar in response to insulin. Men with low testosterone more often have insulin resistance: need to produce more insulin to keep blood sugar normal.

The lower value is found in overweight subjects (BMI >25)⁸. The value decreases with increase in body weight regardless of any range of BMI.

As for fat distribution that is measured by waist circumference and WHR. The waist circumference is found increased with increase in body weight. Collection of fat in waist region is related with serum testosterone level⁹.

Abdominal or central obesity is most likely to be associated with increased risk of cardiometabolic syndrome (hypertension, diabetes mellitus and atherogenic dyslipidemia).

Comparison among subjects based on anthropometric indices revealed that obesity is found in less than half of sample studied as per BMI. WHR >90 is found in more than half of the sample studied shows the central obesity is more prevalent in this group of study. Serum testosterone level is tending towards upper range of normal level. This trend may be responsible for low obesity in our study group.

Conclusion

The multidirectional relationship between serum testosterone and SHBG with obesity. Obesity is accompanied by increased adipokines, cytokines and other pro-inflammatory factor production from adipocytes and macrophages mainly in visceral fat. These factors may alter secretion of testosterone. Testosterone replacement reduces body fat and waist circumference in hypogonadal men with and without obesity, BMI may improve and body fat decreases. The indices were correlated with serum testosterone level negatively. The study emphasizes that sex hormones are the factors that regulate fat metabolism and affect accumulation and distribution of fat in adipose tissues. Increase in serum testosterone level decreases central as well as overall

obesity. This correlation could be applied to prevent cardiometabolic syndrome prospectively.

Ethical Clearance: Present study was approved by institutional and review committee, MLB Medical College Jhansi, UP India

Conflict of Interest: Nil

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