ORIGINAL ARTICLE

EVALUATION OF SERUM TESTOSTERONE LEVEL IN MIDDLE AGED MEN WITH OR WITHOUT METABOLIC SYNDROME

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ABSTRACT

The worldwide prevalence of metabolic syndrome has increased dramatically over the past 20 years. In Bangladesh the incidence rate of metabolic syndrome is also increasing. Low testosterone has been shown to have an effect to develop obesity and metabolic syndrome in men, as evidenced by many studies. This cross-sectional analytical study carried out at Sir Salimullah Medical College & Mitford Hospital (SSMC&MH), Dhaka, Bangladesh from July 2020 to June 2021 aimed to evaluate serum testosterone levels in middle aged men with or without metabolic syndrome. A total of 70 subjects were included in this study with the age range from 30-59 years. Subjects were divided into two groups. Group A included middle aged men without metabolic syndrome and Group B included middle aged men with metabolic syndrome. Samples were taken by non-probability purposive sampling. Important variables in this study were age, height, weight, BMI and serum testosterone. Then serum testosterone levels were compared between the two groups. There was no significant association of metabolic syndrome with age in this study. BMI and waist circumference were significantly higher in Group B than that of Group A. The mean total testosterone level was significantly lower in subjects with metabolic syndrome.

Key words: Middle aged men, Metabolic syndrome, Serum testosterone

Introduction

Metabolic syndrome (MetS) is not a single disease but a cluster of different metabolic abnormalities[1]. MetS is one of the most important threats of 20th century. The prevalence of the MetS is increasing to epidemic proportions not only in the urbanized world but also in developing countries[2]. More recently, MetS prevalence reached a peak of 36.1% in 2007 to 2008 and plateaued at 34.7% during 2011 to 2012, according to data from the NHANES 2003 to 2012[3]. Such prevalence is also evident in countries in the Asia-Pacific region[4].

MetS is also labeled as 'insulin resistance syndrome', 'syndrome X'5. The diabetes consultation group of the World Health Organization created the first internationally recognized definition of MetS in 1998. They defined MetS as the presence of insulin resistance (impaired fasting glucose, impaired glucose

tolerance or type 2 diabetes mellitus) in addition to two of the following risk factors: obesity (waist-hip ratio or body mass index), hyperlipidemia (hypertriglyceridemia, low high-density lipoprotein cholesterol), hypertension or microalbuminuria[5]. Since the initial description of MetS, several iterations of this definition have been proposed by IDF, ATP-III and American Heart Association[5]. Most studies showed that the MetS is associated with an approximate doubling of cardiovascular disease risk and a 5-fold increased risk for incidence of type 2 diabetes mellitus[2,6].

In men, it is well-established that endogenous androgens, such as testosterone decline with advancing age[7]. Testosterone is a sex hormone in males which is produced by testicular Leydig cells and anabolic steroid which regulates fertility, muscle mass and fat distribution[8]. Total testosterone level in serum is composed of the following three fractions- i) sex hormone-binding globulin (SHBG) fraction (35-75%), ii) albumin-bound fraction (25-65%) and iii) free testosterone. Only 0.5-3% of total testosterone exists as free testosterone, which is bioactive[9].

The relationship between MetS/type 2 diabetes mellitus and testosterone or SHBG has recently been reviewed[10-12]. Some studies have demonstrated that low testosterone level predicts MetS development. There is an association between serum testosterone and insulin resistance[12]. Recent large-scale cohort analyses suggest that low testosterone levels are associated with coronary artery disease[13,14].

Although the association between total testosterone and MetS of the adult male population has been comprehensively studied abroad, little evidences are found regarding this matter in our context. Considering these facts, the current study aims to assess the total testosterone levels in metabolic syndrome.

Materials and Methods

This was a cross-sectional analytical study done in Sir Salimullah Medical College & Mitford Hospital, Dhaka, Bangladesh. Study duration was one year from July 2020 to June 2021. Data were collected by pre-designed questionnaire containing all the variables of interest and fulfilling the exclusion and inclusion criteria for the study population. A total of 70 subjects age ranged from 30-59 years were included in this study and divided into two groups. Group A included middle aged men without metabolic syndrome and Group B included middle aged men with metabolic syndrome. Samples were taken by non-probability purposive sampling. Permission for the study was taken from the Institutional Review Board of SSMC. Informed wnitleu consent from each subject was taken before collection of samples. At first height and weight were measured and BMI was calculated as weight in kilogram divided by height in meter square. Waist circumference was measured by measuring tape. Blood pressure was measured by sphygmomanometer in sitting position.

Under all aseptic precautions 5 mL of fasting venous blood sample was taken from each participant using sterile disposable syringe. Two mL venous blood samples were collected in sodium fluoride tube for measuring fasting plasma glucose and another three mL blood sample was were taken in a red top tube and allowed to clot for the collection of serum. Serum was separated by centrifugation for 10 min at 3000 rpm and was taken into microcentriguge for measuring serum total testosterone and TC, HDL and Triglyceride. Biochemical tests were done in the Biochemistry

laboratory of Sir Salimullah Medical College, Dhaka. Plasma glucose was measured by glucose oxidase method. Serum total testosterone level was measured by enzymatic immunoassay. TC, TG and HDL were measured by enzymatic method and LDL was calculated by Friedewald's formula[15]. All the data were processed and analyzed using Microsoft Excel and IBM-SPSS v23.0 for Windows. Statistical inference was based on 95% confidence interval and p-value ≤ 0.05 was considered statistically significant. Variables were expressed as mean±standard deviation (SD). Differences between group means were compared by unpaired Student's 't' test. The association between categorical variables was determined by chi-square test. The summarized data were presented in the form of tables.

Results

A total of 70 subjects age ranged from 30-59 years were included in this study and divided into two groups. Group A included middle aged men without metabolic syndrome and Group B included middle aged men with metabolic syndrome.

Table I shows that age has no significant association with metabolic syndrome as age distribution was almost similar between two groups (p=0.606). There was also no significant difference of age between Group A and Group B (43.77±10.19 vs 42.89±7.99).

Table 1: Distribution of the respondents by their age (n=70)

Age (years)	Group A (n=35) Number (%)	Group B (n=35) Number (%)	p values
30–39	17 (24.29)	17 (24.29)	†0.606
40–49	07 (10)	10 (14.29)	
50–59	11 (15.71)	08 (11.43)	
Mean±SD	43.77±10.19	42.89±7.99	††0.687

†$\chi 2$ test; †† unpaired't' test

Table 2: Comparison of anthropometric measurements between Group A and Group B by unpaired 't' test (n=70)

Variables	Group A (n=35)	Group B (n=35)	p values
Height (m)	1.60±0.041	1.58±0.049	0.101
Weight (kg)	54.14±5.24	61.42±7.41	<0.001
BMI (kg/m^2)	21.87±1.54	24.44±2.51	<0.001
WC (cm)	82.34±9.67	90.17±12.4	<0.01

BMI- Body Mass Index, WC- Waist Circumference

Table II shows comparison of anthropometric measurement between Group A and Group B. There was no significant difference in height (1.60±0.041 vs 1.58±0.049m) between Group A and Group B. But there was significant difference of weight between Group A and Group B (54.14±5.24 vs 61.42±7.41 Kg). In this study BMI (21.87±1.54 vs 24.44±2.51 kg/m2) and waist circumference (82.34±9.67 vs 90.17±12.4 cm) were significantly higher in Group B than that of Group A.

Table III shows that serum total testosterone level was significantly lower in subjects with metabolic syndrome (Group B) than the subjects without metabolic syndrome (Group A) (234.42±1.32 vs 436.52±1.23; p<0.001)

Table 3: Comparison of serum total testosterone levels between Group A and Group B by unpaired 't' test in the study subjects (N=70)

Variable	Group A (n=35) Mean ± SD	Group B (n=35) Mean±SD	p value
Total testosterone (ng/dL)	436.52±1.23	234.42±1.32	<0.001

Unpaired t test was done

Discussion

Testosterone is the principal male sex hormone, mainly secreted by the testes and to a lesser extent by adrenal glands. Testosterone controls the expression and maintains male sexual characteristics and promotes muscle mass, strength and bone density. Lower level of testosterone is associated with sexual dysfunction, abdominal obesity, reduced insulin sensitivity, diabetes, hypertension, and dyslipidemia[16]. So, many of these consequences of lower level of testosterone are the components of MetS[17-19] and it is established that MetS is strongly associated with an increased risk of developing atherosclerotic cardiovascular diseases (CVD)[20].

In both groups, nearly half of the participants were in age group 30-39 years with a mean age of 43.77±10.19 years in Group A and 42.89±7.99 years in Group B. Age distribution was almost similar in both groups. A Korean study demonstrated that prevalence of MetS in adults and middle aged was 27.5% and 30.6% respectively[21]. Studies by Laouali et al[16] and Blaya et al[19] reported higher mean age. The reason behind this discrepancy may be the inclusion criteria of present study.

This study revealed that mean BMI and waist circumference were higher in subjects with MetS. Many observational studies consistently showed a strong association of obesity with low circulating testosterone levels in men. Indeed, epidemiological data suggest that the single most powerful predictor of low testosterone is obesity and that obesity is a major contributor of the age-associated decline in testosterone levels[22]. Obesity leads to low serum testosterone levels through the suppression of SHBG and steroidogenesis in the testis[23,24].

Serum total testosterone level was significantly lower in subjects with MetS (Group B) than in the subjects without MetS (Group A). This similar observations were reported by Li et al[10], Zhong et al[25] and Hejrati et al[26] The decrease in testosterone levels might be determined by insulin resistance-mediated and, possibly, pro-inflammatory cytokine-mediated decrease of sex hormone binding globulin, resulting in a temporary increased free testosterone available for aromatization to estradiol in visceral adipose tissue, followed by a subsequent decrease in free testosterone levels, due to the excess of visceral adipose tissue and aromatization by a direct inhibitory effect of increased leptin levels on Leydig cells and by a reduced gonadotropin secretion induced by estradiol, inflammatory mediators, leptin resistance, and insulin resistance, with the ultimate determination of a substantial hypogonadotropic hypogonadism[27]. It has been concluded that restoring value of serum total testosterone to its physiological concentration by testosterone supplementation in abdominally obese men improves insulin sensitivity and gives beneficial effects[28].

In conclusion it was evident through the study that in middle aged men with metabolic syndrome had low testosterone levels as compared to healthy subjects. So, serum testosterone might be a promising candidate marker for the detection of male metabolic syndrome which is an important risk factor of cardiovascular diseases.

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