The impact of testosterone level on body composition in men with type 2 diabetes (T2D)

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Introduction

It is well-known that sex hormones are important determinant of body composition (1). Several studies have confirmed the significant negative correlation between testosterone (T) and obesity (2) and a positive correlation between T and muscle mass (3-5) as well as that testosterone replacement therapy (TRT) increases muscle mass in hypogonadal men (6, 7). Hypogonadism is a common finding in men with T2D with a prevalence of up to 42% (8). Low T levels are associated with increased fat mass (FM) and reduced fat-free mass (FFM) in males. Testosterone replacement therapy demonstrates beneficial effects on measures of obesity that are partially explained by both direct metabolic actions on adipose and muscle and also potentially by increasing motivation, vigour and energy allowing obese individuals to engage in more active lifestyles. Sex hormone binding globulin (SHBG) is a surrogate marker of insulin resistance (9). Insulin sensitivity correlates positively with muscle mass and negatively with liver and visceral fat. Liver fat is assessed by aspartate transaminase and alanine transaminase ratio (AST/ALT) as well as by the level of ALT.

Methods

A cross-sectional study involving community-based men with T2D (n=200). Men were divided into 2 groups according to their TT levels:

- group 1 (n=102) – men with low TT (<12 nmol/l), untreated (n=95) and sub-optimally treated (n=7) and
- group 2 (n=98) – men with normal TT (≥12 nmol/l), eugonadal (64) and optimally treated (n=34).

The impact of TT level on body composition (FM and FFM) was assessed as well as the significance between body composition and the quartiles of SHBG, the quartiles of haemoglobin A1c (HbA1c), the quartiles of ALT and the quartiles of AST/ALT ratio. Testosterone levels were assayed on an Immulite Simmens analyser. The body composition was assessed using TANITA analyser. The statistical analysis was carried out using SPSS software, and the data was analysed using Univariate analysis of variance (ANOVA) and Mann-Whitney U test.

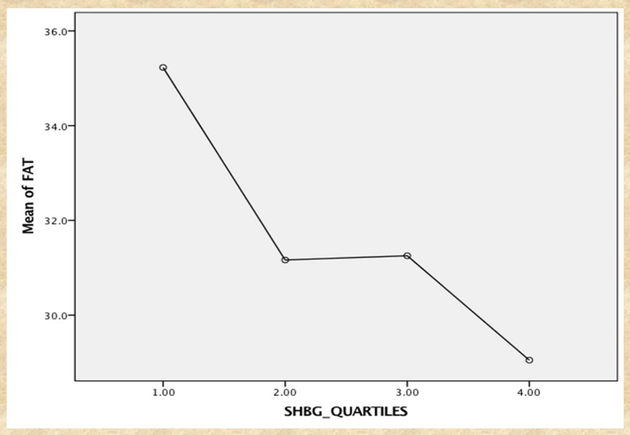
Results

Table 1. Baseline characteristics.

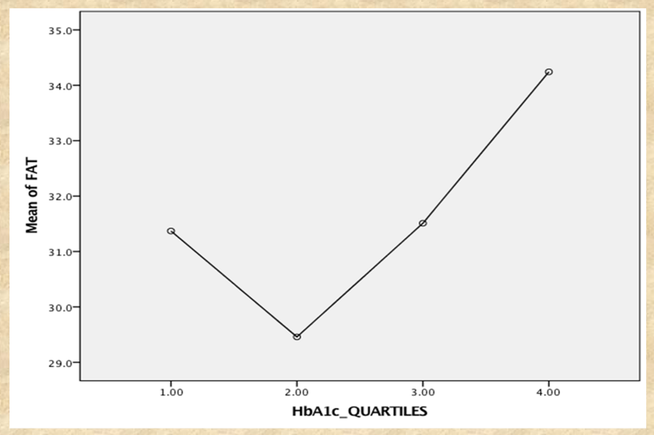
	Group 1	Group 2	p value	Whole
Age	64.1±9.3	63.1±8.3	0.431	63.6±8.8
TT	8.1±2.6	18.2±6.2	0.000	13.1±6.9
BMI	32.7±5.9	31.5±5.5	0.168	32.1±5.7
SHBG	33.6±16.7	36.6±16.9	0.253	35.0±16.8
HbA1c	8.0±1.7	7.3±1.3	0.002	7.7±1.6
AST/ALT	1.05±0.53	0.98±0.28	0.218	1.01±0.43
ALT	27.8±14.7	29.7±17.5	0.401	28.8±16.1

Table 2. Statistical significance between variables. Q - quartile

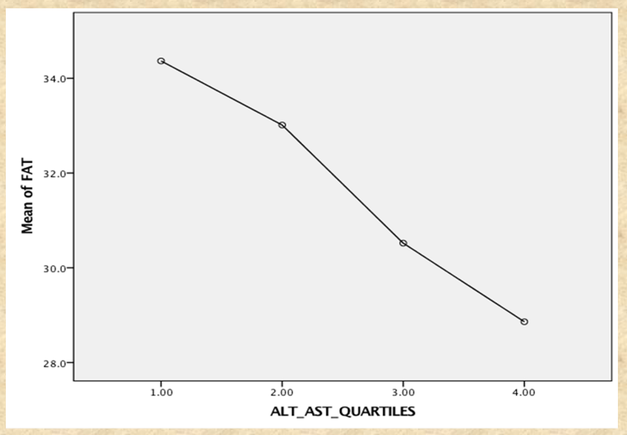
	FAT MASS (p value)
Group1 vs Group2	0.021
Q1 vs Q4 SHBG (graph 1)	0.003
Q1 vs Q4 HbA1c (graph 2)	0.035
Q1 vs Q4 AST/ALT (graph 3)	0.004
Q2 vs Q4 AST/ALT (graph 3)	0.048
Q1 vs Q4 ALT (graph 4)	0.108



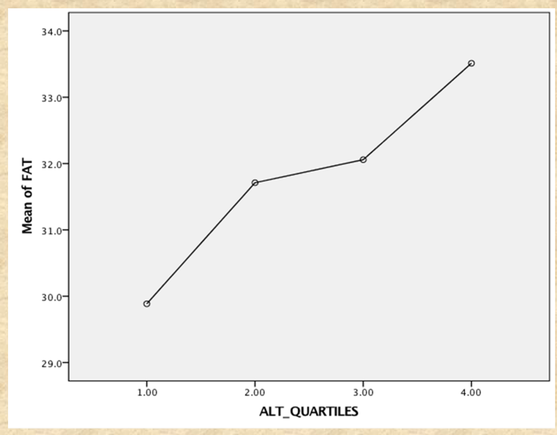
Graph 1.



Graph 2.



Graph 3.



Graph 4.

Conclusion

1. Total testosterone and SHBG positively correlated with fat-free mass and negatively with fat mass.
2. Liver fat as assessed by AST/ALT ratio indicates that low testosterone is associated with a higher risk of hepatic steatosis.
3. Higher fat mass is associated with poor glycaemic control and raised ALT reflecting hepatic steatosis.
4. The presence of hepatic steatosis implies that in the low testosterone state there is impaired uptake and metabolism of glucose and triglycerides. This finding indicates that there is an overspill of lipid deposition into tissues where normally there is no excess deposition of fat. A key component of the overspill hypothesis is that there is lipid deposition in arterial walls that promote the development of atherosclerosis.

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