

FACTORS AFFECTING TESTOSTERONE LEVEL IN MEN

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Abstract: Testosterone is a steroid hormone from the androgen group and is found in mammals, reptiles, birds, and other vertebrates. Testosterone is secreted primarily by the testicles of males, although small amounts are also secreted by the adrenal glands. It is the principal male sex hormone and an anabolic steroid. In men, testosterone plays a key role in the development of male reproductive tissues such as the testis and prostate. Anabolic effects include growth of muscle mass and strength, increased bone density and strength, and stimulation of linear growth and bone maturation. Androgenic effects include maturation of the sex organs, deepening of the voice, growth of the beard and axillary hair. Many of these fall into the category of male secondary sex characteristics. Factors affecting testosterone level in men majorly are comprised of hereditary, diet, psychological issues (stress, anxiety, depression), social habits (alcoholism, smoking tobacco), ageing.

Keywords: testosterone, eugonadal, hypogonadism, anabolic, sex hormone, erectile dysfunction.

Introduction

Testosterone is the best known hormone outside professional medicine. The popularity of the male sex hormone derives from the fact that it acts in all organs and systems and has a significant influence on important aspects of life such as physical appearance, behaviour, mentality, abilities, sexuality and social status. The media are focussed on testosterone and while they disseminate much information, they also indulge in speculations on its effects, as highlighted by the following quotation: 'the He hormone... has become a metaphor of man hood it affects every aspect of our society, from high divorce rates and adolescent male violence to exploding cults of body....'^[1] Often scientific publications reinforce these speculations by finding yet another connection between high or low testosterone levels and physical or mental variables. However, because man consists of more than unrelated components, the question arises whether the one dimensional ups and downs of serum testosterone levels are sufficient to explain the complexities of human life and whether the supposed/alleged connections may not be over simplifying and misleading when generalised or applied to healthy eugonadal individuals not exposed to exogenous testosterone. The multitude of associations of low or high testosterone levels with behavioural and physical characteristics makes one wonder whether one hormone can be responsible for so many features and facets of life. In the current article we will review these associations as described in healthy men based on representative and, as far as possible, controlled studies, and point out methodological pit falls and deficiencies in interpreting results.

Puberty

Puberty occurs when there is an "awakening" of the hypothalamic-pituitary axis. The hypothalamus increases its secretion of gonadotropin releasing hormone (GnRH) which in turn stimulates the release of luteinizing hormone (LH) and follicle stimulating hormone (FSH). This leads to a significant increase in the production of testicular testosterone and the induction of the well-known secondary including energy, strength, motivation and mood.^[2]

Strength training

In men, muscle mass and strength are often described as being associated with testosterone levels.^[3] This applies to older men as well as to adolescents (16,17). Strength training can have an acute effect on endocrine functions. Measurements immediately and 5min post-exercise show an age-dependent increase in testosterone levels (18±22). Persons continuously involved in strength

training, however, do not show significant changes in testosterone levels(20,23,24).^[4] Over training as a physical stress factor may decrease androgen levels. Abuse of exogenous testosterone for anabolic effects can also affect other parameters and will not be discussed further(22,25±29).^[5]

Mental stress

The release of cortisol by activation of the HPA axis as a reaction to mental stress is well documented. Similarly, stress responses by the HPA axis are also seen. This applies not only to physical stress but also to psychologically disturbing events^[6]. Stressful situations as experienced during work, before tournaments or anticipating exams have been shown to decrease testosterone levels(30±36). Stress release, on the contrary, can have an elevating effect on androgen levels, which is demonstrated by a controlled study involving volunteers practising transcendental meditation. The same effect was seen in men undergoing work place reorganisation and threatened by unemployment. After the work place situation changed for the better, testosterone levels clearly rose; however, there was a marked variation between subjects. It remains unclear whether the drop of testosterone levels in exposure to mental stress is caused by decreased LH secretion or whether an adequate response at the pituitary level is not present^[7]. An additional impact factor might be the increased glucocorticoid secretion observed in stressful situations (due to increased corticotropin-releasing hormone production), which may be responsible for down regulated testosterone biosynthesis in the Leydig cell (39)^[8].

Testosterone and body composition

Changes in body composition are seen with ageing. In general terms, ageing males are prone to loss of muscle mass and a gain in fat mass, especially in the form of visceral or central fat^[9]. An epidemiological study of community dwelling men aged between 24 and 85 years has confirmed that total and free testosterone levels are inversely correlated with waist circumference and that testosterone levels are specifically related to this measure of central obesity rather than general obesity (Svartberg, von Muhlen, Sundsfjord et al 2004)^[10]. Prospective studies show that testosterone levels predict future development of central obesity (Khaw and Barrett-Connor 1992; Tsai et al 2000). Reductions in free testosterone also correlate with age related declines in fat free mass (muscle mass) and muscle strength (Baumgartner et al 1999; Roy et al 2002)^[11]. Studies in hypogonadal men confirm an increase in fat mass and decrease in fat free mass versus comparable eugonadal men (Katznelson et al 1998)^[12]. Taken together, the epidemiological data suggest that a hypogonadal state promotes loss of muscle mass and a gain in fat mass, particularly visceral fat and therefore mimics the changes of 'normal' ageing.

Testosterone, cardiovascular disease, and atherosclerosis

Cardiovascular disease, and its underlying pathological process atherosclerosis, is an important cause of morbidity and mortality in the developed and developing world. Coronary heart disease in particular is the commonest cause of death worldwide (AHA 2002; MacKay and Mensah 2004)^[13]. As well as increasing with age, this disease is more common in the male versus female population internationally, which has led to interest in the potential role of sex hormones in modulating risk of development of atherosclerosis. Concerns about the potential adverse effects of testosterone treatment on cardiovascular disease have previously contributed to caution in prescribing testosterone to those who have, or who are at risk of, cardiovascular disease^[14]. Contrary to fears of the potential adverse effects of testosterone on cardiovascular disease, there are over forty epidemiological studies which have examined the relationship of testosterone levels to the presence or development of coronary heart disease, and none have shown a positive correlation. Many of these studies have found the presence of coronary heart disease to be associated with low testosterone levels.^[15]

Libido

Testosterone has several positive effects on sexual function, but its most significant effect is on libido, sexual interest and arousal. Boys going through puberty develop an enhanced interest in sex (thoughts, fantasies, masturbation, intercourse) as a consequence of rising levels of testosterone. Hypogonadal men usually have a significant improvement in libido when TRT is initiated^[16]. Decrease of testosterone in men is also related to declines in sexual desire, which can be restored with testosterone administration. However, reproductive-aged males treated with supra-physiological doses of testosterone do not report enhanced sexual activity, with mixed results for increased libido. In line with these findings, research focusing on natural variation in testosterone among reproductive-aged men has not found that higher testosterone males engage in more frequent sexual intercourse compared to individuals with lower testosterone^[17]

Environmental factors affecting testosterone levels

- Weight loss makes fat men more masculine^[18]. Fat cells synthesize the enzyme aromatase^[19] which converts testosterone, the male sex hormone, into estradiol, the female sex hormone.^[19]
- The hormone vitamin D in levels of 400-1000 IU (10-25 mcg) raise testosterone level^[20].
- Zinc deficiency lowers testosterone level. but over supplementation has no effect on serum testosterone^[21].
- Magnesium raise free testosterone according to studies^[22]
- Implicit power motivation predicts an increased testosterone release in men^[23]
- Aging reduces testosterone release^[24].
- Hypogonadism
- Sleep (REM dream) increases nocturnal testosterone levels^[25].
- Resistance training increases testosterone levels, however, in older men, that increase can be avoided by protein ingestion^[25].
- Licorice. The active ingredient in licorice root, glycyrrhizinic acid has been linked to small, clinically non-significant decreases

in testosterone levels^[26]. In contrast, a more recent study found that licorice administration produced a substantial testosterone decrease in a small, female-only sample^[27]
 Natural or man-made antiandrogens including spearmint tea reduce testosterone levels^[28].

Conclusion

Testosterone is a hormone with multifaceted physiological functions and multiple associations with pathophysiological states. It is an important hormone in male reproductive and metabolic function from intrauterine life to old age. In severe or classical hypogonadal states there is little controversy about the need to administer testosterone by an intramuscular, oral or transdermal formulation. There is controversy about making the diagnosis in the less severe cases of hypogonadism associated with the ageing male but the current evidence suggests that this is efficacious in appropriately selected men and that there is little if any risk in giving ageing symptomatic hypogonadal men a 6 month trial of therapy to determine whether symptoms will improve. Testosterone is not a panacea for prolonging youth by warding off the ageing process. It may, however, provide the appropriately selected symptomatic male with reduced testosterone availability assistance in helping that man move more gracefully into the senior years of his life.

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