

Testosterone (Adult Male) Testing Guide

Symptoms

After the age of 40, men experience a slow decline in levels of testosterone, typically decreasing at a rate of 1-2% per year. Many of these individuals present to their physician with symptoms associated with hypogonadism, a condition where the testes do not produce enough testosterone to maintain optimal sexual, cognitive, and bodily function. While testosterone isn't typically measured until symptoms of hypogonadism appear, low levels don't always lead to symptoms and won't be caught until the patient's health is significantly affected. However, routine screening in asymptomatic individuals is not recommended by current medical guidelines as the treatments used to reverse the condition have both benefits as well as adverse consequences with long-term therapy ¹.

Symptoms Associated w/ Low T

- Reduced libido, erectile dysfunction
- Changes in sleep patterns
- Depression / fatigue
- Reduced body mass, increased body fat
- Low bone density
- Diabetes, hypertension

Treatment

Patients identified as having low testosterone (low T) are often treated using hormone replacement therapy (HRT), where additional testosterone is delivered to the body using an absorptive gel, skin patch, subdermal pellet, or through other means. Physicians monitor levels of testosterone after the start of treatment to ensure the patient is maintaining proper levels of the hormone and to ensure side effects are minimized.

Considerations

When selecting the proper test to identify low T and monitor HRT, physicians take many considerations into account. These include:

- The suspected cause of the deficiency
- The level of hormone that need to be detected
- The results of tests from prior visits or treatment

Total Testosterone

Test Code: 9345
Total Testosterone

Measurement of total testosterone (Total T) is the most common screen for low T in symptomatic men. This test uses an electrochemiluminescent immunoassay to determine the amount of testosterone present in a patient's bloodstream, allowing for a simple baseline assessment of T status. It is important to note that levels of testosterone fluctuate during the day, thus morning blood collections (between 7 a.m. and 10 a.m.) are preferred.

This test is not intended for use in men with extremely low levels of testosterone, prepubertal children, or women. Alternative options are available for these patients.

Free Testosterone

Test Code: 907279
Testosterone, Free & Total

Free testosterone (Free T) represents the fraction of the Total T that is not bound to any proteins in the bloodstream and thus has direct access to testosterone receptors throughout the body. It is primarily useful in patients that have levels of Total T considered borderline (i.e., results are normal, but on the low side). In these cases, measuring Free T may be useful to determine if the hormone present is sufficient and available for the body to use in its metabolic functions.

Free T can be determined in several ways, each of which has its strengths and weaknesses. One of the most common is to determine Free T using mathematical modeling. These models use the results of the Total T and two proteins (sex-hormone binding globulin (SHBG) and albumin) to determine the concentration of Free T². Results obtained in this manner are suitable for most adult male patients being screened or treated for routine cases of low T and are supported by current guidelines¹.

This test is not intended for use in men with extremely low levels of testosterone, prepubertal children, or women. Alternative options are available for these patients.

Bioavailable Testosterone

Test Code: 907280
Testosterone, Free, Total, & Bioavailable

Bioavailable testosterone (Bio T) represents the total pool of testosterone that is available to interact with receptors throughout the body. In the laboratory, it is determined by combining Free T with other testosterone that is weakly bound to proteins such as albumin in the bloodstream. Weakly-bound testosterone can easily transition between being bound to a protein and becoming free in the circulation. As such, along with the Free T, it is considered as part of the functional pool of this hormone in the body.

Bio T is estimated using a mathematical model after measuring the Total T, SHBG, albumin, and calculating the Free T. In general, levels of Bio T and Free T correlate well so clinicians commonly only use one option in their assessment of a patient. However, in older individuals or those with coexisting illness, Bio T may be superior to Free T as protein production may be altered, changing the total functional component of testosterone available to the body.

Sex-Hormone Binding Globulin (SHBG)

Test Code: 907282
Testosterone, Free, Total, Bioavailable, SHBG, & Albumin) or
Test Code: 8091
Sex Hormone Binding Globulin

Sex hormone binding globulin (SHBG) is a protein produced by the liver that binds and transports sex hormones such as testosterone and estradiol (estrogen) in the bloodstream. Along with other physiological mechanisms, SHBG functions as a regulator of androgen and estrogen balance, transporting sex hormones to areas in need and removing those that may be in excess.

In contrast to other proteins such as albumin, SHBG binds testosterone with high affinity, effectively sequestering it from use³. Abnormalities in SHBG thus lead to relative changes in the physiologically available fraction of testosterone available in the body (i.e., Free T and Bio T).

- Decreases in SHBG can lead to a relative androgen excess
- Increases in SHBG can lead to a relative androgen deficiency

Measurement of SHBG is integral to the determination of the Free and Bio T using the mathematical algorithms described. Moreover, physicians may directly request this test to assist in identifying potential causes for low T among other disease states.

References:

1. Bhasin S, Brito JP, Cunningham GR, *et al.* Testosterone therapy in men with hypogonadism: An Endocrine Society clinical practice guideline. *J Clin Endocrinol Metab.* 2018; 103:1715-1744.
2. Vermeulen A, Verdonck L, Kaufman JM. A critical evaluation of simple methods for the estimation of free testosterone in serum. *J Clin Endocrinol Metab.* 1999; 84:3666-3672.
3. Goldman AL, Bhasin S, Wu FCW, *et al.* A reappraisal of testosterone's binding in circulation: Physiological and clinical implications. *Endocr Rev.* 2017; 38:302-324.