

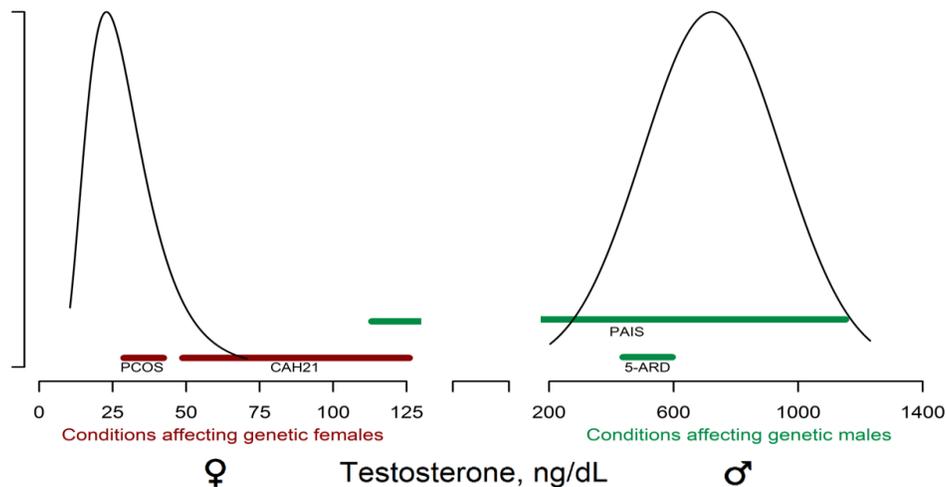


FREQUENTLY ASKED QUESTIONS – ABOUT SCIENCE AND SEX

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Q10. Don't some healthy females produce testosterone in the "male" range?

A10. No. Although females do produce testosterone, mainly in their ovaries, healthy post-pubertal females never produce testosterone levels as high as post-pubertal males. Throughout childhood, up until the onset of male puberty, male and female testosterone levels are about the same; but from the onset of male puberty, male testes produce significantly more testosterone than female ovaries. From that point forward, normal female testosterone levels fall in a narrow range between 0.06 and 1.68 nanomoles per liter (nmol/L), and male levels fall in a broader range between 7.7 and 29.4 nmol/L. The gap between the normal male range and the normal female range is wide. As the following figure indicates, there is no overlap. Some biological females have higher than normal female testosterone levels, for example if they have polycystic ovaries, but again, no healthy female has a testosterone level even close to the normal male range.



This figure shows the normal female testosterone range on the left and the normal male range on the right. It also shows the abnormal testosterone ranges that can be produced by people with certain differences of sex development (DSDs). Some people with DSD prefer to describe themselves as intersex. The conditions marked in red are among those that affect genetic

(biological) females. Those marked in green are two that affect (genetic) biological males. Those conditions are described further in the answer to Question 27 below.

Some advocates for trans and intersex athletes claim that there is an overlap in the normal ranges. This claim is not supported by the data or the current peer-reviewed literature. Their argument depends on the existence of a small number of outlier (abnormal) readings, i.e., on a small number of higher-than-normal female T readings and a small number of lower-than-normal male T readings. These abnormal readings are used by advocates to construct a "spectrum" that *appears* to negate the normal bimodal distribution by "filling in" the gap between the two ranges.¹ The figure above shows one way this optical effect can be achieved. It requires ignoring that more than 99% of the population has readings in the normal ranges, and then "filling in" the gap between those ranges with readings from the less than 1% of the population that has an intersex condition.

As the leading experts in the field have established, however, the overlap argument is not supported by the data points themselves, which do not distinguish between (1) doped and non-doped females; (2) females and males with differences of sex development; and (3) male readings taken at rest and following strenuous exercise—the latter has been established temporarily to lower normal levels. Additionally, they measure testosterone by immunoassay – which is inaccurate at lower testosterone concentrations in women – rather than by state-of-the-art methodology, i.e., by mass spectrometry.² Once those errors are corrected, the overlap disappears.

¹ Advocates may refer to this older paper to support their claim: Healy ML, et al., Endocrine profiles in 693 elite athletes in the postcompetition setting. *Clin Endocr.* 2014; 81(2): 294-305. PMID: 24593684.

² Handelsman DJ, Hirschberg AL, Berman S. Circulating Testosterone as the Hormonal Basis of Sex Differences in Athletic Performance. *Endocr Rev.* 2018;39(5):803-29. Epub 2018/07/17. Clark RV, Wald JA, Swerdloff RS, Wang C, Wu FCW, Bowers LD, Matsumoto AM 2019 Large divergence in testosterone concentrations between men and women: Frame of reference for elite athletes in sex-specific competition in sports, a narrative review. *Clin Endocrinol (Oxf)* 90:15-22.