

*conference abstract**observational**people*

Setting fair regulations for top female athletes that have naturally higher testosterone levels

Top performing female athletes are more likely to have naturally occurring higher testosterone levels, which sporting regulations should take into account, according to findings to be presented in Lyon, at the [European Society of Endocrinology](#) annual meeting, [ECE 2019](#). The researchers show that top female athletes are more likely to have higher testosterone levels and mild disorders, as well as more severe and rarer conditions that increase testosterone levels. These findings suggest that higher testosterone levels can enhance physical performance in women, to levels more comparable to male physiology, and raises questions on how to ensure fairness of competition in women's sport.

Elite athletic competitions have separate male and female events to maintain fairness, as men naturally have physical advantages in strength, speed, and endurance. These characteristics are widely accepted to be due to men having 15- to 20-fold greater levels of testosterone than children or women at any age. Recent regulations introduced by the International Association of Athletics Federation (IAAF) and the International Olympic Committee (IOC) on the management of naturally high testosterone levels in women have been controversial. The new IAAF regulations require women with testosterone levels in the male range to medically reduce them to be allowed to compete, however the fairness and morality of these rules have been challenged by human rights and academic experts. The reasons for high testosterone levels in women are complex and may be caused by rare conditions such as having the male Y chromosome and male gonads. Studies in men show a clear relationship between testosterone levels and enhanced physical performance but fewer studies have examined this relationship in women. It is therefore vital to establish what extent higher levels of testosterone may be enhancing performance in female athletes, towards a more male-like physiology, and to set an acceptable and fair testosterone level range for female athletes to be allowed to compete.

Prof Angelica Lindén Hirschberg from the Karolinska Institutet and Karolinska University hospital in Sweden and colleagues, have investigated the levels of testosterone in female athletes and how these impact on their physical performance. Their studies have shown relationships between higher testosterone levels, increased muscle mass and enhanced physical performance. They found that top female athletes were more likely to have common and mild conditions that increase testosterone levels, like polycystic ovary syndrome (PCOS) but also rare conditions with very high naturally occurring levels of testosterone in the male range. Their data were part of the evidence used to establish recommendations on an acceptable testosterone level range for elite female athletes, to take into account whether the levels are high enough to push women's physiology to be more similar to men's. Levels in healthy men are in the range 7.7 to 29.4 nmol/L and 0 to 1.7 nmol/L in healthy women, so for fairness and considering the over-representation of women with naturally higher levels in sport, the IAAF recently formulated new regulations and defined a maximum testosterone level of 5.0 nmol/L for eligibility in the female classification of middle distance track disciplines. The Court of Arbitration for Sport approved the IAAF's regulations on 1 May 2019.

Prof Hirschberg says, "Sporting success should come from a combination of talent and dedication. In circumstances where women have 10 to 20 times higher testosterone levels than normal they may have a powerful advantage. Elite female athletes want to compete fairly against other women. However, we must also appreciate that drawing a line on an acceptable level is difficult, our recommended limit makes allowances for women with mild conditions like PCOS,

whilst ruling out those with more severe conditions that hugely increase testosterone levels and promote a more male-like physiology.”

Prof Hirschberg comments, “In the interests of fairness in sport for all women, a policy that responds with sensitivity to those who may have a condition causing high testosterone is needed. We have focused specifically on defining the levels that really confer additional advantages on physical performance, and recommended an appropriate limit for competitive fairness.”

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Abstract

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Female hyperandrogenism and elite sport

Androgens are considered beneficial for athletic performance by potent anabolic effects on muscle mass and bone tissue. Testosterone also increases circulating hemoglobin, which will enhance oxygen uptake. Furthermore, androgens may exert behavioral and psychological effects of importance for athletic performance including increased mental drive and competitiveness. Studies in men have shown clear relationships with both exogenous and endogenous circulating testosterone to muscle mass, strength and hemoglobin. Corresponding evidence in women is much more limited. However, recent studies have demonstrated associations between circulating testosterone in the normal female range and muscle mass and strength, respectively. Moreover, it has been demonstrated that women with polycystic ovary syndrome (PCOS) are overrepresented in elite athletes. PCOS, which is a mild form of hyperandrogenism, is associated with an anabolic body composition including more muscle mass than in non-PCOS women. There are data to support that PCOS is advantageous for physical performance. This condition could therefore play a role in the recruitment of women to competitive sports. The prevalence of differences of sex development (DSD) is also increased among female athletes. XYDSD may cause a greatly increased production of testosterone in the male range, i.e. 10-20 times higher than in the normal female range. If the individual has normal androgen sensitivity, her muscle mass will develop as in males, along with increasing signs of virilization. Since sports are divided into female and male classification, it could be considered unfair to allow female athletes with endogenous testosterone in the male range to compete against women with normal female androgen levels. This led the International Association of Athletics Federation and the International Olympic Committee to establish regulations for management of hyperandrogenism in female athletes. However, the regulations are controversial, and have been challenged. Ultimately, it is a question of ensuring fair and meaningful competition in women's sport.

Notes for Editors

1. The symposium talk “*Female hyperandrogenism and elite sport*” was presented on Tuesday 21 May 2019, at the European Congress of Endocrinology at the Lyon Convention Centre, Lyon, France.
2. For other press enquiries please contact the ECE 2019 press office:

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3. The European Congress of Endocrinology was held at Lyon Convention Centre, Lyon, France on the 18-21 May 2019.
4. The [European Society of Endocrinology](#) was created to promote research, education and clinical practice in endocrinology by the organisation of conferences, training courses and publications, by raising public awareness, liaison with national and international legislators, and by any other appropriate means.