Beyond fairness: the biology of inclusion for transgender and intersex athletes

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In November 2015, the International Olympic Committee (IOC) reached a consensus on "Sex Reassignment and Hyperandrogenism" allowing transgender athletes to compete after one year of hormone replacement therapy (HRT) and without sex reassignment surgery (SRS)(9). These recommendations have been applauded by some who argue that these guidelines are supported by the limited scientific data and are in line with current social and legal recognition on transgender issues(11). There are however, many who oppose allowing transgender women to compete against cisgender women under any conditions, especially in those cases where gonadectomy has not been performed(12). While much of this opposition is based on a lack of understanding of the transformative nature of HRT, there are also those who have legitimate concerns over the paucity of scientific studies to support the new IOC guidelines(13).

The primary concern is whether transgender women's prior lives as males give them an unfair advantage. There are a number of sports where anatomical and biological features such as size, muscle mass and even lung capacity would be an obvious advantage with transition to female - a seven-foot basketballer, the above-average reach boxer and the larger skeletal muscle fiber area of the track-and-field athlete. Research into the advantage that transgender women possess in athletics is sparse. Gooren and Bunck measured testosterone and hemoglobin levels in transgender women within a year of SRS and reported the levels of testosterone and hemoglobin are within the female range in transgender women(6). Low testosterone levels in male-to-female (MTF) transgender undergoing HRT have also been reported in other studies(7,14,15). For example, T'Sjoen et al(14), in a cross-sectional study with 50 individuals who made the transition from MTF with SRS, assessed the anti-androgen hormone therapy supplied to MTF individuals and reported a loss of muscle mass, an increase in fat mass, and a decrease in bone mineral density. Significant changes in the MTF transgender are apparent in the first phase of HRT (from month 6 to month 12). Such findings provide some support for the recent recommendations by the IOC to allow transgender women to compete assuming that "normalising" the levels of these hormones removes the vast majority of the advantage of having been male. Unfortunately, none of these studies assess performance and therefore this important

assumption could not be verified directly. In the only study to assess performance in athletes who have transitioned from MTF, Harper(8) compared race times in eight non-elite MTF transgender runners who had competed in distance races in both genders and found their age-and-gender graded performances had not changed once their bodies had adjusted to the transition. Harper's unique study is limited by the fact that none of the eight runners were international-level, raising the question of whether these findings based on a small number of transgender athletes can be extrapolated to elite transgender or even intersex athletes i.e. those who are born with a mixture of male and female biology. The International Association of Athletics Federations (IAAF) also conceded recently that athletic performance is more complex than a focus on testosterone allows. In their own published study on testosterone levels in elite female athletes, they were unable to exclude the existence of other factors that 'in some unknown way may bring an advantage to female athletes'(1).

With respect to hyperandrogenism, the Court of Arbitration for Sport's (CAS) decision to suspend for a period no longer than two years from July 24th 2015(4) the requirement of athletes in female competition to have a blood testosterone level lower than 10 nmol/L, citing that a high level of testosterone was not sufficient evidence for a performance benefit in women, is in odds with some of the scientific literature(2) and the IOC's recommendations(9). Notably, there was no mention by CAS of the role of hemoglobin, yet it is well known that testosterone stimulates erythropoiesis. For example, the administration of long-acting intramuscular testosterone has been shown to increase the levels of hemoglobin and hematocrit in female-to-male (FTM) transgender individuals(10). It is not therefore surprising that the IOC consensus group recommended to reinstate the hyperandrogenism rules(9).

Given the paucity of relevant research and the likely impact of decisions relating to transgender and intersex athletes, there is now an urgent need to determine not only what physical advantages transgender women carry after HRT but also what effect of these advantages may have on transgender women competing against cisgender women in a variety of different sports. Properly designed intervention studies are required to investigate the effect of the transition (both MTF and FTM transitions) on trainability and performance as well as the effects of HRT on performance in intersex individuals. Such studies would allow sex differences in performance to be determined such as disentangling hormonal influences from the unresolved issue of "muscle memory" (see Figure 1). For instance, it has been shown that the number of nuclei within individual muscle cells (called myonuclei) dictate the training response of skeletal muscle in addition to the hormonal milieu(3,5). The important question here is whether the MTF transition and/or HRT with associated muscle atrophy have an impact on the number of myonuclei. If not, some of the biological advantage of a male biology will remain irrespective of "normalising" the levels of circulating hormones. A concerted approach, involving a series of well phenotyped training and performance studies using high-throughput "omics" technologies (such as genomics, transcriptomics, metabolomics and proteomics) will be required to resolve the complex issues surrounding transgender and intersex athletes and secure fair competition for all.

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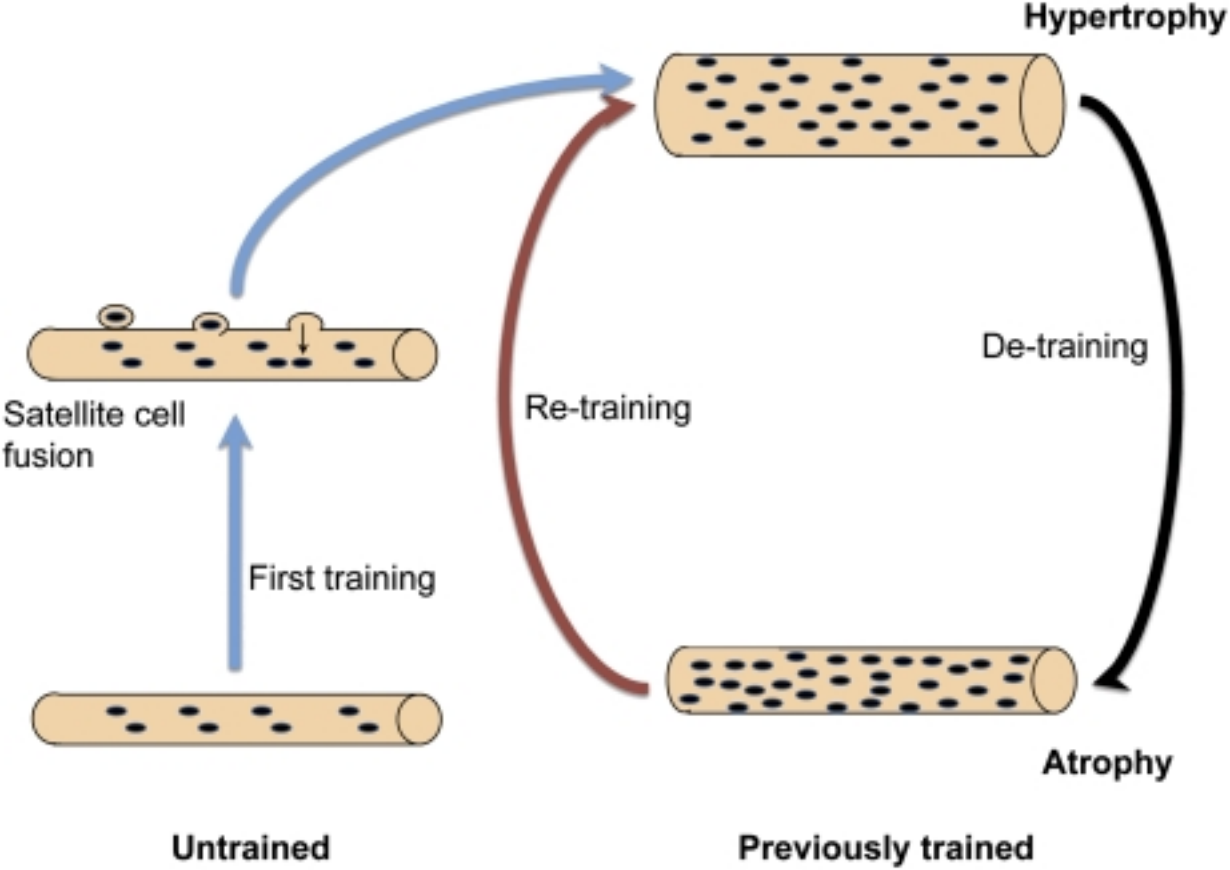
Illustration:

Figure 1: The “muscle memory” model. In this model, myonuclei are permanent. Previously untrained muscles acquire newly formed nuclei by fusion of satellite cells preceding the hypertrophy. Subsequent detraining leads to atrophy but no loss of myonuclei (5).


Hypertrophy
De-training
Re-training
Satellite cell fusion
First training
Atrophy
Untrained
Previously trained