Hyperandrogenism in Elite Athletes:

The Problems in Regulating Female Athletes with High Testosterone Levels

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Abstract

Controversy has long been present within the Olympic games with the most recent source of controversy concerning hyperandrogenic women, women with elevated testosterone levels, and their eligibility to compete within the female category. The most current hyperandrogenism regulations limit women's testosterone levels to 5 nmol/liter, and women with levels above this threshold must take measures to lower their levels if they wish to compete internationally in the female category. The scientific research behind testosterone's potential advantage in athletic competition is limited, and there is no scientific consensus that testosterone gives way to a significant advantage. As it has not been agreed upon within the scientific community that hyperandrogenic women have an edge over their competition, it is important to investigate the consequences the regulations have on the women they impact. Through analyzing the evolution of the hyperandrogenism regulations and the negative effects they can have both physically and mentally on women, it is clear that these regulations cause more harm than good in a playing field that has yet to be shown to be unequal.

Introduction

Currently, in the Olympics, sex is self-determined and is only tested for if suspicions arise. However, if all female competitors in the Olympics were born with two X chromosomes and identified as women, this does not imply that all of these women are physically equal and comparable. Olympians tend to have internal and/or external features that differ from one another and members of the public that enable them to excel. There have been recent debates surrounding female Olympians who may have high rates of testosterone in their bodies, called hyperandrogenism, and therefore may possess an advantage over their competition. Some argue that this potential advantage would be unfair and need to be regulated while others believe that

this phenomenon is naturally occurring and is not necessarily "unfair". With the current status of women's rights and their continuing fight for equality, it is befitting to investigate if female athletes with naturally high levels of testosterone have a competitive advantage over others and what consequences these women could face as a result of regulating their testosterone levels. This argumentative research paper will analyze the hyperandrogenism regulations implemented in 2012 and 2018, the scientific studies on testosterone's potential performance enhancing capabilities, and the social and ethical implications of regulating hyperandrogenic women. I argue that the science behind elevated testosterone levels has not shown that they are advantageous and require regulation, and the pressures and burdens the regulations bear on women are far too detrimental for something that has not yet been demonstrated.

2012 Rules

In 2012, the International Association for Athletics Federation (IAAF) adopted the policy that to be eligible to compete in women's competition, female athletes must have androgen levels below the male norm which is 10 nmol/liter. This policy aimed to respect a woman's privacy regarding possible disorders of sexual development while still maintaining an equal playing field (Xavier and McGill 2012). However, the said privacy in the policy has been questioned by various female athletes, including most recently, by Dutee Chand.

Dutee Chand is a track and field competitor who participated in her first Olympic games in Rio in 2016. Prior to that, she was set to compete in the 2014 Commonwealth games, but was ineligible last minute due to her naturally high level of testosterone, known as hyperandrogenism. The suspicion of hyperandrogenism came solely from the fact that Chand had some masculine features. Chand's privacy and human rights were thought to be questioned

with the decision of revoking her eligibility, so the Indian government appealed to the Court of Arbitration for Sport (CAS) (Worley 2014).

In 2015, the CAS temporarily suspended the hyperandrogenism policy that restricted women like Chand from competing in international track and field. The IAAF was given two years to provide scientific evidence that women with the condition of hyperandrogenism have a significant competitive advantage over other female athletes due to the correlation between testosterone levels and enhanced athletic performance (New York Times 2017).

Studies Brought Forward by the IAAF

Part of the evidence that the IAAF compiled to present their case that women with hyperandrogenism possess an unfair advantage involved a study of elite male and female track and field athletes (Bermon and Garnier 2017). 2,127 observations of the participants' best performances were analyzed against their free testosterone levels. Women with the highest testosterone levels were shown to perform better in the 400 meter, 400 meter hurdles, 800 meter, hammer throw, and pole vault. This pattern did not hold true for the men with the highest testosterone levels, suggesting a possible testosterone level threshold for peak performance (Bermon and Garnier 2017).

The second study the IAAF used to show that higher testosterone levels in women enhance their performance was conducted between 2011 and 2015 (Eklund et al. 2017). Female Swedish Olympic athletes had their blood sampled and their body composition analyzed at a resting state. They then performed standardized exercise tests, and their success in the tests was analyzed against their resting androgen values. It was determined that the presence of androgens, including testosterone, accounted for a more efficient internal energy usage and enhanced performance in the female athletes (Eklund et al. 2017).

Factors Not Considered

The female athletes with elevated testosterone levels are not always intersex women or women with Y chromosomes. They may possess every biologically female characteristic and simply have a disease or syndrome, such as polycystic ovary syndrome. Polycystic ovary syndrome is a hormonal disorder resulting in enlarged ovaries with small cysts on them and can commonly be characterized by hyperandrogenism (de Melo et al. 2017). Hyperandrogenism is, in fact, the most common indicator of polycystic ovary syndrome. The most prominent group of women who have androgen levels above the typical female range are those with polycystic ovary syndrome. Women with polycystic ovary syndrome or differences in sex development are 140 times more common in the elite athlete population than the general population (Rogol and Pieper 2017).

A study challenging the argument that it is solely testosterone levels differentiating the competition between men and women examined 693 elite athletes (Healy et al. 2014). This study by Healy et al. (2014) found that 16.5 percent of the males had testosterone levels below the male range and about 14 percent of the females were above the maximum female testosterone level at the top their range. All of the men tested were at the highest level of their sport and were all comparable in their success at national and international levels, regardless of testosterone level. The lean body mass, LBM, of all participants was surveyed as well, showing the LBM of female athletes to be 85% that of males and males having 118% the LBM of women. This could then easily explain the competitive differences between women and men, since there is more overlap between their testosterone levels than there is between their lean body masses (Healy et al. 2014).

Possessing the condition of hyperandrogenism is rare, even within the athlete population, and has only been looked into when a female appears to possess masculine characteristics, not because she is obviously excelling and outperforming her competition. A 2014 study by Bermon et al. quantified multiple hormones of 849 elite female athletes, and it was found that the 99th percentile for testosterone level in the women was 3.08 nmol/liter. This is well below the 10 nmol/liter limit used for the competition eligibility of females.

A factor that was ignored in the majority of the research studies on hyperandrogenism was where the women were in their ovulation cycles. A study showed that salivary testosterone concentrations were higher in women during ovulation (Crewther and Cook 2018). The same study also questioned the female athletes every day on their competitive desire and training motivation, and an increased level of competitiveness was tied to their ovulations.

When comparing the literature on how oral contraceptives may alter testosterone levels in females, most agree that taking oral contraceptives will reduce testosterone levels. When 1,495 women were studied, it was found that their testosterone levels decreased an average of 61% when taking oral contraceptives (Zimmerman et al. 2014). The IAAF hyperandrogenism regulation did not consider this contribution to testosterone levels and inaccurately framed testosterone levels as fixed amounts.

No Scientific Consensus

The studies provided by the IAAF to suggest testosterone's advantage in women athletes were deemed insufficient by the CAS and said to not fully demonstrate that testosterone gives an advantage in athletic competition. Through the presentation of the IAAF's research, the CAS agreed upon a 1-3% difference in athletic capability between hyperandrogenic women and those

with non-elevated testosterone levels, and a 10-12% athletic advantage males possess over females, implying that women with high testosterone levels are far more suited to compete with other women than they are with men (CAS, 2015). The debate over what is to be deemed "unfair" also added to the picture. Even if testosterone was shown to confer an advantage to female athletes, that does not mean it is inherently unfair. Other molecular and genetic variations (such as large hands on a swimmer) are not said to be unfair, and there is not an upper limit for testosterone in the male category. Both proponents and opponents of the hyperandrogenism policy can agree that there is no evidence that testosterone levels are the sole reason a woman may outcompete her competition and that it is a very difficult concept to test for (Springer Nature 2011).

2018 Rules

Differences from 2012

The IAAF released a new, revised hyperandrogenism policy on April 23, 2018. These new regulations are more specific than the 2012 regulations even though the research on testosterone's supposed advantage has not advanced, and the IAAF has confessed to the absence of definitive research linking hyperandrogenism and athletic performance (Worley 2014). The 2012 rules applied to every sport, but the 2018 rules apply solely to the 400 meter, 800 meter, 1500 meter, 1 mile, and 400 meter hurdles, as well as combined events over the same distances. Along with the regulation of specific events, the 2018 rules also amended the testosterone threshold. The threshold was cut in half, now existing as a maximum of 5 nmol/liter, an arbitrary amount. The 2012 rules received much backlash pertaining to the targeting of all hyperandrogenic women. The majority of the opposition to the 2012 rules came from people arguing how women with two X chromosomes who are biologically women and identify as

women but happen to have naturally high levels of testosterone should not be regulated. In response, the 2018 rules specifically target women with differences of sex development, specifically intersex women. This specification excludes non-intersex diagnoses, in turn reinforcing the binary between male and female in an attempt to make the rules more accessible for everyday people. Strengthening the distinction between the sexes makes the rules appear to be necessary even though many argue that the cause of elevated testosterone levels is irrelevant, even with respect to intersex conditions (Karkazis and Carpenter 2018). Lastly, at face-value, the 2018 rules appear to give more "options" to the women who fall under the hyperandrogenic category. The 2012 rules allowed the affected women who did not wish to lower their testosterone levels to compete with men, legally challenge the rules, or quit competition. These options still apply to the 2018 rules but now along with competing in an intersex category, at the national level, or in unrestricted events.

The Harm in Medically Lowering Testosterone Levels

When women need to lower their testosterone levels in order to be eligible for competition, they can do so pharmacologically or surgically. Although the rules state that surgery is not required, it will be up to the woman and her physician to choose the best plan of action. Thus, these women may still decide upon undergoing surgery. An IAAF study of 4 South Asian athletes with elevated testosterone levels was released in 2013 that disclosed how these women, aged 18-21, had been coerced into undergoing invasive, genital surgeries and gonadectomies (Worley 2014; Karkazis and Carpenter 2018). The physician who operated on these women described the procedures as "unnecessary" and stated that they were "healthy" women (Worley 2014). Lowering testosterone through such gonadectomies can cause detrimental side effects such as "compromising bone and muscle strength and risking chronic

weakness, depression, sleep disturbance, poor libido, adverse effects on lipid profile, diabetes, and fatigue" (Jordan-Young et al. 2014). The operation can also potentially sterilize women. On the other hand, when pharmaceuticals are used to lower testosterone, side effects can include "excessive thirst, urination, and electrolyte imbalances; disruption of carbohydrate metabolism (such as glucose intolerance or insulin resistance); headache; fatigue; nausea; hot flushes; and liver toxicity" (Jordan-Young et al. 2014). Both methods of lowering testosterone can be very harmful for women.

Social and Ethical Implications

Arguments Against the Rules

The hyperandrogenism policy states that a woman will not be forced to go through any evaluation or treatment. However, a loophole clause exists which gives the IAAF permission to investigate any woman deemed "suspicious" (Karkazis and Carpenter 2018). These women must allow for the investigation to proceed, otherwise they will be ineligible to compete in the female category. Essentially, women must self-identify as possibly hyperandrogenic and inform the IAAF for testing or be willing to comply with testing if they are asked to do so. The methods for identifying elevated testosterone levels are often private and invasive, both physically and non-physically. They can include taking blood samples, testing of chromosomes, and genital exams, as well as acquiring medical histories and interviews surrounding the woman's sexuality and gender identity. Within both the forceful nature in assessing these women and the inherent coercion for them to lower their testosterone levels through medical means, it is impossible for meaningful consent to be achieved. Consent is an important concept from a basic human rights standpoint as well as medical ethics. These women will inevitably be influenced by the threat of

their time competing in elite sport coming to an end when agreeing to these interventions (Karkazis and Carpenter 2018).

When female athletes either bring themselves forward or are selected for investigation, the IAAF will pay for the initial screening and diagnosis. However, everything afterward will fall upon the woman financially, including visits with her physician and any prescribed treatments or surgeries. This can be a serious financial and psychological burden for these athletes.

One of the things a woman can do when she is hyperandrogenic and ineligible to compete in her desired category is to challenge the regulations. Although this initially presents itself as a liable option, it is not always a feasible one. Taking on a legal case requires immense amounts of time and energy. It is exhausting financially and emotionally. In an interview with *The Indian Express*, Dutee Chand discussed how stressful the four years were where she was ineligible to compete due to being in the midst of her case with the IAAF (2018). Challenging the regulations may be easier said than done.

Another concern that has arisen about the hyperandrogenism rules is the ties that the studies and parties that are supposed to be neutral have to the IAAF. For instance, the research studies presented by the IAAF when tasked to show that testosterone offers a competitive advantage in female athletes have been said to have been conducted by researchers connected to the IAAF (Kidd 2018). The medical team utilized in the regulation of the women in the Olympics is also personally chosen by the IAAF (Worley 2014). Financial and political incentives need to be absent from Olympic regulations in order for them to be neutral and transparent.

When women do not self-submit to testosterone level testing but appear to be possibly hyperandrogenic, their testing is prompted by visual impressions which is problematic in that it

encourages gender stereotyping (Camporesi 2016). It would make sense for women to be deemed suspicious if they are exceling in their sport by wide margins; however, the main case for suspicion lies in how "manly" a female competitor appears. The narrow, societal definition of femininity creates a tense and stressful environment for female athletes to be scrutinized.

Subjecting women to invasive testing violates their privacy and dignity. The majority of women were born female and have grown up identifying as female while living their lives as women. Arbitrarily testing the hormonal and/or chromosomal makeup of women has the potential to alter everything they have ever known and understood about their lives and identities. An Indian runner in 2006 had her Olympic medal retracted from her after failing a gender test, compromising her mental health and her concept of her own identity to the point of later attempting suicide (BBC News 2009). Investigating vulnerable parts of women can have dire consequences.

When women are forced to compete in non-women competition, this infringes upon both their legal and social identities. They identify legally and socially with the female-category competitors and would be mentally compromising when competing in a different category. This could mimic the gender dysphoria many trans and gender non-conforming people experience and result in distress, discomfort and an inability to identify with one's body, or the potential for self-harm (American Psychiatric Association 2016). The transition into a different class of competition is also privately and publically mortifying, and the hyperandrogenism regulations fail to address the psychological repercussions these women could face. Likewise, when women choose to challenge the regulations, this may involve disclosing personal information about their bodies and identities and could be equally humiliating and uncomfortable.

Throughout history, people have always been scientifically and socially questioned when they are “othered”. When black people became more prominent in sports, rumors developed about black people having differences in muscle structure that allowed for them to excel. Powerful white men were quoted saying things such as “the muscle structure of the black athlete typically is more suited for certain positions in football and basketball” and “blacks have different muscles that react in different ways” in an attempt to belittle their success (Vault 1997). When gay men slowly began to come out of the closet, we questioned their hormone levels and are still to this day on a quest to discover a “gay gene” (The Atlantic 1993). Similarly, when female athletes do not fit the visual definition of femininity, we try to find out what is wrong with them that makes them different. The tight hold society has on what is normative is restrictive and detrimental to many groups, including women.

Finally, to reiterate something that has been previously discussed, even if testosterone was shown to give an advantage to elite female athletes, this by no means insinuates that it is automatically unfair. Olympians have various traits that differ from the general population, both internally and externally. The different sports have different body types associated with them involving variations in height, limb length, muscle mass, and body fat percentage (Live Science 2016). Being an elite athlete requires immense dedication and talent, but still, most of these athletes possess innate physical advantages. Individual body parts outside of the breasts and genitals are not associated with the sexes. The size of the hands, the capacity of the lungs, or the height of an individual are not strictly tied to a specific sex. Conversely, when the hormones testosterone and estrogen become involved, they are denoted to signify sex, even though men and women possess both of these hormones in varying amounts and there is a large overlap between their testosterone level ranges. It is only when the line between male and female is

blurred internally or externally that it has now become “unfair”, even though these women are women for all extensive purposes.

Conclusion

Science

The data is inconclusive in showing that higher testosterone levels in female athletes give them a competitive advantage over other female athletes. Although there have been some studies showing female athletes with hyperandrogenism outcompeting female athletes with normal testosterone levels (Bermon and Garnier 2017; Eklund et al. 2017), there is not enough evidence to state that this is the only reason for this outcome. The differences between female and male athletes cannot be explained by testosterone since there is a prominent overlap between their testosterone levels, with a group of males falling in the female testosterone range and vice versa, and can likely be explained by other factors instead, such as lean body mass (Healy et al. 2014). In fact, it has not been shown that elite female athletes have higher testosterone levels than average non-athletes, and finding a female athlete with an abnormally high level is relatively rare. Adding to the complexity, a female’s testosterone levels are not always constant or naturally occurring. They can fluctuate based on several outside factors, such as where the women are in their ovulation cycles (Crewther and Cook 2018) and if they are taking oral contraceptives or not (Zimmerman et al. 2014). It is extremely difficult to regulate something that is controlled by numerous elements. There are many factors that dictate a woman’s athletic ability, including simply possessing advantageous physical traits like long legs or voluminous lungs, or the intensity of her training. It is challenging to separate all of these internal and external factors from testosterone levels in order to reach conclusive evidence that

hyperandrogenism is directly correlated with enhanced performance in female athletes.

Social and Ethical

The rules put in place on the unjustified claim that hyperandrogenic women are unfairly advantaged are socially and ethically harmful to the women they affect. Women are subjected to invasive assessment based off of not appearing feminine enough and can begin to regrettably question their entire identities. They can be publicly humiliated when having to disclose personal information to the public or having to compete in a non-female category that they clearly do not belong in. Under the newest set of hyperandrogenism regulations, women are financially responsible for any procedure or process required for them to lower and maintain their testosterone levels. Challenging the regulations can also be a large financial burden and require a time investment. With the high stakes at play, hyperandrogenic women are unable to give significant consent as the threat of them losing their career weighs heavily on their decision-making. This can lead to women getting invasive medical procedures or taking drugs to comply with the rules and continue competing, and these both can have very adverse side effects.

The first step in putting a hyperandrogenism policy in place is establishing that there is a clear advantage given by testosterone. Then, it needs to be established that testosterone is a better advantage than everything else internally and externally. As neither of these have been done, constructing such an intense rule set is completely unjustified. It is thus important to evaluate the social and psychological implications these rules have on women to show that it is uncalled for both scientifically and ethically. If the science ever becomes clear that testosterone gives way to a potent advantage, then a set of moderate regulations can potentially be put in place. Since this has not yet been done, it is clear that the current hyperandrogenism regulations on female

athletes in the Olympics act to keep women constrained to what society deems acceptable and further suppress them. Analyzing the scientific and social aspects of the regulations demonstrates how they are both unjustified and detrimental to the women they affect.

References:

Primary Sources

Bermon S and Garnier P. 2017. Serum androgen levels and their relation to performance in track and field: mass spectrometry results from 2127 observations in male and female elite athletes. British Journal of Sports Medicine 51:1309-1314.

Bermon S, Garnier PY, Hirschberg AL, Robinson N, Giraud S, Nicoli R, Baume N, Saugy M, Fénichel P, Bruce SJ, Henry H, Dollé G, and Ritzen M. 2014. Serum androgen levels in elite female athletes. Journal of Clinical Endocrinology and Metabolism 99:4328-4335.

Camporesi S. 2016. Ethics of regulating competition for women with hyperandrogenism. Clinics in Sports Medicine 35:293-301.

Court of Arbitration for Sport (CAS). 2015. CAS2014/A/3759 Dutee Chand v. Athletics Federation of India (AFI) & The International Association of Athletics Federations (IAAF), Lausanne, Switzerland: Court of Arbitration for Sport.

Crewther BT and Cook CJ. 2018. A longitudinal analysis of salivary testosterone concentrations and competitiveness in elite and non-elite women athletes. Physiology and Behavior 188:157-161.

de Melo AS, Dos Reis RM, Ferriani RA, and Vieira CS. 2017. Hormonal contraception in women with polycystic ovary syndrome: choices, challenges, and noncontraceptive benefits. Open Access Journal of Contraception 8:13-23.

Eklund E, Berglund B, Labrie F, Carlström K, Ekström L, and Hirschberg AL. 2017. Serum androgen profile and physical performance in women Olympic athletes. British Journal of Sports Medicine 51:1301-1308.

Healy ML, Gibney J, Pentecost C, Wheeler MJ, and Sonksen PH. 2014. Endocrine profiles in 693 elite athletes in the postcompetition setting. Clinical Endocrinology 81:294-305.

Jordan-Young RM, Sönksen P, and Karkazis K. 2014. Sex, health, and athletes. British Medical Journal 348: g29264.

Karkazis K and Carpenter M. 2018. Impossible "Choices": The Inherent Harms of Regulating Women's Testosterone in Sport. Bioethical Inquiry 15:579.

Kidd, B. 2018. Towards responsible policy-making in international sport: Reforming the medical-scientific commissions. Sport in Society 21(5):773–787.

Rogol AD and Pieper LP. 2017. Genes, gender, hormones, and doping in sport: a convoluted tale. Frontiers in Endocrinology 8:251.

Xavier NA and McGill JB. 2012. Hyperandrogenism and intersex controversies in women's olympics. The Journal of Clinical Endocrinology and Metabolism 97:3902-3907.

Zimmerman Y, Eijkemans MJ, Coelingh Bennink HJ, Blankenstein MA, and Fauser BC. 2014. The effect of combined oral contraception on testosterone levels in healthy women: a systematic review and meta-analysis. Human Reproduction Update 20:76-105.

Secondary Sources

American Psychiatric Association. 2016. What Is Gender Dysphoria?. [Internet]. Available from https://www.psychiatry.org/patients-families/gender-dysphoria/what-is-gender-dysphoria. 2/16

BBC News. 2009. Santhi 'medal should be returned'. [Internet]. Available from http://news.bbc.co.uk/2/hi/south_asia/8253880.stm.

Live Science. 2016. Olympic Form: How Sports Influence Body Shape. [Internet]. Available from https://www.livescience.com/55702-olympic-athletes-body-types.html.

New York Times. 2017. What Qualifies a Woman to Compete as a Woman? An Ugly Fight Resumes. [Internet]. Available from https://www.nytimes.com/2017/08/04/sports/olympics/gender-dutee-chand-india.html .

Springer Nature. 2011. Women with high male hormone levels face sports ban. [Internet]. Available from https://www.nature.com/news/2011/110414/full/news.2011.237.html .

The Atlantic. 1993. Homosexuality and Biology. [Internet]. Available from https://www.theatlantic.com/magazine/archive/1993/03/homosexuality-and-biology/304683/.

The Indian Express. 2018. I have offered Caster Semenya my legal team: Dutee Chand. [Internet]. Available from https://indianexpress.com/article/sports/sport-others/i-have-offered-caster-semenya-my-legal-team-dutee-chand-5153337/.

Vault. 1997. Is It In The Genes? Studies Have Found Physical Differences That Might Help Explain Why Blacks Outperform Whites In Certain Sports—But Scientists Are Wary Of Jumping To Conclusions. [Internet]. Available from https://www.si.com/vault/1997/12/08/8093395/is-it-in-the-genes-studies-have-found-physical-differences-that-might-help-explain-why-blacks-outperform-whites-in-certain-sportsbut-scientists-are-wary-of-jumping-to-conclusions.

Catalyst eNewsletter. 2014. Gender struggles for women to find equality in sport. [Internet]. Available from https://iwg--gti-org.directo.fi/catalyst/august-2014/gender-struggles-for-women-to-fi/#Gender%20struggles%20for%20women%20to%20find%20equality%20in%20sport.