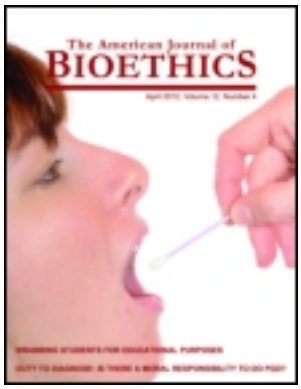

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Out of Bounds? A Critique of the New Policies on Hyperandrogenism in Elite Female Athletes

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Target Article

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In May 2011, more than a decade after the International Association of Athletics Federations (IAAF) and the International Olympic Committee (IOC) abandoned sex testing, they devised new policies in response to the IAAF's treatment of Caster Semenya, the South African runner whose sex was challenged because of her spectacular win and powerful physique that fueled an international frenzy questioning her sex and legitimacy to compete as female. These policies claim that atypically high levels of endogenous testosterone in women (caused by various medical conditions) create an unfair advantage and must be regulated. Against the backdrop of Semenya's case and the scientific and historical complexity of "gender verification" in elite sports, we question the new policies on three grounds: (1) the underlying scientific assumptions; (2) the policymaking process; and (3) the potential to achieve fairness for female athletes. We find the policies in each of these domains significantly flawed and therefore argue they should be withdrawn.

Keywords: feminist ethics, gender/sexuality

This summer, London will capture the world's attention when it hosts the 2012 Olympic Games. At the London Games, more than a decade after the International Association of Athletics Federations (IAAF) and the International Olympic Committee (IOC) abandoned routine sex testing for female athletes, a "sex-testing" policy will once again be in place. The change came in response to the case of Caster Semenya, the South African runner whose sex was first challenged by her competitors and whose spectacular win and powerful physique fueled an international frenzy of speculation about her sex. In the absence of a fair and transparent policy for handling these charges, the IAAF bungled Semenya's case at almost every turn, driving her into hiding to escape scrutiny and humiliation. As a result, the IAAF and the IOC came under intense pressure to rethink how to handle such challenges in the future.

After an 18-month period of review, the IAAF developed a policy that will not return to routine sex testing of all female athletes but that is aimed at systematically responding to questions of eligibility once the sex of a particular female athlete is questioned. In a shift from earlier universal sex testing, the goal is not to determine whether someone is "really" a woman (as previous sex-based exams and tests were meant to do—inevitably failing, as we describe below). Instead, the new policies focus on women with naturally elevated androgen levels (hyperandrogenism). While not disputing that women with hyperandrogenism are female, the new regulations aim to clarify whether women with this condition are "too masculine" to compete with other women (IAAF 2011c, 1). The IOC is expected to release similar policies in time for the 2012 Olympics.

The new policies include a number of rules and regulations, each resting on the assumption that androgenic hormones (such as testosterone and dihydrotestosterone) are the primary components of biological athletic advantage. The policies address hyperandrogenism, a condition in which females produce androgens in excess of the range typical for females. In practice, the policies do not concern all androgens, but focus specifically on testosterone. As such, women with naturally high endogenous levels of testosterone, primarily though not exclusively women with intersex traits, or what are also called disorders of sex development (DSD) (see Table 1), are presumed to have an advantage over women with lower levels of testosterone. Henceforth, women athletes *known or suspected* to have hyperandrogenism will be allowed to compete only if they agree to medical intervention, or if they are found to be "insensitive" to androgens.

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Table 1. Conditions Leading to Hyperandrogenism in Women (First Six Are Intersex Conditions)

- Congenital adrenal hyperplasia (CAH): 21-hydroxylase or 11β-hydroxylase deficiency.
- 3β-Hydroxysteroid dehydrogenase deficiency.
- 5α-Reductase type 2 deficiency.
- Androgen insensitivity syndrome (AIS).
- Ovotesticular DSD (previously called "true hermaphroditism").
- 17β-Hydroxysteroid dehydrogenase type 3 (17β- HSD3) deficiency.
- Polycystic ovary syndrome (PCOS).
- Adrenal carcinoma.
- Luteoma of pregnancy (IAAF 2011).

At first glance, the new policies may seem to be an improvement over past approaches by guaranteeing fair competition among female athletes. They do not return to universal sex testing of all female athletes. They also certainly seem like a more systematic response and thus preferable to ad hoc responses to suspicions about the sex of individual female athletes. Finally, they appear to be less invasive and more objective than previous sex testing methods such as routine gynecological exams and chromosomal tests for all female athletes. But questions about the new policies abound. To start, does endogenous testosterone actually confer athletic advantage in a predictable way, as the new regulations suggest? If there *is* advantage from naturally occurring variation in testosterone, is that advantage *unfair*? In other words, elite athletes differ from most people in a wide range of ways (e.g., rare genetic mutations that confer extraordinary aerobic capacity and resistance against fatigue). Why single out testosterone? Will the new policies ensure that athletes are no longer subjected to the sort of inhumane treatment that Caster Semenya endured? Does the policy succeed in balancing the aim of creating a "fair" playing field for women athletes (which is the ostensible goal of sex-segregated sports), judged in relation to the aim of ensuring fairness for individual athletes on the other? What are the broader social implications of the concern about "overly masculine" women competing in sports? More specifically, how might these policies reinforce dominant understandings of sex and gender?

To explore these questions, we begin with a brief discussion of Caster Semenya's case and the new policies that developed in its wake, and then we consider the underlying assumptions concerning the relationship of gender to biology in these regulations. We discuss three broad grounds on which the legitimacy of the new policies can be questioned: the underlying scientific assumptions, the policy-making process, and the potential to achieve fairness for female athletes. On each of these grounds we find that the policies fall seriously short and, for this reason, we conclude they should be rescinded.

BACKGROUND

Caster Semenya Debacle

In August 2009, Caster Semenya, a young South African runner, won the women's 800-meter race at the Berlin World Championships in Athletics by a margin of 2.45 seconds and immediately found herself at the center of international controversy amid a frenzy of speculation about whether she was "really" a woman (Clarey 2009). The controversy was sparked by complaints from Semenya's competitors; they pointed not to the large margin of her win, but to what one writer referred to as her "breathtakingly butch" appearance (Levy 2009), remarking, "Just look at her" and "These kinds of people should not run with us . . . For me, she is not a woman. She is a man" (Adams 2009; Levy 2009). Shortly after the media reported these comments, a supposedly misdirected fax notified the press that the IAAF had actually required Semenya to undergo "sex testing" shortly *before* her Berlin win (Levy 2009). The IAAF had ordered South African authorities to perform the tests after Semenya broke a national junior record at the African championships in Mauritius. Throughout the testing, Semenya had been under the impression she was undergoing standard doping tests owing to her win (BBC 2009).

In a moment when she might have been celebrating her victory, Semenya endured a cruel and humiliating media spectacle; sports commentators ridiculed her appearance, called her names including "hermaphrodite," and cried out for her medal and prize money to be returned (Levy 2009; D. Smith 2009). Under a typical headline, Time.com trumpeted "Could This Women's World Champ Be a Man?" (Adams 2009). Semenya was reportedly subjected to a two-hour examination during which doctors put her legs in stirrups and photographed her genitalia (Levy 2009; A. D. Smith 2009). Afterward Semenya sent distraught messages to friends and family (Levy 2009; A. D. Smith 2009). Test results purportedly indicated that Semenya had an intersex condition that left her without a uterus or ovaries and with undescended testes producing androgens at three times the typical level for females (known as hyperandrogenism) (Hurst 2009).[1] After these intensely intimate details about Semenya's body became a topic for public debate

1. The testosterone range in adult females is 0.7–2.8 nmol/L and roughly 6.9–34.7 nmol/L in adult males. Roughly 5% of the population does not fall into these ranges (Strauss and Barbieri 1999). If by "three times the *typical level*" it was meant that Semenya had "three times the *most common* level," it is inconceivable that her levels could still be within the usual female range, and well below the typical range for males.

and scrutiny, she went into hiding; she reportedly required trauma counseling in the wake of claims that sex tests confirmed she was a "hermaphrodite" (Levy 2009; A. D. Smith 2009).

The IAAF banned her from competitions while it completed its investigation. Eventually, after an 11-month investigation—a process that involved 10 months of negotiation with the IAAF involving legal representatives and a high-profile mediator known for his work on international disputes—the IAAF cleared Semenya for competition and her Berlin victory was allowed to stand (Dewey & LeBoeuf 2010).

Although Semenya's Berlin results showed a big improvement over her earlier races in the 800-meter, she nevertheless ranks 26th overall and 7th for "juniors" (she does not rank on either men's list) (IAAF 2011a; 2011b). Semenya had previously not been singled out for such scrutiny, but the combination of her win and her appearance raised suspicion about her sex. Leonard Chuene, then president of Athletics South Africa (ASA), observed, "We took this child to Poland to the junior championship under the IAAF. Why was there no story about it? She was accepted there. No-one said anything there because she did not do anything special. She is the same girl" (Farquhar 2009).

The New Policies

The IAAF came under intense criticism for how they handled Semenya's case and her suffering at the hands of the media and the governing athletics bodies. As a result, the IAAF decided, along with the IOC, to revisit the procedure for when questions are raised about whether a particular athlete should be allowed to compete as a woman.

Following a series of international meetings over 18 months, during which the IAAF and the IOC Medical Commission worked in close coordination, the IAAF announced its policy on hyperandrogenism, which went into effect on May 1, 2011 (IAAF 2011c). At the same time, IOC officials announced that similar rules based on principles almost identical to those in the IAAF guidelines would be released in time for the 2012 Olympic Games in London (IOC 2011).[2]

Although males and females alike produce testosterone, women typically produce about one-tenth the level of males (Braunstein 2011; Longcope 1986; Strauss and Barbieri 1999). The IAAF policy defines the "normal male range" of total testosterone in serum as $\geq$10 nmol/L (IAAF 2011c, 12). Only female athletes who have testosterone levels below the "normal male range," or who have an androgen resistance condition, are permitted to participate in women's competitions (IAAF 2011c).[3]

Under the IAAF policy, female athletes who wish to participate in international competitions come to the attention of the IAAF in one of two ways. If a female athlete already has been diagnosed with hyperandrogenism (or is in the process of being diagnosed), she is required to notify the IAAF and undergo evaluation (as outlined in the policy). A second route to evaluation is that an "IAAF Medical Manager may initiate a confidential investigation of any female athlete if he [sic] has reasonable grounds for believing that a case of hyperandrogenism may exist" (IAAF 2001c, 3). Reasonable grounds can come from "any reliable source," including "information received by the IAAF Medical Delegate or other responsible medical official at a competition" (IAAF 2001c, 3).

Once an athlete has been identified for evaluation, she is required to undergo some combination of three types of exams: (1) clinical exam; (2) endocrine exam (testing urine and blood for hormone levels); and/or (3) full exam (which may include genetic testing, imaging, and psychological evaluation). Following evaluation, a female athlete can only compete if she meets the criteria specified in the policy, specifically, a testosterone level below 10 nmol/L for IAAF competitions (and whatever testosterone level medical examiners deem acceptable for Olympic competitions). If the athlete does not "pass" the evaluation, a final diagnosis and "therapeutic proposal" will be issued to her in writing. She will be banned from competition until she lowers her testosterone levels. If she follows the "prescribed medical treatment" as outlined in the written statement, she may be reassessed for possible participation in future women's competitions. The prescribed treatment will presumably entail either pharmaceutical intervention or gonadectomy, since these are the two ways of lowering testosterone.

Gender and Bodies

We cannot think about the Caster Semenya case or evaluate these new policies without careful attention to common assumptions about gender and its relationship to bodies. For decades now, experts in multiple fields, including medicine, psychology, the social sciences, and the humanities, have distinguished between "sex" (biological and anatomical traits that are used to label a person as female or male) and "gender" (psychological and behavioral traits that are designated as "masculine" or "feminine," that is, traits considered more common for or appropriate to boys and men versus girls and women) (e.g., Kessler and McKenna 1978; Laqueur 1990; Rubin 1975; Russett 1989). Although sex and gender are commonly expected to be concordant in an individual, they are not necessarily so. "Gender verification policies" in elite sports are meant to distinguish competitors on the basis of sex-linked biology—that is, *sex* rather than *gender* (e.g., Wilson 2000).

Sex is commonly thought to be straightforward, consisting of two clear categories of male and female. Yet there

2. Thus, although the IOC rules have not been officially released as of this writing, we expect them to be similar to those adopted by the IAAF.

3. The IAAF policy notes: "The Regulations are of mandatory application to all athletes competing, or seeking to compete, in International Competitions and are recommended as a guide to National Federations in Athletics for the management of any cases that might arise at the national level," suggesting wide implementation especially because this is the only available policy (IAAF 2011c, 2).

are at least six markers of sex—including chromosomes, gonads, hormones, secondary sex characteristics, external genitalia, and internal genitalia—and none of these are binary. For example, it is often assumed that people have either XX or XY chromosomes, but some individuals are born with an extra X chromosome and others have a mosaic karyotype where each cell has one karyotype or the other.

We also often expect the traits of "sex-linked" biology to be concordant in individuals. But development can vary at any point, resulting in various combinations and permutations of sex-linked traits. For centuries, defining sex has required negotiation and has elicited disagreement among scientists and clinicians about which traits or body parts should identify one as male or female (Dreger 1998; Laqueur 1990; Reis 2009; Schiebinger 1989). The breadth of human physical variance is more complex than the categories suggest. Take, for example, women with a condition known as complete androgen insensitivity syndrome (CAIS), who are born with XY chromosomes, testes, and testosterone levels in the typical range for males. If only taking chromosomal, gonadal, or hormonal factors into account, one would label these individuals male. Yet these women have a completely feminine phenotype, with breast development and female typical genitalia, because their androgen receptors are not responsive to androgens. Designating women with CAIS as male would be inappropriate, given that they are presumed female at birth, are raised as girls, and overwhelmingly identify as female.

Both experts and lay people tend to think of intersex traits as rare aberrations or deviations. And even those experts who understand that sex is complex and its markers are multiple tend, nonetheless, to assert that, as a matter of biology, sex is "objective" (e.g., Wilson 2000). But the demarcation between male and female categories depends on context (Fausto-Sterling 1985; Karkazis 2008; Kessler 1998; Oudshoorn 1994). In the context of reproduction, the presence of a uterus may categorize someone as female. A woman who has undergone a hysterectomy has no uterus in the same way a woman with CAIS has no uterus, yet no one questions whether the former is really still female.

Adding further complexity, sex markers are not binary; each variable contains significant variation, both within and across individuals. For example, women's testosterone levels range widely among women and also by time of day, time of month, and time of life (Haring et al. 2012).[4] Tissue responses also vary across individuals due to differences in hormone receptors that range from subtle to dramatic. Further variations result from interactions with the environment—for example, things like a change in social status or winning or losing a competition (even a "fake" win or loss that is experimentally assigned by a researcher) can stimulate a rise or drop in testosterone (McCaul et al. 1992; Sapolsky 1997).

It is often assumed that people with intersex traits are somehow exceptional because of their complex biologies, but sex is *always* complex. There are many biological markers of sex but none is decisive: that is, none is actually present in *all* people labeled male or female. Sex testing has been and continues to be problematic because there is no single physiological or biological marker that allows for the simple categorization of people as male or female.

Sex Testing and Gender Policing in Elite Sports

Meanwhile, if sex is meant to distinguish females and males depending on *biological* features, gender is used to point to *social* factors (social roles, position, behavior). The "commonsense" view suggests that biological and social features are concordant. Many people regard the outward signs of gender (how someone acts, dresses, behaves) as if they tell us about someone's biology, about their *sex*. And this brings us back to Caster Semenya, whose victory combined with outward signs of gender that many read as "masculine"—her lack of makeup, her impressive musculature, the braids that give the impression of closely cropped hair, and her height—raised suspicion about her sex.

Women first joined the Olympics in 1900 (Drinkwater and International Federation of Sports Medicine 2000; Olympic.org n.d.). From the beginning, only female athletes have been subjected to sex testing because concerns about "fraud" and "fairness" have centered on the possibility that males could unfairly outperform females. Though ad hoc testing had been practiced since at least the 1936 Olympic Games, mass certification of female sex was first implemented by the IAAF in 1946 (Heggie 2010). By 1948, the IOC followed suit and implemented its first formal policy for female sex determination.

Anxiety about women competitors' femininity has plagued the events almost from the beginning (Olsen-Acre 2003; Stephenson 1996). In the earliest iteration of sex testing, female competitors were required to provide medical "certificates of femininity," but the IAAF and IOC provided no standard criteria and exercised no oversight for making this determination (Heggie 2010). Conceivably, these markers could be based entirely on social and cultural criteria of femininity such as hairstyle and dress (Heggie 2010). Thus, outwardly observable feminine characteristics (gender) served as a proxy for biology (sex).

By the 1960s, the IOC and IAAF adopted supposedly standardized tests to verify sex, including compulsory "nude parades" in front of physicians, genital exams, and evaluation of secondary sex characteristics such as hair patterns (Hay 1972; Ritchie et al. 2008; Simpson et al. 1993). Not surprisingly, these exams garnered intense criticism and the IOC and the IAAF adopted chromosomal testing in 1967 to infer an individual's sex chromosomes relying on visualization of Barr bodies in a buccal smear (using cells swabbed from inside a cheek) (de la Chapelle 1986; Heggie 2010).

4. Measuring testosterone levels is made more complex when one considers that currently available testosterone reference values for women are limited by small and heterogeneous samples, there are various measurement techniques (e.g., conventional immunoassays and liquid chromatography-tandem mass spectrometry), and laboratories have differing standards and norms (see, e.g., Haring 2011).

Adopting this test was based on the assumption that chromosomes are adequate proxies for sex. Using chromosomes to sort individuals into a sex binary, however, leads to peculiar results. The Barr Body Test only detects the presence of X chromosomes. However, the reliance on the presence of X chromosomes as the criterion for female sex excludes women with chromosomal and genetic anomalies: individuals with CAIS who have a 46, XY karyotype and those with Turner syndrome who have a 45, XO karyotype would not be classified as female. Alternatively, it includes men who have more than one X chromosome and thus would incorrectly classify those with Klinefelter syndrome (47, XXY) as females despite their male phenotype. Nevertheless, the Barr Body Test was used throughout the 1970s and 1980s, perhaps because it seemed to be a less invasive and more scientific method of assessing sex.

The problems raised by the exclusive reliance on chromosomes to determine a female athlete's sex reached a head in 1985 when the IOC disqualified Spanish hurdler María José Martínez-Patiño from competitions and withdrew her medals and records because she was "chromosomally male" (Heggie 2010; Martínez-Patiño 2005). Martínez-Patiño, who was born with 46,XY chromosomes and a female phenotype (CAIS), successfully challenged the ruling, arguing that her condition made her completely unresponsive to testosterone and thus gave her no advantage over "normal" XX females (Martínez-Patiño 2005). In response, the IAAF abandoned routine chromosomal and laboratory testing altogether, in favor of returning to a "manual/visual" check for individuals whose femininity was being questioned, and by 1992 had dropped even these exams (Elsas et al. 2000; Heggie 2010, 160).

The IOC, however, turned to a novel technique to detect the presence of the SRY gene—the gene leading to testis development discovered a few years earlier—reasoning that this was the source of male athletic advantage (Dingeon 1993). There was little evidence that this test was useful for sex determination, or any evidence that this gene was linked to athletic advantage. Relying on the presence of the SRY gene for sex determination, however, also classified some women as male. After a round of false positives in the 1996 Olympics—which identified eight women with intersex traits (Genel 2000)—the IOC finally also abandoned all forms of routine sex testing of female athletes (Elsas et al. 2000; Heggie 2010). What followed in the wake of universal sex testing for females was a policy that permitted medical professionals to evaluate on an ad hoc basis individual athletes whose sex has been called into question using a variety of clinical exams and laboratory tests (Genel 2000; Tian et al. 2009).

Despite the long-standing concern about men masquerading as females in elite sports, decades of universal and routine sex testing of female athletes in international sport competitions revealed at best two instances of a man trying to compete fraudulently among women (Cole 2000). Instead, sex testing has mostly "caught" women with intersex traits (Simpson et al. 2000). In fact, while the official rationale for sex testing has been to ferret out men masquerading as females, concerns about possible "unfair advantage" among women with intersex traits go back at least several decades (see Cole 2000). A long-time member of IOC Medical Commission, for example, argued that females with some intersex conditions have "masculine anatomical conditions, [giving them] an unfair and unlawful advantage over the anatomically normal woman athlete" (Hay 1974, 119), and thus "must be barred from competition in order to insure [sic] fair play" (Hay 1972, 998). Justification for "gender verification" has thus intermingled various concerns about unfair advantage created by men impersonating women, performance-enhancing drug use, and women with nonnormative sex and gender traits.

Except for the period when routine biological testing was the policy, perceived gender nonconformity has always played an important role in triggering questions about an athlete's "biological" masculinity. Women athletes are already under a great deal of pressure to appear "feminine" and even "sexy" (Reaney 2011). As the editors of a special issue of *Sociological Perspectives* devoted to gender and sport observed, "Cultural tensions between athleticism and femininity have long been managed by social control or strong encouragement for women athletes to attend charm schools, to wear long hair, painted nails, or other markers of emphasized femininity, and to emphasize their abilities and willingness to be mothers" (Dworkin and Messner 2002, 348). The cultural equations that link external signs of "femininity" with bodily femaleness also link "normalcy" in gender and sex with heterosexuality (Jordan-Young 2010). In other words, when people see gender nonconformity they often infer homosexuality. Thus, gender policing in sports often takes the form of homophobia (Cyphers and Fagan 2011).

This brief history outlining the failed methods for determining sex shows that the problems with sex testing are not with the tests per se, but with the assumption that any singular marker of sex is adequate to classify people into a two sex system. It also shows that female athletes have always been under suspicion, and women with intersex traits have often been scapegoats for broad anxiety about the gender contradiction inherent in the very concept of an elite female athlete. From this perspective, the focus on hyperandrogenism might seem to be an improvement because the stated aim is to ensure fairness and not to eliminate athletes who are not "truly" or "fully" women from women's competitions. But the apparently more modest goal of eliminating women whose masculine characteristics confer "unfair advantage" requires a deeper look. Is the new policy based on sound science? Was it developed via a legitimate process? And finally, will it provide "fair" competition for women athletes?

CRITIQUE

Scientific Gaps and Flaws

The new policies rest on the notion that the difference in athletic performance between males and females is "predominantly due to higher levels of androgenic hormones in males resulting in increased strength and muscle development" (IAAF 2011c, 1). Both policies rely in particular

on testosterone levels as the mark of unfair advantage. Although it may be surprising, given that this is a popular belief and is stated as fact in both IAAF and IOC statements (IAAF 2011d; IOC 2011), the link between athleticism and androgens in general or testosterone in particular has not been proven. Despite the many assumptions about the relationship between testosterone and athletic advantage, *there is no evidence showing that successful athletes have higher testosterone levels than less successful athletes*.

Clinical studies do confirm that testosterone (among many other factors) helps individuals to increase their muscle size, strength, and endurance (Bhasin et al. 1996; Ronnestad et al. 2011; Storer et al. 2003). It may seem logical to infer, then, that a person with more testosterone will have greater athletic advantage than one with less testosterone, but this is not necessarily so. Individuals have dramatically different responses to the same amounts of testosterone, and testosterone is just one element in a complex neuroendocrine feedback system, which is just as likely to be affected by as to affect athletic performance. Studies have shown, for example, that winning a competition raises testosterone—even among fans whose teams prevail, or in experimental subjects randomly assigned to win (McCaul et al. 1992; Oliveira et al. 2009).

Testosterone is far from the decisive factor in athleticism. The most dramatic example is women with CAIS, whose tissues are completely unresponsive to testosterone but who are overrepresented among elite athletes (Tucker and Collins 2010, 138). This fact cannot be readily reconciled with a theory that suggests testosterone is the main source of athletic ability. Moreover, the relationship between testosterone and physique is extremely complex even beyond the issue of receptor variability. Relying on testosterone levels suggests far more certainty than current scientific knowledge allows. Consider women with congenital adrenal hyperplasia (CAH), whose testosterone levels are high. The new policies suggest that these women have a competitive advantage, but women with CAH are disproportionately affected by short stature, obesity, dysregulation of mood hormones, and unpredictable, life-threatening salt-losing crises (Charmandari et al. 2004; Eugster et al. 2001; Meyer-Bahlburg 2011; Speiser and White 2003; Stikkelbroeck et al. 2003; Volkl et al. 2006). Indeed, considering the genital surgery, repeated genital exams, and medical monitoring that women with CAH experience (e.g., Karkazis 2008), athletic competition at an elite level appears "against the odds" for women with CAH.

Because it goes against common wisdom, it is worth repeating that it has not been shown that athletes with higher endogenous testosterone perform better than athletes with lower levels. Furthermore, commentaries sometimes suggest that the psychological aspects of athletic performance, especially competitiveness and willingness to take risks, might be affected by testosterone. Although there is a relationship between testosterone and competitiveness, it is the exact reverse of the usual assumption: Both female and male athletes facing a competition consistently have been shown to experience a rise in testosterone (Bateup et al. 2002; Edwards and O'Neal 2009). Again, however, there are no data to suggest that precompetition testosterone levels predict an athlete's performance on the field.

One of the biggest gaps in current data is that nearly all research on testosterone and athletics has been conducted in men. Direct evidence of the relationship between testosterone and athletic ability in women is limited both by the small number of studies that include women, and by the narrow focus of these studies: The few placebo controlled studies of how testosterone affects muscle in women include only severely hypogonadal women with very low estrogen and androgen levels (Dolan et al. 2004; Miller et al. 2006). Although testosterone serves similar physiologic functions in women and men, there are findings that suggest that the specific mechanisms of action might be different (MacLean et al. 2008). Moreover, there is a 10-fold gap in male and female endogenous testosterone levels, but smaller differences (including overlap) in virtually all aspects of athletic strength and performance, suggesting testosterone's effects on athletic ability are likely to be different in men and women. Consider, for example, the eight races ranging between the 100-meter and the marathon at the 2009 Berlin IAAF Championships where Caster Semenya's performance caused such a stir: There was overlap between the male and female times in all but one race (the 10,000-meter) (Tucker and Collins 2010, 136–137). Many aspects of physique or athletic performance differ between males and females, often substantially; however, none of these is close to 10-fold, further underscoring the limitations of a straightforward comparison of average male–female differences in athletic performance to average male–female differences in testosterone levels. There is also no support for knowing the effect of testosterone level on any individual. While females are generally more sensitive to the effects of testosterone than males, curvilinear effects as well as great interindividual differences make extrapolation of the effects of specific amounts in any given individual impossible.

In sum, there is a great deal of mythology about the physical effects of testosterone and other androgens (Fausto-Sterling 1985; Jordan-Young 2010). Likewise, mental effects of androgens are often implied to give an additional boost to athletes, but placebo-controlled studies of testosterone show that increasing testosterone (above minimum functional levels) has no effects on mood, cognitive performance, libido, or aggression (Bhasin et al. 1996; Bhasin et al. 2001; Kvorning et al. 2006). Optimal levels of testosterone is one of many factors that is necessary for athletes to achieve their own "personal best," but comparing testosterone levels across individuals is not of any apparent scientific value.

The Right People to Do the Job?

The shortcomings of the IAAF policy (and perhaps to a lesser degree the IOC policy) derive in part from the process by which it was developed. As the Semenya debacle exploded into the media, the IOC approached the organizers of an upcoming meeting of specialists in intersex to advise the IOC and the IAAF on "how to determine an

athlete's eligibility by using better testing modalities as well as clearer definitions of what it means to be a male as well as a female . . . [and to] clarify the medical aspect of these issues" (New and Simpson 2011, vi). Five months later, representatives from the IOC and IAAF met in Miami coincident with the January 2010 "2nd World Conference on Hormonal and Genetic Basis of Sexual Differentiation," a continuing medical education course on DSD (New and Simpson 2011). The conference was not convened for the purpose of developing these policies; rather, that aim was added later. As a consequence, all of the presenters at the conference were medical professionals with expertise not in sports physiology, but in DSD (New and Simpson 2010). An attendee at that public meeting observed that it "failed to produce any clear consensus and only seemed to create confusion about what is now considered fair or allowable so far as sports gender divisions go" (Dreger 2010), perhaps precisely because it was open to those with perspectives other than medical. The day after the CME course the IOC and IAAF representatives met privately with the conference presenters.

In October 2010, the IOC held another closed-door meeting in Lausanne, Switzerland, that included IAAF representatives. Unlike the January meeting that was overwhelmingly populated by experts in DSD, this one included "scientists, sports administrators, sports lawyers (including from the IOC Legal Affairs Department), juridical experts in human rights, experts in medical and sports ethics, female athletes and a representative appointed by the intersex community (Organisation Intersex International)" (IOC 2011; Viloria 2011). Although the IAAF representatives attended the IOC meetings, the IAAF working group consisted of five members all of whom were medical professionals with expertise in endocrinology, gynecology, DSD, or polycystic ovary syndrome (PCOS).

The composition of decision-making bodies affects the content of policies (e.g., Hajer and Wagenaar 2003; Hannagan and Larimer 2010). Although the IOC included a variety of perspectives for the Lausanne meeting, in developing the policies it and the IAAF relied primarily on the expertise of individuals associated with the problematic policies of the last 20 years. Moreover, if the goal was to think about how to assess the role and importance of testosterone in athletic achievement, there were no experts in exercise physiology or the relationship between testosterone and athletic performance involved in the process. Specialists in DSD defined both the problem and the nature of possible solutions, and framed them squarely in biomedical terms. Indeed, the introduction to the published proceedings of January 2010 meeting provides a sealed and self-confident narrative of the important issues in the determination of sex difference and athletic advantage (New and Simpson 2011). The following excerpt is illustrative:

> Those presenting at the conference were world class scientists who achieved high recognition for their work over the years on the biological, genetic, and psychological differences between the sexes. They covered recent advances which could be used to clarify confusions and to address controversies among athletes like the South African track star at the International Amateur Athletic Federation [sic] meet in Berlin in August 2009. Her eligibility to compete as a female athlete brought her international media attention and embarrassment as to what gender [sic] is she. The conference presented an extraordinary amount of data that can help avoid such international attention. The conference taught ways to evaluate, diagnose, and treat those with disorders of sexual differentiation to clinicians who normally do not see these types of patients, may have them in their practice unknowingly, or see them on a regular basis without knowing what to do next. Also, knowing the great importance of modalities such as hormonal assays and psychological tests used along with DNA analysis. (New and Simpson 2011)

And yet, at this meeting and later meetings there were no experts who could answer the pertinent medicoscientific question on which both policies are premised: What does testosterone do to and for the female athlete? (IAAF 2011c; IOC 2011).

Furthermore, the IAAF policy does not engage with the questions that might arise from other relevant perspectives. Should endogenous testosterone levels be viewed as on par with intensive training, the use of hypoxic chambers, or Lasik, which are all accepted ways to enhance an athlete's performance? Under what circumstances, if at all, is it ethical to require individuals to undergo medical intervention in order to compete? What unintended consequences might these policies have for female athletes? For example, how might these new policies reinforce pressures to adhere to beauty standards that are irrelevant to athletic performance? How might the new policies intensify the stigmatization and pressure on lesbian athletes to hide or be especially gender conforming?

The Ethical Principles in Play

The IAAF and IOC outlined several principles on which their policies are based, which form a rubric for helping to determine who is tested, why they are tested, and how they are tested (see Table 2) (IAAF 2011c; IOC 2011). The principles outlined under the respective columns for the IOC and IAAF, taken verbatim from the IAAF policy and IOC press release, are predicated on concerns with fairness in female athletic competition, definitions of normal, the health of athletes, and protecting privacy and confidentiality.

Fairness

Both policies were constructed based on "respect for the fundamental notion of fairness of competition in female Athletics" (IAAF 2011c). Fairness is, of course, an essential component of athletic competitions. Achieving this fairness, they assert, requires the continued division of athletics into male and female categories.[5] The issue becomes how to determine such divisions.

5. Notions of women's inferior physical status affect the rules that govern sport, such as female tennis players being limited to three sets in the majors whereas men play five or female speed skaters competing at shorter distances than men. Some sports are not sex

Table 2. Key Principles and Facets of the IAAF and IOC Policies (IAAF 2011c; IOC 2011) ***Extracted verbatim from official IAAF and IOC Communications***

	IAAF	IOC
Eligibility and compliance	An acknowledgement that females with hyperandrogenism may compete in women's competition in Athletics subject to compliance with IAAF Rules and Regulations. A female with hyperandrogenism who is recognized as a female in law shall be eligible to compete in women's competition in athletics provided that she has androgen levels below the male range (measured by reference to testosterone levels in serum) or, if she has androgen levels within the male range she also has an androgen resistance that means that she derives no competitive advantage from such levels. A female athlete who declines, fails or refuses to comply with the eligibility determination process under the regulations shall not be eligible to compete in women's competition.	A female recognized in law should be eligible to compete in female competitions provided that she has androgen levels below the male range (as shown by the serum concentration of testosterone) or, if within the male range, she has an androgen resistance such that she derives no competitive advantage from such levels. If an athlete fails or refuses to comply with any aspect of the eligibility determination process, while that is her right as an individual, she will not be eligible to participate as a competitor in the chosen sport.
Evaluation	The evaluation of complex cases on an anonymous basis through the use of a panel of independent international medical experts in the field. A pool of international medical experts has been appointed by the IAAF to review cases referred to it under the regulations as an independent expert medical panel and to make recommendations to the IAAF in such cases to decide on the eligibility of female athletes with hyperandrogenism. A three-level medical process under the regulations shall ensure that all potentially relevant data is made available to the expert medical panel for the purposes of evaluating an athlete's eligibility. This medical process may include, where necessary, the expert medical panel referring an athlete with potential hyperandrogenism for full examination and diagnosis in accordance with best medical practice at one of the six IAAF-approved specialist reference centers around the world.	An evaluation with respect to eligibility should be made on an anonymous basis by a panel of independent international experts in the field of hyperandrogenism that would in each case issue a recommendation on eligibility for the sport concerned. In each case, the sport would decide on an athlete's eligibility taking into consideration the panel's recommendation. Should an athlete be considered ineligible to compete, she would be notified of the reasons why and informed of the conditions she would be required to meet should she wish to become eligible again.
Fairness	A respect for the very essence of the male and female classifications in athletics. A respect for the fundamental notion of fairness of competition in female athletics.	Rules are needed and . . . these rules should respect the essence of the male/ female classification and also guarantee the fairness and integrity of female competitions for all female athletes.

(Continued on next page)

Table 2. Key Principles and Facets of the IAAF and IOC Policies (IAAF 2011c; IOC 2011) ***Extracted verbatim from official IAAF and IOC Communications*** **(*Continued*)**

	IAAF	IOC
Fairness (continued)	Competition in athletics will continue to be divided into men's and women's competition recognizing that there is a difference in sporting performance between elite men and women, that is predominantly due to higher levels of androgenic hormones in men.	Although rare, some women develop male-like body characteristics due to an overproduction of male sex hormones, so-called "androgens." The androgenic effects on the human body explain why men perform better than women in most sports and are, in fact, the very reason for the distinction between male and female competition in most sports. Consequently, women with hyperandrogenism generally perform better in sport than other women.
Health	The early prevention of problems associated with hyperandrogenism.	In order to protect the health of the athlete, *sports* authorities should have the responsibility to make sure that any case of female hyperandrogenism that arises under their jurisdiction receives adequate medical follow-up.
Privacy and Confidentiality	A respect for confidentiality in the medical process and the need to avoid public exposure of young females with hyperandrogenism who may be psychologically vulnerable. The medical process under the regulations shall be conducted in strict confidentiality and all cases shall be referred to the expert medical panel on an anonymous basis.	The investigation of a particular case should be conducted under strict confidentiality.

Current science suggests that any advantage that might be conferred by hyperandrogenism is so complex that testosterone levels alone are a nearly useless indicator of advantage, and certainly not an appropriate measure for determining eligibility. Furthermore, certain medical conditions give females high levels of testosterone. The new policies ban females with hyperandrogenism on the grounds that they have an unfair advantage. Unlike doping, in hyperandrogenism the hormones are not external to the athlete's body and are not added intentionally to confer advantage over competitors (i.e., cheating). Women with hyperandrogenism have not introduced any foreign matter into their bodies, nor have they engaged in any unfair practices (Foddy and Savulescu 2011).

Even if some sort of evaluation were available that could decisively link hyperandrogenism to sporting ability (the traits of which would vary considerably by sport as well), hyperandrogenism should be viewed as no different from other biological advantages derived from exceptional biological variation. Numerous biological advantages that everyone accepts are frequently found in groups of elite athletes. Several runners and cyclists have rare mitochondrial variations that give them extraordinary aerobic capacity and exceptional resistance against fatigue (Eynon, Birk, et al. 2011; Eynon, Moran, et al. 2011; Eynon, Ruiz, et al. 2011; Pitsiladis et al. 2011). Basketball players who have acromegaly, a hormonal condition that results in exceptionally large hands and feet, are not banned from competition (Clemmons 2008; Mannix 2007). Perfect vision exists among baseball players at a significantly higher rate than in the general population (Laby et al. 1996). Many have also speculated that Michael Phelps, the record-breaking Olympian swimmer, has Marfan's syndrome, a rare genetic mutation that results in exceptionally long limbs and flexible joints that help to make him an exceptional swimmer (Foxnews.com 2008). Some elite athletes have variations in the ACE gene (which affects muscle growth and efficiency) and in the NOS gene (which affects blood flow to skeletal muscles) (Ostrander et al. 2009). Elite athletes thus already display myriad types of biological and genetic advantages. Hyperandrogenism is a naturally occurring phenomenon

segregated, such as horseracing or car racing, whereas others such as billiards and chess are for reasons that are not clear. Still other sports are not sex segregated at the collegiate level but are at the Olympic level (e.g., riflery and Olympic shooting). Moreover, there are many recent examples of sex integration, such as women in professional golf and girls joining Little League baseball and high school football teams. However, in some sports men will have a distinct advantage whereas in other sports women will tend to excel (e.g., endurance events). We expect the overall value of sex segregation is both sport specific and a moving target, as some differences may diminish as greater numbers of girls play sports at young ages and as opportunities for elite, including professional, competition expand for adult women.

and therefore no different than any other exceptional biological variation in the human body.

Eligibility and Notions of Normal

Both policies state that legally recognized females are eligible to compete in women's competitions provided that they have testosterone levels below the so-called male range (as shown by serum concentration) or "if within the male range, she has an androgen resistance such that she derives no competitive advantage from such levels" (IAAF 2011c; IOC 2011). The policies thus do not exclude female athletes with hyperandrogenism per se, yet they do require that women already diagnosed with these conditions report their condition to the appropriate bodies and undergo evaluation, presumably even if they are already seeing a medical specialist and have no health concerns related to their condition. Moreover, although the policies state that no woman is required to undergo medical intervention, if a woman with hyperandrogenism wants to compete, she must undergo "treatment" as a prerequisite to competition. Treatment would presumably vary on a case-by-case basis and include anything from hormone blockers to gonadectomy. Given that medical intervention is required to compete, we are concerned that compliance with the IOC and IAAF policies may lead to coercion as it relates to treatment, which is especially worrisome if such intervention is medically unnecessary.

Androgen excess is the most common endocrine disorder in women of reproductive age (Abdel-Rahman and Hurd 2010). Using the definition of hyperandrogenism in females as those with testosterone levels "above typical female range"—roughly 1.5–2 nmol/L (averages and ranges for elite female athletes are not known)—females with the diagnoses listed in Table 1 will have hyperandrogenism, but most are unlikely to have endogenous testosterone levels above 10 nmol/L.[6]

The IOC policy, while more flexible, may actually require a much broader group of women to undergo "treatment" in order to compete. It also introduces a high degree of subjectivity: At what point is a woman's testosterone level too high? This could be 3.5 nmol/L for one practitioner and 5.5 nmol/L for another. Of two women with the same levels, one could conceivably be required to lower her levels while the other is not required to. There are yet other problems. When does a difference from the typical female range become meaningful or even problematic and in whose eyes? What is the target level to which a woman must reduce her testosterone? One physician could recommend a woman's level be within the female typical range, whereas another practitioner might simply want it below the male typical range. Given the inconsistent policies discussed earlier, an athlete might be required to undergo intervention according to one policy and not another. Moreover, using testosterone levels alone as a marker of eligibility fails to take into account that some women have androgen resistance that renders their testosterone levels meaningless.

Health, Treatment, and the Question of Medical Need

Both IAAF and IOC policies express concern with health. The IAAF policy aims for "the early prevention of problems associated with hyperandrogenism" and the IOC press release states, "In order to protect the health of the athlete, *sports* authorities should have the responsibility to make sure that any case of female hyperandrogenism that arises under their jurisdiction receives adequate medical follow-up" (IAAF 2011c; IOC 2011, emphasis in original).

Androgens affect various bodily tissues, such as those in the brain, breast, bone, and the cardiovascular system. Some conditions that cause hyperandrogenism present important health issues, and it is certainly possible that the policy will lead some women to a diagnosis they might not otherwise have had available to them (though it must be underscored that there is no provision in the new policy to pay for medical care that the examiners may deem to be necessary). One health concern may be possible malignancy of testicular tissue, often managed with prophylactic gonadectomy. But it is not always clear when removal of the gonads is appropriate: The procedure not only sterilizes individuals, but may significantly impair quality of life (e.g., by inducing "hot flashes"). In many cases, however, there is no clear health risk from higher than typical testosterone levels. Yet these policies strongly imply that treatment to lower testosterone levels is medically necessary.

Ironically, though, the anti-androgens used to treat hyperandrogenism can have sequelae that may be particularly problematic for a serious athlete, such as diuretic effects that cause excessive thirst, urination, and electrolyte imbalances; disruption of carbohydrate metabolism (e.g., glucose intolerance, insulin resistance); headache; fatigue; nausea; and liver toxicity (Archer and Chang 2004). Furthermore, testing as proposed in the evaluation can reveal genetic and other medical information that is deeply personal—infertility, mutations, and other conditions that have little bearing on eligibility.

Perhaps some women may derive health benefits from policies on hyperandrogenism. But this is a hypothetical benefit that must be weighed against actual harms of unnecessary medical treatment and stigmatization of women with atypical sex-linked traits. Moreover, the IAAF policy provides for evaluation and recommendation of treatment, but it explicitly states it will not pay for medical intervention creating the potential for financial harm in order to compete. Given the very real documented harms owing to sex testing generally, exclusion of female athletes on the basis of having "male" sex traits, undergoing a gynecological exam under anesthesia, and the mental impact and risk of insensitive and inappropriate discussion and disclosure of

6. A functional adult testis (not a steroidogenic block or PCOS) or tumor could produce testosterone levels above 10 nmol/L; this might include females with partial AIS (PAIS), ovotesticular DSD, and adrenal carcinoma. As a result, the level of 10 is high enough that it would not apply to many women, but these policies will especially target women with intersex traits.

information, we suggest that the harms here may be greater than any possible health benefit.

Confidentiality, Leaks, and Whisper Triggers

Another ground on which both policies fall short of their stated principles is the privacy and confidentiality for female athletes, which are undermined by several factors. First, the process of testing, vetting, and treating an athlete takes months, a time during which she is ineligible to compete. As in Semenya's case, the suspension and thus absence of the athlete from competitions not only exacts a psychological toll, but also can arouse suspicion; others inevitably notice the "secret" investigation, which violates the athlete's privacy. A recent article co-authored by IOC medical commissioner Arne Ljunqvist and Martínez-Patiño, the Spanish hurdler disqualified years ago, argues that women with DSD "should not be disqualified from competing in elite sports events. Nor should they be stigmatised and their right to privacy should be guaranteed by sports organizations *during the process of gender verification*" (2006, 225–26; emphasis added). We agree that, at the very least, the policies should not suspend female athletes who are being investigated.

Another concern stems from how investigations are brought. The IAAF policy specifically states that females suspected of having hyperandrogenism may be targeted for testing on "reasonable grounds" (IAAF 2011c, 3). It is troubling that more than half of the indicators of hyperandrogenism identified by the IAAF policy to determine which female athletes should undergo sex testing are entangled with deeply subjective and stereotypical Western definitions of femininity: "deep voice, breast atrophy, never menstruation (or loss of menses since several month), increased muscle mass, body hair of male type (vertex alopecia, > 17 years), Tanner score low (I/II), F&G score (>6 /! minimized by the beauty), no uterus, clitoromegaly [larger than typical clitoris]" [sic] (IAAF 2011c, 20). Moreover, the IAAF notes (without support) that "the individuals concerned often display masculine traits and have an uncommon athletic capacity in relation to their fellow female competitors" (IAAF 2011c, 1). Targeting gender nonconforming female athletes who present as more "masculine" is paradoxical, as the characteristics identified with masculinity—notably, skeletal and muscular development—are also characteristics strongly correlated with athleticism (Heggie 2010, 158).

Outward signs of gender are already triggers that raise suspicion about a female athlete's sex. Indeed, competitors, athletics officials, the media, and the general public began obsessively commenting on Semenya's appearance immediately after her win, asking, "Could she really be a he?" Yet even if outwardly visible markers of gender were not triggers, the manner through which suspicions about sex are reported and acted on will inevitably come to public attention. Indeed, the fact that anyone can make their concerns about an athlete known to an IAAF medical director may mean that leaks of private health information or a whisper campaign about an athlete exists prior to the beginning of an investigation or even triggers an investigation. Confidentiality is an admirable goal, but as long as these testing policies persist, the potential for grave harm to athletes' lives and careers is nearly undeniable and unavoidable.

CONCLUSION

A central assumption underlying the IAAF and IOC policies is that atypically high levels of endogenous testosterone in women create an unfair advantage and must therefore be regulated. The current scientific evidence, however, does not support the notion that endogenous testosterone levels confer athletic advantage in any straightforward or predictable way. Even if naturally occurring variation in testosterone conferred advantage, is that advantage unfair? It bears noting that athletes never begin on a fair playing field; if they were not exceptional in one regard or another, they would not have made it to a prestigious international athletic stage. Athletic excellence is the product of a complex entanglement of biological factors and material resources that have the potential to influence athletic advantage. However, the IAAF and IOC target testosterone as the most important factor in contributing to athletic advantage. The policies seek to do the impossible: isolate androgen from other possible biological factors and material resources to determine the impact that it alone, in the form of testosterone, has on athletic advantage. Setting hyperandrogenism apart from other possible biological factors that are not regulated by the IAAF and IOC but that also might influence athletic advantage seems illogical and unfair.

The policies raise troubling concerns about whether they succeed in balancing the aim of creating a "fair" playing field for women athletes against the aim of ensuring fairness for individual athletes. Given the very real documented harms that have come to female athletes who have undergone evaluation and sex testing, these policies are unlikely to protect against breaches of privacy and confidentiality that may arise because they are inconsistent and suspend athletes undergoing evaluation. Furthermore, they require female athletes to undergo treatment that may not be medically necessary and may, in fact, be medically and socially harmful, in order to compete. Finally, beyond those athletes who are directly affected by these investigations, the new policies may intensify the harmful "gender policing" that already plagues women's sports.

Considerations of fairness support an approach that allows all legally recognized females to compete with other females, regardless of their hormonal levels, providing their bodies naturally produce the hormones. While a legal definition of sex opens up a scrutiny of its own, it is currently the single best sex categorization measure we have to rely on. It is true that countries may define sex in different ways, but this variability is not necessarily bad; it also allows countries to do so how they see fit.

The answer to Caster Semenya's case depends on the values that are deemed important in elite sports and competition. Elite sport can value diversity and ensure that all women, including those with intersex traits, have equal

opportunity to participate in sports, that they are treated humanely, that they are not forced to undergo what may be unnecessary medical treatment, and that they are not made ineligible based on advantages they may not even have. Performance in sports is both a "celebration of and a challenge posed by our embodiment" (Murray 2009, 236). All bodies, to one degree or another, present functional limitations; "sports provide an opportunity to live fully in those bodies, to test their capabilities and limits, and to integrate them with our will, intellect, and character" (Murray 2009, 237). We need to move beyond policing biologically natural bodies and the resultant exceptional scrutiny of extraordinary women. ■

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