

## The Unreliability of Sex testing in Athletics

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### Introduction:

I am not an expert on athletics. I am also not all that well versed on the rules governing athletics. So it came as quite a surprise to me when I was asked to write a scientific, but easy to understand, document as part of a presentation to the International Olympic Committee who had asked for "hard science". I do know that the IOC seem to be rather arbitrary about what constitutes a female or a male athlete; and in asking for "hard science", I suspect they would be looking at reading some scientific paper where some expert re-enforces their past and, to some extent, present policy of sex testing. The problem with this is that you can read the science in any way you wish. It is very easy to pull a reference from any paper that says:

*"XX chromosome pairings lead to a female developmental pathway and XY chromosome pairings lead to a male developmental pathway."*

I do not see it quite that way and can easily present many papers and articles that go into more detail about this that would render the above statement meaningless. However, to someone on a committee who is trying to draw the line between athletes gaining an "unfair advantage" and athletes whose biological make up needs to be clearly understood for the purposes of competing, (this being the IOC's stated premise), chromosomal sex testing is in truth as good as useless.

My area of expertise lies in computational biology and bio-informatics. I am also a patient with a genetic condition that would, were I myself to take up a career in athletics, be relevant to this debate. In this initial overview I am hoping to explain how sex differentiation works, drawn from my own experience as a computational biologist and as someone with an intersex condition.

I will also hope to explain this in a way that would be relevant to the IOC in terms of the science the IOC would be asking for, assuming of course that what they are asking is clearly about primary and secondary sex characteristics with regards to athletic competition.

### Uncertain Answers:

I think one problem that faces the IOC is the need to define what a man or a woman is and then to ask the question how do these definitions work in the context of segregated sport. The first thing I suspect the IOC really needs to consider more carefully is the mistaken notion that "some women are not women" and thus have an "unfair advantage" in female only events. I think it is fair to say that the reason for the segregation lies in the

differences between most men and women in terms of secondary characteristics. And generally speaking such characteristics are determined by steroidal hormones. The whole argument presented by the IOC is about gaining "unfair advantage" being conferred by androgenic hormones, which are generally 3-oxy steroids, and they have at their disposal considerable expertise in the area of steroid chemistry since many performance enhancing drugs consist of 3-oxy steroids. Surely the logical approach on the part of the IOC is to focus more on steroid chemistry. I say this because chromosomal sex testing would provide little or no information about the hormonal status of an individual. So why have chromosomal sex testing still taking place among the Olympic Committee of Asia for example?

I say this because, genetically speaking, many of the processes that involve steroid synthesis in humans are rooted in genes that lie in chromosomes other than the 23rd pair. They lie in the autosomes basically. To make life even more complicated, androgen receptors are coded for by genes on the X chromosome not the Y chromosome, the region being Xq12, and are common to both men and women.

I imagine the problem for the IOC with regards to defining sex is one of discussing developmental pathways that lead to being one or the other sex, which for the purposes of governing athletics is rather like looking one day down a road as a large truck comes up from behind. I say this because sex differentiation is really about hormones in this context, and the IOC know a lot about hormones. This makes the truck on our metaphorical road. Why look the other way at chromosomes which are about as relevant as an empty road? All the action that is relevant to the IOC is on the truck, not an empty road.

To determine "genetic sex" in this context, you would have to map all the genes involved in steroid synthesis and monitor those, and then decide if they are regulating the endocrine system within the parameters the IOC would consider acceptable for a male or a female athlete. A woman with CAIS, Complete Androgen Insensitivity Syndrome, could have her bloodstream swimming in testosterone, but with the lack of androgen receptors, she would certainly gain no advantage in terms of muscular development etc. Actually an "XX" woman would have the advantage if using androgens over the "XY" woman in this case. This example alone renders the chromosomal sex testing utterly meaningless. The woman with CAIS cannot cheat.

This is why I find the IOC very hard to understand. I would suggest the IOC look at the whole issue from a different perspective for two reasons. Firstly, if they get stuck in a rut about sex dimorphism while clearly not taking any notice of the real issue, they will not be focusing on performance enhancing drugs that really get round detection and so on. They will be too busy looking at the clear road to notice the truck bearing down on them. Secondly, people with some conditions that give rise to "chromosomes contrary to their sex" would in some cases be at a disadvantage compared to other competitors.

In 2000 prior to the Sydney Olympics, the IOC announced that they were stopping sex testing. However, in 2006 Santhi Soundararajan, who won a silver medal in the women's

800m race at the Asian Games in Doha, was subjected to a sex test and "failed". The problem with this was that the "sex test" was chromosomal, and I understand that Santhi may have CAIS. But as I have already explained, the handling of this particular case probably makes a mockery of the IOC's stance on "unfair advantage". If anything it makes the OCA look stupid. Because a woman with CAIS does not have any sensitivity to testosterone so would not gain any advantage from the presence of testosterone in any case. In that regard she could not gain such an advantage even if she wanted to.

The obvious or glaring question would be why did the OCA see fit to declare this woman "a cheat who failed a sex test". Sexism, perhaps?

The problem for me is actually a very simple one. I am going to stick with the science and leave others to discuss the politics. However, I will point out before discussing the science in more depth, that I find the IOC a bit strange, to say the least, when it comes to this business of sex testing. I am going to look in more detail at the policies so far and try to explain where they are fundamentally in error. The point of this is to place before those on the IOC my understanding of the science and pose scientific questions. If, as many have pointed out, this is a matter of corporate image or making the "Olympic Brand" appear squeaky clean, then I would argue that the arbitrary sex testing and the skewed focus on chromosomes, at the expense of an understanding of the genetics of sex differentiation, will ultimately result in the "Olympic Brand" appearing un-scientific and informed by sexism and prejudice.

What bothers me the most is that the medical advisors to the IOC know full well that in segregated events the issues are of the advantages or disadvantages conferred on a competitor by the state of their endocrine system at the time of competing which is a very important point when considering those athletes who have transitioned from one sex to another either prior to or during their careers. Why then do the medical advisors see fit to literally look at biological factors that are essentially irrelevant to the debate about segregated events?

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**Steroids Vs Chromosomes:**

In 1994 the IOC published a statement by Arne Ljungqvist about a set of guidelines from the IAAF that were discussing the eligibility of someone to compete in a segregated event after gender reassignment. The IAAF were perhaps on the right track given that the focus was clearly on endocrine status at the time of competing, while the specific criteria were not entirely perfect, they were clearly a step in the right direction. However, it is perhaps best to look at the questions the IOC asked 1994:

*"The present recommendation is the result of an updating of the IAAF guidelines by a panel of experts and to which clear requirements have been added with*

*respect to eligibility for competition under the new gender following sex reassignment after puberty. The most debated aspects have been:*

*(A) For how long will the hormonal influence of the earlier puberty be of importance?*

*(B) Will the testosterone influence on the muscular strength during male puberty ever disappear?*

*(C) For how long should the treatment with female hormones last in order to be considered sufficient?*

*(D) How can one make sure that the required treatment with female hormones does really take place? All those questions were addressed by the panel, which also sought advice from further outside experts, before the enclosed recommendations were agreed upon.”*

I will start by answering these questions myself, simply as an exercise in explaining why the focus should be on endocrine status.

Q: For how long will the hormonal influence of the earlier puberty be of importance?

Androgens, the hormones that will be in question, tend to leave the system quite quickly, while there are long term effects, such as a deeper voice and male pattern hirsutism and bone maturation that develop during puberty. The anabolic effects of these hormones can vary. Basically it is down to nitrogen retaining properties of these steroids, which is essential for protein synthesis in muscles. Basically you need to have a "positive nitrogen balance" where the body retains more nitrogen than it secretes. This "balance" is usually maintained by the presence of these steroids. So the question about puberty is actually a complex one. It should be about how long the effects that would be of benefit to an athlete last? Testosterone does not stay around for all that long. So why would the IOC fuss about past exposure to this particular steroid via puberty?

Q: Will the testosterone influence on the muscular strength during male puberty ever disappear?

This depends again on what effects are long-term, and what effects are not, and what effects would be of benefit to an athlete.

(C) For how long should the treatment with female hormones last in order to be considered sufficient?

This is where life becomes complicated. Basically estrogen based therapies tend to block androgen receptors, but you have to consider additional things like aromatization, the conversion of testosterone to estrogen, or the use of other steroidal compounds, cyproterone acetate for example to further block the androgen receptors. Then, there are the actual levels of androgens themselves. Are the testes still present or are we talking about adrenal secretion of androgens alone? Then there is the question of sex hormone-

binding globulin. How much of this is present as a consequence of estrogen therapy? It all varies from person to person.

Q: How can one make sure that the required treatment with female hormones does really take place?

I will answer that with a question. Would a 3-oxy steroid like cyproterone acetate show up as a banned substance in an IOC certified test? There is method in my madness there because I do wonder about the testing procedures and what properties they look for with regards to any steroid that is present.

While there are no simple answers to those questions, and I am certain the experts dealing with this already know that, I do sense a lack of commitment to more accurate testing. I find this a little worrying because there are more sophisticated ways of cheating that do not just involve the administration of steroids themselves. Do the IOC have a uniform system of checking for enzyme levels for example?

This really brings me on to the genetics, the area I am perhaps better qualified to discuss. There are many medical conditions that can effect the production of enzymes required to synthesize hormones naturally. You have to regard "sex testing" in this light rather than looking at chromosomes. What are the IOC trying to determine when it comes to sex? And more so, what relevance does this have when dealing with "weeding out cheats"? Aside from the "obvious", none.

This is the problem though. Everyone thinks in terms of the "obvious". There is some urban myth that goes round stating that anyone who was at some point in their lives "male" would have an unfair advantage in a female only event. And yet even more obvious, or it should be to the IOC, is that women who take high doses of anabolic steroids start to look like men and perform in events like men. Logically, wouldn't someone who had removed any source of naturally occurring anabolic steroids, such as an athlete who transitioned from male to female, have less of an advantage? Or am I being led to believe that the adrenal glands fully supplement what is missing or something?

The problem for the IOC is a simple one when we delve into genetics. While yes, you can say there are "genetic males" and "genetic females", it should be also plainly obvious by now that chromosomes do not act as the last word when it comes to sex differentiation. And they certainly do not in themselves confer any advantage. With Complete Androgen Insensitivity Syndrome we are talking about someone born outwardly female, and inwardly just lacking a uterus, but in terms of competing in events, they would be at a slight disadvantage compared to other women because they are insensitive to androgens.

What if they have Swyers syndrome, where they have a uterus, and are again female in every respect? Well, this is interesting because the IOC probably have not come across that yet, since CAIS has been mentioned most often, along with those who have transitioned. In many respects this is where the problem really lies, arbitrary thinking.

The IOC sadly are not alone in this mistaken belief that chromosomes and chromosomes alone make men and women. I can think of a number of researchers who have fallen into the trap of calling women with XY chromosomes "really male".

You will find these researchers talking about nothing but SRY boxes and various other mysterious sounding entities that reside on the X and Y chromosomes as being the genesis of sex differentiation, and to some extent they are correct, but one interesting phrase often crops up that makes no sense. Let's say an "SRY box" (or SOX) Gene does not express. Let's use SOX9, as this has appeared in the media of late, which lurks on the Y chromosome and is essentially the gene that makes testes. This in many respects is the key point at which male differentiation starts. Before then there is nothing. What do we read in the media? "Their SOX is not working so they are sex reversed." How can they be "sex reversed" if the process of virilization hasn't even started? So how can someone with the physical make up of someone with Swyers for example be "sex reversed"?

This is where "the science" is often read to suit someone else's politics. With me it is even more complicated, I have 5 alpha reductase deficiency, which means all the genes on my X and Y chromosomes add up and my not being male makes me "Sex reversed". Fair enough, but two genes in my case are not working and they are not in the X or Y chromosomes. These are either SRD5a1 or SRD5a2. Without them I do not produce dihydrotestosterone. Some with 5 alpha are born looking like they have CAIS, but a tissue biopsy checking for androgen sensitivity would make a differential diagnosis. (Well, not quite, but it would rule CAIS out).

A lot of researchers love to say that people with 5 alpha grow up as girls and then suddenly turn into big beefy men. (I get the feeling a cold war Eastern Bloc endocrinologist would like that to happen, but it wouldn't, and actually in my case it didn't.)

In the next section I am going to discuss the genetics in more depth. In fact I am going to simply revise and update a paper I have already written on this very issue, only here deal with this in the context of sport and segregated events.