Positioning of the Spanish Society of Sports Medicine concerning participation in sport of gender-affirmed, transsexual or intersex persons

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Summary

The social changes related to gender identity that have been taking place in recent years have a notable and growing impact on sports practice. The incorporation of people with sex reassignment, transsexuals, and intersex (different sexual development) in sports competition raises issues that until now were very rare and relevant but that are currently causing doubts, debate, and controversy. The Spanish Society of Sports Medicine (SEMED), aware that this issue has important repercussions, both on the professional practice of physicians who care for athletes, and on the health of the athletes themselves, understands that it is necessary to deepen the knowledge of the sports practice of people with sex reassignment, transsexuals and intersexuality and considers it appropriate to make an official position on this issue. This work addresses sex reassignment, transsexuality, and intersexuality, shedding light on their definitions, their prevalence, and the differences in sports performance between men and women. He also considers it important to make a reference to the forms of classification in sport, as well as the role of androgens (testosterone and dihydrotestosterone, DHT) in sport. It analyzes the sports participation of people with sex reassignment, transsexuals and intersexuals since the emergence of the Caster Semenya case to end with the positioning of the Spanish Society of Sports Medicine and the recommendation on actions proposed to the sports authorities on addressing the sports participation of people with sex reassignment, transsexuals, and intersex from the perspective of the functional, injury and incentive consequences of women's sports practice.

Key words:
Sex reassignment. Gender. Sex. Transsexuality. Intersexuality. Sports classification.

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Posicionamiento de la Sociedad Española de Medicina del Deporte sobre la participación deportiva de personas con reasignación de sexo, transexuales y con intersexualidad

Resumen

Los cambios sociales relacionados con la identidad de género que se están produciendo en los últimos años tienen una notable y creciente repercusión en la práctica deportiva. La incorporación de personas con reasignación de sexo, transexuales e intersexuales (desarrollo sexual diferente) en la competición deportiva genera cuestiones que hasta ahora eran muy poco frecuentes y relevantes pero que en la actualidad están provocando dudas, debate y controversia. La Sociedad Española de Medicina del Deporte (SEMED) consciente de que este tema tiene importantes repercusiones, tanto sobre el ejercicio profesional de los facultativos que atienden a deportistas, como sobre la salud de los propios deportistas, entiende que es necesario profundizar en el conocimiento de la práctica deportiva de las personas con reasignación de sexo, transexuales y con intersexualidad y considera oportuno efectuar un posicionamiento oficial sobre este tema. Este trabajo aborda la reasignación de sexo, la transexualidad y la intersexualidad aportando luz sobre sus definiciones, sobre su prevalencia y sobre las diferencias de rendimiento deportivo existentes entre hombres y mujeres. También considera importante hacer una referencia a las formas de clasificación en el deporte, así como el papel de los andrógenos (testosterona y dihidrotestosterona, DHT) sobre el deporte. Analiza la participación deportiva de personas con reasignación de sexo, transexuales e intersexuales desde la irrupción del caso de Caster Semenya para terminar con el posicionamiento de la Sociedad Española de Medicina del Deporte y la recomendación sobre actuaciones propuestas a las autoridades deportivas sobre el abordaje de la participación deportiva de las personas con reasignación de sexo, transexuales e intersexuales desde la óptica de las consecuencias funcionales, lesionales y de incentivación de la práctica deportiva de las mujeres.

Palabras clave:
Reasignación de sexo. Género. Sexo. Transexualidad. Intersexualidad. Clasificación deportiva.

Introduction

Over the last few years, gender identity-related social changes have taken place with repercussions on sport. It would be easy to predict that these issues will become increasing important in the future.

Including gender-affirmed, transsexual and intersex persons (differences of sexual development) in sporting competition raises questions which have been infrequent and not particularly relevant until now, but which are currently raising doubts, debate and controversy.

The Spanish Society of Sports Medicine (SEMED) is aware that this topic has significant repercussions, both on the work of physicians attending athletes and on the health of the actual athletes. It understands that knowledge of sporting practice for gender-affirmed, transsexual or intersex persons must be explored in greater depth, considering it relevant to take an official position on this matter.

Definitions

Transsexuality is defined as a persistent manifestation of personal discordance between the sex assigned at birth (genetic, gonadal, genital and morphological) and the affirmed gender. This discordance causes a strong feeling of rejection towards the primary and secondary sexual characteristics of their biological sex, and they seek hormonal and surgical treatments to adapt their body to correct their appearance and manage to live and be treated socially in accordance with their affirmed and chosen gender[1].

Gender dysphoria is defined as the incongruity between gender at birth and sexual identity[2].

Differences of sexual development (DSD). Heterogeneous group of congenital anomalies caused by discordance between the genetic sex determination (sexual chromosomes), of gonads (masculine, testicles or feminine, ovaries) and internal genitals (vasa deferentia, epididymis and prostate or fallopian tubes, uterus and vagina) and/or external genitals (masculine urethra, penis and scrotal sacks or clitoris, labia majora and minora and vaginal opening) that lead to an alteration in the determination or differentiation of the sex. This is estimated to affect 1 in every 4,500 newborn children (excluding isolated hypospadia and the secondary DSD to chromosomal anomalies)[3].

Rectifying the sex registration in the Civil Registry. Modification of the entry regarding the sex initially recorded when registering the birth, in accordance with the registration legislation in force[4].

Prevalence

Estimations of the prevalence of gender dysphoria vary considerably. Studies from the United Kingdom and the Netherlands show a prevalence of one case per 12,000 inhabitants in males and one case in every 30,000 inhabitants in females. In Spain, a prevalence has been found of one case per 9,685-21,031 in biological males and one case per 15,456-48,096 in biological females[5].

Regarding the prevalence and proportion between sexes of transsexuality in various national and international studies, it has been found that the ratio of transsexual women (a woman assigned male at birth) to transsexual men (a man assigned female at birth) is between 4:1 and 2:1 respectively[6].

Differences in sporting performance between women and men

Sex determines differences between women and men, beyond morphological differences, which are enormously important in terms of affecting sporting performance, although there are highly diverse phenotypes in top-level sport and, in some cases, the differences can be minor or even cancelled out.

Table 1 summarises the physical, functional and sporting performance differences between women and men.

Classification in sport

In the early days of sporting regulation, a form of classification determined by gender was agreed upon, setting feminine and masculine categories that are used in practically all sports and contexts. The reason behind this type of classification was to allow women to take part in sport, competing in equal conditions to a certain extent, and to achieve sporting results, which would have been impossible if there was only one classification category.

Other forms of classification exist, precisely to avoid insurmountable performance differences, such as seen between women and men, namely age categories, weight categories and functional categories in Paralympic sport that, although some issues remain, seem to be fairer and less discriminatory.

This considerably limits performance differences between competitors who therefore all have a chance of winning and achieving sporting results, which would be unthinkable with another type of classification.

The role of androgens (testosterone and dihydrotestosterone, DHT)

Testosterone plays a fundamental role regarding sporting participation for two very important reasons: firstly, alongside genetic characteristics, this hormone is responsible for the characteristics which distinguish the male body and determine its functional capacity, and secondly, it is proposed that gender-affirmed, transsexual or intersex persons can take part in a sport by reducing their testosterone levels.

Testosterone, the main androgenic hormone, is responsible for masculine characteristics and therefore also the majority of the aforementioned differences between men and women, but its metabolite, dihydrotestosterone (DHT), produced peripherally, is the most active natural androgen in terms of androgen receptors. Almost all testosterone is produced in the testicles, although a small quantity is secreted in the suprarenal glands and in the ovaries. Consequently, testosterone is also found in women, although in quantities which are 15 times smaller than in men[22].

Some federations, such as athletics[23], swimming[24], cycling[25], and rugby[26], have set rules that allow participation from transgender persons (specifically trans women, assigned male at birth) and persons with DSD with a female phenotype, with a high production of testosterone and receptor sensitivity to it, obliging low testosterone levels to be maintained, as a measure to allow trans women to take part in sport.

However, permanently reducing testosterone levels under 2.5 nmol/L in gender-affirmed persons does not eliminate the effects of previous exposure to higher testosterone levels. It has been seen that after treatment used to reduce testosterone levels, there was barely a drop in muscle power[27] and that trans women retain some of the advantages of their previous male physiology irrespective of the duration of the hormone therapy treatments[28,29].

Table 1. Relevant physical, functional and performance differences in sport between male and female organisms[7-21].

Physical differences **Variable**	**Percentage of male/ female difference**
Height	9%
Length of femur	9%
Length of humerus	12%
Width of shoulders	14%
Width of pelvis	- 6%
Body fat	- 30%
Lean body mass	45%
Lower body muscle mass	33%
Upper body muscle mass	40%
Tendon strength	83%
Cardiac output	30%
Stroke volume	34%
Quantity of haemoglobin	11%
Functional differences **Variable**	**Percentage of male/ female difference**
Grip strength	57%
Quadriceps strength	54%
Biceps strength	88%
Total strength of the upper limbs	90%
Vertical jump	33%
Arm speed	21%
Punch power	162%
Maximum absolute oxygen consumption	50%
Maximum relative oxygen consumption	26%
Differences in sporting performance **Variable**	**Percentage of male/ female difference**
Swimming	11%
Rowing	11%
Athletics races	12%
Cycling races	16%
Jumping	19%
Tennis serve	20%
Driving in golf	20%
Weightlifting	31%
Pitching in baseball	52%
Lifting weights	66%
Scrum strength in rugby	120%

Androgenic suppression therapy does affect male physiological adaptations prior to the transition experienced after puberty. Therefore, trans women who transition after completing male puberty will have greater lung capacity, heart size and bone structure, which will give them advantages such as greater maximum oxygen consumption and systolic volume, plus much more efficient joint biomechanics[30-34].

Nevertheless, it has been shown that full gender-affirming surgery where testicles are removed does reduce testosterone levels to castration levels, <1 nmol/L[35].

At this point, an explicit reference should be made to differences of sexual development (DSD) which, due to the case of the South African athlete Caster Semenya, caused rules to be published that require treatment to reduce testosterone levels. These rules are applied in several sports federations, specifically athletics[23-26]. Differences in sexual development (DSD) comprise a wide spectrum of discordances between the chromosomal, gonadal and phenotypic (genital) criteria that define sexual differentiation[36]. In diverse clinical conditions of DSD, with variable phenotypes and affirming of the female gender, a significant secretion of testosterone can take place during puberty which, if this coincides with normal sensitivity of the testosterone receptors, will cause the effects of this hormone that, as indicated, considerably improves sporting performance. On the contrary, in one cause of DSD, complete androgen insensitivity syndrome (CAIS), there is no response to testosterone, so it will not improve sporting performance.

When the first rule was set to allow differences in sexual development to take part in sports by World Athletics[37], the Spanish Society of Sports Medicine, the Spanish Agency of Health Protection in Sport (AEPSAD) and the Spanish Medical Colleges Organisation[38] published a report which opposed the use of hormones to reduce the quantity of testosterone in these persons. This led to a declaration by the World Medical Association recommending that doctors should not apply the World Athletics rules[39]. Following this stance, World Athletics modified this rule[40], although it maintains the requirement to permanently reduce testosterone levels.

The psychological perspective

From a psychological perspective, the hormonal modifications that must be made for gender-affirming surgery frequently cause physiopathological alterations on the anxious depressive spectrum and eating disorders (anorexia and bulimia)[41,42], and there have even been descriptions of a high prevalence and significantly greater probabilities of mental disorder diagnoses among the transgender population compared to the cisgender population[43].

Hormone treatment brings endocrine changes that make exercise more difficult and can even make certain physical activities impossible, particularly very demanding sports, which require not only tough physical training but also changes to temperament and character, depending on the baseline personality.

On the other hand, hormone therapies sometimes require a psychopharmacological treatment to reduce the side effects, which in turn can cause competitive advantages.

Participation in sport from gender-affirmed, transsexual or intersex persons

Since the case of Caster Semenya first arose, a debate has raged on regulation of participation in sport for persons who are gender-affirmed, transsexual and intersex.

In 2018, World Athletics published the first rule of participation[37] based on reducing testosterone levels which was adopted by at least the swimming[24], cycling[25] and rugby[26] federations.

Other federations have not changed their rules to date, probably because no problematic case has ever arisen for them.

Finally, arguments are being raised and sought to justify setting up an open category or a third gender category for elite fencing competitions, understanding that it promotes fair competition, while allowing trans women to compete in their chosen sport[44].

Positioning of the Spanish Society of Sports Medicine

As a consequence of all the above, regarding participation in sport of gender-affirmed, transsexual or intersex persons (or with differences in sexual development, DSD) the Spanish Society of Sports Medicine indicates the following:

- Biology determines two genders, male and female, which have different morphological and functional characteristics.
- Male characteristics are fundamentally determined by the androgens (testosterone and dihydrotestosterone) and by genetic characteristics.
- In some cases, biological sex at birth conflicts with the person's perception and acceptance, which is known as gender dysphoria.
- The conflict between assigned gender and this feeling causes some persons to seek ways of adapting their body to their affirmed gender by means of hormonal and surgical treatments.
- In Spain, there is no legal limitation to a change of gender.
- The prevalence of persons who are gender-affirmed, transsexual or intersex is very low.
- Anatomofunctional differences between females and males are highly significant. The male gender demonstrates much higher percentages of functional and sporting performance advantages than females, between 15 and 30% overall.
- These differences mean that women would obtain much lower sporting results than men if they were to compete together.
- The gender classification system, used ever since women began to take part in sport, is based on the insurmountable performance differences between women and men.

- Including trans women (a woman assigned male at birth), by reducing their testosterone to levels allowed by the current rules in some sports federations, generally implies a considerable significant functional performance advantage when competing against women.
- Including trans women who have not reduced testosterone figures when competing with women generally represents the same advantage that men have over women.
- Including trans men (a man assigned female at birth), of which there is no record of any cases, would not provide any functional advantage in sporting performance.
- The obligation for persons with differences of sexual development to indiscriminately reduce testosterone levels is unacceptable from the point of view of medical ethics. The consideration should be individualised, considering the cause of the DSD, the degree of sensitivity to testosterone and the medical indications.
- Women and trans women competing together, including trans women who have reduced testosterone levels and those who have not, has the following effects:
    - Increase in the risk of injuries among women in many sports.
    - Trans women have greater functional characteristics.
    - Trans women have better sporting performance and results.
    - Insurmountable performance differences remain for women.
    - Women might leave sport.
    - Possible lack of incentive for women to take part in sport.

In summary, sporting authorities are recommended to address participation in sport from gender-affirmed, transsexual or intersex persons from the perspective of the functional, injury and incentive consequences on women taking part in sport who have the right to participate and achieve sporting results competing against people with the same functional characteristics.

Regarding gender-affirmed or transsexual persons participating in sport, from a medical point of view, one highly appropriate option could be to set up an open or third-gender category for the competition.

Conflicts of interest

The authors declare that there is no conflict of interest.

Bibliography

1. Hengstschläger M, van Trotsenburg M, Repa C, Marton E. Huber JC, Bernaschek G. Sex chromosome aberrations and transsexualism. *Fertil Steril.* 2003;79:639-40.
2. Manual MSD. https://www.msdmanuals.com/es-es/professional/trastornos-psiqui%C3%A1tricos/sexualidad-disforia-de-g%C3%A9nero-y-parafilias/disforia-de-g%C3%A9nero. Consultado: 23-8-23.
3. Guerrero-Fernández J, Amat Boua M, Audí Parera L, Azcona Sanjulian MC, Carcavilla Urquía A, Castaño González L, *et al.* Diagnóstico multidisciplinar del desarrollo sexual diferente. *Rev Esp Endocrinol Pediatr*. 2023; 14. Suppl 2.
4. Ministerio de Justicia. Rectificación registral de sexo. https://www.mjusticia.gob.es/es/ciudadania/tramite?k=solicitud-rectificacion-registral-sexo
5. Hurtado-Murillo F. Disforia de género en infancia y adolescencia: Guía de práctica clínica. *Rev Esp Endocrinol Pediatr*. 2015; 6 (Suppl). 45-52.
6. Moreno-Pérez O, Esteva de Antonio I. Guías de práctica clínica para la valoración y tratamiento de la transexualidad. Grupo de Identidad y Diferenciacion Sexual de la SEEN (GIDSEEN). *Endocrinol Nutr.* 2012. Doi:10.1016/j.endonu.2012.02.001.
7. Pike J, Hilton E, Howe LA. *Faster, higher, stronger. The biological and ethical challenges to including transgender athletes in women's sports.* Macdonald-Laurier Institute Publication. Otawa (Canada). 2021.
8. Mero A, Komi PV, Korjus T, Navarro E, Gregor RJ. Body segment contributions to javelin throwing during final thrust phases. *J Appl Biomechanics.* 1994;10(2):166-77.
9. Jantz LM, Jantz RL. Secular change in long bone length and proportion in the United States, 1800-1970. *Am J Phys Anthropol.* 1999;110:57-67.
10. Brinckmann P, Hoefert H, Jongen HT. Sex differences in the skeletal geometry of the human pelv Lepley AS, Joseph MF, Daigle NR, Digiacomo JE, Galer J, Rock E, Rosier SB, Sureja PB. Sex differences in mechanical properties of the achilles tendon: longitudinal response to repetitive loading exercise. *J Strength Cond Res.* 2018; 32:3070-9.
11. Lee DH, Keum N, Hu FB, Orav EJ, Rimm EB, Sun Q, *et al*. Development and validation of anthropometric prediction equations for lean body mass, fat mass and percent fat in adults using the National Health and Nutrition Examination Survey (NHANES) 1999-2006. *Br J Nutr*. 2017;118:858-66.
12. Lepley AS, Joseph MF, Daigle NR, Digiacomo JE, Galer J, Rock E, *et al.* Sex differences in mechanical properties of the achilles tendon: Longitudinal response to repetitive loading exercise. *J Strength Cond Res.* 2018;32:3070-9.
13. Tong E, Murphy WG, Kinsella A, Darragh E, Woods J, Murphy C, *et al.* Capillary and venous haemoglobin levels in blood donors: a 42-month study of 36,258 paired samples. *Vox Sang.* 2010;98:547-53.
14. Bohannon RW, Wang YC, Yen SC, Grogan KA. Handgrip strength: A comparison of values obtained from the NHANES and NIH Toolbox studies. *Am J Occup Ther*. 2019;73:7302205080p1-7302205080p9.
15. Neder JA, Nery LE, Shinzato GT, Andrade MS, Peres C, Silva AC. Reference values for concentric knee isokinetic strength and power in nonathletic men and women from 20 to 80 years old. *J Orthop Sports Phys Ther.* 1999;29:116-26.
16. Hubal MJ, Gordish-Dressman H, Thompson PD, Price TB, Hoffman EP, Angelopoulos TJ, *et al.* Variability in muscle size and strength gain after unilateral resistance training. *Med Sci Sports Exerc.* 2005;37:964-72.
17. Murray MP, Gore DR, Gardner GM, Mollinger LA. Shoulder motion and muscle strength of normal men and women in two age groups. *Clin Orthop Relat Res.* 1985;192:268-73.
18. Haugen TA, Breitschädel F, Wiig H, Seiler S. Countermovement jump height in national-team athletes of various sports: A framework for practitioners and scientists. *Int J Sports Physiol Perform*. 2021;16:184-9.
19. Morris JS, Link J, Martin JC, Carrier DR. Sexual dimorphism in human arm power and force: implications for sexual selection on fighting ability. *J Exp Biol.* 2020 23;223(Pt 2):jeb212365.
20. Pate RR, Kriska A. Physiological basis of the sex difference in cardiorespiratory endurance. *Sports Med.* 1984;1:87-98.
21. Hilton EN, Lundberg TR. Transgender women in the female category of sport: perspectives on testosterone suppression and performance advantage. *Sports Med*. 2021;51:199-214.
22. Handelsman DJ, Hirschberg AL, Bermon S. Circulating testosterone as the hormonal basis of sex differences in athletic performance. *Endocr Rev.* 20181;39:803-829.
23. World Athletics. *Eligibility regulations for transgender athletes*. March 2023.
24. World Aquatics. *Policy on eligibility for the men's and women's competition categories.* 24 March 2023.
25. UCI Cycling regulations. Part 13. Medical Rules. Chapter V. Eligibility regulations for transgender athletes. 17.07.2023.
26. World Rugby. *Transgender Guidelines*. https://www.world.rugby/the-game/player-welfare/guidelines/transgender.
27. Wiik A, Lundberg TR, Rullman E, Andersson DP, Holmberg M, Mandić M, *et al*. Muscle strength, size, and composition following 12 months of gender-affirming treatment in transgender individuals. *J Clin Endocrinol Metab*. 2020;105:dgz247.
28. Knox T, Anderson LC, Heather A. Transwomen in elite sport: Scientific and ethical considerations. *J. Med. Ethics* 2019;45:395–403.
29. Harper J, O'Donnell E, Sorouri Khorashad B, McDermott H, Witcomb GL. How does hormone transition in transgender women change body composition, muscle strength and haemoglobin? Systematic review with a focus on the implications for sport participation. *Br J Sport Med*. 2021;55:865–72.
30. Caenegem V, Wierckx K, Taes Y. Body composition, bone turnover, and bone mass in trans men during testosterone treatment: 1-year follow-up data from a prospective case–controlled study (ENIGI). *Eur J Endocrinol*. 2015;172:163–71.

31. Gooren LJ, Kreukels B, Lapauw B, Giltay EJ. Pathophysiology of cross-sex hormone administration to transsexual people: The potential impact of male–female genetic differences. *Andrologia*. 2015;47:5–19.
32. Alvares LAM, Santos MR, Souza FR, Santos LM, de Mendonça BB, Costa EMF, *et al.* Cardiopulmonary capacity and muscle strength in transgender women on long-term gender-affirming hormone therapy: A cross-sectional study. *Br J Sport Med* 2022;56:1292–9.
33. Roberts TA, Smalley J, Ahrendt D. Effect of gender affirming hormones on athletic performance in transwomen and transmen: implications for Sporting organisations and legislators. *Br J Sports Med.* 2020 Dec 7:bjsports-2020-102329.
34. Heather AK. Transwoman elite athletes: Their extra percentage relative to female physiology. *Int J Environ Res Public Health.* 2022;19:9103.
35. Schneider F, Kliesch S, Schlatt S, Neuhaus N. Andrology of male-to-female transsexuals: Influence of cross-sex hormone therapy on testicular function. *Andrology* 2017;5:873–80.
36. Hughes IA, Houk C, Ahmed SF, Lee PA, Lawson Wilkins Pediatric Endocrine Society/ European Society for Paediatric Endocrinology Consensus Group. Consensus statement on management of intersex disorders. *J Pediatr Urol*. 2006;2:148-62.
37. IAAF. Eligibility regulations for the female classification (athletes with Differences of Sex Development). 2018.
38. Manonelles P. Terreros JL. Rodríguez Sendín JJ. Informe sobre las normas de clasificación deportiva de deportistas con diferencias en el desarrollo sexual. http://www.femede.es/documentos/Normas_clasificacion_DSD.pdf. Consultado: 1-9-23.
39. Association WM. WMA urges physicians not to implement IAAF rules on classifying women athletes. 2019. https://www.wma.net/ news-post/wma-urges-physicians-not-to-implement-iaaf-rules-on-classifying-women-athletes. Consultado: 23-8-23.
40. World Athletics. Eligibility regulations for the female classification of athletes with Differences of Sex Development. March 2023.
41. Meyer G, Boczek U, Bojunga J. Hormonal gender reassignment treatment for gender dysphoria. *Dtsch Arztebl Int*. 2020;117:725-32.
42. Bandini E, Fisher AD, Castellini G, Lo Sauro C, Lelli L, Meriggiola MC, *et al.* Gender identity disorder and eating disorders: similarities and differences in terms of body uneasiness. *J Sex Med.* 2013;10:1012-23.
43. Hanna B, Desai R, Parekh T, Guirguis E, Kumar G, Sachdeva R. Psychiatric disorders in the U.S. transgender population. *Ann Epidemiol.* 2019 Nov;39:1-7.e1.
44. Tidmas V, Halsted C, Cohen M, Bottoms L. The participation of trans women in competitive fencing and implications on fairness: A physiological perspective narrative review. *Sports (Basel).* 2023;11:133.