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REVIEW

Transgender competition in combat sports: Position statement of the Association of ringside physicians

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ABSTRACT
The Association of Ringside Physicians (ARP) is committed to the concept of fair competition. It advocates for two equally skilled and matched athletes to keep bouts fair, competitive, entertaining, and, most importantly, safe for all combatants. Numerous studies have proven that transgender women may have a competitive athletic advantage against otherwise matched cis-gender women. Likewise, transgender men may suffer a competitive disadvantage against cis-gender men. These differences – both anatomic and physiologic – persist despite normalization of sex hormone levels and create disparities in competitive abilities that are not compatible with the spirit of fair competition. More importantly, allowing transgender athletes to compete against cisgender athletes in combat sports, which already involve significant risk of serious injury, unnecessarily raises the risk of injury due to these differences. Hence the ARP does not support transgender athlete competition against cisgender athletes in combat sports.

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Preamble: development of this statement

The Association of Ringside Physicians (ARP) is an international, nonprofit organization dedicated to the health and safety of athletes in combat sports. This position statement expresses a collaborative effort among the authors, subject matter experts, ARP Board of Directors, and Emeritus Board. An extensive literature search including, but not restricted to MEDLINE, Cochrane Review, and non-indexed peer-reviewed articles published in online medical journals was performed regarding transgender athletes and sports competition. Though studies evaluating transgender athletes in combat sports are lacking, common sense principles, extrapolation from related research, and decades of combat sports medical experience form the foundation for these rational recommendations.

Definitions and background

Competitive sports have categories to create a field of competition that is fair and equal: biological sex, weight, age, level of competition, and affiliation [1]. Birth sex is one of the standard metrics – indeed the most important one – used to create fairness in sports competition. Given the intimate relationship between sex and gender, combat sports are gender affected; therefore, scientific analysis to determine safety measures is a mandatory component of our regulatory policies.

Sex refers to a person's physical characteristics, including their reproductive system (whether they have ovaries or testes), hormones, chromosomes (classically male XY and female XX), and external genitalia. The basis of sex determination is commonly on external genitalia. Intersex people (those with differences in sexual development (DSD)) are born with reproductive anatomy, chromosomes, and hormones that sometimes limit categorization of an individual as male or female. In the scientific literature, the terms 'male' and 'female' refer to biological sex. Outside of science, 'male' and 'man' are used interchangeably, as are 'female' and 'woman.'

Gender refers to one's sense of self as a man or a woman (or something else such as gender-neutral or gender-fluid). *Cis-women* are those women whose sex and gender align – they are born female and identify as such. Equally, a *cis-man*'s sex and gender are both male. For some people, sex and gender do not align. A person may be of the male sex but identify as a woman or be of the female sex but identify as a man. These people are *transgender*. A transgender person may or may not undergo transition, including social changes ('coming out' to friends and family, changing one's name and personal pronoun, and style of dress) and medical intervention (hormone therapy, gender affirmation surgery).

For our statement, we are defining transgender combat sports athletes as those who have a gender identity that is different from their birth sex. These athletes may not have necessarily begun a medical transition to affirm their gender identity. The use of various laboratory blood values, such as testosterone and estrogen levels, can gauge an athlete's medical transition.

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Several transgender inclusive sports policies demonstrate a lack of scientific evidence to support their conclusions and struggle to protect the integrity of women's sports and provide for the inclusion of transgender athletes [2]. The complexity regarding the current sports policies on transgender athletes is exemplified by governing bodies of different athletic organizations having very different policies these athletes must follow to be included in sports competitions [3]. In 2015, the International Olympic Committee (IOC) set out guidelines that restricted athletes transitioning from male to female from competing in the female category until testosterone was below 10 nmol/L for at least 12 months prior to competition [4]. Recognizing the complexity in determining how an athlete may be at a disproportionate advantage compared with their peers, the IOC updated these guidelines in 2021 by dropping specific laboratory criteria and instead providing a framework for sport governing bodies to develop eligibility criteria applicable to their sport [5]. Currently, professional combat sports organizations do not have any formal policies regarding transgender competition.

Anatomical and physiological effects of male and female puberty

Differentiation between male and female begins in utero, driven by differential expression of several thousand genes on autosomal and sex chromosomes as well as hormonal actions [6–9]. Athletic performance differences between males and females prior to puberty are often considered inconsequential or relatively small [10–12]. Small differences in athletic performance demonstrated between the sexes in childhood [13,14] may be due to social factors [15], as well as the phenomenon known as 'minipuberty.' The latter is a surge of gonadotropins and sex hormones during the first few months of life that may correlate with differences in growth velocity and body composition seen in prepubertal males and females [16–19].

The phenomenon of sex dimorphism is the secondary sex characteristics that develop during puberty. The secondary sex characteristics evolve under sexual selection pressures to improve reproductive fitness and thus generate anatomical divergence beyond the reproductive system. Ultimately these secondary sex characteristics result in adult body types that are measurably different between sexes. During puberty, testes-derived testosterone levels increase 20-fold in males, resulting in circulating testosterone concentrations at least 15 times higher in males than in females of any age [19–21]. Testosterone in males induces changes in muscle mass, strength, anthropometric variables, and hemoglobin levels as part of the sexually dimorphic characteristics observed in humans [19].

Generally, males are bigger and stronger than females [22]. It follows that, within competitive sports, males enjoy significant performance advantages over females, predicated on the superior physical capacity developed during puberty in response to testosterone [19,22,23]. Thus, the biological effects of elevated pubertal testosterone are primarily responsible for driving the divergence of athletic performances between males and females [19]. However, since the 1990s, the difference in performance records between males and females has been relatively stable. Therefore, the difference in performance suggests that biological differences created by androgenization explain most of the male advantages and are insurmountable by training and physical conditioning alone [12,24–26].

Testosterone drives anatomical and physiological sex differences in the human body (Table 1). Sex differences that affect athletic performance involve the central nervous system, musculoskeletal structure, metabolism, and cardiorespiratory system. These systems differ in the extent to which they are modifiable with hormone therapy [22,27]. Testosterone drives changes to the brain, skeletal structure, and cardiorespiratory system both in utero and during puberty that are unlikely to be manipulated significantly with hormone therapy later in life. Muscle mass, strength and hemoglobin levels are modifiable in response to post-pubertal testosterone concentration changes but not to the extent that inherent sex differences are eliminated [27–30].

Differences in athletic performance in cisgender males and females

Sports have historically been split into categories (age, sex, weight class, ability) to promote a competitive environment that is fair, safe, and inclusive. While sex is biologically binary, categorizing sports this way does not always match the gender identity of these people. In addition, the prevalence of people with disorders of sexual development (DSD) is much higher in elite female athlete populations [17]. Therefore, various testosterone level thresholds (lower limit of male testosterone <10 nmol/L, <5 nmol/L to allow for mild hyperandrogenism) [19] have been used to create fair competition, particularly for biological females.

Research has identified differences anatomical, physiological, and hormonal differences between males and females, translating into objective performance advantages for males that range from 10% to 30%. These advantages are present in activities relying on muscular strength and/or cardiorespiratory endurance but are more pronounced in activities relying heavily on muscular strength and power, especially in the upper extremities. For example, in Powerlifting, where weight class is indexed, men outperform women by over 20% [22,25,31].

Males have larger and denser muscles and stiffer connective tissue, with an associated capacity to exert greater muscular force more rapidly and efficiently [32–35]. Males also have a reduced fat mass and different distribution of body fat and lean muscle mass [36–38], which increases power-to-weight ratios and upper-to-lower limb strength in sports, which may be a crucial determinant of success [39,40]. Males also have longer, and larger skeletal structures [41,42] creating advantages in sports such as swimming, where levers influence force application, longer limb/digit length is favorable, and height, mass, and proportions are directly responsible for performance capacity [9]. Longer limbs have shown to be advantageous, particularly in the striking aspects of combat sports [43–45].

Table 1. Anatomical and physiological differences between males and females affecting athletic performance.

Physiologic and Anatomic Differences Between Male and Female Athletes [7,9,18]	• Greater muscle mass and cross-sectional area • Fiber type composition favoring higher force production • Stiffer connective tissue • Higher testosterone levels • Longer, larger, and more dense skeletal structure • Higher hemoglobin concentration • Greater muscle-to-fat ratio • Greater heart and lung capacity • Tendency to greater aptitude in motor skills
Permanent Sex Differences that Affect Athletic Performance, which is Considered Architectural [9,18,29]	**Brain** • MRI shows increased intraconnectivity in males for regions of the brain attributed to perception-action-coordination, auditory/visual spatial awareness • Biological male dominance in spatial ability, visual memory tasks, and perception shows no decrease in transwomen after 12 months of estrogen therapy **Skeletal structure** • Bone mineral density and bone size/structure provide biomechanical advantage (Q angle, humeral ulnar angle), larger area for skeletal muscle attachment and protection against trauma • Transgender women generally maintain bone mass over the course of at least 24 months of testosterone suppression **Cardiorespiratory** • Men have larger lung volumes, alveolar number • Shorter diaphragm reduces ribcage dimensions in females • Lower oxygen capacity uptake in females • Females have heart size 85% that of males relative to body size and on average 1/3 smaller stroke volume
Modifiable Physiologic differences due to Testosterone Effects [9,18,28]	**Muscle mass and strength** • testosterone suppression results in loss of lean body mass, muscle size and strength however this may not make up for the typical gap between males and females **Aerobic capacity** • testosterone suppression reduces hemoglobin levels in transwomen essentially eliminating the gap between ciswomen
Current Research Findings [18,26,28,36]	• Transwomen retain an advantage in upper body strength (push-ups) over female controls for 1–2 years after starting gender-affirming hormones • Transwomen retain an advantage in endurance (1.5 mile run) over female controls for over two years after starting gender-affirming hormones • Transwomen generally maintain bone mass over the course of at least 24 months of suppression, skeletal size and structure unlikely to change • Testosterone suppression reduces hemoglobin levels in transwomen to similar levels seen in ciswomen but is unlikely to significantly change lung and heart size • Hormone therapy decreases muscle size, cross sectional area, lean body mass, and strength. However, these values remain higher than that in cisgender women, even after 36 months of therapy.

Competing in combat sports is highly reliant on the oxidative energy system [46]. Males are known to have superior cardiovascular and respiratory function compared to females. Males have greater absolute and relative cardiac mass, stroke volume, blood volume, hemoglobin concentration which all contribute to males having a larger VO2max (the maximum volume of oxygen consumed per kg of body weight, and a widely validated measure of cardiorespiratory fitness) compared to females even after normalizing for fat free mass [47–49]. Males also have larger lungs and conductive airways when matched for size compared to females, leading to a lower oxygen cost of respiration [27,50,51]. Therefore, males have a more efficient system for delivering oxygen to active skeletal muscle. Further, testosterone contributes to physiological factors, including body composition, skeletal structure, and the cardiovascular and respiratory systems across the life span, with significant influence during the pubertal period [19,52].

From puberty onwards, males have, on average, 10% more bone, leading to more bone surface area which accommodates more skeletal muscle accumulation [53,54]. On the other hand, females have a lower bone surface area, lower muscle mass, and lower cross-sectional area of type II muscle fibers, all leading to decreased strength and power compared to males. These differences are more pronounced in the upper body compared to the lower body, with females demonstrating upper body strength that is 50–60% of their male counterparts [52,55]. This provides males an advantage in sports like boxing, weightlifting, and skiing. These differences in body strength and power can significantly impact athletic performance and essentially underwrite the significant differences in world record times and distances set by men and women.

In contrast, the principal female hormone, estrogen, can have effects that disadvantage female athletic performance. For example, females have larger hip-width-to-femur-length ratios resulting in differences in biomechanical forces between the sexes. The pelvis and hip shape are established during puberty and are driven by estrogen. The different angles and forces resulting from the female bony architecture may increase risk of lower extremity injury [56–58]. In addition to this, estrogen is known to have ergolytic effects on cardiac contractility and vascular preload leading to decreased stroke volume [59]. Estrogen also affects body composition by influencing fat deposition. Females, on average, have a higher percentage of body fat, which holds true even for highly trained healthy athletes (men 5%–10%, women 8%–15%) [52]. Fat is necessary in females for normal reproduction and fertility, but it is not performance-enhancing. Hence, males with higher muscle mass and lower body fat will generally be stronger per kilogram of body weight than females.

In summary, testosterone profoundly affects vital physiological parameters that underlie athletic performance in males. There is substantial evidence regarding the effects on muscle gain, bone strength, and the cardiovascular and respiratory systems, all of which drive enhanced strength, speed, and recovery. Together the scientific data point to testosterone providing an all-purpose benefit across a range of body systems that contribute to athletic performance for almost all sports. The advantages of testosterone are exemplified best by the male dominance of sporting world records.

Effects of hormone treatment on sports performance of transgender males and females

The physiological factors related to testosterone underpin strength, speed, and recovery, with all three elements required to be competitive in almost all sports [21,60,61]. Therefore, testosterone benefits athletic performance almost ubiquitously and is one of the main reasons its dosing in supraphysiologic levels is banned from most competitive sports [62,63].

Testosterone suppression attempts to reverse the advantageous physiological changes that happen with male puberty to a fair and adequate level. While testosterone suppression is known to decrease muscle mass and strength [7,64,65] and oxygen-carrying capacity [65], the reduction does not appear to make up for the significant baseline differences between males and females even after three years of treatment [12,66–71]. In addition, other advantageous physiology such as bone density and morphology [72–75], lung volume, heart size, and joint articulation are unlikely to be affected [6,27]. However, it should be noted that studies in transgender individuals are few and limited by sample size and study design. Furthermore, studies thus far have generally been performed in a non-athlete population.

Hilton and Lundberg [12] presented data demonstrating that superior anthropometric, muscle mass, and strength parameters achieved by males at puberty, and underpinning a considerable portion of the male performance advantage over females, are not entirely removed by the current regimen of testosterone suppression permitting participation of transgender women in female sports competitive categories. Instead, the male performance advantage remains substantial.

Discussion

Combat sports are unique because the objective is to win by striking, submissions, joint holds, or forcing the opponent's body into compromised positions through forceful joint manipulation. Therefore, combat sports carry an exceedingly high risk for acute and chronic neurological and musculoskeletal injuries. In addition, the inherent danger in these sports and the mismatch in physical capabilities leave cis-women and transgender men at risk if allowed to compete with opponents of the opposite biological sex.

Testosterone levels in isolation are inadequate to ensure fairness at the time of a competition. A transgender woman combatant who has gone through male puberty, thus conferring her with a male's musculature and bony structure, still has an unfair advantage over a similarly sized cis-woman combatant. A transgender man who has already gone through female puberty, thus conferring him with a female's musculature and bony structure, may have an unfair disadvantage against a cis-male combatant. Therefore, combat sports competitions between a transgender woman and a cis-woman, or between a transgender man and a cis-man, are inherently unfair and less safe based on proven anatomic and physiologic advantages. These facts should necessitate a consensus on prohibiting competition between combat sports athletes who are not of the same sex as their birth sex. Gender identity has no role in determining competition classification in combat sports.

While inclusivity and fairness are essential in sports, safety should be the prime concern. Currently, there is no consensus on an acceptable degree of residual advantage held by transgender women that would be tolerable in the female category of sport. There is a significant dispute over this issue, especially since the physiological determinants of performance vary across different sporting disciplines [12]. The residual advantage carried by transgender women that has thus far been demonstrated in the literature raises obvious concerns about fair and safe competition in combat sports, where muscle mass, strength, and power are key performance determinants.

From a medical-ethical point of view, it is questionable whether a solitary requirement to lower testosterone below a certain level to ensure sporting fairness in competition can be justified [12]. Since the permanent testosterone advantage persists to a large degree, as evidence shows, simply setting a certain testosterone level to be eligible for sports competition will not achieve the objective of physiological and anatomical fairness. Manipulating testosterone levels for sports competition inclusion criteria may also drive medical practice toward endpoints that an individual may not want or require without achieving its intended benefit. Furthermore, the data demonstrate that testosterone suppression only trivially affects strength, lean body mass, muscle size, and bone density [12,72,74]. The reductions observed in muscle mass, size, and strength are minimal compared to the baseline differences between males and females in these variables. Thus, there are significant performance and safety implications in sports where these attributes are competitively significant – especially so in combat sports.

It is essential to recognize that the biological factors underpinning athletic performance are unequivocally established. Hence the potential performance implications in combat sports are applicable despite the lack of direct sport-specific studies in this athletic group. Therefore, restricting transgender women from the female category of combat sport and transgender men from the male category is necessary and proportionate to the goal of ensuring fair, safe, and meaningful competition. Regardless of what the future will bring in terms of revised transgender policies, it is clear that different sports differ vastly in terms of physiological determinants of success, which should create sports-specific safety considerations and may alter the importance of retained performance advantages [12,44,46]. Combat sports carry extensive risks to support following these universal guidelines for transgender athletes in sports.

One of the essential components of athletic competition is fairness and integrity to the sport's rules. Combat sports distinguish competition between athletes based on two criteria: sex at birth and weight. While this does not guarantee a compelling, equal, or safe outcome, it is the most unbiased and utilitarian way to achieve fairness. Cis-males have biological advantages in most sports, and these differences are most significant at the professional and elite levels [24,68,73,76]. Administration of exogenous hormones, including testosterone suppression, has not been scientifically shown to eliminate this advantage [12,27,65,67,69,72,75], even in trans-females taking hormones for years [67,70,75,77,78]. Furthermore, many biological advantages in cis-males have not been evaluated in the literature or shown to significantly be affected by testosterone suppression [52], including skeletal morphology, heart and lung size, tendon stiffness,, anaerobic capacity, maximal power output and other factors that are known to impact physical performance [12,22,72,74]. This is an important point as Cheung et al [79] recently demonstrated that physical performance in terms of strength and VO2max between transgender and cis-gender controls can be minimized when controlling lean mass and weight, however, there remain many other factors that impact performance even if these were to be controlled for in competition [44,46]. Furthermore, the impact of training on changes seen with hormone therapy is still uncertain since this has not been studied in transgender athletes [80].

Combat sports are unique in their risk for acute and chronic skeletal, vascular, ophthalmological, and brain injuries. Athletes have died in the ring/cage or the immediate aftermath of a bout. The usual cause of death in these cases is a traumatic subdural hematoma. Therefore, the ARP's position on transgender athlete competition in combat sports is that only competitors of similar weight and with the same sex at birth compete against each other in combat sports. Until the scientific knowledge of gender transformation has evolved to a level where particular physiological advantages for cis- and trans- persons cannot meaningfully be distinguished, ARP will maintain this position to maximize the health and safety of all participants. The ARP recognizes that this science is ever evolving and reserves the right to update our stance based on the most recent evidence. The relevance of this topic in combat sports is constantly progressing. Scientific medical data is the foundation of any future ARP recommendations.

In this pivotal moment in the trajectory of sports and inclusivity, the significance of the ARP's position statement on transgender athlete competition in combat sports cannot be overstated. In an age characterized by nuanced discussions on identity, fairness, and equality, this declaration stands as a landmark testament to the evolving landscape of athletic competition. As society continues to traverse unchartered territories of gender recognition, the ARP's stance underscores the ethical responsibility to address this complex matter in combat sports. The statement's recognition of the ever-evolving nature of scientific knowledge displays a commitment to remaining at the forefront of progress, adapting to the most current evidence to shape its policies. This approach illuminates a path for all stakeholders invested in the intersection of sports and identity, offering a comprehensive foundation upon which decisions can be formulated.

Practical application for ringside physicians

Since athlete safety is the most important priority above considerations such as inclusion, conducting a proper risk assessment is imperative within combat sports that continue to include transgender women in the female category, or transgender men in the male category [9]. Those states or organizations that allow transgender women to compete against cis-women, or transgender men against cis-men in combat sports, neglect the inherent safety risks. Therefore, ringside physicians are encouraged to consider the following parameters:

- Encourage the use of non-binary identification of gender identity on physical exam forms to identify transgender and cisgender athletes.
- Raise concerns to athletes, coaches, sport regulators and other medical professionals about the safety concerns of cisgender vs transgender competition, including unfair physiologic differences, athletic performance, competition record, and athlete awareness of their opponent being transgender.
- Use supported data identifying that testosterone alone is an insufficient metric to ensure fair and safe competition between a transgender and cisgender combatant.
- Recognize that competition between transgender and cisgender athletes raises medicolegal risks to ringside physicians, promoters, matchmakers, and regulatory commissions due to elevated injury risk.

Qualifying statement

These guidelines are recommendations to assist ringside physicians, combat sports athletes, trainers, promoters, sanctioning bodies, governmental bodies, athletes and others in making decisions and setting policy. These recommendations may be adopted, modified, or rejected according to clinical needs and constraints and are not intended to replace local commission laws, regulations, or policies already in place. In addition, the guidelines developed by the ARP are not intended as standards or absolute requirements, and their use cannot guarantee any specific outcome. Guidelines are subject to revision as warranted by the evolution of medical knowledge, technology, and practice. They provide the basic recommendations that are supported by synthesis and analysis of the current literature, expert and practitioner opinion, commentary, and clinical feasibility.

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