Biological Integrity
Integrating the Mind and Body

FACT SHEET: MALE PARTICIPATION IN FEMALE SPORTS – HOW SPORTS PERFORMANCE IS IMPACTED BY BIOLOGICAL SEX

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Males have anatomic and physiologic advantages over females that impact sports performance across the lifespan.

1. **Genetics is the primary driver of sex differences.**
    a. Primary sex determination occurs at fertilization, is directed by genes on the X and Y chromosomes that are present in every nucleated somatic cell, and is not altered by drugs or surgical interventions.
    b. The same genes may be expressed differently in males versus females. There are, for example, over 3000 genes that are expressed differently in male and female skeletal muscles.[1]
    c. Sex hormones are also major contributors to differences in male and female athletic performance.

2. **The major sex steroid hormone that influences athletic performance is testosterone.**
    a. Testosterone production begins in the male testes by 2 months after conception prompting the development of the male reproductive organs which is completed by the 13th week of gestation.[2 (p. 2337)] It also affects many organ systems in the body, and helps develop regions of the brain where interconnectivity may give males advantages over females in coordination, spatial awareness, and control.[3]
    b. During a developmental stage called "minipuberty," there is an increase in serum testosterone in infant boys with a peak at 1 – 3 months after birth, followed by a decline to prepubertal levels by 6 – 9 months.[2 (p. 2337)]
    c. During puberty, testosterone levels greatly increase in males so that by age 18 years, boys have experienced a 30-fold increase in this sex hormone.[2 (p. 2338)] After puberty, male circulating testosterone concentrations are 15 times greater than those of females at any age.[4]
    d. Testosterone plays important roles in regulating brain development, bone mass and shape, fat distribution, muscle mass and strength, heart size, lung capacity, and the production of red blood cells.[2]
    e. The result is a clear male advantage in muscle mass, strength and circulating hemoglobin levels even after adjusting for sex differences in height and weight.[4]
    f. Exceptions to the clear male advantage in competitive sports include archery and shooting in which technical skill is more important than speed, strength, endurance or power.[2 (p. 2333)]

3. **Specific effects of testosterone include the following:**
    a. Males are generally taller, have greater lean body mass, lower percentage of fat, and longer upper and lower limbs with larger and denser bones than females.[2 (p. 2335)]
    b. Muscle mass on average is greater in males (38.4%) than in females (30.6%).[5]
    c. Females have lower percentages of muscle mass in the upper body (39.7%) compared with males (42.9%), but a higher percentage in the lower body (57.7%) versus 54.9% in males.[5]
    d. These anatomical differences provide greater leverage (greater torque) for muscular limb power to be exerted in jumping, throwing, and other explosive power activities in biological males.[4]
    e. Because of greater overall muscle mass, males demonstrate 15 – 50% greater anaerobic power in their lower limbs.[2 (p. 2335)]
    f. Muscle fibers are different with males having a higher proportion of Type II (fast twitch) fibers that allow muscles to contract faster.[5]
    g. Aerobic power is also greater in males, due to higher cardiac output. Maximum oxygen consumption is 5 – 10% higher in males.[2 (p. 2336)]
    h. Higher hemoglobin levels allow males to have increased oxygen carrying capacity.[3]
    i. Male lungs have greater vital capacity, total lung capacity and peak flows.[6]
    j. Female hearts are 26% smaller than male hearts and have 22% less cardiac output than male hearts.[7 (p. 3)]

4. **Research shows differences between the athletic abilities of boys and girls even before puberty.**
    a. A study of junior athletes (8 years old and under; and 9 - 10 years) in various running distances found, “In each distance and age group between 2016 and 2023, the individual fastest male was faster than the individual fastest female by 3.7 +/- 2.3%.” [8]
    b. A study of over 85,000 Australian children between 9 and 17 years demonstrated differences between young boys and girls, with 9-year-old boys running faster than girls in short sprints (9.8%) and in the mile run (16.6%), as well as jumping farther from a standing start (9.5%).[9 (p.201)]

5. **Research in adult athletes consistently shows when matched for training and age, males outperform females in speed, strength, endurance, and power.**[2 (p. 2328)]
    a. Evaluation of world records and best performances of events that rely on endurance and muscle power shows that males have a 10 - 30% advantage over females.[2 (p. 2332)]
    b. A literature review on sports performance differences between men and women elite athletes found the smallest performance gaps were seen in rowing, swimming, and running (11 - 13%)”. Performance gaps increased to 16% in cycling and to 18% in jumping events.[9 (p. 201)]

6. **Estrogen use by males results in physiologic changes but does not eliminate male athletic advantages.**
    a. Causes redistribution of fat, reduction in muscle mass, suppression of testosterone, reduction of hemoglobin levels [10]
    b. Cardiopulmonary function decreases but remains higher than females [10]
    c. Muscle strength decreases but remains higher than females even after 36 months of hormone "therapy" [11]
        i. In one study using MRIs, the male muscle mass decreased by 12% but still remained 13% greater than females.[12]
        ii. A review of 12 longitudinal studies revealed not one found muscle loss greater than 12%. This is small compared with the 40% greater muscle mass of males.[9 (p. 205-207)]

7. **Evaluation of males on estrogen and/or androgen suppressants shows performance decreases but remains higher than females.**
    a. "The 15-31% athletic advantage that transwomen displayed over their female counterparts prior to starting gender affirming hormones declined with feminising therapy. However, transwomen still had a 9% faster mean run speed after the 1year period of testosterone suppression that is recommended by World Athletics for inclusion in women's events." [13]
    b. A systematic search of research on "transgender women" found, "The data presented here demonstrate 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 removed by the current regimen of testosterone suppression permitting participation of transgender women in female sports categories. Rather, it appears that the male performance advantage remains substantial." [9 (p. 209)]

Conclusion

In athletic performance, males possess significant anatomical and physiological advantages over females which are present before birth, accelerate during puberty, and continue throughout life. This is especially true in terms of strength, power, endurance, and speed during and after puberty. These advantages are not eliminated by cross-sex hormones. Therefore, it is not safe or fair to allow male participation in competitive female sports which require strength, power, endurance and speed. Sports, such as shooting and archery, which do not exercise the aforementioned traits, may be safe and fair when carried out in a coed context even after puberty.

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