No. 24-38 and No. 24-43

In The Supreme Court of the United States

BRADLEY LITTLE, GOVERNOR OF IDAHO, *et al.*,
Petitioners,
v.

LINDSAY HECOX, *et al.*,
Respondents.

WEST VIRGINIA, *et al.*,
Petitioners,
v.

B. P. J., BY HER NEXT FRIEND AND MOTHER, HEATHER JACKSON.,
Respondent.

On Writs of Certiorari to the United States Courts of Appeals for the Ninth and Fourth Circuits

BRIEF OF *AMICI CURIAE* SPORT SCIENTISTS IN SUPPORT OF PETITIONERS

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INTEREST OF *AMICI CURIAE*[1]

Amici are sport physiology experts. They are Lara Carlson, founder and president of the Carlson Laboratory and a fellow of the American College of Sports Medicine, Glyn Howatson, professor in the Department of Sport, Exercise, and Rehabilitation at Northumbria University, Newcastle upon Tyne, Tommy Lundberg, docent in physiology and assistant senior lecturer in the Division of Clinical Physiology at Karolinska Institute, Kerry McGawley, professor in the Department of Health Sciences at Mid Sweden University, Marie Murphy, professor of exercise and health at Ulster University, and Jordan Santos-Concejero, associate professor in the Department of Physical Education and Sport at the University of the Basque Country.

Amici wish to apprise the Court of the research that they and others have conducted on human sexual dimorphism, athletic performance, and the physiological effects of testosterone suppression. They believe that the scientific evidence and the interests of competitive parity favor Petitioners' position.

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[1] Pursuant to this Court's Rule 37.6, counsel for *amici curiae* affirm that no counsel for a party authored this brief in whole or in part and that no person or entity other than *amici* and its counsel made a monetary contribution intended to fund the preparation or submission of this brief.

SUMMARY OF THE ARGUMENT

Sex-based categories for athletic competitions are the only scientifically defensible method for ensuring competitive parity between men and women. Men enjoy large physiological advantages over women. The male physiological advantage creates an observable athletic advantage of such magnitude that men and women cannot fairly compete against one another in any sport that relies on strength, speed, power, or aerobic capacity. The male athletic advantage begins in boyhood but accelerates during adolescence. Therefore, sporting bodies generally host separate events for adolescent and adult men and women.

Recently, some individuals and organizations have advocated a new set of categories based partly on testosterone levels. These categories purport to maintain fair competition while allowing athletes to compete in their preferred category. Yet there is no evidence that testosterone-based standards would maintain competitive parity. Rather, evidence shows that testosterone suppression does not erase the male advantage in athletics and that it does not diminish men's physiological advantage at all if paired with a sufficient regimen of physical exercise. This Court should therefore clarify that Title IX and the Equal Protection Clause do not require states to jettison sex-based standards in favor of unscientific alternatives.

ARGUMENT

I. Men have significant physiological advantages over women.

There are two human biological sexes: male and female. The male sex is the phenotype with a reproductive system that produces a smaller gamete (sperm). The female sex is the phenotype with a reproductive system that produces a larger gamete (the egg). *See, e.g.*, Aditi Bhargava et al., *Considering Sex as a Biological Variable in Basic and Clinical Studies: An Endocrine Society Scientific Statement*, 42 ENDOCRINE REV. 219, 221 (2016).

Physiologically, humans are sexually dimorphic. That means that an average adult human male (man) is physically different from an average adult human female (woman). *See* Emma N. Hilton & Tommy R. Lundberg, *Transgender Women in the Female Category of Sport: Perspectives on Testosterone Suppression and Performance Advantage*, 51 SPORTS MED. 199, 201 (2021). Normal differences between men and women affect muscle mass, tendon properties, bone geometry, lung capacity, and cardiac output. *See id.* at 202. In untrained and moderately trained persons, men average 33% more lower body muscle mass and 40% more upper body muscle mass than women. *See id.* Due to proportional differences in body composition, lean body mass in men averages 45% higher than in women. *See id.* Male tendons average 83% more force and 41% more stiffness. *See id.* Male bones are usually larger: for instance, femur average length is 9.4% higher, humerus average length is 12% higher, and radius average length is 14.6% higher. *See id.* Maximum lung ventilation averages 48% higher in men. *See id.* And maximum cardiac output averages 30% higher in men. *See id.*

The physiological differences between men and women correspond to differences in physical capabilities. Men are on average more than 50% stronger than women of the same age. *See* J. Alberto Neder et al., *Reference Values for Concentric Knee Isokinetic Strength and Power in Nonathletic Men and Women from 20 to 80 Years Old,* 29 J. ORTHOPAEDIC & SPORTS PHYSICAL THERAPY 116, 116–26 (1999)*;* Richard W. Bohannon et al.*, Handgrip Strength: A Comparison of Values Obtained from the NHANES and NIH Toolbox Studies,* 73 AM. J. OCCUPATIONAL THERAPY 1, 1–9 (2019). Some strength disparities are even more pronounced—men average 54% higher knee extension strength and 57% higher grip strength. *See* Hilton & Lundberg at 202. In the bicep muscle, men average 89% higher dynamic strength (ability of a muscle to generate force related to a one-repetition exercise) and 109% greater isometric strength (ability of a muscle to generate force in a static position). *See id.* at 204.

Moreover, these male advantages sometimes synergize. For example, the average power associated with a man's simulated punch motion exceeds that of a woman's punch by 162%, despite no single variable—such as arm length or muscle mass—achieving that magnitude of difference. *See id.* A recent study of moderately trained individuals found that even the least powerful man had a stronger punch than the most powerful woman under laboratory conditions. *See* Jeremy S. Morris, et al., *Sexual Dimorphism in Human Arm Power and Force: Implications for Sexual Selection on Fighting Ability*, 223 J. EXPERIMENTAL BIOLOGY (RESEARCH ARTICLE) 1, 1–7 (2020).

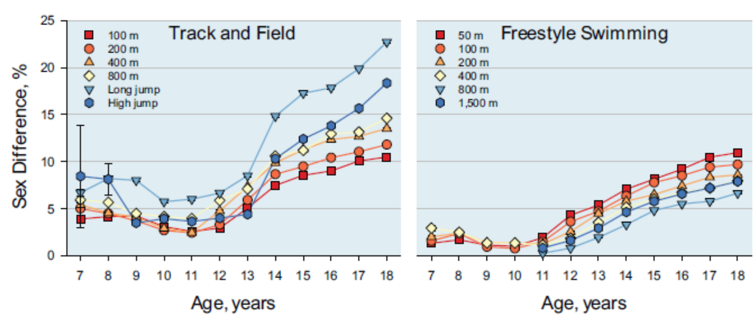
II. Men's physiological advantages confer athletic advantages over women.

The differences in physical capabilities between men and women result in a categorical athletic advantage for men in competitive sports.

The male athletic advantage begins in childhood. An average prepubescent human male (boy) is physically different from an average prepubescent human female (girl). Transient increases in sex hormones during infancy (so-called "minipuberty") are associated with increased growth, greater muscle mass, and greater muscle strength in boys relative to girls. *See id.* Those differences correspond to disparities in athletic performance. For example, among the best prepubescent athletes, boys outperform girls by 1-5% in swimming events, 3-5% in track and field events, and 5-10% in jumping events. *See id.* Data from testing over 85,000 Australian children show that boys had a 13.8% stronger grip and completed 33% more push-ups in a 30-second interval than girls. *See* Mark J. Catley & Grant R. Tomkinson, *Normative Health-Related Fitness Values for Children: Analysis of 85,347 Test Results on 9–17-Year-Old Australians Since 1985*, 47 BR. J. SPORTS MED. 98, 98–108 (2013).

Puberty magnifies the male-female performance gap. Testosterone levels begin to diverge between boys and girls when they are about 11 years old. *See* Michael J. Joyner et al., *Evidence on Sex Differences in Sports Performance*, 138 J. Applied Physiology 274, 277 (2025). When they are about 14 years old, there is no longer any meaningful overlap in testosterone levels between the two sexes. *See id.* By adulthood, testosterone concentrations ordinarily range between 0.1–1.7 nmol/L[2] in women and 7.7–29.4 nmol/L in men. *See* Tommy R. Lundberg et al., *The International Olympic Committee Framework on Fairness, Inclusion and Nondiscrimination on the Basis of Gender Identity and Sex Variations Does Not Protect Fairness for Female Athletes*, 34 Scandinavian J. Med. & Sci. Sports (Note), 1, 3 (2024). Testosterone exposure during adolescence makes male skeletal muscles bigger, stronger, and faster. *See* Joyner et al. at 277. It also increases bone size, strength, and density, and it increases red blood cell counts. *See id.* These changes drive the increased gap in athletic performance between men and women as compared to boys and girls. For example, increasing adolescent testosterone levels are almost perfectly correlated (r > 0.98) with the growth in the male-female performance gaps for swimming. *See id.* Figure 1 captures the increase in sex differences before, during, and after puberty in numerous track and field and freestyle swimming events:

Figure 1

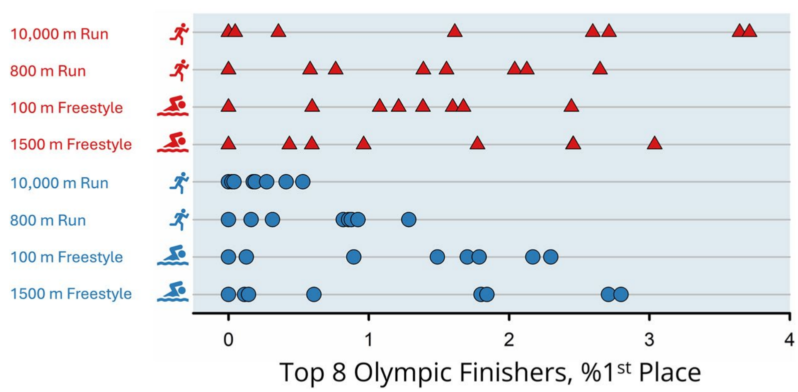


2 The unit nmol/L is nanomoles per liter and expresses the concentration of a substance in a solution.

Id. at 276.

Given the availability of public statistics on athletic performance for most major sports, the evidence of men's advantage is overwhelming. For context, elite sports generally feature a tiny margin of victory. At the 2020 Tokyo Summer Olympics, for example, the top three medal winners for both sex categories in four events—800-meter track running, 10,000-meter track running, 100-meter freestyle swimming, and 1500-meter freestyle swimming—each had finishing times within 1.1% of one another. *See* Joyner et al. at 275. Figure 2 displays the percentage difference between the top eight finishers in four Olympic categories for men (red) and women (blue):

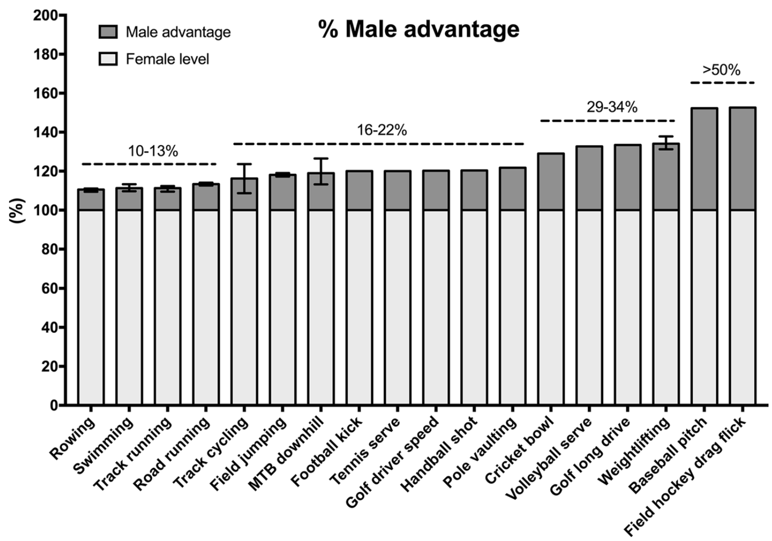
Figure 2



Id. Sports policy makers thus routinely regulate factors that confer an athletic advantage of even 1%. *See id.* at 274.

Yet depending on the activity, the magnitude of men's advantage in sport ranges between 10% to 50%. Hilton & Lundberg at 202. Figure 3 illustrates the male advantage relative to the female baseline in a variety of sports:

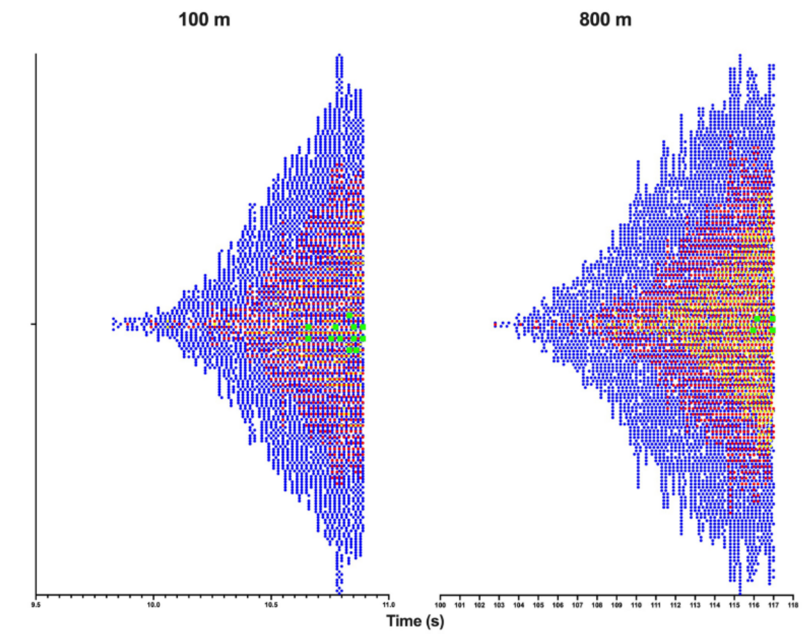
Figure 3



Id.

Thus, allowing men to compete in women's sports would displace the achievements of female athletes. In the sport of track and field, for instance, each year there are hundreds and usually thousands of men who run faster, jump higher, or throw further than the women's world record holder. Joyner et al. at 275. Figure 4 illustrates this fact by presenting the run times for the top-ranked female runners in the world (green) as compared to the run times for men under 18 (yellow), under 20 (red), and older (blue):

Figure 4



Lundberg et al. at 6.

In sum, men outperform women in sporting disciplines that rely on strength, speed, power, or aerobic capacity. *See* Joyner et al. at 275.

For all these reasons, sporting bodies have traditionally hosted separate events for men and women during and after adolescence. Separate categories allow for greater competitive parity for both sexes that adjusts for the immutable characteristic of sex. Though other immutable genetic traits besides sex exert some influence on athletic outcomes, such as height differences between persons of the same sex, those traits are exceptional characteristics that contribute to the talent or skill of an individual athlete. By contrast, sex differences are unexceptional yet extraordinarily significant in athletic settings. Categories that address the disparities between men and women by reference to a competitor's biological sex are thus commonplace in nearly all sporting events.

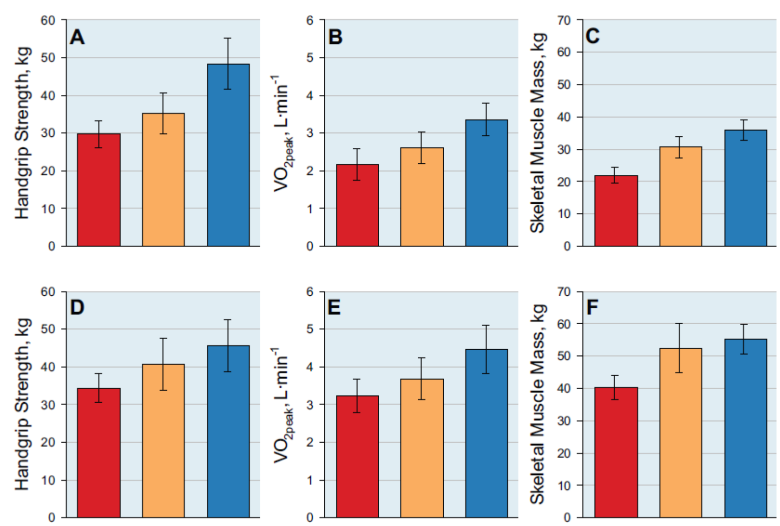
III. Testosterone suppression does not erase the male advantage.

In recent years, some individuals and organizations have advocated a new set of competition categories based partly on testosterone levels rather than sex. For example, in 2015, the International Olympic Committee required testosterone suppression below 10 nmol/L for one year before and during competition to qualify for women's sporting events. *See* Joanna Harper et al., *IOC Consensus Meeting on Sex Reassignment and Hyperandrogenism*, IOC (Nov. 2015), https://stillmed.olympic.org/Documents/Commissions_PDFfiles/Medical_commission/2015-11_ioc_consensus_meeting_on_sex_reassignment_and_hyperandrogenism-en.pdf. These categories allow persons who have undergone certain hormonal interventions to compete in their preferred category, while purporting to accomplish the competitive parity that sex-based categories achieve.

But there is no evidence that testosterone-based standards achieve competitive parity. Given men's large athletic advantage, the traditional separation of athletes by sex, and the new standards' stated goal of maintaining parity, one should expect evidence that testosterone-based standards achieve parity. Yet advocates for the new standards generally confront at least two problems. First, they cannot identify a physiological mechanism by which testosterone suppression could undo certain sex-based advantages. For example, there appears to be no biological means through which testosterone suppression could reduce height or skeletal measurements, which confer athletic advantages where height, limb length, and handspan are key (such as in basketball or volleyball). *See* Hilton & Lundberg at 205. Second, there is a widespread lack of empirical evidence that testosterone suppression does in fact equalize performance across sexes. For example, there is no evidence that testosterone suppression equalizes sex differences in endurance. *See id.* at 208.

Instead, the best available evidence shows that sexual disparities remain despite testosterone suppression. Twelve controlled longitudinal studies collectively show that testosterone suppression for one year in untrained or moderately trained individuals induces only a 5% loss of muscle mass or strength. *See* Lundberg et al. at 4. That loss accounts for a fraction—one-fifth or less—of the male advantage in strength and muscle mass. *See id.* For example, 83% of the male advantage in thigh muscle volume remains after one year of testosterone suppression. *See id.* Likewise, testosterone suppression does not affect bone mass over the course of at least two years. *See* Hilton & Lundberg at 205. One major cross-sectional study found that testosterone suppression over a mean duration of eight years was associated with 17% less lean mass and 25% lower peak quadriceps muscle strength than the male control group. *See* Bruno Lapauw et al., *Body Composition, Volumetric and Areal Bone Parameters in Male-to-Female Transsexual Persons*, 43 Bone 1016, 1016–21 (2008). But the final average lean body mass, after testosterone suppression, would still have rated in the top decile for women. *See* Hilton & Lundberg at 208. In the same study, grip strength in men after testosterone suppression was still 25% higher than in women. *See* Bruno Lapauw et al. at 1016–21. Figure 5 depicts the handgrip strength, maximal aerobic capacity, and skeletal muscle mass of two tested populations, with blue representing men, the orange representing those undergoing testosterone suppression, and the red representing women:

Figure 5



Joyner et al. at 278.

Even over long timescales, hormonal interventions do not erase the male-female performance gap. While most longitudinal studies have reported a decline in muscle, lean mass, and strength after one year of testosterone suppression, the net loss does not significantly change over the next four years. *See* Tommy R. Lundberg and Andrea Tryfonos et al., *Longitudinal Changes in Regional Fat* *and Muscle Composition and Cardiometabolic Biomarkers over 5 Years of Hormone Therapy in Transgender Individuals*, 297 J. Internal Med. 156, 169 (2025). That result suggests that the effects of testosterone suppression plateau in later years. The maximum timeframe of current longitudinal studies is five years of testosterone suppression, at which point the male advantage in muscle mass and strength is still present. *See id.* at 160. In cross-sectional studies, the male advantage is still evident in persons who have suppressed testosterone for up to 14 years. *See* Lundberg et al. at 4.

Not only does testosterone suppression fail to erase the male advantage, it can have no effect at all if adequate training routines are followed. In one randomized placebo-controlled study, testosterone suppression lasted for three months and was paired with a three-day-per-week athletic training regimen during the final eight weeks. *See* Thue Kvorning et al., *Suppression of Endogenous Testosterone Production Attenuates the Response to Strength Training: A Randomized, Placebo-Controlled, and Blinded Intervention Study,* 291 AM. J. PHYSIOLOGY-ENDOCRINOLOGY & METABOLISM, E1325–1332 (2006). At the end of the study, despite testosterone suppression to female levels of 2 nmol/L, the test subjects experienced a +4% increase in lean leg mass and a +2% increase in overall lean body mass. *See id.* In select exercises, the improvement was larger: by the end of the study period, test subjects were able to leg press 32% more weight and bench press 17% more weight. *See id.* Similarly, a 12-week training study of men undergoing testosterone suppression found increased lean body mass (+3%), thigh muscle volume (+6%), knee extension strength (+28%), and leg press muscle endurance (+110%). *See* Erik D. Hanson et al., *Strength Training Induces Muscle Hypertrophy and Functional Gains in Black Prostate Cancer Patients Despite Androgen Deprivation Therapy*, 68 J. Gerontology: Series A, Biological Sci. & Med. Sci. 490, 490–498 (2013). These results suggest that hormonal suppression could have less physiological impact among athletes, who exercise regularly.

Thus, the available scientific evidence indicates that competitive parity requires a sex-based distinction between men's and women's sports. The notion that testosterone-based standards achieve parity lacks theoretical and empirical support. Rather, longitudinal and cross-sectional studies suggest that hormonal interventions do not bridge the athletic chasm between men and women. Worse, consistent exercise can negate the athletic effects of testosterone suppression, rendering such standards competitively meaningless.

This Court should therefore clarify that Title IX and the Equal Protection Clause do not require states to jettison sex-based standards in favor of unscientific alternatives.

CONCLUSION

This Court should reverse the decisions below.

Respectfully submitted,

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