Friday, November 11, 2022

[redacted]

My name is Greg Brown, and I am a Professor of Exercise Science at the University of Nebraska at Kearney. I earned a Bachelor of Science in Physical Education (pre-Physical Therapy emphasis) from Utah State University in 1997, a Master of Science in Exercise and Sport Science (Exercise Physiology Emphasis) from Iowa State University in 1999, and a Doctor of Philosophy in Health and Human Performance (Biological Basis of Health & Human Performance emphasis) from Iowa State University in 2002. I am a Fellow of the American College of Sports Medicine and an American College of Sports Medicine Certified Exercise Physiologist. My research and teaching focus on Exercise Physiology and Sports Nutrition. I have previously provided expert testimony for the legal cases of Soule v. Connecticut Association of Schools, Hecox v. Little (in Idaho), B.P.J. v. West Virginia State Board of Education, and L.E. v. Lee (in Tennessee) and before several state legislative bodies regarding the inclusion of transwomen in women's sports. I have also presented on this topic at the American Physiological Society 2021 conference on New Trends in Sex & Gender Medicine, and have reviewed scholarly manuscripts on this topic for several peer reviewed journals.

This statement represents a considerably abbreviated summary of my expert report in the case of B.P.J. v. West Virginia State Board of Education (which can be found at this link, on the Alliance Defending Freedom website). This statement represents my own analysis of the available science and does not represent an official statement from the University of Nebraska.

I have three main points to make in this statement, and they are: 1) Eons of human experience and thousands of research studies show that there are important biological differences between human males (boys & men) and human females (girls & women), 2) these biological differences confer inherent athletic advantages to boys & men, and 3) the athletic advantages conferred by male biology are not erased by transgender identification and the use of cross sex hormones.

Sex is an important biological factor that is determined at conception based on the presence of XX or XY chromosomes. Although there are differences of sexual development (sometimes called disorders of sexual development) in which biological sex is ambiguous at birth, these conditions are rare (approximately 0.017% of all births) and are a separate issue from gender dysphoria in which a person's perception of gender does not match their biological sex [1-3]. In the 2021 paper *Considering Sex as a Biological Variable in Basic and Clinical Studies: An Endocrine Society Scientific Statement* [4] the authors state that "Sex is dichotomous", "a clear causative biological underpinning of gender identity remains to be demonstrated", and "sex often influences gender [identity], but gender [identity] cannot influence sex." The importance of biological sex on growth, development, health, and risk of disease has been a point of emphasis in research and clinical application from the National Institutes of Health, Institute of Medicine, and most other medical and biologically based scientific professional societies for almost 30 years [3,5]. Indeed, every cell has a sex and every system in the body is influenced by sex.

Briefly summarized, boys & men have more muscle mass, have higher bone mineral density, less fat mass, have larger hearts and lungs, and are bigger, faster, and stronger than comparably aged and trained girls & women. This information has been well established by human experience, in innumerable research papers, and can be found in pretty much any textbook on the topic of Exercise Physiology or Fitness Testing.

Fitness testing in children as young as 3 years old shows that boys perform better than girls of the same age on tests of muscular strength, muscular endurance, and aerobic fitness [6-11]. The youth records from USA Track and Field show boys outperforming girls in every age group from 8 & under through 17-18 years old and in every event [12]. Comparing competitive performance after age 11, boys and men run 10-15% faster than girls & women, jump 15-20% longer and higher, and can lift 30-60% more weight than comparably aged and trained girls and women [13-26]. To help put this into perspective, based on NCAA Outdoor Championship running performance, the typical time difference between first place and second place is often 0.5-0.7% or less, and the difference between a gold medal and no medal is typically less than 2%.

Some will argue that if biological males take puberty suppressing or testosterone suppressing drugs and cross-sex hormones the athletic advantages conferred by male biology are erased, but that argument is not supported by research. Of eleven separate research studies published since 2015 measuring the effects of male-to-female hormone administration on muscle strength, three showed no decrease in muscle strength after 12 months of androgen suppression and cross-sex hormone use [27-29], five others show only a 4-9% reduction in muscle strength [30-34] after 6-24 months of androgen suppression and cross-sex hormone use (keep in mind that men are typically 30-60% stronger than women). The handgrip strength in these studies showed that the male-to-female transwomen were weaker than most comparably aged men but were stronger than 95% of comparably aged women, even after 2 years of androgen suppression and cross-sex hormone use. A single study indicates that even after 14 years of male-to-female hormone use biologically male transwomen were still 18% stronger than comparably aged women [35]. In a study of transgender US Air Force personnel Roberts et al. [36] reported that after 2 years of androgen suppression and cross-sex hormone use the difference between females and males in the number of sit ups and pushups performed in 1 minute was erased. In contrast, in another study of transgender US Air Force personnel Chiccarelli et al. [37] indicates that even after 4 years of androgen suppression and cross-sex hormone use the biologically male subjects still performed more pushups and sit-ups in 1 minute than did comparable women.

There is less data on endurance performance. To date only 1 study has measured VO_2max, (a critical determinant of endurance performance) in male-to-female transgender subjects, and the data indicate that even after 14 years of testosterone suppression and cross-sex hormone use the absolute VO_2max was 20% higher in the biologically male transwomen than in comparable women. Roberts et al. [36] reported that, in transwomen US Air Force personnel, running performance was still 12% faster in the biologically male subjects than comparably aged women even after 2 years of testosterone suppression and cross-sex hormone use. In contrast Chiccarelli et al. [37] reports that after 2 years of testosterone suppression and cross-sex hormone use in male-to-female US Air Force personnel the difference between females and males in the time to run 1.5 miles was erased. Collectively, it's difficult to say conclusively how testosterone

suppression and cross-sex hormone use influence endurance performance, but the currently available data suggest that male advantages are not entirely erased even after several years.

Keeping in mind that men typically have 30-40% more muscle mass than women, a number of longitudinal research studies show that male-to-female hormone use only reduces muscle mass by 4-12% over the course of up to 3 years [27,28,30,31,34,38-46]. Finally, four recent review papers [1,17,47,48], an in-depth evaluation by World Rugby [49] another by FINA [50] (the international federation for administering international competitions in water sports), and another by the United Kingdom Sports Councils [51] summarized the research on the changes in physiological factors that influence athletic performance and how these factors are affected by male-to-female hormone use, and all came to the same conclusions; that a year or more of testosterone suppression and cross-sex hormone use does not erase the inherent athletic advantages biologically conferred upon males. World Rugby further concluded that transwomen cannot safely be included in women's rugby due to the inherent advantages conferred by biological male sex [49]. The FIMS (International Federation of Sports Medicine) 2021 Consensus Statement on Integrating Transwomen and Female Athletes with Differences of Sex Development (DSD) into Elite Competition concludes that while "trans athletes have a right to participate in sports, cisgender women have a right to participate in a protected category of sport [1]."

Of relevance to middle and high school sports, it is well known and demonstrated that males in this age group outperform females on tests of muscular strength, muscular endurance, aerobic fitness, and in most areas of athletic performance [6-11,15,26]. McManus and Armstrong [52] stated it well when they wrote "Sexual dimorphism underlies much of the physiologic response to exercise" and "Young girl athletes are not simply smaller, less muscular boys." It is also important to note that a male-to-female individual will never experience a menstrual cycle, or exercise induced amenorrhea, both of which cause variations in hormones that can have profound effects on health and athletic performance [53]. In the only paper evaluating muscle strength in transgender youth, Tack et al. [29] observed that in 16-year-old male-to-female subjects the use of anti-androgens attenuated the age associated increases in handgrip strength and muscle mass, but did not eliminate the advantages in muscle mass, body composition, and strength inherent to biological males. Another paper demonstrated that after 8 years of puberty blockers and cross sex hormones administered to teenagers through early adulthood male advantages in lean body mass were not eliminated [54]. And finally, a recent paper demonstrated that the use of puberty blockers and cross sex hormones administered to teenagers through early adulthood did not eliminate male advantages in adult body height [55]. Although it is currently unknown how the use of puberty blockers and cross sex hormones in children influences athletic performance, the current evidence indicate that puberty blockers and cross sex hormones do not eliminate inherently male biological factors that contribute to male athletic advantages.

In summary, males have undeniable biologically based athletic advantages over females in almost all sports, and research currently indicates that neither transgender identity nor extended use of puberty blockers, testosterone suppression, and cross-sex hormones erases those advantages.

Sincerely,

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