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Most Americans Significantly Underestimate the Performance Gap between Elite Male and Female Athletes

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Abstract

Widely established evidence shows that anatomical and physiological sex differences favor males over females in nearly every athletic event, yet a small number of researchers have put forth widely publicized claims of an inherent female advantage in many athletic events. The present study assessed the beliefs of a representative sample of 300 U.S. adults for each of four athletic events (1500-m run, 100-m dash, long jump, and 800-m swim). Participants were asked, “In [this event], the world record for professional women is closest to the world record for males of what age?” The correct answer for each event is age 14, yet, for each event, at least 64% of participants indicated that the women’s record was closest to the record for males of age 18 or older (median = age 20). This stark and pervasive misconception indicates that many people in the U.S. and perhaps elsewhere sharply underestimate the contribution of biology to the male-female performance gap in athletics. By extension, this finding suggests that many people underrate the impact of allowing biological males to compete in female-only sports.

Keywords: Misconception, Performance, Gap, Sex, Male, Female, Athletics

Introduction

Elite male athletes outperform elite female athletes in events requiring speed, strength, and endurance, and this performance gap is widely attributed to anatomical and physiological sex differences that emerge during puberty [1] (Cheuvront et al., 2005; Hunter et al., 2023; Seiler et al., 2007; Thibault et al., 2010). To be sure, the best women in any athletic event can easily defeat most men, but elite men outperform elite women by a large margin. In fact, in nearly every Olympic track and field or swimming event, the women's world record is closest to the record for boys of age 13 or 14 (Table S1). Furthermore, the male-female record gaps in these events have not narrowed since the 1980s (Figure 1; Hunter et al., 2023; Rohrer, 2024; Seiler et al., 2007; Thibault, 2010).

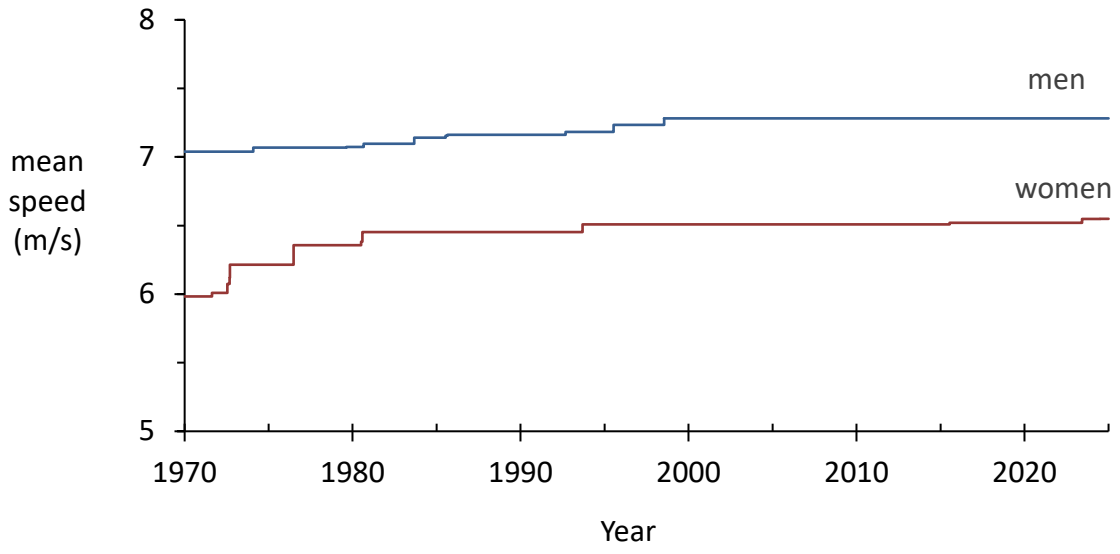

Figure 1. *Progression of world records in the 1500-m run.* The women's record improved rapidly during the 1970s and early 1980s, as women athletes received more opportunities and support, but the record gap has since remained roughly unchanged. Records ratified by World Athletics. Time span equals 1 January 1970 through 1 January 2025.

[1] In this report, males have XY chromosomes, and females have XX chromosomes.

Despite the evidence for an inherent biological male advantage in sport, a few researchers have argued that sex differences favor women over men in some athletic events. For instance, decades ago, two teams of researchers predicted in the scientific journal *Nature* that the men-women world record gap in several running events, including sprints, would narrow and ultimately reverse (Tatem et al., 2004; Whipp & Ward, 1992). Both predictions relied on inappropriate and deceptive methods (Cheuvront et al., 2005; Reinboud, 2004; Rohrer, 2024), and both predictions failed. In fact, the men-women records gaps in every Olympic running event ceased narrowing *before* these predictions were published (e.g., Figure 1; Hunter et al., 2023; Rohrer, 2024; Seiler et al., 2007; Thibault, 2010).

Other researchers have asserted that physiological sex differences favor women over men in endurance contests such as ultramarathons, which are running races of at least 50 km (e.g., Bam et al., 1997; Beneke et al., 2005; Ocobock & Lacy, 2023). These authors, however, simply omitted much of the relevant evidence, including the sex differences that favor men over women in endurance running, including longer limbs, less body fat, and higher VO_2 max (Cheuvront et al., 2005; Hunter et al., 2023; Seiler et al., 2007). Moreover, world records plainly show that the men-women percentage gap does not shrink at longer distances. In fact, whereas the men-women world record gap in sprinting events is about 11%, the record gap in most ultramarathon events exceeds 13% (Table S2). Again, these authors' unfounded claims conflict with the prevailing view. In a recent consensus statement from the American College of Sports Medicine, 10 experts examined the evidence and concluded, "In athletic events and sports relying on endurance, muscle strength, speed, and power, men typically outperform women because of fundamental sex differences dictated by sex chromosomes at puberty, in particular, testosterone" (Hunter et al., 2023, p. 2328).

To be clear, the arguments for a female advantage in some athletic events have been put forth by only a number of researchers, often without peer review, but their claims have been widely reported through English-language popular media. The aforementioned predictions of

women's records surpassing men's records were reported by the news media worldwide, but the failures of these claims have received little attention. The assertion that women are better suited than men to endurance events appears frequently throughout the popular press and Internet, yet the broadly accepted evidence for a male advantage in nearly every athletic event receives far less attention.

In light of the pervasive false claims about men and women athletes, the present study assessed the preregistered hypothesis that nonexperts will underestimate the male-female performance gap in athletics. A representative sample of 300 U.S. adults estimated the male-female gap in each of four Olympic events (1500-m run, 100-m dash, long jump, 800-m swim). Rather than ask participants to quantitatively estimate the size of the men-women record gap (e.g., "men are 10% faster" or "men are 2 seconds faster"), which requires expertise about the event, participants were asked, "In [this event], the world record for professional women is closest to the world record for males of what age?" The correct answer for each event is age 14.

Method

Transparency and Replicability

The hypothesis, method, and analyses were preregistered (https://osf.io/7vgt4). Materials and data are publicly available (https://osf.io/qr6te/). Analyses excluded data from participants who did not complete the survey, as noted below, but all other collected data are reported accurately. The study was conducted twice because the first iteration inadvertently lacked two elements of the preregistered method (question order was not randomized, and the participant sample was not stratified by political affiliation). Both iterations of the study showed the same error, though the mean response was unreliably greater in the first iteration than in the second. The study was approved by the Institutional Review Board at the University of South Florida. None of this written report has been plagiarized from work by someone who is not an author. None of the research or writing was assisted by A.I.

Participants

The sample consisted of 300 adults recruited though the company Prolific. Another 15 participants began but did not finish the survey, and their data were excluded from all analyses. Participants resided in the U.S. and understood English. Their age, sex, and political affiliation were provided by Prolific and represented the population of U.S. adults (Table 1).

Table 1

Participants' Age, Sex, and Political Affiliation (n = 300)

	Age (years) [a]									
	18–24		25–34		35–44		45–54		55–85	
	M	F	M	F	M	F	M	F	M	F
Democrat	5	6	8	7	7	7	6	6	17	20
Independent	9	9	14	13	13	13	10	10	17	19
Republican	4	4	6	5	5	5	7	7	19	22
Total	18	19	28	25	25	25	23	23	53	61

[a] Mean = 45.6, SD = 15.8, Range = 18–85

Materials

The four events were chosen so that the events required varying mixtures of speed, power, and endurance. The selection was limited to Olympic events in swimming or track and field. Events not considered include running races with hurdles or barriers (which are higher for men than women and thus preclude direct comparison of male and female performance), throwing events such as the shotput and discus (which are heavier for men than for women), running races of at least 5000 m (which are rarely contested in meets for athletes under the age of 16), and events for which the women's world record is closest to the world record for males of age 13 rather than age 14, as the selection of the former events would have likely led to larger observed errors and thus worked in favor of the hypothesis.

Procedure

Participants were required to complete the online survey on a computer or tablet. Any cheating by participants, such as obtaining answers from the internet or another person, would have weakened the observed finding. The order of the four questions was randomized for each participant. Participants were forced to answer each question before they saw the next question, and they could not return to a prior question. Each question included a dropdown menu with answer choices ranging from ages 1 through 27 in 1-year increments, thus ensuring that the middle choice equaled the correct answer of 14. The survey concluded with an attention check item that all participants answered correctly. Screenshots of the survey appear in the supplementary materials.

Results

For each athletic event, 91%–94% of participants indicated that the women's world record is closest to the world record for males *older* than the correct answer of age 14, and 64%–70% chose an age of 18 or older. Participant's estimates in each event correlated positively with their estimates in other events (for all six pairwise comparisons in the four events, $r > 0.6$, $p < .001$). The magnitude of participants' estimates did not correlate with their age, sex, or political affiliation. Details are provided in Table 2 and Figure 2.

Table 2

Participants' Estimates (years)

	Mean	SD	Cohen's *d* [a]	Median	Interquartile
1500-m run	20.08	4.09	1.49	20	16 – 24
100-m dash	19.68	4.20	1.35	19	16 – 23
long jump	19.74	4.12	1.39	19	16 – 23
800-m swim	19.85	3.87	1.51	20	17 – 23

[a] Cohen's *d* = difference between mean and correct answer (age 14), measured in *SD* units.

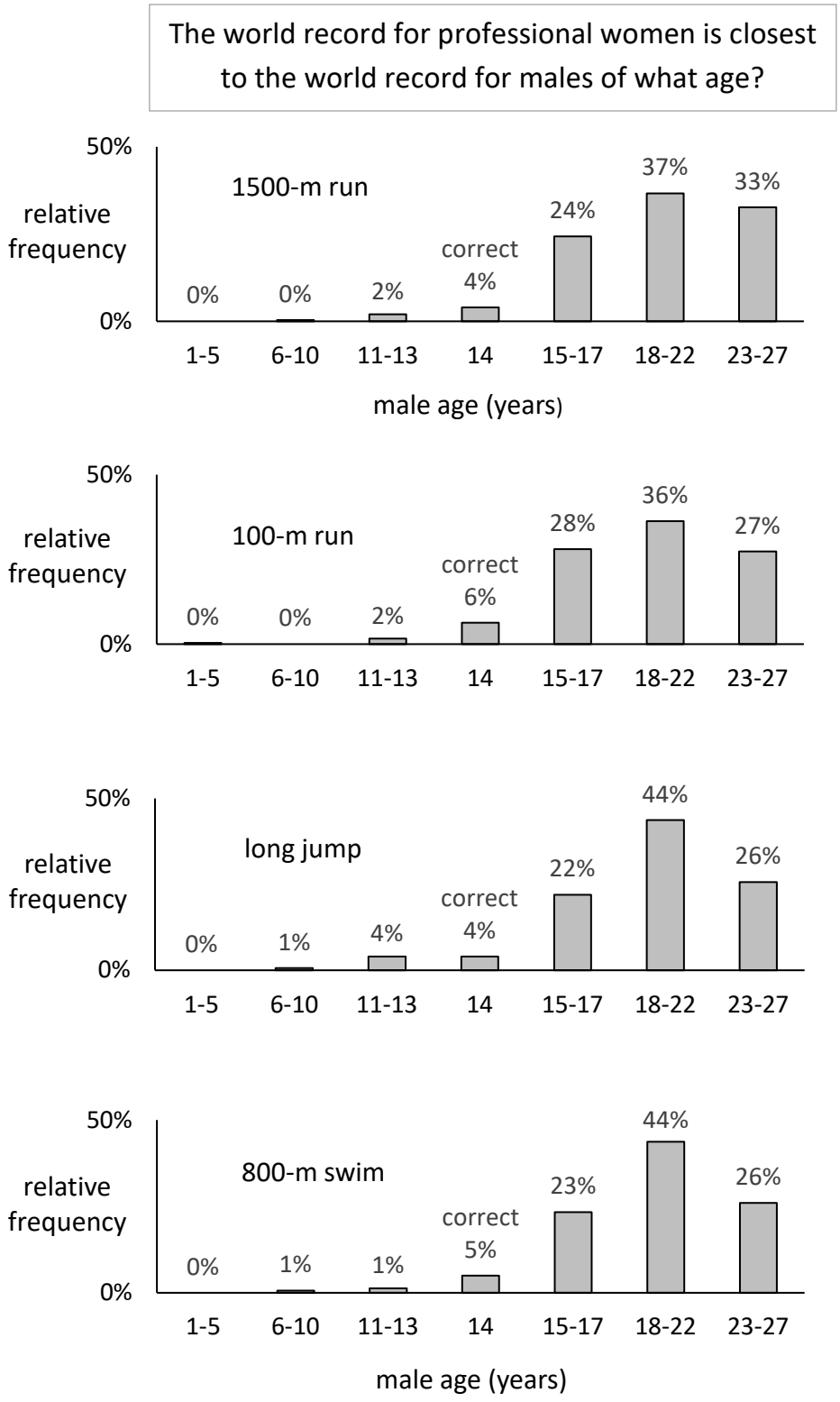

Figure 2. *Distribution of responses*. Values are rounded to the nearest one percent and thus do not necessarily sum to 100%. Summary statistics are given in Table 2.

Discussion

For each of four athletic events, about 2 in 3 participants indicated that the elite women perform as well as elite males of at least age 18, when, in fact, the women's record is approximately equal the record for boys of age 14. This blatant misconception suggests that most people in the U.S. and perhaps elsewhere markedly underestimate the performance gap between elite male and female athletes, and this in turn suggests that they underappreciate the anatomical and physiological sex differences that underlie this gap. The origin of this misconception is unknown, but it might be due at least partly to the small number of academics who have asserted that females have an inherent advantage over males in many athletic events. These claims conflict with the established evidence yet nevertheless receive disparate attention from the English-language news media and appear frequently throughout the internet.

Some of the claims for female superiority in certain athletic events might be charitably attributed to the authors' lack of familiarity with the relevant literature and the performance data, but the deceptive practices underlying these claims indicate that a more plausible explanation is bias. For instance, all but one of the published claims that were cited in the Introduction were marred by the blatant cherry picking of evidence that always worked in favor of the authors' argument (Cheuvront et al., 2005; Reinboud, 2004; Rohrer, 2024), and this is a telltale sign of researcher bias (Gelman, 2018; Jussim & Honeycutt, 2023; Simmons et al., 2011; Wicherts, 2017). The publication of these claims also might reflect the political bias of the editors or reviewers who invited or recommended publication (e.g., Clark et al., 2023; Jindra & Sakamoto, 2023).

Many published arguments for a biological female advantage in sport did not undergo peer review yet nevertheless in reputable outlets. The widely disseminated predictions that elite women would overtake elite men appeared in the scientific journal *Nature* (Tatem et al., 2004; Whipp & Ward, 1992), but each analysis seems to be a kind of correspondence rather than a peer-reviewed scientific article. A recent argument that women are better suited than men to

long endurance events, primarily because of estrogen, was the cover story of the U.S. magazine *Scientific American* (Ocobock & Lacy, 2023) and thus avoided the scrutiny of peer review required by scientific journals. In other cases, academics avoid peer review by placing their claims in a book, as did two academics who recently argued that the male-female performance gap in athletics has no basis in biology and is instead due solely to social factors (Bekker & Mumford, 2025).

Finally, the misconception reported here has obvious implications for the controversy surrounding biological males who identify as females and compete in female-only sports. Simply put, people who underestimate the male-female performance gap in athletics almost certainly underrate the impact of allowing males to compete in female-only sports. This raises the possibility that some people would alter their views on this contentious issue if they fully appreciated the magnitude of the male-female performance gap in athletics. After all, many people understand that athletic competition between 12- and 17-year-old boys is a mismatch and thus support segregation of sport by age, and thus they might support segregation by sex as well if they knew, for example, that the performance gap between 12- and 17-year-old boys is *smaller* than the gap between 17-year-old girls and 17-year-old boys. To be sure, this politically charged issue is a question of policy rather than science, but the public can better evaluate the consequences of a policy when scientists faithfully report the evidence.

References

Bam, J., Noakes, T. D., Juritz, J., & Dennis, S. C. (1997). Could women outrun men in ultramarathon races? *Medicine and Science in Sports and Exercise, 29*(2), 244–247. https://doi.org/10.1097/00005768-199702000-00013

Bekker, S., & Mumford, S. (2025). *Open play: The case for feminist sport.* Reaktion.

Beneke, R., Leithäuser, R. M., & Doppelmayr, M. (2005). Women will do it in the long run. *British Journal of Sports Medicine, 39*, 410. https://doi.org/10.1136/bjsm.2004.017574

Cheuvront, S. N., Carter, R., DeRuisseau, K. C., & Moffatt, R. J. (2005). Running performance differences between men and women. *Sports Medicine, 35*, 1017–1024. https://doi.org/10.2165/00007256-200535120-00002

Clark, C. J., Jussim, L., Frey, K., Stevens, S. T., al-Gharbi, M., Aquino, K., Bailey, J. M., Barbaro, N., Baumeister, R. F., Bleske-Rechek, A., Buss., D., Ceci, S., Del Giudice, M., Ditto, P. H., Forgas, J. P., Geary, D. C., Geher, G., Haider, S., Honeycutt, N., ... & von Hippel, W. (2023). Prosocial motives underlie scientific censorship by scientists: A perspective and research agenda. *Proceedings of the National Academy of Sciences*, *120*(48), e2301642120. https://doi.org/10.1073/pnas.2301642120

Gelman, A. (2018). Ethics in statistical practice and communication: Five recommendations. *Significance*, *15*(5), 40–43. https://doi.org/10.1111/j.1740-9713.2018.01193.x

Hunter, S. K., Angadi, S. S., Bhargava, A., Harper, J., Hirschberg, A. L., Levine, B. D., Moreau, K. L., Nokoff, N. J., Stachenfeld, N. S., & Bermon, S. (2023). The biological basis of sex differences in athletic performance: Consensus statement for the American College of Sports Medicine. *Medicine and Science in Sports and Exercise, 55*(12), 2328–2360. https://doi.org/10.1249/MSS.0000000000003300

Jindra, M., & Sakamoto, A. (2023). When ideology drives social science: Statistical cherry-picking and malfeasance are rife. *Chronicle of Higher Education*. https://www.chronicle.com/article/when-ideology-drives-social-science

Jussim, L., & Honeycutt, N. (2023). Psychology as science and as propaganda. *Psychology Learning and Teaching, 22*(3), 237–244. https://doi.org/10.1177/14757257231195347

Ocobock, C., & Lacy, S. (2023). The theory that men evolved to hunt and women evolved to gather is wrong. *Scientific American*, *329*(4), 22–29. www.scientificamerican.com/article/the-theory-that-men-evolved-to-hunt-and-women-evolved-to-gather-is-wrong1/

Reinboud, W. (2004). Linear models can't keep up with sport gender gap. *Nature, 432*, 147. https://doi.org/10.1038/432147a

Rohrer, D. (2024). Researcher bias and the enduring gap between the world's fastest men and women. *Frontiers in Physiology*, *15,* 1360731. https://doi.org/10.3389/fphys.2024.1360731

Seiler, S., De Koning, J. J., & Foster, C. (2007). The fall and rise of the gender difference in elite anaerobic performance 1952-2006. *Medicine and Science in Sports and Exercise, 39*(3), 534–540. https://doi.org/10.1249/01.mss.0000247005.17342.2b

Simmons, J. P., Nelson, L. D., & Simonsohn, U. (2011). False-positive psychology: Undisclosed flexibility in data collection and analysis allows presenting anything as significant. *Psychological Science*, *22*(11), 1359-1366. https://doi.org/10.1177/0956797611417632

Tatem, A. J., Guerra, C. A., Atkinson, P. M., & Hay, S. I. (2004). Momentous sprint at the 2156 Olympics? *Nature, 431*(7008), 525. https://doi.org/10.1038/431525a

Thibault, V., Guillaume, M., Berthelot, G., El Helou, N., Schaal, K., Quinquis, L., Nassif, H., Tafflet, M., Escolano, S., Hermine, O., & Toussaint, J.-F. (2010). Women and men in sport performance: the gender gap has not evolved since 1983. *Journal of Sports Science & Medicine, 9*, 214–223.

Whipp, B. J., & Ward, S (1992). Will women soon outrun men? *Nature, 355*(6355), 25. https://doi.org/10.1038/355025a0

Wicherts, J. M. (2017). The weak spots in contemporary science (and how to fix them). *Animals 7(12)*, 90. https://doi.org/10.1177/09567976221083219