

# Physiology Does Not Explain All Sex Differences in Running Performance

Sex differences in elite athletic performance have been of long-standing interest to physiologists. For example, the 10%–12% sex gap observed for most running world records and elite competitions spurred numerous studies on the contributors to maximal oxygen consumption (4). Moreover, the sex gap varies substantially across sports and age groups, and this variation has stimulated further physiological hypotheses (4,5).

There is a potential problem, however, with using elite performances as physiological indicators: the population size of potential competitors has a massive effect on what reaches the threshold of a world record or elite performance (1,4). Thus, gender gaps in athletic performance could reflect that fewer females are competing.

Although scholars have acknowledged the potential importance of differential participation in the sex gap, the new study by Hunter and Stevens (3) is apparently the first to quantify it. These authors assessed the performances of the top 10 male and female finishers in each age group in the New York City marathon from 1980 to 2010. As expected, among the first place finishers in the younger age groups, the sex gap was about 12%, near physiological expectation. However, the gap became much larger in older age groups and with increasing place (i.e., 1st vs 10th). These patterns seemingly cannot be fully accommodated by physiological mechanisms. Because the ratio of male-to-female participants decreased over time and varied across age groups, Hunter and Stevens were able to demonstrate that more than one third of the variation in the sex gap was due to sex differences in participation. Even more crucially, the regression equation indicated that if there was no difference in participation, the sex gap would revert to physiological expectation for the top 10 finishers in each age group.

One implication of the new study is that scientists studying sex differences in elite performance across sports and age groups should be exceedingly cautious in using such results as the basis

for physiological hypotheses (e.g., aging women undergo more rapid physiological deterioration than aging men). This caution applies especially to sports with a pronounced male bias in participation. Conversely, small or nonexistent gender gaps in some disciplines (e.g., ultramarathon running) should be initially considered products of small participant pools, rather than indicating physiological phenomena. Another implication is that the age-graded calculators that are often used by race directors and statisticians to compare men's and women's performances will be substantially biased if there is a sex difference in participation.

A caveat must be noted about this study: its finding that participation and physiology account for virtually all sex gaps in the New York City marathon does not seem to generalize to other races and populations of distance runners. In particular, I have demonstrated that, in the United States, the sex difference in performance depth occurs consistently in recreational, high school, collegiate, and professional populations (2). The difference is large, with roughly three males running within 10% or 25% of the male world record (or similar elite standard) for every female running within the corresponding female record. This difference is too large to be accounted for by sex differences in participation, which are generally modest (approximately 20% in high school) or absent (collegiate and recreational). I have argued that the most parsimonious explanation for this pattern is that more male than female distance runners are motivated to maintain the large training volumes and intensive training needed for elite performances. Other possibilities are certainly conceivable, such as a greater proportion of males possessing the physiological and biomechanical traits necessary for elite running. Hopefully these hypotheses will receive attention soon.

In conclusion, although scholars will continue to draw on sex differences in elite performances to test and generate hypotheses, the new research shows that the diversity of hypotheses can and should be expanded.

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