ANY OLYMPIC JUMP THAT WOMEN CAN DO, MEN CAN DO NEARLY 20% BETTER

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Men clearly outperform women in events that depend on moving the body's mass through space. However, the between-sex differences may vary with event specific mechanical demands. Existing observations suggest between-sex differences are relatively greater for jumping than running events. We tested this sytematically by comparing the top 50 performances for men and women in Olympic running (n=9) and three jumping (n=3) events over a recent 15-year period. We found that mean male–female difference across the three jumping events (17.8± 2.7%) was 1.5 times greater than the respective mean for the nine running events (11.2 ± 1.4%) examined. We conclude that male–female differences are substantially greater for all-out jumping versus running events.

KEYWORDS: male – female differences, athletics, sports, track and field

INTRODUCTION: To even casual observers of sport, the performance differences between men and women are readily apparent. Not surprisingly, quantitative assessments of these differences have been of considerable interest since shortly after women were allowed to compete in the same athletic events as men in the modern Olympics. Following a boom in participation by women in athletics in the last few decades of the 20th century, the gap between men and women substantially narrowed (Cheuvront et al, 2005).The narrowing was so rapid that late in the last century that on the basis of historical trends Whipp and Ward (1992), proposed that the performance difference between the sexes might ultimately disappear at some point in the future. However, in the three decades since their provocative proposal, the male–female differences in running events have remained largely unchanged, with men racing on average at velocities 11% greater than women (Weyand and Davis, 2005; Ospina Betancurt et al, 2018).

Male-female differences in jumping events have not received equivalent attention, but are potentially equally revealing. Thibault et al.'s (2010) analysis indicated that the male-female differences for jumping maybe substantially larger than those generally observed for running. However, the magnitude of the sex differences in running compared to jumping events has received relatively little attention. Here, on the basis of information available, we hypothesized that male-female performance differences for jumping will be two times that of running events.

METHODS: We approached the question of relative male-female performance differences between running and jumping using performance data from highly specialized performers for standard Olympic running and jumping events. This strategy allowed us to aggregate equivalently athletic male and female populations that should therefore provide performance data that are reasonably representative of the intrinsic performance difference between the sexes.

The top 50 performers from 2003-2018 of the 12 events in question were acquired for both male and female performances from the World Athletics listings. Race times for running events were divided by event distance for running event performances of the 100, 200, 400, 800, 1,500, 3,000, 5,000, 10,000 meter and marathon, to determine mean race velocities.

Jump performances were quantified from horizontal jump distances for long and triple jump and estimated vertical displacement of the body's centre of mass (COM) for high jump. The latter was determined from the difference between estimated height of the COM and recorded bar clearance. COM standing height was estimated as 56.8% of total height in males and 55.4% in females (Croskey et al., 1922).

Percent difference in male and female performance was calculated using equation 1.

$$\left(\frac{\text{male performance} - \text{female performance}}{\text{male performance}}\right) * 100 \qquad \text{(Equation 1)}$$

RESULTS: The male and female mean race velocities by event appear in figure 1 and reveal moderate between-sex differences ranging from 0.6 to 1.1 m/s. When expressed as percentages (figure 2) the overall mean was 11.2 ± 1.4% with no apparent across-distance trend. On a percentage basis, values ranged from 7.9% in the 100 meter race to 12.8% in the 800 meter race.

Male and female mean performances for Olympic jumping events appear in figure 3. The male-female offset in the jumping events was more variable. Absolute differences were 0.3, 2.8, and 1.4 meters for the high jump, triple jump, and long jump respectively. The percent differences in performance for the jumping events in figure 4 were substantially greater than those for running. On a percentage basis, men outperformed women by 20.8%, 15.7% and 16.9% for high jump, triple jump and long jump respectively. When compared to running events the overall mean difference for jumping events was 1.5 times greater than the running event overall mean, (17.8% vs 11.2%).

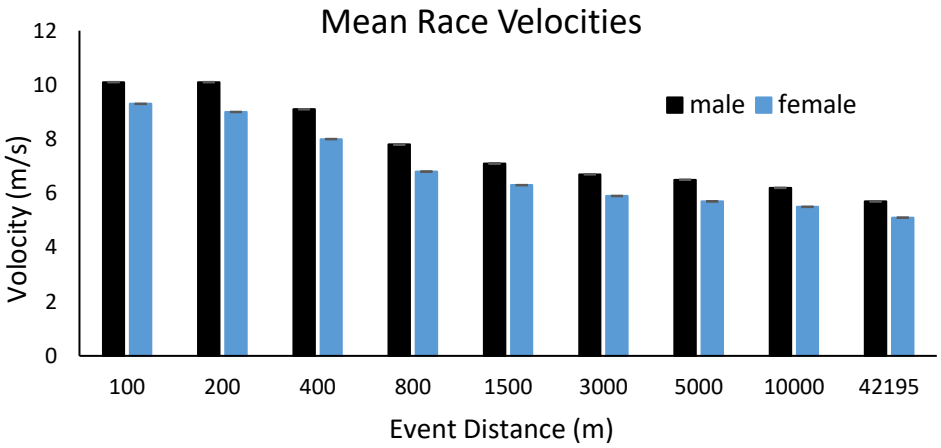

Figure 1: Mean male and female racing velocities of the top 50 performers at nine standard Olympic racing distances from 2003-2018 (SEM ± 0.01 for all means).

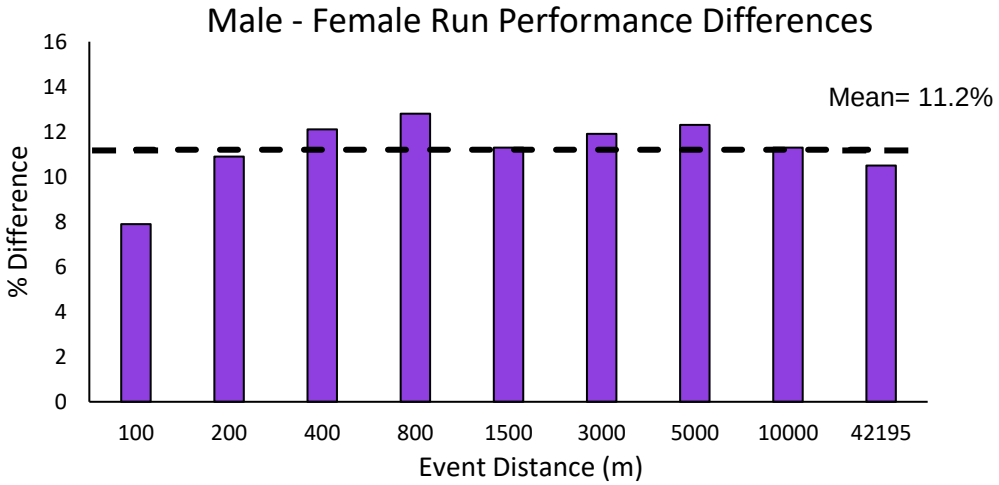

Figure 2: Male-female percent performance difference in the nine Olympic standard Olympic running event distances.

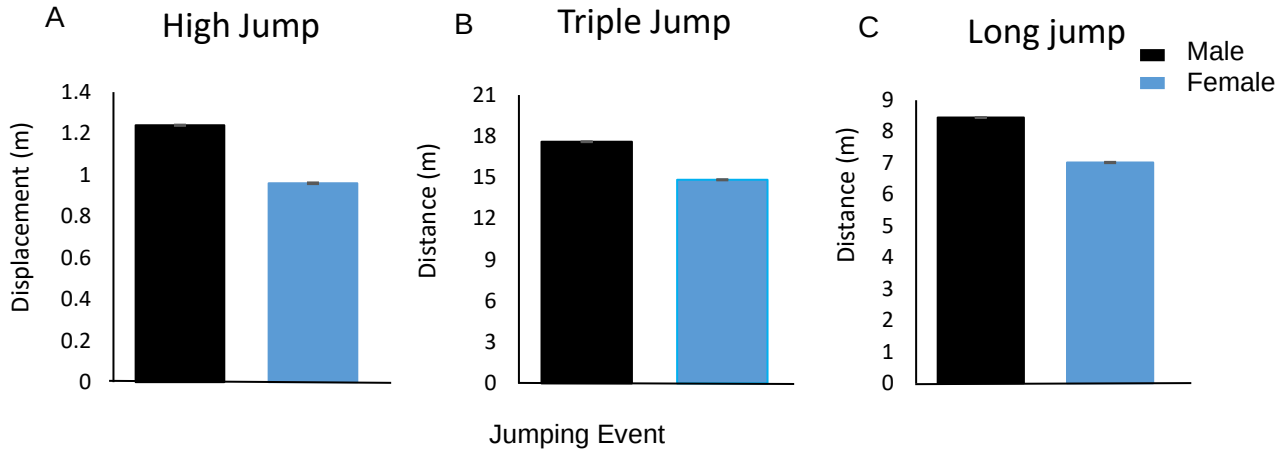

Figure 3: Mean male and female displacement of the top 50 performers in three standardized jumping events (SEM ± 0.01 for all means).

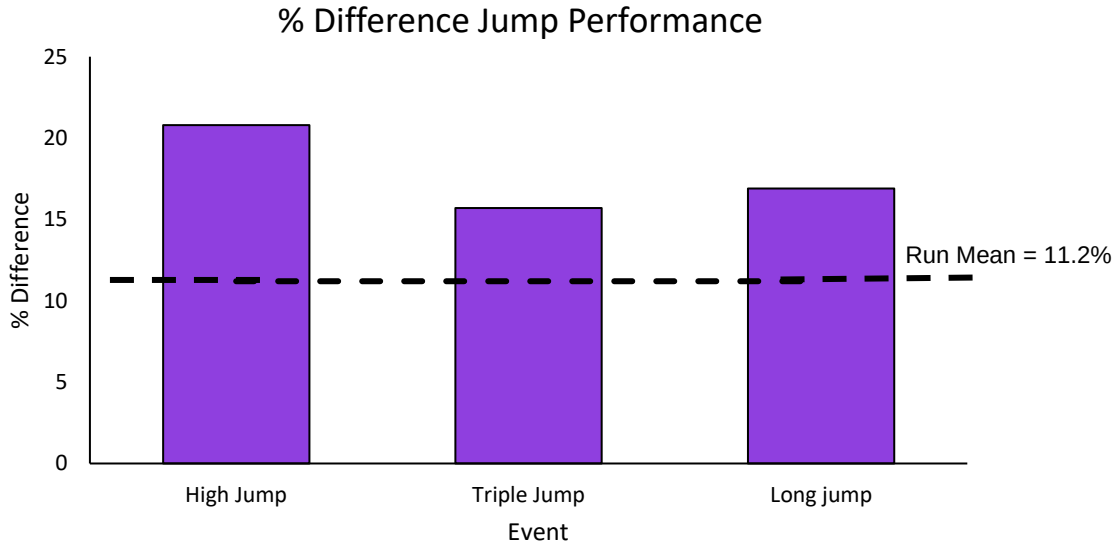

Figure 4: Male – female percent performance differences for different Olympic jumping events.

DISCUSSION: The overall male-female performance difference for the jumping events was 1.5 times greater than the mean difference for running (17.8% vs 11.2%). The difference quantified is less than our initial, somewhat speculative hypothesis, but substantial nonetheless. Given that the smallest difference for the jumps was greater than the largest difference for running, we can reasonably conclude that the male-female performance differences are greater for jumping than running events, but why?

This seems almost certainly due to the inherent differences in the mechanical requirements of running and jumping. Jumping requires maximizing the *distance* the body's mass is moved. In contrast, running events require minimizing the *time* required to move the body's mass over a standard distance. The relatively larger male-female jumping versus running performance difference may simply reflect differences in the basic mechanical requirements or objectives.

Sex differences seem likely from a physical standpoint, to directly influence the maximum distances male and female athletes can displace their body masses during maximal-effort jumps. Although running stride lengths would be similarly influenced by, and indeed likely be directly proportional to height, these stride length differences would be offset by the greater stride frequencies of shorter female runners. Thus, long standing observations of the magnitude of male-female performance differences may be explained simply by body dimensions and event-specific mechanical requirements.

For running, the additional proportion of the body's mass comprised of fat for females versus males has successfully accounted for most or perhaps all of the percentage difference in performance (Sparling & Cureton, 1983; Weyand & Davis, 2005). The mechanistic reason for the sex difference for jumping events considerably exceeds the differences expected on the basis of body composition differences alone awaits further investigation. It is noteworthy that body composition differences between male and female athletes for running and jumping events do not vary. Thus, it is reasonable to assume that the mechanical requirements of the event in combination with the body composition differences leads to the substantial variation in sex-difference in performance between running and jumping events.

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