Commentaries on Viewpoint: The two-hour marathon: what’s the equivalent for women?

THE WOMEN’S PHYSIOLOGICAL EQUIVALENT OF A 2-H MARATHON

TO THE EDITOR: Hunter et al. (1) are to be congratulated for their insightful commentary regarding the equivalent of a 2-h marathon for women. It is a difficult task, as there are many possible determinants of marathon performance (not just physiological) and there is little published research about the capabilities of elite marathon runners. Nonetheless, we would like to suggest that one approach is to estimate the physiological requirements for a man to complete a 2-h marathon, followed by determination of the equivalent physiology in women, and then calculation of the time that a woman might achieve with this physiology. If we start with the simple physiological model provided by Joyner (3) [marathon running speed = V̇O₂max × lactate threshold × running economy], then the speed required to complete a 2-h marathon (21.0975 km/h) could be achieved with a V̇O₂max of 76.9 ml·kg⁻¹·min⁻¹ (4), a lactate threshold of ~81% V̇O₂max (5), and a running economy of 175 ml·kg⁻¹·km⁻¹ (2). In considering that men and women appear able to obtain the same LT (relative to V̇O₂max) and RE (1), the remaining calculation is to estimate the equivalent V̇O₂max for a female [66–69 ml·kg⁻¹·min⁻¹ given the 10–14% difference between men and women (1)]. Putting these values into Joyner’s equation produces estimated marathon times of 2:13:20 to 2:20:32. Thus, although Radcliffe’s time is exceptional, we do not believe that it is possible to state unequivocally that the physiological equivalent of the men’s 2-h marathon has already been achieved by a woman.

REFERENCES

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THE NEED FOR MORE RESEARCH INVESTIGATING MECHANISMS OF MUSCLE FATIGABILITY IN THE FEMALE ATHLETE

TO THE EDITOR: The Viewpoint article by Hunter et al. (3) argues that the equivalent 2-h marathon for women has already been achieved by the impressive British athlete Paula Radcliffe. When detailing the factors that affect sex differences in performance, Hunter et al. (3) suggest that muscle fatigability would likely have a minimal influence among elite distance runners. However, this point is based upon insufficient evidence from locomotor exercise studies, both in the mode of exercise and population under consideration. In well-trained male runners, significant muscle fatigability develops throughout marathon running (4), but comparable data from a female population are scarce because the majority of mechanistic fatigue research focuses predominately on male populations (e.g., 2). When comparing mechanisms of fatigability in running between men and women, Temesi et al. (5) recently demonstrated an attenuated level of fatigability in women vs. men after a 110 km ultra-trail. Specifically, aspects of knee-extensor and plantar-flexor function were preserved in the female athletes compared with that of their performance-matched male counterparts. Similar findings have been found in recreational marathon runners (1); a lower drift in energy cost was observed in women during this study, which could reflect a less pronounced degree of additional motor unit recruitment during prolonged exercise as a consequence of the lower degree of muscle fatigue. More substantive evidence is
needed on this topic before we can conclusively say that mechanisms of muscle fatigability will have a minimal effect on explaining marathon performance between elite male and female distance runners.

REFERENCES

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HAS THE “EQUIVALENT TWO-HOUR MARATHON” FOR OLDER ATHLETES ALREADY BEEN ATTAINED?

TO THE EDITOR: Hunter et al. (2) proposed a very interesting viewpoint concerning sex differences in marathon running. They argued that not only is the female world record in the marathon performed by Paula Radcliffe in 2003 comparatively better than the record for males but also that this performance is equivalent to being under the 2-h barrier for men. We hereby propose that data from master’s athletes (age >40 years old) also supports these viewpoints.

For the past 30 years, participation of master’s athletes in marathon has risen greatly. For example, in the New York marathon, master’s athletes represent more than 50% of male and 40% of female finishers, respectively (3). Masters athletes have also improved their performances especially in the older categories (e.g., average running time of the best men within the 70–74 year age group significantly decreased by ~17 min during the past three decades) (3).

Therefore, it would be interesting to establish a master athlete-specific model to estimate the equivalent performance of older compared with younger runners. The model could be built from 1) the number of masters athletes in marathon races, 2) their performance, and 3) the knowledge of the age-related alterations of some physiological parameters, such as maximal oxygen consumption (1), which is well known to limit performance (4). By doing so, we could understand whether for example, the performance of Canadian Ed Whitlock, who holds the marathon world record for age groups up to 80 years old with a time of 3:15:54 (5), is equivalent to the 2-h barrier. Therefore, the following question should be addressed in the future: What is equivalent to a 2-h marathon performance for master’s athletes?

REFERENCES

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THE SEX DIFFERENCE IN PERFORMANCE DEPTH REFLECTS A SEX DIFFERENCE IN COMPETITIVENESS

TO THE EDITOR: Hunter and colleagues (5) acknowledge that interpreting Radcliffe’s performances is complicated by the sex difference in performance depth, a difference they attribute to women enjoying fewer athletic opportunities. Although fewer opportunities for women undoubtedly can be impactful, this cannot provide a complete explanation for the sex difference in performance depth.

Crucial evidence comes from the U.S., where women’s opportunities and incentives have increased dramatically since the 1980s and, in distance running, no longer favor men (2, 3). Studies show that although the sex difference in running participation has disappeared, the sizable sex difference in performance depth has not been shrinking (1, 2, 4).

Evidence instead supports the hypothesis that the sex difference in performance depth reflects that more male than female runners possess a competitive orientation, an apparent requirement for elite performances (2). A recent study of 13,000 masters runners (40+ years) supported this by showing that men were more likely to choose to participate in competitive contexts (3).

Specifically, although there was no sex difference in participation at road races, men were three times as likely as women to participate in distance events at track meets. This is remarkable because fast performances (relative to sex and age standards) occur 20 times more often at track meets. Thus track meets are competitions, whereas road races are generally recreational events. Furthermore, the sex difference in track meet participation did not decline from 1998 to 2012.

Thus the sex difference in performance depth partly reflects a sex difference in competitiveness not merely opportunities.

REFERENCES
SEX DIFFERENCES IN RUNNING PERFORMANCE: LESSONS LEARNED FROM THE ULTRAMARATHON

TO THE EDITOR: The viewpoint that Paula Radcliffe’s world marathon record is equivalent, if not faster than a 2-h marathon for men (3) is consistent with our recent commentary (see Ref. 4). It is important to examine a larger continuum of distance running events to fully appreciate the underlying mechanisms for sex differences in running performance. Ultramarathons include any distance greater than the traditional marathon and have been rapidly growing in popularity among running enthusiasts. The official world record for the 100-km road race is 6:33:11 for women vs. 6:13:33 for men, a difference of only 5% (i.e., one-half the sex difference for the marathon). In fact, it is not uncommon for women to be among the top finishers, and in some cases, winning ultramarathon races against men. There is no doubt that aerobic capacity, lactate threshold, and running economy are critical determinants of performance as suggested by Hunter et al. (3). However, in the absence of compelling data, it may be premature to dismiss the potential influence of sex differences in substrate utilization (5) and skeletal muscle fatigue resistance. Increasing the rate of fat oxidation will increase exercise endurance by sparing muscle glycogen (2). Indeed, some have hypothesized that this may partially explain the greater fatigue resistance in female ultramarathon runners compared with males (1). These distinct sex differences in physiology may explain, at least in part, why the performance gap tends to decrease with increasing distance and why, in relative terms, Radcliffe’s marathon performance is so impressive compared with the men’s record.

REFERENCES

ARE FEMALE PERFORMANCES IN OTHER OLYMPIC DISTANCE RUNNING EVENTS EQUIVALENT TO PAULA RADCLIFFE’S?

TO THE EDITOR: We would agree with Hunter et al.’s conclusions (1), but the question could be posed if other female Olympic running performances are as outstanding as that of Paul Radcliffe. If a similar analysis to that of the authors is repeated on other athletes’ performances, Florence Griffith-Joyner (100 m) and Marita Koch (400 m) would both emerge as accomplished women’s world records (WR) equivalent or better than those of the men.

First, the sex differences in the 100 m (9.5%) and 400 m (10.2%) WR are analogous with, or better than, the sex difference in marathon (10.1%). In other Olympic running distances, sex differences ranged between 11.2% and 12.4%.

Second, based on the Mercier score (2), Hunter et al. (1) proposed that the women’s WR by Radcliffe is equivalent to the 2-h barrier for men and below the men’s WR (2:02:57). We note that the 10'49 performed by Florence Griffith-Joyner in the 100 m is equivalent to 9'59 for men, close to the WR of Usain Bolt (9'58), and the 47'6 performed by Marita Koch in the 400 m is equivalent to 42'55 for men, well below the WR by Michael Johnson (43'18).

Finally, unlike Hunter et al.’s (1) analysis, using publicly available data (3) we calculated the relative time of the 100th best performer and compared it with the corresponding WR for each sex and three distances. We found that the differences were relatively small in the 100 m (men: 95.8% vs. women: 95.1%) but more pronounced in the 400 m (men: 96.7% vs. women: 94.8%) and marathon (men: 97.0% vs. women: 94.4%).

In conclusion, using a similar approach to Hunter et al. (1) we suggest that Florence Griffith-Joyner and Marita Koch accomplished a WR at least equal to the men’s WR of Usain Bolt and Michael Johnson, respectively.

REFERENCES

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COMMENT ON “THE TWO-HOUR MARATHON: WHAT’S THE EQUIVALENT FOR WOMEN?”

TO THE EDITOR: Hunter, Joyner, and Jones (3) make a strong case that Ms. Radcliffe’s world record can be equated to a 2-h performance by a man. I have two points to add. First, based on the world’s best marathon times by year from 1980 (year IAAF sanctioned the women’s marathon) through 2014, the mean sex difference (W-M/W) is 10.8% (median = 11.0%) (1, 4). Over these 35 years, the smallest differences were 8.5% in 2002, 7.8% in 2003, and 8.3% in 2005 when Paula Radcliffe ran the three fastest times ever by a woman. Recalculating without these three outliers, the mean sex difference is 11.0%, which equates a 2-h time by a man to a 2:14:50 by a woman. Second, for over a decade, the relative depth of marathon performances for the top men vs. women has been remarkably stable (i.e., % differences between 100th best man and woman by year: 2001-13.1, 2002-13.5, 2003-13.7, 2004-13.6, 2005-13.4, 2006-13.4, 2007-13.7, 2008-13.0, 2009-13.5, 2010-13.4, 2011-12.9, 2012-13.2, 2013-13.5) (2). In the early days of women’s competition in the marathon, the depth of women’s performances was less than that of men because of less opportunity and scarce encouragement for women (3, 4). Over the first 20 years, the sex difference in depth steadily declined, and since about 2000 has plateaued (2, 4). In summary, Paula Radcliffe’s marathon performances are extraordinary and analysis of annual world best performances by men and women supports the equivalency of her 2:15 to a 2-h marathon for a man.

REFERENCES

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HUMAN LIMITS IN THE MARATHON: WHAT CAN WE REALLY KNOW?

TO THE EDITOR: The possibility of a sub-2-h marathon men’s world record (WR) has recently attracted considerable attention, whereas women’s sports achievements tend to be overlooked. The hypothesis nicely postulated by Hunter et al. (1) is thus timely. Scientific discussions on sports WRs are provocative, especially if they deal with the perpetual comparison between sexes or with the possibility of women outrunning men (4, 5), at the risk of making erroneous assumptions (3).

A key issue should be considered in such discussions but seems to be ignored by most: the number of people engaging in the artificial selection process (hard training and lifestyle) that starts in childhood and ends with the attainment of elite sports performance later in life is extremely small compared with the world population and even null in most countries. It is only such a
selection process that allows the emergence of individuals with the genetic endowment and will to extend human performance limits. As such, most available evidence is underpowered to make estimations on WRs for men or women, especially in an event like the marathon, where the chances of socioeconomic promotion are much less compared with other sports and make it less attractive. Just as an example, there could be perhaps ~41,000 Spanish individuals with a “near optimal” polygenic profile to excel in the marathon (2). But who of them would like to live the life of a Kalenjin runner or to train like Paula Radcliffe? Current WRs might not reflect the actual limits of our species.

REFERENCES


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COMMENTARY ON VIEWPOINT: THE TWO-HOUR MARATHON: WHAT’S THE EQUIVALENT FOR WOMEN?

TO THE EDITOR: Hunter and colleagues (2) raise a provocative question, whose resolution is constrained by the impracticalities of sequential, appropriately focused investigation of the truly elite; that one of the authors accomplished this to a degree over a 15-yr period is noteworthy (3).

The world-record progression in marathon [expressed as mean running velocity (V_R), a proxy of race energy cost] has slowed relative to the pre-1985 linear characteristic (4) more markedly in men than women, with proximate linear regression slopes of 0.424 and 2.295 m/min/yr, respectively (Ward, unpublished). There is also a perceptible sex narrowing between world-record performance year-on-year, the women’s V_R being 89.57% of the men’s in 1998, 89.33% in 1999, 91.50% in 2002, and 92.25% in 2003 (Ward, unpublished). So is it the case, as the authors state, that “sex difference among the best runners has fluctuated minimally over the last 30 years” (2)?

The authors target running economy and critical velocity as determinants of “superior” marathon performance (2). Embedded in these are constructs such as oxygen uptake kinetics and the W’ parameter of the power-duration relationship and how, in men and in women, these might conspire in the face of strategic race-pace fluctuations around critical velocity. And what of potential respiratory-mechanical limitation at high running velocities? A degree of protection for the current women’s world record holder might be afforded by the larger lung volumes conferred by her relative height (1.73 m) (1). In conclusion, if women have indeed attained a “2-h” equivalent marathon, when might this be achieved by men?

REFERENCES


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