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## Last Word on Viewpoint: The Two-hour Marathon: What's the Equivalent for Women?

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# Last Word on Viewpoint: The Two-hour Marathon: What's the Equivalent for Women?

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to the editor: We thank our colleagues who commented (see Ref. 2) on the "The two-hour marathon: what's the equivalent for women?" (5). In general the comments highlighted several important points.

## Exercise performance of women and the underlying physiological mechanisms deserves more attention.

Noted by several commentaries (see Ref. 2), there is a dearth of data on the physiological limitations and mechanisms of fatigability and performance in women during running specifically and exercise/sports in general. This is, in part, because of the historical and current bias of studying proportionally more men than women in both human and animal-based physiology studies [e.g., (1)] and the presumption that women and men respond similarly to exercise. This sex bias exists right across exercise science, creating a field that is ripe with opportunities.

## Sex differences in muscle fatigability.

Women's muscles are less fatigable than those of men during static and slow-to-moderate velocity contractions in recreationally active young adults (4). Whether there are sex differences in muscle fatigability during dynamic exercise that contribute to differences in whole body performance between men and women is not known. The possibility of glycogen sparing in female muscle could present an advantage over men during the marathon, but it is not known if this occurs among elite athletes. We postulated there is only a minimal difference in muscle fatigability among the world's best men and women runners based on the similar running economy and lactate threshold values. These ideas again highlight opportunities for high impact studies.

## Psychological aspects of human performance that inform strategy such as pacing can differ between individuals and between men and women.

Competitiveness, decision making, and increased arousal ultimately affect human performance. At the elite level, the differences are likely minimal between men and women [e.g., (3)], but they may contribute to sex differences among recreational level athletes.

## Alternative approaches to address an equivalent 2-h marathon for women.

Our approach used real world performance data backed by observations from physiological data. Alternative methods using somewhat similar approaches were highlighted and for the most part they were in agreement that ~2:15 h:min is an equivalent benchmark for the women's marathon. Also raised was whether we really know the true limitations to marathon performance in men and women because of the complex interaction between training and competitive opportunities and the "best" biological talent pool.

## Real world performance data can inform us about human limits and physiology: a model to examine other events and populations.

Some comments suggested that a similar approach to that used in our Viewpoint could be used to highlight the limitations to human performance in other events (e.g., sprints, ultramarathon) and populations (e.g., master athletes). Certainly, real world data, where motivation is high, can inform us of differences in physiology among and between populations that may not be possible to achieve with laboratory experiments (6).

In closing, we thank our colleagues for their comments and are confident that the issues highlighted above and in our Viewpoint will lead to pivotal and creative studies that help to resolve these truly fascinating issues.

## DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the author(s).

## AUTHOR CONTRIBUTIONS

Author contributions: S.K.H., M.J.J., and A.M.J. conception and design of research; S.K.H., M.J.J., and A.M.J. drafted manuscript; S.K.H., M.J.J., and A.M.J. edited and revised manuscript; S.K.H., M.J.J., and A.M.J. approved final version of manuscript.

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