Ultramarathon Runners: Nature or Nurture?

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Ultramarathon running is increasingly popular. An ultramarathon is defined as a running event involving distances longer than the length of a traditional marathon of 42.195 km. In ultramarathon races, ~80% of the finishers are men. Ultramarathoners are typically ~45 y old and achieve their fastest running times between 30 and 49 y for men, and between 30 and 54 y for women. Most probably, ultrarunners start with a marathon before competing in an ultramarathon. In ultramarathoners, the number of previously completed marathons is significantly higher than the number of completed marathons in marathoners. However, recreational marathoners have a faster personal-best marathon time than ultramarathoners. Successful ultramarathoners have 7.6 ± 6.3 y of experience in ultrarunning. Ultramarathoners complete more running kilometers in training than marathoners do, but they run more slowly during training than marathoners. To summarize, ultramarathoners are master runners, have a broad experience in running, and prepare differently for an ultramarathon than marathoners do. However, it is not known what motivates male ultramarathoners and where ultramarathoners mainly originate. Future studies need to investigate the motivation of male ultramarathoners, where the best ultramarathoners originate, and whether they prepare by competing in marathons before entering ultramarathons.

Keywords: ultraendurance, training, marathon, experience

The intention of this review is to describe how these unique athletes—who perhaps best reflect the hunter-gatherer heritage of our species—get to be this way. Are they intrinsically good at very prolonged performance? Are they just bad marathon runners who find success in ever-longer events? Is there something special about how they prepare for ultradistance races?

Ultramarathon running is increasing in popularity. For 100-mile ultramarathons in North America between 1977 and 2008, the annual number of races and number of finishes increased exponentially across years.[1] The growth in the number of finishers was due to increased participation among runners >40 years of age and women.

The first step is to define the term *ultramarathon*. Generally, an ultramarathon is defined as a running event involving a distance longer than the traditional marathon length of 42.195 km. In addition, an ultraendurance competition is defined as an event exceeding 6 hours in duration.[2] In ultramarathon running, 2 different types of races have to be distinguished: events covering a defined distance and those taking place during a defined time. The most common ultramarathon races with a defined distance are 50 km, 100 km, 50 miles, and 100 miles in length. There are also famous ultramarathons with distances longer than 200 km, such as Spartathlon (www. spartathlon.gr) or Badwater (www.badwater.com). For ultramarathons with a defined time, there are 6-hour, 12-hour, 24-hour, and 48-hour running races offered (www.ultramarathonrunning.com). In addition to these single-stage races, multistage races are held (http://multidays.com) where ultramarathoners cross a region,[3–6] a country,[7] or a continent.[8] Multiday runs include timed events up to 6 and 10 days.

Gender

There are large gender differences in ultramarathon participants. In 161-km ultramarathons, ~80% of the participants are men.[1,9–12] In 100-km ultramarathons, the percentage of women competitors is ~13%.[13] It has been assumed that women might outrun men in ultra-distances.[14] Indeed, it has been reported that a women ultramarathoner was able to win a multistage run.[15] However, the gender difference in ultrarunning was ~17% for winners and ~22% for top-10 runners in 100-km ultramarathoners across years.[13] It seems unlikely that women ultramarathoners will exceed men ultramarathoners in the near future.

Age

For ultramarathoners, the mean age of successful finishers is ~45 years.[11,12] In 161-km ultramarathoners, the highest number of successful finishers is in the 40- to 44-year age group.[11] In 100-km ultramarathoners, most

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of the successful finishers are in the 40- to 49-year age group.[13] In marathoners, most of the successful finishers are also in the 40- to 49-year age group.[16] However, the age of peak performance is different between marathoners and ultramarathoners. In elite marathoners, the age of peak marathon performance is 30 years,[17] considerably younger than ultramarathoners. For 100-km ultramarathoners, the best running times were observed between 30 and 49 years of age for men and between 30 and 54 years for women.[13]

Previous Experience

Most probably, future ultrarunners start with a marathon before competing in an ultramarathon. Several studies reported the personal-best marathon time as a strong predictor variable for ultramarathon performance in 100-km ultramarathoners[18–21] and 24-hour ultramarathoners.[22–24] In 100-km ultramarathoners, the number of previously completed marathons (34 ±73) was significantly higher than the number of completed marathons (12 ± 21) in marathoners.[25] However, recreational marathoners (207 ± 31 min) have a faster personal-best marathon time than 100-km ultramarathoners (216 ± 32 min).[25] In addition, experience in ultramarathon running is needed. Successful ultramarathoners in a 161-km ultramarathon have 7.6 ± 6.3 years of experience in ultrarunning.[12]

Training

Table 1 summarizes the details of the training of ultramarathoners. Male ultramarathoners invest 8.9 ± 4.4 hours of running training per week and complete 85.0 ± 35.8 km/wk while running at a mean speed of 10.5 ± 1.5 km/h. The weekly running kilometers are far below the volume of 145.3 ± 23.3 of elite marathoners.[26] However, the training volume of the ultramarathoners is higher than the 4.8 ± 2.5 hours and 44.7 ± 24.7 km weekly running of recreational male marathoners.[25] Ultramarathoners run during training at 10.2 ± 2.2 km/h, significantly slower than marathoners, who run 11.0 ± 1.4 km/h during training.[25]

Origin and Sociocultural Background

East African runners dominate long-distance running up to the marathon distance.[27,28] For ultramarathoners, however, data are lacking regarding their origin. Hoffman and Fogard[12] reported that 161-km ultramarathoners in North America were generally men (80.2%), were married (70.1%), and had bachelor's (43.6%) or graduate (37.2%) degrees. During training, they maintained their body mass with aging and rarely missed work due to illness or injury.

Motivation

Little is known about the motivation to compete in ultramarathons. There are probably large differences between elite marathoners and ultramarathoners. For elite Kenyan marathoners, Onywera et al[28] reported that Kenyan athletes see athletics as a means of making money to help their families, parents, and siblings. For ultramarathoners, Krouse et al[29] described women ultrarunners as task-oriented, internally motivated, and health- and financially conscious individuals.

Conclusions

To summarize, ultramarathoners are master runners, have a broad experience in running, and prepare differently for an ultramarathon than marathoners. However, we do not know what motivates male ultramarathoners and where ultramarathoners mainly originate. Future studies need to investigate the motivation of male ultramarathoners, where the best ultramarathoners originate, and whether they prepare by competing in marathons before entering ultramarathons.

Table 1   Weekly Running Hours, Weekly Running Kilometers, and Running Speed During Training for Ultramarathoners

Runners	Weekly training, h	Weekly training, km	Running speed during training, km/h	Reference
Multistage runners	12.4 ± 5.0	115.0 ± 46.0		30
Multistage runners	8.5 ± 5.9	80.0 ± 59.7	10.0 ± 1.0	21
24-h runners	10.6 ± 3.5	98.8 ± 31.8		22
24-h runners	9.2 ± 5.3	85.7 ± 35.8	10.3 ± 1.5	23
100-km ultramarathoners	7.6 ± 6.3	70.3 ± 27.6	10.7 ± 1.5	19
100-km ultramarathoners	7.5 ± 2.8	75.4 ± 30.1	10.6 ± 1.6	18
100-km ultramarathoners	7.0 ± 2.0	70.0 ± 20.0	10.9 ± 0.8	20
Total mean ± SD	8.9 ± 4.4	85.0 ± 35.8	10.5 ± 1.3	

References

1. Hoffman MD, Ong JC, Wang G. Historical analysis of participation in 161 km ultramarathons in North America. *Int J Hist Sport.* 2010;27(11):1877–1891.

2. Zaryski C, Smith DJ. Training principles and issues for ultra-endurance athletes. *Curr Sports Med Rep.* 2005;4(3):165–170.

3. Knechtle B, Kohler G. Running 338 km within 5 days has no effect on body mass and body fat but reduces skeletal muscle mass—the Isarrun 2006. *J Sports Sci Med.* 2007;6:401–407.

4. Knechtle B, Knechtle P, Rüst CA, et al. Regulation of electrolyte and fluid metabolism in multi-stage ultra-marathoners [published online ahead of print May 25, 2012]. *Horm Metab Res.*

5. Scheer BV, Murray A. Al Andalus Ultra Trail: an observation of medical interventions during a 219-km, 5-day ultra-marathon stage race. *Clin J Sport Med.* 2011;21(5):444–446.

6. Zouhal H, Groussard C, Vincent S, et al. Athletic performance and weight changes during the "Marathon of Sands" in athletes well-trained in endurance. *Int J Sports Med.* 2009;30(7):516–521.

7. Knechtle B, Duff B, Schulze I, Kohler G. A multi-stage ultra-endurance run over 1,200 km leads to a continuous accumulation of total body water. *J Sports Sci Med.* 2008;7:357–364.

8. Freund W, Weber F, Billich C, Schuetz UH. The foot in multistage ultra-marathon runners: experience in a cohort study of 22 participants of the Trans Europe Footrace Project with mobile MRI. *BMJ Open.* 2012;2(3). PubMed doi:10.1136/bmjopen-2012-001118

9. Hoffman MD. Ultramarathon trail running comparison of performance matched men and women. *Med Sci Sports Exerc.* 2008;40(9):1681–1686.

10. Hoffman MD. Performance trends in 161-km ultramarathons. *Int J Sports Med.* 2010;31(1):31–37.

11. Hoffman MD, Wegelin J. The Western States 100-Mile Endurance Run: participation and performance trends. *Med Sci Sports Exerc.* 2009;41(12):2191–2198.

12. Hoffman MD, Fogard K. Demographic characteristics of 161-km ultramarathon runners. *Res Sports Med.* 2012;20(1):59–69.

13. Knechtle B, Rüst CA, Rosemann T, Lepers R. Age-related changes in 100-km ultra-marathon running performance [published online ahead of print July 28, 2011]. *Age (Dordr).*

14. Bam J, Noakes TD, Juritz J, Dennis SC. Could women outrun men in ultramarathon races? *Med Sci Sports Exerc.* 1997;29(2):244–247.

15. Knechtle B, Duff B, Schulze I, Kohler G. The effects of running 1,200 km within 17 days on body composition in a female ultrarunner-Deutschlandlauf 2007. *Res Sports Med.* 2008;16(3):167–188.

16. Leyk D, Erley O, Ridder D, et al. Age-related changes in marathon and half-marathon performances. *Int J Sports Med.* 2007;28(6):513–517.

17. Hunter SK, Stevens AA, Magennis K, Skelton KW, Fauth M. Is there a sex difference in the age of elite marathon runners? *Med Sci Sports Exerc.* 2011;43(4):656–664.

18. Knechtle B, Wirth A, Knechtle P, Rosemann T. Training volume and personal best time in marathon, not anthropometric parameters, are associated with performance in male 100-km ultrarunners. *J Strength Cond Res.* 2010;24(3):604–609.

19. Knechtle B, Knechtle P, Rosemann T, Lepers R. Predictor variables for a 100-km race time in male ultra-marathoners. *Percept Mot Skills.* 2010;111(3):681–693.

20. Knechtle B, Knechtle P, Rosemann T, Senn O. What is associated with race performance in male 100-km ultra-marathoners—anthropometry, training or marathon best time? *J Sports Sci.* 2011;29(6):571–577.

21. Knechtle B, Knechtle P, Rosemann T. Race performance in male mountain ultra-marathoners: anthropometry or training? *Percept Mot Skills.* 2010;110(3):721–735.

22. Knechtle B, Wirth A, Knechtle P, Zimmermann K, Kohler G. Personal best marathon performance is associated with performance in a 24-h run and not anthropometry or training volume. *Br J Sports Med.* 2009;43(11):836–839.

23. Knechtle B, Knechtle P, Rosemann T, Lepers R. Personal best marathon time and longest training run, not anthropometry, predict performance in recreational 24-hour ultrarunners. *J Strength Cond Res.* 2011;25(8):2212–2218.

24. Knechtle B, Knechtle P, Rüst CA, Rosemann T. Leg skinfold thicknesses and race performance in male 24-hour ultra-marathoners. *Proc (Bayl Univ Med Cent).* 201;24(2):110–114. PubMed

25. Rüst CA, Knechtle B, Knechtle P, Rosemann T. Similarities and differences in anthropometry and training between recreational male 100-km ultra-marathoners and marathoners [published online ahead of print]. *J Sports Sci.*

26. Karp JR. Training characteristics of qualifiers for the U.S. Olympic marathon trials. *Int J Sports Physiol Perform.* 2007;2(1):72–92.

27. Hamilton B. East African running dominance: what is behind it? *Br J Sports Med.* 2000;34(5):391–394.

28. Onywera VO, Scott RA, Boit MK, Pitsiladis YP. Demographic characteristics of elite Kenyan endurance runners. *J Sports Sci.* 2006;24(4):415–422.

29. Krouse RZ, Ransdell LB, Lucas SM, Pritchard ME. Motivation, goal orientation, coaching, and training habits of women ultrarunners. *J Strength Cond Res.* 2011;25(10):2835–2842.

30. Knechtle B, Duff B, Schulze I, Rosemann T, Senn O. Anthropometry and pre-race experience of finishers and nonfinishers in a multistage ultra-endurance run—Deutschlandlauf 2007. *Percept Mot Skills.* 2009;109(1):105–118.