Women Pace Better Than Men in a 100-mile Distance Running Race

Julia A. Moffitt, Gracie L. Call
School of Health Sciences
Stephens College, Columbia MO

Abstract:
PURPOSE: Even or negative split pacing strategies in long-distance running have been well-established to yield the best performances up to the marathon distance. In addition, women have been found to pace better than men in the marathon. Optimal pacing strategy and sex differences in ultramarathon running are not well-known. The purpose of this study was to determine pacing strategies employed by the fastest finishers in a 100-mile distance run and determine if any sex differences exist. **METHODS**: Ten years (2010-2019) of finish times from 991 men and 462 women in the Umstead 100-mile endurance run were obtained from publicly available data. The course is a 12.5-mile loop repeated 8 times over relatively flat terrain with 16 splits recorded for each runner at checkpoints (CP) located at miles 5.65 and 12.5. Pace was normalized by expressing the data as %mean running speed (%MRS) and compared by sex and quartile finish. Data were statistically analyzed by one- and two-way ANOVA for repeated measures. **RESULTS**: Women had a significantly lower %MRS at CPs 2, 3, 4 and 5 as compared to men and had a significantly higher %MRS at the 16th and final CP. Quartile analysis revealed that the fastest runners in the 1st quartile adopted a significantly more even pacing strategy than 2nd, 3rd or 4th quartile finishers and 2nd quartile finishers adopted a significantly more even pacing strategy than 3rd or 4th quartile finishers. Differences in pacing were greatest early in the race with the best performers beginning at 125$\pm$1.2 %MRS, while the poorest performers began the race at 140$\pm$1.2 %MRS. While there were few sex differences in 1st, 2nd or 3rd quartile finishers across CPs, in the 4th quartile women adopted a significantly more conservative pace in CPs 1-8, 10 and had a significantly higher %MRS at CPs 14, 15 and 16.**CONCLUSIONS**: In the 100-mile distance, overall women adopted a more conservative pacing strategy at earlier CPs and finished with a faster %MRS as compared to men. Runners who performed better (finished in higher quartiles) adopted a more even pacing strategy as compared to performers who finished in lower quartiles. The sex difference in pacing was most striking in the 4th quartile with women adopting a more even pacing strategy than men through the first half of the race and finishing at a faster %MRS in the final 3 CPs of the 100-mile distance.

Introduction

- For optimal endurance running performance a negative or even split achieves the best results (1-3,6-7).
- To be able to attain a negative or even split in endurance running requires skill at pacing.
- Factors that have been shown to significantly influence pacing include performance (finish time or placing), sex, and age (1-4,6-7).
- It is well established that faster endurance runners tend to show a more even pacing pattern up to the marathon distance (1-3,6-7).
- Previous studies have found that women pace better than men in the half-marathon and marathon distance (1-3, 6-7), with the difference being increasingly evident from the half-marathon to the marathon distance (1-3, 7).
- These data suggest that the longer the distance of the race, the greater skill in pacing in women possess as compared to men.
- Optimal pacing strategies or the factors that significantly influence pacing beyond the marathon distance are not as well understood (4-5).
  - Renfree et. al. found that women paced better than men in a 100km race (4).
  - However, there was no difference between sexes in a 24-hour endurance race (5).

Aim

- The aim of this study was to evaluate pacing in a large number of participants in a 100-mile distance run where variables such as terrain, weather, and format are relatively controlled.

Hypotheses

- Women will display a more even pacing strategy than men in running a 100-mile distance race.
- Runners who pace more conservatively at the beginning of the race will preform better overall.

jmoffitt@stephens.edu

Methods

- Results from 991 male and 462 female finishers of the Umstead 100-Mile Endurance Run (publicly available) were statistically compared from 2010 to 2019.
- The course consists of a relatively flat12.5 mile loop repeated 8 times allowing for consistency in running splits.
- Sixteen splits recorded for each runner from checkpoints located at miles 5.65 (even checkpoints) and 6.85 miles (odd checkpoints) were analyzed.
- Data were statistically compared across all years to ensure consistency in pacing and finish times.
- Running speed across sex and age groups (data not shown) were normalized by expressing the data as the percent mean finish time.
- Data indicated that sex was a factor that significantly influenced pacing, thus performance was evaluated by dividing the data into quartiles based on finish placement with respect to sex.
- One-way ANOVA was used to detect differences between genders and two-way ANOVA with repeated measures was to determine statistical significance ($p \leq 0.05$) among quartiles.
- When a significant interaction was detected Tukey's post-hoc analysis was applied.
- Lack of sphericity was corrected using the Greenhouse-Geisser correction.

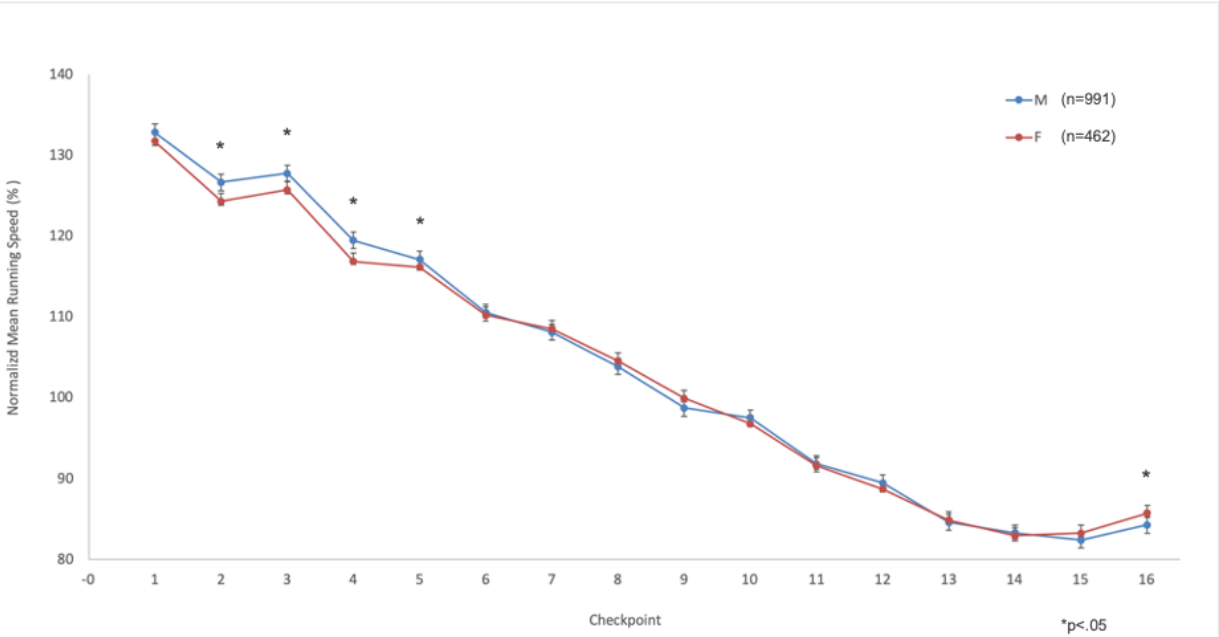

Figure 1. Comparison of normalized mean running speed (mean ± S.E.) across all 16 checkpoints of the Umstead 100-mile endurance run between sexes. Data show women paced significantly more conservative earlier in the race (checkpoints 2-5) and finished significantly faster (checkpoint 16).

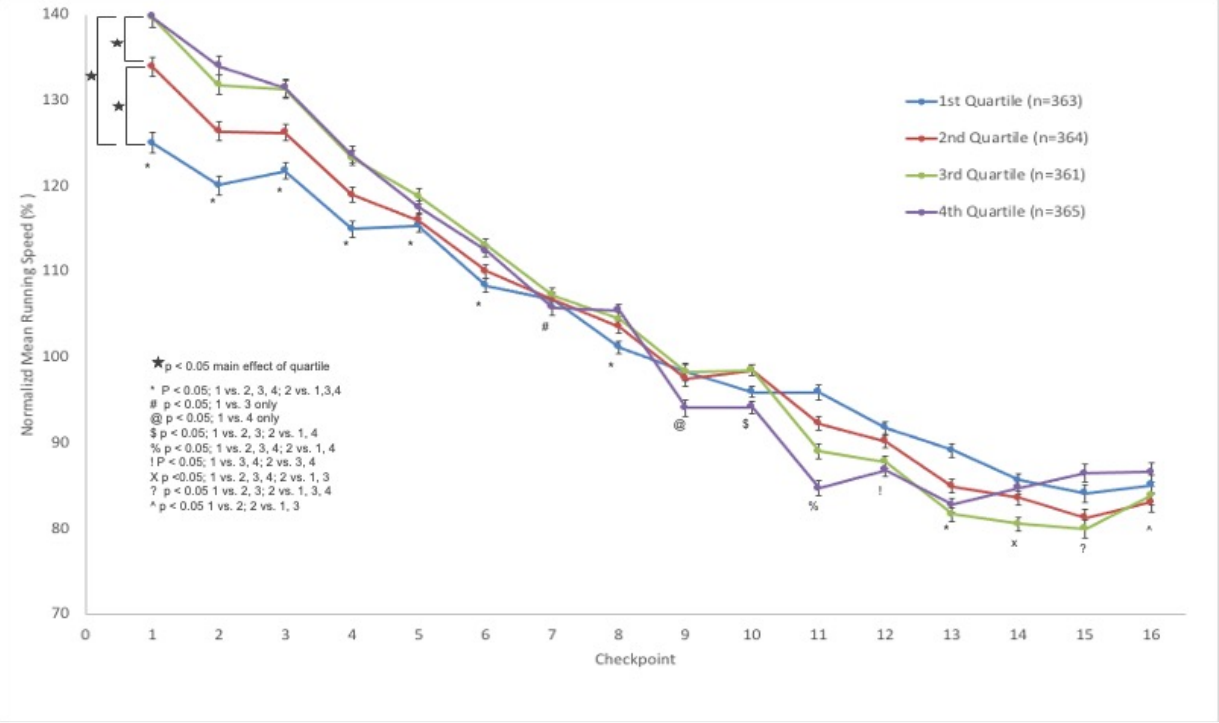

Figure 2. Data grouped by quartile finish ranked with respect to sex. 2-way ANOVA with repeated measures indicated a significant main effect for quartile and interaction between sex and quartile finish. Significant differences at each checkpoint are shown within the figure. Overall, 1st and 2nd quartile finishers paced better through the first half of the race and finished faster and thus placed higher than 3rd or 4th quartile runners.

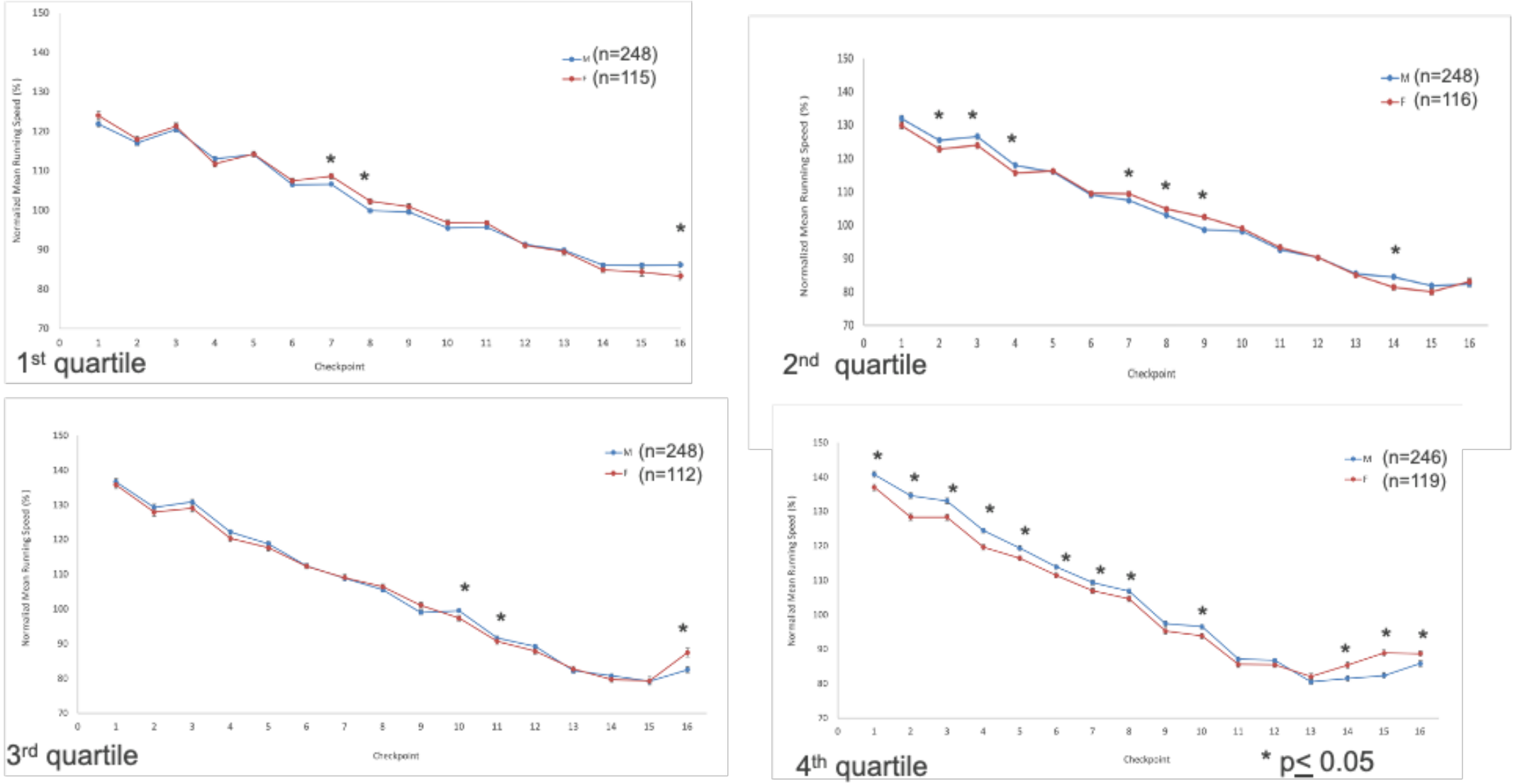

Figure 3. Sub-analysis comparison between men and women by quartile. Data clearly show the greatest sex difference between runners in the 4th quartile, with women pacing significantly more conservative during the first half of the race (checkpoints 1-8 & 10) and finishing significantly faster at the end of the race (checkpoints 14-16).

Conclusions

- Overall, data show that women paced more even over a 100-mile distance race than men.
- The biggest sex differences were found in the 4th quartile among the lowest performing runners.
- First quartile runners displayed the most even pacing strategy, thus better performing runners had better skill at pacing the 100-mile distance.
- First quartile runners displayed a pacing strategy of starting at ~120% of their expected mean running speed and experiencing a positive split.
- Although previous studies up to marathon distance show a negative or even split is best for optimal performance (1-3, 6-7), our data show negative or even split is impractical for the 100-mile distance.
- While there was little difference between males and females in the 1st quartile, 4th quartile female runners showed dramatically better pacing skill than male runners.

References

1. March DS, Vanderburgh PM, Titlebaum PJ, Hoops ML. Age, Sex, and Finish Time as Determinants of Pacing in the Marathon: *J Strength Cond Res*. 2011;25(2):386–91.
2. Nikolaidis PT, Cuk I, Rosemann T, Knechtle B. Performance and Pacing of Age Groups in Half-Marathon and Marathon. *Int J Environ Res Public Health* [Internet]. 2019;16(10) doi:10.3390/ijerph16101777.
3. Nikolaidis PT, Ćuk I, Knechtle B. Pacing of Women and Men in Half-Marathon and Marathon Races. *Med Kaunas Lith* [Internet]. 2019;55(1) doi:10.3390/medicina55010014.
4. Renfree A, Crivoi do Carmo E, Martin L. The influence of performance level, age and gender on pacing strategy during a 100-km ultramarathon. *Eur J Sport Sci*. 2016;16(4):409–15.
5. Bossi AH, Matta GG, Millet GY, et al. Pacing Strategy During 24-Hour Ultramarathon-Distance Running. *Int J Sports Physiol Perform*. 2017;12(5):590–6.
6. Cuk I, Nikolaidis PT, Markovic S, Knechtle B. Age Differences in Pacing in Endurance Running: Comparison between Marathon and Half-MarathonMen and Women. *Med Kaunas Lith* [Internet]. 2019;55(8) doi:10.3390/medicina55080479.
7. Deaner RO, Carter RE, Joyner MJ, Hunter SK. Men are more likely than women to slow in the marathon. *Med Sci Sports Exerc*. 2015;47(3):607–16.