Reviewer's report

Title: Pacing strategy in male elite and age group 100 km ultra-marathoners

Version: 2  Date: 17 October 2014

Reviewer: Simon Angus

Reviewer's report:

Major Compulsory Revisions.

I. The Scientific Intent and Setup of the Paper

The authors should be commended for attempting to address previously identified concerns with the work.

However, I am not at all satisfied that the study delivers, scientifically, on its aims.

My primary concern is with the overall logic and methodology of the study.

At present, we have:

* A hypothesis about the increased slow-down (i.e. the normalised (but not corrected for gradient) running speed as a proxy for effort allocation) in pacing of older runners relative to younger runners, without, to my mind, justification;

* A lack of any hypothesis around what 'elite' runners' pacing strategy will be, despite elite runners being studied;

* A methodology which doesn't just compare the late effort to the early effort to capture differences in pacing between ages, (and the elite?), but instead, a confusing set of comparisons between intermediate segments within the race and over the whole race;

* An attempt at including gradient into the study but without an explicit description of the model used (what is the regression equation?) nor the use of gradient/to adjust/ the running speed data so that they represent 'gradient-adjusted running speed', rather, 'gradient' is considered as a kind of side-project rather than a step in the methodology towards a purer rendition of pacing strategy.

Together, these are fatal flaws the scientific approach and communication of the study.

Let me attempt a recovery of what I believe the main aim of the study is:

"Do non-elite older runners slow-down more than younger runners in ultra-marathons?"

If the authors agree with this hypothesis then my I suggest that the study be greatly simplified and focussed along the following lines:
1. The hypothesis focusses not on the /pacing function/ (that is, the shape of the pacing profile over the whole race), but rather, simply the 'end' versus the 'start' pacing question.

-- The former (pacing function) needs a far more elaborate identification strategy which includes adjustments for changes in gradient, wind-vectors and so on since pacing function from running speed needs to eliminate any source of bias /correlated with the progression of the race/ that would distort this trace.

-- The latter requires only a comparison of running speed at the 'end' of the race and at the 'start' of the race. There is no need to handle changes in gradient along the race's progression.

2. The hypothesis focusses on AGE as the key independent variable conditioning the change in pacing outcomes. As such, the ratio proposed in (1) should be compared statistically across age cohorts -- not along the progress of the race.

3. Elite runners can now be considered as a kind of 'gold standard' of pacing (end/start) since we may assume that they have got their pacing right. Elite runners now enter the study as a point of discussion with respect to the results for the age-cohorts.

4. Inter-year comparisons are not relevant to the research question. Whilst the authors may have their own interest in this question, they should write a different paper asking about the slow-down or not in running speeds in the event over time. The approach proposed above can pool all end/start ratios across years since the 'year-effects' (slower versus faster years) will be completely handled in the end/start running speed normalisation.

This would be how I suggest the paper be re-written.

These suggestions simplify greatly, I believe, and clarify the scientific intent of the paper.

II. Suggested Methodological Approach

My suggestion to the authors is to simplify and focus their study:

1. Obtain, for each year, the ratio of final to first segment running speed for each age cohort. Combine these ratios across years. (we make the assumption here that there were no 'extreme' wind events etc. that may have impacted the final segment relative to the first across years --- this could be checked by weather archives)

2. First, plot the mean + s.d. of these ratios on a graphic with age-cohort on the X-axis.

3. What is the trend? .. is there a consistent pattern from younger to older runners?
4. Analyse statistically by either:

a) Comparing the ratio (mean, std.) of the 'older' cohorts to the younger ones. Are these ratios statistically different? At what level of significance? By how much?

b) If the trend appears linear, or other easily linearisable form, conduct a simple regression with 'age' as one dependent variable. Is the coefficient on 'age' significantly different to 0?

The key point I'm trying to make is that the study should lose its presentation of 'distance through the race' (segment-wise) as a variable of interest. .. The X-axis (variable) of interest is AGE. Not distance through the race.

III. Basis for the Underlying hypothesis: "older runners slow down more than younger runners"

I am still bewildered as to why the author's 'assume' (i.e. their testable hypothesis) (see Abstract.Background, and last paragraph of Background, for example) that older runners will show more positive pacing (slow down more) than younger runners in a 100km ultra. The authors have just pointed to the literature on marathoners (p.4) showing that 'older, female, and faster runners are better pacers than younger, male and slower runners' (i.e. older runners slow down less).

Why would this relationship switch for a 100km event? .. On what basis? .. The authors provide no evidence for such a theory.

This is critical to the paper since it is the key (only) hypothesis that they say they aim to test in this study.

IV. Handling the 'elite' runners.

Now, the authors also actually have a second, parallel, question around the pacing strategy of the 'elite' (top 10 finishers). Here, I suggest that the authors use the elite runners as a kind of 'reference' group for quasi-ideal pacing. We can assume that the elite runners are not only physiologically superior, but that they have discovered a quasi-optimal pacing strategy for this race. We can assume this since there are very likely physiologically equivalent runners who partook each race, but finished outside the top ten, for reasons that they made mistakes with their pacing.

With this perspective, the authors can place the pacing ratio (last/first segment) of the elite group and discuss this ratio (and statistically test it) versus the age-cohort ratios. This would illuminate if any one (non-elite) age cohort had discovered a similar quasi optimal pacing approach, or at least, quantify the distance between the cohort's pacing approach and that of the elite approach.

I. 'Pacing' v 'Average Speed' - a lingering problem.
I am not sure that the authors fully comprehend the difference between 'running speed' and 'pacing'. These are importantly distinct concepts. However, the revised manuscript still mixes these terms. For me, this is still a major issue.

For instance, the Abstract states in the Background,
"This study investigated changes in running speed over segments in male elite and age group 100 km ultra-marathoners..."

I would suggest this be re-written as,

"This study investigated changes in normalised running speed (as a proxy for effort distribution) over segments in male elite and age group 100 km ultra-marathoners..."

To save on parentheses, the Method should address this directly. Such as,

"Normalised average running speed (relative to segment 1 of the race, corrected for gradient) was analysed as a proxy for pacing in elite and age group finishers ...

From here, the authors can now talk about 'pacing strategy'. However, without this kind of presentation, the reader is left wondering at all the confounding impacts that break the connection between average running speed over a segment and pacing.

I urge the authors to correct their language throughout with the distinction between pacing and running speed in mind.

Level of interest: An article whose findings are important to those with closely related research interests

Quality of written English: Needs some language corrections before being published

Statistical review: No, the manuscript does not need to be seen by a statistician.

Declaration of competing interests:

I declare that I have no competing interests