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

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Version: Date: 6 October 2014

Author's response to reviews:

Dear Prof. Bailey

MS: 2096703534136475 - Pacing strategy in male elite and age group 100 km ultra-marathoners

We thank you for your e-mail from September 5, 2014.

Find below the answers to the questions raised by the reviewers.

All changes are marked in red in the revised manuscript.

We hope the revised manuscript will be suitable for publication in BMC Sports Science, Medicine and Rehabilitation.

Yours sincerely,
EDITOR'S COMMENTS:
"The reviewer's comments on and enthusiasm for your manuscript was mixed. In order to improve their rating of this manuscript a number of major revisions are required. Reviewer 1 has requested that the research question is more clearly defined and that some additional analyses are performed to account for the influence of gradient and wind on pacing and performance. The reviewer has provided some references to assist the author in making these additional analyses. These important points require attention. Reviewer 2 has also requested additional statistical analyses and highlight concerns with the data presentation that also require attention."
Answer: We have worked on all comments and hope all questions could be fully answered.

EDITORIAL REQUIREMENTS:
*Please include the email address of all authors in the title page.
Answer: We inserted the e-mails on the title page

*Acknowledgements: We strongly encourage you to include an Acknowledgements section between the Authors' contributions section and Reference list. Please acknowledge anyone who contributed towards the study by making substantial contributions to conception, design, acquisition of data, or analysis and interpretation of data, or who was involved in drafting the manuscript or revising it critically for important intellectual content, but who does not meet the criteria for authorship. Please also include their source(s) of funding. Please also acknowledge anyone who contributed materials essential for the study.

Authors should obtain permission to acknowledge from all those mentioned in the Acknowledgements. Please list the source(s) of funding for the study, for each author, and for the manuscript preparation in the acknowledgements section. Authors must describe the role of the funding body, if any, in study design; in the collection, analysis, and interpretation of data; in the writing of the manuscript; and in the decision to submit the manuscript for publication.

Answer: We have no acknowledgements
*We note that the figures have been included in the manuscript file. Please upload the figures as separate figure files using the "upload" form on the submission system only, and delete the figure from the manuscript file. The figure file should not include the title (e.g. Figure 1... etc.) or the figure number. The legend and title should be part of the manuscript file, given after the reference list. Please ensure that the order in which your figures are cited is the same as the order in which they are provided. Every figure must be cited in the text, using Arabic numerals. Please do not use ranges when listing figures. For more information, see the instructions for authors: http://www.biomedcentral.com/info/ifora/figures
Answer: We uploaded the figures separately.

*We recommend that you copyedit the paper to improve the style of written English. If this is not possible, you may need to use a professional language editing service. For authors who wish to have the language in their manuscript edited by a native-English speaker with scientific expertise, BioMed Central recommends Edanz (www.edanzediting.com/bmc1). BioMed Central has negotiated a 10% discount to the fee charged to BioMed Central authors by Edanz. Use of an editing service is neither a requirement nor a guarantee of acceptance for publication. For more information, see our FAQ on language editing services at http://www.biomedcentral.com/authors/authorfaq/editing.
Answer: The manuscript was checked by a native English speaker.

Reviewer's report
Title: Pacing strategy in male elite and age group 100 km ultra-marathoners
Version: 1
Date: 15 August 2014
Reviewer: Simon Angus
Reviewer's report:
A. Major Compulsory Revisions
A1. Underlying hypothesis to be tested
The brief review of the literature points directly to the fact that 'older, faster, and female' (p.4) competitors are better able to achieve even (less slow down) pacing
in similar events. However, the second paragraph on p.5 which outlines the central hypothesis that the paper will test says, "Since running performance in 100 km ultra-marathon running decreased with increasing age, we may assume that older runners (i.e. older than ~35-45 years) will faster slow down during a 100 km ultra-marathon than younger runners (i.e. younger than ~35-45 years)." The authors seem here to confuse 'average running speed' with 'poor pacing'. To be clear, the literature finds that:

a) Older runners tend to achieve lower average running speeds over the event (lowering their relative performance); but

b) Older runners tend to achieve more even (arguably better) pacing over the event.

The authors must clarify what their hypothesis is -- are they testing the age--average speed nexus, or the age--pacing nexus? These are difference questions.

Answer: We agree with the expert reviewer and changed to 'The aim of the present study was to investigate running speed over segments in male elite and age group 100 km ultra-marathoners in the ‘100 km Lauf Biel’ held in Switzerland with the assumption that running speed over segments would decrease at a faster rate (i.e. positive pacing) during the race with increasing age'.

A2. Lack of control for gradient

The authors study a running race over 100km, in the out-doors, natural environment. The major analytical approach of the study is to compare an athlete's average speed in two of the four segments in the race (see B1). Indeed, the title of the paper and its ensuing language indicate that the authors wish to study the 'pacing strategy' of the athletes in the study. 'Pacing strategy' is the distribution of effective power an athlete makes over the course of a race. In running, since we do not have direct access to power (e.g. measured by a device in the shoe), we fall back to measuring the speed of the athlete as a proxy. However, the speed of the athlete, in field conditions, represents the power signal that we wish to focus on /and/ the impact of gradient and incident wind vectors and other environmental factors. Thus, to recover 'pacing strategy' from field data, and so compare earlier to later proxies for power of the athlete, one needs to make an attempt to 'net out' other significant factors that pollute the power signal obtained from running speed.

Answer: We agree with the expert reviewer and inserted the changes in altitude in the analysis, see model 2 in the new mixed modelling analyses.

In this event we have segment variation in both of the gradient- and wind- vector dimensions. The authors include, in Figure 6, the altitude variation on course. We can see from here, or for example in the more detailed data obtainable from a major GSP community website [1] that the variation in the gradient is significant. Hence, we cannot really talk about 'pacing strategy' derived from speed without correcting in some way for the influence of gradient on-course. Wind could also be a factor and would be worth exploring likewise. Yes, the course is 'out and back', but given that it traces something of a circle, the impact of the wind (if
constant through the race) on each segment will vary from side, to tail, to head, to side and so on. Though, it could be argued, at ultra-marathon pace, the influence of wind is reduced relative to shorter running events. In any case, the point remains that without correcting for gradient (and perhaps wind) I do not believe that we can say anything about small changes in average segment running speed over the course of this event.

Answer: We agree with the expert reviewer and inserted the changes in altitude in the analysis, see model 2 in the new mixed modelling analyses. We use AIC to compare the models to judge which model is better.

I note that the authors point to such variations as possible reasons for pacing variation in the Discussion section, but it is my opinion that this is not really good enough. All they have really done here is to admit that the data they have presented are polluted by 'environmental' (including gradient) factors: rendering all previous conclusions which compare one average speed segment to another invalid.

Answer: We agree with the expert reviewer and inserted the changes in altitude in the analysis, see model 2 in the new mixed modelling analyses. We use AIC to compare the models to judge which model is better.

The request being made here is not beyond the ability or revealed technology of the field. The authors could look at two papers which have addressed methodologically, and in example, these problems with field data. [2] [3]


Answer: We agree with the expert reviewer and used http://www.gpsies.com/map.do?fileId=jxecmrwuazirqtcy to calculate the changes in altitude to use for the new analyses. Since we are not able to calculate for each runner for each segment the wind as influencing factor, we inserted one of the two papers as references in the limitations.

B. Minor Essential Revisions

B1. Clarification of running speed data

The basis of the speed data in this paper is the time taken by an athlete to complete one of 4 segments of the race. Hence, the best that we can say about the 'speed' of any athlete is the 'average speed for segment X' (where X \in \{1..4\}). However, the authors persist in several places to use language of instantaneous speed. e.g. in the Abstract, "Running speed at time station (TS) 2 (56.1 km) was compared to running speed at TS1 (38 km) and TS3 (76.7 km) and running speed at TS3 was compared to running speed at the finish." All references to 'running speed at location X' should be removed and a standard
system of referring to 'average running speed over a segment' should instead be used to avoid mis-interpretation.

Answer: We agree with the expert reviewer and changed throughout the manuscript

B2. You have two 'Figure 5's.
Answer: We agree with the expert reviewer and insert the second figure 5 in the methods as figure 1 now

Level of interest: An article of limited interest

Quality of written English: Acceptable

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

Reviewer's report
Title: Pacing strategy in male elite and age group 100 km ultra-marathoners
Version: 1
Date: 18 August 2014
Reviewer: Brian Hanley

Reviewer's report:
The purpose of this study was to investigate pacing strategies amongst male competitors in an ultra-marathon race. There is a rationale for this study in terms of showing differences between age groups and with regard to the area of ultra-marathon running in general. The authors have completed a reasonably good study, although there are some areas where the article can be improved. More specific comments are below:

- Major Compulsory Revisions
1. Methods, Paragraph 4 - Some of your statistics are on percentages (which tend to be skewed) so please arcsine transform them for the purposes of comparing groups (this is especially important given how close the values are to 100%). This webpage is quite useful in explaining more: http://archive.bio.ed.ac.uk/jdeacon/statistics/tress4.html

Answer: We agree with the expert reviewer and made the requested changes, see in the methods. We adapted the results in the tables; they are now marked in red.

2. Methods, Paragraph 4 – While you have found p-values (which is fine), you
should also have some measure of effect size. For example, a quick calculation using Cohen’s d of some of your significantly different findings showed that the effect size is very small and might not be important (this might actually improve the robustness of your important findings). Please calculate these and include them as appropriate.

Answer: We agree with the expert reviewer and calculated the effect sizes for the most important findings as suggested. They are now inserted in the models.

3. You can simplify the results section a lot by combining the information from different tables, figures and text. For example, the statistical information in Table 3 should be included with the data in Table 2 (this will simplify the information for the reader greatly). Figure 4 and Table 2 should also be combined as they present the exact same data (some of which are unnecessarily repeated in the text).

Answer: We agree with the expert reviewer and combined Table 2 with Table 3. Figure 4 is now deleted. We insert a new analysis with a mixed-effects regression model with time stations and change in altitude as fixed variables and summarize the results in two tables.

4. Discussion, Paragraph 3 – Please provide a reference that supports your suggestions for why the athletes might be motivated by increasing daylight.

Answer: We agree with the expert reviewer and inserted a section with ‘It has been reported that bright light has an effect on the human circadian system which is qualitatively different from that of dim light. Environmental factors impinging on circadian rhythms include different aspects such as light, heat, air ionization, activity and eating patterns, and social activities. Endogenous rhythms are desynchronized when perturbed by nocturnal shift work or time-zone transitions. Circadian rhythmicity in athletic performance can be modulated by different influences such as workload, psychological stressors, motivation, ‘morningness/eveningness’ differences, lighting, sleep disturbances, altitude, dietary constituents, gender, and age. Athletes over 50 years of age tend to be higher in ‘morningness’, habitually scheduling relatively more training in the morning and selecting relatively higher work-rates during exercise compared with young athletes’ to explain this aspect,

I would also recommend you make more of the idea that knowing the finish is near, as this is something that has been noted in other long distance competitions, such as 50 km race walking

Answer: We agree with the expert reviewer and inserted a section ‘A potential explanation for an even or a negative pacing between TS3 and finish could be due to motivational factors and experience. Motivation might be increased by knowing that the finish is near after passing the last time station (TS3). Hanley [2014] showed recently that gold medallists competing in the World Cross Country Championships were faster than the other medallists only after the final laps. It was concluded that athletes should patiently approach during the early stages of the race to benefit for a faster finish. When 20 km and 50 km race
walkers competing in the IAAF World Championships were compared [Angus 2013], the fastest finishers started the slowest relative to previous best performance. Lower-placed finishers tended to decrease pace earlier’ in the Discussion.

5. Discussion, Paragraph 6 – Although you have explained this part quite well (about the differences in age groups), I think you can emphasize it even more as it’s probably the most important finding of your study. It is noticeable that you haven’t included any recommendations for ultra-marathon runners so please do so (i.e. highlight the benefits of this research). One of them might be for younger athletes to be more cautious about pacing, to complete many shorter races in advance, etc.

Answer: We agree with the expert reviewer and inserted a section ‘practical applications’ where we inserted ‘This analysis shows that athletes in age group 18-24 years showed the largest decrease in running speed over segments. Younger athletes intending to compete in a 100 km should be more cautious about pacing and are recommended to complete many shorter races in advance’

- Minor Essential Revisions

1. You don’t need to use the term ‘ultra-marathon’ as often as you do, as it is clearly explained in the first sentence (Introduction, first paragraph) what defines an ultra-marathon. So, for example, you could rewrite “the 100 km ultra-marathon distance” as “the 100 km distance”.

Answer: We agree with the expert reviewer and changed as suggested throughout the manuscript.

2. There are instances where the meaning of a sentence is fairly clear but it could be improved by a native speaker of English to make it more idiomatically correct. For example, in the Introduction, Paragraph 2, “also the pacing strategy has been investigated” is better written as “the pacing strategy has also been investigated”.

Answer: We agree with the expert reviewer and changed as suggested

3. Introduction, Paragraph 4 – Please delete the last part that’s in brackets as you have already explained this in the first sentence of this paragraph.

Answer: We agree with the expert reviewer and deleted as suggested

4. Methods, Paragraph 2 – It would be better to refer to Figure 6 here (and therefore also change the numbering of your Figures) as this is where you first mention that there is a change in altitude. This is important information that needs to be made clearer at this point so the reader knows the course has many changes in gradient before seeing the results.

Answer: We agree with the expert reviewer and expanded the section of the race details also by inserting this figure.

5. Methods, Paragraph 4 – Would it not have been easier to perform a repeated measures ANOVA with repeated contrasts to compare the running speeds? This is essentially what you have done (although you don’t say if the ANOVA was
repeated measures); please include some references to justify the choice of statistics used, so that the reader can see what the basis for them was (e.g. if they wanted to do a similar study to yours).

Answer: We asked our expert in biostatistics and he agreed with us to use repeated measures one-way analysis of variance (ANOVA). We specify in the methods with ‘To test whether athletes became slower during the race, relative average running over segment TS1-TS2 (expressed as percent of running speed at TS1) was compared to relative average running over segment Start-TS1 (defined as 100%) and relative average running over segment TS2-TS3 was compared to relative average running over segment T3-Finish using repeated measures one-way analysis of variance (ANOVA) with the Greenhouse-Geisser correction and Sidak’s multiple comparison tests with individual variances calculated for each comparison’. We base our calculations on http://www.methodenberatung.uzh.ch/index.html, http://archive.bio.ed.ac.uk/jdeacon/statistics/tress4.html, and http://www.graphpad.com/guides/prism/6/statistics/index.htm?stat_comparing_three_or_more_groups.htm.

- Discretionary Revisions

1. Results, Paragraph 1 (and Figure 2) – I can’t really see the importance of comparing between editions of the race, as there are so many variables that can differ. Please either remove this information or justify its inclusion (it might have an importance that is not obvious to the reader).

Answer: Prior to pooling all data from the ten editions, we wanted to know whether the trend was the same in all editions. Since one of the co-authors already competed in that race and found different weather conditions leading to very different race times, it was very important for us to know whether the trend was the same for all years. With the actual calculations, we see that the trend was the same in all editions.

Table 5 is also confusing – were these the temperatures at the time of the race? How hot was it during the night (e.g. at midnight) when the athletes were actually running? I would advise you to either remove this Table or insert meaningful data like temperature and humidity values.

Answer: We agree with the expert reviewer and deleted the table.

2. Similarly, in the Discussion, Paragraphs 1 and 2, please explain why the decrease in speed of the top ten finishers is such an important finding. I think you should remove this and concentrate on the other two findings, which are far more important and useful.

Answer: We found in this race a decrease in running speed over calendar years. This is in contrast to the general trend for 100 km ultra-marathoners. We add now ‘This results is, however, very astonishing since the worldwide trend is an improvement in performance across calendar years in 100 km ultra-marathoners. Cejka et al. recently investigated running speed of the annual fastest women and men in all 100 km ultra-marathons held worldwide between 1960 and 2012. Running speed increased highly significantly for the annual ten fastest men from
10.23±1.22 to 15.05±0.29 km/h and for the annual ten fastest women from 7.18±1.54 to 13.03±0.18 km/h’

- Minor issues not for publication
1. In some instances (e.g. first line of Introduction, Paragraph 2), you have not included a space between the number and the unit. Please correct this as appropriate.
   Answer: We agree with the expert reviewer and changed throughout the manuscript

2. Introduction, Paragraph 2 – Please remove the words “during the race” from the fourth line as this is obvious from the rest of the text.
   Answer: We agree with the expert reviewer and deleted as suggested

3. Methods, Paragraph 3 (and throughout text) – Using ‘annual’ in this context doesn’t read very well, so in some cases you should omit it where it’s not needed, and in others you might want to rephrase it (e.g. to something like “the top ten athletes in each edition”).
   Answer: We agree with the expert reviewer and changed throughout the manuscript to ‘the top ten athletes in each edition’

4. Discussion, Paragraph 1 – Please change the phrase “such as the” in the first sentence as this was the actual race analyzed, not an example of one.
   Answer: We agree with the expert reviewer and changed that sentence to ‘This study investigated the changes in running speed in a 100 km for both elite and age group athletes and it was hypothesized that running speed would decrease faster during the race in older than in younger age group athletes’

5. Discussion, Paragraph 3 – Please use either 0530 or 5:30 a.m., and not a combination of both systems.
   Answer: We agree with the expert reviewer and changed as suggested

Level of interest: An article of importance in its field

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

Statistical review: Yes, and I have assessed the statistics in my report.

Declaration of competing interests: I declare that I have no competing interests

Reviewer's report

Title: Pacing strategy in male elite and age group 100 km ultra-marathoners
This is a brief, applied design that will have special interest in the pacing field, supporting some flaws on ultra endurance events. I agree with the whole design, structure and manuscript length, with several minor comments to be solved. Congratulations.

- Minor Essential Revisions:

Page #10 to #11. Discussion about why front runners show even or negative pacing from T3 to the finish line sounds too close to opinion the way you say it. You could mention this argument as the 2nd, since the slope conditions initially can better support that. When considering psychological reasons, please try to sustain this motivation-based concept with literature. A possibility is to linking it to the concepts of positive affect and persistence striving discussed elsewhere (read the following references, at least #1):


You can also read a recent paper attached which is ahead-of-print and discusses about that at some point (Esteve-Lanao et al In press)

Answer: We agree with the expert reviewer and inserted a new section in the Discussion with ‘Psychological reasons for decision taking in pacing strategy should also be considered. The performance level of the athletes seems the most important reason. Renfree and St Clair Gibson investigated the influence of different performance levels on pacing strategy in elite female marathoners competing in the IAAF Women’s Marathon Championship in 2009. Athletes finishing in the first 25% of finishers ran the first two 5-km segments at a relatively lower speed than athletes in the second to fourth 25% of finishers but at a relatively higher speed after km 35. The authors concluded that psychological factors influenced decision making in a major competitive event. Similarly, top runners in the ‘New York City Marathon’ tried to maintain an even pacing profile by avoiding an excessively fast start which might result in a decrease in running speed in the second half of the race. Esteve-Lanao et al. investigated the pacing strategy in World Cross Country Championships between 2007 and 2013. They showed that top ten finishers displayed a more even pacing compared to the other finishers who showed a more positive pacing.
The rest of the discussion is well defended and expected. Knowing full well that this might be impossible, we wonder on the potential effect of racing experience both athletic events and particularly in marathon and ultra-marathon events. If this could be possible to be obtained at any race edition, it would be really interesting as a subset analysis or even as a particular comment to be included in the discussion. If it would not be possible, I understand.

Answer: We agree with the expert reviewer. Although we could find the results of these athletes for other ultra-marathons, this analysis would not be within the scope of the present study. A future study will investigate the aspect of previous experience for ultra-marathoners competing in the very long distances (3100 miles) and consider what they achieved in the shorter ultra-marathons.

Page #20. Typing mistake with the Title of Figure 6. There says ‘5’ twice. Congratulations for this interesting paper. I encourage you to solve these queries and send it back soon. We will appreciate.

Answer: We agree with the expert reviewer and Figure 6 is now moved to Figure 1 in the methods.

Level of interest: An article of importance in its field