Author's response to reviews

Title: Comparison of vertical ground reaction forces during overground and treadmill running. A validation study

Authors:

Bas Kluitenber (b.kluitenber@umcg.nl)
Steef W Bredeweg (s.w.bredeweg@umcg.nl)
Sjouke Zijlstra (s.zijlstra@umcg.nl)
Wiebren Zijlstra (wiebren.zijlstra@umcg.nl)
Ida Buist (i.buist@umcg.nl)

Version: 2 Date: 3 October 2012

Author's response to reviews: see over
Regarding: revised manuscript MS: 1538407277735627

Dear Ms Abigail Quiniquini,

Journal Editorial Office

Biomed Central

Thank you for offering us the opportunity to submit a revised version of our manuscript entitled “Comparison of vertical ground reaction forces during overground and treadmill running. A validation study”. We thank the reviewers for the valuable comments that enabled us to improve our manuscript. We have rewritten the introduction as advised by the editor and Dr. Hreljac. Now the introduction is more focused on validating the treadmill instead of running injuries. We have also clarified the data analysis part for the treadmill and extended the results to give more insights in overground/treadmill running differences. With regard to the technical description of the instrumented treadmill, we have extended the description of the treadmill in the methods part and included a schematic figure of the positioning of the force transducers. Furthermore, high noise artifacts due to the treadmill belt were filtered out during the data analysis.

Please find enclosed a revised version of the manuscript and an itemized series of responses to the comments of reviewers.

Sincerely,

Bas Kluitenberg

Center for Sports Medicine
University Medical Center Groningen
Hanzeplein 1
9713 GZ Groningen
The Netherlands
b.kluitenberg@umcg.nl
Reviewer's report

Title: Comparison of vertical ground reaction forces during overground and treadmill running. A validation study

Version: 1 Date: 17 August 2012

Reviewer: Alan A.H. Hreljac

Reviewer's report:

Discretionary Revisions

1) Background: In the opening paragraph, and periodically throughout the manuscript, the authors have focused on issues related to running injuries. As the authors noted, the relationship between running injuries and vertical GRFs "remains unclear." There are, however, many reasons for researchers to study vertical GRFs during running. Of course, among these reasons is to study the injurious effects of vertical GRFs during running. Similarly, many of the running related issues that are mentioned by the authors are not necessarily related to vertical GRFs. It would be better to focus this first paragraph on the major point of the research, which is to validate the use of an instrumented treadmill for studying vertical GRFs during running. This background related to running injury research is only peripherally related to your study. I would suggest trying to refocus the introductory paragraphs.

   - The reason we choose to focus on injuries when validating the treadmill was to emphasize the importance of measuring vertical GRFs during running, also for clinicians. We totally agree that studying vertical GRFs during running is of interest for many reasons besides injuries and that the introduction might not be the place for linking injuries to studying GRFs. Therefore the introduction is rewritten and more focused on validating the treadmill itself.

2) Methods: Since this study appears to be primarily conducted to look at impact peaks and loading rates (Background, 2nd last paragraph), it may have been more appropriate to include only heelstrike runners as subjects.

   - It is true that for validating impact forces and loading rates only heelstrike runners would have been convenient. However, we wanted to study the behavior of running overground and on a treadmill in a broader sense. Therefore also non-heelstrike runners participated in the study.

3) Methods: As noted in the Background, one major advantage of an instrumented treadmill is the ability to monitor multiple consecutive steps of data. Although single sided data are often collected in overground running studies, it would have been preferable for the researchers to collect data on both feet to determine whether variations occurred on either side of the body.
The primary objective of the study was to validate treadmill measured vertical GRF parameters with a traditional force platform. It would be interesting to study possible differences (asymmetry) in these parameters, but for the validation purpose itself this was not required. As a matter of fact at this moment another paper on this topic is under revision. This article describes levels of kinetic asymmetry and their link to the development of running related injuries.

4) Discussion, Paragraph 1: Some type of "curve comparison" analysis would have been helpful to determine the extent of the agreement more objectively.

Some sort of curve comparison would have been instructive and definitely strengthen the qualitative on-sight agreement. The primary objective of the study, however, was to validate GRF parameters and therefore a curve comparison would be less informative.

5) Discussion, Paragraph 2: A more flattened landing style may indicate differences in AP GRF curves. This may be important in the resultant GRF and in the joint kinetics that would be determined using an inverse dynamics approach.

A change in foot strike pattern may indeed indicate differences in AP forces. This remark is added in the second paragraph of the discussion. This point and its consequences for inverse dynamics are also emphasized in the limitations part of the discussion on page 11.

Major Compulsory Revisions

1) Methods: It is not clear how many steps of data were collected and used for the analysis of the treadmill running trials. Five steps should have been used to match overground trials. If only five steps were used for analysis, which five were chosen?

The number of steps that was used to analyze treadmill data was indeed not clear. It was only mentioned in the abstract. We have stated it more clearly in the data analysis part of the methods section.

2) Results: Was the landing pattern within speed conditions consistent between the treadmill and overground (i.e. did subjects who used a HS pattern at a certain speed exhibit this pattern overground and on the treadmill?). The level of consistency of landing strategy between treadmill and overground running at a given speed would be an important comparison to make when determining the validity of using a treadmill to predict overground patterns of vertical GRFs. For example, if runners are not generally consistent in the landing pattern, the use of a treadmill may be contraindicated.

It is very true that the level of consistency during overground and treadmill running within a speed condition is important. Therefore we have added a table in the results part (table 2) which includes the overground landing strategy for each
speed condition and the landing strategy of these subjects during treadmill running. The consistency is expressed as a percentage.

3) Discussion, Paragraph 2: Actual statistical comparisons of the various "inconsistencies" in landing patterns would be instructive, as these differences may be important in determining whether treadmill and overground kinetics are similar.

- **True**, as mentioned above, we have added the number of subjects that showed a consistent overground/treadmill landing strategy and expressed this consistency as percentage to the overground golden standard. As can be seen in table 2, consistency for heelstrike and non-heelstrike landing is highest at preferred speed. Therefore it is recommended to use this speed condition for determining landing strategy.

4) Discussion: At some point in your Discussion, two very important limitations of using an instrumented treadmill should be mentioned. Even if an instrumented treadmill were able to measure vertical GRFs in perfect agreement with overground running, it would not be possible to conduct a study in which joint kinetics could be assessed using a standard inverse dynamics methodology since AP and ML force data are not measured. The other important limitation is obviously that an instrumented treadmill would have very limited usefulness for walking studies.

- **Indeed two important limitations of using an instrumented treadmill. Both points are added at the end of the discussion on page 11.**

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

**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: Comparison of vertical ground reaction forces during overground and treadmill running. A validation study

Version: 1 Date: 21 August 2012

Reviewer: Patrick O Riley

Reviewer's report:

- Discretionary Revisions

On page 11 the sentence: “Besides the high between …… For these parameters was high.” Is difficult to understand.

  - Absolutely true, this sentence was not clear. We rewrote the sentence.

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

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.