Author's response to reviews

Title: Kinetic and kinematic differences between Deadlifts and Goodmornings

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Author's response to reviews: see over
Point by point response to the Reviewer’s comments:

First of all, we would like to thank both of the Reviewers for their useful comments. They helped to improve the manuscript considerably!

*Authors’ contribution: Please place the Authors’ Contributions section after Competing interests. Please check the instructions for authors on the journal website for the correct format to use for Authors’ Contributions.

The paragraph has now been moved and reads as follows: “FS and JL acquired the data, and undertook the data analyses including the preparation of the tables and figures. FS performed the statistical analysis and helped drafting the manuscript. RL supported the measurement set up, data analysis and helped drafting the manuscript. BT helped in both interpreting the data and drafting the manuscript. SL made the concept and design of this study, supervised the data analyses and interpretation and helped drafting the manuscript. All authors read and approved the final manuscript.”

*Consent statement (to use image in figure 1): Please state in the Methods section whether written informed consent for participation in the study was obtained from participants or, where participants are children, a parent or guardian.

The consent statement has now been added to the Methods section: “The study was approved by the Ethics committee of ETH Zurich, Switzerland (EK 2012-N-57). One subject provided written informed consent to the publication of their images and all subjects provided written informed consent to participate in the study”.

Reviewer: Kimi Sato

Reviewer’s report:

General comments
The purpose of the study was to identify the biomechanical difference between deadlift and goodmorning, specifically analyzing the trunk, hip and knee. Overall this paper is very well-written and covers great contents. Only minor edits are needed.

Specific comments.
Title: Minor Essential Revisions
1) Authors should erase “- a biomechanical study of the knee, hip, and back” since they used the term “kinetic and kinematic” in the first part of the title.
The title was changed to: “Kinetic and kinematic differences between Deadlifts and Goodmornings”

Introduction: Minor Essential Revisions
2) Line 41-43 & 51: The two sentences are contradictory. First one says about lack of a complete biomechanical understanding of loading conditions, but later (line 51) says biomechanics of lift have been studied extensively. Authors need to rephrase to be consistent.

The first sentence provided a comment on the conditions during training and the second one during competition. To clarify these statements within the manuscript, the first sentence has now been changed to “Despite these astounding statistics, a complete biomechanical understanding of the loading conditions of many exercises during strength training remains lacking.”

3) Line 70: “…but an athlete should ensure good lifting technique when approaching near maximal effort to avoid injury”. Authors should restate this since good lifting technique is essential no matter what effort level you are lifting. Plus this sounds like authors are talking about acute injuries whereas some injuries in the back and knee comes from accumulation of stress from poor technique and progress too early.

The second part of this sentence was changed to: “…but for all levels of performance, good lifting technique is required when approaching near maximal effort to avoid acute injury or long-term damage.”

Methods: Minor Essential Revisions
4) Line 143: Authors stated “eight valid” executions from each lifter. It is somewhat subjective. From the reliability standpoint, authors should report ICC and each variable over the eight repetitions. That way authors can confirm the lifting technique consistency.

Only 8 repetitions were recorded so an average of all of them was presented. The sentence was changed to:
“All eight repetitions of every subject were averaged for the statistical calculations.”

In order to quantify the repeatability of the subjects, the following comment has now been added to the Results section: “The typically observed intra-subject standard deviation of the maximal joint angles of the knee and hip, as well as of their ROM, over the eight repetitions was < 2.5°.”

Results & Discussion: Minor Essential Revisions
5) Line 159-160 & 176-177: Are there sentences talking about the exact same thing? If so, just keep one.
One sentence was deleted.

6) Line 164: “In so doing…”, should be “In doing so…”
The sentence was changed as suggested.
7) Line 170: “the studies of Cholewski, McGill [12]…”, should be “Cholewski, McGill, and Norman [12]”

The reference style was adapted throughout the entire manuscript.

References: Minor Essential Revisions
8) I noticed that reference formats are not consistent for abbreviation of journal articles. Please follow the guideline.

The correct reference style “biomedcentral.ens” is now used throughout the entire manuscript.

Reviewer: Gerwyn Hughes
Reviewer’s report:
Major compulsory revisions
Introduction
1. Overall, I feel you need to provide a much stronger rationale for this study. Justify why you are comparing these two exercises in particular.

A part of the introduction has now been rewritten to read: “GMs and DLs are comparable in their ability to train agility, speed and power in all sport types {Radcliffe, 2007 #36}, including typical strength exercises for ACL rehabilitation {Lorenz D, 2011 #35}, but also for potential injury risk during exercising {Colado, 2009 #37}. Despite the widespread use of GMs and DLs, the critical differences in lower limb and trunk motion, and more importantly the resulting loading conditions on the joints, during GMs and DLs remain unknown.”

Method
2. Lines 126-134; you need to provide more detailed definitions of how joint angles and moments were calculated. I am especially unsure about how L4/L5 moments were calculated as there seems no clear definition. In addition, are you referring to internal or external joint moments? Your definition states that inverse dynamics were used which usually refers to internal moments but your results and discussion section seems to contradict this in the way the results have been interpreted. Either method is appropriate but there needs to be clear definitions provided and consistency throughout the manuscript.

We decided to use the wording “external moment” since we were referring to the ground reaction force. The wording “internal” in that sense has now been removed from the entire manuscript.

The paragraph describing the methods to determine the moments has now been partially rewritten:
“The joint centres of the knee and hip were functionally determined from the basic motion tasks [22], and the joint centre of L4/L5 defined anatomically based on anthropometric data [24]. The external joint moments in the sagittal plane were calculated using an inverse dynamics approach and normalized to BW [25]. The flexion / extension moments at the knees and hips were averaged over both limbs. The inverse dynamics was performed in a quasi-static manner and included the position of the joints, the forces acting on each foot, and the gravitational...
force of the segments [25]. All calculations were performed in Matlab (version 8, The MathWorks Inc., Natick, MA, USA).

The position and orientation of each segment was determined relative to the reference segments defined by the standing trial as the neutral position (0° rotation) using a least-squares fit of the corresponding marker point clouds [22]. Joint rotations were described using a helical axis approach and for clinically interpretable rotational components, the attitude vector was decomposed along the axes of a segment fixed, orthogonal, anatomically defined joint coordinate system [22]. The joint angles, the curvature and the moments were all analysed in the sagittal plane.”

Tables/Figures
3. Revise table format. Firstly, I suggest not including data from other studies here, only present your own data in the tables and then compare your data to previous research in the text. Secondly, avoid too many gridlines, tables should only have three horizontal gridlines and avoid vertically directed text.

The tables were revised accordingly. However we felt that the text became cumbersome and difficult to read, so some of the other study data have been kept in the tables.

Minor essential revisions
Abstract
4. Line 10; this is the first example in the manuscript but this comment applies throughout where you use the term ‘moments in the knee/hip/spine. It is more conventional to use terms such as ‘knee flexion/extension moment’ or ‘moment about the knee in the sagittal plane’. Consider revising throughout.

In order to clarify, the term “moment” was specified at each occurrence throughout the manuscript including the caption of the figures and the tables.

Introduction
5. Line 48; I believe the word ‘knee’ should be replaced by ‘the’ here.

This has now been changed, as suggested

6. Line 45; you start to describe the DL exercise technique but do not provide full details. I suggest you elaborate to fully describe the lifting technique.

The requested information has now been added to the introduction:

“The movement includes mainly an extension of the knee and hip until the body reaches an upright standing position.”

7. Line 67; I feel you need to describe the lifting technique of GM’s somewhere here, similar to as suggested in previous comment related to the DL.

These details have now been added in the introduction section:

“Starting in an upright standing position and with the barbell on the shoulders, the hips are
progressively flexed until maximum hip flexion is reached, but the knees remained straight throughout.”

Methods
8. Line 113; The information in Table 1 does not seem to relate to the text where it is being referred to. The information in the table seems to refer to ways in which the tasks were standardised but the text relates to determination of joint centres.
There the reference to Table 1 was deleted.

9. Line 115; I feel you need to describe the tasks more clearly by giving detailed description of the task and referring to Table 1 for standardisation points somewhere in your descriptions.
A clarification of the task has now been added:
“The subject received standardized instructions for the two exercises (Table 1). Both exercises started in the upright position. For the GM the subjects were advised not to bend their knees.”

10. Line 118-120; here you refer to the definitions for the start and the end of a trial but the information here only relates to GM’s and no description is provided for DL’s.
The definition was the same for both exercises, and these details have now been added to the text:
”The definition of a repetition of both of the two exercises was based on the start and stop point by using the vertical velocity of the two markers attached on the barbell (v_{barbell} > 0.04 m/s).”
The starting position for both exercises was mentioned earlier in the Methods section.

11. Line 124-125; you have already stated that joint centres were determined through basic motion tasks, suggest removing.
The first statement was removed, as suggested.

Results and Discussion
12. Generally, when describing the results, please state in the text if results were significantly different or not.
The text was adapted accordingly to clarify the results that were significantly different.

13. Line 178; you use the term ‘isometric exercise of the knee’ but it would be more appropriate to describe what muscles are acting isometrically.
This is indeed a slightly more complex issue due to the two joint structures and the interaction of the hip and knee during the exercises. While the knee flexion angle remains isometric, the actual muscles undergo eccentric contraction due to motion at the hip. The sentence has therefore been carefully changed in order to clarify the situation: “The largest extension moment in the knee was, in fact, observed during GMs (Table 3). It should be noted that GMs are a rather isometric exercise for the knee flexors, but the hamstrings undergo eccentric and
concentric contraction due to motion at the hip (Figure 2).”

14. Line 191; you use the general term ‘multi-joint muscles’ but the rest of the sentence refers to hip and knee joint. Therefore I suggest referring specifically to the hamstrings here as the rest of the paragraph only seems to relate to that muscle group.
This was specified accordingly:
“For the training of multi-joint muscles, such as the M. semimembranosus and M. semitendinosus, the joint...”

15. Line 192-195; as per previous comment relating to definitions of joint moments, this section in particular is difficult to interpret without a clear understanding whether joint moments refer to internal of external joint moments.
This was specified accordingly.

16. Line 232; in your first sentence on Practical implications you state that a large RoM and moment is required. Please back this up with reference to previous literature and you need to be specific about the direction of the moment about the knee.
The sentence was changed to: “In order to optimize the training effect of the quadriceps, a large RoM (Baechle, 2008 #38) and external flexion moment in the knee is demanded.”

17. Line 236; when you say ‘to train the hip’ I would suggest it more appropriate to describe the muscles being trained rather than the joint. Since the joint can move in multiple directions and therefore the training effect will be different for different muscles.
The sentence was changed to: “To train the M. gluteus maximus, GMs produce a higher sagittal moment but a smaller range of motion than DLs.”

18. Line 238-239; when you describe the choice of exercise in relation to whether a subject has a previous injury, surely this would depend on which stage of rehabilitation they were at?
The sentence now reads: “The small RoM in the knee suggests that GMs should be chosen before DLs at the early stage of rehabilitation for subjects with a previous knee injury.”

19. Line 242-243; the ranking of strength exercises here has already been stated in the discussion. Consider removing from here.
The ranking was removed as suggested.

Tables/Figures
20. Table 2; unsure of what the units are for lumbar and thoracic ROM. Also, there seems to be no need for the definitions of ‘skilled’ and ‘unskilled’ at the bottom of the table.
The units are now presented in the caption. The terms skilled and unskilled have now been completely removed.
21. Table 3; no units of measurement are given. 
The units are now presented in the caption.

22. Figure 2. Why are you referring to squats in the caption of this Figure? You did not analyse the squat movement so I am unsure what this relates to. 
The aim was to provide a comparison against squat, but the Reviewer is completely correct that these data were not determined within this study – however, the data are from previous work of our group. The caption was therefore changed to: 
"Figure 2: Normalized knee moment in the sagittal plane [N*m*kg^{-1}] (positive for external knee flexion moment) averaged over all repetitions for all subjects during Goodmornings and Deadlifts with corresponding knee flexion angle ([°], zero represents a straight leg, defined on the basis of the standing trial) compared to the squat exercise (data taken from [28]). 
*: starting point of the eccentric phase at the upright position; blue: DL with 25% extra load; red: DL with 50% extra load; green: GM with 25% extra load; blue dotted: squats with 25% extra load; red dotted: squats with 50% extra load.”

Discretionary revisions
23. Title: I do not feel there is a need to include the term ‘strength training’ at the start of the title. Consider revising.
The title was changed to: “Kinetic and kinematic differences between Deadlifts and Goodmornings”

Abstract
24. Line 9; consider revising the sentence where you say that kinetic and kinematic data were captured using a motion analysis system. I suggest you include that it was a 3D system and that ground reaction force was recorded by a force plate.
The sentence was changed to: “Using the kinetic and kinematic data captured using a 3D motion analysis and force plates, ...”

25. Line 15; suggest changing the word ‘in’ to ‘of’.
Changed as suggested

26. Line 16; suggest changing the word ‘in’ to ‘for’.
Changed as suggested

Introduction
27. Line 33; I suggest rewording the first sentence of the introduction so that you avoid using ‘e.g.’ in the middle of the sentence.
The term “E.g.” has now been removed.

28. Line 41; suggest avoiding using the word ‘astounding’.
Method
30. Line 102: suggest changing the term ‘measurement frequency’ to ‘sampling frequency’.
   This term has been changed as suggested

31. Line 102: I suggest not referring to Figure 1 here but referring to it later in the paragraph
   since I don’t feel the text here relates clearly to what is shown in Figure 1.
   The reference has now been moved, as suggested.

Results and Discussion
32. Line 240-241: this sentence is unclear, consider revising.
   The sentence has now been revised and reads as follows: “Furthermore, GMs are suited to
   avoid external flexion moments at the knee. The magnitude of the resulting extension moments
   during GM is similar to the magnitude of the flexion moment during DLs.”

Tables/Figures
33. Figures 2, 3 and 4; these figures would be easier to interpret if a key was provided to
    indicate which lines relate to (rather than simply text in the caption).
    Small stick figures were added to the figures.