Author's response to reviews

Title: Does gait biomechanics in flip-flops differ from sandals, barefoot and shoes?

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Author's response to reviews: see over
We would like to express our appreciations to the editor and two reviewers for their insightful comments to our revised manuscript. We believe these comments have improved the manuscript significantly.

Additional editor's comments:
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Both reviewers raised concerns about the sample size and how this was determined. There is much confusion and debate in the literature over the use of post-hoc power analysis and observed power data. See: HOENIG JM and HEISEY DM. The Abuse of Power: The Pervasive Fallacy of Power. Calculations for Data Analysis. The American Statistician, 55(1):19-24, 2001.

Therefore we suggest that you do not include the sentence on post-hoc power analysis (lines 208-209). Instead focus on the small sample as a limitation within the discussion and leave the sentences in lines 331-333. Add a sentence in the results that justifies why a power calculation was not possible in the protocol planning stages eg. ?Investigation of flip-flops and open toe sandals is a relatively new area and thus little preliminary data exists from which sample size calculations could be performed?. Also add your justification from your response to reviewer 2 to your discussion (line 333) that other studies of this type have used sample samples ie ?In the recent paper by Chard et al. (2013), they had 13 subjects and Shakoor et al. (2010) had 31 subjects in their study?.

Thank you for your suggestions. We have removed the observed power sentence. We also added a sentence about the lack of previous studies to do the sample size estimation at the time in the result section: “A priori sample size estimation was not conducted as the flip-flops and open-toe sandals were relatively new and there was a lack of previous research of these types of footwear in healthy population.” (Lines 233-235) We also added another justification sentence in the limitation section of the discussion: “However, a recent study of effects of a thong style flip-flops on walking and running kinematics of healthy children also used a relatively small sample size of 12 participants [9].” We did not cite the Shakoor et al. (2010) as the participants were knee osteoarthritis patients in that study. (Lines 363-365)

Formatting:
Please note the heading hierarchy: JFAR only accepts TWO levels of heading hierarchy. The first level should be indicated with bold Arial 16-point font, and the second level with bold Arial 11-point font (no italics). If you require a third level, this should be indicated by italics in the standard font used in the main text, followed by a colon and no carriage return.

We have modified the headings and sub-headings according to JFAR’s requirements.

Please avoid the use of ?subjects? throughout the manuscript and change all uses of the word subjects to ?participants? instead.
We have replaced “subjects” with “participants”.

Please check consistency throughout the methods, results and discussion for the footwear test conditions. At times you have digressed to using slip-on sandals, open-toe footwear, and shoes and therefore these should be changed to your initial statement of the test conditions (line 135)ie flip-flops, sandals and running shoes. Please also note that your title also differs from the consistency. If you do change the title in your manuscript, please ensure that this is also changed in the online submission system too.

Thank you for the suggestion. We have removed slip-on from the title and text and only kept it in the method section where the footwear conditions are presented (Lines 151). We kept the term “open-toe footwear” as it covers both flip-flops and sandals.
Reviewer's report
Title: Does gait biomechanics in flip-flops differ from slip-on sandals, barefoot and shoes?
Version: 2 Date: 19 July 2013
Reviewer: Wendi Weimar
Reviewer's report:
Thank you for your consideration and commitment to addressing all of my comments.

Major Compulsory Revisions
Line 227 – I believe that the loading rate is fastest in barefoot because the foot strike is so much closer to the center of gravity of the walker. In the shod conditions there is more of a heel strike and therefore it takes longer for the body of the walker to get over the foot.

Thanks for your comment on this. We have added the suggested explanation and the sentence was modified as: “..., which was also supported by the greater loading rates in the open-toe footwear and barefoot compared to shoes as a more heel strike pattern is normally observed in shod walking.” (Lines 256-258)

Line 250 – I do not think that the propulsive GRFs were greater in the barefoot and open-toed shoe conditions, but rather it was less in the running shoe condition, due to the forward slope of the shoe. I think that the attempt to describe the “greater propulsive GRF” in bare foot and open-toed shoe conditions weakens the argument, particularly in light of the lack of a significant finding for the plantar flexion moment in late stance. As a result, I think that this project would have benefited from a zero drop athletic shoe.

We agreed with your comment and have modified the sentence as: “The greater forefoot slope in shoes may have required less propulsive forces at push-off compared to barefoot, flip-flops and sandals in order to maintain the set walking speed.” (Lines 281-283) We also added one sentence at the end of the paragraph per your comment: “Comparisons of open-toe footwear with a zero drop athletic shoe (forefoot vs. heel sole height) are warranted in future studies.” (Lines 285-286)

Line 254– I still cannot agree with the notion of a smaller moment arm during the barefoot and open-toed shoes vs the shoe condition. While I understand that when standing a case could be made that the location of the force was closer to the heel, but this was not measured and it the height of the heel of the sneaker would play a role. Either way, this variable was considered in late stance phase when, presumably the heel has come off the ground, this would move the force to the ball of the foot for all footwear conditions.

Thanks for the comment. We agreed with your assessment and removed the sentence.

Line 264–267 – I think that you should consider the features of the foot bed in explaining that increased movement of the COP in the M/L direction. The medial arch support, though minimal, may have prevented the roll of the foot medially in the shoe conditions.
We removed the sentence about mid-foot torsion and added a sentence about the shoed conditions of M/L COP movement per your suggestion: “The sole of the open-toe footwear and shoes might have reduced medial rolling of foot and therefore reduced the medial COP displacement.” (Lines 293-295)

Line 269 – the ankle was plantar flexed at foot contact, it did not have a smaller dorsiflexed position?

We have changed the sentence as: “The flatter foot contact angle and more plantarflexed ankle contact angle in barefoot compared to other footwear conditions likely caused a more anterior COP at heel contact and may explain the reduced AP COP displacement in barefoot.” (Lines 296-299)

Line 289 – Shroyer found an increase in Tibialis Anterior (a dorsiflexor) activity during swing phase

Thanks for pointing this out. The sentence was modified as: “The reduction in swing phase dorsiflexion may explain the smaller foot angle and more plantarflexed ankle angle at heel strike (Figure 2A) as the dorsiflexors may be more active as co-contraction of both dorsiflexors and plantarflexors increases before foot strike in flip-flops compared to shoes.” (Lines 316-319)

Table 3 - I think peak ankle inversion moment in late stance reached significance

This was an oversight on our part. We have modified the table and added the sentence describing the two significant comparisons in the result section: “The peak ankle inversion moment in late stance was significantly greater in barefoot compared to two open-toe shoes.” (Lines 228-230)

Minor Essential Revisions

Line 84 – I think that the references should go from 5-9 instead of 5-7 (you say 5-7, but then you only talk about 7,8,9?)

We added references # 8 and #9 to the sentence.

Line 89- need a space between 50 and mm

The change was made.

Line 104 – change on to of

The change was made.

Line 160 – should parallel be perpendicular?
It should be parallel to “the shank” in how we defined the virtual foot.

Line 161 – there should be a comma between markers and was

The change was made.

Line 216, 237 – reduction I think is misleading, a smaller loading rate or longer loading rate may be more helpful to the reader.

The suggested changes were made.

Line 229 – plantar flexors is misspelled

The correction was made.

Line 253 – plantar flexion is misspelled

The correction was made.

Line 255 – add the word conditions after barefoot

The original sentence was removed in response to your earlier comment.

Line 265 – change and to we

The original sentence was removed in response to your earlier comment.

Line 343- add an s to moment

The change was made.

Discretionary Revisions

Line 294-296 – since the heel is not the only part of the foot making contact with the ground, heel strike is not as appropriate as a phrase such as initial contact.

We made the change as suggested.

Last, I think it would be beneficial for this paper to be reviewed by a person with a strong statistical background. The power vs number of variables vs related variables vs sample size is troubling. I think a MANOVA is appropriate for the joint kinematic variables.

We appreciate your comment on the MANOVA part. We added a sentence in the limitation paragraph of the discussion: “…and a multivariate analysis of variance may
offer a more stringent statistical test for a study with a small sample size.” (Lines 362-363)
Reviewer's report
Title: Does gait biomechanics in flip-flops differ from slip-on sandals, barefoot and shoes?
Version: 2 Date: 24 July 2013
Reviewer: Stephen Preece
Reviewer's report:

Major compulsory revisions:

1. The authors have made no attempt to integrate the information on sample size into the flow of the document. I would suggest at sentence at the end of the methods says something like “Given the relatively sample size, statistical power was calculated for each comparison…” This information then needs to be integrated properly into the text of the results section.

Thanks for your comment. Per the editor’s suggestion, we removed the sentence about the observed power in the result section and added a justification of why we did not perform the sample size estimation: “A priori sample size estimation was not conducted as the flip-flops and open-toe sandals were relatively new and there was a lack of previous research of these types of footwear in healthy population.” (Lines 233-235)
We also added another justification sentence in the limitation section of the discussion: “However, a recent study of effects of a thong style flip-flops on walking and running kinematics of healthy children also used a relatively small sample size of 12 participants [9].” (Lines 363-365)

2. The authors could add a few words (line 151) to justify their choice of footwear in the manuscript.

We added two sentences to justify the choice of the three types of footwear: “The flip-flops and sandals were chosen for their popularity and simple design that can accommodate the ease of reflective marker placements for the mid-foot and forefoot regions for purpose of implementing a multi-segment model (not reported in this paper). The running shoe was a standard neutral running shoe used in our laboratory for gait analysis studies.” (Lines 152 – 157)

3. In their responses the authors state ……We did use a virtual foot segment in ankle kinematic calculation in Visual 3D. We added the following sentence in the revised text: “A virtual foot segment which was defined as parallel to the shank but tracked with foot tracking markers was used in ankle angular kinematic calculation, and the ankle angle was, therefore, zero in static standing position.” (Lines 160-162)……
This should be rephrased “…A virtual foot segment was defined which was aligned with the shank during the static trial and tracked with foot tracking markers. Interpretation of kinematic data with this approach is straightforward as a zero ankle angle corresponds to the standing trial. However, however this approach can mask kinematic differences resulting from differences in heel height between footwear conditions……” the authors
should then state the differences between the relative forefoot-heel heights in each of the shoes.

We have made suggested changes to the method section: “Interpretation of ankle kinematic data with this approach is straight forward as a zero ankle angle corresponds to the standing trial. However, this approach can mask kinematic differences resulting from differences in heel height between footwear conditions.” (Lines 165 – 168) We also added the measurements of relative heel and forefoot heights for each of the three shoes as requested: “The relative heel-forefoot height [(heel height/forefoot height) * 100] was 96.6% for flip-flops, 123.6% for sandals, and 178.4% for running shoes. If the relative height is less than 100% it indicates lower heel height compared to forefoot height and if the relative height is greater 100% it indicates a higher heel height compared to forefoot height.” (Lines 168 – 172) We also added one sentence about the relative heights of the shoes in the discussion section to provide additional support for the statement related to the relative heights: “In fact, the relative heel-forefoot heights for flip-flops (96.6%) and sandals (123.6%) are much smaller than that of running shoes (178.4%) in the current study.” (Lines 278 - 280)

4. The information on the calculation of the different parameters, now given as table footnotes, should be incorporated into the methods section. Diagrams would help to clarify how these parameters were calculated. Because it is not clear how parameters such as loading rate were calculated, it is not possible to properly interpret the comments in the discussion.

We have added (with minor modifications) the definitions and conventions of the included variables in the method section (Lines 181 - 190). We kept the original definitions in the tables’ footnote for the convenience of the readers.

5. The authors have added the sentence: “Although unsubstantiated, it is possible that the subjects took longer steps in the open-toe footwear conditions.” (Line 275-76). Do not say it was unsubstantiated! - You should be able to obtain this information from you kinematic data.

Thanks for the suggestion. We only collected the data on the right side of the subjects and unfortunately cannot compute the step length and time related data. Based on your suggestion, we have changed the sentence to: “It is possible that the participants may have taken longer steps in the open-toe footwear conditions.” (Lines 304-305)

6. New paragraph line 220, beginning the increased loading rate….

The new paragraph started as suggested.

7. Replace plantarplexors with plantarflexors (line229).
The change was made.

8. The section which has been modified to “In the current study, we did not report mid-foot torsion but based on findings of previous literature and suspect that a greater ROM of mid-foot torsion may have allowed for greater ML COP displacement in barefoot compared to other footwear conditions.” Should be rewritten as “with our experimental approach we were unable to calculate mid-foot torsion, however it is possible that the greater ML COP displacement in barefoot compared to other footwear conditions, was the result of an increased mid-foot torsional movement.”

Per suggestion of the other reviewer, we have deleted the sentence and replaced it with this sentence to provide further explanation of the increase ML COP displacement in barefoot condition: “The sole of the open-toe footwear and shoes might have reduced medial rolling of foot and therefore reduced the medial COP displacement.” (Lines 293-295)

Discretionary revisions:
1. You have now added extra material (on the study by Chard) into the 3rd paragraph. Originally I had suggested this was combined with the 4th paragraph but, given the extra material, it would now be better as two separate paragraphs.

We have broken the paragraph into two at “Gender difference in lower extremity …”.

2. I still feel that the sample size is small for a study of this kind and this could limit the generalizability of the findings. I would recommend further data collection on at least another 5 subjects. However, I will leave the final decision on this to the journal editor.

Thank you for your suggestion. Per the suggestion of the editor, we have added a sentence about the lack of previous studies to do the sample size estimation at the time in the result section: “A priori sample size estimation was not conducted as the flip-flops and open-toe sandals were relatively new and there was a lack of previous research of these types of footwear in healthy population.” (Lines 233-235) We also added another justification sentence in the limitation section of the discussion: “However, a recent study of effects of a thong style flip-flops on walking and running kinematics of healthy children also used a relatively small sample size of 12 participants [9].” (Lines 363-365)

3. In addition to the tables presented in the results section, it would be useful to have some comparison plots of the kinematic/kinetic/force/pressure curves in the results to show visually the differences between the four footwear conditions. These graphs should be referred to in the discussion and would make reading of this section much easier.

Thank you for the suggestions. Based on your suggestion, we have added two figures: Figure 2 of ensemble curves of ankle sagittal plane angle and moment and frontal plane
angle and moment, and Figure 3 of ensemble curves of knee sagittal plane angle and moment, of the four footwear conditions. We also added reference to these figures in the result section and discussion.