Reviewer's report

Title: Does flip-flop style footwear modify ankle biomechanics and foot loading patterns?

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Reviewer: Sharon Dixon

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Major Compulsory Considerations

General
1. Performing a study to compare barefoot, flip-flop and FitFlop seems useful. However, in its current form, the aims and focus of the manuscript are difficult to justify. There is a strong suggestion that the tested FitFlops may provide an alternative to the traditional flip-flop. Consideration of the images provided in Figure 1 highlights that these are completely different footwear items, and would appeal to totally different markets. I cannot see a teenager attracted to wearing a Havaiana flip-flop considering the illustrated FitFlop as a realistic alternative (although I am no expert in fashion). Comparing both of these footwear types to barefoot could provide useful information, but I do not think for the reasons presented.

2. The specific aim of the study is unclear. In parts, it seems to be to find an alternative to the traditional flip-flop by comparing it with FitFlop, whilst in other sections it is to compare both footwear types with barefoot. The start of the discussion section suggests the aim is to compare flip-flop with barefoot and with FitFlop. What is the aim?

3. The finding that the FitFlop reduces rearfoot movement is interpreted as positive because of a possible association with reduced injury risk. However, this observation is contrary to the marketed aim of the FitFlop to provide 'a soft midsole to induce instability', as described in the introduction. This point cannot be ignored.

Specific

Abstract
4. I am not sure that all readers of the abstract will know what a FitFlop is. Some detail / description is required. Readers from different countries will also not know what a flip-flop is.

5. The background detail suggests that a flip-flop and FitFlop are compared, but the results also mention barefoot. Please be consistent within the abstract.

6. The end of the methods section suggests two conditions, but there appear to be three.

7. The eversion angle provided for flip-flop is negative and barefoot is positive, when both are stated to be increases in eversion compared with FitFlop. I
imagine both should have the same sign?

8. Is the reduction in loading rate for FitFlop a comparison with the flip-flop (as the text suggests), or compared with barefoot?


Background

Para 1

10. The description of the features of a typical ‘flip-flop’ style shoe provided here (thin sole, no arch support, no heel-toe pitch) appear comparable to several features of a typical minimal shoe currently popular with runners. Are these specific features therefore really currently considered to ‘break recommendations for footwear’?

Para 2, final argument

11. I think this argument is not sufficiently clear. I imagine there a numerous models of flip-flop available on the market with different features in terms of the comfort, midsole material properties etc. Considering ‘flip-flop’ as one condition and comparing to something that essentially is also a flip-flop is not currently justified by the argument presented. What exactly do you mean by ‘bench-marking’ in this sense? As performed, it looks like the study uses barefoot as the control condition and compares the other footwear types to this. Surely a systematic variation of the properties of a flip-flop style shoe would be the best way forward for understanding how best to develop an appropriate shoe of this type?

Para 3

12. Are all of the gait modifications highlighted in the previous paragraph necessarily negative? Why is barefoot gait considered to be the best?

13. Study aim – is the aim to compare barefoot and flip-flop with FitFlop, but not be compare barefoot with flip-flop (as suggested in the stated aim). The hypotheses are not consistent with this aim. (the start of the discussion section seems to highlight another different aim).

14. Hypothesis 1: the literature presented in the background section [8] suggest an increase in swing plantar-flexion, so how is an expectation of increased dorsi-flexion justified?

15. Hypothesis 2: it does not make sense to hypothesise that there will be lower frontal plane movement for the FitFlop compared with barefoot as a result of the ‘thicker strap’, as there is no strap for the barefoot condition.

Methods

Para 1

16. I suggest describing the participants as being university students (or other), rather than being from ‘the University’. Or perhaps just name the University.

17. Footwear Conditions: in what way did the FitFlop vary between genders? The figure provided suggests they are very different.
18. Protocol: once a self-selected speed was performed, was this then controlled for individual participants?

Kinematics and kinetics (Page 7)

19. You have not hypothesised anything with regard to joint moments, so it is not clear why these are being calculated?

20. What are ‘variable magnitudes’?

Results

21. Many more variables are presented in the results section than are justified in the background section or included in the hypotheses. Please justify.

Ankle angle swing

22. It is stated that ankle plantar- and dorsi-flexion differ between conditions – between which conditions and in what direction?

23. Under the title of ‘ankle angle swing’, ground contact moments are also presented – please justify or change section heading.

Discussion

Para 1

24. The start of this paragraph suggests that the main focus of the study is to compare the flip-flop with barefoot and with the FitFlop. This does not seem to be the case throughout the manuscript. Even the final sentence of this paragraph suggests the aim has been to compare both footwear types with barefoot. Consistency in the study aim is required.

Ankle angle swing

25. You have not hypothesised anything about ankle angle at heel strike or toe-off.

Frontal plane ankle

26. Please elaborate regarding why a reduction of around 1 degree in peak eversion may be potentially beneficial. The 4 degrees of reafoot eversion observed for the barefoot and the flip-flop cannot be considered ‘excessive’, so why would a reduction in this be desirable. You could argue the opposite?

27. Did you consider looking at gender differences, as you have 20 of each?

Loading rate

28. I am not clear how results of a study comparing heel velocity for flip-flops and trainers can be compared with results of a study of flip-flops and barefoot.

Conclusions

29. Does your study demonstrate that ‘gait modifications’ are reduced for the FitFlop compared with the flip-flop? When both footwear conditions are compared with barefoot, the flipflop is closer to barefoot, suggesting that the flip-flop demonstrates reduced gait modifications.
**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.