Author's response to reviews

Title: Effect of children's shoes on gait: a systematic review and meta-analysis

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Author's response to reviews: see over
Dear Editor in Chief,

Please find enclosed our revised manuscript entitled “Effect of shoes on the gait of children: a systematic review and meta-analysis”. Below is a point by point response to the concerns raised by each reviewer. All revisions in the manuscript and additional files have been highlighted with the ‘track changes’ function.

All authors have approved the revisions to the manuscript.

Kind regards

Caleb Wegener
Adrienne Hunt
Benedicte Vanwanseele
Joshua Burns
Richard Smith
Title: Effect of children’s shoes on gait: a systematic review and meta-analysis

Reviewer: Meredith Wilkinson

Major compulsory revisions:
1) **Reviewer’s comment:** Inclusion of relevant studies. My concern is that the paper and therefore the analysis are incomplete. This reviewer’s unpublished thesis

“The Effects of Footwear on Selected Parameters of Gait in Early independent Walking” LaTrobe University, January 1997, is not cited. The methods, variables and results from the thesis seem to address the inclusion criteria of this current paper. The findings in the unpublished thesis are consistent with some of the findings in this current paper including: an increase in total excursion of ankle joint range of motion, a trend toward increase in step and stride length and an increase in base of support and a decrease in cadence. I recommend that the authors, if they have not already done so, consider the unpublished thesis as it may provide additional support for their conclusions.

**Author’s response:** This thesis suggested by the reviewer has been added to the review and the relevant changes have been made throughout the manuscript.

2) **Reviewer’s comment:** Table 5 and sagittal ankle ROM: Sagittal plane ankle ROM is reportedly increased (Kinematics findings 1st paragraph). However, there is no inclusion of this variable from the Wegener et al. study in the corresponding Table 5. Furthermore, Table 5 in the study by Wolf et al. indicates a decrease in the Tibia-foot flexion variable. This appears to be inconsistent with the statement that ankle range of movement increased.

**Original:** “Compared to barefoot, shod walking resulted in: increased sagittal plane ankle range of motion (ROM)”

**Author’s response:** Wolf et al. and Wegener et al. measured ankle ROM as tibia-rearfoot motion to eliminate the contribution of the midfoot joints. The text has now been changed to be consistent with Table 5:

“Compared to barefoot, shod walking resulted in: increased sagittal plane tibia-rearfoot range of motion (ROM)”

With the addition of the Wilkinson et al. study sagittal tibia-foot flexion is now significant. This change has been added to the table and text:

“increased tibia-foot ROM in athletic shoes;”

Minor issues not for publication:

1) **Reviewer’s comment:** Table 8. Query whether the caption below should read “shod running” compared with barefoot running?
Original: “A negative mean difference value indicates a decrease during shod walking compared to barefoot running.”

Author’s response: The caption for this table has been corrected as suggested by the reviewer. The caption now reads as follows:

“A negative mean difference value indicates a decrease during shod running compared to barefoot running.”

2) Reviewer’s comment: Discussion. 1st paragraph last line states two variables, whereas under the subheading Walking, 4th paragraph, the last sentence lists three variables.

Original: 1st paragraph of the discussion: “Meta-analyses between the included studies were restricted to a maximum of five studies for two variables.”

Walking, 4th paragraph: “Meta-analysis could only be performed for hallux ROM, tibia-rearfoot ROM and tibia-foot ROM between two studies [8, 22, 25].”

Author’s response: The 1st paragraph of the discussion refers to all variables. The sentence under the subheading Walking, 4th paragraph, refers only to kinematic data. The sentence has been changed to reflect this:

“Meta-analysis of kinematic variables could only be performed for hallux ROM, tibia-rearfoot ROM and tibia-foot ROM between two studies [8, 22, 25].”

Discretionary revision:

1) Reviewer’s comment: Discussion, Clinical implications, 1st paragraph. It is only in an ideal world where, in a clinical situation, a standardized shod condition could be available to assess in-shoe intervention. Given the variable nature of the shape of feet, even if a standard footwear type (across all sizes) was available, the practical problem of fit would still exist. Furthermore, it is important to evaluate any intervention in the footwear that the child is most likely to wear, as the differing characteristics of different footwear will affect function and the impact of in-shoe intervention will therefore vary across individuals. Although differences between footwear types in this current paper were largely not analysed.

Original: “The clinical assessment of shoe and in-shoe interventions in children should consider the numerous effects of shoes on their gait. Perhaps a standardised shod condition could be utilised during the clinical assessment and prescription of in-shoe interventions to ensure that any improvement is due to the intervention, rather than the shoe only.”

Author’s response: This point was raised as discussion point as a potential gold standard practice. In the clinical setting a standard shoe may only need to be
standard for the assessments or comparison of interventions undertaken on an individual patient.

Reviewer: Daniel Bonanno

Major Compulsory Revisions
Not required

Minor Essential Revisions
1) **Reviewer’s comment:** Abstract, Results, Line 6: I suggest placing ‘and’ before ‘tibialis anterior activity’.

   **Original:** “knee sagittal plane ROM (P< 0.003), tibialis anterior activity.”

   **Author’s response:** The word ‘and’ has been added to this sentence:

   “knee sagittal plane ROM (P< 0.003) and tibialis anterior activity.”

2) **Reviewer’s comment:** Background, line 4: I suggest that ‘malalignment’ is not the most appropriate word to describe the height of the medial longitudinal arch. Is a lower MLA really a malalignment or a variation of foot posture?

   **Original:** “While it has long been thought that poorly designed and fitted shoes contribute to paediatric foot and toe deformity [1], empirical evidence of specific malalignment is equivocal.”

   **Author’s response:** The word ‘malaligement’ has been replaced with the ‘effects of shoes’.

   “While it has long been thought that poorly designed and fitted shoes contribute to paediatric foot and toe deformity [1], empirical evidence of specific effects of shoes is equivocal.”

3) **Reviewer’s comment:** Methods, Inclusion and exclusion criteria, line 1: Replace ‘a’ with ‘this’ before ‘study were determined a priori’.

   **Original:** “Inclusion and exclusion criteria for a study were determined a priori.”

   **Author’s response:** The word ‘a’ has been replaced with the word ‘this’.

   “Inclusion and exclusion criteria for this study were determined a priori.”

4) **Reviewer’s comment:** Results, Kinetics findings, line 3: It is stated that no significant findings were found in kinetic walking variables. In the very next sentence it states that Kristen et al. reported significantly higher vertical GRF for
shod walking than barefoot. This needs to be clarified as the latter comment is in contrast with the previous which may leave the reader confused as to whether there is or isn’t any differences between the shod and unshod conditions.

Original: “However, Kristen et al. [15] reported a significantly higher vertical ground reaction force for shod walking than for barefoot walking using the Chi-Square tests for significance.”

Author’s response: The sentence has been reworded to address this concern.

“However, a higher vertical ground reaction force for shod walking was reported by Kristen and co-researchers [15] using the less cautious Chi-Square test for significance.”

5) Reviewer’s comment: Discussion, Walking, paragraph 1: The general structure of this paragraph could be structured differently to allow greater readability. I would encourage the authors to consider trying to either merge some sentences together and/or create better links between the sentences.

Original: “The meta-analysis of five studies showed that children walk faster while wearing shoes. Since cadence decreased during shod walking, the increase of velocity is due to the increased stride length with shoes. The increased stride length is possibly due to perceived protection while walking with shoes. It may also result from greater inertia during the swing phase due to increased mass on the foot during shod walking [9]. The increased heel height of shoes and the consequent increase of effective leg length may have been a contributing factor to the increase in stride length. Lythgo et al., [7] identified that a 4 cm leg length increase from 5 to 6 year old children was associated with a 4 cm and 7 cm increase in step and stride length respectively. While a 1 cm to 2 cm increase in effective leg length due to shoes may not be the sole contributor to the increase in stride length in shoes, it may be a contributing factor. The increased activity of the tibialis anterior during shod walking may have been the result of the increased stride length or due to the increased ankle joint moment arm in shoes.”

Author’s response: Following the advice of the reviewer the first paragraph of the discussion on walking has been reworked. The revised paragraph is below.

“Children walked faster when wearing shoes. Since walking cadence was found to decrease, the increase in stride length is particularly noteworthy. Possible explanations for the longer stride in shoes include that of an effective increase of leg length of approximately 1cm to 2cm. Indeed, in children aged between 5 and 6, a 7 cm increase in stride length can be expected for a 4 cm increase in leg length [7]. The increased stride length could also be due to the increase in mass of the shod foot, which results in increased inertia of the leg during the swing phase [9]. It is also possible that the shoe provides a perception of protection, giving confidence to the wearer to ‘stride out’.”
6) **Reviewer’s comment:** Discussion, Running, paragraph 2, lines 1-2: The sentence opens with ‘Running with shoes…and at the end of the sentence it closes with ‘during running’. I suggest removing the latter as ‘running’ is already implied early in the sentence.

**Original:** “Running with shoes resulted in decreased angular velocity of the knee joint and swing back velocity of the tibia during running.”

**Author’s response:** The words ‘during running’ have been removed from the end of the sentence.

“Running with shoes resulted in decreased angular velocity of the knee joint and swing back velocity of the tibia.”

7) **Reviewer’s comment:** Discussion, Running, paragraph 2, line 5: A better link between the discussion on running velocity and rearfoot strike positions would be beneficial.

**Original:** “Running with shoes resulted in decreased angular velocity of the knee joint and swing back velocity of the tibia. Reductions of these variables indicate a shift away from the technique patterns of elite adult sprinters [26], which may be due to the increased weight of shoes on the end of the leg. In contrast to walking, a non-significant trend of decreased running velocity was present in shoes. According to Lieberman et al., [23], children are also more likely to land in a rearfoot strike pattern while running in shoes. However, Lieberman and colleagues [23] suggested that Such a shift away from a forefoot and midfoot strike pattern towards a rearfoot strike position is a consistent finding with adults, for whom it has been hypothesised to be a technique to improve shock attenuation while running barefoot [23, 33].”

**Author’s response:** In light of the reviewers comments the paragraph has been split into two paragraphs.

“Sprinting with shoes resulted in decreased angular velocity of the knee joint and swing back velocity of the tibia [26]. The increased weight of shoes on the end of the foot and the consequent increase in the moment of inertia may be responsible for these changes.

During shod running there was an increase in the prevalence of a rearfoot strike pattern from 62% barefoot to 97% shod [23]. There was a corresponding decrease of forefoot and midfoot strike patterns [23]. This change in pattern from barefoot to shod running is a consistent finding with that of adults [23, 33]. It has previously been hypothesised that a forefoot and midfoot strike pattern while running barefoot is a strategy to improve shock attenuation [23, 33]. Interestingly, the majority of children (62%) ran with a rearfoot strike pattern whilst barefoot [23].”
8) **Reviewer’s comment:** Discussion, Clinical Implications, title: Overuse of capitals with ‘Implications’. Change ‘I’ to lower-case.

**Original:** “Clinical Implications”

**Author’s response:** The letter ‘I’ has been changed to lowercase.

“Clinical implications”

Discretionary revisions

1) **Reviewer’s comment:** Abstract, Results: You have provided ‘increases’ and ‘decreases’ for shod walking but you have only provided ‘decreases’ for shod running. Even if there were no ‘increases’ found for shod running I feel it would be worth stating this in the abstract.

**Author’s response:** The following sentence has been added to address the reviewers concern:

“No variables increased during shod running.”

2) **Reviewer’s comment:** Abstract, Conclusions: Do the authors think it is worth stating whether the changes seen when wearing shoes are considered hazardous, beneficial, or unknown?

**Author’s response:** The following sentence has been added to the abstract:

“The long-term effect of these changes on growth and development are currently unknown.”

9) **Reviewer’s comment:** Methods, Quality assessment, lines 5-12: I believe the description of the Quality Index sub-scales could benefit from some basic sentence re-structuring which should make for easier reading. For example, consider replacing ‘study reporting 10 items’ with ‘10 items assessed study reporting’. The same approach can be applied to internal/external validity, study power etc.

**Original:** “A total score of 32 is possible across 27 items organised into 5 subscales: study reporting 10 items (including reporting of study objectives, outcomes, participants characteristics, interventions, confounders, findings, adverse events and probability); external validity 3 items (the ability to generalise the results); internal validity selection bias 7 items (bias in the measurement of the intervention); internal validity confounding 6 items (bias in the selection of study participants); study power 1 item (to assesses if negative findings from a study could be due to chance).”

**Author’s response:** The above suggested changes have been implemented:
“A total score of 32 is possible across 27 items organised into 5 subscales: 10 items assessed study reporting (including reporting of study objectives, outcomes, participants characteristics, interventions, confounders, findings, adverse events and probability); 3 items assessed external validity (the ability to generalise the results); 7 items assessed internal validity selection bias (bias in the measurement of the intervention); 6 items assessed internal validity confounding (bias in the selection of study participants); 1 item assessed study power (to assesses if negative findings from a study could be due to chance).”

10) **Reviewer’s comment:** Results, Description of methodological approach of included studies, line 5: Should it be noted whether the ‘self-selected gait velocity’ was controlled within trials as altered walking or running speed could possibly explain differences between shod and unshod findings.

   **Author’s response:** In line with the reviewers recommendation the following sentence has been added to the results section:

   “No studies reported monitoring gait velocity between conditions/trials.”

11) **Reviewer’s comment:** Results, Kinematics findings: Should this be titled ‘Kinematic findings’ rather than ‘Kinematics’?

   **Original:** “Kinematics findings”

   **Author’s response:** The word ‘Kinematics’ has been changed to ‘Kinematic’.

   “Kinematic findings”

12) **Reviewer’s comment:** Results, Kinematics findings, paragraph 2, line 9: Consider changing ‘19% each’ to ‘19% for both’.

   **Original:** “Lieberman et al., [23] reported that rearfoot strike mode increased from 62% to 97% during shod running while midfoot and forefoot strike reduced from 19% each to 3% and 0% respectively.”

   **Author’s response:** The word ‘each’ has been replaced with ‘for both’ as suggested by the reviewer.

   “Lieberman and co-investigators, [23] reported that rearfoot strike mode increased from 62% to 97% during shod running while midfoot and forefoot strike reduced from 19% for both to 3% and 0% respectively.”

13) **Reviewer’s comment:** Results, Kinetics findings: Should this be titled ‘Kinetic findings’ rather than ‘Kinetics’?
Original: “Kinetics findings”

Author’s response: The word ‘Kinetics’ has been changed to ‘Kinetic’.

“Kinetic findings”

14) Reviewer’s comment: Results, EMG: As there is no table for EMG statistics, unlike other variables previously discussed, the authors should consider providing the statistical data in-text.

Original: Electromyography

Mueller et al. [21] reported the activity of the tibialis anterior to be significantly greater during shod walking than barefoot walking. No differences were reported for the peroneus longus, and medial gastrocnemius between the barefoot and shoe condition [21].

Author’s response: Unfortunately no standard deviations/errors were reported by the authors. The mean values for barefoot and shoes have been added to the paragraph.

“Mueller and co-investigators [21] reported that EMG amplitude of the tibialis anterior during weight acceptance and midstance was significantly (P<0.05) greater during shod walking (mean 1.78) than barefoot walking (mean 1.63) using a univariate ANOVA. There were no differences for the peroneus longus, and medial gastrocnemius [21]. No additional data were able to be obtained for further meta-analysis.”

15) Reviewer’s comment: Discussion, Running, Quality assessment, line 2: Consider changing ‘selection bias and confounding’ to ‘selection and confounding biases’.

Original: “The main limitations were with external and internal validity, selection bias and confounding.”

Author’s response: The sentence has been changed as suggested by the reviewer ‘selection bias and confounding’ has been changed to ‘selection and confounding biases.’

“The main limitations were with external and internal validity, selection and confounding biases.”

16) Reviewer’s comment: Discussion, Clinical Implications, paragraph 2 line 3. Two sentences in a row start with ‘However’ – it is possible to use a different word here that is still appropriate?
Original: “However, previous reviews have suggested that children’s shoes should be based on the barefoot model [11].”

Author’s response: As suggested by the reviewer the word ‘however’ has been replaced with the word ‘nonetheless’.

“Nonetheless, previous reviews have suggested that children’s shoes should be based on the barefoot model [11].”

17) Reviewer’s comment: Discussion: It is noted that in the ‘results’ section of the paper the age of the participants ranged from 2 to 15 years with all but two studies including children in the middle childhood age (ages 7-11). I believe it is worth noting this as a limitation as the outcomes of this systematic review were largely determined from research involving children in middle childhood and therefore it’s application to younger, and even older children, will need to be considered with an element of caution.

Author’s response: The following sentence has been added to paragraph 1 of the discussion section of the paper to address the reviewers concerns.

“We note that the participants ranged in age from 2 to 15 years with all but two studies including children in the middle childhood age (ages 7-11 years). We believe it is worth noting this as a limitation as the outcomes of this systematic review were largely determined from research involving children in middle childhood and therefore it’s application to younger, and even older children, will need to be considered with an element of caution."

18) Reviewer’s comment: In-text referencing: Throughout the document ‘et al.’ is used where there are multiple authors. I suggest that when there are two authors that they are both provided in-text eg. ‘Jones and Smith (23) have previously shown...’ and where is more than two authors I would suggest the use of ‘Jones and co-investigators (or co-researchers, colleagues etc.) have previously shown...’

Author’s response: As suggested by the reviewer the abbreviation ‘et al.’ has been replaced throughout the text of the paper with the terms ‘and colleagues’, ‘and co-investigators’ and ‘and co-researchers’.