Author's response to reviews

Title: Factors affecting dynamic foot function in older adults: the Framingham Foot Study

Authors:

Thomas J. Hagedorn (thomashagedorn@hsl.harvard.edu)
Alyssa B. Dufour (alyssadufour@hsl.harvard.edu)
Yvonne M. Golightly (golight@email.unc.edu)
Jody L. Riskowski (jriskowski@gmail.com)
Howard J. Hillstrom (hillstromh@hss.edu)
Virginia A. Casey (virginiacasey@hsl.harvard.edu)
Marian T. Hannan (hannan@hsl.harvard.edu)

Version: 2 Date: 16 April 2013

Author's response to reviews:

Factors Affecting Center of Pressure in Older Adults: The Framingham Foot Study.
by TJ Hagedorn, AB Dufour, YM Golightly, JL Riskowski, HJ Hillstrom, VA Casey, MT Hannan

Reviewer 1

Major Compulsory Revisions

Some further methods about the Framingham Foot Study would be helpful, rather than just referring to ref #13, in order to review the sampling method and study population, and assess any selective reporting issues.

RESPONSE: The following passage describing the Framingham Foot Study has been added to the methods section of the paper:

“The study population was drawn from two cohorts of the Framingham Heart Study. The Framingham Original Cohort was started in 1948 to investigate risk factors of Heart disease [14]. Participants were selected through a two thirds sample of the town of Framingham, and have been examined biennially since. The Framingham Offspring Cohort is composed of the adult children of the Original cohort members and their spouses who reside in or around Framingham. The Offspring cohort was started 1972 to investigate familial risk factors of heart disease, and participants have been examined every four years since [15].”

The plantar pressure protocol whereby data were collected from only one trial is an unusual approach. Often 3-5 trials are collected and averaged for analysis. Can the authors justify this approach in regards to reliability and validity? The effect of a larger degree of measurement error using this method, noted in the discussion, could actually be compounded by a larger sample size i.e. one might
more firmly conclude an inaccurate ‘significant’ result.

RESPONSE: Due to the time constraints associated with such a large epidemiological study, a single walking trial was recorded. It is important to point out that while we expect some measurement error with the plantar pressure system, large numbers of participants were included that should balance out the random misclassification from non-precise sensors and gait variability. Thus, while precision may be affected, this will not produce a different answer to our study questions, only a difference in precision. This was noted in the Limitations section of the manuscript.

Can the authors speculate why the CPEI is smaller in women than men and what clinical implications this might have? Is a smaller CPEI thought to be deleterious or even protective against pain, injury, disability, etc?

RESPONSE: We now provide thoughts on the implications of lower CPEI in women on page 6 with the following text: “Smaller CPEI values are associated with greater amounts of pronation. This in part may be due to women having a more planus foot structure than men. Recent literature suggests that arch height is reduced post-partum (Segal et al 2013). As over-pronation has been clinically observed associated with several pedal pathologies (hallux valgus, hallux limitus, hallux rigidus, posterior tibial dysfunction, etc.), this may mean that women are at a greater risk of foot issues.”


Similarly, can the authors speculate why the CPEI is smaller in older people and what clinical implications this might have?

RESPONSE: On page 7, we have clarified the following passage with additional details to speculate on the implications of lower CPEI in older participants: "Clinicians have qualitatively observed that arches may become lower as persons age, and this observation is consistent with studies noting increased rates of flat feet [24] and pronated feet [5] with increasing age. If older individuals are becoming more planus they may be predisposed to a greater incidence of associated pathologies. As foot pathologies have been linked to functional limitations [25] and fall risk [26], this age related change might have significant consequences over time While there was no statistically significant difference in mean foot function between men # 65 or < 65 years, both sexes had significantly lower CPEI among those 75 years or older, relative to those under 55, with a trend towards decrease over time in the other age groups. Future research should more thoroughly investigate biomechanical changes in the foot with age, as well as sex differences with age in foot function as perhaps it may help explain differences in rates of knee injury [27] and joint degeneration [28] between the sexes.

Minor Essential Revisions

The title “Factors Affecting Dynamic Foot Function in Older Adults: The Framingham Foot Study” is a little misleading because only center of pressure
excursion index was assessed. A more accurate title would be “Factors Affecting Center of Pressure in Older Adults: The Framingham Foot Study”.

RESPONSE: The manuscript title has been changed as suggested by this reviewer and now better reflects the paper’s content.

Discretionary Revisions

Although only one foot per person was used for analysis, it might be interesting to evaluate symmetry of CPEI between feet and its relationship with demographics.

RESPONSE: Thank you for this suggestion. It would be an interesting question to examine this aspect of work and we will plan to conduct this work in the future. We believe that including it here is beyond the scope of this particular manuscript.

Are there any other pressure variables available to broaden the scope of the analysis?

RESPONSE: While additional plantar loading variables are available, we are reluctant to broaden this particular analysis at this point. Future work in this cohort will further examine the other plantar loading variables.

Reviewer 2:

To note the sampling frequency of the Tekscan, at 40Hz is quite low in comparison with some studies, therefore sampling at 40 times per second rather than, for example, 100 times per second, the data collected to generate the line of centre of pressure is not going to be as detailed.

RESPONSE: The sampling rate of the MatScan used in this study was 40Hz, which we believe is sufficient for the type of data we collected (and what the system is designed for). A frequency spectrum analysis of plantar loading by Harris et al revealed frequency contents primarily below 10 Hz, with the exception of the heel strike transient, which was associated with a higher frequency of 75Hz (IEEE Trans Rehabil Eng 1996;4:360-374). As impulsive loads at heel strike were not of interest in our study, the Nyquist sampling theorem suggests that a sampling rate of 20Hz is sufficient for the type of data we collected, which is well within the MatScan’s capabilities.

Minor Essential

Typographical error in Abstract – after (p<0.001 – there needs to be ‘..),..’ inserted

RESPONSE: This error has been corrected in the Abstract

To include a justification of why CPEI was used as the measure of foot function rather than other measures

RESPONSE:

To better justify the use of CPEI as the measure of foot function, we have added the following passage to page 4: “CPEI has previously been shown to
discriminate between feet clinically determined to have planus versus rectus and planus versus cavus foot types [18, 19], whereas other measures of function typically only distinguish planus versus cavus feet [19]. A comparison of data from two independent raters shows that CPEI has high inter- and intra-tester reliability [18].”

To include a justification of why the age ranges analyzed were under and over 65.

RESPONSE: We have now added the following phrase as justification on page 5: Age groups were dichotomized as ≥ 65 years or < 65 years “to provide information on older adults at a common population cut-point.”

In addition, as requested by Reviewer 2, in order to provide additional insights on the issue of age-related changes in foot function we have included additional groups of age (<55, 55-64, 65-74, 75+) to investigate where changes in foot function occur with age. Passages have been added to the Methods (page 5), Results (page 6) and Discussion sections (page 7) to incorporate this additional analysis. Table 3 has also been added.

To include the exclusion criteria for a collected footstep –that is what would cause a ‘footstep’ not to be saved for later analysis and result in another footstep being collected. Footstep data can range enormously for each individual, so it is inevitable that some of the collected footsteps were not suitable.

RESPONSE: We appreciate this comment and on page 4 we have now added a sentence to our inclusion criteria in the paper: “As CPEI requires a heel-to-toe gait pattern, participants who did not have this gait pattern starting in the heel were excluded.”

Additionally, the plantar pressure protocol described on page 4 has been altered to include the following passage: “During testing, participants were allowed to practice walking across the mat. Scans were repeated in instances where participants struck the mat with the wrong foot, altered their gait to strike the mat, or failed the strike the mat with their whole foot.”

Table 1 – presumably the values are mean values for age, BMI and PASE, so this needs to be stated. It would be useful to include ranges too for these variables.

RESPONSE: Table 1 has been modified to indicate that the values presented in the manuscript are means. Additionally, the standard deviations have been added to Table 1. The ranges in age and BMI have been added to the Results section. The PASE values covered the entire possible range.

Discretionary Revisions

It would be useful to further stratify the sample into smaller age groups (albeit with smaller sample sizes) to see when these changes to CPEI were beginning to occur.

RESPONSE: As requested, we have added stratification for additional groups of age (<55, 55-64, 65-74, 75+), along with additional text describing this analysis.
and its results to the Methods (page 5), Results (page 6), and Discussion (page 7) sections and a new table (Table 3). We believe this information further strengthens our paper and are grateful for this comment!

Re-word on p7, 3rd paragraph down “However, the effects of high heels on barefoot gait…”. Suggested wording “However, the effects of habitual high heel wearing on barefoot gait…”

RESPONSE: The sentence (now on page 8) has been changed to read “However, the effects of habitually wearing high heels on barefoot gait are not well understood,” as suggested.

Additional Correction: As the first author will be leaving our institution to attend graduate school, we have changed our Corresponding Author to Dr. Marian T. Hannan, whose email is hannan@hsli.harvard.edu as now indicated in the manuscript.