Effects of Body Weight Loading on Arch Height

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The Effects of Body Weight Loading on Arch Height
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Introduction
Foot functionality is integral to normal human locomotion. Locomotor impacts are associated with structural medial longitudinal arch deformation under body weight (BW) load.

The most reliable assessment of the arch is the Arch Height Index Measurement System (AHIMS). This measurement takes the Arch Height Index (AHI) in sitting and standing. However, there are some limitations; one being that this AHI assessment is static. The other being that sitting is estimated to be 10% of BW while standing is representative of 50% BW. There were two primary aims for this study,

1. Assess if the established baseline sitting and standing AHI are actually representative of their BW conditions.
2. Establish a BW load and arch deformation relationship by increasing BW loading using 10% load increments from 10-120% BW.

Methods
Participants
25 (17 F) healthy subject were recruited
- Age = 20.12 ± 0.97 years
- Height = 1.72 ± 0.08 m
- Weight = 73.7 ± 14.5 kg

Experimental Protocol
Each subject was first weighed on a floor-mounted force plate to establish 10% increments of BW from 10-120%.

First, the sitting and standing baseline measures were taken. After, a force target-matching procedure was performed for each BW incremental load condition. The force data was streamed to a computer monitor that included each target position with a 1% error window on each side. The subject would stand on the force plate and adjust their body weight load to ensure that it was on the screen. Once the subject could hold this weight steady, AHI measurements were taken. This was repeated for each condition in a progressive fashion. At the 70% condition, the weighted vest was added and used through the end of the study.

Results
The baseline sitting and standing AHIs were 0.365 (0.020) and 0.326 (0.023), respectively. The baseline sitting observed to be 7% greater than the 10% BW condition. The baseline standing did not differ from the 50% condition.

Discussion
When comparing the baseline measurements and their respective BW condition, one the standing was a valid assessment of the 50% BW condition. However, the use of sitting as a 10% BW condition may need to be re-evaluated. This 10% assumption is used in equations such as Arch Stiffness.

The relationship between BW and AHI was two-fold; there was both a linear and quadratic relationship. While there was a negative relationship, there was an eventual ceiling effect seen towards the higher magnitudes of BW.

Further studies should examine how the arch reacts to stresses higher than 120% of BW to see if any deformation is possible. Additionally, since this study utilized a quasi-static approach, the momentum in gait was essentially eliminated. This is likely to underestimate the AHI during locomotion.

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