

A Novel Wearable Insole BCG as a Surrogate of the Standard Vertical Weighing Scale BCG

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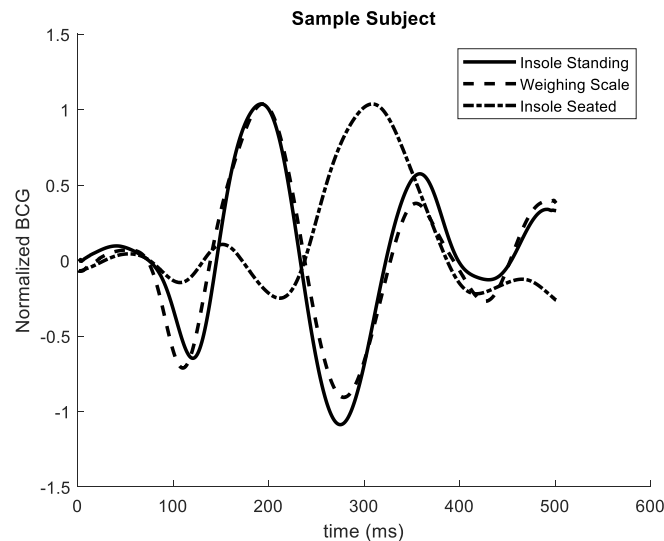
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Aims: This work compares the ballistocardiogram (BCG) obtained with a new wearable system based on a piezoelectric sensor embedded in a shoe insole with the well-known standard vertical BCG obtained on a weighing scale, which can be related to relevant cardiovascular parameters such as aortic Pulse Transit Time (a-PTT), aortic Pulse Wave Velocity (a-PWV) and potentially, blood pressure (BP). Nevertheless, as different mechanical interfaces and measurement axes can significantly change the BCG waveform, the BCG waveform shape and peak timings of the new wearable BCG system need to be compared with the standard to determine its potential to track relevant cardiovascular parameters from it.

Methods: BCG and ECG from 3 healthy subjects (35 ± 19 years) at rest have been recorded for 2 min by sequentially standing on a modified weighing scale and then on the insole system in standing and seated positions. Thirty ensemble averages were obtained by applying Woody's method selecting 20 random beats from each recording. From them, the mean position for the main peaks of BCG, I, J, K, and its uncertainty together with a final average BCG shape were obtained.

Results: The weighing scale BCG and the insole BCG obtained while standing present a very similar shape (and very different from the one obtained while seated (see Figure)) and the difference between J peak time positions obtained with the two systems is below the uncertainty level (about ± 10 ms).



Conclusion: The weighing scale BCG and the insole BCG wearable system measured while standing present a very similar shape and peak timings. Therefore the new system has the potential to obtain the same cardiovascular parameters but with the added advantage of the much more continuous tracking capabilities of wearable systems.