

First in Man Measurement of Arterial Stiffness Using a Connected Bathroom Scale: Calibration against SphygmoCor

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Background: Measurement of arterial stiffness (AS) is still considered difficult. We developed a non-invasive technique to assess AS from a connected bathroom scale, based on ballistocardiography (BCG) and impedance plethysmography (IPG).

Methods: We included 192 subjects and patients, 106 for calibration study (cal), 86 for validation study (val), 33% hypertensives, mean age 48 ± 17 years, 48% women. The scale pulse transit time (WS-PTT) was calculated as the difference between BCG systolic signals and IPG blood flow in the foot. Distance was estimated from body height and PWV was calculated. Carotid to femoral transit time (CF-PTT) was measured using SphygmoCor. Spearman and robust multivariate regressions were used.

Results: The WS-PTT correlated well with CF-PTT with $R=0.73$ in pooled population (cal 0.79, val 0.66). WS-PWV correlated with CF-PWV with $R=0.76$ (cal 0.80, val 0.70). The standard deviation of difference was 1.39 m/s with a bias of 0.25 m/s compared with CF-PWV. Correlations of WS-PWV with age and blood pressure were similar ($R=0.72$ and 0.59 , resp.) to those of CF-PWV ($R=0.67$ and 0.61 , resp.). These good correlations were non-trivial given the differences in wave paths, the fact that measurements are made in orthostatic position and totally investigator-free.

Conclusion: We show in two distinct populations that a simple user-oriented instrument such as a connected bathroom scale can estimate arterial stiffness with accuracy close to healthcare-oriented systems. Because these devices will be used by the general population, the availability of arterial stiffness data on very large, non-medicalized populations will change our management of well-being and health.