Response to "Repeatability of Different Segmental Pulse Wave Velocity Measurements"

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To the Editor: We appreciate the thoughtful comments by Papaioannou and colleagues[1] regarding our recently published article "Repeatability of Central and Peripheral Pulse Wave Velocity Measures: The Atherosclerosis Risk in Communities (ARIC) Study."[2] Numerous methods are used to evaluate repeatability of measurements and those chosen are influenced by the study question. Our interest was to examine the sources of variability in repeated measures at 2 time points using the intraclass correlation coefficient and SE of measurement. Repeatability could also be evaluated using the SD of differences and Bland–Altman method. The latter relies on a visual evaluation of plots to assess bias and whether the magnitude of differences between pairs of measures varies across the range of the mean. Since we used 1 device to obtain all measurements, we cannot speak to measurement-specific bias (other than from the literature).

For validation of pulse wave velocity (PWV) measurement devices, the ARTERY Society recommends <1 month between measurements as optimal to avoid bias due to aging and confounding factors.[3] Our interest, however, was to quantify variability in PWV re-measured 4–8 weeks later, to enable the unbiased estimation of biologically meaningful change in PWV over repeated examinations. Papaioannou *et al.* suggest that since the time between measurements exceeds the guidelines, the lower repeatability of aortic PWV may be due to biological vs. technical factors. We agree that variation in lifestyle and physiologic traits between visits could affect repeatability, which was a deliberate and realistic feature of our study design, and is thus included in our between-visit variability estimates. In contrast, we do not expect age to have a measurable effect on measurements made on average 1 month apart. Carotid–femoral PWV increases annually by 24.4 cm/s in treated hypertensives and 11.4 cm/s in normotensives >50 years old,[4] which would extrapolate to a small monthly change.

Papaioannou *et al.* also suggest to reclassify the repeatability results using the ARTERY Society's criteria.[3] These criteria, however, may not generalize to studies such as ours since the intended reference device is the SphygmoCor and for comparison of 2 devices with an average of 3 measurements each. Our study presents repeatability of single measurements from 1 device. Furthermore, the SphygmoCor estimates pulse transit time by the intersecting tangent method, which as mentioned by Papaioannou *et al.*, could contribute to variation in PWV across devices. While this is correct as a general statement, it is not a concern when using a single device. For the Omron VP-1000 Plus, arterial waveforms were passed through a low-frequency and band-pass filter. The lowest down-sloping point is then taken as "foot" of the systolic upstroke in the arterial waveform.

As expected, PWV values in our study were higher than standard reference values since the latter were derived among normotensive individuals with no cardiovascular risk factors.[5] Reproducibility studies are typically conducted in a population similar to the ones of interest for estimation and general inference, which was the case for our study. We hope that our report and this discussion highlight the importance of assessing measurement repeatability in the setting of individual studies, to supplement published reports.

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Initially submitted April 27, 2016; accepted for publication April 27, 2016; online publication May 11, 2016.

doi:10.1093/ajh/hpw051

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