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More Information on the Reproducibility of the Ambulatory Arterial Stiffness Index

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In 2006, based on physiologic principles already published in 1914,¹ we defined the ambulatory arterial stiffness index (AASI) as 1 minus the regression slope of diastolic on systolic blood pressure (BP) in individual 24-h ambulatory BP recordings.² AASI is an integrated measure, which is characteristic for an individual, and which reflects the combined effects of left ventricular ejection, active and passive components of arterial stiffness, and the reflection of the arterial pulse wave. The stiffer the arterial tree, the closer the regression slope is to 0 and AASI is to 1.

In this issue of the journal, Stergiou and colleagues reported on the reproducibility of AASI at an interval of 2–4 weeks in 126 untreated hypertensive patients.³ Mean values of AASI were similar in first and repeat ambulatory recordings. The repeatability coefficient of AASI expressed as a percentage of near maximal variation was 50%. Stergiou's findings³ are in keeping with those reported by us at an 8-day interval in 152 patients with systolic and diastolic hypertension (55%) and at a 31-day interval in 145 patients with isolated systolic hypertension (61%).⁴ Stergiou and colleagues estimated the repeatability coefficient of AASI from published statistics available in other reports. It was 58% in 38 healthy volunteers at a 2-week interval,⁵ and 55% and 58% in 568 normotensive subjects and 211 hypertensive patients, respectively, at a 2-year interval.⁶ By and large, the findings from all studies^{3–6} show that AASI has moderate repeatability, comparable with that of the morning surge in BP (52–75%),⁷ but lower than the repeatability of the 24-h BP level (30%).⁴ Higher values of the repeatability coefficient indicate lower reproducibility.

Stergiou and colleagues also reported the repeatability of AASI computed from daytime (69%) and night time (74%) recordings. We do not recommend to compute AASI for daytime and night time separately, because fewer BP readings over a narrower BP range result in erratic estimates of the

regression slope of diastolic on systolic BP. A worse fit of the AASI regression line results in lower reproducibility, as also exemplified by Stergiou's results.³ In our Chinese population study ($n = 348$),¹ the correlation coefficients of the central and peripheral augmentation indexes with AASI were substantially weaker for the daytime AASI ($r = 0.29$ and 0.09) and night time AASI ($r = 0.32$ and 0.09) than for the 24-h AASI ($r = 0.48$ and 0.50). Along similar lines, in 166 Chinese volunteers,¹ the correlation of pulse wave velocity with daytime AASI ($r = 0.18$) and night time AASI ($r = 0.22$) was lower than that with 24-h AASI ($r = 0.51$). Ben-Dov proposed symmetrical AASI⁸ as an alternative to our definition of AASI,¹ because it would be less affected by the nocturnal dipping of BP. However, Stergiou's study³ highlighted that in terms of reproducibility symmetrical AASI does not offer any advantage over usual AASI. For reasons argued elsewhere,⁹ we suggest not to use symmetrical AASI, unless prospective studies would show that it is a better predictor of all and cause-specific fatal and nonfatal cardiovascular outcomes than AASI as initially defined.¹

One limitation of Stergiou's study, as stated in the Discussion,³ was that he did not address the issue to what extent the fit of the AASI regression line, as expressed by the coefficient of determination (r^2) affects the reproducibility of AASI. We demonstrated that a higher goodness of fit of the AASI regression line in individual subjects strengthens the association with the known¹ determinants of AASI.⁴ Indeed, the z -score for the association of AASI with four determinants of AASI combined (age, height, mean arterial pressure, and heart rate) increased curvilinearly with r^2 , with most of the increase occurring above the 20th percentile of r^2 (0.36). We found lower repeatability, when in each of two repeat recordings r^2 was <0.36 as opposed to ≥ 0.36 (repeatability coefficients 68% vs. 44%, respectively).

In line with other studies,^{4–6} Stergiou and colleagues³ demonstrated that AASI has only limited reproducibility. However, what clinically counts most, is that AASI improves the risk stratification based on ambulatory BP monitoring. To date, several cross-sectional studies and at least three prospective cohort studies have demonstrated association of AASI with either signs of target organ damage, or with incidence of cardiovascular mortality and morbidity.¹⁰ When adjusted for pulse pressure or pulse wave velocity, AASI remained predictive, in particularly of stroke.¹⁰ Thus the moderate reproducibility of AASI did not preclude its ability

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to be associated with target organ damage or to predict outcome.¹⁰ Although AASI was introduced only 3 years ago,¹ a PubMed search using the term “ambulatory arterial stiffness index” at the time of writing of this Commentary yielded close to 70 hits. Moderate reproducibility is therefore unlikely to affect the interest in AASI for use in clinical practice and epidemiologic research.

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