

P7 Assessing Vascular Age from Peripheral Pulse Waves: a Study of Existing Indices, and Directions for Future Research

Peter Charlton^{1,*}, Maria Aresu², Jeanette Spear², Phil Chowienczyk¹, Jordi Alastruey¹

¹King's College London, King's Health Partners, London, UK

²Imperial College London, London, UK

ABSTRACT

Purpose: Vascular age may be a better marker of cardiovascular risk than age. It has been proposed that vascular age could be assessed easily and inexpensively from the photoplethysmogram (PPG) pulse wave, which is measured by pulse oximeters and fitness bands. Our aim was to assess the performance of existing PPG-derived indices and provide directions for future research.

Methods: Two datasets were used. The Airwave dataset [1] contains finger PPG pulse waves alongside brachial-femoral pulse wave velocities (PWVs) from police employees: high quality data from 4,378 subjects aged 20 to 66 were used in this study. The arterial pulse wave database [2] contains simulated PPG pulse waves for 3,837 virtual subjects aged 25 to 75 exhibiting healthy ageing and normal variation in cardiovascular properties. Pulse wave features were derived, and the following indices were assessed: the ageing index (AGI) [3], modified AGI [4], informal AGI [5], and a novel AGI obtained by fitting a linear regression model to the five features most strongly correlated with age.

Results: See Figure 1. Existing indices correlated weakly with age. The new AGI was more strongly correlated with age on both datasets. It was weakly correlated with PWV and BP on Airwave, but strongly correlated with PWV on simulated data.

Conclusion: The improved performance of the new AGI indicates that there is scope for improving PPG-derived indices of vascular ageing. Indices appear to be correlated with age, PWV and BP, indicating that with further research they could be useful markers of cardiovascular risk.

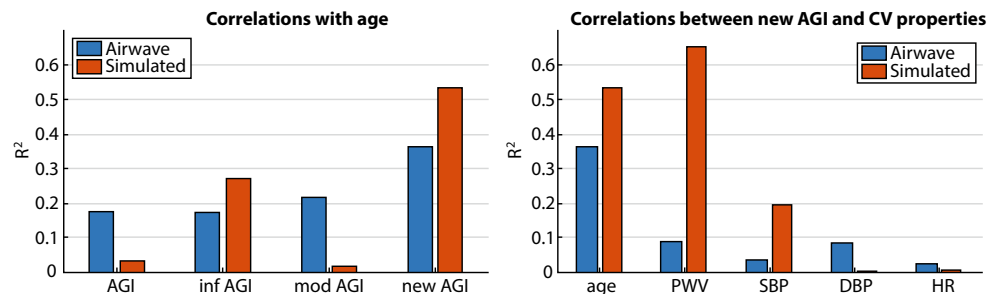


Figure 1

REFERENCES

- [1] Elliott P, Vergnaud AC, Singh D, Neasham D, Spear J, Heard A. The Airwave Health Monitoring Study of police officers and staff in Great Britain: Rationale, design and methods. *Environ Res* 2014;134:280–5.
- [2] Charlton PH, Mariscal Harana J, Vennin S, Li Y, Chowienczyk P, Alastruey J. Modeling arterial pulse waves in healthy ageing: a database for in silico evaluation of hemodynamics and pulse wave indexes. *Am J Physiol Heart Circ Physiol* 2019;317:H1062–H85.
- [3] Takazawa K, Tanaka N, Fujita M, Matsuoka O, Saiki T, Aikawa M, et al. Assessment of vasoactive agents and vascular aging by the second derivative of photoplethysmogram waveform. *Hypertension* 1998;32:365–70.
- [4] Ushiroyama T, Kajimoto Y, Sakuma K, Minoru U. Assessment of chilly sensation in Japanese women with Laser Doppler Fluxmetry and Acceleration Plethysmogram with respect to peripheral circulation. *Bull Osaka Med Coll* 2005;51:76–84.
- [5] Baek HJ, Kim JS, Kim YS, Lee HB, Park KS. Second Derivative of Photoplethysmography for Estimating Vascular Aging. In: 2007 6th International Special Topic Conference on Information Technology Applications in Biomedicine. Tokyo, Japan: IEEE; 2007, pp. 70–2.

© 2019 Association for Research into Arterial Structure and Physiology. Publishing services by Atlantis Press International B.V. This is an open access article distributed under the CC BY-NC 4.0 license (<http://creativecommons.org/licenses/by-nc/4.0/>).