1.3: PAST SMOKERS DECELERATE VASCULAR AGING IN THE LONG TERM

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To cite this article: Dimitrios Terentes-Printzios*, Charalambos Vlachopoulos, Nikolaos Ioakeimidis, Athanasios Aggelis, Panagiotis Xaplanteris, Panagiota Pietri, Dimitrios Tousoulis (2015) 1.3: PAST SMOKERS DECELERATE VASCULAR AGING IN THE LONG TERM, Artery Research 12:C, 39–40, DOI: https://doi.org/10.1016/j.artres.2015.10.004

To link to this article: https://doi.org/10.1016/j.artres.2015.10.004

Published online: 7 December 2019
1.1 DIASTOLIC LEFT VENTRICULAR FUNCTION IN RELATION TO CIRCULATING METABOLIC BIOMARKERS IN A GENERAL POPULATION
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Background: The metabolic signature associated with subclinical diastolic left ventricular (LV) dysfunction in the general population is unknown.

Objectives: This population study aimed at identifying a specific profile of circulating me-tabolites associated with asymptomatic diastolic LV dysfunction.

Methods: In 711 randomly recruited Flemish (50.8% women; mean age, 50.8 years), we assessed echocardiographic indexes of diastolic LV dysfunction and central 24 h PP up to the age of 39 years. The above relationship weakened with age and became mostly non-significant after the age of 40 (all \( r < 0.10 \)). Similar, although weaker, trends were observed for office PP (both brachial and central).

Conclusion: 24-h PP has a strong direct association with LV stroke volume in the young only, and might more exclusively depend on arterial stiffness later in life. Since the above relationship was also observed with estimated central PP, it may not depend on PP amplification. The “young” and “old” pathological patterns of PP may help to explain the increasingly adverse prognostic value of PP observed with advancing age.

1.2 AGE-DEPENDENT ASSOCIATION OF 24-HOUR PERIPHERAL AND CENTRAL PULSE PRESSURES WITH STROKE VOLUME
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Objective: Pulse pressure (PP) is a complex physiologic trait affected by many variables, including LV contractility (reflected by stroke volume), arterial stiffness, and central-to-brachial amplification. The impact of age on the relationship between stroke volume and central or brachial PP has not been investigated.

Methods: 3765 untreated hypertensive adults (men 56%, age 50 ± 12 years) underwent 24-hour ambulatory BP monitoring (SpaceLabs) and M-mode echocardiography. In a subset of 982 subjects in whom central PP was measured by applying a transfer function to radial pulse wave (SphygmoCor), we also estimated central office (or 24 h) PP by regression equations based on office (or 24 h) PP and MAP, heart rate, age, height and sex (\( R^2 = 0.92 \) between estimated and measured central PP). The same equations were then applied to the original population to obtain estimated central PP.

Results: Stroke volume had a significant direct association with both brachial and central 24 h PP up to the age of 39 years. The above relationship weakened with age and became mostly non-significant after the age of 40 (all \( r < 0.10 \)). Similar, although weaker, trends were observed for office PP (both brachial and central).

Conclusion: 24-h PP has a strong direct association with LV stroke volume in the young only, and might more exclusively depend on arterial stiffness later in life. Since the above relationship was also observed with estimated central PP, it may not depend on PP amplification. The “young” and “old” pathological patterns of PP may help to explain the increasingly adverse prognostic value of PP observed with advancing age.

1.3 PAST SMOKERS DECELERATE VASCULAR AGING IN THE LONG TERM
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Objectives: Smoking has an unfavorable effect on arterial properties. Vascular aging is an independent predictor of cardiovascular risk. We examined the effect of quitting smoking on the progression of arterial stiffness.

Methods: 142 subjects (mean age 51.9 ± 10.8 years, 94 men) with no established cardiovascular disease were investigated in 2 examinations over a 2-year period. Subjects were categorized in current smokers, non-smokers and ex-smokers. Ex-smokers were further categorized according to the

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time elapsed since smoking (<5 years, 5–15 years and > 15 years). Subjects had at the beginning and end of the study determinations of carotid-femoral pulse wave velocity (PWV) and common carotid intima-media thickness. Based on these measurements the annual absolute changes were calculated.

**Results:** Smoking at baseline was not associated with statistically significant differences in PWV and CIMT. However, the annual change of PWV was statistically different between the groups of smokers, non-smokers and the 3 groups of ex-smokers (p = 0.041) after adjustment for relevant confounders. Specifically, smokers had 0.23 m/s/year (95% CI: 0.10 to 0.35), non-smokers 0.17 m/s/year (95% CI: 0.08 to 0.25), quitters (>5 years) had 0.28 m/s/year (95% CI: 0.07 to 0.49), quitters (5–15 years) had 0.35 m/s/year (95% CI: 0.11 to 0.59) and quitters (>15 years) –0.07 m/s/year (95% CI: –0.26 to 0.13). Similar trend for slower progression was observed for CIMT in past smokers (>5 years) but this was not statistically significant.

**Conclusions:** Quitting smoking slows down progression of vascular aging after many years, implying a period of adjustment for former deleterious effects of smoking.

### 1.4 CHILDHOOD DETERMINANTS OF EARLY ADULT ARTERIAL STIFFNESS IN DIFFERENT ETHNIC GROUPS

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Childhood determinants of aortic pulse wave velocity [PWV] are poorly understood. We tested how factors measured twice previously in childhood in the NRC ‘DASH’ study, particularly body mass (BMI) components and BP, affected PWV in young adults.

**Methods:** Of 6643 London children, aged 11–13 y, from 51 schools in samples of about 1000 in 6 ethnic groups, with markedly different adult cardiovascular risk, 4785 (72%), were seen again at 14–16 y. In 2013, 66% (97% of invited) took part in a young-adult pilot (21–23 y) follow-up. With psychosocial, anthropometric and BP measures, PWV was recorded via an upper arm cuff on the calibrated Arteriograph device. In a subsample (n = 334) PA was measured over 5 days via the ActivPal.

**Results:** Unadjusted PWVs in Black Caribbean and White UK young men were similar (mean±SD 7.9 ± 0.3 vs 7.6 ± 0.4 m/sec) and lower in other groups at similar systolic (s)BPs (120 mmHg) and BMIs (24.6 kg/m²). In fully adjusted regression models, independent of BP effects, while Black Caribbean (higher BMIs and waists), Black African and Indian young women had lower PWV (by 0.5–0.8, 95% CI 0.1–1.1 m/sec) than White UK women (6.9 ± 0.2 m/sec), values were still increased by age, BP, powerful impacts from waist/height and time spent sedentary but a reducing impact of time walking >100steps/min (both p < 0.01), with a racism effect (+0.4 m/sec) in women. Childhood effects of waist/hip on PWV were also detectable.

**Conclusion:** Even by young adulthood, increased waist/height ratios, lower physical activity, BP and psychosocial variables (eg: perceived racism) are independent determinants of arterial stiffness, likely to increase with age.

### 1.5 RELATION OF ARTERIAL STIFFNESS WITH LEFT VENTRICULAR DIASTOLIC FUNCTION IN GENERAL POPULATION

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Left ventricular diastolic function declines with aging and hypertension. It is well known that elevated blood pressure results in increased arterial stiffness. The study aims to determine the relationship between arterial stiffness and left ventricular diastolic function in general population.

**Methods:** We recruited 303 (mean age, 46.9 years; 167 women; 156 normotensives) members of randomly recruited families. Normotension and hypertension were diagnosed based on both office and ambulatory blood pressure measurements, or history of antihypertensive treatment. Pulse wave velocity (PWV), peripheral and central pulse pressure (pPP; cPP) were evaluated by means of pulse wave analysis. Left ventricle (LV) diastolic function was determined by measuring transmural (early (E) and late (A) diastolic peak velocities and E/A ratio) and pulmonary (peak systolic (S) and diastolic (D) velocity and S/D ratio) flow velocities and diastolic velocities of septal and lateral mitral annulus (E’ wave and E’/E’ ratio) obtained in tissue doppler. Additionally we measured left atrium diameter (LAd).

**Results:** After adjusting for relatedness, pPP and cPP were negatively associated with E/A, and positively with E’/E’ and S/D (p < 0.001). In multi-variate analysis the most closely related parameters were: cPP with E’/E’ (β = 0.04, P = 0.001), cPP with S/D (β = −0.004, P = 0.011) and pPP with E’/E’ (β = −0.03, P = 0.003). Additionally pPP was associated with LAd (β = 0.058, P = 0.011). In hypertensives pPP and cPP related both to E’/E’ and S/D (p < 0.01).

**Conclusions:** Our study suggested that increased arterial stiffness as estimated by pulse pressure measurement might be considered as a determinant of left ventricular diastolic dysfunction.

### 1.6 THE BODE INDEX PROGNOSTIC SCORE IS AN INDEPENDENT DETERMINANT OF ARTERIAL STIFFNESS IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

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**Introduction:** COPD is associated with increased cardiovascular risk, independent of established risk factors. Arterial stiffness is a surrogate of cardiovascular risk and we sought to determine its relationship with COPD severity and prognosis in the ERICA (Evaluation of role of inflammation in airways disease) multi-site UK study: the largest cohort study focusing on cardiovascular manifestations in COPD.

**Methods:** Spirometry and haemodynamic measures (aortic pulse wave velocity [aPWV], augmentation index [Alx]) were performed in 729 COPD subjects aged >40 years. COPD severity was classified by BODE Index [BMI (low BMI worse prognosis), Obstruction (FEV1), Dyspnoea (mMRC score), Exercise tolerance (6-minute walk distance) high BODE index: worse outcome], a validated score and prognosis in the ERICA (Evaluation of role of inflammation in airways disease) multi-site UK study: the largest cohort study focusing on cardiovascular manifestations in COPD.

**Results:** After adjusting for relatedness, pPP and cPP were negatively associated with E/A, and positively with E’/E’ and S/D (p < 0.001). In multi-variate analysis the most closely related parameters were: cPP with E’/E’ (β = 0.04, P = 0.001), cPP with S/D (β = −0.004, P = 0.011) and pPP with E’/E’ (β = −0.03, P = 0.003). Additionally pPP was associated with LAd (β = 0.058, P = 0.011). In hypertensives pPP and cPP related both to E’/E’ and S/D (p < 0.01).

**Conclusions:** Our study suggested that increased arterial stiffness as estimated by pulse pressure measurement might be considered as a determinant of left ventricular diastolic dysfunction.

### 2.1 A METHOD FOR THE MEASUREMENT OF PRESSURE SENSITIVITY OF CAROTID-FEMORAL PULSE WAVE VELOCITY IN HUMANS

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**Background:** Carotid-femoral pulse wave velocity (cPWV), a marker of cardiovascular disease, is modified by both blood pressure and changes in...