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ABSTRACTS Open Access

# Selected Abstracts from Artery 21

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## 1.1

### Central pulse pressure in adolescence is more strongly associated with future cardiovascular health than peripheral pulse pressure

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**Background:** Increased left ventricle mass (LVM), arterial stiffness and carotid intima-media thickness (cIMT) are predictors of cardiovascular disease independent of blood pressure. Cross-sectional investigation in adolescence has shown that central pulse pressure (cPP) is more closely associated with target organ damage than peripheral pulse pressure (pPP) (1). Longitudinal follow-up of these adolescents is required to determine if pPP or cPP is more closely associated with future cardiovascular health.

**Methods:** 3898 participants (2173 female) in the Avon Longitudinal Study of Parents and Children (ALSPAC) underwent repeat measurements of pPP and cPP (SphygmoCor), LVM (echocardiography n = 1346), carotid-to-femoral pulse wave velocity (cfPWV n = 1596, Vicorder) and cIMT (n = 1520) aged 17 years and 24 years. LVM was indexed to height$^{1.7}$ (LVMI). Multivariable linear regression was used to assess longitudinal associations between pPP/cPP aged 17 years and LVMI, cfPWV and cIMT aged 24 years. Data for sexes were pooled and adjusted for age, sex and parental socioeconomic position (model 1). Bootstrapping (10,000 replications) was used to compare pPP and cPP associations.

**Results:** Aged 17 years, the difference between pPP and cPP was marked (mean difference (95% CI) = 20.7 (20.5, 21.0) mmHg). pPP and cPP were both positively associated with future LVMI cfPWV and cIMT aged 24 years (Table 1) but associations were stronger for cPP (bootstrap $p < 0.0001$ for all). Differences in strength of associations remained after adjustment (model 1).

Table 1: Associations between cPP and pPP aged 17yrs and future LVMI, cfPWV and cIMT aged 24yrs (Data are beta coefficients (ß) from regression analysis and 95% confidence intervals (CI))

| | Unadjusted | | Model 1 Adjusted for age, sex and socioeconomic position | |
|---|---|---|---|---|
| **LVMI (g/m$^{1.7}$)** | ß (95 CI) | p-value | ß (95 CI) | p-value |
| cPP (mmHg) | 0.29 (0.24,0.35) | <0.0001 | 0.40 (0.29,0.51) | <0.0001 |
| pPP (mmHg) | 0.18 (0.15,0.22) | <0.0001 | 0.26 (0.18,0.34) | <0.0001 |
| **cfPWV (m/s)** | | | | |
| cPP (mmHg) | 0.034 (0.026,0.048) | <0.0001 | 0.009 (-0.002,0.019) | 0.1 |
| pPP (mmHg) | 0.020 (0.014,0.026) | <0.0001 | 0.002(-0.005,0.008) | 0.6 |
| **cIMT (mm)** | | | | |
| cPP (mmHg) | 0.0012 (0.0009,0.0017) | <0.0001 | 0.0012 (0.0008,0.0017) | <0.0001 |
| pPP (mmHg) | 0.0009 (0.0006,0.0011) | <0.0001 | 0.0009 (0.0006,0.001) | <0.0001 |

**Conclusion:** Adolescent cPP is more closely associated with future LVM, cfPWV and cIMT than bPP. These results suggest that central rather than peripheral blood pressure may be a better measure of future risk in adolescence.

## 1.2

### New carotid stiffness population centiles in the young and association with measures of general and abdominal obesity

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**Background:** Data on carotid stiffness (cS) in unselected adolescents and young adults are scarce. To validly investigate associations with established risk factors, centiles are needed by age and growth. Although evidence has accumulated linking obesity in the young to elevated cIMT, studies rarely included cS or compare obesity parameters.

**Methods:** The KiGGS cohort 11-year-follow-up included high-resolution B-mode CCA-sonography with semi-automated edge-detection and automatic electrocardiogram-gated real-time quality control. Distensibility coefficient, stiffness index ß, Young's and Peterson's elastic modulus were assessed in 4,305 participants aged 14–28 years. Following cS and CIMT centile estimation with GAMLSS models, associations were investigated using log-binominal regression models with cS and CIMT ≥ 90th centile as outcomes and covariates including

**Conclusions:** Given the size, low processing power, and long battery life, it is impressive that the Casio BP-100 provided some directional information on BP. It is also one of the few commercial devices to this day using two-point individualisation calibration. Likely in part due to limitations in the algorithms for finding fiducial waveform points, BP estimation was poor. As we look to the future of cuffless BP, we should emulate the positive aspects of the Casio BP-100 whilst looking at ways to improve accuracy.

## P.27

### Comparison of Quantitative Reflection Indices of Forward–Backward Pulse Wave Decomposition Techniques: A Virtual Subject Study

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**Background:** Studies of the forward–backward propagating pulses in arterial bed provide novel insights into vascular dynamics and clinical conditions. The conventional pulse wave separation techniques—flow-based Wave Separation Analysis (WSAMF) and Wave Intensity Analysis (WIA)—require measured pressure-flow waveforms (1). As alternatives, simplified methods that require pressure wave alone (modelled flow wave (2) or approximated to a triangular wave (WSATF) (3) have gained acceptance. This work compares performance of WIA, WSAMF, and WSATF using established wave reflection indices.

**Methods:** Methods' performance was evaluated on virtual subjects' data (4) (N = 500, age: 25–75 years). The pressure and flow waveform were extracted for the left carotid artery. Reflection Magnitude (RM), Reflection Index (RI), Pulse Pressure Backward (ΔPb) and Pulse Pressure Forward (ΔPf) were obtained and compared for said three methods.
**Results:** Samples of forward–backward pressure waves obtained from all the three methods are illustrated in Fig. 1. The comparative analysis is presented in Table I. Largest deviation in RM and RI was observed between WSATF and WSAMF (14.7% and 8.71%, respectively), and the minimum deviation was between WSAMF and WIA (6.66% and 3.71%, respectively). Deviation for ΔPb and ΔPf among methods ranged between 1.2% – 8.34%, with highest deviations against WSATF.

TABLE I: Comparison of reflection parameters for $WSA_{MF}$, $WSA_{TF}$, WIA

| Reflection Parameter | Method A - Method B | Bland-Altman Analysis | | Regression Analysis | |
|---|---|---|---|---|---|
| | | Bias | 98% CI | R-Value | P-Value |
| RM | $WSA_{MF}$ & WIA | -0.02 | (-0.15 ,0.11) | 0.65 | <0.001 |
| | $WSA_{MF}$ & $WSA_{TF}$ | -0.089 | (-0.19, 0.02) | 0.72 | <0.001 |
| | WIA & $WSA_{TF}$ | 0.068 | (-0.03, 0.17) | 0.6 | <0.001 |
| | $WSA_{MF}$ & WIA | 1.56 | (-0.15, 0.11) | 0.64 | <0.001 |

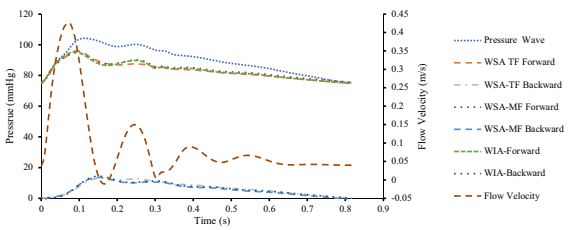


**Fig. 1** Comparison of wave separation in all the methods for a sample subject from database, along with pressure and flow velocity waveform extracted from left carotid artery.

## P.28

### Evaluation of Arterial Pulse Reflection Parameters using Multi-Gaussian Decomposition Model: Association with Stiffness Markers

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**Background:** Recent methods to quantify arterial wave reflections perform wave separation analysis (WSA) based on single-site pressure and flow information to evaluate reliable metrics: Reflection Magnitude (RM) and Reflection Index (RI), contrary to conventional augmentation index (1). Addressing challenges associated with such methods, we have developed a new WSA technique using Multi-Gaussian Decomposition (MGD).

**Methods:** The MGD model decomposes the diameter-scaled pressure waveform into multiple Gaussians for WSA without requiring flow information. The method's functionality was investigated on 100 participants (35 ± 10 years, 50 hypertensives) where diameter measured using ARTSENS (2) were used to evaluate RM and RI. RM and RI are validated by their associations with stiffness markers and screening ability.

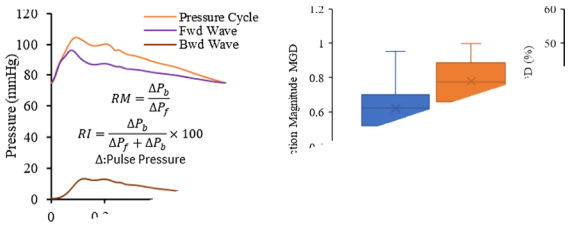


**Fig. 1**(a). Separated waves using MGD, (b) Box and Whisker plots for RM and RI comparing normotensives versus hypertensives.
**Results:** Adequately high-quality diameter waveforms were captured. The group averages of RM (= 0.69 ± 0.16) and RI (= 40.73 ± 6.1) % were comparable with earlier reported WSA studies (3–4). They exhibited significant correlation ($r > 0.5$, $p < 0.0001$) with the stiffness markers: β, elastic modulus, compliance, pulse wave velocity and AIx. Both RM and RI were significantly ($p < 0.05$) higher for hypertensives than normotensives, by 25.20% and 15.4%, respectively.
**Conclusion:** The study demonstrated the method's functionality in estimating reliable RM and RI that evidently associated with other clinically popular stiffness markers and discriminated between hypertensives and normotensives. Given the advantage that the method requires strictly one pulse waveform alone, its potential clinical and research applications are further being explored.

## P.29 Vascular function is unaltered after aerobic acute exercise in physically active young and older male adults

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**Purpose:** Vascular acute responses to successive bouts of exercise may cumulatively induce exercise-related adaptations in an intensity-dependent manner. However, these responses are inconsistent across age groups, and whether there are age or physical activity associated response patterns on brachial artery flow-mediated dilation (FMD) and arterial stiffness indices to high-intensity interval exercise (HIIE) and moderate-intensity continuous exercise (MICE) remains unknown. We compared the response pattern of FMD and arterial stiffness indices,