SUPPLEMENTAL MATERIAL

Table S1. Associations between blood pressure and arterial stiffness at baseline with demographic features. Beta-coefficients and r^2 are shown for univariate general linear models. In models adjusted for age / sex or for age / sex / cardiovascular risk factors (diabetes, current smoking and cholesterol). The beta-coefficient for each independent variable (by row) with the dependent variable (by column) is given, with the R^2 squared change compared to the models including only age and sex; or age, sex and cardiovascular risk factors. Associations are reported for the population in whom arterial stiffness index (ASI) was recorded at baseline. SBP=systolic blood pressure; DBP = diastolic blood pressure, PP = pulse pressure. All associations are significant, except where indicated *p>0.05. n=169,742. ASI = arterial stiffness index; SBP = systolic blood pressure; DBP = diastolic blood pressure; PP = pulse pressure; MBP = mean blood pressure; HTN = hypertension; BMI = body mass index;

	SBP		**DBP**		**PP**		**ASI**	
	β	**ΔR^2**	**β**	**ΔR^2**	**β**	**ΔR^2**	**β**	**ΔR^2**
Univariate								
Age	0.75	0.106	0.05	0.002	0.7	0.174	0.08	0.043
Female Sex	3.96	0.022	2.38	0.027	1.59	0.007	0.85	0.038
Diabetes	0.94	0.002*	-2.34	0.001	3.22	0.005	-0.05	0.002*
HTN	12.91	0.094	5.52	0.058	7.33	0.058	0.7	0.01
Smoking Base	-2.75	0.002	-0.65	0	-2.09	0.002	0.7	0.005
Ever Smoked	1	0.001	0.07	0*	0.93	0.001	0.61	0.01
Creatinine	0.06	0.004	0.03	0.004	0.03	0.002	0.02	0.009
Cholesterol	1.72	0.011	1.16	0.017	0.55	0.002	0	0*
BMI	0.73	0.035	0.59	0.077	0.14	0.003	0.07	0.013
Weight	0.2	0.03	0.18	0.081	0.02	0.001	0.03	0.03
SBP			0.38	0.488	0.62	0.715	0.03	0.024
DBP	1.28	0.488			0.28	0.045	0.06	0.034
MBP	1.42	0.837	0.79	0.863	0.46	0.149	0.05	0.034
PP	1.16	0.715	0.16	0.045			0.02	0.006
ASI	0.94	0.024	0.6	0.034	0.34	0.006		
+ Age / Sex								
SBP			0.41	0.502	0.59	0.56	0.01	0.004
DBP	1.25	0.452			0.25	0.035	0.05	0.022
MBP	1.38	0.734	0.81	0.855	0.41	0.108	0.03	0.014
PP	1.17	0.596	0.17	0.041			-0.01	0.001
ASI	0.4	0.007	0.52	0.02	-0.11	0.005		
+ CV RFs								
SBP			0.4	0.454	0.60	0.544	0.01	0.004
DBP	1.21	0.402			0.21	0.026	0.05	0.021
MBP	1.38	0.678	0.81	0.795	0.40	0.093	0.03	0.013
PP	1.13	0.561	0.13	0.056			-0.01	0.003
ASI	0.32	0.026	0.48	0.049	-0.15	0.01		

Dependent variables are shown in each column, with independent variables listed by row.

Table S2. Associations between blood pressure and arterial stiffness at follow-up 2, with demographic features and ASI or blood pressure at baseline. Beta-coefficients and r^2 are shown for univariate general linear models. In models adjusted for age / sex or for age / sex / cardiovascular risk factors (diabetes, current smoking and cholesterol) the beta-coefficient for each key index (row) with the dependent variable (by column) is given, with the R^2 squared change compared to the models including only age and sex; or age, sex and cardiovascular risk factors. Associations are reported for the population in whom arterial stiffness index (ASI) was recorded at baseline. SBP=systolic blood pressure; DBP = diastolic blood pressure; MBP = mean blood pressure; HTN = hypertension; PP = pulse pressure; BMI = body mass index; n=13761.

	Measures at follow-up 2							
	SBP		**DBP**		**PP**		**ASI**	
	β	**ΔR²**	**β**	**ΔR²**	**β**	**ΔR²**	**β**	**ΔR²**
Univariate								
Age	0.74	0.11	0.07	0	0.66	0.17	0.06	0.03
Female	4	0.02	2.36	0.03	1.65	0.01	1.23	0.1
Diabetes	1.66	0.001*	-2.09	0	3.7	0	-0.13	0.001*
HTN	13.11	0.1	6.04	0.07	7.02	0.06	0.59	0.01
Smoking Base	-3.5	0	-0.86	0	-2.64	0	0.59	0
Ever Smoked	0.73	0	0.02	0*	0.72	0	0.58	0.01
Creatinine	0.08	0.01	0.04	0.01	0.03	0	0.02	0.03
Cholesterol	1.74	0.01	1.13	0.02	0.6	0	-0.05	0
BMI	0.75	0.04	0.61	0.09	0.14	0	0.07	0.01
Weight	0.21	0.03	0.18	0.09	0.03	0	0.04	0.06
Baseline SBP			0.39	0.51	0.61	0.71	0.02	0.02
Baseline DBP	1.3	0.51			0.3	0.05	0.06	0.05
Baseline MBP	0.84	0.29	0.42	0.24	0.42	0.12	0.03	0.02
Baseline PP	1.18	0.71	0.18	0.05			0	0
Baseline ASI	0.83	0.02	0.78	0.05	0.06	0		
+ Age / Sex								
SBP			0.43	0.52	0.57	0.56	0	0
DBP	1.26	0.47			0.26	0.04	0.04	0.02
MBP	0.76	0.22	0.43	0.23	0.33	0.07	0.02	0.01
PP	1.18	0.59	0.18	0.05			-0.02	0.01
ASI	0.17	0	0.64	0.03	-0.46	0.01		
+ CV RFs								
SBP			0.41	0.46	0.59	0.54	0	0
DBP	1.22	0.41			0.22	0.03	0.04	0.02
MBP	0.74	0.19	0.42	0.20	0.31	0.06	0.02	0.01
PP	1.14	0.55	0.14	0.06			-0.02	0.01
ASI	0.08	0.02	0.59	0.05	-0.5	0.01		

Dependent variables are shown in each column, with independent variables listed by row.

Table S3. Effect of adjustment of baseline associations between blood pressure, arterial stiffness and demographic characteristics, adjusted for measurement variation between baseline and the second follow up visit. Adjustment for measurement variation is derived from the internal variability estimated in patients with ASI measured at baseline and the second follow-up visit. The beta-coefficient for the general linear model is reported for univariate associations, adjusted non-parametrically (see methods) or parametrically by Cronbach's alpha. Differences in R^2 values are determined by dis-attenuation. Multivariate adjustment for measurement variation is performed by multi-variate regression calibration. SBP=systolic blood pressure; DBP = diastolic blood pressure; MBP = mean blood pressure; HTN = hypertension; PP = pulse pressure; BMI = body mass index; n=169,742

	SBP			**DBP**			**PP**			**ASI**		
	β_{raw}	β_{α}	β_{np}	β_{raw}	β_{α}	β_{np}	β_{raw}	β_{α}	β_{np}	β_{raw}	β_{α}	β_{np}
Effect on β												
Age	0.75	0.75	0.75	0.05	0.05	0.05	0.70	0.70	0.70	0.08	0.08	0.08
Creatinine	0.06	0.08	0.07	0.03	0.04	0.03	0.03	0.04	0.03	0.02	0.03	0.02
Cholesterol	1.72	2.19	2.29	1.16	1.48	1.54	0.55	0.70	0.73			
BMI	0.73	0.82	0.76	0.59	0.66	0.62	0.14	0.16	0.15	0.07	0.08	0.07
SBP				0.38	0.53	0.48	0.62	0.87	0.79	0.03	0.04	0.04
DBP	1.28	1.85	1.59				0.28	0.40	0.35	0.06	0.09	0.07
PP	1.16	1.67	1.74	0.16	0.23	0.24				0.02	0.03	0.03
ASI	0.94	3.09	2.92	0.6	1.97	1.86	0.34	1.12	1.06			
Effect on r²	r^2	r^2_{dis}		r^2	r^2_{dis}		r^2	r^2_{dis}		r^2	r^2_{dis}	
Age	0.106	0.144		0.002	0.003		0.174	0.236		0.043	0.130	
Creatinine	0.004	0.006		0.004	0.007		0.002	0.003		0.009	0.031	
Cholesterol	0.011	0.019		0.017	0.030		0.002	0.003		0.000	0.000	
BMI	0.035	0.050		0.077	0.115		0.003	0.004		0.013	0.042	
SBP				0.488	0.94		0.715	1.316		0.024	0.099	
DBP	0.488	0.94					0.045	0.087		0.034	0.146	
PP	0.715	1.308		0.045	0.086					0.006	0.024	
ASI	0.024	0.099		0.034	0.146		0.006	0.025				
+ Age / Sex	*β*	*p-val*		*β*	*p-val*		*β*	*p-val*		*β*	*p-val*	
SBP				0.72	<0.001		1.03	<0.001		0.02	<0.001	
DBP	2.42	<0.001					0.50	<0.001		0.09	<0.001	
PP	2.42	<0.001		0.34	<0.001					-0.01	<0.001	
ASI	2.10	<0.001		2.67	<0.001		-0.57	<0.001				
+ CV RFs												
SBP				0.72	<0.001		1.05	<0.001		0.02	<0.001	
DBP	2.51	<0.001					0.50	<0.001		0.09	<0.001	
PP	2.42	<0.001		0.34	<0.001					-0.01	<0.001	
ASI	2.15	<0.001		2.75	<0.001		-0.60	<0.001				

Dependent variables are shown in each column, with independent variables listed by row. Results are reported as β coefficients and r^2 for univariate models, and adjusted for age and sex or age, sex and CV risk factors (diabetes, current smoking and cholesterol)

Table S4. Associations between measures of blood pressure and arterial stiffness at baseline, with percentage change in these indices per annum at follow-up, adjusted for baseline measures, standardised by centre and including only patients with notched ASI recordings at baseline and follow-up. Beta-coefficients and r^2 are shown for univariate general linear models. In models adjusted for age / sex or for age / sex / cardiovascular risk factors (CV RFs = diabetes, current smoking and cholesterol) the beta-coefficient for each key index (row) with the dependent variable (by column) is given, with R^2 squared change compared to the models including only age and sex; or age, sex and CV RFs. Associations are reported for those with arterial stiffness index (ASI) was recorded at baseline. SBP=systolic blood pressure; DBP = diastolic blood pressure; MBP = mean blood pressure; HTN = hypertension; PP = pulse pressure; BMI = body mass index; n=13761

	Percentage Change in Indices per annum at either follow-up							
	SBP		**DBP**		**PP**		**ASI**	
Baseline Indices	**β**	**ΔR²**	**β**	**ΔR²**	**β**	**ΔR²**	**β**	**ΔR²**
Univariate								
Age	0.02	0.011	-0.02	0.01	0.10	0.044	0.03	0.001
Female	0.2	0.007	0.15	0.004	0.27	0.003	1.19	0.015
Diabetes	-0.2	0*	-0.15	0*	-0.64	0.001*	1.08	0*
HTN	0.3	0.004	0.12	0*	0.59	0.004	0.53	0.001
Smoking Base	0.07	0*	0.17	0*	-0.03	0*	0.16	0*
Ever Smoked	0.11	0.001	-0.01	0*	0.3	0.002	0.3	0*
Creatinine	0.01	0.004	0.01	0.001	0.01	0.004	0.03	0.003
Cholesterol	-0.02	0*	-0.04	-0.001*	0.01	0.002*	0.03	-0.002*
BMI	0.03	0.006	0.02	0.002	0.06	0.006	0.04	0.001
Weight	0.01	0.007	0.01	0.004	0.02	0.006	0.03	0.006
SBP	-0.04	0	-0.01	0.005	0.01	0.002	0.03	0.006
DBP	0	0*	-0.07	0	0.01	0.002	0.07	0.01
MBP	0.01	0.004	-0.03	0.005	-0.05	0	0.06	0.009
PP	0	0*	-0.01	0.005	-0.11	0	0.02	0.001
ASI	0.04	0.004	0.01	0*	0.1	0.007	-1.42	0
+ Age / Sex								
SBP	-0.04	0	-0.01	0.002	0.01	0.001	0.02	0.002
DBP	0.01	0*	-0.07	0	0.01	0.001	0.06	0.006
MBP	0.01	0*	-0.02	0.002	-0.06	0	0.05	0.006
PP	-0.01	0*	-0.01	0.002	-0.13	0	0	0*
ASI	0.02	0.001	0.01	0*	0.03	0*	-1.53	0
+ CV RFs								
SBP	-0.05	-0.001	-0.01	0	0.01	0.002*	0.02	-0.001
DBP	0.01	-0.001*	-0.07	-0.002	0.01	0.002*	0.06	0.003
MBP	0.01	0.001	-0.02	0.001	-0.058	0.001	0.05	0.005
PP	-0.01	-0.001*	-0.01	0	-0.13	0.002	0	-0.002*
ASI	0.01	-0.001*	0.01	-0.002*	0.02	0.002*	-1.54	-0.002
+ SBP + DBP								
PP	0	-0.001*	-0.01	-0.002	-0.14	0.001	-0.07	-0.003
ASI	0.01	-0.001*	0	-0.003*	0.02	0.001*	-1.57	-0.003

Dependent variables are shown in each column, with independent variables listed by row.

Table S5. Associations between measures of blood pressure and arterial stiffness at baseline, with percentage change in these indices at follow-up, adjusted for baseline measures, standardised by centre and by age at baseline less than or greater than 60 years. Beta-coefficients and r^2 are shown for univariate general linear models. In models adjusted for age / sex or for age / sex / cardiovascular risk factors (diabetes, current smoking and cholesterol) the beta-coefficient for each key index (row) with the dependent variable (by column) is given, with the R^2 squared change compared to the models including only age and sex; or age, sex and cardiovascular risk factors. Associations are reported for the population in whom arterial stiffness index (ASI) was recorded at baseline. SBP=systolic blood pressure; DBP = diastolic blood pressure; MBP = mean blood pressure; PP = pulse pressure; ASI = arterial stiffness index; All associations were significant except where indicated: * = p>0.05

	Percentage change in indices per annum at either follow-up							
	SBP		**DBP**		**PP**		**ASI**	
Baseline Indices	**β**	**ΔR²**	**β**	**ΔR²**	**β**	**ΔR²**	**β**	**ΔR²**
Age <60								
Univariate								
Age	0.03	0.01	-0.02	0.003	0.05	0.01	0.08	0.003
Female	0.16	0.005	0.19	0.008	0.06	0	0.63	0.003
SBP	-0.03	0	-0.004	0.001	-0.17	0.13	0.04	0.007
DBP	0.007	0.001	-0.07	0	0.34	0.13	0.07	0.009
MBP	0.01	0.001	-0.013	0.001	-0.04	0	0.06	0.009
ASI	0.05	0.009	0.018	-0.017	0.12	0.02	-1.43	0
Adjusted								
SBP	-0.04	0.002	-0.005	0.003	-0.19	0.15	0.03	0.001
DBP	0.008	0.003	-0.07	0.002	0.37	0.15	0.07	0.004
MBP	0.01	0.003	-0.014	0.003	-0.05	0	0.05	0.003
ASI	0.03	0.001	0.01*	-0.017	0.10	0.007	-1.50	-0.002
Age >60								
Univariate								
Age	0.01	0.0003	-0.02	0.001	-0.02	0	0.17	0.003
Female Sex	0.07	0.001	0.07	0.001	0.19	0.002	0.93	0.007
SBP	-0.04	0	-0.01	0.005	-0.13	0.12	0.03	0.005
DBP	-0.013	0.003	-0.07	0	0.27	0.11	0.04	0.002
MBP	-0.019	0.002	-0.03	0.004	-0.07	0	0.05	0.004
ASI	0.01*	0.002	-0.008	-0.001	0.08	0	-1.14	0
Adjusted								
SBP	-0.05	0.005	-0.01	0.009	-0.14	0.11	0.03	0.007
DBP	-0.015	0.008	-0.08	0.004	0.27	0.11	0.04	0.005
MBP	-0.022	0.007	-0.03	0.008	-0.08	0.003	0.04	0.007
ASI	0.004*	0.01	-0.01*	0.006	0.07	0.004	-1.46	0.004

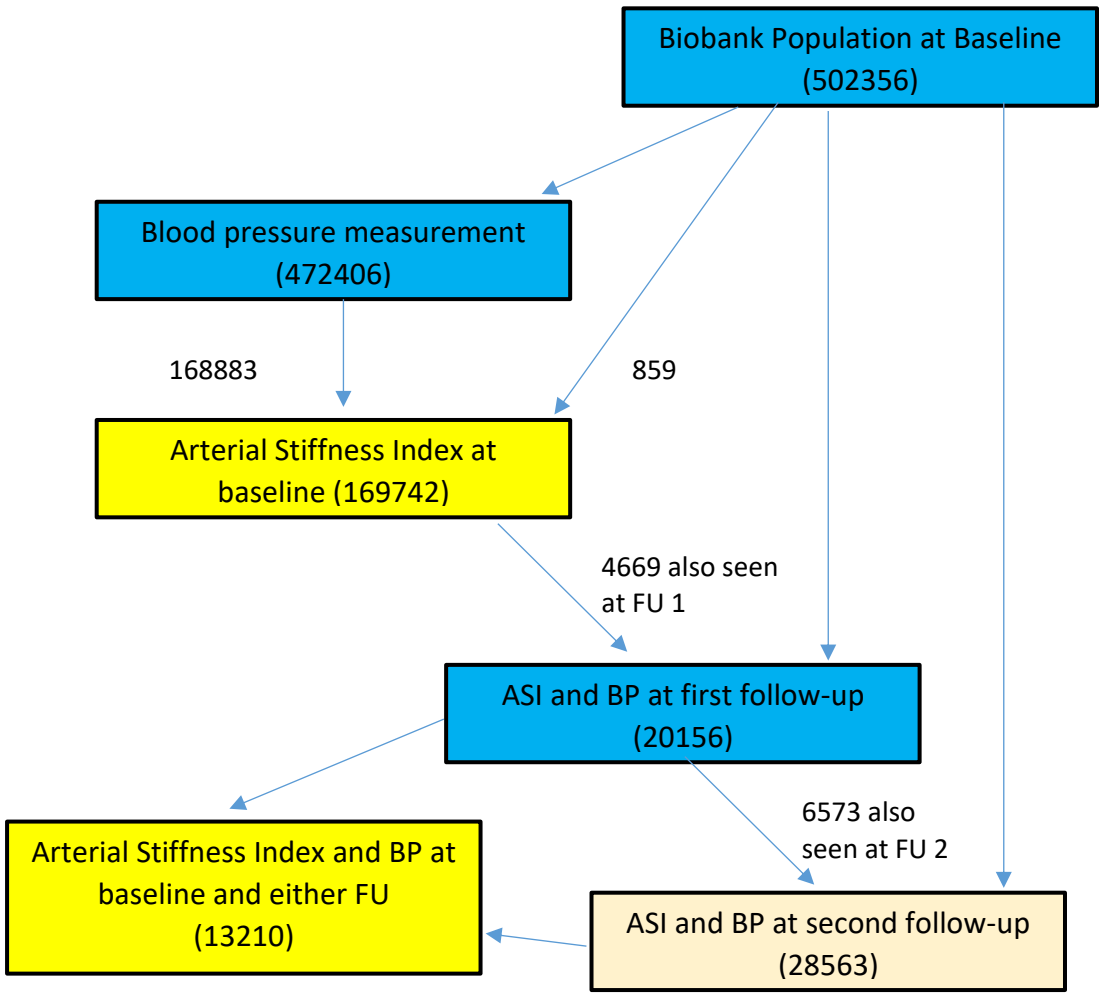
Dependent variables are shown in each column, with independent variables listed by row.

Table S6. Risk of progression to hypertension or increased arterial stiffness index (ASI) at either follow-up. Results are presented for progression from normotension (norm) to any hypertension (HTN), mixed hypertension (SDH) to isolated systolic hypertension (ISH) or from low ASI (<10m/s) to high ASI (>10m/s). Values are odds ratios (OR) for logistic regression and 95% confidence intervals (CI), unadjusted and adjusted for variability, by non-parametric (NP) or parametric (Para) methods. . SBP=systolic blood pressure; DBP = diastolic blood pressure; BMI = body mass index

	Norm → HTN			**SDH → ISH**			**Norm → ISH**			**ASI Transition**		
	Unadj	Para	NP	Unadj	Para	NP	Unadj	Para	NP	Unadj	Para	NP
Unadjusted												
ASI	1.36	2.60	2.53	0.98	0.94	0.95	1.30	2.29	2.23	1.22	2.78	1.84
SBP	2.59	4.80	3.35	1.40	2.32	1.53	2.58	4.77	3.33	1.25	1.35	1.32
DBP	1.81	2.49	2.09	0.74	0.33	0.69	1.39	1.67	1.51	1.21	1.3	1.26
Cholesterol	1.12	1.14	1.15	0.98	0.97	0.97	1.16	1.20	1.21	1.04	1.04	1.05
Creatinine	1.18	1.23	1.21	1.00	1.00	1.00	1.07	1.09	1.08	1.09	1.11	1.1
BMI	1.38	1.43	1.40	0.94	0.93	0.93	1.18	1.20	1.19	1.05	1.05	1.05
Weight	1.35	1.37	1.36	0.94	0.93	0.94	1.13	1.14	1.13	1.11	1.12	1.11

Figure S1. Flow chart of participants at each stage of the study. The key analyses (in yellow) are performed for cross-sectional analyses at baseline in individuals in whom ASI was measured, and for rate of progression of indices by pooling individuals from both follow-ups, including participants with arterial stiffness index (ASI) measured at baseline and at a minimum of one follow-up. Most participants had blood pressure measured at baseline, but only a proportion had ASI measured (at specific centres). Different participants were followed up at each follow-up visit, with only a limited number who had ASI measured at baseline followed up at any follow-up, and a very limited number followed up at both follow-ups. The numbers progressing directly from one group to another are shown adjacent to arrows, whilst the number in each group are shown within each box.

A)



B) Statistical Analyses

Cross-sectional Relationships

- Performed at baseline and follow-up 2
- Associations between SBP, DBP, PP and ASI, univariate and adjusted for confounders (general linear models)
- Adjusted for visit-to-visit variability in predictors by regression calibration and regression dilution ratio
- Evolution of relationships between ASI, SBP and DBP with age determined by stratification into deciles of age, and quartiles of BP indices

Longitudinal Relationships

- In population with ASI and BP at baseline and either follow up
- Indices standardised by % change per annum
- Associations between baseline SBP, DBP, PP and ASI and progression of these indices determined for univariate associations and adjusted for confounders (general linear models)
- Risk of transition to hypertensive phenotypes (mixed hypertension, isolated systolic hypertension, diastolic hypertension) or excess ASI determined by logistic regression

Figure S2. Recorded BP and arterial stiffness measures at baseline and follow up, stratified by baseline Biobank assessment centre. Variation in mean indices at each centre is shown for mean ASI (A+B), DBP (C), SBP (D) and pulse pressure (E) at baseline, first follow-up and second follow-up, stratified by the baseline centre attended. Significant variation between centres is seen for ASI and SBP, with greater between-centre variation for measures taken at baseline than measures taken at follow-up for both SBP and ASI. Differences between visits and across follow-ups were more consistent for DBP and PP. SBP=systolic blood pressure; DBP = diastolic blood pressure; MBP = mean blood pressure; PP = pulse pressure; ASI = arterial stiffness index; FU = follow-up.

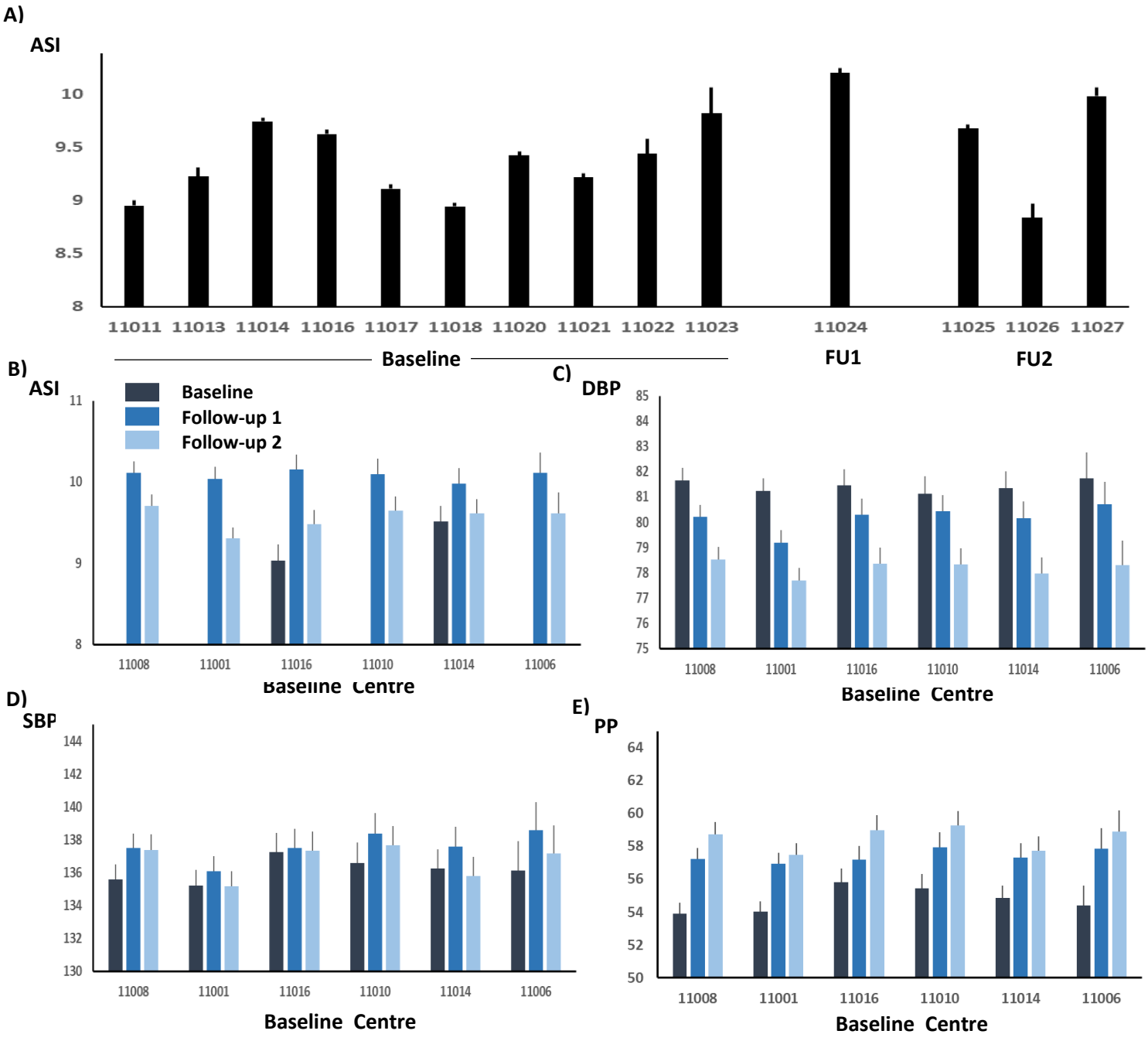


Figure S3. Average pulse waveforms by tertile of Arterial stiffness index (ASI) at baseline across the whole population, stratified by quartile of age.

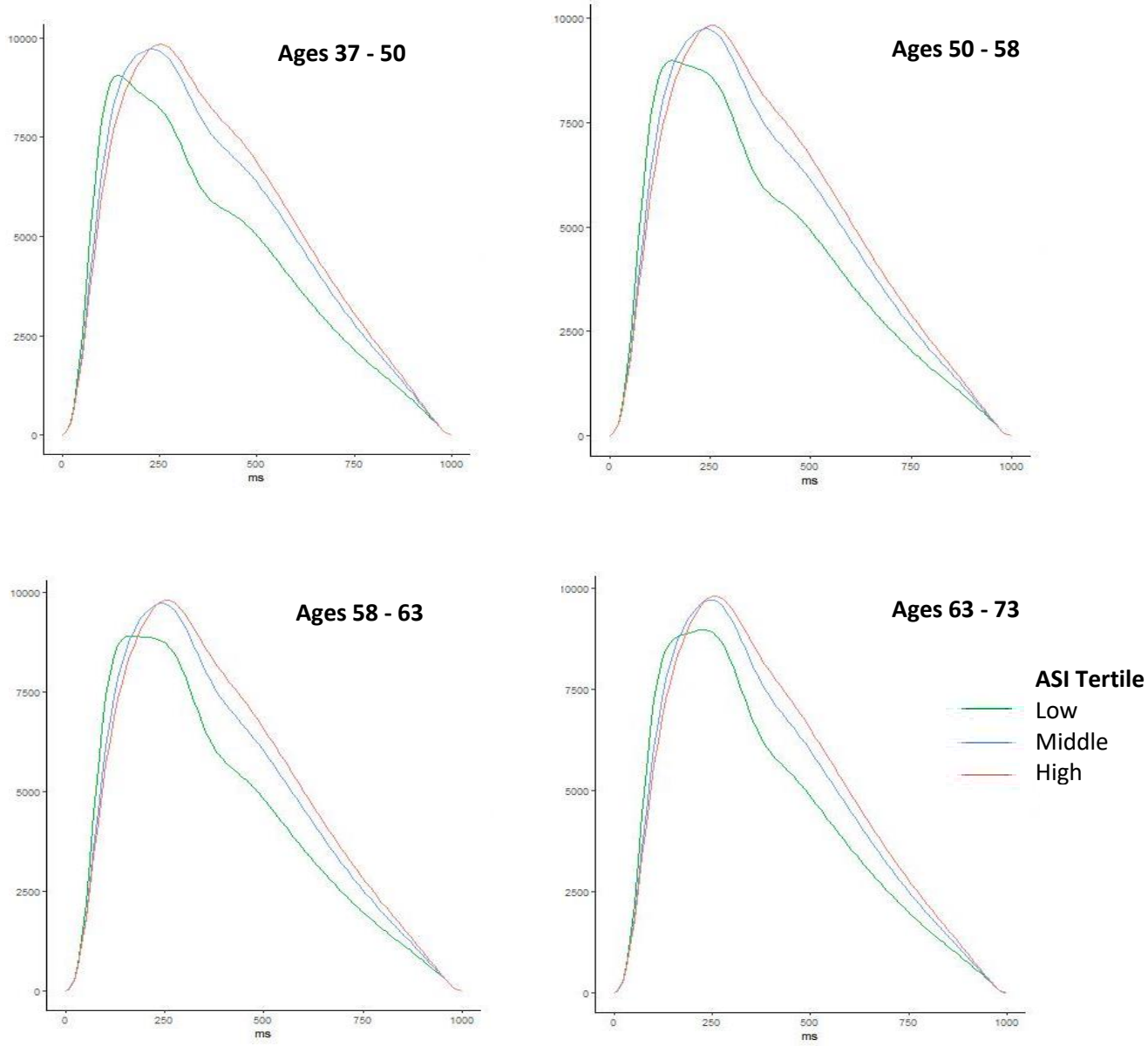


Figure S4. Relationship between baseline arterial stiffness index (ASI), age and blood pressure variability at baseline. ASI is divided into deciles, and stratified by quartiles of age, plotted against standard deviation of systolic BP (SBP-SD) or diastolic BP (DBP-SD) or their coefficients of variation (CV)