

Variable type	Variable name	Definition and coding
Outcome variable	Chronic kidney disease (CKD)	Defined as eGFR < 60 mL/min/1.73 m ² . Coding: 1 = present, 0 = absent.
Exposure variable	Standardized residual of ePWV	Obtained by regressing ePWV against age and MBP. Categorized into quartiles (Q1, Q2, Q3, Q4), with Q1 as the reference group. For details of ePWV calculation, see Methods section.
Covariate	Age	Continuous variable, in years.
Covariate	Sex	Categorical variable: 0 = female, 1 = male.
Covariate	Body mass index (BMI)	Continuous variable: BMI = weight (kg) / height (m) ² .
Covariate	Smoking status	Categorical variable: 0 = no, 1 = yes.
Covariate	Alcohol consumption	Categorical variable: 0 = no, 1 = yes.
Covariate	Hypertension	Categorical variable: 0 = no, 1 = yes.
Covariate	Diabetes or elevated blood glucose	Categorical variable: 0 = no, 1 = yes (self-reported diabetes history or fasting blood glucose ≥ 7.0 mmol/L).
Covariate	Dyslipidemia	Categorical variable: 0 = no, 1 = yes.
Covariate	Stroke history	Categorical variable: 0 = no, 1 = yes.

3 Note: eGFR, estimated glomerular filtration rate; ePWV, estimated pulse wave velocity; MBP, mean
4 blood pressure. Smoking status, alcohol consumption, hypertension, diabetes or elevated blood
5 glucose, dyslipidemia, and stroke history were derived from self-reported data in the CHARLS
6 questionnaire. Age, sex, and BMI were derived from the CHARLS questionnaire and physical
7 examination. Biochemical indicators (including serum creatinine for eGFR calculation and blood
8 glucose for diabetes definition) were obtained from blood sample measurements. For details of eGFR
9 calculation, see the "Definitions of CKD and ePWV" section in Methods; for details of ePWV and
10 MBP calculation, see the same section; for covariate coding, see the "Covariates" section in Methods.

Supplementary Table S2. Collinearity diagnosis of the linear regression of ePWV against age and mean blood pressure (MBP)

Item	Value
Model R ²	0.988
VIF for age	1.013
VIF for MBP	1.013
Residual standard deviation	0.046

Note: ePWV, estimated pulse wave velocity; MBP, mean blood pressure; VIF, variance inflation factor. The R² of 0.988 indicates that age and MBP together explain 98.8% of the variance in ePWV, and the residual standard deviation of 0.046 suggests minimal residual variation, supporting the use of the residual approach to further extract the “excessive vascular aging” component.

Supplementary Table S3. Sensitivity analysis: association between original ePWV and CKD in the fully adjusted model

Variable	<i>B</i>	<i>SE</i>	<i>Wald</i> χ^2	<i>P</i>	<i>OR</i>	95% CI lower	95% CI upper
Gender (male vs. female)	0.261	0.185	1.990	0.158	1.298	0.903	1.865
BMI	0.001	0.020	0.002	0.966	1.001	0.962	1.041
Smoking (yes vs. no)	0.027	0.184	0.022	0.882	1.028	0.716	1.474
Alcohol consumption (yes vs. no)	0.466	0.195	5.682	0.017	1.593	1.086	2.337
Hypertension (yes vs. no)	0.455	0.160	8.124	0.004	1.576	1.153	2.154
Dyslipidemia (yes vs. no)	0.223	0.219	1.042	0.307	1.250	0.814	1.919
Diabetes or elevated blood glucose (yes vs. no)	0.444	0.243	3.351	0.067	1.559	0.969	2.507
Stroke (yes vs. no)	0.776	0.287	7.288	0.007	2.172	1.237	3.816
ePWV	0.155	0.307	0.255	0.613	1.168	0.640	2.130
Age	0.084	0.056	2.223	0.136	1.087	0.974	1.214
MBP	0.003	0.023	0.022	0.881	1.003	0.959	1.050
Constant	-11.884	2.763	18.501	<0.001	—	—	—

Note: Adjusted for sex, BMI, smoking, alcohol consumption, hypertension, dyslipidemia, diabetes or

elevated blood glucose, stroke, age, and MBP. The original ePWV lost statistical significance after adjustment for age and MBP ($P = 0.613$), indicating severe multicollinearity among the three variables. Abbreviations: ePWV, estimated pulse wave velocity; MBP, mean blood pressure; OR, odds ratio; CI, confidence interval.

Supplementary Table S4. Sensitivity analysis: association between standardized residual (continuous) and CKD in the fully adjusted model

Variable	OR (95% CI)	P
Standardized Residual (per 1-SD)	1.686 (1.538–1.849)	<0.001
Gender (male vs. female)	1.427 (0.984–2.069)	0.061
BMI	0.947 (0.911–0.984)	0.006
Smoking	1.051 (0.725–1.522)	0.793
Alcohol drinking	1.837 (1.254–2.690)	0.002
Hypertension	2.697 (2.004–3.630)	<0.001
Dyslipidemia	1.188 (0.776–1.821)	0.428
Diabetes or elevated blood glucose	1.715 (1.075–2.736)	0.024
Stroke	2.512 (1.438–4.390)	0.001

Note: Adjusted for sex, BMI, smoking, alcohol consumption, hypertension, dyslipidemia, diabetes or elevated blood glucose, and stroke. Age and MBP were not included because the standardized residual had already been mathematically purged of their linear effects. Each 1-SD increase in the residual was associated with a 68.6% higher odds of CKD. Abbreviations: OR, odds ratio; CI, confidence interval; SD, standard deviation.