

Association of Pulse Wave Velocity and Pulse Pressure with Decline in Kidney Function

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OBJECTIVES

- The association of arterial stiffness and kidney function decline in patients with mild-to-moderate chronic kidney disease (CKD) is not well established.
- This study investigated whether pulse wave velocity (PWV) and pulse pressure (PP) are independently associated with glomerular filtration rate (GFR) and rapid kidney function decline in early CKD

METHODS

- 913 patients (mean age, 63 ± 10 years; baseline eGFR, 84 ± 18 ml/min/1.73 m²).
- Carotid femoral PWV (cfPWV), brachial-ankle PWV (baPWV), and PP were measured.
- Estimated GFR was measured at baseline and at follow-up.
- Renal outcome: Rapid kidney function decline (estimated GFR loss, >3 ml/min/1.73 m² per year).
- The median follow-up duration was 3.2 years.

RESULTS

Table 1. Baseline clinical characteristics

	Estimated GFR(ml/min/1.73m ²) ^a			P value	Linea P
	≥ 90 (n=370)	89-60 (n=443)	59-30 (n=100)		
Age (year)	57.3±9.5	65.0±8.9	70.6±7.4	<0.001	
Male gender (%)	50.3	59.4	72.0	<0.001	
Hypertension (%)	95.1	94.3	100	0.204	
Diabetes mellitus (%)	17.0	27.7	37.6	<0.001	
Dyslipidemia (%)	10.8	13.6	9.9	0.710	
Body mass index (kg/m ²)	24.2±2.9	24.5±2.8	24.3±2.8	0.393	
Heart rate (beats/min)	66.7±10.6	67.3±12.4	69.8±14.6	0.061	
SBP (mmHg)	125±17	125±18	124±21	0.921	
DBP (mmHg)	76±11	75±11	72±11	0.008	
MAP (mmHg)	92±12	91±12	89±14	0.143	
Coronary artery disease (%)	42.8	48.2	49.5	0.112	
Cerebrovascular disease (%)	2.7	7.7	14.9	<0.001	
Smoking (%)	27.9	31.8	40.6	0.018	
Heart failure (%)	0.0	1.8	1.0	0.062	
eGFR (ml/min/1.73m ²) ^a	100.0±7.4	78.0±8.5	48.8±8.0	<0.001	
Ejection fraction (%)	66.1±6.5	64.7±7.9	63.5±9.4	0.002	
Hemoglobin (g/dl)	13.7±1.5	13.5±1.6	12.7±1.9	<0.001	
Uric acid (mg/dl)	4.7±1.3	5.3±1.5	6.4±1.7	<0.001	
hs-CRP (g/l)	0.48(0.23,1.08)	0.66(0.29,1.76)	0.97(0.40,2.54)	<0.001	
LDL-cholesterol (mg/dl)	107.2±35.6	104.1±33.0	96.0±31.4	0.028	

Table 2. Correlation of various covariates with baseline estimated GFR

	Total cohort (unadjusted)		Total cohort (Adjusted for age)	
	r	P value	r	P value
Age (year)	-0.546	<0.001	-	-
MAP (mmHg)	0.045	0.176	0.006	0.859
BMI (kg/m ²)	-0.576	0.085	-0.105	0.004
Ejection fraction (%)	0.073	0.029	0.110	0.003
Uric acid (mg/dl)	-0.317	<0.001	-0.385	<0.001
PP (mmHg)	-0.076	0.021	-0.010	0.793
cfPWV (cm/s)	-0.317	<0.001	-0.065	0.058
baPWV (cm/s)	-0.223	<0.001	-0.011	0.744

Table 3 Association of PWV and PP with baseline kidney function indicated by estimated GFR

	B Value (95% Confidence Interval)	R ²	P value
Unadjusted			
Pulse pressure (10mmHg)	-1.090(-2.557, -0.589)	0.011	0.002
cfPWV (cm/s) ^a	-18.43(-22.30, -13.93)	0.094	<0.001
baPWV (cm/s) ^a	-15.07(-19.33, -10.81)	0.050	<0.001
Age-Adjusted			
Pulse pressure (10mmHg)	-0.049(-0.917, 0.777)	0.292	0.871
cfPWV (cm/s) ^a	-3.406(-7.347, 0.534)	0.290	0.090
baPWV (cm/s) ^a	0.177(-3.875, 4.230)	0.292	0.932
Fully Adjusted^b			
Pulse pressure (10mmHg)	-0.222(-1.402, 0.763)	0.423	0.562
cfPWV (cm/s) ^a	-3.234(-7.950, 1.483)	0.407	0.179
baPWV (cm/s) ^a	-1.273(-6.433, 3.887)	0.424	0.628

^aContinuous log-transformed. B values represent a decline in estimated GFR (ml/min/1.73m²) per doubling of pulse wave pressure.
^bAdjusted for age; sex; mean arterial pressure; diabetes mellitus; cerebrovascular disease; smoking history; ejection fraction; levels of hemoglobin, uric acid, hs-CRP, and LDL cholesterol; and medication with ACE inhibitors, ARBs, and statins.
 B = un-standardized coefficient.

Figure 1. PWV and PP in patients with CKD categorized according to the baseline eGFR

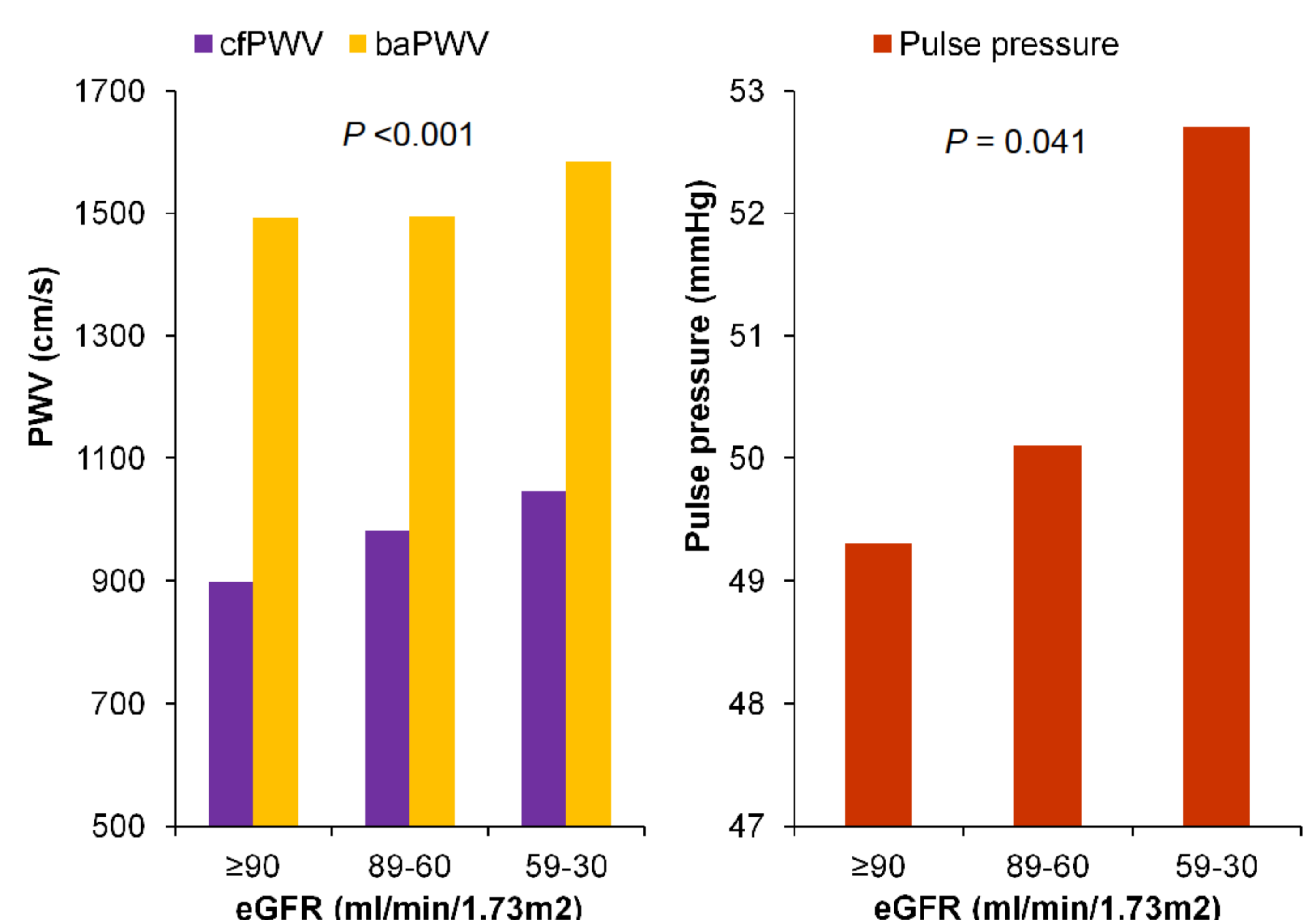


Table 4. Association of PWV and PP with rapid kidney function decline (renal outcome)

	Odds Ratio (95% Confidence Interval)		
	Unadjusted	Model 1	Model 2
Estimated GFR <-3ml/min/1.73m²/year			
PP (per10mmHg)	1.32(1.15-1.50) ^b	1.31(1.14-1.50) ^b	1.22(1.01-1.48) ^b
cfPWV ^a	2.62(1.18-5.82) ^b	2.36(0.93-5.98)	1.39(0.41-4.65)
baPWV ^a	4.27(1.78-10.22) ^b	4.01(1.52-10.56) ^b	2.51(0.66-9.46)

^aContinuous log-transformed.
^bP < 0.05
 Model 1: Adjusted for age and sex
 Model 2: Adjusted for age; sex; mean arterial pressure; diabetes mellitus; cerebrovascular disease; smoking; ejection fraction; levels of hemoglobin, uric acid, hs-CRP, and LDL cholesterol; and medication with ACE inhibitors, ARBs, and statins.

CONCLUSIONS

- Arterial stiffness assessed using cfPWV and baPWV was not correlated with lower estimated GFR and rapid kidney function decline after adjustment for various confounders.
- PP is an independent risk factor for rapid kidney function decline in population with relatively preserved kidney function (estimated GFR ≥ 30 ml/min/1.73 m²).