Urinary albumin excretion, blood pressure changes and hypertension incidence in the community: effect modification by kidney function

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OBJECTIVES

Increased albuminuria and reduced kidney function may predict blood pressure (BP) progression and may exacerbate each other's effects. We investigated associations and interactions between these two risk factors and BP changes and hypertension incidence in community-dwelling elderly men.

METHODS

Cross-sectional and longitudinal observational study in the Uppsala Longitudinal Study of Adult Men (ULSAM) of 1051 men (all aged 71 years) with assessments on urinary albumin excretion rate (UAER), 24-hour ambulatory BP monitoring (ABPM) and cystatin C estimated glomerular filtration rate (eGFR). Of these, 574 men attended re-examination after 6 years, and ABPM measurements were again recorded.

Table 1. Multivariable regression models showing the cross-sectional associations of UAER with blood pressure measurements as assessed by ABPM in all available subjects at the baseline visit (*n*=1051).

Log_2(UAER, ug/min)	Crude Model		Adjusted Model 1		Adjusted Model 2	
	Beta (95% CI)	P value	Beta (95% CI)	P value	Beta (95% CI)	P value
24-hour SBP (mmHg)	2.53 (1.99, 3.07)	<0.001	2.18 (1.58, 2.79)	<0.001	2.18 (1.57, 2.78)	<0.001
24-hour DBP (mmHg)	1.33 (1.06, 1.59)	<0.001	1.23 (0.94, 1.53)	<0.001	1.22 (0.92, 1.51)	<0.001
24-hour MAP (mmHg)	1.72 (1.40, 2.05)	<0.001	1.54 (1.18, 1.91)	<0.001	1.53 (1.17, 1.90)	<0.001
24-hour PP (mmHg)	1.20 (0.78, 1.62)	<0.001	0.95 (0.48, 1.42)	<0.001	0.96 (0.50, 1.43)	<0.001

Covariance in Model 1 includes BMI, smoking status, physical activity, cardiovascular disease, diabetes, hyperlipidemia,eGFR, and the use of angiotensin-converting-enzyme inhibitors.
Covariance in Model 2 includes BMI, smoking status, physical activity, cardiovascular disease, diabetes, hyperlipidemia,eGFR, and the use of any anti-hypertensive drugs (angiotensin-converting-enzyme inhibitors, calcium channel blockers, β-blockers, α-blockers, and/or diuretics).

Table 2. Multivariable regression models showing the association between baseline UAER and changes in ambulatory blood pressure measurements after 6 years in all available subjects (*n*=574) and after stratification by the presence of impaired renal function (eGFR≥60mL/min/1.73m^2: *n*=329; eGFR<60mL/min/1.73m^2: *n*=245).

Log_2(UAER, ug/min)	Adjusted Model 1		Adjusted Model 2	
	Beta (95% CI)	P value	Beta (95% CI)	P value
Delta-24-hour SBP (mmHg)				
All subjects	0.52 (-0.17, 1.22)	0.14	0.70 (0.02, 1.39)	0.045
eGFR≥60mL/min/1.73 m^2	-0.36 (-1.22, 0.51)	0.42	-0.32 (-1.18, 0.54)	0.47
eGFR<60mL/min/1.73m^2	1.59 (0.47, 2.72)	0.006	2.02 (0.93, 3.12)	<0.001
P for interaction	0.009		0.004	
Delta-24-hour DBP (mmHg)				
All subjects	0.33 (-0.06, 0.73)	0.09	0.45 (0.06, 0.83)	0.03
eGFR≥60mL/min/1.73 m^2	0.14 (-0.36, 0.64)	0.58	0.19 (-0.30, 0.69)	0.44
eGFR<60mL/min/1.73m^2	0.62 (-0.01, 1.24)	0.05	0.81 (0.18, 1.43)	0.01
P for interaction	0.26		0.18	
Delta-24-hour MAP (mmHg)				
All subjects	0.43 (-0.02, 0.89)	0.06	0.56 (0.11, 1.01)	0.02
eGFR≥60mL/min/1.73 m^2	-0.02 (-0.60, 0.56)	0.96	0.02 (-0.55, 0.59)	0.94
eGFR<60mL/min/1.73m^2	1.01 (0.29, 1.74)	0.006	1.28 (0.56, 2.00)	0.001
P for interaction	0.04		0.02	
Delta-24-hour PP (mmHg)				
All subjects	0.03 (-0.48, 0.53)	0.92	0.11 (-0.40, 0.61)	0.68
eGFR≥60mL/min/1.73 m^2	-0.62 (-1.26, 0.02)	0.06	-0.62 (-1.26, 0.02)	0.06
eGFR<60mL/min/1.73m^2	0.76 (-0.07, 1.59)	0.07	1.00 (0.19, 1.82)	0.02
P for interaction	0.008		0.006	

Adjusted Model 1 includes BMI, smoking status, physical activity, cardiovascular disease, diabetes, hyperlipidemia, eGFR, blood pressure measured by ambulatory blood pressure monitoring at baseline (systolic blood pressure, diastolic blood pressure, mean arterial pressure, and pulse pressure, respectively), and the use of angiotensin-converting-enzyme inhibitors at baseline.
Adjusted Model 2 includes BMI, smoking status, physical activity, cardiovascular disease, diabetes, hyperlipidemia, eGFR, blood pressure measured by ambulatory blood pressure monitoring at baseline (systolic blood pressure, diastolic blood pressure, mean arterial pressure, and pulse pressure, respectively), the use of angiotensin-converting-enzyme inhibitors at baseline, and the use of any anti-hypertensive drugs at re-examination.

RESULTS

UAER associated with ABPM both at baseline and longitudinally (**Table 1**). In longitudinal analysis, there were significant interactions between UAER and kidney function in relation to changes of systolic BP, mean arterial pressure, and pulse pressure (**Table 2**). After stratification for renal function state, UAER independently predicted BP changes only in those who had eGFR<60 mL/min/1.73m^2. At re-examination, 71 new cases of hypertension were recorded. Multivariable logistic models showed similar interactions on hypertension incidence: UAER was an independent predictor of incident hypertension only in those with reduced renal function (**Figure 1**). These associations were evident also in non-diabetics and in those with normal range UAER (<20ug/min).

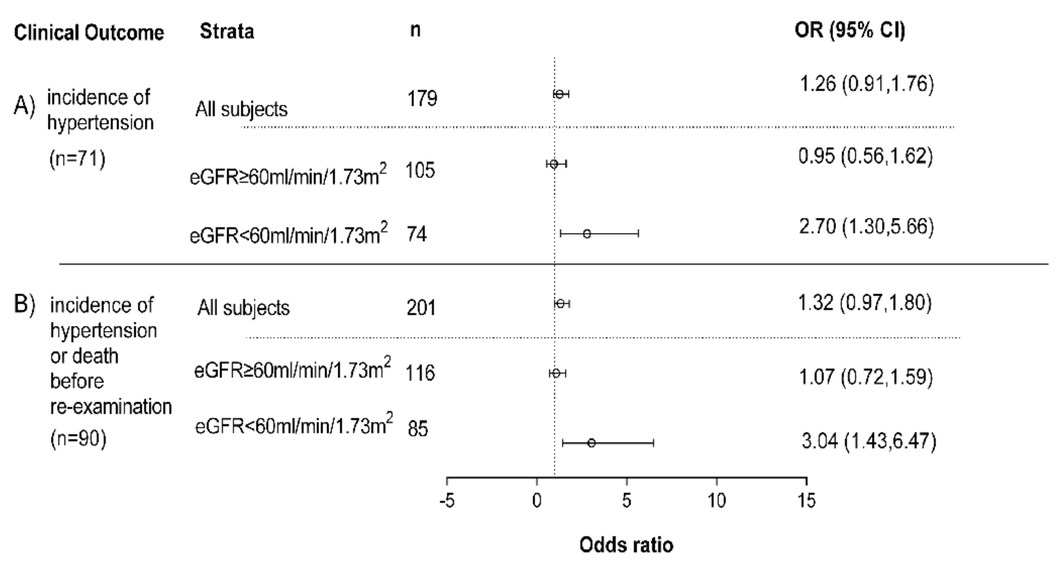

Figure 1 **Odd ratios and 95 % confidence intervals for hypertension incidence or the composite outcome of death and incident hypertension associated with UAER and stratified by the presence of reduced renal function.**

CONCLUSIONS

In community-dwelling elderly men, UAER - even within the normal range- associates with BP progression and hypertension incidence. Concurrent reduction of renal function modifies and exacerbates these associations.

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