



Abstract Type : Poster exhibition

Abstract Submission No.: A-0642

Abstract Topic : Hypertensive Kidney Disease + Vascular Biology in CKD

Isolated Hypertension and Hypotension and Kidney Outcome: Results from UK Biobank Data

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Objectives : Isolated effects of blood pressure (BP) patterns and their effect on kidney function remain underexplored. This study aimed to evaluate the independent contributions of isolated BP patterns to kidney outcome.

Methods : Using data from the UK Biobank, we analyzed 383,950 individuals with an initial SBP ≥ 90 mmHg and eGFR of ≥ 60 mL/min/1.73 m². Participants were categorized into BP groups based on their BP patterns: combined hypertension (Both HTN, SBP ≥ 140 mmHg and DBP ≥ 90 mmHg), isolated systolic hypertension (ISH, SBP ≥ 140 mmHg and DBP < 90 mmHg), isolated diastolic hypertension (IDH, SBP < 140 mmHg and DBP ≥ 90 mmHg), normotension (SBP < 140 mmHg and $60 \leq$ DBP < 90 mmHg), and isolated diastolic hypotension (IDHypo, SBP < 140 mmHg and DBP < 60 mmHg). Kidney outcome was incident CKD and ESKD defined by ICD-10 diagnosis (N18) and OPAC-based surgery codes.

Results : The median age of the participants was 57 years and 57.5% were women. During a median follow-up of 13.6 (12.9-14.3) years, a total of 8,624 events of kidney outcome occurred. In multivariable Cox models, ISH was significantly associated with an increased risk of kidney outcome (aHR 1.21, 95% CI 1.13–1.28), as was both HTN (aHR 1.15, 95% CI 1.07–1.23). In contrast, IDH (aHR 0.95, 95% CI 0.80–1.13) and IDHypo (aHR 1.10, 95% CI 0.80–1.51) were not significantly associated with kidney outcome in the overall population. However, among participants with diabetes, ISH remained a significant risk factor (aHR 1.14, 95% CI 1.00–1.29), and IDHypo was also associated with an increased risk of kidney outcome (aHR 1.68, 95% CI 1.02–2.78).

Conclusions : These findings highlight the significant impact of ISH on kidney outcome, whereas IDH appears to have minimal influence in the general population. In patients with diabetes, cautious monitoring of isolated DBP reduction is warranted.

Table 1.jpg



Table 1. Baseline characteristics

Characteristic	Normotension N = 209,778 ^f	ISH N = 86,443 ^f	IDH N = 12,350 ^f	Both HTN N = 72,549 ^f	IDHypo N = 2,830 ^f	P
Age, years	54 (47 - 61)	62 (56 - 65)	52 (46 - 58)	58 (51 - 63)	56 (48 - 62)	<0.001
Sex						<0.001
Female	131,158 (63%)	47,886 (55%)	6,539 (53%)	33,015 (46%)	2,184 (77%)	
Male	78,620 (37%)	38,557 (45%)	5,811 (47%)	39,534 (54%)	646 (23%)	
Ethnic						<0.001
White	196,228 (94%)	82,651 (96%)	11,266 (91%)	68,122 (94%)	2,667 (94%)	
Asian	5,561 (2.7%)	1,503 (1.7%)	440 (3.6%)	1,668 (2.3%)	61 (2.2%)	
Black	3,200 (1.5%)	964 (1.1%)	318 (2.6%)	1,401 (1.9%)	22 (0.8%)	
Mixed	1,569 (0.7%)	327 (0.4%)	108 (0.9%)	399 (0.6%)	24 (0.9%)	
Other	2,236 (1.1%)	599 (0.7%)	139 (1.1%)	613 (0.8%)	34 (1.2%)	
BMI, kg/m ²	25.8 (23.4 - 28.8)	26.9 (24.4 - 29.9)	29.3 (26.1 - 33.2)	28.2 (25.5 - 31.4)	23.1 (21.1 - 25.4)	<0.001
SBP, mmHg	126 (118 - 133)	149 (144 - 157)	136 (132 - 138)	157 (149 - 167)	107 (100 - 115)	<0.001
DBP, mmHg	77 (72 - 82)	84 (80 - 87)	92 (91 - 94)	96 (93 - 100)	58 (56 - 59)	<0.001
Alcohol						<0.001
Current	192,078 (92%)	79,358 (92%)	11,324 (92%)	67,557 (93%)	2,507 (89%)	
Never	9,436 (4.5%)	3,942 (4.6%)	565 (4.6%)	2,823 (3.9%)	158 (5.6%)	
Previous	7,719 (3.7%)	2,946 (3.4%)	410 (3.3%)	2,015 (2.8%)	152 (5.4%)	
Smoking						<0.001
Current	24,192 (12%)	7,794 (9.0%)	1,389 (11%)	7,044 (9.7%)	372 (13%)	
Never	118,410 (57%)	45,952 (53%)	6,873 (56%)	39,610 (55%)	1,557 (55%)	
Previous	66,195 (32%)	32,238 (37%)	4,012 (33%)	25,556 (35%)	879 (31%)	
Education status						<0.001
high	101,481 (48%)	32,168 (37%)	5,574 (45%)	29,369 (40%)	1,442 (51%)	
low	34,446 (16%)	14,896 (17%)	2,408 (19%)	13,536 (19%)	427 (15%)	
middle	45,048 (21%)	18,706 (22%)	2,731 (22%)	15,846 (22%)	560 (20%)	
unknown	234 (0.1%)	85 (0.1%)	17 (0.1%)	60 (0.1%)	6 (0.2%)	
unspecified	28,569 (14%)	20,588 (24%)	1,620 (13%)	13,738 (19%)	395 (14%)	
Income status, £						<0.001
18,000 to 30,999	42,032 (20%)	20,802 (24%)	2,414 (20%)	16,167 (22%)	585 (21%)	

Table 1.jpg



Table 2. Association between isolated BP pattern groups and kidney outcome

BP groups							
	Events	1000- Person-yr	Rate	Hazard ratio (95% confidence interval), P value			
				Unadjusted		Adjusted *	
Whole population							
Normotension	3632	2806404	1.29	1.00 (Reference)		1.00 (Reference)	
Both HTN	1771	962572	1.84	1.43 (1.35-1.51)	<0.001	1.15 (1.07-1.23)	<0.001
ISH	2937	1133909	2.59	2.01 (1.92-2.11)	<0.001	1.21 (1.13-1.28)	<0.001
IDH	219	165998	1.32	1.02 (0.89-1.17)	0.736	0.95 (0.80-1.13)	0.569
IDhypo	65	37422	1.74	1.35 (1.05-1.72)	0.018	1.10 (0.80-1.51)	0.563
Population with diabetes							
Normotension	776	143582	5.40	1.00 (Reference)		1.00 (Reference)	
Both HTN	326	60253	5.41	1.00 (0.88-1.14)	0.948	1.10 (0.94-1.28)	0.237
ISH	707	99405	7.11	1.33 (1.20-1.47)	<0.001	1.14 (1.00-1.29)	0.045
IDH	42	10822	3.88	0.72 (0.53-0.98)	0.036	0.68 (0.45-1.08)	0.062
IDhypo	24	1958	12.26	2.35 (1.56-3.52)	<0.001	1.68 (1.08-2.78)	0.042

*: Models were adjusted for age, sex, ethnic, BMI, education and income status, smoking, alcohol, physical activity, baseline eGFR, antihypertensive agents, and history of diabetes (only for the analysis of whole population)