Burden of chronic kidney and cardiovascular diseases on life expectancy and health service utilization - A cohort study of Hong Kong Chinese hypertensive patients

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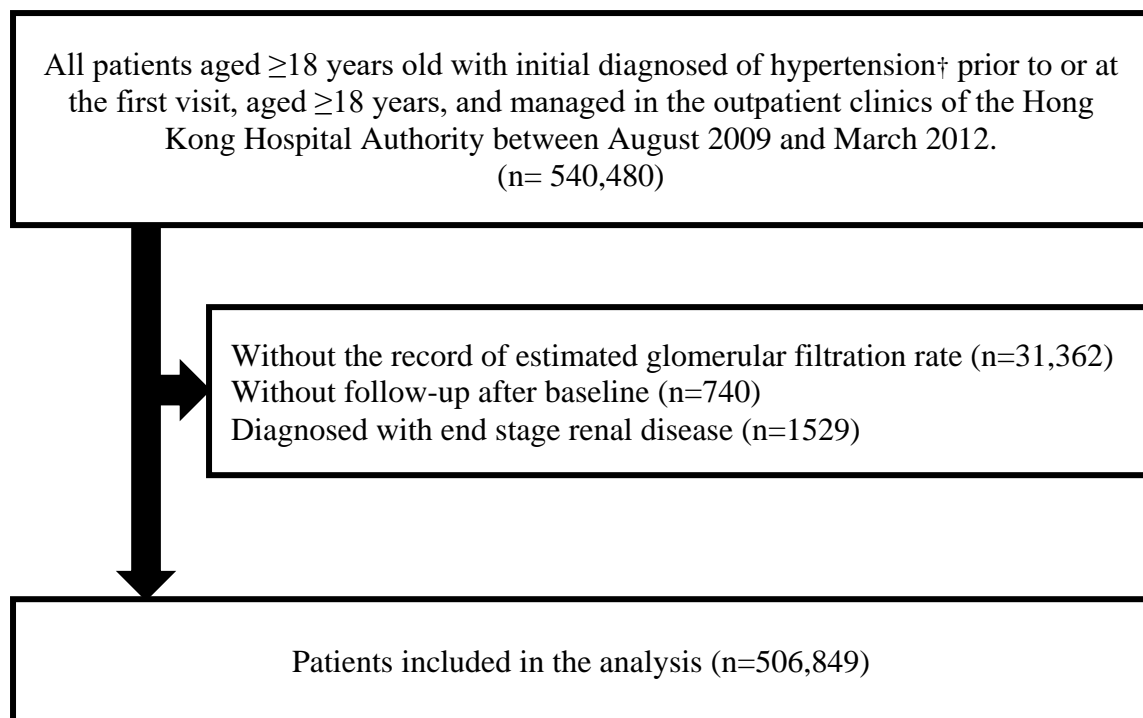
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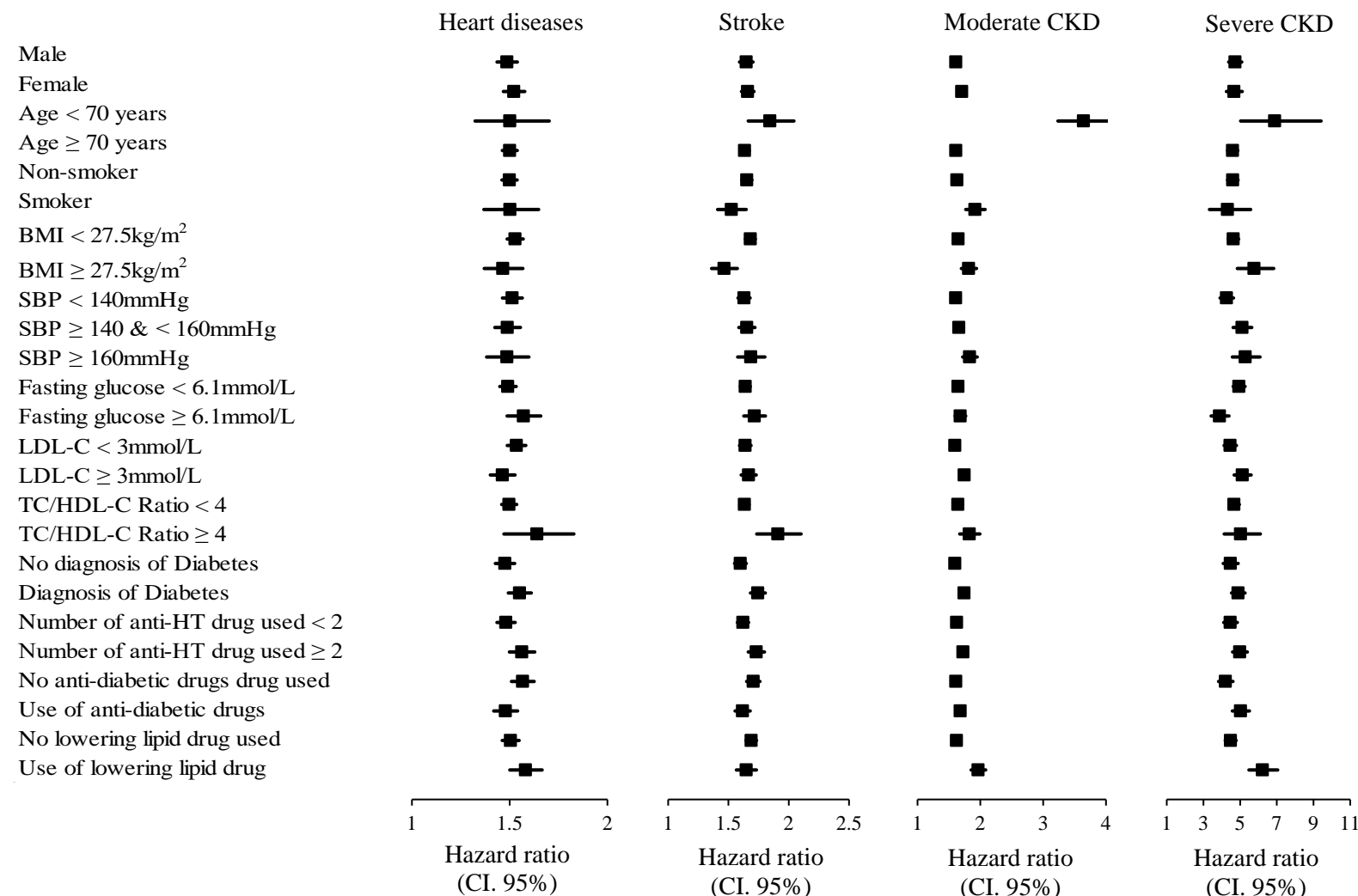
Supplement document

Supplementary Figure 1. Flow chart of patients

All patients aged ≥18 years old with initial diagnosed of hypertension† prior to or at the first visit, aged ≥18 years, and managed in the outpatient clinics of the Hong Kong Hospital Authority between August 2009 and March 2012.
(n= 540,480)

Without the record of estimated glomerular filtration rate (n=31,362)
Without follow-up after baseline (n=740)
Diagnosed with end stage renal disease (n=1529)

Patients included in the analysis (n=506,849)

† Patients diagnosed with HTN were defined using the International Classification of Primary Care-2 (ICPC-2) codes of 'K86' and 'K87', with the prescription of an anti-hypertensive drug, systolic blood pressure ≥ 140mmHg or diastolic blood pressure ≥ 90mmHg in the year prior to baseline, which was defined as the first date of attendance in the outpatient clinic during the inclusion period.

Supplementary Figure 2. Adjusted all-cause mortality hazard ratios of patients with vs. without heart disease, stroke, moderate CKD, and severe CKD in selected subgroups

CKD = Chronic Kidney Disease; BMI = Body Mass Index; SBP = Systolic Blood Pressure; LDL-C = Low Density Lipoprotein - Cholesterol; TC = Total Cholesterol; HDL-C = High Density Lipoprotein - Cholesterol; HT = Hypertension; CI = Confidence Interval;

Notes:

Heart diseases includes coronary heart disease and heart failure;

Moderate CKD: Estimated Glomerular Filtration Rate 30-59 ml/min/1.73 m^2, severe CKD: Estimated Glomerular Filtration Rate 15-29 ml/min/1.73 m^2

The p-values for all hazard ratios were <0.001 by multivariable Cox proportional hazard regression.

All hazard ratios were adjusted for age, gender, smoking status, systolic and diastolic blood pressure, low-density lipoprotein cholesterol, body mass index, total cholesterol to high-density lipoprotein ratio, triglyceride and fasting glucose, diagnosis of diabetes mellitus, use of diabetes drugs, number of antihypertensive drugs used and use of lipid drugs at baseline.

Supplementary table

Supplementary table 1. Definition of the diseases

Event		ICPC-2 codes	ICD-9-CM codes	eGFR (ml/min/1.73m^2)
HT		K86, K87	NA	NA
DM		T89, T90	NA	NA
Heart disease	CHD	K74-K76	410-414	NA
	Heart failure	K77	428	NA
Stroke		K89-K91	430-438	NA
Moderate CKD		NA	585.3	$\geq$ 30 & < 60
Severe CKD		NA	585.4	< 30

ICPC-2 = the International Classification of Primary Care-2; ICD-9-CM = the International Classification of Diseases, Ninth Edition, Clinical Modification; HT = Hypertension; DM = Diabetes Mellitus; CHD = Coronary heart disease; CKD = chronic kidney disease; eGFR = Estimated Glomerular Filtration Rate; NA = Not applicable;

Supplementary Table 2. Unit Costs of Public Health Services

Health Service / Cost	Cost (US$)	
	Eligible Persons†	Non-Eligible Persons†
GOPC	6 per visit	49 per visit
SOPC	First Attendance – 13 per visit Subsequent Attendance – 8 per visit Drug Charge per Item – 1 per visit	142 per visit
Allied Health Professionals	8 per visit	71 per visit
A&E	13 per visit	127 per visit
Hospitalization	13 per day	587 per day

Data source: 2013 HKSAR Government Gazette and hospital authority ordinance (chapter 113)
GOPC = General Out-patient Clinic; SOPC = Specialist Out-patient Clinics; A&E = Accident and Emergency;

Note:
† Only patients falling into the following categories are eligible for the rates of charges applicable to "Eligible Persons": (1) holders of Hong Kong Identity Card issued under the Registration of Persons Ordinance (Chapter 177), except those who obtained their Hong Kong Identity Card by virtue of a previous permission to land or remain in Hong Kong granted to them and such permission has expired or ceased to be valid; (2) children who are Hong Kong residents and under 11 years of age; or (3) other persons approved by the Chief Executive of the Hospital Authority. Persons who are not Eligible Persons are classified as Non-eligible Persons.

Supplementary Table 3. Data completion rates of baseline covariates of patients by disease status

Factor	Total (N = 506,849)	No CVD or moderate/severe CKD (N = 424,939)	Heart diseases (N = 28,858)	Stroke (N = 35,095)	Moderate CKD (N = 27,851)	Severe CKD (N = 1,876)
Socio-Demographic						
Gender	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Age	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Smoking Status	99.08%	99.42%	97.05%	97.01%	97.03%	89.98%
Clinical Characteristics						
SBP	99.63%	99.77%	98.43%	98.93%	99.03%	96.54%
DBP	99.63%	99.77%	98.43%	98.93%	99.03%	96.54%
LDL-C	90.54%	91.24%	89.40%	88.54%	81.77%	79.74%
TC/HDL-C Ratio	91.13%	91.87%	89.68%	88.79%	82.41%	80.06%
Triglyceride	91.41%	92.12%	90.06%	89.12%	82.92%	80.49%
BMI	75.61%	77.29%	66.77%	64.20%	66.42%	54.21%
Fasting Glucose	87.88%	88.18%	89.00%	87.87%	81.53%	82.57%
Diagnosis of Diabetes	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Use of anti-HT drugs	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Use of anti-diabetic drugs	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Use of lipid-lowering agent	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

CVD = Cardiovascular disease; CKD = Chronic kidney disease; SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure; LDL-C = Low Density Lipoprotein - Cholesterol; TC = Total Cholesterol; HDL-C = High Density Lipoprotein - Cholesterol; BMI = Body Mass Index; eGFR = Estimated Glomerular Filtration Rate; HT = Hypertension;
Note:
Patients had more than one clinically diagnosis of diseases (e.g. heart and stroke), and thus the sum of the patients in the table is not equal to the total of patients (506,849) in this study.
Heart diseases includes coronary heart disease and heart failure;
Moderate CKD: eGFR 30-59 ml/min/1.73 m^2, severe CKD: eGFR 15-29 ml/min/1.73 m^2

Supplementary Table 4. Adjusted hazard ratios of all-cause mortality by disease status at baseline

Disease Status at Baseline	N	Hazard Ratio (95% CI)			
		Age and Sex	Age, Sex, and Smoking	Age, Sex, Smoking, and Intermediate Risk Factors†	Age, Sex, Smoking, Intermediate Risk Factors, diagnosis of diabetes and medications‡
None of CVD or Moderate/Severe CKD	431,840	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Heart diseases	27,885	1.45 (1.42,1.49)	1.46 (1.42,1.50)	1.46 (1.43,1.50)	1.52 (1.48,1.55)
Stroke	21,394	1.69 (1.65,1.73)	1.68 (1.64,1.73)	1.65 (1.60,1.69)	1.71 (1.67,1.76)
Moderate CKD	20,590	1.75 (1.70,1.79)	1.74 (1.69,1.78)	1.75 (1.71,1.80)	1.72 (1.68,1.77)
Severe CKD	1,202	5.06 (4.78,5.35)	5.04 (4.76,5.33)	4.90 (4.63,5.20)	4.78 (4.51,5.07)
Stroke and Heart diseases	2,904	2.46 (2.37,2.54)	2.46 (2.37,2.54)	2.41 (2.32,2.49)	2.59 (2.50,2.69)
Heart diseases and Moderate CKD	3,299	2.54 (2.45,2.63)	2.54 (2.45,2.63)	2.57 (2.48,2.66)	2.61 (2.52,2.70)
Heart diseases and Severe CKD	330	7.35 (6.92,7.81)	7.36 (6.93,7.81)	7.17 (6.74,7.63)	7.25 (6.81,7.71)
Stroke and Moderate CKD	3,132	2.54 (2.43,2.66)	2.53 (2.42,2.65)	2.49 (2.38,2.61)	2.54 (2.42,2.66)
Stroke and Severe CKD	243	8.55 (8.04,9.09)	8.49 (7.98,9.02)	8.07 (7.58,8.60)	8.19 (7.68,8.73)
Stroke, Heart diseases and Moderate CKD	830	3.69 (3.51,3.89)	3.70 (3.51,3.89)	3.64 (3.46,3.84)	3.85 (3.65,4.06)
Stroke, Heart diseases and Severe CKD	101	12.42 (11.65,13.25)	12.39 (11.61,13.21)	11.81 (11.05,12.62)	12.41 (11.60,13.27)

CVD = Cardiovascular disease; CKD = Chronic Kidney Disease; CI = Confidence Interval;

Notes:
Heart diseases includes coronary heart disease and heart failure;
Moderate CKD: Estimated Glomerular Filtration Rate 30-59 ml/min/1.73 m^2, severe CKD: Estimated Glomerular Filtration Rate 15-29 ml/min/1.73 m^2
* Significant at 0.05 level by multivariable Cox proportional hazard regression adjusted with the interaction term between stroke and moderate CKD.
† Intermediate risk factors include systolic and diastolic blood pressure, low-density lipoprotein cholesterol, body mass index, total cholesterol to high-density lipoprotein ratio, triglyceride and fasting glucose at baseline.
‡ Diagnosis of diabetes and medications include number of antihypertensive drugs used, use of antidiabetic drugs and lipid drugs at baseline.

Supplementary Table 5. Multiplier of annual public direct medical cost by disease status at baseline

Disease Status at Baseline	N	Multiplier (95% CI)			
		Age and Sex	Age, Sex, and Smoking	Age, Sex, Smoking, and Intermediate Risk Factors†	Age, Sex, Smoking, Intermediate Risk Factors, diagnosis of diabetes and medications‡
None of CVD or Moderate/Severe CKD	431,840	1 (Reference)	1 (Reference)	1 (Reference)	1 (Reference)
Heart diseases	27,885	1.55 (1.49,1.62)	1.55 (1.49,1.62)	1.49 (1.43,1.55)	1.53 (1.47,1.59)
Stroke	21,394	1.70 (1.64,1.77)	1.70 (1.63,1.76)	1.65 (1.59,1.71)	1.70 (1.64,1.76)
Moderate CKD	20,590	1.96 (1.87,2.04)	1.95 (1.86,2.03)	1.89 (1.81,1.97)	1.86 (1.78,1.94)
Severe CKD	1,202	4.15 (3.58,4.81)	4.13 (3.57,4.79)	3.95 (3.41,4.57)	3.86 (3.34,4.47)
Stroke and Heart diseases	2,904	2.64 (2.50,2.79)	2.64 (2.50,2.78)	2.45 (2.32,2.59)	2.60 (2.46,2.75)
Heart diseases and Moderate CKD	3,299	3.04 (2.87,3.22)	3.02 (2.86,3.20)	2.81 (2.65,2.97)	2.84 (2.68,3.00)
Heart diseases and Severe CKD	330	6.45 (5.54,7.50)	6.43 (5.52,7.48)	5.87 (5.05,6.82)	5.91 (5.08,6.86)
Stroke and Moderate CKD	3,132	2.56 (2.32,2.84)	2.56 (2.31,2.84)	2.44 (2.20,2.69)	2.46 (2.22,2.72)
Stroke and Severe CKD	243	7.06 (6.06,8.22)	7.01 (6.02,8.17)	6.51 (5.60,7.56)	6.56 (5.64,7.62)
Stroke, Heart diseases and Moderate CKD	830	3.98 (3.58,4.44)	3.98 (3.57,4.44)	3.62 (3.25,4.03)	3.76 (3.38,4.18)
Stroke, Heart diseases and Severe CKD	101	10.97 (9.39,12.82)	10.90 (9.33,12.74)	9.67 (8.29,11.29)	10.03 (8.60,11.71)

CVD = Cardiovascular disease; CKD = Chronic Kidney Disease; CI = Confidence Interval; SD = Standard Deviation;

Notes:
Heart diseases includes coronary heart disease and heart failure;
Moderate CKD: Estimated Glomerular Filtration Rate 30-59 ml/min/1.73 m^2, severe CKD: Estimated Glomerular Filtration Rate 15-29 ml/min/1.73 m^2
The p-values for all multiplier were <0.001 by generalized linear model with Gamma family and log link function.
† Intermediate risk factors include systolic and diastolic blood pressure, low-density lipoprotein cholesterol, body mass index, total cholesterol to high-density lipoprotein ratio, triglyceride and fasting glucose at baseline.
‡ Diagnosis of diabetes and medications include number of antihypertensive drugs used, use of antidiabetic drugs and lipid drugs at baseline.