Supplemental Online Content

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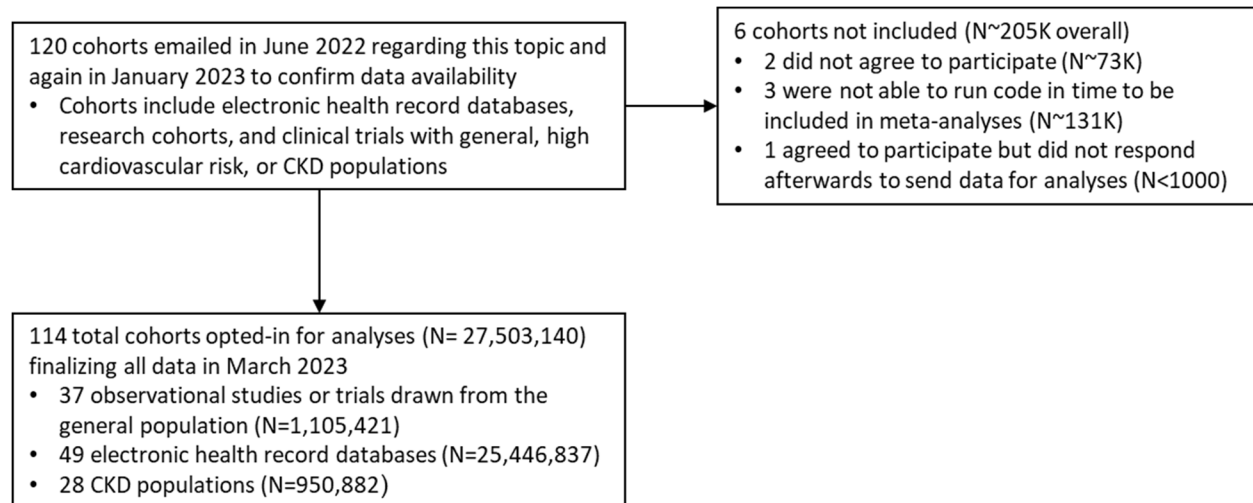
eReferences

This supplemental material has been provided by the authors to give readers additional information about their work.

eAppendix 1. Data analysis overview and analytic notes for some individual cohorts

1.1 Overview:
In order to determine the cohorts eligible for this paper, in June 2022 all cohorts in CKD-PC were contacted regarding their interest in this topic and in January 2023 cohorts were contacted to confirm availability of data.

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120 cohorts emailed in June 2022 regarding this topic and
again in January 2023 to confirm data availability
•  Cohorts include electronic health record databases,
   research cohorts, and clinical trials with general, high
   cardiovascular risk, or CKD populations
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6 cohorts not included (N~205K overall)
•  2 did not agree to participate (N~73K)
•  3 were not able to run code in time to be
   included in meta-analyses (N~131K)
•  1 agreed to participate but did not respond
   afterwards to send data for analyses (N<1000)
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114 total cohorts opted-in for analyses (N= 27,503,140)
finalizing all data in March 2023
•  37 observational studies or trials drawn from the
   general population (N=1,105,421)
•  49 electronic health record databases (N=25,446,837)
•  28 CKD populations (N=950,882)
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As previously described,[1] the collaborating cohorts were asked to compile a dataset with approximately 30 variables (main exposure [serum creatinine to estimate GFR, albuminuria, age, sex, race/ethnicity, history of cardiovascular diseases, smoking, diabetes, diabetes medications systolic blood pressure, antihypertensive medications, total cholesterol, HDL cholesterol, use of statins, BMI], outcome [all-cause mortality, cardiovascular mortality, myocardial infarction, stroke, heart failure, peripheral artery disease, atrial fibrillation, kidney failure with replacement therapy, acute kidney injury, hospitalizations]).

To be consistent across cohorts, the CKD-PC Data Coordinating Center sent definitions for those medical history variables to participating cohorts (outlined below). We instructed studies not to impute any variables and let us know of any differences in definitions.

Medical history variable	Definition
History of cardiovascular disease (CVD)	Prior diagnosis of CVD based on myocardial infarction, bypass grafting, percutaneous coronary intervention, heart failure, or stroke. Identification at any time during study period (from baseline to follow-up).
History of coronary heart disease (CHD)	Prior diagnosis of CHD based on myocardial infarction, bypass grafting, percutaneous coronary intervention. Identification at any time during study period (from baseline to follow-up).
History of heart failure (HF)	Prior diagnosis of heart failure. Identification at any time during study period (from baseline to follow-up).
History of stroke	Prior diagnosis of stroke. Identification at any time during study period (from baseline to follow-up).
History of atrial fibrillation (Afib)	Prior diagnosis of atrial fibrillation. Identification at any time during study period (from baseline to follow-up).
History of peripheral artery disease (PAD)	Prior diagnosis of peripheral artery disease. Identification at any time during study period (from baseline to follow-up).
Diabetes mellitus	Glycated hemoglobin A1c $\geq$6.5% or fasting glucose $\geq$7.0 mmol/L ($\geq$126 mg/dL) or non-fasting glucose $\geq$11.1 mmol/L ($\geq$200 mg/dL) or use of glucose lowering drugs (ADA 2010 criteria). Self-report of physician diagnosed diabetes can be included. Identification at any time during study period (from baseline to follow-up).

Hypertension	Systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg or antihypertensive drugs (JNC-7 criteria). Self-reported hypertension if other data not available. Identification at any time during study period (from baseline to follow-up).
History of cancer	Prior diagnosis of any cancer. Identification at any time during study period (from baseline to follow-up).
History of liver disease	Prior diagnosis of liver disease. Identification at any time during study period (from baseline to follow-up).
History of chronic obstructive pulmonary disease (COPD)	Prior diagnosis of COPD. Identification at any time during study period (from baseline to follow-up).

Outcome definitions below were provided to cohorts, cohort deviations from these definitions listed in the analytic notes for each cohort.

Outcome	Definition
All-cause mortality	Death
Cardiovascular mortality	Death due to CVD
Myocardial infarction	First incidence of myocardial infarction or fatal myocardial infarction
Stroke	First incidence of stroke (ischemic or hemorrhagic) or fatal stroke
Heart Failure	First hospitalization or death due to heart failure
Peripheral artery disease	First incidence of peripheral artery disease based on your study definition
Atrial fibrillation	First incidence of atrial fibrillation
Kidney failure with replacement therapy	Initiation of dialysis or transplantation
Acute kidney injury	First hospitalization of acute kidney injury
Hospitalizations	First hospitalization after baseline

ICD codes used to define outcomes within cohorts, if not specified in analytic notes

Outcome	ICD-9 codes	ICD-10 codes
Cardiovascular mortality	401-414, 426-443 (excluding 426.7, 429.0, 430, 432.1, 437.3, 437.4, 437.5)	I10-I25, I44-I73 (excluding I45.6, I51.4, I60, I62.0, I67.1, I67.5, I67.7)
Myocardial infarction (MI)	410	I21, I22
Stroke	431, 432, 433.x1, 434.x1	I61, I62, I63
Heart failure	428	I50
Peripheral artery disease	440.2, 440.3, 440.4, 38.18, 39.25, 39.29, 39.50, 84.1	I70.2, I70.3, I70.4, I70.5, I70.92, 031, 041, 047, 04B, 04C, 04H, 04R, 04U, 0Y6
Atrial fibrillation	427.3	I48
Acute kidney injury	584	N17

The CKD-PC data request and processing procedures are as follows. After obtaining opt-in preferences from cohorts for the topics for each phase, the Data Coordinating Center (DCC) requests de-identified data using a specific data request document describing the variables and preferred definitions needed for the current phase of the CKD-PC. Cohorts work with the DCC on any data use agreements, IRB approvals, and other logistic issues for de-identified data transfer. The DCC also advises on any differences in definitions or questions on data formatting. Cohorts then provide de-identified data (in whatever program format, e.g., Stata, SAS, csv) via a secure data transfer provided or their own secure transfer program/platform. Data is stored on a secure password protected network server that is only accessed by limited faculty and staff (<10). All those faculty and staff have completed HIPAA and CITI certification and have signed internal data use agreements to not use the data for any other than stated purposed and to not remove the data from that network drive. The CKD-PC does not share data with any external parties. Once data is received and stored in the network drive, the DCC programmer reviews the data and the data dictionary provided by the cohort to check for any missing information, outliers, and potentials issues with variable units, dates, etc. Any questions are sent to the cohort representatives for data checking and cleaning. Further data checking is done throughout the analysis process for each CKD-PC paper, including a review from a cohort representative of all tables and figures to confirm their cohort representation.

For 98 of the 114 cohorts in this specific study, the DCC at Johns Hopkins University conducted the analysis; the remainder ran the standard code written in Stata by the DCC and shared the output with the DCC. As in the data processing procedures above, the DCC works with the cohort to confirm the variable definitions and data formatting to prepare for the code. The standard code was designed to automatically save all estimates and variance-covariance matrices needed for the meta-analysis. Then the DCC meta-analyzed the estimates across cohorts using Stata.

As detailed in our previous reports,[2,3] each cohort was instructed to standardize their serum creatinine and report its method when available. The reported creatinine standardization allows grouping studies into studies that reported using a standard IDMS traceable method or conducted some serum creatinine standardization to IDMS traceable methods (ARIC, AusDiab, BIS, CanPREDDICT , CKD-JAC, CKD-REIN, COBRA, CRIC, ESTHER, GCKD, Geisinger, GLOMMS, Go-DARTS, Gubbio, ICES-KDT, ICKD, LCC, JHS, Maccabi, MASTERPLAN, MMKD, Nanjing CKD, NEPHROTEST, NHANES, Okinawa, PREVEND, PSPA, Rancho Bernardo, RCAV, REGARDS, SCREAM, SKS, SEED, SRR-CKD, STOP-CKDu, Takahata, West of Scotland, UK Biobank) and studies where the creatinine standardization was not done (AASK, ADVANCE, Aichi, CARE, BC CKD, Beijing, China NS, CHS, CIRCS, CRIB, Framingham, KP Hawaii, MDRD, MESA, MRC, NEFRONA, NIPPON DATA80/90, Ohasama, Pima, PSP-CKD, RENAAL, SMART, Sunnybrook, Taiwan MJ, TLGS, ULSAM, ZODIAC). For those cohorts without standardization, the creatinine levels were reduced by 5%, the calibration factor used to adjust non-standardized MDRD Study samples to IDMS.[2,4]. We did not adjust creatinine levels in those studies with unknown standardization status (CURE-CKD, Gonryo, Hong Kong CKD, JMS, J-SHC, Mt Sinai BioMe, SHARP, NRHP-URU, YWSCC, and OLDW all cohorts).

Serum cystatin C values were calibrated and/or standardized to International Federation for Clinical Chemists (IFCC) reference (Inker et al., 2011; Grubb et al., 2010).[5,6] Cohort details below:

Cohort	Notes including if a calibration equation was applied
ARIC	IFCC Cystatin C = 1.12*(0.083+0.914*(ARIC cystatin C))
AUSDIAB	IFCC Cystatin C = 1.12*(-0.25+1.07*(AusDiab cystatin C))
BIS	ERM-DA471/IFCC Standardized assay
CHS	IFCC= 1.12*(0.083+0.789*(CHS cystatin C))
ESTHER	IFCC= 1.12*(0.105+0.848*(ESTHER cystatin C))
FRAMINGHAM	IFCC= 1.12*(0.083+0.789*(Framingham cystatin C))
MESA	IFCC= 1.12*(0.083+0.789*(MESA cystatin C))
NHANES99-02	IFCC= 1.12*((NHANES1999-2002 cystatin C)-0.12)
PREVEND	IFCC= 1.12*(0.083+0.789*(PREVEND cystatin C))
REGARDS	Calibrated by primary study
SCREAM	Calibrated by primary study
UK BioBank	ERM-DA471/IFCC Standardized assay
ULSAM	IFCC= 1.12*(0.083+0.789*(ULSAM cystatin C))
AASK	IFCC= 1.12*(0.083+0.789*(AASK cystatin C))
CKD-Rein	ERM-DA471/IFCC Standardized assay
CRIB	IFCC= 1.12*(0.083+0.789*(CRIB cystatin C))
CRIC	Calibrated by primary study
GCKD	ERM-DA471/IFCC Standardized assay
MASTERPLAN	IFCC=1.12*(MASTERPLAN cystatin C))
MDRD	IFCC=1.12*(0.083+0.789*(MDRD cystatin C))

We calculated eGFR using the 2021 CKD-EPI creatinine and the 2021 CKD-EPI creatinine-cystatin C equations,[7] as follows:

Sex	Serum Creatinine (mg/dL)	Serum Cystatin C (mg/L)	Equation
CKD-EPI creatinine equation			
Female	≤0.7		GFR= 142 x (Scr/0.7)$^{-0.241}$ x 0.9938^{Age}
	>0.7		GFR= 142 x (Scr/0.7)$^{-1.200}$ x 0.9938^{Age}
Male	≤0.9		GFR= 142 x (Scr/0.9)$^{-0.302}$ x 0.9938^{Age}
	>0.9		GFR= 142 x (Scr/0.9)$^{-1.200}$ x 0.9938^{Age}
CKD-EPI creatinine-cystatin C equation			
Female	≤0.7	≤0.8	GFR= 135 x (Scr/0.7)$^{-0.219}$ x (Scys/0.8)$^{-0.323}$ x 0.9961^{Age} x 0.963
		>0.8	GFR= 135 x (Scr/0.7)$^{-0.544}$ x (Scys/0.8)$^{-0.778}$ x 0.9961^{Age} x 0.963
	>0.7	≤0.8	GFR= 135 x (Scr/0.7)$^{-0.219}$ x (Scys/0.8)$^{-0.323}$ x 0.9961^{Age} x 0.963
		>0.8	GFR= 135 x (Scr/0.7)$^{-0.544}$ x (Scys/0.8)$^{-0.778}$ x 0.9961^{Age} x 0.963
Male	≤0.9	≤0.8	GFR= 135 x (Scr/0.9)$^{-0.144}$ x (Scys/0.8)$^{-0.323}$ x 0.9961^{Age}
		>0.8	GFR= 135 x (Scr/0.9)$^{-0.544}$ x (Scys/0.8)$^{-0.778}$ x 0.9961^{Age}
	>0.9	≤0.8	GFR= 135 x (Scr/0.9)$^{-0.144}$ x (Scys/0.8)$^{-0.323}$ x 0.9961^{Age}
		>0.8	GFR= 135 x (Scr/0.9)$^{-0.544}$ x (Scys/0.8)$^{-0.778}$ x 0.9961^{Age}

The selection of knots for eGFR and urine albumin-to-creatinine ratio was based on clinical thresholds.[8] Baseline for each study was considered first available creatinine unless otherwise noted. Other variables were taken either on baseline date or within one year before baseline date.

Each analysis was performed separately within each cohort. The models were adjusted for the following variables:

Outcome	Model adjustment variables
All-cause mortality	Age, sex, smoking status (current, former, never), systolic blood pressure, body-mass index, use of anti-hypertensive medications, and a medical history of diabetes, coronary heart disease, stroke, heart failure, atrial fibrillation, peripheral artery disease, cancer, and chronic obstructive pulmonary disease
Cardiovascular mortality	Age, sex, smoking status (current, former, never), systolic blood pressure, total cholesterol, high-density lipoprotein cholesterol, body-mass index, use of anti-hypertensive medications, and a medical history of diabetes, coronary heart disease, stroke, heart failure, atrial fibrillation, peripheral artery disease, cancer, and chronic obstructive pulmonary disease
Myocardial infarction	Age, sex, smoking status (current, former, never), systolic blood pressure, total cholesterol, high-density lipoprotein cholesterol, body-mass index, use of anti-hypertensive medications, and a medical history of diabetes, stroke, heart failure, atrial fibrillation, peripheral artery disease, cancer, and chronic obstructive pulmonary disease
Stroke	Age, sex, smoking status (current, former, never), systolic blood pressure, total cholesterol, high-density lipoprotein cholesterol, body-mass index, use of anti-hypertensive medications, and a medical history of diabetes, coronary heart disease, heart failure, atrial fibrillation, peripheral artery disease, cancer, and chronic obstructive pulmonary disease
Heart Failure	Age, sex, smoking status (current, former, never), systolic blood pressure, total cholesterol, high-density lipoprotein cholesterol, body-mass index, use of anti-hypertensive medications, and a medical history of diabetes, coronary heart disease, stroke, atrial fibrillation, peripheral artery disease, cancer, and chronic obstructive pulmonary disease

Peripheral artery disease	Age, sex, smoking status (current, former, never), systolic blood pressure, total cholesterol, high-density lipoprotein cholesterol, body-mass index, use of anti-hypertensive medications, and a medical history of diabetes, coronary heart disease, stroke, heart failure, atrial fibrillation, cancer, and chronic obstructive pulmonary disease
Atrial fibrillation	Age, sex, smoking status (current, former, never), systolic blood pressure, total cholesterol, high-density lipoprotein cholesterol, body-mass index, use of anti-hypertensive medications, and a medical history of diabetes, coronary heart disease, stroke, heart failure, peripheral artery disease, cancer, and chronic obstructive pulmonary disease
Kidney failure with replacement therapy	Age, sex, smoking status (current, former, never), systolic blood pressure, body-mass index, use of anti-hypertensive medications, and a medical history of diabetes, coronary heart disease, stroke, heart failure, atrial fibrillation, peripheral artery disease, cancer, and chronic obstructive pulmonary disease
Acute kidney injury	Age, sex, smoking status (current, former, never), systolic blood pressure, body-mass index, use of anti-hypertensive medications, and a medical history of diabetes, coronary heart disease, stroke, heart failure, atrial fibrillation, peripheral artery disease, cancer, and chronic obstructive pulmonary disease
Hospitalizations	Age, sex, smoking status (current, former, never), systolic blood pressure, body-mass index, use of anti-hypertensive medications, and a medical history of diabetes, coronary heart disease, stroke, heart failure, atrial fibrillation, peripheral artery disease, cancer, and chronic obstructive pulmonary disease

Within each cohort, if a variable was missing more than 50% or not available, the variable was not included in the model. For variables that were missing <50% of the time, missing values were imputed with the mean.

By definition, age, sex, and eGFR were never missing.

Because albuminuria was a main exposure, different criteria were used. If albuminuria was missing <10%, complete case analysis was performed. Otherwise, missing albuminuria was analyzed as a separate "dummy" category. For estimation of hazard ratios in meta-analysis, the missing category was meta-analyzed only for EHR cohorts.

Details of missingness in each cohort are provided in the supplement Table S1.

1.2 Notes for individual cohorts:

Cohort	Study Design	Baseline Year(s)	Albuminuria type(s)*	Cystatin C available	Specific notes, including outcome ascertainment
General and High-Risk Cohorts					
ADVANCE	Clinical trial cohort	2001-03	ACR	No	This study is a clinical trial which includes participants with diabetes only. All outcomes were actively ascertained and verified by an adjudication committee blinded to the randomized treatment.
Aichi	Worker health checkup database	2002-03	Dipstick	No	Reports from the worksite's healthcare division, and self-report with or without hospital records review were used to ascertain cardiovascular diseases incidence. The former and the reports of the next of kin were used to ascertain mortality.
ARIC	Research Cohort	1996-98	ACR	Yes	Visit 4 was used as the baseline. Kidney failure replacement therapy was ascertained through linkage to the USRDS.[9] All-cause mortality was actively ascertained as well as through linkage to a registry. Cardiovascular mortality was ascertained through review of ICD codes.
AusDiab	Research Cohort	1999-2000	ACR	Yes	Linkage to National Death Index for all-cause mortality and other fatal outcomes.
Beijing	Research Cohort	2004	ACR	No	All-cause mortality was actively ascertained.
BIS	Research Cohort	2009-11	ACR,	No	Kidney failure replacement therapy was ascertained by self-report during follow-up and validated by health records. All-cause mortality was actively ascertained through information of the insurance company and death certificates. Cardiovascular mortality was ascertained through death certificates. All other outcomes were self-reported.
CARE	Clinical trial cohort	1989-90	Dipstick	No	All outcomes were actively ascertained by an independent review committee.
China NS	Research cohort	2006-10	ACR	No	All-cause mortality was actively ascertained. Cardiovascular mortality was ascertained from medical chart review of death due to CHD or stroke.
CHS	Research Cohort	1996-97	ACR	Yes	Kidney failure replacement therapy was ascertained through linkage to a registry. All-cause mortality was actively ascertained. Cardiovascular mortality was

Cohort	Study Design	Baseline Year(s)	Albuminuria type(s)*	Cystatin C available	Specific notes, including outcome ascertainment
					ascertained through review of autopsies, death certificates, hospitalization records, and physician notes by the CHS Events Committee.
CIRCS	Research Cohort	1986-93	Dipstick	No	All-cause mortality was actively ascertained. Cardiovascular mortality was ascertained from medical chart review of fatal CHD or death within 30 days of an incident stroke. MI was ascertained by chart review. Stroke was ascertained by a physician panel reviewing medical charts and CT/MRI images for most cases.
COBRA	Research Cohort	2004-05	ACR	No	This study had no separate history of CHD, thus all participants with history of CVD were excluded from any of the analyses of CVD outcomes. Ascertainment of mortality and CVD mortality in COBRA was via active follow-up of participants and review of records (not linked registry).
ESTHER	Research Cohort	2000-02	Dipstick	Yes	All outcomes were actively ascertained by questionnaires sent to the study participants and their general practitioners 2, 5, 8, 11 and 14 years after the cohort's baseline assessment. In addition, fatal disease events were ascertained by a mortality register and ICD-10 codes of the leading cause of death on the death certificate.
Framingham	Research Cohort	1981-86	ACR	Yes	All outcomes from medical record review.
Geisinger	Healthcare administrative database	2008-19	ACR, PCR, Dipstick	No	Kidney failure replacement therapy was ascertained through linkage to a registry. No cause of death information available. Cardiovascular mortality was defined by any hospitalization with related ICD codes and died within 30 days. Baseline index date was set as the earliest date of a serum creatinine measurement after 2008 and at least one year after enrollment.
GLOMMS	Clinical database	2010-19	ACR, PCR	No	Kidney failure replacement therapy was ascertained through linkage to a registry. Baseline index date was set as the earliest date of a serum creatinine at least one year after enrollment.
Go-DARTs	Research cohort	2004-12	ACR	No	Kidney failure replacement therapy was ascertained through linkage to the Scottish Renal Registry plus eGFR<15 on two occasions at least 90 days apart. Baseline

Cohort	Study Design	Baseline Year(s)	Albuminuria type(s)*	Cystatin C available	Specific notes, including outcome ascertainment
					index date was set as the earliest date of a serum creatinine measurement at least one year after enrollment.
Gubbio	Research Cohort	1988-92	ACR	No	All outcomes were actively ascertained. Cardiovascular mortality was ascertained via ICD codes for MI based on hospital diagnoses or death certificates.
ICES-KDT	Healthcare administrative database	2008-17	ACR, PCR, Dipstick	No	Kidney failure replacement therapy was ascertained through linkage to a registry and ICD codes. Baseline index date was set as the earliest date of a serum creatinine measurement at least one year after enrollment.
JHS	Research Cohort	2000-04	ACR	No	All-cause mortality and cardiovascular mortality and events were ascertained through active follow-up in annual follow-up phone calls as well as review of medical records for hospitalizations. Cardiovascular events are validated and adjudicated.
JMS	Research Cohort	1992-95	Dipstick	No	
J-SHC	Health checkup database	2008	Dipstick	No	To ascertain all-cause mortality, in each district, used the birth date, sex, death date, and address code to identify the subject in both the National database of death certificates and National Health Insurance agency. If not clear in that first step, as the study does not have names, they asked for help from public health nurses in each district to confirm deaths. The study does not have the name in both databases, but the public health nurse has both information such as who participated and who died after the screening. Final data was verified by Chiho Iseki, Okinawa Heart and Renal Association. Cardiovascular mortality was ascertained using ICD-10 codes for cause of death.
KP Hawaii	Clinical database	2005-09	PCR	No	Kidney failure replacement therapy was actively ascertained.
Maccabi	Healthcare administrative database	2008-17	ACR	No	Urine albumin-to-creatinine ratio measures above 300 were imputed by PCR measures. First creatinine after 2008 was selected. Kidney failure replacement therapy was actively ascertained. No cause of death information available. Cardiovascular mortality was defined by any hospitalization with related ICD codes and died within 30 days. Baseline index date was set as the earliest date of a

Cohort	Study Design	Baseline Year(s)	Albuminuria type(s)*	Cystatin C available	Specific notes, including outcome ascertainment
					serum creatinine measurement after 2008 and at least one year after enrollment.
MESA	Research cohort	2000-02	ACR	Yes	All participants free from previous cardiovascular disease at baseline. There was no information of kidney failure replacement therapy in this study. All-cause mortality was actively ascertained. Cardiovascular mortality was ascertained through review of hospital records or, for participants who experienced out-of-hospital cardiovascular deaths, review of interviews with next of kin and physicians by the MESA morbidity and mortality review committee.
MRC	Research cohort	1995-99	Dipstick	No	Outcomes were ascertained through linkage with national death and hospitalization records.
Mt Sinai BioMe	Clinical database	2008-15	ACR, PCR	No	Kidney failure replacement therapy was ascertained through ICD codes. Cardiovascular events were ascertained from ICD codes at hospital discharge. No mortality information available. Baseline index date was set as the earliest date of a serum creatinine measurement after 2008 and at least one year after enrollment.
NHANES	Research cohort	1988-2014	ACR	Yes	The information of kidney failure replacement therapy is not available in for this analysis. All-cause mortality was ascertained through linkage to National Death Index files. Cardiovascular mortality was ascertained by ICD codes.
NIPPON DATA80	Research cohort	1980	Dipstick	No	Cardiovascular mortality was ascertained by ICD codes from death certificates.
NIPPON DATA90	Research cohort	1990	Dipstick	No	Cardiovascular mortality was ascertained by ICD codes from death certificates.
Ohasama	Research cohort	1992-2011	Dipstick	No	All-cause mortality was actively ascertained. Cardiovascular mortality was ascertained from ICD codes for fatal CHD or fatal stroke. Stroke included fatal stroke from ICD codes and ischemic and hemorrhagic stroke adjudicated by a physician panel.
Okinawa	Health screening	1993-94	Dipstick	No	Kidney failure replacement therapy was ascertained through linkage to a registry.
OLDW	Healthcare administrative database	2012-2021	ACR, PCR, Dipstick	No	This study used de-identified electronic health record (EHR) data from the Optum Labs Data Warehouse (OLDW). The database contains longitudinal health information on enrollees and patients, representing a

Cohort	Study Design	Baseline Year(s)	Albuminuria type(s)*	Cystatin C available	Specific notes, including outcome ascertainment
					diverse mixture of ages, ethnicities and geographical regions across the United States. The EHR-derived data includes a subset of EHR data that has been normalized and standardized into a single database.[10] Cohort inclusion criteria was more than 50 events of any outcome before excluding missing values of main exposure variables. Smoking status might be under measured in this study. All outcomes were defined by ICD codes from encounters. No cause of death information available. Cardiovascular mortality was defined by any hospitalization with related ICD codes and died within 30 days. Baseline index date was set as the earliest date of a serum creatinine measurement after 2008 and at least one year after enrollment.
Pima	Research cohort	1982-2007	ACR	No	All-cause mortality was ascertained by linkage to the National Death Index. Cardiovascular mortality was adjudicated by review of all available clinical records and the ICD codes from the death certificate. Kidney failure replacement therapy was ascertained through review of clinical records.
PREVEND	Research cohort	1997-98	ACR	Yes	All-cause mortality was ascertained by linkage to a death registry. Cardiovascular mortality was ascertained by ICD codes from the death registry. Cardiovascular events were ascertained by ICD codes at hospital discharge.
Rancho Bernardo	Research cohort	1992-96	ACR	No	All-cause mortality was ascertained by linkage to a death registry. Cardiovascular mortality was ascertained by ICD codes from the death registry. Non-fatal cardiovascular events were ascertained by participant self-report.
RCAV	Healthcare administrative database	2004-2011	ACR, PCR	No	Kidney failure replacement therapy was ascertained through linkage to a registry. All other outcomes were defined by ICD codes from encounters. No cause of death information available. Cardiovascular mortality was defined by any hospitalization with related ICD codes and died within 30 days. Baseline index date was set as the earliest date of a serum creatinine at least one year after enrollment.

Cohort	Study Design	Baseline Year(s)	Albuminuria type(s)*	Cystatin C available	Specific notes, including outcome ascertainment
REGARDS	Research cohort	2003-07	ACR	Yes	Kidney failure replacement therapy was ascertained through linkage to USRDS.[9] All-cause mortality was actively ascertained. Cardiovascular mortality was ascertained through death certificates, medical records, and autopsy reports obtained to adjudicate cause of death.
SCREAM	Clinical database	2008-18	ACR, Dipstick	Yes	Kidney failure replacement therapy was actively ascertained through linkage to a registry that validates these endpoints through medical record comparison. All other non-mortality outcomes were defined by ICD codes from encounters. Baseline index date was set as the earliest date of a serum creatinine measurement after 2008 and at least one year after enrollment.
SEED	Research cohort	2004-11	ACR	No	All-cause mortality, cardiovascular mortality, acute myocardial infarction, stroke and kidney failure replacement therapy were ascertained by linkage to National Disease Registry and Death Registry.
SHARP	Clinical trial cohort	2003-2007	ACR	No	All outcomes were actively ascertained.
SMART	Research cohort	1996-2018	ACR	No	Kidney failure replacement therapy was actively ascertained (with chart validation). All-cause mortality was actively ascertained. Cardiovascular outcomes were adjudicated by a physician panel.
STOP-CKDu	Research cohort	2018	PCR	No	All-cause mortality was ascertained through active participant contact, medical record review, and verbal autopsy.
Taiwan MJ	Research cohort	1994-2011	Dipstick	No	Cardiovascular mortality was ascertained from ICD codes.
Takahata	Research cohort	2004	ACR, PCR, Dipstick	No	Cardiovascular mortality was ascertained from ICD codes from death certificates.
TLGS	Research cohort	1999-2001	Dipstick	No	Cardiovascular mortality was ascertained by cause of death adjudicated by a physician panel.
UK BioBank	Clinical database	2007-10	ACR	Yes	All-cause mortality was ascertained by linkage to a death registry. Cardiovascular mortality was ascertained by ICD codes from the death registry. All other outcome events were ascertained by ICD codes at hospital discharge.
ULSAM	Research cohort	1991-95	ACR	Yes	All-cause mortality was ascertained by linkage to a death registry. Cardiovascular mortality was ascertained by ICD

Cohort	Study Design	Baseline Year(s)	Albuminuria type(s)*	Cystatin C available	Specific notes, including outcome ascertainment
					codes from the death registry. All other outcome events were ascertained by ICD codes at hospital discharge.
ZODIAC	Research cohort	1998-2002	ACR	No	Mortality was ascertained by coupling information with the official death registration in the Netherlands, and where possible, ascertained cause of death with the GPs.
CKD Cohorts					
AASK	Clinical trial cohort	1995-98	PCR	Yes	This study only had black participants. Kidney failure replacement therapy and all-cause mortality were actively ascertained. There was no information of cardiovascular mortality.
BC CKD	Clinical database	2012	ACR, PCR	No	Kidney failure replacement therapy was actively ascertained.
CanPREDDICT	Research cohort	2008	ACR, PCR	No	Kidney failure replacement therapy was actively ascertained.
CKD-JAC	Research cohort	2007-08	ACR, PCR	No	All outcomes were actively ascertained. Cardiovascular events were adjudicated by an independent committee.
CKD-REIN	Research cohort	2013-15	ACR, PCR	Yes	All outcomes were actively ascertained. Furthermore, kidney failure with replacement therapy and all-cause mortality were also ascertained through linkage with national registries. Cardiovascular deaths were adjudicated by 2 cardiologists.
CRIB	Research cohort	1996-98	ACR, Dipstick	Yes	Kidney failure replacement therapy was actively ascertained (with chart validation).
CRIC	Research cohort	2003-08	ACR, PCR	Yes	Kidney failure replacement therapy was actively ascertained with chart validation as well as through linkage to a registry. All-cause mortality was actively ascertained as well as through linkage to a registry. Cardiovascular mortality was ascertained through adjudicated chart review.
CURE-CKD	Healthcare administrative database	2007-17	ACR, PCR	No	All outcomes were ascertained from ICD codes.
GCKD	Research Cohort	2010-12	ACR	Yes	All outcomes were actively ascertained (with confirmation in medical chart review).
Gonryo	Research Cohort	2006-08	PCR, Dipstick	No	All outcomes were actively ascertained.

Cohort	Study Design	Baseline Year(s)	Albuminuria type(s)*	Cystatin C available	Specific notes, including outcome ascertainment
Hong Kong CKD	Clinical database	2007-12	PCR	No	All outcomes were actively ascertained. Cardiovascular events and mortality were adjudicated by a physician panel.
ICKD	Research Cohort	2013-19	ACR	No	All outcomes were actively ascertained through direct contact with participants and medical record review.
LCC	Clinical database	2011	ACR, PCR	No	All-cause mortality was ascertained from medical records. All other outcomes ascertained through ICD codes from hospital discharge.
MASTERPLAN	Clinical trial cohort	2004-05	ACR, PCR	Yes	All outcomes were actively ascertained.
MDRD	Clinical trial cohort	1989-91	PCR	Yes	Kidney failure replacement therapy and all-cause mortality were actively ascertained as well as through linkage to a registry. Cardiovascular mortality was ascertained through review of ICD codes. Due to super low eGFR in this study, eGFR was modeled as linear term without knot.
MMKD	Research cohort	1997-98	PCR	No	Kidney failure replacement therapy was actively ascertained.
Nanjing CKD	Research cohort	2003-15	PCR, Dipstick	No	All outcomes were actively ascertained.
NEFRONA	Research cohort	2009-12	ACR, PCR	No	Participants free from previous cardiovascular disease at baseline. Cardiovascular events were ascertained by ICD codes from referring physicians.
NephroTest	Research cohort	2000-12	ACR, PCR	No	All-cause mortality and cardiovascular mortality and events were actively ascertained. Kidney failure replacement therapy was ascertained through linkage to a registry.
NRHP-URU	Clinical database	2001-14	ACR, PCR, Dipstick	No	Kidney failure replacement therapy was ascertained through linkage to a registry.
PSP-CKD	Clinical database	2010-13	ACR, PCR, Dipstick	No	All-cause mortality was ascertained from medical records. All other outcomes ascertained through ICD codes from hospital discharge.
PSPA	Research cohort	2009-10	PCR	No	Kidney failure replacement therapy was actively ascertained as well as through linkage to a registry. All-cause and cardiovascular mortality were actively ascertained.
RENAAL	Clinical trial cohort	1996-98	ACR	No	All outcomes were actively ascertained (with physician panel adjudication).
SKS	Research cohort	2002-16	PCR	No	All outcomes were actively ascertained (with physician panel adjudication).

Cohort	Study Design	Baseline Year(s)	Albuminuria type(s)*	Cystatin C available	Specific notes, including outcome ascertainment
SRR-CKD	Renal registry	2005-11	ACR	No	All-cause mortality was ascertained from medical records. Kidney failure replacement therapy was ascertained through linkage to a registry.
Sunnybrook	Clinical database	2001-10	ACR, PCR, Dipstick	No	Kidney failure replacement therapy was ascertained through linkage to a registry. All other outcomes ascertained through ICD codes from hospital discharge.
West of Scotland CKD	Clinical database	2009-18	ACR, PCR, Dipstick	No	Kidney failure replacement therapy, hospitalizations, myocardial infarction, stroke, heart failure, atrial fibrillation and peripheral arterial disease were actively ascertained and prospectively recorded by clinical staff in the renal electronic record. All-cause mortality was additionally ascertained by linkage to non-renal electronic health records.
YWSCC	Clinical database	2017	ACR, PCR, Dipstick	No	

*Type of albuminuria used in analyses with a preference for ACR. Does not necessarily indicate all types available within the cohort.

Appendix 2. Acronyms or abbreviations for cohorts included in the current study, investigators by cohort, and members of the CKD-PC steering committee and data coordinating center

General population and High Cardiovascular Risk Cohorts	
ADVANCE	The Action in Diabetes and Vascular Disease: Preterax and Diamicron Modified Release Controlled Evaluation (ADVANCE) trial[11]
Aichi	Aichi Workers' Cohort Study[12]
ARIC	Atherosclerosis Risk in Communities Study[13]
AusDiab	Australian Diabetes, Obesity, and Lifestyle Study[14]
Beijing	Beijing Cohort Study[15]
BIS	Berlin Initiative Study[16]
CARE	The Cholesterol and Recurrent Events (CARE) Trial[17]
China NS	The China National Survey of Chronic Kidney Disease
CHS	Cardiovascular Health Study[18]
CIRCS	Circulatory Risk in Communities Study[19]
COBRA	Control Of Blood Pressure and Risk Attenuation Study[20]
ESTHER	Epidemiologische Studie zu Chancen der Verhütung, Früherkennung und optimierten THerapie chronischer ERkrankungen in der älteren Bevölkerung [GERMAN][21]
Framingham	Framingham Heart Study[22]
Geisinger	Geisinger Health System[23]
GLOMMS	Grampian Laboratory Outcomes, Morbidity and Mortality Studies[24]
Go-DARTs	Genetics of Diabetes Audit and Research in Tayside Scotland[25]
Gubbio	Gubbio Study[26]
ICES-KDT	ICES, Provincial Kidney, Dialysis and Transplantation program (ICES KDT)[27]
JHS	Jackson Heart Study[28]
JMS	Jichi Medical School cohort
J-SHC	Japan Specific Health Checkups Study[29]
KP Hawaii	Kaiser Permanente Hawaii Cohort[30]
Maccabi	Maccabi Health System[31]
MESA	Multi-Ethnic Study of Atherosclerosis[32]
MRC	MRC Study of assessment of older people[33]
Mt Sinai BioMe	Mount Sinai BioMe Biobank Platform[34]
NHANES	US National Health and Nutrition Examination Survey, using both NHANES III and the continuous NHANES from 1999-2010[35]
NIPPON DATA80	National Integrated Project for Prospective Observation of Non-communicable Disease And its Trends in the Aged 1980[36]
NIPPON DATA90	National Integrated Project for Prospective Observation of Non-communicable Disease And its Trends in the Aged 1990[37]
Ohasama	Ohasama Study[38]
Okinawa	Okinawa 93-96 Cohort[39]
OLDW	Optum Labs Data Warehouse
Pima	Pima Indian Study[40]
PREVEND	Prevention of Renal and Vascular End-stage Disease Study[41]
Rancho Bernardo	Rancho Bernardo Study[42]
RCAV	Racial and Cardiovascular Risk Anomalies in CKD Cohort[43]

General population and High Cardiovascular Risk Cohorts	
REGARDS	Reasons for Geographic And Racial Differences in Stroke Study[44]
SCREAM	Stockholm CREAtinine Measurements Project[45]
SEED	Singapore Epidemiology of Eye Diseases[46]
SHARP	Study of Heart and Renal Protection
SMART	Second Manifestations of ARTerial Disease Study[47]
STOP-CKDu	Study to Test and Operationalize Preventive Approaches for CKD of Undetermined Etiology in Andhra Pradesh, India
Taiwan MJ	Taiwan MJ Cohort Study[48]
Takahata	Takahata Study[49]
TLGS	Tehran Lipid and Glucose Study[50]
UK BioBank	The United Kingdom Biobank Study[51]
ULSAM	Uppsala Longitudinal Study of Adult Men[52]
ZODIAC	Zwolle Outpatient Diabetes project Integrating Available Care[53]
CKD cohorts	
AASK	African American Study of Kidney Disease and Hypertension[54]
BC CKD	British Columbia CKD Study[55]
CanPREDDICT	Canadian Study of Prediction of Death, Dialysis and Interim Cardiovascular Events[56]
CKD-JAC	Chronic Kidney Disease Japan Cohort[57]
CKD-REIN	Chronic Kidney Disease - Renal Epidemiology and Information Network Collaboration (CKD-REIN) cohort[58]
CRIB	Chronic Renal Impairment in Birmingham[59]
CRIC	Chronic Renal Insufficiency Cohort Study[60]
CURE-CKD	Center for Kidney Disease Research, Education, and Hope[61]
GCKD	German Chronic Kidney Disease Study[62]
Gonryo	Gonryo Study[63]
Hong Kong CKD	Hong Kong CKD Studies[64]
ICKD	Indian Chronic Kidney Disease Study[65]
LCC	The Leicester City and County Chronic Kidney Disease Cohort[66]
MASTERPLAN	Multifactorial Approach and Superior Treatment Efficacy in Renal Patients with the Aid of a Nurse Practitioner[67]
MDRD	Modification of Diet in Renal Disease Study[68]
MMKD	Mild to Moderate Kidney Disease Study[69]
Nanjing CKD	Nanjing CKD Network Cohort
NEFRONA	Observatorio Nacional de Aterosclerosis en Nefrologia[70]
NephroTest	NephroTest Study[71]
NRHP-URU	National Renal Healthcare Program - Uruguay
PSP-CKD	Primary-Secondary Care Partnership to Prevent Adverse Outcomes in Chronic Kidney Disease[72]
PSPA	Parcours de Soins des Personnes Agées[73]
RENAAL	Reduction of Endpoints in NIDDM with the Angiotensin II Antagonist Losartan[74]
SKS	Salford Kidney Study[75]
SRR-CKD	Swedish Renal Registry CKD Cohort[76]
Sunnybrook	Sunnybrook Cohort[77]
West of Scotland CKD	West of Scotland study[78]
YWSCC	Yonsei Wonju Severance CKD Cohort

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eAppendix 3. Acknowledgements and funding for collaborating cohorts

Cohort	List of sponsors
AASK	AASK was supported by grants to each clinical center and the coordinating center from the National Institute of Diabetes and Digestive and Kidney Diseases. In addition, AASK was supported by the Office of Research in Minority Health (now the National Center on Minority Health and Health Disparities, NCMHD) and the following institutional grants from the National Institutes of Health: M01 RR-00080, M01 RR-00071, M0100032, P20-RR11145, M01 RR00827, M01 RR00052, 2P20 RR11104, RR029887, and DK 2818-02. King Pharmaceuticals provided monetary support and antihypertensive medications to each clinical center. Pfizer Inc, AstraZeneca Pharmaceuticals, Glaxo Smith Kline, Forest Laboratories, Pharmacia and Upjohn also donated antihypertensive medications.
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ARIC	The Atherosclerosis Risk in Communities study has been funded in whole or in part with Federal funds from the National Heart, Lung, and Blood Institute, National Institutes of Health, Department of Health and Human Services, under Contract nos. (HHSN268201700001I, HHSN268201700003I, HHSN268201700005I, HHSN268201700004I, HHSN2682017000021). The authors thank the staff and participants of the ARIC study for their important contributions.
AusDiab	We wish to thank the AusDiab Steering Committee for providing data from the AusDiab study. Funding from NHMRC of Australia, Grant #1007544.
BC CKD	BC Provincial Renal Agency, an Agency of the Provincial Health Services Authority in collaboration with University of British Columbia.
Beijing	The research for this study was supported by the Program for New Century Excellent Talents in University (BMU2009131) from the Ministry of Education of the People's Republic of China, and the grants for the Early Detection and Prevention of Non-communicable Chronic Diseases from the International Society of Nephrology Research Committee.
BIS	Foundation for Preventive Medicine of the KfH (Kuratorium für Heimdialyse und Nierentransplantation e.V. – Stiftung Präventivmedizin; www.kfh-stiftung-praeventivmedizin.de). Verband deutscher Nierenzentren (DDnÄ)
CanPREDDICT	N/A
CARE	Alberta Heritage Foundation for Medical Research/Alberta Innovates Health Solutions Interdisciplinary Team Grants Program
China NS	N/A
CHS	This research was supported by contracts HHSN268201200036C, HHSN268200800007C, HHSN268201800001C, N01HC55222, N01HC85079, N01HC85080, N01HC85081, N01HC85082, N01HC85083, N01HC85086, 75N92021D00006, and grants U01HL080295 and U01HL130114 from the National Heart, Lung, and Blood Institute (NHLBI), with additional contribution from the National Institute of Neurological Disorders and Stroke (NINDS). Additional support was provided by R01AG023629 from the National Institute on Aging (NIA). A full list of principal CHS investigators and institutions can be found at CHS-NHLBI.org.
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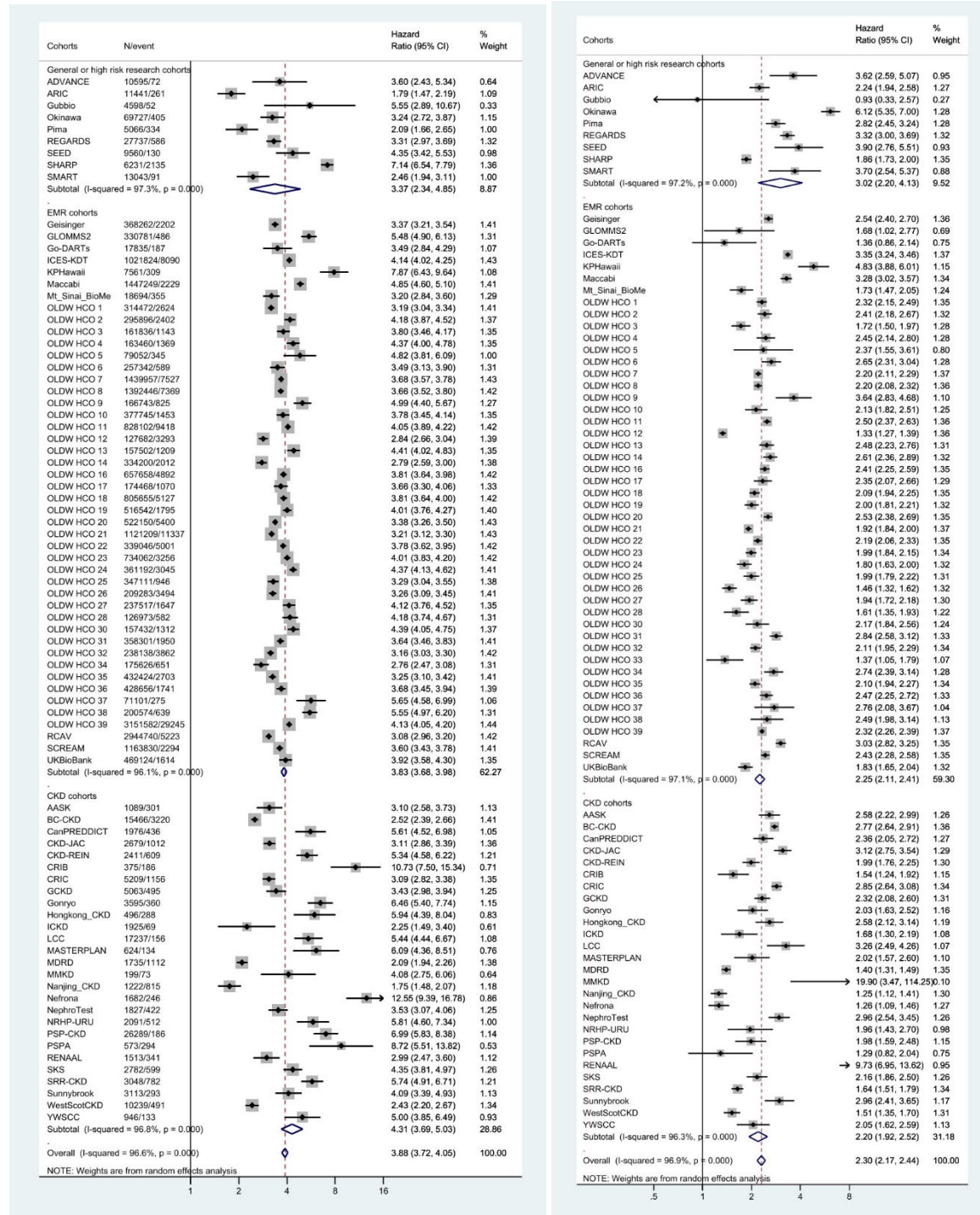| Cohort	List of sponsors
	GlaxoSmithKline (GSK) since 2012 and Vifor France since 2018, Sanofi-Genzyme from 2012 to 2015, Baxter and Merck Sharp & Dohme-Chibret (MSD France) from 2012 to 2017, Amgen from 2012 to 2020, Lilly France from 2013 to 2018, Otsuka Pharmaceutical from 2015 to 2020, AstraZeneca from 2018 to 2021 and Boehringer Ingelheim France since 2022.
COBRA	Wellcome Trust, UK
CRIB	British Renal Society Project Grant Award British Heart Foundation Project Grant Award.
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Cohort	List of sponsors
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Maccabi	N/A
MASTERPLAN	The MASTERPLAN study is a clinical trial with trial registration ISRCTN registry: 73187232. Sources of funding: The MASTERPLAN Study was supported by grants from the Dutch Kidney Foundation (Nierstichting Nederland, number PV 01), and the Netherlands Heart Foundation (Nederlandse Hartstichting, number 2003 B261). Unrestricted grants were provided by Amgen, Genzyme, Pfizer and Sanofi-Aventis.
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eFigure. Forest plot of hazard ratios associated with kidney failure with replacement therapy, stratified into general population cohorts, electronic health record cohorts, and CKD cohorts: from the continuous model: eGFR (first panel) and albuminuria (second panel)

*The forest plot depicts adjusted hazard ratios derived in each cohort using the continuous model depicted in Table 3. The first panel depicts the coefficient for the spline term for eGFR <60 ml/min/1,73 m2, expressed per 15

ml/min/1.73 m2 lower eGFR value. The second panel reflects the coefficient for the albuminuria coefficient, expressed per 8-fold higher albuminuria.

**N/n also included people missing albuminuria, which was modeled with an indicator variable. The median cohort % with albuminuria was 66 (6.3-100%) in the analytical eGFRcr population.

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