Global, regional, and national prevalence of kidney failure with replacement therapy and associated aetiologies, 1990–2023: a systematic analysis for the Global Burden of Disease Study 2023

*GBD 2023 Kidney Failure with Replacement Therapy Collaborators**

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*Collaborators listed at the end of the Article

Correspondence to: Quinn Rafferty, Institute for Health Metrics and Evaluation, University of Washington, Seattle, WA 98195, USA **qwr@uw.edu**

Summary

Background Kidney failure with replacement therapy (KFRT) such as dialysis or transplantation represents a severe stage of chronic kidney disease (CKD) and poses a major global health burden. Although many CKD cases are diagnosed in the earlier stages, the greatest risk occurs when CKD progresses to KFRT. Despite its considerable financial and imposing impact on public health, there is a notable gap in international policies addressing CKD and KFRT. To bridge this gap and help policy makers and health systems effectively tackle the public health challenge of KFRT, a better understanding of the disease burden is essential. Thus, this analysis aims to provide a detailed overview of the global prevalence of KFRT and its associated aetiologies with estimates from the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) from 1990 to 2023.

Methods This study defined KFRT as individuals on maintenance dialysis for 90 days or more or those who have undergone a kidney transplant, aligning with the Kidney Disease: Improving Global Outcomes (KDIGO) 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. Renal registries served as the primary data sources. Prevalence and underlying aetiology estimates (type 1 diabetes, type 2 diabetes, hypertension, glomerulonephritis, and other causes) were generated with DisMod-MR 2.1, an epidemiological Bayesian mixed-effects meta-regression modelling tool. Both all-age and age-standardised estimates were reported and accompanied with 95% uncertainty intervals (UIs).

Findings In 2023, the number of global cases of KFRT was 4·59 million (95% UI 4·17–5·08) for both sexes and all ages, with an age-standardised prevalence of 50·7 (46·1–56·0) per 100 000 population. Over the past three decades, there has been a steady increase in KFRT prevalence globally. The highest prevalence was found in the GBD high-income regions, while the lowest was observed in sub-Saharan Africa. KFRT prevalence was generally higher in countries classified within the World Bank's high-income and upper-middle-income groups, while lower prevalence was more common in countries within the World Bank's low-income and lower-middle-income groups. Additionally, a pronounced sex disparity was identified, where male dialysis and transplant prevalence estimates were consistently higher than those for females in most countries. Type 2 diabetes and hypertension were among the leading associated aetiologies of KFRT globally. From 1990 to 2023, the all-age and age-standardised prevalence estimates across the ascribed aetiologies increased for KFRT, with the largest increases associated with type 2 diabetes and hypertension.

Interpretation KFRT affects approximately 5 million people globally, with high treatment and mortality costs. Our study unveiled considerable geographical variation in KFRT prevalence, which should be seen as indicators of health-care system opportunities. As the prevalence of the leading aetiologies of KFRT—type 2 diabetes and hypertension—continues to rise, there is a crucial need to prioritise the development and implementation of cost-effective strategies aimed at preventing CKD and its progression to KFRT, particularly in low-resource settings. These preventive efforts must happen in tandem with efforts to expand capacity for dialysis and transplant services.

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Introduction

Chronic kidney disease (CKD) is a progressive non-communicable disease that imposes a substantial population health burden globally.[1] CKD is clinically characterised by the reduction of kidney function that is present for at least 3 months, indicated by an estimated glomerular filtration rate (eGFR) of less than 60 mL/min per 1·73 m², or markers of kidney damage, such as albuminuria.[2] In 2019, CKD was responsible for 1·4 million deaths globally and was ranked the eighth-highest cause of death due to non-communicable diseases.[3] Although CKD-associated mortality is a major

Research in context

Evidence before this study

The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) is a systematic and comprehensive effort that produces estimates of chronic kidney disease (CKD) prevalence at the global, super-region, region, national, and territorial levels for both males and females, all ages, and across time. Although there have been previous GBD efforts to report global estimates of CKD, this is the first GBD analysis to focus and report solely on kidney failure with renal replacement therapy (KFRT). To estimate the prevalence of KFRT, the main data sources used were renal registries identified through cross-referencing previously published systematic reviews of renal registries, collaborators within the GBD Collaborator Network, and the Global Health Data Exchange (GHDx). The most recent update and extractions of data from renal registries occurred in 2022. Data from the scientific literature and reports were also included if they satisfied the case definition and inclusion criteria for KFRT.

Added value of this study

To compile epidemiological data on KFRT, we used annual renal replacement therapy registries spanning from 1970 to 2022 and supplemented these data sources with reports identified through systematic reviews of renal registries. In total, we gathered 888 unique sources. Additionally, we engaged the GBD Collaborator Network to identify registry reports that had not been included in earlier GBD iterations. Our statistical modelling approach enabled us to generate KFRT prevalence estimates even for countries without primary data. Leveraging the strengths of the systematic and robust methodology of GBD, this study presents global estimates of KFRT as well as detailed estimates for seven super-regions, 21 regions, and 204 countries and territories, disaggregated by age and sex, over the time series from 1990 to 2023. Moreover, this analysis elucidates the associated causes of KFRT, including type 1 and type 2 diabetes, hypertension, glomerulonephritis, and other contributing factors. By quantifying the prevalence of KFRT, we aim to enhance public health officials' and policy makers' understanding of both the current and future impacts of this disease, thereby informing targeted and effective strategies to alleviate its burden.

Implications of all the available evidence

The rising global prevalence of KFRT underscores the urgent need for targeted interventions, especially for syndemic metabolic conditions such as type 2 diabetes and hypertension. As the prevalence of these conditions rises, the global population ages, and the costs of critical treatments remains high, health-care systems will face increasing pressure. Disparities in treatment access—especially between high-income and low-income countries—must be addressed to ensure equitable care. In resource-limited settings, the challenges are even more pronounced, as seen in sub-Saharan Africa, where dialysis and transplant rates are low. Developing early identification and management programmes for CKD or integrating CKD into existing non-communicable disease programmes could help prevent progression to KFRT, offering an effective strategy to reduce the global burden of kidney disease and improve outcomes for all.

concern, the morbidity associated with it also warrants attention due to its impact on quality of life and its potential progression to more severe stages, leading to complications such as cardiovascular disease.[2] In 2019, CKD accounted for 8·7 million years lived with disability (YLDs), putting the disease in the top 7% of highest-ranking contributors to global YLDs.[3] The majority of CKD cases are among those with earlier stages of the disease, which can be effectively managed and controlled with pharmaceutical interventions and lifestyle modifications.[1] However, the most critical risk associated with CKD occurs when it progresses to its most advanced and life-threatening form, known as kidney failure.[4]

Kidney failure is clinically characterised as an eGFR less than 15 mL/min per 1·73 m² and might lead to the use of maintenance dialysis or a kidney transplantation.[2] In cases when these therapies are used, this is referred to as kidney failure with replacement therapy (KFRT). The tracking and documentation of KFRT care primarily rely on renal registries, which generally encompass data on prevalence and several associated aetiologies.[5]

KFRT has a variety of associated causes, but approximately half of cases are estimated to result from diabetes and hypertension.[6] This is primarily ascribed to the steadily increasing prevalence of diabetes and hypertension, contributing to the changing landscape of KFRT.[7,8] Additionally, the financial burden associated with KFRT is substantial, with the majority of KFRT-specific costs attributed to dialysis and dialysis-associated expenses; for instance, in high-income countries such as France and Singapore, the annual total expenditure on dialysis alone is estimated at US$2·29 billion and $89·9 million, respectively.[9]

Despite the large burden of KFRT on population health, there is a noticeable gap in international policies and goals, with CKD and KFRT often not being explicitly identified or targeted. To bridge this gap and effectively tackle the public health challenge of KFRT, a deeper understanding of its non-fatal manifestations is essential. Such insight is integral for the formulation of nuanced and targeted strategies to manage the KFRT burden. The present analysis aimed to present a rigorous overview of the global prevalence of KFRT, including aspects of dialysis and kidney transplantation, as well as their associated aetiologies. Using the modelling framework and estimates from the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD), we provide a detailed analysis of the prevalence of KFRT and its ascribed aetiological proportions across the GBD location hierarchy for 204 countries and territories, seven super-regions, and 21 regions by age and sex from 1990 to 2023.

This manuscript was produced as part of the GBD Collaborator Network and in accordance with the GBD Protocol.[10]

Methods

Case definitions and data

We defined KFRT as being on dialysis (inclusive of haemodialysis or peritoneal dialysis, or both) for 90 days or more or being a kidney transplant recipient. This definition of KFRT is classified according to the Kidney Disease: Improving Global Outcomes (KDIGO) 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease.[2]

We made estimates for five associated aetiologies informed by primary renal diagnoses in renal registries: type 1 diabetes, type 2 diabetes, hypertension, glomerulonephritis, and a residual "other causes" group. The residual "other causes" group includes, but is not limited to, genetic kidney diseases and nephrotoxicity.

The main data sources we used to estimate KFRT were renal registries. Renal registries were identified through cross-referencing previously published systematic reviews or reports of renal registries,[11] collaborators within the GBD Collaborator Network, and the Global Health Data Exchange (GHDx). Data from the scientific literature and reports were also included if they satisfied our case definition of KFRT and did not violate our exclusion criteria (appendix table S2). Prevalence data were extracted from these renal registries, scientific literature, and reports, and cause-specific data were extracted as proportion data. Input data that were included but reported large age ranges, were non-sex-specific, or both, were split in a data process called age–sex splitting. Further details of the age–sex splitting process are provided in the appendix (section 1.2). In total, 888 unique data sources were included in the analysis that spanned the years 1970 to 2022. More information about these sources is available on the GHDx, and a map of input sources' country-year counts is shown in the appendix (figure S1).

Modelling

We estimated the overall prevalence of KFRT, along with the prevalence by treatment modality—dialysis and transplantation—using a Bayesian mixed-effects meta-regression modelling tool called DisMod-MR 2.1.[3] One of the greatest strengths of DisMod-MR 2.1 is its ability to produce estimates for data-sparse locations by leveraging data from nearby geographies and proximate years and ages. More information about DisMod-MR 2.1 is detailed elsewhere.[3] The dialysis and transplant models used the Healthcare Access and Quality Index covariate in prevalence estimates when data were missing for a given location or year (appendix section 2). The resulting models and outputs were a dialysis prevalence model and a kidney transplant prevalence model. The dialysis and kidney transplant prevalence estimates were then aggregated to form prevalence estimates for total KFRT.

To calculate the estimates for the associated aetiologies of KFRT, we used DisMod-MR 2.1 to generate proportion-only models for each of the five associated aetiologies we defined above. The KFRT-due-to-hypertension-proportion-model included a systolic blood pressure covariate (appendix section 2). To ensure that the proportions of the associated aetiologies in our proportion-only models collectively add up to 100%, we modified the proportions by applying a scaling adjustment. We then multiplied the scaled aetiology proportions by the KFRT prevalence for each location-year-age-sex. The resulting models and outputs are five scaled KFRT aetiology proportion models, five prevalence models of dialysis ascribed to each aetiology, and five prevalence models of kidney transplant ascribed to each aetiology.

To strengthen our ability to compare the prevalence of KFRT across locations with different population age structures, we report age-standardised estimates. In the GBD framework, the standard population was established by calculating the unweighted average of the age-specific population distribution proportions for all countries with populations exceeding 5 million in 2019.[3] Alongside all the reported measures and metrics, 95% uncertainty intervals (UIs) are included. To compute these 95% UIs, each modelling step was conducted at the draw level, where each draw represents a distinct realisation of the model. We then took the 2·5th and 97·5th percentiles from 1000 draws to inform our lower and upper bounds, respectively.

For more on the **Global Health Data Exchange** see https://ghdx.healthdata.org/

See **Online** for appendix

This analysis complies with the GATHER statement, as detailed in the appendix (table S1). Analyses were completed with Python (version 3.10.4), Stata (version 13.1), and R (version 4.2.1). All data are presented to three significant figures.

Role of the funding source

The funder of this study had no role in study design, data collection, data analysis, data interpretation, the writing of the report, or the decision to submit the manuscript for publication.

For more on **these sources** see https://ghdx.healthdata.org/keyword/chronic-kidney-diseases/

Results

KFRT prevalence

In 2023, the number of global cases of KFRT was 4·59 million (95% UI 4·17–5·08) for both sexes and all ages, with an age-standardised prevalence of 50·7 (46·1–56·0) per 100 000 population. The highest age-standardised prevalence was 111 (104–119) per 100 000 in the high-income super-region, whereas the lowest was in sub-Saharan Africa at 3·80 (3·30–4·50)

	Age-standardised prevalence per 100 000		Number of cases	
	1990	2023	1990	2023
Global	**36·8 (33·0–41·6)**	**50·7 (46·1–56·0)**	**1 590 000 (1 420 000–1 800 000)**	**4 590 000 (4 170 000–5 080 000)**
Central Europe, eastern Europe, and central Asia	**18·7 (17·0–21·2)**	**30·0 (27·9–32·9)**	**86 700 (78 100–98 400)**	**179 000 (165 000–195 000)**
Central Asia	28·4 (24·5–33·9)	29·2 (25·2–34·4)	15 000 (13 000–17 600)	28 200 (24 200–33 400)
Armenia	31·6 (26·7–37·7)	32·2 (27·5–38·9)	956 (807–1150)	1390 (1170–1700)
Azerbaijan	26·5 (22·8–31·9)	27·9 (23·6–33·8)	1530 (1310–1820)	3320 (2780–4050)
Georgia	35·7 (30·2–42·6)	39·5 (37·7–41·3)	2180 (1810–2620)	2050 (1940–2140)
Kazakhstan	27·1 (23·5–32·5)	28·2 (24·3–33·9)	3910 (3380–4680)	6010 (5100–7230)
Kyrgyzstan	27·9 (23·8–33·3)	29·1 (25·0–34·8)	925 (787–1090)	1820 (1540–2200)
Mongolia	25·8 (22·1–30·6)	26·0 (22·4–30·9)	342 (300–400)	784 (671–933)
Tajikistan	20·3 (19·2–21·2)	25·5 (21·9–30·0)	669 (635–698)	2010 (1720–2350)
Turkmenistan	26·8 (23·2–32·1)	26·9 (22·8–32·0)	630 (545–745)	1330 (1120–1590)
Uzbekistan	29·2 (25·2–35·4)	29·6 (25·4–35·1)	3830 (3340–4530)	9520 (8110–11 300)
Central Europe	29·1 (26·8–32·0)	54·4 (51·4–58·1)	42 200 (38 700–46 500)	99 300 (93 800–106 000)
Albania	36·0 (30·5–42·5)	35·0 (34·1–36·0)	922 (780–1080)	1320 (1280–1360)
Bosnia and Herzegovina	43·4 (37·1–51·8)	48·8 (47·2–50·4)	1940 (1630–2330)	2650 (2550–2740)
Bulgaria	21·2 (19·2–23·7)	34·3 (33·4–35·3)	2460 (2210–2750)	4150 (4030–4290)
Croatia	50·5 (48·9–52·2)	53·1 (51·9–55·0)	3090 (2980–3190)	3430 (3350–3540)
Czechia	46·7 (44·9–48·1)	70·9 (69·1–72·4)	5830 (5610–6020)	11 600 (11 400–12 000)
Hungary	24·8 (22·3–27·6)	47·9 (46·0–49·8)	3280 (2930–3690)	7430 (7160–7730)
Montenegro	21·1 (18·4–24·5)	21·2 (19·6–23·3)	132 (115–152)	195 (179–215)
North Macedonia	44·1 (42·0–46·6)	57·6 (56·2–59·3)	866 (821–916)	1640 (1600–1700)
Poland	25·6 (22·3–29·4)	56·4 (49·3–64·6)	11 100 (9620–12 700)	33 200 (29 100–38 500)
Romania	15·0 (13·9–16·4)	63·1 (61·3–65·1)	4060 (3750–4430)	20 100 (19 400–20 700)
Serbia	41·5 (35·9–49·4)	46·1 (44·8–47·4)	4470 (3840–5300)	6500 (6310–6690)
Slovakia	34·0 (31·7–37·0)	44·2 (43·0–45·2)	1980 (1850–2160)	3770 (3670–3850)
Slovenia	57·2 (53·9–60·1)	54·2 (41·7–62·9)	1340 (1260–1410)	1840 (1390–2160)
Eastern Europe	11·2 (10·0–12·8)	16·4 (14·9–18·4)	29 600 (26 200–34 000)	51 500 (46 500–57 500)
Belarus	15·7 (14·9–16·6)	26·0 (25·2–26·7)	1880 (1780–1990)	3580 (3480–3700)
Estonia	20·6 (19·3–21·5)	45·7 (44·4–46·8)	380 (357–398)	898 (876–920)
Latvia	21·6 (20·3–22·9)	42·0 (40·8–43·2)	705 (663–744)	1180 (1150–1220)
Lithuania	26·2 (24·7–27·9)	49·6 (48·5–50·6)	1100 (1040–1170)	2190 (2140–2240)
Moldova	3·80 (3·30–4·50)	3·90 (3·40–4·60)	174 (150–204)	207 (177–248)
Russia	11·3 (10·0–13·2)	16·1 (14·5–18·3)	19 600 (17 300–22 900)	35 400 (31 600–40 000)
Ukraine	8·70 (7·60–10·2)	12·0 (10·7–14·0)	5720 (4960–6670)	8060 (7090–9450)
High income	**64·6 (59·0–71·4)**	**111 (104–119)**	**710 000 (645 000–782 000)**	**1 970 000 (1 830 000–2 110 000)**
Australasia	37·8 (36·1–39·7)	67·3 (65·6–69·8)	8410 (8010–8840)	31 000 (30 200–32 200)
Australia	39·8 (38·3–41·4)	69·0 (67·5–71·0)	7390 (7100–7700)	27 000 (26 400–27 700)
New Zealand	27·8 (23·1–35·8)	57·8 (49·6–67·7)	1010 (840–1300)	4010 (3450–4610)
High-income Asia Pacific	105 (92·7–121)	134 (124–146)	212 000 (187 000–246 000)	479 000 (441 000–524 000)
Brunei	143 (132–152)	96·9 (83·1–116)	207 (195–219)	466 (398–557)
Japan	121 (106–141)	141 (128–159)	199 000 (173 000–232 000)	361 000 (324 000–406 000)
South Korea	31·6 (30·3–33·0)	117 (115–118)	11 800 (11 300–12 200)	105 000 (103 000–106 000)
Singapore	62·9 (60·0–66·0)	136 (130–141)	1710 (1640–1790)	12 300 (11 700–12 700)
High-income North America	77·1 (68·8–86·3)	165 (154–176)	247 000 (220 000–277 000)	921 000 (851 000–986 000)
Canada	38·7 (38·0–39·4)	75·2 (72·7–77·3)	12 200 (11 900–12 400)	44 900 (43 300–46 400)
Greenland	61·0 (53·9–68·9)	66·2 (58·6–75·0)	28·3 (25·2–32·0)	47·7 (41·4–54·7)
USA	81·3 (72·2–91·5)	176 (163–189)	235 000 (208 000–265 000)	876 000 (808 000–940 000)
Southern Latin America	51·2 (49·4–53·4)	58·1 (54·3–63·4)	24 200 (23 300–25 300)	50 300 (47 000–55 000)
Argentina	51·1 (49·1–53·5)	55·4 (51·4–60·5)	16 600 (16 000–17 400)	31 300 (29 000–34 200)
Chile	56·2 (53·9–58·4)	64·8 (60·2–70·3)	6210 (5960–6460)	16 300 (15 100–17 700)
Uruguay	38·2 (36·6–40·0)	55·3 (52·5–58·8)	1380 (1320–1450)	2650 (2490–2810)

(Table continues on next page)

	Age-standardised prevalence per 100 000		Number of cases	
	1990	2023	1990	2023
(Continued from previous page)				
Western Europe	43·2 (40·6–46·2)	66·6 (63·0–71·3)	217 000 (205 000–232 000)	484 000 (457 000–519 000)
Andorra	49·3 (44·3–54·8)	52·5 (47·2–60·3)	29·9 (26·7–33·4)	75·8 (68·0–87·4)
Austria	41·2 (39·6–43·1)	66·2 (65·0–67·5)	4140 (3970–4360)	9770 (9580–10 000)
Belgium	44·2 (42·4–46·1)	79·2 (77·5–81·0)	5850 (5610–6120)	14 800 (14 400–15 100)
Cyprus	26·9 (25·7–27·9)	57·6 (50·9–65·1)	218 (209–226)	1080 (960–1220)
Denmark	36·8 (34·8–38·8)	60·4 (59·6–61·4)	2510 (2360–2670)	5560 (5490–5660)
Finland	33·8 (32·4–35·6)	56·3 (55·2–57·4)	2150 (2060–2270)	4990 (4890–5090)
France	44·9 (43·0–47·1)	80·3 (78·4–82·0)	32 500 (31 100–34 100)	89 200 (86 600–91 500)
Germany	42·5 (41·0–44·3)	52·0 (45·5–61·3)	47 600 (45 800–49 600)	77 900 (67 800–92 700)
Greece	35·0 (32·8–37·8)	72·7 (70·8–74·6)	4870 (4520–5300)	14 400 (14 000–14 800)
Iceland	29·2 (27·8–30·6)	52·5 (51·6–53·5)	77·3 (73·4–81·2)	269 (263–273)
Ireland	20·3 (19·7–21·1)	29·6 (26·4–34·0)	779 (751–809)	2230 (1980–2570)
Israel	41·7 (40·5–42·9)	79·5 (77·8–81·1)	1980 (1920–2040)	9090 (8890–9270)
Italy	41·4 (36·6–47·8)	55·8 (49·2–64·5)	32 600 (28 700–37 900)	61 300 (53 600–71 600)
Luxembourg	27·2 (26·2–28·6)	37·9 (32·3–45·9)	138 (133–146)	369 (313–453)
Malta	44·9 (40·3–49·9)	50·1 (44·7–57·3)	190 (170–212)	432 (382–497)
Monaco	45·2 (40·3–50·8)	48·1 (43·0–55·0)	24·0 (21·2–27·2)	36·1 (32·2–41·6)
Netherlands	41·2 (39·3–43·3)	64·1 (62·6–65·5)	7460 (7090–7840)	18 000 (17 500–18 400)
Norway	42·4 (35·7–51·9)	66·4 (56·0–80·0)	2220 (1890–2690)	5310 (4560–6320)
Portugal	51·7 (49·2–54·9)	111 (110–113)	6610 (6280–7060)	20 700 (20 400–21 000)
San Marino	49·0 (44·6–54·9)	51·8 (46·9–59·1)	13·7 (12·3–15·4)	33·1 (29·3–38·5)
Spain	32·0 (30·3–34·0)	77·8 (76·8–78·8)	14 900 (14 100–15 800)	60 000 (59 200–60 800)
Sweden	44·2 (42·0–46·6)	67·6 (65·9–69·3)	5190 (4920–5500)	10 900 (10 500–11 200)
Switzerland	38·4 (37·0–40·2)	55·9 (54·8–57·4)	3430 (3290–3590)	7990 (7820–8200)
UK	55·4 (48·9–62·8)	67·4 (59·3–77·7)	41 800 (37 100–47 000)	69 000 (61 100–77 700)
Latin America and Caribbean	**36·7 (32·5–42·6)**	**61·2 (55·0–69·7)**	**98 300 (87 800–115 000)**	**406 000 (365 000–464 000)**
Andean Latin America	18·3 (16·0–20·7)	24·8 (22·2–29·2)	4580 (4040–5150)	16 700 (14 900–19 700)
Bolivia	13·3 (8·30–15·7)	22·3 (19·3–29·2)	551 (366–643)	2520 (2190–3280)
Ecuador	14·8 (12·3–17·3)	23·1 (20·1–29·0)	962 (818–1120)	4180 (3640–5250)
Peru	21·3 (19·3–23·5)	26·5 (24·0–30·0)	3060 (2790–3380)	10 000 (9060–11 400)
Caribbean	29·7 (26·5–33·9)	34·4 (31·1–39·1)	8390 (7490–9520)	19 100 (17 200–21 800)
Antigua and Barbuda	41·3 (33·9–50·2)	41·0 (33·9–49·9)	21·1 (17·5–25·7)	47·0 (38·5–57·4)
The Bahamas	46·9 (38·9–56·6)	46·1 (38·7–56·2)	86·3 (72·0–104)	220 (181–270)
Barbados	46·8 (39·0–56·7)	47·1 (38·5–58·4)	123 (103–150)	222 (177–280)
Belize	39·4 (32·8–47·7)	37·8 (31·1–46·3)	41·6 (35·4–49·2)	135 (111–164)
Bermuda	46·5 (37·9–56·9)	49·2 (41·3–60·0)	30·6 (25·1–37·6)	55·5 (45·5–68·7)
Cuba	14·7 (13·8–16·4)	20·0 (18·4–21·6)	1560 (1460–1730)	3490 (3220–3770)
Dominica	37·3 (31·0–46·0)	37·3 (30·7–46·3)	24·6 (20·5–30·3)	33·3 (27·3–41·8)
Dominican Republic	29·2 (24·2–34·9)	25·9 (23·5–29·4)	1300 (1090–1550)	2830 (2580–3220)
Grenada	36·9 (30·7–44·7)	37·0 (30·5–44·7)	28·2 (23·6–34·2)	53·9 (43·5–65·8)
Guyana	33·6 (27·7–40·8)	32·5 (27·1–39·8)	158 (132–188)	256 (210–314)
Haiti	29·8 (24·8–36·0)	28·7 (23·4–35·3)	1160 (972–1380)	2790 (2330–3420)
Jamaica	26·8 (22·1–32·8)	25·8 (21·2–31·6)	479 (395–587)	825 (674–1010)
Puerto Rico	69·6 (63·9–76·0)	102 (93·5–110)	2530 (2320–2770)	6360 (5800–6980)
Saint Kitts and Nevis	35·2 (28·9–43·2)	36·0 (29·9–44·5)	12·4 (10·3–15·0)	22·0 (17·7–27·4)
Saint Lucia	38·0 (31·9–46·2)	38·6 (32·4–47·6)	36·4 (30·8–43·6)	92·4 (76·6–115)
Saint Vincent and the Grenadines	37·5 (31·2–45·1)	37·4 (31·1–45·2)	28·7 (24·1–34·3)	55·9 (46·2–67·8)
Suriname	35·9 (29·4–43·6)	34·5 (28·9–42·3)	107 (88·4–127)	232 (191–285)
Trinidad and Tobago	34·1 (28·2–40·8)	34·1 (28·5–41·8)	314 (262–374)	643 (529–804)
Virgin Islands	66·9 (55·4–82·8)	86·2 (67·7–110)	64·0 (52·8–78·9)	145 (109–192)

(Table continues on next page)

	Age-standardised prevalence per 100 000		Number of cases	
	1990	2023	1990	2023
(Continued from previous page)				
Central Latin America	40·0 (35·9–45·5)	80·1 (71·0–91·5)	41 600 (37 700–47 800)	220 000 (196 000–252 000)
Colombia	22·6 (21·0–24·3)	35·2 (32·0–38·6)	4970 (4630–5390)	20 700 (18 800–22 700)
Costa Rica	19·8 (18·7–21·0)	30·9 (28·6–33·6)	427 (402–450)	1890 (1740–2050)
El Salvador	24·3 (13·3–29·0)	37·5 (34·4–42·2)	847 (487–1000)	2340 (2150–2640)
Guatemala	18·6 (16·0–21·1)	25·9 (23·6–29·2)	868 (763–979)	3430 (3100–3850)
Honduras	15·7 (8·20–20·3)	21·5 (19·3–24·9)	420 (234–523)	1790 (1600–2070)
Mexico	55·3 (48·8–64·7)	126 (111–146)	29 600 (26 200–34 600)	178 000 (156 000–206 000)
Nicaragua	10·1 (8·30–12·5)	9·90 (9·00–11·2)	197 (163–241)	583 (528–662)
Panama	24·5 (19·0–29·6)	33·3 (30·2–36·9)	426 (333–510)	1500 (1360–1660)
Venezuela	32·9 (31·5–34·2)	32·2 (29·1–35·6)	3890 (3740–4050)	10 100 (9100–11 200)
Tropical Latin America	39·6 (34·7–47·0)	56·4 (50·8–64·0)	43 700 (38 300–52 500)	150 000 (135 000–171 000)
Brazil	40·3 (35·3–47·8)	57·4 (51·7–65·2)	43 400 (38 000–52 200)	149 000 (134 000–170 000)
Paraguay	12·7 (12·2–13·2)	13·2 (11·8–14·6)	327 (314–342)	816 (731–905)
North Africa and Middle East	**24·0 (21·7–26·6)**	**41·4 (38·1–45·8)**	**51 900 (47 200–58 400)**	**230 000 (212 000–255 000)**
North Africa and Middle East	24·0 (21·7–26·6)	41·4 (38·1–45·8)	51 900 (47 200–58 400)	230 000 (212 000–255 000)
Afghanistan	21·5 (18·3–25·7)	19·7 (16·7–23·6)	1590 (1330–1920)	3480 (3010–4150)
Algeria	13·1 (12·0–14·4)	17·7 (14·8–21·5)	2050 (1850–2300)	7550 (6240–9270)
Bahrain	32·7 (27·6–39·4)	33·7 (28·7–40·7)	102 (87·9–126)	519 (433–629)
Egypt	23·6 (21·8–25·9)	31·4 (26·0–38·4)	8030 (7420–8840)	26 300 (21 600–32 400)
Iran	33·5 (29·5–38·9)	45·8 (40·7–53·4)	11 500 (10 100–13 400)	42 500 (37 500–49 500)
Iraq	26·7 (22·4–31·9)	26·6 (22·6–31·7)	2680 (2290–3140)	8800 (7450–10 600)
Jordan	35·8 (30·3–42·7)	38·3 (35·0–42·2)	686 (586–799)	4380 (3990–4850)
Kuwait	27·9 (15·5–32·6)	53·4 (45·9–59·3)	271 (157–316)	2290 (1940–2560)
Lebanon	9·60 (5·70–11·5)	20·4 (17·3–24·5)	248 (156–296)	1260 (1070–1510)
Libya	18·1 (16·4–20·4)	27·5 (23·1–33·8)	441 (397–500)	1840 (1530–2280)
Morocco	10·0 (9·10–11·6)	17·0 (14·4–20·6)	1820 (1630–2120)	6590 (5550–8020)
Oman	40·6 (34·3–48·7)	64·4 (63·1–65·9)	440 (373–528)	2370 (2320–2440)
Palestine	28·7 (24·1–34·7)	29·0 (24·3–34·8)	314 (268–371)	1060 (888–1260)
Qatar	41·3 (34·6–49·7)	48·6 (44·9–52·1)	110 (91·2–137)	1150 (1040–1250)
Saudi Arabia	54·1 (51·2–57·2)	69·1 (61·7–81·1)	4760 (4520–5040)	17 200 (15 600–19 700)
Sudan	9·70 (5·80–11·5)	14·0 (11·9–17·1)	1120 (753–1330)	3910 (3310–4720)
Syria	28·2 (23·6–33·3)	27·7 (23·4–33·1)	1890 (1600–2200)	4530 (3790–5530)
Tunisia	40·9 (38·0–44·3)	28·1 (17·9–32·7)	2420 (2260–2610)	3980 (2510–4640)
Türkiye	21·5 (19·6–24·0)	80·9 (78·8–83·1)	9490 (8600–10 700)	81 900 (79 800–84 100)
United Arab Emirates	32·5 (27·5–38·6)	33·9 (28·5–41·9)	340 (287–423)	3690 (2860–4620)
Yemen	24·4 (20·7–29·2)	23·5 (20·1–28·3)	1600 (1370–1890)	4880 (4250–5900)
South Asia	**9·80 (8·50–11·5)**	**11·5 (10·6–12·7)**	**79 500 (69 400–94 300)**	**210 000 (192 000–232 000)**
South Asia	9·80 (8·50–11·5)	11·5 (10·6–12·7)	79 500 (69 400–94 300)	210 000 (192 000–232 000)
Bangladesh	6·40 (6·00–6·80)	14·7 (13·9–15·6)	4580 (4280–4930)	23 500 (22 400–25 200)
Bhutan	10·4 (8·80–12·6)	10·5 (8·90–12·8)	42·8 (36·6–52·4)	79·3 (67·4–97·0)
India	10·1 (8·70–11·9)	11·4 (10·4–12·6)	65 700 (56 400–78 500)	165 000 (150 000–182 000)
Nepal	9·60 (8·10–11·6)	9·60 (8·10–11·6)	1330 (1120–1600)	2840 (2390–3420)
Pakistan	10·2 (9·10–12·0)	9·70 (8·70–11·5)	7890 (7010–9130)	18 100 (16 000–21 400)
Southeast Asia, east Asia, and Oceania	**43·9 (38·8–50·6)**	**51·6 (45·4–59·5)**	**555 000 (489 000–638 000)**	**1 580 000 (1 380 000–1 830 000)**
East Asia	47·0 (41·5–54·2)	55·4 (48·7–64·2)	454 000 (402 000–523 000)	1 280 000 (1 110 000–1 500 000)
China	44·9 (39·5–52·2)	53·1 (46·5–61·8)	419 000 (368 000–485 000)	1 180 000 (1 030 000–1 390 000)
North Korea	74·2 (62·8–87·8)	76·3 (63·9–92·2)	12 700 (10 700–15 100)	26 300 (21 900–32 100)
Taiwan (province of China)	130 (119–141)	160 (149–171)	22 700 (20 800–24 700)	67 500 (62 500–72 500)

(Table continues on next page)

	Age-standardised prevalence per 100 000		Number of cases	
	1990	2023	1990	2023
(Continued from previous page)				
Oceania	48·3 (40·1–59·0)	47·5 (39·0–58·1)	1670 (1380–2010)	4470 (3660–5470)
American Samoa	52·5 (43·6–64·3)	50·9 (42·1–62·6)	14·2 (11·8–17·2)	25·7 (20·8–31·9)
Cook Islands	59·2 (48·5–73·0)	61·0 (50·8–74·8)	7·92 (6·45–9·75)	11·8 (9·63–14·6)
Federated States of Micronesia	43·9 (36·4–54·3)	42·9 (35·5–53·2)	23·9 (20·0–29·5)	36·6 (30·0–45·8)
Fiji	47·8 (39·6–58·6)	46·5 (38·8–57·5)	205 (171–249)	401 (329–495)
Guam	61·1 (50·9–75·3)	60·2 (49·2–72·9)	55·7 (46·5–68·3)	125 (100–154)
Kiribati	40·7 (33·7–50·4)	39·1 (32·6–47·9)	17·0 (14·1–21·1)	34·3 (28·3–41·6)
Marshall Islands	44·1 (36·4–54·7)	43·5 (36·0–53·9)	8·61 (7·14–10·6)	13·0 (10·7–16·1)
Nauru	42·6 (35·1–52·2)	40·5 (33·6–49·6)	1·90 (1·56–2·32)	2·80 (2·31–3·38)
Niue	50·7 (41·7–62·5)	49·1 (40·2–60·0)	1·08 (0·900–1·34)	1·11 (0·890–1·38)
Northern Mariana Islands	58·3 (48·8–72·0)	56·0 (46·5–68·2)	14·6 (12·2–18·2)	30·5 (24·5–37·5)
Palau	49·5 (40·5–61·1)	49·4 (40·9–60·9)	5·36 (4·41–6·56)	11·7 (9·39–14·5)
Papua New Guinea	47·9 (39·5–58·6)	47·5 (38·7–58·2)	1020 (833–1230)	3130 (2570–3840)
Samoa	51·4 (42·3–62·7)	51·0 (42·3–62·7)	48·5 (39·9–58·8)	86·3 (70·5–107)
Solomon Islands	46·0 (38·0–56·7)	43·9 (36·9–54·2)	73·2 (60·2–90·1)	226 (188–277)
Tokelau	50·5 (41·6–63·0)	49·9 (41·5–61·0)	0·682 (0·561–0·856)	0·838 (0·694–1·03)
Tonga	53·4 (43·8–65·0)	52·4 (43·7–64·7)	32·4 (26·6–39·3)	45·9 (38·2–56·9)
Tuvalu	43·1 (35·4–53·0)	44·7 (37·1–55·3)	3·08 (2·49–3·79)	4·43 (3·58–5·46)
Vanuatu	46·5 (38·9–56·8)	44·3 (36·8–54·1)	36·0 (30·4–44·3)	97·6 (80·7–118)
Southeast Asia	33·1 (28·6–38·3)	39·6 (35·3–45·2)	98 900 (86 000–115 000)	296 000 (263 000–340 000)
Cambodia	35·2 (29·9–42·2)	36·3 (31·1–43·8)	1900 (1630–2240)	5500 (4700–6610)
Indonesia	23·1 (20·3–27·1)	17·7 (15·6–20·6)	27 400 (24 100–32 000)	52 400 (45 700–61 900)
Laos	34·7 (29·8–41·6)	36·3 (31·1–43·5)	836 (720–976)	2140 (1840–2530)
Malaysia	72·0 (60·8–86·7)	130 (124–137)	7960 (6790–9490)	44 300 (42 400–46 700)
Maldives	46·3 (39·3–55·8)	51·9 (44·2–62·2)	51·6 (44·1–61·4)	248 (209–298)
Mauritius	66·5 (56·1–81·0)	66·5 (56·6–80·6)	558 (471–673)	1200 (997–1470)
Myanmar	35·4 (30·3–41·5)	36·1 (30·8–43·1)	9420 (8080–11 000)	20 100 (17 100–24 100)
Philippines	33·3 (29·4–38·7)	38·3 (33·7–44·4)	12 100 (10 700–14 100)	36 800 (32 400–42 700)
Seychelles	42·9 (37·1–51·8)	44·7 (38·4–54·0)	25·0 (21·6–30·1)	57·6 (48·9–70·3)
Sri Lanka	46·4 (39·3–55·0)	48·1 (40·8–57·7)	5750 (4910–6740)	13 900 (11 800–16 800)
Thailand	31·9 (18·6–39·0)	61·6 (54·1–71·9)	13 300 (7950–16 400)	66 400 (57 600–77 800)
Timor-Leste	39·6 (33·8–47·5)	39·8 (33·9–48·1)	152 (129–178)	391 (336–471)
Viet Nam	43·5 (37·1–51·7)	46·0 (39·7–54·2)	19 300 (16 500–22 700)	52 300 (44 700–62 100)
Sub-Saharan Africa	**2·70 (2·40–3·20)**	**3·80 (3·30–4·50)**	**8010 (6940–9630)**	**28 000 (24 400–33 400)**
Central sub-Saharan Africa	4·50 (3·80–5·50)	4·40 (3·70–5·40)	1430 (1220–1750)	3970 (3330–4760)
Angola	3·80 (3·20–4·80)	3·80 (3·20–4·70)	227 (190–278)	785 (651–955)
Central African Republic	4·00 (3·30–4·90)	3·80 (3·10–4·70)	64·6 (53·3–78·9)	135 (112–165)
Congo (Brazzaville)	2·40 (2·10–2·70)	3·10 (2·60–3·80)	35·9 (31·8–41·7)	122 (103–151)
Democratic Republic of the Congo	4·70 (3·90–5·80)	4·60 (3·90–5·70)	1040 (882–1270)	2750 (2310–3290)
Equatorial Guinea	4·50 (3·70–5·50)	4·90 (4·20–5·90)	11·4 (9·38–14·0)	46·9 (39·3–57·5)
Gabon	8·80 (7·40–10·8)	8·90 (7·50–10·9)	60·7 (50·9–73·5)	129 (108–157)
Eastern sub-Saharan Africa	1·40 (1·20–1·70)	1·50 (1·30–1·80)	1600 (1360–1920)	4310 (3700–5210)
Burundi	1·30 (1·10–1·60)	1·40 (1·10–1·70)	44·5 (37·4–54·7)	122 (101–149)
Comoros	1·50 (1·20–1·80)	1·50 (1·30–1·90)	4·32 (3·54–5·26)	10·2 (8·42–12·4)
Djibouti	1·50 (1·20–1·80)	1·50 (1·30–1·90)	3·65 (2·98–4·43)	16·2 (13·3–19·7)
Eritrea	1·30 (1·00–1·50)	1·30 (1·10–1·60)	25·7 (21·1–31·3)	65·5 (54·6–79·9)
Ethiopia	1·40 (1·20–1·60)	1·50 (1·30–1·80)	421 (366–502)	1130 (981–1340)
Kenya	1·50 (1·30–1·70)	1·80 (1·60–2·10)	206 (179–243)	667 (582–796)
Madagascar	1·40 (1·20–1·80)	1·50 (1·20–1·80)	106 (87·0–128)	295 (243–356)

(Table continues on next page)

	Age-standardised prevalence per 100 000		Number of cases	
	1990	2023	1990	2023
(Continued from previous page)				
Malawi	1·30 (1·10–1·60)	1·30 (1·10–1·60)	77·9 (65·5–95·3)	176 (145–213)
Mozambique	1·30 (1·10–1·60)	1·30 (1·10–1·60)	113 (93·2–137)	257 (215–313)
Rwanda	1·10 (1·00–1·40)	1·20 (1·00–1·50)	49·5 (40·9–60·3)	126 (104–154)
Somalia	1·30 (1·10–1·60)	1·20 (1·00–1·50)	59·2 (48·9–72·4)	158 (130–194)
South Sudan	1·50 (1·20–1·80)	1·40 (1·20–1·70)	53·9 (44·6–64·9)	93·7 (77·8–114)
Tanzania	1·40 (1·20–1·80)	1·50 (1·20–1·80)	228 (186–276)	631 (518–763)
Uganda	1·40 (1·20–1·70)	1·40 (1·20–1·70)	140 (118–171)	390 (325–471)
Zambia	1·30 (1·10–1·60)	1·30 (1·10–1·70)	60·7 (50·6–74·1)	170 (141–206)
Southern sub-Saharan Africa	5·90 (5·30–6·80)	15·9 (14·1–18·5)	2150 (1910–2470)	12 300 (10 900–14 500)
Botswana	1·10 (0·900–1·40)	1·40 (1·10–1·70)	9·40 (7·82–11·3)	27·9 (22·9–34·5)
Eswatini	2·20 (1·80–2·60)	2·20 (1·90–2·60)	10·1 (8·49–11·9)	19·9 (16·9–24·0)
Lesotho	2·10 (1·80–2·50)	2·10 (1·70–2·50)	22·4 (18·9–26·5)	30·7 (26·0–36·7)
Namibia	2·30 (2·10–2·40)	2·50 (2·20–2·80)	21·1 (19·3–23·1)	57·1 (50·9–64·6)
South Africa	7·30 (6·50–8·40)	19·7 (17·5–23·0)	1980 (1750–2280)	12 000 (10 600–14 200)
Zimbabwe	1·80 (1·60–2·00)	1·80 (1·50–2·30)	109 (94·4–127)	197 (161–243)
Western sub-Saharan Africa	2·40 (2·10–2·80)	2·40 (2·00–2·80)	2820 (2420–3380)	7440 (6340–8910)
Benin	3·80 (3·10–4·70)	3·80 (3·20–4·60)	104 (85·4–127)	326 (277–395)
Burkina Faso	2·50 (2·10–3·10)	2·40 (2·00–3·10)	142 (115–173)	351 (290–431)
Cabo Verde	3·10 (2·60–3·80)	3·20 (2·70–4·00)	7·53 (6·25–9·19)	14·9 (12·6–18·3)
Cameroon	2·40 (2·00–3·00)	2·40 (2·00–3·00)	148 (124–180)	495 (410–600)
Chad	2·50 (2·10–3·00)	2·40 (2·00–3·00)	89·8 (74·7–108)	236 (192–291)
Côte d'Ivoire	3·30 (2·80–4·10)	3·30 (2·70–4·10)	220 (183–270)	687 (574–851)
The Gambia	2·70 (2·20–3·30)	2·60 (2·10–3·10)	14·3 (11·9–17·6)	39·6 (33·2–47·8)
Ghana	1·20 (0·900–1·40)	1·20 (1·00–1·50)	106 (84·2–129)	273 (218–349)
Guinea	2·50 (2·10–3·10)	2·50 (2·00–3·10)	99·6 (82·6–124)	209 (172–254)
Guinea-Bissau	2·20 (1·90–2·80)	2·20 (1·80–2·70)	12·7 (10·3–15·6)	27·6 (22·5–34·0)
Liberia	2·60 (2·20–3·30)	2·60 (2·20–3·30)	41·1 (34·1–50·2)	99·3 (82·7–121)
Mali	2·50 (2·10–3·10)	2·50 (2·10–3·20)	134 (111–163)	348 (284–435)
Mauritania	5·80 (4·80–7·20)	6·00 (5·10–7·40)	77·1 (64·8–93·2)	189 (161–231)
Niger	2·60 (2·10–3·20)	2·50 (2·10–3·20)	109 (89·1–133)	342 (282–420)
Nigeria	2·30 (2·00–2·60)	2·20 (2·00–2·60)	1300 (1150–1540)	3260 (2850–3860)
São Tomé and Príncipe	2·80 (2·40–3·60)	2·90 (2·40–3·60)	2·23 (1·83–2·74)	4·83 (4·01–5·93)
Senegal	2·10 (1·70–2·60)	2·10 (1·70–2·60)	93·6 (77·0–114)	253 (203–309)
Sierra Leone	2·60 (2·10–3·20)	2·50 (2·10–3·10)	68·7 (57·3–84·5)	131 (109–162)
Togo	2·50 (2·10–3·10)	2·50 (2·10–3·00)	49·3 (40·9–60·2)	145 (119–177)

Data in parentheses are 95% uncertainty intervals. All data are presented to three significant figures.

Table: **Age-standardised prevalence of kidney failure with replacement therapy in 1990 and 2023**

per 100 000. Regionally, high-income North America had the highest age-standardised prevalence (165 [154–176] per 100 000) while eastern sub-Saharan Africa had the lowest (1·50 [1·30–1·80] per 100 000). Only two countries—the USA and Taiwan (province of China)—had an age-standardised prevalence greater than 150 per 100 000 population. The three highest ratios of KFRT to advanced CKD (eGFR >30 mL/min per 1·73 m²) at the country level were in Portugal, South Korea, and Singapore (appendix figure S4). Conversely, 18 countries, all in sub-Saharan Africa, had rates less than two per 100 000, and these countries had the lowest ratios of KFRT to advanced CKD (eGFR >30 mL/min per 1·73 m²; appendix figure S4). Specific rates by location are presented in the table and figure 1.

Dialysis prevalence

In 2023, there were 3·57 million (95% UI 3·11–4·17) global dialysis cases, with an age-standardised prevalence of 39·3 (35·6–44·4) per 100 000. The highest age-standardised prevalence of dialysis cases was in the GBD high-income super-region (75·9 [71·1–83·1] per 100 000) and the lowest was in sub-Saharan Africa (3·40 [2·90–4·10]; figure 2; appendix table S4). Regionally, high-income Asia Pacific had the highest prevalence, at 115 (107–128) per 100 000, and eastern sub-Saharan Africa

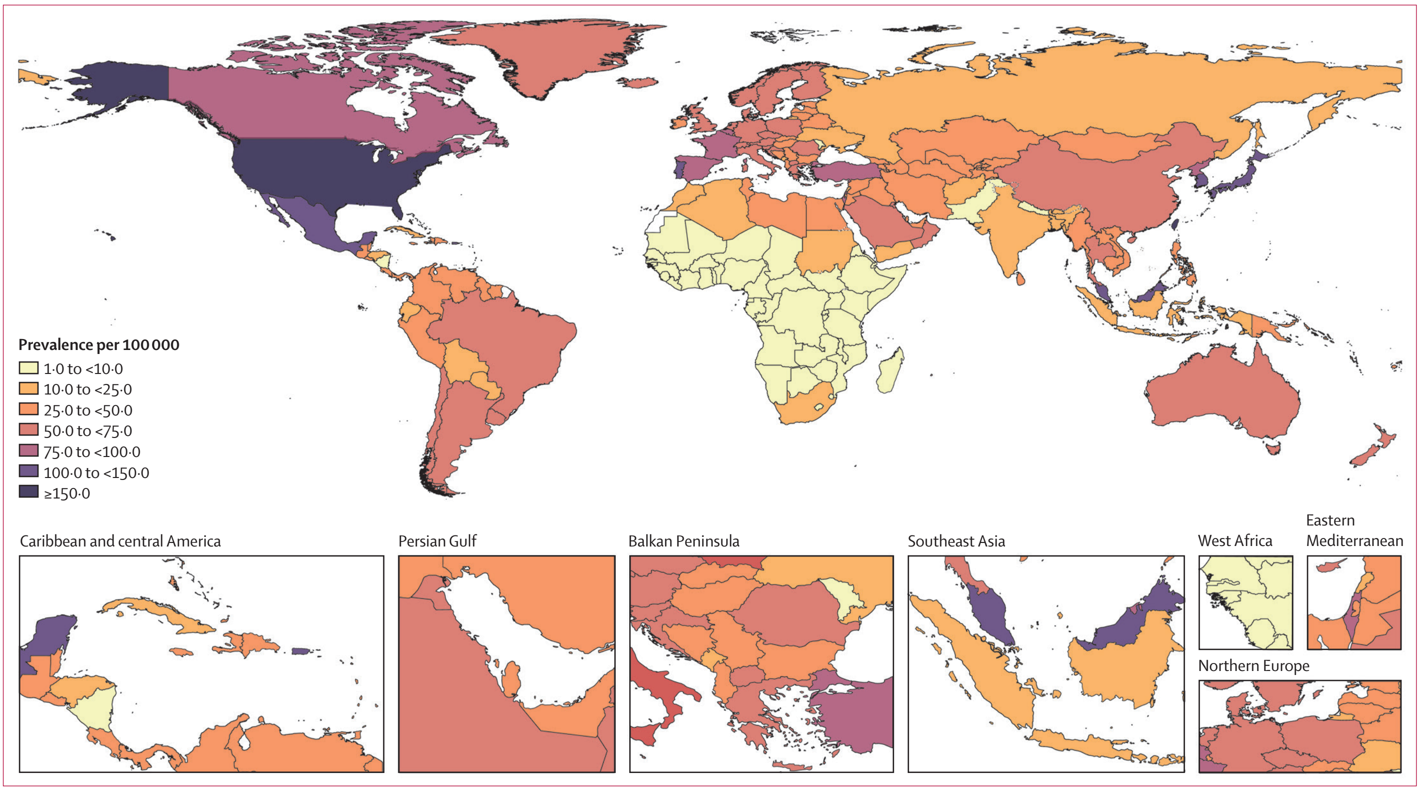

Figure 1: **Global age-standardised prevalence of kidney failure with replacement therapy per 100 000 in 2023**

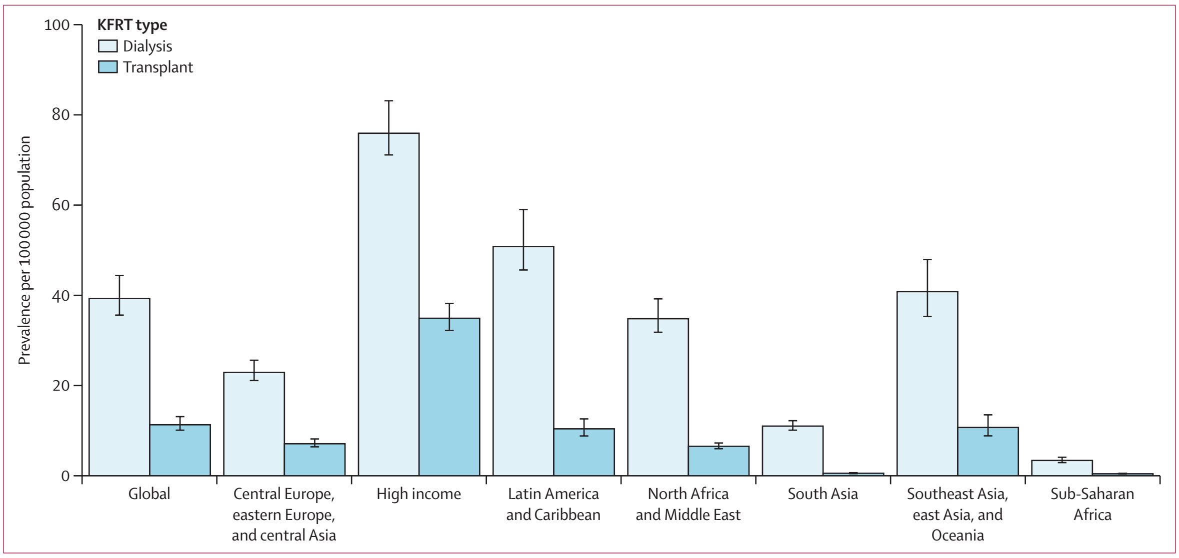

Figure 2: **Age-standardised prevalence of dialysis and kidney transplantation per 100 000 by GBD super-region in 2023**
GBD=Global Burden of Diseases, Injuries, and Risk Factors Study. KFRT=kidney failure with replacement therapy.

had the lowest, at 1·30 (1·10–1·50) per 100 000 (appendix table S4). Only six countries had a dialysis prevalence exceeding 100 per 100 000, and all of these countries were classified within the World Bank's high-income and upper-middle-income groups, as shown in figure 3. In stark contrast, 22 countries had a dialysis prevalence lower than two per 100 000. Among these, 12 countries were classified in the World Bank's lower-middle-income group, while the remaining ten were classified in the World Bank's low-income group (figure 3).

From 1990 to 2023, the global all-age prevalence of dialysis for both sexes rose by 104·0%

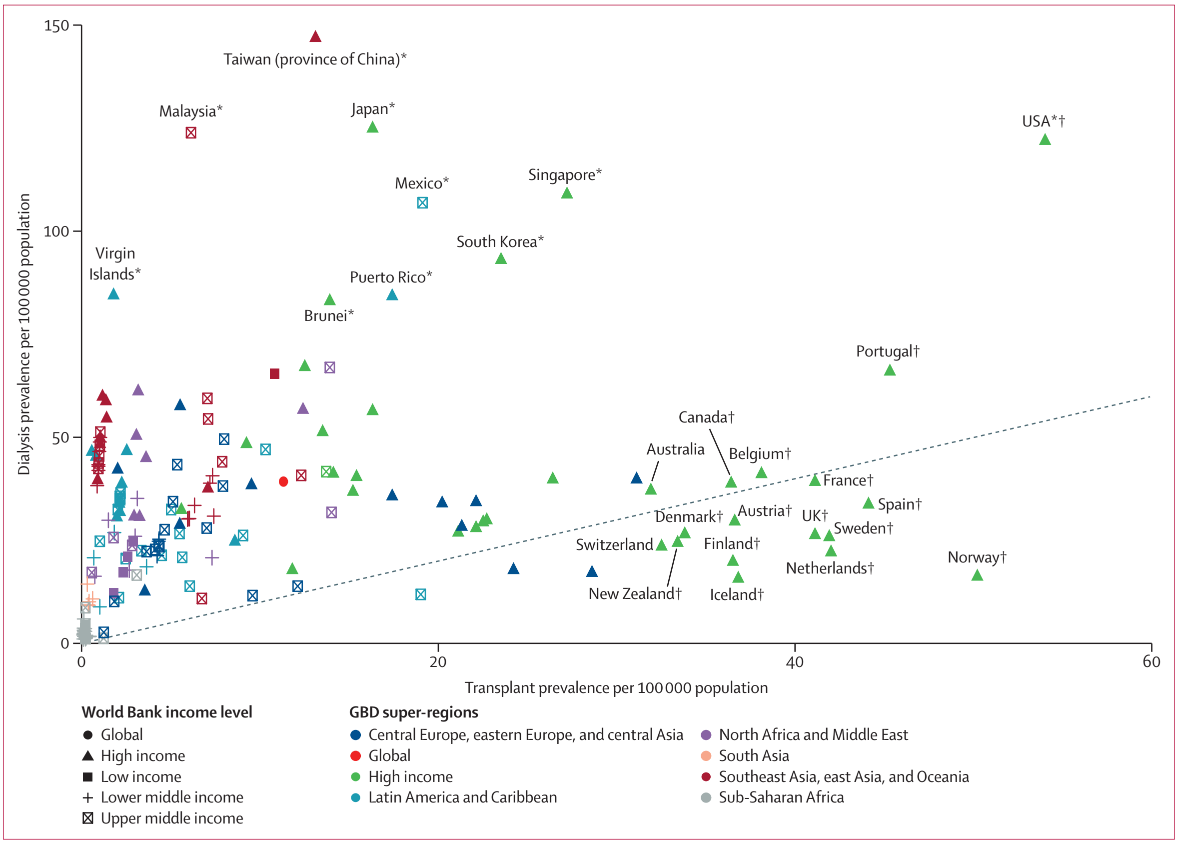

Figure 3: **Age-standardised prevalence of dialysis and kidney transplantation per 100 000 by GBD super-region and World Bank income level in 2023**
The dotted line represents a line of equality. GBD=Global Burden of Diseases, Injuries, and Risk Factors Study. *Locations with the highest kidney transplantation prevalence. †Locations with the highest dialysis prevalence.

(95% UI 95·3–113·0), from 21·7 (19·0–25·1) per 100 000 to 44·3 (39·8–50·1) per 100 000, while the age-standardised prevalence rose by 44·0% (38·9–48·9), from 27·3 (24·0–31·6) per 100 000 to 39·3 (35·6–44·4) per 100 000. Every super-region saw an increase in their all-age and age-standardised prevalence. Regionally, the largest percentage increase from 1990 to 2023 in all-age and age-standardised prevalence occurred in southern sub-Saharan Africa. All regions saw an increase in their all-age and age-standardised prevalence except for Oceania, western sub-Saharan Africa, and central sub-Saharan Africa, which saw negligible decreases. Among countries, South Korea, New Zealand, Türkiye, Romania, and Spain experienced the largest increases in their all-age prevalence, exceeding 500%, and their age-standardised prevalence exceeded a 300% increase. All all-age and age-standardised prevalence estimates of dialysis by location for 1990 and 2023 are presented in the appendix (table S4).

Across the global, super-regional, and regional levels in 2023, male prevalence of dialysis was significantly higher than female prevalence, except in the super-region of southeast Asia, east Asia, and Oceania, where the difference in the prevalence of dialysis between males and females was negligible (figure 4). At the country level, the prevalence was higher for males than for females in all countries (appendix figure S2).

Kidney transplant prevalence

In 2023, there were 1·02 million (95% UI 0·874–1·20) global kidney transplant cases, with an age-standardised prevalence of 11·3 (10·1–13·1) per 100 000 and all-age prevalence of 12·7 (11·2–14·6) per 100 000 (figure 2; appendix figure S3 and table S4). The highest age-standardised prevalence of kidney transplant cases among super-regions was in the GBD high-income super-region, at 34·9 (32·2–38·2) per 100 000, and the lowest was in sub-Saharan Africa (0·40 [0·40–0·50] per 100 000). Regionally, high-income North America had the highest prevalence, at 52·1 (47·3–57·8) per 100 000, and western sub-Saharan Africa had the lowest, at 0·20 (0·10–0·20) per 100 000. At the country level, the top 50 countries with the highest kidney transplant prevalence were all classified within the World Bank's high-income and upper-middle-income groups. Among these, the top 30 countries were exclusively from the GBD high-income group (figure 3). By contrast, 63 countries reported transplant prevalence lower

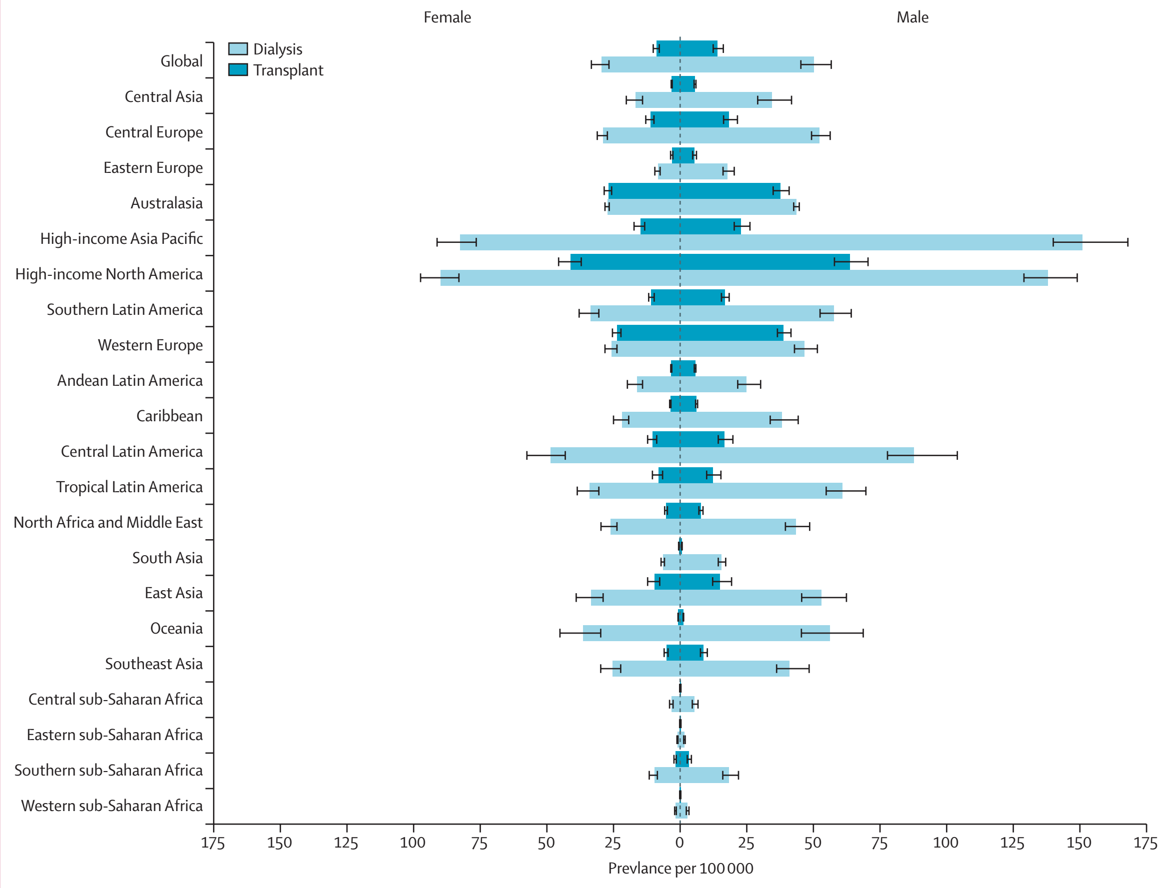

Figure 4: **Female and male age-standardised prevalence of dialysis and kidney transplantation per 100 000 by GBD regions in 2023**
GBD=Global Burden of Diseases, Injuries, and Risk Factors Study.

than 1 per 100 000. Of these, 53 countries were categorised within the World Bank's low-income or lower-middle-income levels (figure 3).

From 1990 to 2023, the global both-sex all-age prevalence of kidney transplant rose by 57·5% (95% UI 50·5–65·5), from 8·10 (7·00–9·50) per 100 000 to 12·7 (11·2–14·6) per 100 000, and the age-standardised prevalence increased by 20·0% (16·2–24·3), from 9·50 (8·30–11·1) per 100 000 to 11·3 (10·1–13·1) per 100 000. Every super-region saw an increase in their all-age and age-standardised prevalence, except for south Asia and southeast Asia, east Asia, and Oceania, which experienced a slight decrease in age-standardised prevalence. Regionally, the largest percentage increase in all-age and age-standardised prevalence occurred in high-income North America. Similar to the super-regional trend, all regions experienced an increase in their all-age and age-standardised prevalence, except for age-standardised prevalence in Oceania, east Asia, and south Asia. Among countries, the USA and South Korea were the only two countries that saw an increase in their all-age prevalence that was greater than 200%; the age-standardised prevalence increased above 125%. Similar to dialysis, all-age and age-standardised prevalence estimates for kidney transplant for 1990 and 2023 are provided in the appendix (table S4).

The sex differences observed for kidney transplants at all levels of the geographical hierarchy followed a similar pattern to that of the dialysis sex trends discussed above (figure 4; appendix figure S2).

Associated aetiologies of KFRT

In 2023, type 2 diabetes and hypertension were attributed to 40·6% (95% UI 35·1–47·1) of global KFRT cases across all ages and both sexes (figure 5). By contrast, other associated aetiologies contributed a smaller proportion, with 34·4% (30·5–38·3) attributed to other and unspecified causes, 17·0% (14·7–19·7) attributed to glomerulonephritis, and 8·00% (6·10–9·80) attributed to type 1 diabetes (figure 5). Among super-regions, the proportion of cases of KFRT attributed to type 2 diabetes varied, reaching as high as a quarter of cases in the high-income super-region, while hypertension was responsible for nearly a third of KFRT cases in sub-Saharan Africa (figure 5). Additionally, we observed that between 42% and 45% of KFRT cases were related to

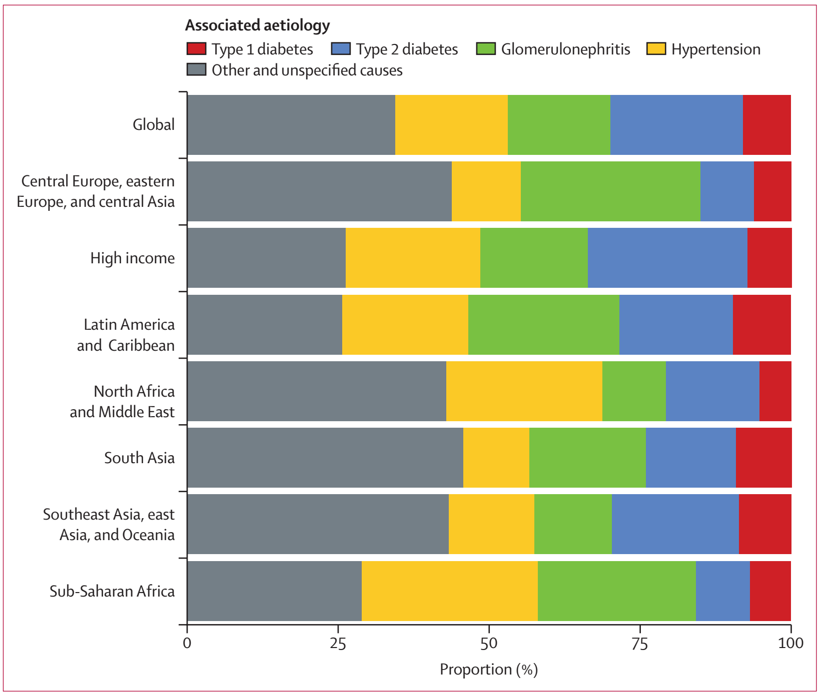

Figure 5: **Proportion of associated aetiologies of kidney failure with replacement therapy by GBD super-region in 2023**
GBD=Global Burden of Diseases, Injuries, and Risk Factors Study.

other and unspecified causes in the south Asia super-region, central Europe, eastern Europe, and central Asia super-region, southeast Asia, east Asia, and Oceania super-region, and north Africa and the Middle East super-region (figure 5). At the regional level, the proportion of KFRT cases attributable to type 2 diabetes and hypertension ranged from 17% in eastern Europe to 61% in high-income North America. Furthermore, in southeast Asia, the Caribbean, and high-income Asia Pacific, more than 50% of KFRT cases in both sexes and all age groups were attributed to type 2 diabetes and hypertension (appendix figure S3). Among the 204 countries, type 2 diabetes and hypertension accounted for at least a quarter of KFRT cases in 149 countries (appendix table S5).

From 1990 to 2023, the global all-age and age-standardised prevalence of KFRT attributed to the specified associated aetiologies included in this analysis increased substantially, with changes ranging from 60·8% to 144% for all-age prevalence, and from 24·0% to 62·1% for age-standardised prevalence (appendix figure S3). Among these, type 2 diabetes and hypertension showed the largest increases, followed by other and unspecified causes, type 1 diabetes, and glomerulonephritis. These trends were consistent across all super-regions (appendix figure S3). This pattern was generally observed at the regional level, apart from western sub-Saharan Africa, where all-age prevalence of glomerulonephritis, type 2 diabetes, and hypertension showed minimal decreases. Age-standardised prevalence followed a similar increasing trend, with exceptions in western sub-Saharan Africa, central sub-Saharan Africa, and Oceania, where all associated aetiologies (except for type 2 diabetes) did not show an increased rate (appendix figure S3). At the country level, Australia saw a substantial increase in both all-age and age-standardised prevalence of KFRT attributed to type 2 diabetes, exceeding 1000%. Similarly, South Korea and Romania experienced large fluctuations in all-age prevalence of KFRT ascribed to type 2 diabetes and hypertension, with increases also surpassing 1000% from 1990 to 2023 (appendix figure S3).

Discussion

We estimated that almost 5 million people worldwide were receiving KFRT in 2023. Over the past three decades, the global KFRT prevalence has steadily increased, although large and stark geographical disparities were evident. The highest prevalence and highest ratios of KFRT of advanced CKD were found in the GBD high-income regions, while the lowest prevalence and ratios were observed in sub-Saharan Africa. Both dialysis and transplant prevalence were generally higher in countries classified within the World Bank's high-income and upper-middle-income groups, while countries within the World Bank's low-income and lower-middle-income groups had lower prevalence. Additionally, a pronounced sex disparity was identified, where male dialysis and transplant prevalence estimates were consistently higher than those for females in most countries. Among the primary aetiologies of KFRT, type 2 diabetes and hypertension were responsible for a large majority of all cases. Furthermore, all aetiologies, particularly type 2 diabetes and hypertension, showed substantial growth between 1990 and 2023, even after adjusting for age standardisation.

Quantifying KFRT prevalence shows not only the increasing burden associated with the most advanced stages of CKD, but also the strain placed on health systems due to the costly and resource-intensive nature of KFRT treatments. Additionally, epidemiological estimates of KFRT underscore the urgent need for cost-effective strategies, given the high costs associated with its treatment. The global median annual cost of dialysis in 2021 was approximately $19 380 per person and the median first-year cost of kidney transplantation was $26 903 per person.[6] However, early management of syndemic[12] metabolic chronic conditions has the potential to reduce KFRT-related expenses by addressing kidney health before it manifests into KFRT.[13,14] By intervening earlier and improving management of these chronic conditions, health systems can substantially lower costs while improving not only kidney health but overall health too.

Despite the considerable health and economic impact of CKD and KFRT, there is a notable absence of specific policies targeting CKD in non-communicable disease prevention strategies, both globally and nationally.[6] This concern has been highlighted by the International Society of Nephrology (ISN) Global Kidney Health Atlas (ISN-GKHA), where the authors advocated for the incorporation of CKD and KFRT into relevant policies, recognising the substantial benefits their inclusion would yield.[6] In response to these challenges, international efforts by organisations such as ISN and initiatives such as World Kidney Day[15]—along with the work of regional nephrology associations such as the European Renal Association (ERA),[16] American Society of Nephrology (ASN),[16] Latin American Society of Nephrology (SLANH), Asian Pacific Society of Nephrology (APSN), and African Association of Nephrology (AFRAN)—have focused on raising awareness and overcoming barriers that impede countries' abilities to prevent, diagnose, and treat CKD and its progression to KFRT. The present report provides age-sex-time-specific estimates of KFRT, by therapy and associated aetiology, for 204 countries and territories with the goal of supporting and complementing these initiatives.

Although our study reveals substantial geographical disparities in KFRT prevalence, it is imperative not to interpret lower prevalence as being indicative of a lack of concern or a lack of disease burden related to KFRT.[11] Instead, the observed differences might signal systemic issues such as inadequate health-care infrastructure, insufficient awareness, and barriers to timely intervention for treatment.[11] A survey by the ISN-GKHA found that less than half of 167 countries allocate public funding for dialysis and kidney transplantation, contributing to considerable challenges in delivering appropriate and timely KFRT care,[6] and there have been reported shortages in skilled health-care personnel and inadequate access to donor organs.[17,18] These issues are not confined to a single country, as similar challenges are observed across various nations, underscoring the importance of political, social, and health-care structures as key contextual factors in understanding potential drivers of KFRT prevalence. As one example, although certainly not the only possible one, our results indicate that South Korea's KFRT prevalence estimates showed some of the most significant changes from 1990 to 2023. Several studies suggest that South Korea's high KFRT prevalence over time can be attributed to a combination of factors, including health-care reimbursement systems that reduce patient costs,[19] the rising prevalence of related metabolic conditions,[20] and the gradual expansion of essential infrastructure, particularly dialysis clinics, over time.[20] However, even within this system, challenges persist, including human resource sustainability, the need for increased awareness and education about CKD among clinicians and the public, and whether the system can keep pace with the rising prevalence of related metabolic conditions. To reiterate, these challenges are not unique to South Korea; they are worldwide concerns. Yet, in countries with scarce resources, these barriers are magnified, making them even more difficult to address and affecting the ability of patients to receive the treatment they need, particularly as populations age and there is no evidence that the trajectory of advanced CKD is plateauing or declining.[1] The geographical disparities should therefore be seen as indicators of health-care system opportunities, rather than inherent differences in the KFRT burden, emphasising the urgent need for further investigation into the factors influencing the needs of patients with kidney failure, and access to replacement therapy.

As health systems build their KFRT capacity and future research builds on understanding the drivers behind access to replacement therapy, a promising and feasible approach to continue to address the KFRT burden could involve health-care policies to embrace and implement preventive strategies for CKD alongside other conditions that contribute to the CKD burden. Integration of CKD into existing non-communicable disease programmes and policies might be another efficient pathway. Our estimates indicate that, as of 2023, more than 4·5 million individuals are either on dialysis or have undergone a kidney transplant. Although this number is large, it only constitutes a small proportion of total prevalent cases of CKD.[1] Previous studies have shown that the majority of prevalent CKD cases are among those in the early stages of disease.[1] This demographic constitutes an important and substantial population that stands to gain the most from health-care strategies and policies focused on slowing disease progression before it reaches more advanced stages. Previous studies have investigated strategies aimed at preventing CKD progression at various phases over the clinical course of the disease.[21] Largely, these prevention strategies not only mitigate the overall burden of CKD—and subsequently KFRT—at the population level, but many have also been shown to be cost-effective, especially in high-risk populations such as individuals with diabetes or hypertension, if screened for CKD in line with KDIGO guidelines.[21] Implementing less cost-intensive preventive measures such as the use of angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, or non-steroidal mineralocorticoid receptor antagonists, as well as adoption of lifestyle and dietary modifications, can further enhance the efficacy of these strategies.[21–23] GLP-1 receptor agonists and SGLT2 inhibitors have been shown to be particularly effective in reducing the risk of kidney disease progression.[2,24] Recently, SGLT2 inhibitors have also been listed among WHO's essential medicines, highlighting their importance in management of chronic conditions.[25] The cost of these medicines can pose another barrier for already financially overburdened health systems; however, as these medicines become more affordable, their widespread implementation—particularly in resource-restricted settings—should be considered. Although addressing financial constraints and barriers associated with KFRT care remains of

For more on the **Latin American Society of Nephrology** see https://uia.org/s/or/en/1100065130

For more on the **Asian Pacific Society of Nephrology** see https://www.apsneph.org/web/index.php

For more on the **African Association of Nephrology** see https://afran.org/

paramount importance, especially for resource-limited countries, it is equally important to recognise that adopting preventive care strategies capable of curbing progression to the most severe stages of CKD offers a cost-effective approach that countries can reasonably adopt.

This analysis identified a distinct sex disparity in dialysis and transplant prevalence estimates, which is consistent with findings from several other studies that have observed a sex disparity for CKD and KFRT cases.[26–28] Although the precise direct drivers of this disparity remain unclear, there are several potential contributing factors, ranging from biological to sociocultural, that should be considered. Many studies have detailed how biological mechanisms, such as sex hormones, contribute to the progression of CKD to kidney failure differently in males than in females.[29,30] Additional evidence highlights specific causative factors, such as certain health conditions and risk factors that are more prevalent in males, rendering them more susceptible to the development of KFRT.[7,31,32] Other studies highlight sociocultural factors—such as gender roles, inequities in access to health care, and health-seeking behaviours—that have been documented to contribute to differential health-care utilisation rates between males and females, which in turn affect the prevention and management of KFRT.[27,33] Moreover, contextual factors such as socioeconomic status, educational opportunities, and cultural beliefs can influence the likelihood that individuals, particularly women, will receive timely diagnosis and treatment for kidney diseases.[28,34,35] Overall, the combination of these various drivers calls for further and deeper exploration to better understand the impact of these factors on KFRT cases.

Our estimates show that, globally, KFRT ascribed to type 2 diabetes and hypertension increased between 1990 and 2023 and accounted for the majority of all KFRT cases by 2023. As the world's nutritional landscape and health economics evolve over time, the rise in metabolic conditions such as high BMI, hypertension, and type 2 diabetes follows suit.[7] The increasing proportion of KFRT cases ascribed to type 2 diabetes and hypertension highlights the importance of implementing preventive measures, early detection strategies, and efficacious management approaches for these conditions, which in turn could affect and reduce the burden of KFRT. This issue becomes even more urgent as projections from one study show that all countries are expected to see a substantial increase in the prevalence of type 2 diabetes, with some countries projecting a larger than 200% rise by 2050.[7] This sharp increase should raise alarms for management of CKD and subsequently KFRT, given its strong link to metabolic conditions such as diabetes. The rapid global increase in type 2 diabetes and hypertension, coupled with other factors such as an ageing population,[1] a rise in dietary and nutritional risks,[36] and increased obesity[37] raises major concerns about the capacity of health systems around the world to manage and control the future burden of KFRT.

There are several limitations of this analysis that need to be considered. Our analysis highlights the four most common aetiologies of KFRT; however, we recognise that there are several other aetiologies of CKD, such as exposure to toxins or pollutants,[38] drug toxicity,[39] and inherited kidney diseases such as *APOL1*-mediated kidney disease[40] and polycystic kidney disease.[41] We did not explicitly model these aetiologies due to inadequate specificity and inconsistent reporting of data across renal registries; however, these aetiologies are included in our associated cause category labelled "other causes". Given this limitation, our results cannot provide detailed information about the landscape of these specific aetiologies, or their relationship to KFRT. The only cause with potentially sufficient coverage across renal registries and the demographic dimensions of interest was polycystic kidney disease, the inclusion of which is currently under exploration for future iterations of GBD.

Another limitation is that we relied on renal registries properly reporting causal diagnoses, so our estimations were subject to differences in diagnosing practices across regions, insufficient rules for coding procedures and diagnoses, and difficulties in diagnosing comorbidities associated with these codes.[42] Substantial global variations exist in the quality, accessibility, and sustainability of renal registries, with low-income and middle-income countries often lacking a national registry compared to their high-income counterparts.[5] Nevertheless, it is important to note that the relationship of certain conditions, such as diabetes and hypertension, to KFRT has been extensively studied, so the relationship between these aetiologies and KFRT is well established.[43,44]

At the time of the present analysis, COVID-19 had not been included as a risk factor for KFRT. Despite emerging evidence associating COVID-19 with kidney conditions, specifically acute kidney injury, the conclusive strength of this association and its causal pathway to KFRT are as yet unconfirmed, primarily due to constraints in data availability.[45] In forthcoming iterations of KFRT estimation within the GBD framework, due consideration should be given to integrating potential impacts stemming from COVID-19 on the non-fatal health components of KFRT, contingent upon the emergence of additional studies and evidence.

Last, this analysis does not present forecasted estimates for KFRT, limiting thorough evaluation of the anticipated prevalence. The current forecasting framework used in other GBD publications does not have the ability to produce projections for KFRT. This forecasting methodology has been elaborated on elsewhere.[46] Nevertheless, this limitation highlights the need for future research with a focus on exploring and incorporating forecasted estimates.

In conclusion, KFRT represents a major global health issue, with marked regional disparities. Lower prevalence should not be interpreted as a diminished concern or disease burden, but rather as an indication of underlying health-care system gaps. This analysis emphasises the urgent need for more research into the factors influencing access to KFRT care. As health systems work to expand their KFRT capacity and address the weaknesses, incorporating CKD prevention into both new and existing non-communicable disease policies could provide a cost-effective solution. The variation in KFRT prevalence by sex also warrants further investigation into the factors driving these disparities. Type 2 diabetes and hypertension are the leading aetiologies of KFRT, with their prevalence rising significantly over time. Given the association between CKD, diabetes, and hypertension, prioritising prevention and early management of these conditions is essential. Addressing the burden of KFRT is complex and requires a multifaceted approach: strengthening CKD prevention, enhancing our understanding of the unmet need, and improving early diagnosis, particularly in regions with scarce health-care resources for management of KFRT, will become increasingly important as global populations age.

GBD 2023 Kidney Failure with Replacement Therapy Collaborators
Quinn Rafferty,* Lauryn K Stafford, Theo Vos, Fernando Saldanha Thomé, Hasan Aalruz, Yohannes Habtegiorgis Abate, Cristiana Abbafati, Samar Abd ElHafeez, Armita Abedi, Olugbenga Olusola Abiodun, Lucas Guimarães Abreu, Eman Abu-Gharbieh, Salahdein Aburuz, Ahmed Abu-Zaid, Lawan Hassan Adamu, Isaac Yeboah Addo, Oyelola A Adegboye, Abiola Victor Adepoju, Olorunsola Israel Adeyomoye, Qorinah Estiningtyas Sakilah Adnani, Sanjay Kumar Agarwal, Shahin Aghamiri, Krishna Kumar Agrawaal, Bright Opoku Ahinkorah, Aqeel Ahmad, Muayyad M Ahmad, Sajjad Ahmad, Ali Ahmed, Ayman Ahmed, Syed Anees Ahmed, Marjan Ajami, Shiva Akhlaghi, Sreelatha Akkala, Ziyad Al-Aly, Mohammed Albashtawy, Khalifah A Aldawsari, Hediyeh Alemi, Adel Ali Saeed Al-Gheethi, Fadwa Naji Alhalaiqa, Endale Alemayehu Ali, Syed Shujait Ali, Omar Almidani, Rajaa M Mohammad Al-Raddadi, Farrukh Jawad Alvi, Nelson Alvis-Guzman, Nelson J Alvis-Zakzuk, Yaser Mohammed Al-Worafi, Safwat Aly, Karem H Alzoubi, Reza Amani, Hubert Amu, Ganiyu Adeniyi Amusa, Catalina Liliana Andrei, Abhishek Anil, Adnan Ansar, Anayochukwu Edward Anyasodor, Jalal Arabloo, Elshaimaa A Arafa, Mesay Arkew, Johan Ärnlöv, Tahira Ashraf, Mohammad Athar, Seyyed Shamsadin Athari, Maha Moh'd Wahbi Atout, Adedapo Wasiu Awotidebe, Zewdu Bishaw Aynalem, Sina Azadnajafabad, Hamed Azhdari Tehrani, Shahkaar Aziz, Hassan Babamohamadi, Muhammad Badar, Arvind Bagga, Sara Bagherieh, Ovidiu Constantin Baltatu, Hiba Jawdat Barqawi, Sanjay Basu, Saurav Basu, Kavita Batra, Nebiyou Simegnew Bayleyegn, Neeraj Bedi, Amir Hossein Behnoush, Alehegn Bekele, Luis Belo, Bright Benfor, Isabela M Bensenor, Amiel Nazer C Bermudez, Akshaya Srikanth Bhagavathula, Sonu Bhaskar, Gurjit Kaur Bhatti, Jasvinder Singh Bhatti, Ali Bijani, Boris Bikbov, Mariah Malak Bilalaga, Veera R Bitra, Kaustubh Bora, Yasser Bustanji, Zahid A Butt, Luis Alberto Cámera, Juan Jesus Carrero, Márcia Carvalho, Ferrán Catalá-López, Alberico L Catapano, Muthia Cenderadewi, Joshua Chadwick, Promit Ananyo Chakraborty, Eeshwar K Chandrasekar, Vijay Kumar Chattu, Endeshaw Chekol Abebe, Patrick R Ching, Enayet Karim Chowdhury, Rajiv Chowdhury, Dinh-Toi Chu, Sheng-Chia Chung, Massimo Cirillo, Alyssa Columbus, Josef Coresh, Natalia Cruz-Martins, Omid Dadras, Xiaochen Dai, Lalit Dandona, Rakhi Dandona, Saswati Das, Mohadese Dashtkoohi, Mogamat Razeen Davids, Ivan Delgado-Enciso, Berecha Hundessa Demessa, Xinlei Deng, Hardik Dineshbhai Desai, Vinoth Gnana Chellaiyan Devanbu, Syed Masudur Rahman Dewan, Daniel Diaz, Lankamo Ena Digesa, Abhinav Dixit, Thao Huynh Phuong Do, Camila Bruneli do Prado, Khanh Duy Doan, Klara Georgieva Dokova, Deepa Dongarwar, Robert Kokou Dowou, Hisham Atan Edinur, Michael Ekholuenetale, Temitope Cyrus Ekundayo, Muhammed Elhadi, Waseem El-Huneidi, Mohamed A Elmonem, Christopher Imokhuede Esezobor, Francesco Esposito, Farshid Etaee, Adeniyi Francis Fagbamigbe, Razana Faiz, Aida Fallahzadeh, Emerito Jose A Aquino Faraon, Alireza Feizkhah, Ginenus Fekadu, Nuno Ferreira, Bikila Regassa Feyisa, Florian Fischer, Abduzhappar Gaipov, Aravind P Gandhi, Miglas Welay Gebregergis, Mathewos Mekonnen Gemmechu, Mansour Ghafourifard, Ibrahim Abdelmageed Ginawi, Ebisa Zerihun Gindaba, Mahaveer Golechha, Pouya Goleij, Davide Golinelli, Shi-Yang Guan, Mesay Dechasa Gudeta, Anish Kumar Gupta, Rajat Das Gupta, Rajeev Gupta, Sapna Gupta, Veer Bala Gupta, Vivek Kumar Gupta, Najah R Hadi, Hailey Hagins, Teklehaimanot Gereziher Haile, Sobia Ahsan Halim, Rabih Halwani, Nadia M Hamdy, Samer Hamidi, Ahmad Hammoud, Habtamu Endashaw Hareru, S M Mahmudul Hasan, Md Saquib Hasnain, Johannes Haubold, Jiawei He, Keyvan Heydari, Yuta Hiraike, Praveen Hoogar, Hassan Hosseinzadeh, Mehdi Hosseinzadeh, Mihaela Hostiuc, Hong-Han Huynh, Segun Emmanuel Ibitoye, Irena M Ilic, Md Rabiul Islam, Sheikh Mohammed Shariful Islam, Muhammad Islampanah, Nahlah Elkudssiah Ismail, Hiroyasu Iso, Gaetano Isola, Masao Iwagami, Chidozie Declan Iwu, Mahboobeh Jafari, Khushleen Jaggi, Ammar Abdulrahman 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Sandeep B Maharaj, Amir Ali Mahboobipour, Mansour Adam Mahmoud, Reza Malekzadeh, Kashish Malhotra, Ahmad Azam Malik, Emmanuel Manu, Patrick B Mark, Winfried März, Elezebeth Mathews, Andrea Maugeri, Stephen Peter McDonald, Steven M McPhail, Hadush Negash Meles, Mohsen Merati, Tomislav Mestrovic, Tomasz Miazgowski, Niloofar Mirdamadi, Erkin M Mirrakhimov, Vinaytosh Mishra, Nouh Saad Mohamed, Mustapha Mohammed, Shafiu Mohammed, Alireza Mohseni, Ali H Mokdad, AmirAli Moodi Ghalibaf, Yousef Moradi, Linda Morales-Juárez, Negar Morovatdar, Parsa Mousavi, Kavita Munjal, Efren Murillo-Zamora, Ahmad Mustafa, Muhammad Muzaffar, Shankar Prasad Nagaraju, Mohsen Naghavi, Pirouz Naghavi, Tapas Sadasivan Nair, Jobert Richie Nansseu, Abdallah Y Naser, Gopalakrishnan Natarajan, Zuhair S Natto, Ashish Kumar Nayyar, Athare Nazri-Panjaki, Mohammad Negaresh, Ruxandra Irina Negoi, Nawi Ng, Dang Nguyen, Hau Thi Hien Nguyen, Hien Quang Nguyen, Phat Tuan Nguyen, Van Thanh Nguyen, Robina Khan Niazi, Muhammad A Nizam, Mamoona Noreen, Jean Jacques Noubiap, Chisom Adaobi Nri-Ezedi, Chimezie Igwegbe Nzoputam, Bogdan Oancea, Oluwakemi Ololade Odukoya, Hassan Okati-Aliabad, Osaretin Christabel Okonji, Andrew T Olagunju, Tosin Abiola Olasehinde, Hany A Omar, Alberto Ortiz, Wael M S Osman, Uchechukwu Levi Osuagwu, Mayowa O Owolabi, Ifeoluwa Temitayo Oyeyemi, Alicia Padron-Monedero, Jagadish Rao Padubidri, Anamika Pandey, Shahina Pardhan, Romil R Parikh, Seoyeon Park, Maja Pasovic, Jay Patel, Shrikant Pawar, Prince Peprah, Norberto Perico, Simone Perna, Hoang Tran Pham, Anil K Philip, Elton Junio Sady Prates, Jagadeesh Puvvula, Ibrahim Qattea, Mosiur Rahman, Muhammad Aziz Rahman, Masoud Rahmati, Shakthi Kumaran Ramasamy, Sheena Ramazanu,

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Bruce B Duncan,§ Simon I Hay,§ Christopher J L Murray,§ and Kanyin Liane Ong.§
*Lead author
§Co-senior authors

Affiliations
Please see the appendix (pp 3–13) for the affiliations of individual authors.

Contributors

Please see the appendix (pp 13–17) for more detailed information about individual author contributions to the research, divided into the following categories: managing the overall research enterprise; writing the first draft of the manuscript; primary responsibility for applying analytical methods to produce estimates; primary responsibility for seeking, cataloguing, extracting, or cleaning data; designing or coding figures and tables; providing data or critical feedback on data sources; developing methods or computational machinery; providing critical feedback on methods or results; drafting the manuscript or revising it critically for important intellectual content; and managing the estimation or publications process. The lead and senior authors had full access to the data in the study and had final responsibility for the decision to submit the manuscript for publication.

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Data sharing

Our study follows the GATHER statement and analyses were completed with Python (version 3.10.4), Stata (version 13.1), and R (version 4.2.1). The findings of this study are supported by data available in public online repositories, data publicly available upon request of the data provider, and data not publicly available due to restrictions by the data provider. Non-publicly available data were used under license for the current study but might be available from the authors upon reasonable request and with permission of the data provider. Information about these data sources are publicly available to view in the Global Health Data Exchange (https://ghdx.healthdata.org/keyword/chronic-kidney-diseases).

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References

1 Bikbov B, Purcell CA, Levey AS, et al, and the GBD Chronic Kidney Disease Collaboration. Global, regional, and national burden of chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet* 2020; **395:** 709–33.

2 Stevens PE, Ahmed SB, Carrero JJ, et al, and the Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. KDIGO 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. *Kidney Int* 2024; **105:** S117–314.

3 Vos T, Lim SS, Abbafati C, et al, and the GBD 2019 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet* 2020; **396:** 1204–22.

4 Kalantar-Zadeh K, Jafar TH, Nitsch D, Neuen BL, Perkovic V. Chronic kidney disease. *Lancet* 2021; **398:** 786–802.

5 Liu FX, Rutherford P, Smoyer-Tomic K, Prichard S, Laplante S. A global overview of renal registries: a systematic review. *BMC Nephrol* 2015; **16:** 31.

6 Bello AK, Okpechi IG, Levin A, et al, and the ISN-GKHA Group. An update on the global disparities in kidney disease burden and care across world countries and regions. *Lancet Glob Health* 2024; **12:** e382–95.

7 Ong KL, Stafford LK, McLaughlin SA, et al, and the GBD 2021 Diabetes Collaborators. Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet* 2023; **402:** 203–34.

8 Zhou B, Carrillo-Larco RM, Danaei G, et al, and the NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. *Lancet* 2021; **398:** 957–80.

9 Ismail H, Abdul Manaf MR, Abdul Gafor AH, Mohamad Zaher ZM, Nur Ibrahim AI. International comparisons of economic burden of endstage renal disease to the national healthcare systems. *IIUM Med J Malays* 2020; **18:** 191–92.

10 Institute for Health Metrics and Evaluation. Protocol for the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD). Version 4. https://www.healthdata.org/research-analysis/about-gbd/protocol (accessed Dec 6, 2024).

11 Liyanage T, Ninomiya T, Jha V, et al. Worldwide access to treatment for end-stage kidney disease: a systematic review. *Lancet* 2015; **385:** 1975–82.

12 The Lancet. Syndemics: health in context. *Lancet* 2017; **389:** 881.

13 Triozzi JL, Parker Gregg L, Virani SS, Navaneethan SD. Management of type 2 diabetes in chronic kidney disease. *BMJ Open Diabetes Res Care* 2021; **9:** e002300.

14 Pugh D, Gallacher PJ, Dhaun N. Management of hypertension in chronic kidney disease. *Drugs* 2019; **79:** 365–79.

15 Collins AJ, Couser WG, Dirks JH, et al. World Kidney Day: an idea whose time has come. *Am J Kidney Dis* 2006; **47:** 375–77.

16 Francis A, Harhay MN, Ong ACM, et al, and the American Society of Nephrology, and the European Renal Association, and the International Society of Nephrology. Chronic kidney disease and the global public health agenda: an international consensus. *Nat Rev Nephrol* 2024; **20:** 473–85.

17 Riaz P, Caskey F, McIsaac M, et al. Workforce capacity for the care of patients with kidney failure across world countries and regions. *BMJ Glob Health* 2021; **6:** e004014.

18 Mudiayi D, Shojai S, Okpechi I, et al. Global estimates of capacity for kidney transplantation in world countries and regions. *Transplantation* 2022; **106:** 1113–22.

19 Kim Y-S, Kim Y, Shin SJ, et al. Current state of dialysis access management in Korea. *J Vasc Access* 2019; **20:** 15–19.

20 Choi HS, Han K-D, Oh TR, et al. Trends in the incidence and prevalence of end-stage renal disease with hemodialysis in entire Korean population: a nationwide population-based study. *Medicine* 2021; **100:** e25293.

21 Shlipak MG, Tummalapalli SL, Boulware LE, et al, and the Conference Participants. The case for early identification and intervention of chronic kidney disease: conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Controversies Conference. *Kidney Int* 2021; **99:** 34–47.

22 Yang A, Shi M, Lau ESH, et al. Clinical outcomes following discontinuation of renin-angiotensin-system inhibitors in patients with type 2 diabetes and advanced chronic kidney disease: a prospective cohort study. *EClinicalMedicine* 2022; **55:** 101751.

23 Barrera-Chimal J, Girerd S, Jaisser F. Mineralocorticoid receptor antagonists and kidney diseases: pathophysiological basis. *Kidney Int* 2019; **96:** 302–19.

24 Badve SV, Bilal A, Lee MMY, et al. Effects of GLP-1 receptor agonists on kidney and cardiovascular disease outcomes: a meta-analysis of randomised controlled trials. *Lancet Diabetes Endocrinol* 2025; **13:** 15–28.

25 Danne T, Ampudia-Blasco FJ, Mathieu C. Diabetes and the WHO model list of essential medicines. *Lancet Diabetes Endocrinol* 2022; **10:** 18–19.

26 Bikbov B, Perico N, Remuzzi G, on behalf of the GBD Genitourinary Diseases Expert Group. Disparities in chronic kidney disease prevalence among males and females in 195 countries: analysis of the Global Burden of Disease 2016 Study. *Nephron J* 2018; **139:** 313–18.

27 Antlanger M, Noordzij M, van de Luijtgaarden M, et al, and the ERA-EDTA Registry. Sex differences in kidney replacement therapy initiation and maintenance. *Clin J Am Soc Nephrol* 2019; **14:** 1616–25.

28 Salas MAP, Chua E, Rossi A, et al. Sex and gender disparity in kidney transplantation: historical and future perspectives. *Clin Transplant* 2022; **36:** e14814.

29 Conte C, Antonelli G, Melica ME, Tarocchi M, Romagnani P, Peired AJ. Role of sex hormones in prevalent kidney diseases. *Int J Mol Sci* 2023; **24:** 8244.

30 Ricardo AC, Yang W, Sha D, et al, and the CRIC Investigators. Sex-related disparities in CKD progression. *J Am Soc Nephrol* 2019; **30:** 137–46.

31 Connelly PJ, Currie G, Delles C. Sex differences in the prevalence, outcomes and management of hypertension. *Curr Hypertens Rep* 2022; **24:** 185–92.

32 Beckwith H, Lightstone L, McAdoo S. Sex and gender in glomerular disease. *Semin Nephrol* 2022; **42:** 185–96.

33 García GG, Iyengar A, Kaze F, Kierans C, Padilla-Altamira C, Luyckx VA. Sex and gender differences in chronic kidney disease and access to care around the globe. *Semin Nephrol* 2022; **42:** 101–13.

34 Muscat DM, Kanagaratnam R, Shepherd HL, Sud K, McCaffery K, Webster A. Beyond dialysis decisions: a qualitative exploration of decision-making among culturally and linguistically diverse adults with chronic kidney disease on haemodialysis. *BMC Nephrol* 2018; **19:** 339.

35 Tafuna'i M, Matalavea B, Voss D, et al. Kidney failure in Samoa. *Lancet Reg Health West Pac* 2020; **5:** 100058.

36 Verma P, Mahajan J, Kumar S, Acharya S. Lifestyle modification and nutrition: halt the progression to end-stage renal disease. *Int J Nutr Pharmacol Neurol Dis* 2022; **12:** 105–11.

37 Kovesdy CP, Furth SL, Zoccali C, and the World Kidney Day Steering Committee. Obesity and kidney disease: hidden consequences of the epidemic. *Can J Kidney Health Dis* 2017; **4:** 2054358117698669.

38 Bowe B, Xie Y, Li T, Yan Y, Xian H, Al-Aly Z. Associations of ambient coarse particulate matter, nitrogen dioxide, and carbon monoxide with the risk of kidney disease: a cohort study. *Lancet Planet Health* 2017; **1:** e267–76.

39 Pazhayattil GS, Shirali AC. Drug-induced impairment of renal function. *Int J Nephrol Renovasc Dis* 2014; **7:** 457–68.

40 Elliott MD, Marasa M, Cocchi E, et al. Clinical and genetic characteristics of CKD patients with high-risk *APOL1* genotypes. *J Am Soc Nephrol* 2023; **34:** 909–19.

41 Köttgen A, Cornec-Le Gall E, Halbritter J, et al, and the KDIGO Conference Participants. Genetics in chronic kidney disease: conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Controversies Conference. *Kidney Int* 2022; **101:** 1126–41.

42 Dendooven A, Peetermans H, Helbert M, et al, and the Kidney Biopsy Codes for Pathologists project. Coding practice in national and regional kidney biopsy registries. *BMC Nephrol* 2021; **22:** 193.

43 Staplin N, Herrington WG, Murgia F, et al. Determining the relationship between blood pressure, kidney function, and chronic kidney disease: insights from genetic epidemiology. *Hypertension* 2022; **79:** 2671–81.

44 Agarwal R. Pathogenesis of diabetic nephropathy. In: Chronic kidney disease and type 2 diabetes. Arlington, VA: American Diabetes Association, 2021. http://www.ncbi.nlm.nih.gov/books/NBK571720/ (accessed Feb 16, 2025).

45 Geetha D, Kronbichler A, Rutter M, et al. Impact of the COVID-19 pandemic on the kidney community: lessons learned and future directions. *Nat Rev Nephrol* 2022; **18:** 724–37.

46 Vollset SE, Ababneh HS, Abate YH, et al, and the GBD 2021 Forecasting Collaborators. Burden of disease scenarios for 204 countries and territories, 2022–2050: a forecasting analysis for the Global Burden of Disease Study 2021. *Lancet* 2024; **403:** 2204–56.