**Original Article**

**The global burden of diabetes-related chronic kidney disease from 1990 to 2021, with predictions of incidence to 2036**

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**Abbreviation list:**

GBD, Global Burden of Diseases; CKD, chronic kidney disease; DKD, diabetic kidney disease; ESRD, end-stage renal disease; T1D-CKD, type 1 diabetes-related CKD; T2D-CKD, type 2 diabetes-related CKD; DALYs, disability-adjusted life years; ASIR, age-standardized incidence rate; ASPR, age-standardized prevalence rate; ASDR, age-standardized death rate; SDI, socio-demographic index; UIs, uncertainty intervals; ARIMA, autoregressive integrated moving average

**Abstract**

**Objective:** Diabetes-related chronic kidney disease (CKD) is one of the leading causes of CKD and end-stage renal disease. We aimed to examine the updated global trends of the burden of diabetes-related CKD over time by location, age, and sex (from 1990 to 2021).

**Methods:** Using the GBD 2021 dataset, we quantified CKD burden metrics-including prevalence, incidence, mortality, and disability-adjusted life years (DALYs)-attributable to diabetes worldwide.

**Results:** Global epidemiological surveillance from 1990 to 2021 identified a persistent increase in the burden of diabetes-attributable CKD, with age-standardized incidence rates (ASIR) rising significantly across SDI quintiles. Forecasted ASIR for type 2 diabetes-related CKD (T2D-CKD) show a consistent pattern of escalation, whereas type 1 diabetes-related CKD (T1D-CKD) is expected to decrease from 2021 to 2036. In each socio-demographic index (SDI) quintile, ASIR of diabetes-related CKD increased progressively, with high SDI regions showing higher ASIR than other regions. Moreover, the global number of DALYs reached maximal DALYs in the 50-54 age group for T1D-CKD and between ages 65-69 for T2D-CKD in Southeast Asia, East Asia, and Oceania super-region. The global burden of diabetes-related CKD was higher in males, while the prevalence rate of T1D-CKD was higher in females.

**Conclusion:** The impact of diabetes-related CKD has shown a significant global increase across diverse geographical regions between 1990 and 2021. It is important to implement target strategies to reduce the burden of diabetes-related CKD and address this health challenge.

**Keywords:** Diabetes-related chronic kidney disease, Incidence, Prevalence, Death, Disability-adjusted life years.

**Introduction**

The global prevalence rates of type 1 diabetes (T1D) and type 2 diabetes (T2D), the two most common forms of the disease, have been rising steadily. According to recent estimates from the Global Burden of Diseases (GBD), Injuries, and Risk Factors Study 2021, approximately 529 million people worldwide are living with diabetes, and by 2050, more than 1.31 billion people are expected to have diabetes, thus leading to substantial challenges to healthcare systems worldwide[1]. The global prevalence of diabetes in adults is about 8%, with almost 90% of these individuals having T2D and ~10% having T1D[2]. About half of people with T2D and ~30% of those with T1D can develop chronic kidney disease (CKD) over time, and analysis of CKD causes identified diabetes mellitus as the leading global pathogenic driver[3, 4]. Among the long-term complications of diabetes, CKD imposes the greatest burden, with diabetic kidney disease (DKD) accounting for almost a third of disability-adjusted life-years (DALYs), an indicator reflecting the overall disease burden[5].

Diabetes-related CKD is characterized by progressive kidney damage mainly due to chronic hyperglycemia, encompassing a spectrum of renal abnormalities that range from abnormal albuminuria to end-stage renal disease (ESRD)[6]. In the next two decades, the population living with diabetes is expected to increase by ~50% to approximately 700 million people[7, 8]. Age and sex are two strong disease modifiers in the arena of diabetes-related CKD[9, 10]. Women with diabetes tend to have a higher prevalence of advanced CKD and more diabetes-related renal risk factors compared to men, with these sex-related disparities being most pronounced among the elderly[11]. Furthermore, epidemiological analyses from the GBD Study demonstrate a substantial increase in CKD burden attributable to T2D between 1990 and 2019[12]. Thus, diabetes-related CKD is a major cause of morbidity and mortality in people with diabetes, posing substantial challenges to healthcare systems worldwide. Besides estimating the current and future burden of diabetes, it is crucial to accurately identify and characterize the patient population at the highest risk who require more tailored prevention strategies.

Therefore, this large study aimed to describe the global epidemiological characteristics of diabetes-related CKD by analyzing data from the publicly available GBD 2021 database, including worldwide trends in disease burden from 1990 to 2021, forecasts to 2036, differences between countries and regions, and variations by sex and age.

**Methods**

**Data sources**

The data for this study were obtained from the GBD 2021 study, a comprehensive and publicly available database that consistently provides updated global, regional, and national estimates of the burden of diseases, injuries, and risk factors over time. In particular, in this analysis, we quantified the burden of T1D-related CKD and T2D-related CKD over the past 30 years (from 1990 to 2021) using the Global Health Data Exchange query tool (GHDx, <https://vizhub.healthdata.org/gbd-results/>). The GBD 2021 framework categorizes etiological factors into a four-tiered hierarchy, with diabetes-related CKD (T1D-related and T2D-related CKD) systematically classified as a Level 3 condition (non-communicable diseases) within this taxonomy. Specifically, we used data on (1) the prevalence and death rates by location both as absolute numbers and age-standardized rates (per 100,000 population) in 2021; (2) the incidence rates by socio-demographic index (SDI) and age-standardized rates (per 100,000 population) from 1990 to 2021; (3) the prevalence, incidence, and death rates per 100,000 population across sexes in five SDI levels in 2021; and (4) the number of DALYs by super-region in 2021.

**Definitions**

DALYs are a measure used to quantify the overall burden of disease, reflecting the total number of years lost due to ill health, disability, or early death within a population. They are used in public health to assess and compare the impact of different diseases and conditions. Calculated as the sum of Years of Life Lost (YLL) due to premature death and Years Lived with Disability (YLD), this indicator provides an integrated measure of population health gaps[13, 14]. The YLL is calculated by subtracting the age at death from a standard life expectancy. The GBD study applies a fixed standard to define this life expectancy to ensure cross-regional and cross-temporal comparability, avoiding biases attributable to variations in local life expectancies[15]. The YLD is derived from the product of the disability weight and the duration of disability. The disability weight, a numerical value ranging from 0 (full health) to 1 (death), quantifies the severity of a health state. These weights are determined through large-scale population surveys and expert consensus. The duration of disability is estimated based on epidemiological data (e.g., incidence, remission, and mortality rates), incorporating the disease’s natural history and the impact of intervention measures[16].

SDI is a summary measure that reflects a population's social and demographic development and categorizes countries or regions based on their social and economic development levels through a 0-1 scaled composite score, with 0 corresponding to the theoretical minimum of socio-demographic development across constituent dimensions and 1 denoting the theoretical maximum attainment within the index framework[13, 14]. Calculated from the geometric mean of normalized rankings for three socio-demographic components, including per capita income, mean years of education, and total fertility rate, this index enables cross-regional comparisons within the framework of the Global Burden of Disease study. The SDI stratifies nations and territories into five quintile developmental tiers: low, low-middle, middle, high-middle, and high SDI categories.

In the GBD 2021 database, we used ICD-9 codes (ranging from 250.4 to 250.43) and ICD-10 codes (ranging from E10.2 to E10.29 and E11.2 to E11.29) to classify diabetes-related CKD. Diabetes was defined as a fasting plasma glucose concentration of ≥126 mg/dL (≥7 mmol/L), or a 2-hour post-load glucose concentration of ≥200 mg/dL (≥11.1 mmol/L), or use of any glucose-lowering medications[17]. Diabetes-related CKD, a subtype of CKD attributable to diabetes, was primarily identified by a urinary albumin/creatinine ratio >30 mg/g and/or an estimated glomerular filtration rate (eGFR) <60 ml/min per 1.73 m2.

**Statistical Analysis**

The GBD database provides 459 health outcomes and risk factors from 204 countries and territories, plus dozens of subnational locations, demonstrating temporal trajectory at regional, national, and local levels[18]. A division of these countries into 21 clusters was established using epidemiological indicators and geographical criteria, and five distinct quintiles by socioeconomic index[5]. Using GBD 2021's standardized methodology, we derived absolute counts and age standardized rate (ASR) per 100,000 person-years for three core metrics: 1) period prevalence, 2) annualized incidence, and 3) mortality, all reported with 95% UIs through Monte Carlo simulation techniques. To evaluate temporal trends of the incidence rates of diabetes-related CKD in the global population, we estimated age-standardized incidence rates (ASIR) (per 100,000 population) and corresponding 95% UIs by joinpoint regression analysis in different SDI levels from 1990 to 2021. Joinpoint regression analysis helps determine whether inflection points occurred during this time interval. Forecasting uses an autoregressive integrated moving average (ARIMA) model consisting of the autoregressive and moving average models. The fundamental assumption is that data series are time-dependent random variables, with autocorrelation that can be described by an ARIMA model, allowing future values to be forecasted based on historical values, as described in detail elsewhere[19]. We conducted comparisons between different age groups (by 5-year intervals: <14, 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, up to >95 years), as well as sex and location, to compute the global burden of disease. Statistical analyses were conducted using R (version 4.2.1) in this study.

**Results**

**Global trends and burden of diabetes-related CKD**

Epidemiological profiling revealed 6 million (95% UI 5 to 7) globally prevalent cases of T1D-CKD with 94 thousand (95% UI 71 to 119) attributable deaths for T1D-related CKD in 2021 (**Supplementary Table 1**).Concurrently, T2D-CKD affected 107 million individuals (95% UI 99 to 115), resulting in 477 thousand deaths (95% UI 401 to 565) in 2021 (**Supplementary Table 2**). Within the SDI framework, we demonstrated that the peak absolute prevalence of T1D-CKD (1.8 million [95% UI 1.6 to 2.2]) and T2D-CKD (36million [95% UI 33 to 39]) occurred in populations with middle SDI development levels, which present an inverse U-shaped curve in the interaction between prevalence and SDI. Similarly, mortality covariates yield the results stated above, where the regions in middle SDI had the highest death of T1D-CKD (42 thousand [95% UI 32 to 54]) and T2D-CKD (182 thousand [95% UI 151 to 216]) **(Supplementary Table 1** and **Supplementary Table 2)**. At a national level, the prevalent cases of T1D-related CKD in 2021 were more concentrated in India (1 million; 95% UI 0.8 to 1.3), followed by Indonesia (0.5 million; 95% UI 0.37 to 0.67) and China (0.49 million; 95% UI 0.41 to 0.58) **(Supplementary Table 1)**. Besides, the prevalent cases of T2D-related CKD were more concentrated in China (20 million; 95% UI 19 to 22), followed by India (20 million; 95% UI 18 to 22)(**Supplementary Table 2**).

Regarding variation in ASRs, the highest country-level ASIR for T1D-related CKD was found in the Russian Federation, while the highest country-level ASIR for T2D-related CKD was observed in Qatar **(Figure 1)**. Furthermore, the overall ASIR in T1D-related CKD and T2D-related CKD categorized by SDI quintiles has gradually increased **(Figure 2)**. Both T1D-related and T2D-related CKD showed similar epidemiological trends: ASIR persistently peaked in high SDI regions, while consistently reaching nadir values in low SDI quintiles. Notably, both T1D-CKD and T2D-CKD exhibited periods of stagnation in low SDI regions, while all other SDI quintiles showed progressive increase—albeit at variable rates—throughout the observation period. For T1D-related CKD, the middle SDI quintile significantly increased the overall ASIR from 1.1 (95% UI 0.83 to 1.47) to 1.35 (95% UI 1.06 to 1.72), however, the low SDI quintile demonstrated minimal temporal changes in ASIR, with rates ranging from 0.95 (95% UI 0.65 to 1.42) to 1.1 (95% UI 0.78 to 1.56) between 1990 and 2021 **(Figure 2A)**. Regarding T2D-related CKD, the middle SDI quintile showed the largest change of ASIR from 17.13 (95% UI 15.38 to 18.97) to 22.95 (95% UI 21.15 to 24.58), conversely, high SDI quintile exhibited the least pronounced change in ASIR, transitioning from 25.59 (95% UI 23.30 to 27.81) to 28.34 (95% UI 26.19 to 30.30) during the same period **(Figure 2B)**. The increase in global ASIR was also observed in T1D-related CKD from 1990 to 2021. However, the global ASIR for T1D-related CKD is expected to decrease from 2021 to 2036 **(Figure 3A)**. In contrast, the global ASIR of T2D-related CKD shows a consistent increase from 1990 to 2036 **(Figure 3B)**.

**Burden of diabetes-related CKD by region and age**

As reported in **Figure 4A**, a considerable global change was noted in diabetes-related CKD burden in 2021, in which the global number of DALYs of T1D-related CKD peaked at 624 thousand (95% UI 372 to 914) between ages 50-54. In this age group, the number of DALYs for T1D-related CKD was the highest in Southeast Asia, East Asia, and Oceania super-region, at 276 thousand (95% UI 166 to 387); conversely, the number of DALYs for T1D-related CKD was the lowest in Central Europe, Eastern Europe, and Central Asia super-region, at 11 thousand (95% UI 7 to 16) **(Figure 4A)**. Regarding the T2D-related CKD burden in 2021, the number of DALYs peaked at 1.7 million (95% UI 1.3 to 2.1) between ages 65-69. Super-region, Southeast Asia, East Asia, and Oceania super-region had the highest number of DALYs, while Central Europe, Eastern Europe, and Central Asia had the lowest number of DALYs in 2021, at 695 thousand (95% UI 537 to 855) and 37 thousand (95% UI 25 to 50), respectively. With the exception of the high-income super-region, where the number of DALYs peaked in the 70–74 age group, the remaining six super-regions exhibited peak DALY values in the 65–69 age range.Among these, data from our analysis indicated that high-income super-region had the highest number of DALYs between age above 85 years **(Figure 4B)**.

**Sex and age differences in diabetes-related CKD by SDI levels**

In 2021, the global incidence and death rates of T1D-related CKD were higher in males than females, whereas the global prevalence rate of T1D-related CKD was higher in females **(Figure 5)**. Categorized by SDI levels, it is evident that the incidence rate of T1D-related CKD remained the highest, and the death rate remained the lowest, in the high SDI quintile **(Figure 5A, 5C)**. Due to its early onset characteristic, the incidence rate of T1D-CKD primarily occurred in the 0-14 age group **(Figure 5A)**. Furthermore, the highest prevalence rate of T1D-related CKD varied between the sexes among different age groups. For females, the prevalence rate mainly peaked at 20-29 years, while the low SDI quintile peaked at 30-34. However, for males, the prevalence rate of T1D-related CKD primarily peaked at 40-49 years, but the high-middle SDI quintile peaked at 20-24 years **(Figure 5B)**. Because of its early onset, the death rates of T1D-CKD were observed mainly in middle and older age groups, at 55-69 years **(Figure 5C)**. Regarding the T2D-related CKD burden in 2021, the global incidence, prevalence and death rates were higher in males than females **(Figure 6)**. ASIR of T2D-related CKD was particularly pronounced in older people, especially in those aged 70-84 years, and males were more susceptible than females. Similarly, the high SDI quintile exhibited the highest incidence rate of T2D-related CKD, which peaked between ages 80-84 **(Figure 6A)**. Further, the low-middle SDI quintile had the highest prevalence rate, and the middle SDI quintile had the highest death rate of T2D-related CKD **(Figure 6B, 6C)**. Besides, the prevalence and death rates of T2D-related CKD peaked between ages 80-84 and 95-plus across different SDI levels, respectively. This temporal trajectory was more pronounced in males, suggesting that the risks associated with T2D-related CKD may be associated with increasing age, particularly in men.

**Discussion**

Diabetes accounts for the majority of CKD cases, with its epidemiological prevalence showing relentless growth. Current projections estimate that 1.3 billion individuals will develop diabetes by 2050, foreshadowing compounded burdens from accelerated diabetes-related CKD progression[1]. Additionally, the diabetes-related CKD burden varies significantly across different geographic regions, particularly across middle SDI quintiles between 1990 and 2019, with elevated systolic blood pressure and increased body-mass index (BMI) emerging as the predominant population-attributable risk factors[9, 20, 21]. Using the updated GBD 2021 database, partly consistent with previously published studies[22], but our study provides a comprehensive reassessment of the globalburden of T1D and T2D-related CKD generally. In 2021, globally, there were 113 million prevalent cases, 2.1 million incident cases, and 0.57 million deaths due to diabetes-related CKD.

In each SDI quintile, the ASIR of both T1D-related and T2D-related CKD showed sustained growth over the past three decades (from 1990 to 2021). This trend has been driven by the combined effects of demographic aging and increasing global prevalence of obesity. The high SDI countries had a higher incidence rate of diabetes-related CKD than other regions, which was likely due to the increasing global prevalence of diabetes, marked population expansion, aging, and the continuous upward temporal trajectory in obesity; all contributing to the escalating burden of diabetes-related CKD worldwide. In contrast, we showed that the number of deaths attributable to T1D-related and T2D-related CKD was lower in high SDI countries, probably due to advanced economic and educational levels, which led to a greater disease awareness and treatment options. Our studies clearly indicate that the prevalence, incidence, and DALYs of T1D-CKD and T2D-CKD in middle SDI, Southeast Asia, East Asia, and the Oceania super region, significantly contribute to the overall burden of CKD. Over the past decades, India's population has grown rapidly, making it the world's second most populous country. Previous studies have shown that the genetic predisposition of South Asian populations, including Indians, predisposes them to develop visceral fat accumulation and insulin resistance at lower BMI thresholds, leading to a higher risk of diabetes and related complications even among younger and leaner individuals[22]. India has the highest prevalence of diabetes among Asian countries, with peak incidence occurring nearly a decade earlier than in Chinese and Japanese populations[23]. Furthermore, the incidence rates and progression speed of diabetes-related CKD are significantly higher in South Asian populations with type 2 diabetes than in Dutch-European diabetes cohorts, indicating a genetic predisposition to diabetes-related CKD in Indians [24]. Although the global diabetes pandemic is centered around India, high SDI has the highest ASIR. Studies have reported that HLA-DR3 and HLA-DR4 genotypes are strongly associated with an increased risk of type 1 diabetes, with HLA genes accounting for about 40–50% of the familial clustering of this disease. Notably, the highest carrier frequency of these genotypes is found in Northern European populations[25].

The analysis from the GBD 2021 database also indicated that multivariate risk attribution analysis identified elevated body mass index and systolic hypertension as predominant modifiable determinants for T2D-CKD progression, supporting previous GBD assessments[20]. Notably, the prevalence of microalbuminuria increased proportionally to BMI severity—from 9.5% in normal-weight individuals to 29.3% in obese males—underscoring adiposity-driven nephropathy mechanisms[26]. Another analysis of data from the Framingham Heart Study also found that obesity was significantly associated with a higher risk of developing CKD[27]. It is well known that hypertension is another crucial comorbidity in the progression of diabetes-related CKD and an established risk factor for ESRD. Therefore, treatment and management of hypertension can improve hypertension-induced progression of diabetes-related CKD and slow the progression to ESRD[28, 29]. However, an analysis from Indonesia identified hypertension as the main comorbid condition, but only 36.2% of participants received a prescription for anti-hypertensive medications, and of these, only 21.7% took the medications regularly[30]. Therefore, in addition to controlling blood glucose levels in patients with diabetes, managing body weight and blood pressure is also clinically important for preventing the development or slowing the progression of diabetes-related CKD.

Our analysis of GBD 2021 database also showed that the global prevalence, incidence, and death rates of diabetes-related CKD are higher in males than in females. Hormonal, genetic, and lifestyle factors might explain this sex-related difference[31, 32]. Globally, the prevalence of T2D is generally higher in males than in females, which may be attributed to more pronounced visceral fat accumulation and lower insulin sensitivity in males. However, postmenopausal women experience a sharp increase in risk, as declining plasma estrogen levels lead to abdominal fat redistribution and exacerbated insulin resistance, resulting in a gradual convergence of T2D prevalence rates between postmenopausal females and males[33]. Some of these sex-related differences might also reflect variability in muscle mass and protein intake [34]. Furthermore, sex-specific analysis showed faster progression to end-stage renal disease in males, which may be mechanistically linked to androgen-mediated overexpression in renal fibroblasts. Conversely, premenopausal estrogen conferred protection by upregulating renal oxidative stress and fibrotic markers[35]. In contrast, premenopausal estrogen seems to reduce renal disease progression by suppressing the renin-angiotensin system and proinflammatory pathways. However, the loss of estrogen’s protective effects after menopause coincides with a significant acceleration of renal pathology in females, narrowing the sex-based gap in diabetes-related CKD outcomes[11].

Published studies have shown that many ethnic and racial groups have a higher risk of developing diabetes and its related chronic vascular complications[36, 37]. Racial disparities in diabetes also exist between men and women, and socioeconomic status may also affect diabetes development in women[38]. A study found that South Asian people tend to have a higher prevalence of diabetes-related CKD than White Europeans and Afro-Caribbean individuals with T2D. In this study, South Asian people also showed a higher incidence and faster progression to advanced stages of diabetes-related CKD than other ethnic groups[39]. In addition, African Americans have higher rates of kidney disease than European Americans. It is estimated that the G1 and G2 variants of the *APOL1* gene (commonly found in populations of African ancestry) significantly increase the risk of non-diabetes chronic kidney disease, while in diabetes nephropathy, they may work together with hyperglycemia to accelerate renal injury[40].

From our analysis of the GBD database, we suggest it should be possible to reduce the significant epidemiological impact of CKD globally through coordinated efforts in diabetes-related CKD prevention, screening, treatment, and rehabilitation. For example, the GBD data facilitates the quantification of the burden of diabetes-related CKD at the subnational level, including critical metrics such as prevalence, incidence, mortality, and DALYs. This evidence-based approach supports policymakers in identifying priority areas for targeted interventions by implementing community-based diabetes awareness campaigns and promoting healthy dietary habits, especially sodium restriction and a plant-based diet, along with regular physical exercise and routine medical check-ups to lower the incidence rates of diabetes, hypertension, and diabetes-related CKD. Additionally, comparative analyses of health disparities across demographic groups (e.g., ethnicity, sex, and age) reveal systemic inequities in healthcare resources, guiding policies that focus on vulnerable populations. Governments could strengthen healthcare systems by expanding infrastructure, increasing the number of specialized healthcare providers, and improving the treatment of diabetes-related CKD.Prioritizing healthcare resource allocation based on the burden of diabetes-related CKD and risk factor profiles enables policymakers to optimize limited resources for the greatest public health benefit. In high-prevalence regions, such as India and Indonesia, targeted investments in preventing diabetes-related kidney disease (e.g., community-based screening) and scaling evidence-based treatments (e.g., affordable SGLT2 inhibitor access) are critical. Comparative analyses of intervention strategies across diverse settings (e.g., India, Indonesia, and China) can inform context-specific adaptations of successful models, while fostering cross-national collaboration to harmonize clinical guidelines and share best practices in nephropathy management.

However, our study has several limitations that are inherent to the GBD database. First, in regions lacking strong population-level CKD surveillance systems, especially low-income countries and marginalized populations, GBD estimates rely heavily on statistical modeling, predictive covariates, and meta-regression of limited primary data. While these methods improve global comparability, they may also spread uncertainties in places where diabetes screening and kidney diagnostics are not optimal, possibly hiding local epidemiological details. Second, determining the cause of CKD remains a key challenge. Without gold-standard kidney biopsy confirmation, GBD algorithms depend on ICD coding patterns, clinical assumptions, and the probabilistic redistribution of ‘unspecified nephropathy’ cases. This method cannot fully account for the complex causes in diabetes patients who also have hypertension, obesity, or cardiovascular disease which is an important limitation since most diabetes-related CKD involves additional conditions that increase kidney decline. Thirdly, heterogeneity in eGFR introduces systematic biases. The GBD framework standardizes eGFR thresholds (e.g., <60 mL/min/1.73m² for CKD staging), yet formula selection varies across studies, and race-adjusted coefficients lack universal validation. Compounding this, creatinine assay standardization remains inconsistent globally, disproportionately affecting regions with limited laboratory infrastructure. Consequently, the prevalence of CKD may be overestimated in populations with high muscle mass or underestimated in elderly or sarcopenic individuals[41]. Additionally, the computational efficiency of various formulas for estimating eGFR varies[42]. Therefore, the results of our analysis might represent an overestimate or an underestimate of the prevalence of CKD.

In conclusion, using the GBD database, we found that the global trends and epidemiological impact of diabetes-related CKD have increased over the past three decades (from 1990 to 2021), with variations across regions and countries. Counts and ASRs for incidence, deaths, and DALYs related to diabetes-related CKD showed an upward trend over time, which was more pronounced in males than in females. The ASIR of diabetes-related CKD also rose with SDI levels, and the highest SDI quintile was linked to the highest ASIR worldwide. Most of the global burden of diabetes-related CKD was observed in Asian countries, especially in the South and East. China and India experienced the heaviest burden of diabetes-related CKD. The forecast for ASIR of T2D-related CKD shows a consistent increase, while T1D-related CKD is expected to gradually decrease from 2021 to 2036.

**Disclosure summary:** The authors have no conflicts of interest to declare.

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**Authors' contributions**

**Dan-Qin Sun:** Project administration, Funding acquisition, Supervision, Conceptualization. **Ming-Hua Zheng:** Project administration, Supervision, Conceptualization. **Wen-Ying Chen:** Writing – original draft, Visualization

**Wen-Yue Liu:** Data curation, Visualization. **Jia-Hui Zhang:** Data curation. **Giovanni Targher:** Writing – review & editing, Funding acquisition. **Christopher D. Byrne:** Writing – review & editing, Funding acquisition. **Anoop Misra:** Writing – review & editing. **Amedeo Lonardo:** Writing – review & editing.

**Data Availability Statement**

GBD study 2021 data resources were publicly available online from the Global Health Data Exchange (GHDx) query tool (<http://ghdx.healthdata.org/gbd-results-tool>).

**Ethical approval**

This study utilized publicly available data from the GBD Study 2021, conducted by the Institute for Health Metrics and Evaluation. As all data are de-identified and openly accessible, additional ethical approval was not required.

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**Figure legends**

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**Figure 1:** Global age-standardized incidence rates for T1D-related CKD (A), and T2D-related CKD (B) in 2021.



**Figure** **2:** Age-standardized incidence rates by SDI quintiles for T1D-related CKD (A), and T2D-related CKD (B), 1990–2021.



**Figure 3:** Global age-standardized incidence rates for T1D-related CKD (A) and T2D-related CKD (B) from 1990 through 2036 forecasts.



**Figure 4****:** Number of DALYs for T1D-related CKD (A), and T2D-related CKD (B) by age and super-region in 2021.

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**Figure 5:** Rates of incidence (A), prevalence (B), and deaths (C) for T1D-related CKD burden from 1990 to 2021 in different age groups and SDI areas.



**Figure 6:** Rates of incidence (A), prevalence (B), and deaths (C) for T2D-related CKD burden from 1990 to 2021 in different age groups and SDI areas.