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Original Article

Study of the Prevalence and Risk Factors of Chronic Kidney Disease in the Kyrgyz Republic

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Abstract:

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Background: Chronic kidney disease (CKD) is an increasing global health concern and a major contributor to cardiovascular morbidity and mortality. Although its global prevalence is estimated at about 13%, data from Central Asia are limited.

Objective: To assess the prevalence, structure, and key determinants of CKD among adults in the Kyrgyz Republic.

Methods: A population-based cross-sectional study was conducted among adults aged ≥18 years across different regions. CKD was defined according to Kidney Disease: Improving Global Outcomes (KDIGO) criteria as an estimated glomerular filtration rate (eGFR) <60 mL/min/1.73 m² and/or a urinary albumin-to-creatinine ratio (UACR) ≥30 mg/g. Disease severity was staged by eGFR and albuminuria categories. Logistic regression identified independent predictors of CKD.

Results: The overall CKD prevalence was 10.8%, comparable to global estimates. Prevalence increased with age, reaching 25.0% among participants ≥70 years, of whom 64.3% had reduced kidney function. CKD was more common in women than in men ($p<0.001$). Major etiologic factors included diabetes mellitus (29%), chronic glomerulonephritis (23%), chronic pyelonephritis (17%), and hypertension (10%). In multivariable analysis, diabetes, hypertension, dyslipidemia, obesity (BMI ≥30), and rural residence were independent predictors of CKD ($p<0.05$).

Conclusion: CKD is highly prevalent among adults in the Kyrgyz Republic. Risk factors align with international data, but regional patterns show higher rates of chronic glomerulonephritis and pyelonephritis. Strengthening early detection, integrating CKD screening into national health programs, and focusing on high-risk groups—older adults, women, and rural populations—are crucial to reducing the CKD burden in Kyrgyzstan.

Keywords: Chronic Kidney Disease; Prevalence; Risk Factors; Diabetes; Hypertension; Dyslipidemia; Obesity; Kyrgyz Republic; Central Asia

Introduction

Chronic kidney disease (CKD), with a global prevalence of 13.4%, is one of the leading causes of morbidity and mortality related to noncommunicable diseases (1). It ranks 12th among the global causes of death and is projected to become the 5th leading cause of mortality by 2040 (2–4). CKD is an independent predictor of premature death, increased hospitalization rates, economic burden for patients and healthcare systems, and reduced quality of life (5–9). In 2016, approximately 1.2

million deaths were attributed to CKD, and it is estimated that by 2040, CKD-related deaths will reach 2.2–4.0 million globally (10).

Between 1990 and 2016, the global burden of CKD showed a concerning upward trend: incidence increased by 89%, prevalence by 87%, mortality by 98%, and disability-adjusted life years by 62% (11). This rise is largely driven by the increasing prevalence of type 2 diabetes mellitus (T2DM), arterial hypertension (HTN), and obesity, alongside global population aging.

CKD is defined as the presence of structural or functional abnormalities of the kidneys persisting for more than three months and having clinical implications for health. The glomerular filtration rate (GFR) is considered the gold standard for assessing kidney function. A sustained decrease in GFR below 60 mL/min/1.73 m² for more than three months indicates CKD, whereas end-stage renal disease (ESRD) is defined as a GFR below 15 mL/min/1.73 m². CKD is associated with an increased risk of developing cardiovascular disease (CVD) (8,9,12).

Asia has one of the highest prevalences of CKD globally and is currently experiencing a rapid rise in diabetes mellitus (DM) and arterial hypertension (HTN) (13). Most Central Asian countries are classified as low- and middle-income nations, characterized by constrained healthcare resources and the absence of comprehensive national CKD registries, resulting in insufficient data on the prevalence, burden, and impact of implemented health programs.

The objective of this study was to assess the prevalence of chronic kidney disease (CKD) in order to inform the development of national policies aimed at improving healthcare delivery for CKD patients.

Methods

A cross-sectional population-based study was conducted to evaluate the prevalence of CKD across all seven regions of the Kyrgyz Republic. A cluster sampling design was applied to ensure representativeness across different areas of the country. The sampling framework was based on territorial and demographic principles, taking into account urban and rural settings, sex, and age distribution.

A multistage cluster sampling method was used, involving the division of the country into administrative units - regions (oblasts), districts, rural municipalities, and settlements. At each stage, clusters were randomly selected to ensure representativeness of the sample.

Study participants included residents of all age groups from selected areas who had lived at their current address for at least 12 months. Pregnant women and individuals with cognitive impairments were excluded. The age structure of the sample was formed using stratified sampling, with an equal number of men and women included in each age stratum, ranging from 18–29 to 70–79 years.

The sample size included 10,478 adults, representing 94.8% of those invited to participate. Population data from the National Statistical Committee of the Kyrgyz Republic served as the basis for sample formation (https://stat.gov.kg/ru/statistics/naselenie/).

The study protocol was approved by the Ethics Committee of the National Center of Cardiology and Internal Medicine, and written informed consent was obtained from all participants.

After sample formation, the frequency of risk factors, disease severity, and etiologic causes of CKD were assessed. The severity of CKD was determined according to staging based on kidney function and degree of microalbuminuria (MAU) (14).

Risk factors for end-stage kidney disease (ESKD) were defined according to the following parameters: blood glucose level, systolic blood pressure consistent with hypertension (≥140 mmHg), total cholesterol level, body mass index (BMI) indicative of obesity (≥25 kg/m²), as well as the presence of smoking habits and insufficient physical activity (<30 minutes per day).

Each study participant underwent a standardized interview conducted by specially trained personnel, which included the collection of data on sociodemographic characteristics, behavioral and dietary habits, physical activity levels, and personal and family medical history. In addition, a physical examination was performed to assess anthropometric and physiological parameters, including height, body weight, waist circumference, blood pressure (BP), and heart rate.

Height and weight measurements were obtained according to a standardized protocol, and the body mass index (BMI) was calculated as weight (kg) divided by height squared (m²). For blood pressure analysis, the mean value of the last two consecutive measurements was used. All participants also underwent fasting venous blood sampling and provided a morning urine sample for MAU testing.

Biochemical analyses included the determination of plasma glucose, lipid profile, uric acid, and serum creatinine levels. Urinary albumin concentration was assessed using a microalbuminuria test. The estimated glomerular filtration rate (eGFR) was calculated from serum creatinine using the CKD-EPI equation (15).

The diagnosis of CKD was based on a single measurement of serum creatinine, eGFR, and MAU. Because of the cross-sectional design and reliance on a single assessment, transient reductions in kidney function or albuminuria could not be excluded, and CKD prevalence may therefore be over- or underestimated.

Newly diagnosed arterial hypertension was defined as a blood pressure ≥140/90 mmHg recorded during the physical examination in individuals without a prior diagnosis of hypertension. Previously diagnosed hypertension was identified based on medical history confirming a documented diagnosis at primary healthcare facilities and/or the use of antihypertensive medications within the preceding two weeks. Blood pressure control among hypertensive participants was defined as achieving BP <140/90 mmHg at the time of examination.

Newly diagnosed diabetes mellitus was identified in individuals without a prior diagnosis but who met the diagnostic criteria of the American Diabetes Association (ADA, 2010) (16). Dyslipidemia was defined as a total cholesterol level exceeding 5.2–6.2 mmol/L. Hyperuricemia was defined as a serum uric acid concentration >420 μmol/L. Overweight and obesity were classified according to body mass index (BMI) values of 25.0–29.9 kg/m² and ≥30 kg/m², respectively. Central obesity was defined as a waist circumference ≥90 cm in men and ≥85 cm in women.

To assess the prevalence of CKD in the general population, the minimum sample size was calculated using the Epi Info software, considering a 95% confidence level, a margin of error of ±5%, and a design effect (DEFF) of 1.5. 95% confidence intervals (CIs) for prevalence estimates were computed using the Taylor series linearization method with finite population correction, implemented in the STATISTICA software, version 7.

Similarly, multivariable logistic regression models were constructed to identify factors associated with CKD, reduced kidney function, and albuminuria. The models included sociodemographic characteristics, behavioral and dietary habits, physical activity level, comorbid conditions, and laboratory parameters as independent variables.

In addition, the prevalence of arterial hypertension, diabetes mellitus, and dyslipidemia was estimated, and indicators of awareness, treatment, and control of these conditions among patients receiving therapy were determined.

Missing data were handled through listwise deletion (complete case analysis). Participants with missing values for any of the key variables included in the regression model were excluded from the multivariable analysis. The proportion of missing data for these variables was low (<3%) and was deemed unlikely to materially influence the findings.

Ethical Approval: Protocol № 4 of the meeting of the Ethics Committee, May 13, 2022.

Results

A total of 10,478 adult participants were enrolled in the study, with an overall response rate of 94.8%. All included participants had available data on estimated glomerular filtration rate (eGFR) and urinary albumin-to-creatinine ratio (UACR), forming the analytical sample for the present study.

The prevalence of CKD in the Kyrgyz Republic, defined as reduced kidney function (eGFR <60 mL/min/1.73 m²) and/or albuminuria (UACR ≥30 mg/g), was 10.8% (95% CI, 10.2–11.4). The prevalence of impaired kidney function and albuminuria alone was 3.6% (95% CI, 3.1–4.1) and 6.7% (95% CI, 6.4–7.1), respectively.

The distribution of CKD stages and albuminuria categories is presented in Table 1.

Table 1. Prevalence of chronic kidney disease in the Kyrgyz Republic.

Stage of CKD, % (95% CI)					**Albuminuria**, UACR		
C 1	C2	C3	C4	C5	A1	A2	A3
4.0 (3.6–4.4)	3.2 (2.9–3.5)	3.1 (2.8–3.4)	0.4 (0.28–0.52)	0.1 (0.04–0.16)	4.0 (3.6–4.4)	2.2 (1.9–2.5)	0.5 (0.37–0.63)
Total – 10.8%							

The overall prevalence of CKD was 10.8%, with stage 1 — 4.0%, stage 2 — 3.2%, stage 3 — 3.1%, stage 4 — 0.4%, and stage 5 — 0.1%.

The mean age of the study participants was 40.1 years, with 54.7% women and 45.3% men. Urban residents accounted for 52% of the study population, while 48% resided in rural areas.

A statistically significant difference was observed when comparing the prevalence of CKD stages and microalbuminuria (MAU) by sex. Women demonstrated poorer kidney function parameters, characterized by lower estimated glomerular filtration rate (eGFR) and higher levels of albuminuria (Table 2).

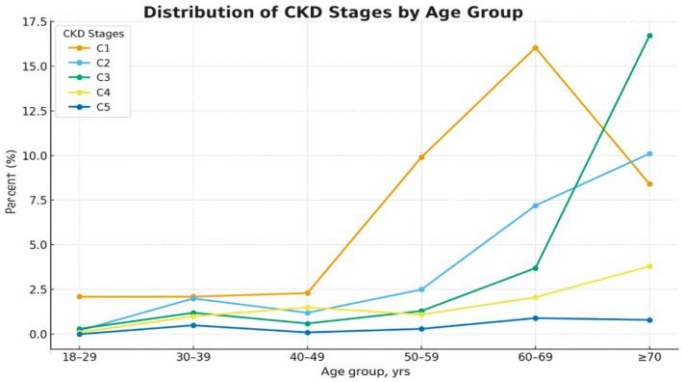
Table 2. Prevalence of chronic kidney disease by sex.

Parameters	Quantity n (%)		
	Total	Males	Females
e-GFR, ml/min/1,73m²			
≥90	7606 (72.6)	3399 (71.6)	4207 (73.4)
60-89	2495 (23.8)	1211 (25.5)	1284 (22.4)
30-59	329 (3.1)	123 (2.6)	206 (3.6)
15-29	39 (0.4)	10 (0.2)	29 (0.5)
<15	11 (0.1)	5 (0.1)	6 (0.1)
UACR, mg/g			
<30	9776 (93.3)	4520 (95.2)	5256 (91.7)
30-299	636 (6.1)	195 (4.1)	441 (7.7)
≥300	67 (0.6)	33 (0.7)	34 (0.6)

Abbreviations: e-GFR — estimated glomerular filtration rate; UACR — urine albumin-to-creatinine ratio. *P*<0.001

Specifically, the proportion of women with eGFR <60 mL/min/1.73 m² and microalbuminuria was significantly higher than that of men (p<0.001)

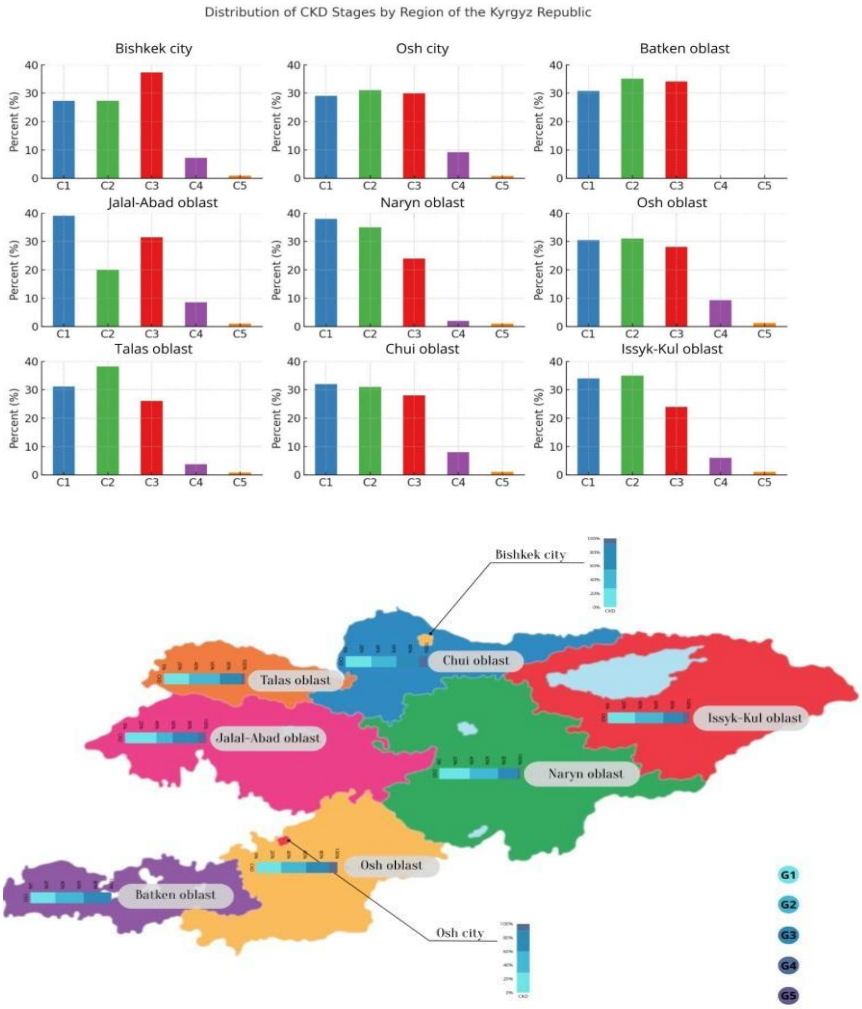
In addition, the prevalence of CKD – particularly at advanced stages – increased markedly with age in our study population. Among participants aged 70 years and older, the prevalence of CKD reached 25.0%, with 64.3% of these individuals demonstrating impaired kidney function (Figure 1).



Age,yrs	CKD stage,%				
	C1	C2	C3	C4	C5
18-29	2.1 (1.8 – 2.3)	0.2 (0.1 – 0.2)	0.3 (0.2 – 0.4)	0,1 (0.04 – 0.6)	-
30-39	2.1 (1.8–2.3)	2.0 (1.7–2.2)	1.2 (0.9–1.4)	1,0 (0,8–1.1)	0.5 (0.3–0.6)
40-49	2.3 (2.0 – 2.5)	1.2 (0.9 – 1.4)	0.6 (0.4 – 0.7)	1,5 (1.2 – 1.7)	0,1 (0.04 – 0.1)
50-59	9.9 (9.39 – 10.4)	2.5 (2.2 – 2.7)	1.3 (1.07 – 1.5)	1,1 (0.9 – 1.3)	0.3 (0.2 – 0.4)
60-69	16.03 (15.36 – 16.7)	7,2 (6.75 – 7.65)	3.7 (3.36 – 4.04)	2,07 (1.80 – 2,3)	0,9 (0,7 – 1.09)
>70	8,4 (7.9 – 8.9)	10.1 (9.6 – 10.6)	16.7 (16.0 – 17.4)	3.8 (3.45 – 4.15)	0.8 (0.62 – 0.98)

Figure 1. Prevalence of chronic kidney disease by stage across different age groups.

The prevalence of CKD by stage in the cities of Bishkek and across different regions of the Kyrgyz Republic is presented in Figure 2.



Region	CKD stages				
	C1	C2	C3	C4	C5
Bishkek city	306	305	418	81	10
Osh city	328	351	339	104	9
Batken oblast	317	362	351	0	0
Jalalabad oblast	441	226	356	96	11
Naryn oblast	430	396	271	23	11
Osh oblast	345	351	317	105	14
Talas oblast	351	430	294	43	9
Chui oblast	362	351	317	90	11
Issyk-Kul oblast	385	396	271	68	11

Figure 2. Prevalence of chronic kidney disease in the Bishkek and Osh cities and across the regions of the Kyrgyz Republic.

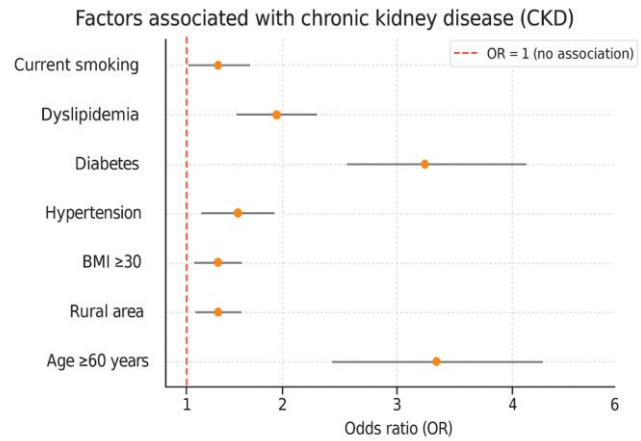
Among the surveyed participants, CKD stages 1–2 were identified in 2,495 individuals. Stage C3 CKD was diagnosed in 329 participants, stage C4 in 39, and stage C5 in 11 participants.

CKD risk factors were highly prevalent among the adult population: obesity was observed in 29.9%, hypertension in 28.2%, diabetes mellitus in 20.6%, and dyslipidemia in 36.4% of participants. Smoking was significantly more common among men (54.6%) compared to women (3.4%) (Table 3).

Table 3. Risk factors for chronic kidney disease in the study population.

Risk factors	Quantity n (%)		
	Total	Males	Females
Smoking			
Never	7215 (68.8)	1718 (36.2)	5497 (95.9)
Former	477 (4.6)	437 (9.2)	40 (0.7)
Current	2787 (26.6)	2592 (54.6)	195 (3.4)
Physical inactivity (<150 min/week)	3472 (33.1)	1724 (36.3)	1748 (30.5)
BMI ≥25,0	2231 (21.3)	1156 (24.3)	1075 (18.7)
BMI ≥30,0	902 (8.6)	455 (9.6)	447 (7.8)
Arterial hypertension			
None	5529 (52.8)	2339 (49.3)	3190 (55.7)
Newly detected	1658 (15.8)	883 (18.6)	775 (13.5)
Previously diagnosed	3290 (31.4)	1525 (32.1)	1765 (30.8)
Diabetes mellitus			
None	8318 (79.4)	3808 (80.2)	4510 (78.7)
Newly diagnosed	776 (7.4)	404 (8.5)	372 (6.5)
Previously diagnosed	1383 (13,2)	535 (11.3)	848 (14.8)
Blood pressure			
<140 mmHg	2398 (81.2)	1102 (81.2)	1296 (81.1)
140-199 mmHg	416 (14.1)	179 (13.2)	237 (14.8)
≥200 mmHg	142 (4.8)	76 (5.6)	66 (4.1)
Dyslipidemia	3823 (36.4)	2098 (44.2)	1725 (30.1)
Hyperuricemia	1332 (12.7)	1120 (23.6)	212 (3.7)
Previously diagnosed kidney disease	484 (4.6)	227 (4.8)	257 (4.5)
Previously diagnosed cardiovascular disease	417 (3.9)	194 (4.1)	223 (3.9)
Place of residence			
Urban	5487 (52.4)	2460 (51.8)	3027 (52.8)
Rural	4991 (47.6)	2287 (48.2)	2704 (47.2)
Education level			
Secondary education	3484 (33.2)	1431 (30.1)	2053 (35.8)
Vocational secondary education	3414 (32,6)	1604 (33,8)	1810 (31,6)
Higher education	3580 (34,2)	1713 (36,1)	1867 (32,6)

Thus, analysis of CKD risk factors revealed that a higher prevalence of CKD was observed among older individuals, women, rural residents, and participants with lower levels of education and income. Increased CKD prevalence was also noted among former smokers, physically inactive individuals, and those with established risk factors such as obesity, hypertension, diabetes mellitus, dyslipidemia, and cardiovascular disease.



Factor	Odds ratio (95% CI)	P
Age ≥60 years	4.8 (3.5–6.4)	<0.001*
Male	1.2 (0.9–1.5)	0.21
Living in a rural area	1.4 (1.1–1.8)	0.012*
BMI ≥ 30	1.3 (1.0–1.7)	0.047*
Arterial hipertension	2.6 (1.9–3.4)	<0.001*
Diabetes mellitus	3.9 (2.8–5.4)	<0.001*
Dyslipidemia	1.5 (1.1–2.0)	0.02*
Current smoking	1.1 (0.8–1.5)	0.36

(*) P<0.05

Figure 3. Factors associated with chronic kidney disease.

In multivariable logistic regression analysis, age over 60 years, diabetes mellitus, hypertension, dyslipidemia, rural residence, and a BMI ≥30 were identified as independent predictors of CKD (p<0.05) (Figure 3).

The etiological structure of CKD is shown in Figure 4.

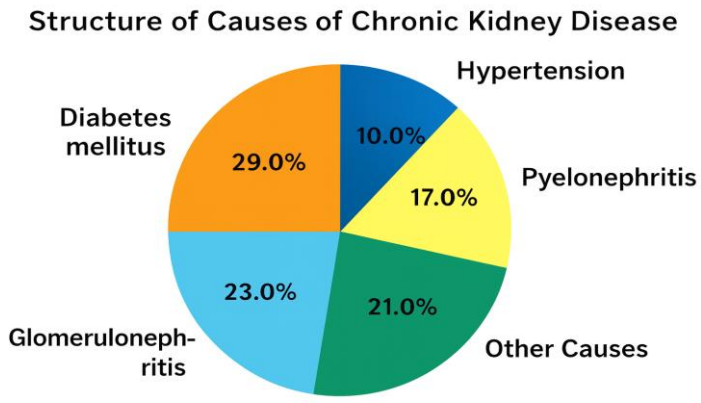


Figure 4. Etiological structure of chronic kidney disease in the Kyrgyz Republic.

Analysis of the etiological structure of CKD in our cohort revealed that the most common causes were diabetes mellitus (29%), chronic glomerulonephritis (23%), chronic pyelonephritis (17%), arterial hypertension (10%), and other causes (21%).

Discussion

According to the results of a systematic review and meta-analysis of observational studies that included 100 studies with a total of 6,908,440 participants, the average global prevalence of chronic kidney disease (CKD) in the general population was estimated at 13.4% (95% CI: 11.7–15.1%), while the prevalence of stages 3–5 CKD was 10.6% (95% CI: 9.2–12.2%) (16). The stage-specific prevalence was as follows: stage 1 — 3.5% (2.8–4.2%), stage 2 — 3.9% (2.7–5.3%), stage 3 — 7.6% (6.4–8.9%), stage 4 — 0.4% (0.3–0.5%), and stage 5 — 0.1% (0.1–0.1%). These rates varied across regions, ranging from 7% in South Asia and 8% in Africa to 11% in the United States and 12% in Europe and South America (16).

The overall CKD prevalence in Central Asia remains uncertain; however, based on data from neighboring countries and global estimates, CKD represents a significant public health concern. According to the Global Burden of Disease Study (2021), the age-standardized prevalence rate of CKD in the Central Asia region was approximately 10,698 per 100,000 population, equivalent to about 10.7% (95% UI: 10,022.94–11,348.10) (17). It should be noted that a limitation of this estimation method is the inclusion of only individuals with estimated glomerular filtration rate (e-GFR) <60 mL/min/1.73 m², which does not account for patients with early-stage CKD (stages 1–2). Therefore, the true prevalence of CKD in Central Asia, including early stages, is likely somewhat higher.

In our study, the overall prevalence of CKD was 10.8%, with stage 1 — 4.0%, stage 2 — 3.2%, stage 3 — 3.1%, stage 4 — 0.4%, and stage 5 — 0.1%. Patients receiving renal replacement therapy were not included in our study, which, although to a minor extent, may have influenced the overall CKD prevalence estimate in the Kyrgyz Republic.

Comparable data from neighboring Central Asian countries are limited but suggest a similar or slightly higher burden. In Kazakhstan, a nationally representative survey of 6,720 adults aged 18–69 years across 14 regions and three major cities reported that mild CKD was most frequently detected in East Kazakhstan (10.4%), followed by Almaty and Karaganda regions (7.8–8.0%). CKD with eGFR < 60 mL/min/1.73 m² was most prevalent in East Kazakhstan (15.3%), followed by Almaty (10.6%) and Atyrau (9.4%) (2). In Uzbekistan, approximately 118,026 CKD patients were registered nationally in 2020, although the lack of population denominator precludes precise prevalence estimates (18).

Overall, these findings indicate that the CKD prevalence in the Kyrgyz Republic is broadly consistent with regional trends, while differences in study design, diagnostic criteria, and registration systems likely contribute to variability between countries.

Global epidemiological data indicate that CKD exhibits significant differences by sex, with variations observed in both disease progression and outcomes between men and women. Meta-analyses indicate that women have a slightly higher prevalence of CKD compared to men (13.0% vs. 12.1%, respectively), which may be attributed to longer life expectancy, more frequent healthcare utilization, and earlier detection of mild disease. However, men tend to experience more rapid CKD progression and higher mortality from renal complications (19).

The results of our study demonstrate a similar trend: women exhibited a higher prevalence of reduced eGFR and albuminuria compared to men, confirming the greater burden of CKD among females. Specifically, the proportion of women with eGFR <60 mL/min/1.73 m² and microalbuminuria was significantly higher than that of men.

Thus, our findings are consistent with global observations indicating that CKD is more prevalent among women, although men are more likely to develop severe outcomes and end-stage kidney disease (20, 21–23).

In our study, the prevalence of CKD - especially in its advanced stageы - rose substantially with increasing age. Among participants aged 70 years and older, 25.0% had CKD, and 64.3% of them exhibited impaired kidney function.

These results are consistent with the well-established pattern reported in previous studies, showing that the prevalence of CKD increases sharply with advancing age. According to CDC/NIDDK data from the United States, CKD is most common among individuals aged ≥65 years (approximately 34%), while in several European cohorts, the proportion of individuals with CKD stages 3–5 reaches approximately 25–33% in those aged 70–79 years and exceeds 50% among those aged 80 years and older; some reviews even report prevalence rates exceeding 40% in individuals over 65 years of age (24, 25).

The differences between our findings (25.0% in participants aged ≥70 years) and the higher values reported in some international studies likely reflect methodological and population-related factors - such as differences in CKD definitions (inclusion or exclusion of albuminuria), sample age structure, prevalence of comorbid conditions (diabetes, hypertension), access to healthcare, and study design. Additionally, regional variations and limitations in diagnostic accessibility may lead to underdiagnosis of early CKD stages in certain settings.

Taken together, our findings confirm the general global trend of a significant increase in CKD burden with age, while providing slightly lower prevalence estimates among older adults compared to some large Western cohorts.

Among the surveyed participants, CKD stages C1–C2 were detected in 2,495 individuals, while 329 participants had stage C3, 39 had stage C4, and 11 were diagnosed with stage G5 CKD. A lower number of patients with stages C4 and C5 CKD was observed in the Talas and Batken regions, which can be attributed to the limited availability of nephrologists and hemodialysis centers in these remote areas, leading to patient migration to larger cities and other regions.

Analysis of CKD risk factors demonstrated a higher prevalence among older individuals, females, rural residents, and participants with lower educational attainment. CKD prevalence was also elevated among former smokers, individuals with low physical activity, and those with established comorbidities, including obesity, hypertension, diabetes mellitus, dyslipidemia, and cardiovascular disease. In multivariable analysis, age over 60 years, diabetes mellitus, hypertension, dyslipidemia, rural residence, and a BMI ≥30 were identified as independent predictors of CKD.

The results of our study are consistent with findings from previous international studies. Diabetes mellitus and arterial hypertension are recognized as leading causes and key risk factors for the development and progression of CKD in most population-based studies (1,24,25).

In addition, obesity is considered an independent predictor of CKD. Meta-analyses have shown that individuals with an elevated BMI have approximately a 1.8-fold higher risk of developing CKD, with a clear dose - response relationship between the degree of obesity and the decline in kidney function (26).

In our study, we found that dyslipidemia was associated with an increased risk of CKD development and progression. An unfavorable lipid profile - marked by elevated triglycerides and low HDL cholesterol - was linked to a more rapid decline in glomerular filtration rate (27).

It is also noteworthy that the association identified in our study between rural residence and higher CKD prevalence aligns with previously published data. Several studies have reported that CKD tends to be more common and more severe in rural areas. This pattern has been attributed to limited access to healthcare services, higher exposure to occupational and environmental hazards, and lower public awareness of chronic noncommunicable diseases (28, 29).

According to recent Global Burden of Disease data, diabetic nephropathy and hypertensive nephropathy account for the majority of CKD burden worldwide, while glomerulonephritis remains an important cause, especially in low- and middle-SDI regions. In this context, our cohort shows a relatively higher share of chronic glomerulonephritis and chronic pyelonephritis which may be explained by regional epidemiologic patterns and differences in the provision of medical care and diagnostic methods. In other countries, the etiological distribution of CKD also varies. For example, studies from Saudi Arabia indicate that diabetic nephropathy is the predominant cause of CKD in that setting, highlighting the influence of regional epidemiological and healthcare characteristics (30).

Although our survey represents a population-based screening of CKD, arterial hypertension accounted for only the third most common cause of CKD in our dataset. This finding contrasts with global data, where hypertension is recognized as one of the leading etiologies of CKD. The lower proportion observed in our study is likely explained by systemic underdiagnosis and underreporting of hypertension in the Kyrgyz Republic. According to the KIOD-2007 survey, only 27% of individuals with elevated blood pressure were aware of their condition, and national electronic health record data show a much lower "observed" prevalence of hypertension compared with population-based surveys such as WHO STEPS and INTEREPID (31-34). These discrepancies highlight substantial gaps in blood pressure screening, registration, and etiological attribution within the healthcare system, resulting in the underestimation of hypertensive nephropathy in national CKD statistics.

In contrast, our cohort demonstrated a relatively higher prevalence of chronic pyelonephritis (17%), which likely reflects regional characteristics - specifically, the high burden of urinary tract infections and the

limited availability of early diagnostic services for metabolic disorders. The relatively low proportion of hypertensive nephropathy (10%) may be explained by potential underrecognition of patients with long-standing hypertension without overt proteinuria, as well as by differences in the classification of CKD etiologies at the regional level.

An analysis of CKD prevalence according to altitude of residence was not conducted in the present study. The sampling framework was designed to ensure representativeness of the adult population of the Kyrgyz Republic, encompassing households located in both highland and lowland regions. However, the distribution of participants across altitude categories was uneven, which could have reduced the statistical robustness of altitude-specific comparisons. As the primary aim of the study was to estimate the overall population-based prevalence of CKD, the analysis was performed for the total representative sample without stratification by altitude.

This study has several limitations. First, the classification of CKD status was based on a single measurement of e-GFR and urinary albumin concentration. This approach may lead to an overestimation of CKD prevalence, as the diagnosis requires confirmation of persistent abnormalities over at least three months. Repeated assessment of renal biomarkers over time would provide more accurate estimates of disease prevalence.

Second, only adult participants were included in the study, which limits the generalizability of the findings to the pediatric population.

Third, the study did not include data on patients receiving renal replacement therapy, which may have resulted in a slight underestimation of CKD stage 5 cases. According to national data, as of September 2025, the prevalence of dialysis therapy in the Kyrgyz Republic was approximately 65 patients per 100,000 population (0.065%), which likely has minimal impact on the overall population-based CKD prevalence estimate.

Finally, due to the cross-sectional nature of the study, causal relationships between CKD and associated risk factors cannot be established.

Conclusion

In this population-based study, the prevalence of CKD among the adult population of the Kyrgyz Republic was 10.8%, which is comparable to global estimates. Over the past decade, there has been a growing trend in CKD prevalence, likely attributable to the increasing burden of diabetes mellitus, hypertension, and obesity, as well as improvements in laboratory diagnostic capacity and the implementation of screening programs.

Diabetes mellitus, chronic glomerulonephritis, and chronic pyelonephritis were the predominant causes of CKD in this cohort, reflecting regional characteristics of disease pathogenesis and underlying socioeconomic factors.

Despite improvements in detection, population-level control of CKD and its major risk factors remains insufficient. To reduce the burden of CKD in the Kyrgyz Republic, a comprehensive strategy is needed - one that includes expanding early detection programs, integrating CKD surveillance into national noncommunicable disease monitoring systems, improving awareness among the general population and primary care providers, and implementing cross-sectoral interventions aimed at preventing diabetes, hypertension, and obesity. Particular attention should be directed toward vulnerable groups, including older adults, women, and residents of rural areas.

Author Contributions: A.D. and B.A. - the overall conceptualization of the study and the development of its methodological framework, drafted the initial version of the manuscript, coordinated the integration of contributions from all co-authors. K.A., O.T., T.S., K.S., and K.Y. contributed to data acquisition, validation, and comprehensive statistical analysis, supporting the interpretation of findings across regional contexts. K.R. provided senior academic supervision and oversight throughout all stages of the research process, offering methodological guidance, ensuring adherence to scientific and ethical standards. All authors contributed to the interpretation of the data, participated in the critical revision of the manuscript for important intellectual content, and approved the final version for publication.

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