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Chronic kidney disease screening in primary care: a descriptive analysis of the Girona Sud health region

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Abstract

Aims Chronic kidney disease (CKD) is a major global health concern, often underdiagnosed in primary care settings. This study aimed to assess CKD screening practices using estimated glomerular filtration rate (eGFR) and urine albumin-to-creatinine ratio (UACR) among individuals in a primary care population in Girona Sud, Catalonia.

Methods A cross-sectional analysis was conducted using anonymised electronic health records from Girona Sud primary care centres. We included active patients aged ≥ 15 years with a recorded medical history. Demographic, clinical, and laboratory data, including eGFR and UACR, were analysed. CKD was defined as eGFR < 60 ml/min/1.73 m^2 and/or UACR ≥ 30 mg/g. Descriptive and inferential statistical analyses were performed.

Results Among the studied population ($N = 230,922$), 37% had mildly decreased eGFR (60–89 ml/min/1.73 m^2), while 3% had more advanced CKD (G3b-G5). Albuminuria was mostly A1 (89%), with moderate (9.4%) and severe (1.8%) cases observed. Screening was more frequent in patients with type 2 diabetes, hypertension, and dyslipidaemia. Renal protective drugs, such as ACE inhibitors, ARBs, and SGLT2 inhibitors, were mainly prescribed in early CKD stages.

Conclusions Early-stage CKD is prevalent in our primary care population, particularly among those with cardiometabolic conditions. It is important to optimize the CKD detection and management in primary care. Despite the availability of renal protective treatments, their underutilization in advanced stages of CKD highlights missed opportunities for timely and optimal intervention.

Keywords Chronic kidney disease, Primary care, EGFR, Albuminuria, Screening, Type 2 diabetes, Hypertension, Kidney protective therapy, Real-world data

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Introduction

Chronic kidney disease (CKD) is an important healthcare problem worldwide, with an increasing number of new cases in recent decades [1]. It is estimated that incidence has increased by 1.82% (average annual per cent change) annually since 1990, and the prediction is that more than 1.1 billion people over 65 years old will be affected by this condition by 2035 [2], converting this disease among the fifth causes of death globally [3]. The drastic increase in new CKD cases is mainly due to the ageing of the population globally, but also due to the rising number of diabetes and arterial hypertension, which are considered principal risk factors for progressive renal damage [4].

According to the KDIGO (kidney disease: Improving Global Outcomes) guidelines, CKD is defined as: estimated Glomerular filtration rate (eGFR) < 60 ml/min/1.73m^2, and/or the presence of at least one kidney damage marker, among them including albuminuria (urine albumin-to-creatinine ratio-UACR) ≥ 30 mg/g, during a period over three months [5]. The classification of CKD is based on three main axes: the eGFR category (G1-G5), albuminuria category (A1-A3) and underlying cause. For diagnosis confirmation and to rule out possible acute kidney damage, it is important to repeat the evaluation of these parameters [5].

The early diagnosis of CKD depends on identifying risk factors such as predisposing factors, initiators, and accelerators of its progression. The most common CKD risk factors are considered advanced age (≥ 60 years), family history of CKD or end-stage kidney disease (ESKD), diabetes (type 1 or type 2), arterial hypertension, cardiovascular disease or obesity [6]. On the other hand, as an accelerator risk factor for CKD progression, it is considered poor blood pressure and glycaemic control, dyslipidaemia, smoking, metabolic syndrome, and prolonged use of nephrotoxic drugs. Due to the progressive and irreversible nature of this disease, prevention and early treatment are crucial to slow down the worsening of renal function and reduce the need for renal replacement therapies, such as dialysis or renal transplant [7]. In this context, primary health care is important in identifying at-risk individuals, making early diagnoses, and implementing therapeutic strategies based on clinical guidelines. The periodic follow-up of eGFR and UACR is fundamental for the early detection of CKD and the prevention of its progression. Implementation of specific screening programs could optimise the diagnosis and the treatment in the early stages, improving the disease prognosis of these people and lowering the disease burden. In Spain, primary care is the first point of contact with the healthcare system. According to the national guidelines' recommendations, primary care physicians should screen high-risk patients for CKD using eGFR and UACR, stratify risk per KDIGO guidelines, and ensure regular monitoring and early referral when needed [8].

Despite the high burden of morbidity and mortality of this condition, CKD remains underdiagnosed in the early stages due to its asymptomatic nature [9]. The absence of the early symptoms of this disease makes early detection difficult and delays the implementation of therapeutic strategies that could slow the progression [10]. For those reasons, most of the people affected by CKD are diagnosed at advanced stages, without proper clinical management, which limits the therapeutic options and increases the risk for severe complications such as ESKD, cardiovascular events and premature death [7]. There are few real-world studies on CKD underdiagnosis in primary care. In the U.S., only 28.7% of patients with diabetes, 10.5% with hypertension, and 41.4% with both were assessed for CKD among 28 million at-risk individuals [11]. In Spain, a study of 90,735 people with type 2 diabetes reported a CKD prevalence of 31.4%, but only 53% were documented in medical records [12]. Another study in Catalonia found a CKD prevalence of 33%, with 29.4% having eGFR 30–59 ml/min/1.73 m^2 or UACR > 30 mg/g, and 3.6% with eGFR < 30 ml/min/1.73 m^2 [13]. These findings underscore the need to implement more effective and sustained CKD screening strategies in primary care settings. In this context, our real-world data study aims to evaluate chronic kidney disease (CKD) screening practices by assessing estimated glomerular filtration rate (eGFR) and urine albumin-to-creatinine ratio (UACR) among individuals managed in primary care. In addition, we investigated the use of renal-protective medications, including renin–angiotensin–aldosterone system (RAAS) inhibitors, sodium-glucose cotransporter-2 (SGLT2) inhibitors, and glucagon-like peptide-1 receptor agonists (GLP-1 RAs), among these subjects.

Methods

Design and settings

We did a descriptive cross-sectional analysis on a cohort of people at risk for CKD from the primary care sanitary region of Girona Sud. We analysed routinely collected anonymised healthcare data from electronic medical records. Girona Sud (serveis d'atenció primària SAP Girona Sud) is a sanitary region in the north east part of Catalonia, Spain (Supplementary Fig. 1). The date of observation (December 31 st, 2024) was considered the final date available in the database.

Study subjects

As of the observation date, all individuals aged 15 years or older with an available medical history who had attended any of the 18 primary care centres within SAP Girona Sud were included, representing the full population under the primary care. All available data for eligible

individuals were included up to the database observation date. No predefined observation window was applied; the most recent eGFR and UACR values were used to define CKD categories.

Study variables

We analysed variables related to the demographics (sex and age), clinical variables (body mass index-BMI, diabetes duration), toxic habits (smoking status), laboratory parameters (HbA1c, lipid profile determinations, eGFR in ml/min/1.73 m^2 estimated by CKD-EPI equation and UACR in mg/g). We also collected data on concomitant treatment by different groups of pharmacological families (renal protective antihypertensive drugs and antidiabetic drugs). In Spain, GLP-1 receptor agonists are reimbursed only for adults with T2DM insufficiently controlled with diet and exercise, either as monotherapy when metformin is contraindicated or not tolerated, or in combination with other glucose-lowering drugs in patients with BMI ≥ 30 kg/m^2. The most important comorbidities, such as obesity, hypertension, dyslipidaemia, type 1 or type 2 diabetes, ischemic heart disease, stroke, heart failure, and peripheral arteriopathy, were analysed as well. The metabolic disease was defined as the presence of hypertension and/or dyslipidaemia and/or obesity and/or type 2 diabetes mellitus, and/or chronic kidney disease. These comorbidities were defined as the presence of (International Statistical Classification of Diseases and Related Health Problems, 10th Revision) ICD10 diagnostic codes in the database. Cardiovascular prevention status was categorized as primary or secondary prevention, based on whether patients had established cardiovascular disease. This stratification was used to describe pharmacological treatment patterns according to cardiovascular risk and clinical indication, ensuring a consistent interpretation of therapy use within the at-risk population. Primary prevention was defined as the absence of cardiovascular disease, while secondary prevention was defined as the presence of stroke and/or ischemic heart disease and/or peripheral arteriopathy. The CKD was defined as the presence of eGFR < 60 ml/min/1.73 m^2 and/or a UACR ≥ 30 mg/g. Results are presented for all KDIGO eGFR and UACR categories (G1–G5 and A1–A3) to provide a complete overview of CKD screening patterns, including both patients meeting CKD criteria (eGFR < 60 and/or UACR > 30 mg/g) and those at earlier stages.

Statistical analysis

We conducted a comprehensive descriptive analysis of the study variables. Continuous variables were summarised using appropriate measures of central tendency and dispersion, including means with standard deviations (SD) for normally distributed data and medians with interquartile ranges (IQR) for non-normally distributed data. Categorical variables were presented as absolute frequencies and corresponding percentages. For inferential statistical analysis, different tests were applied based on the nature and distribution of the variables. Parametric test, such as the Welch Two Sample t-test, were used for normally distributed continuous variables. In contrast, non-parametric tests, including the Pearson's Chi-squared test, was employed for non-normally distributed data. All statistical analyses were conducted using R software (R Core Team. (2024). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available at: https://www.R-project.org/), ensuring reproducibility and robustness of the findings.

Results

Clinical characteristics of the subjects

The clinical characteristics of the study population (N = 230,922) are summarised in Table 1. The mean age of the overall population was 47 years (± 32.6), with 27% of individuals aged over 60 years. The prevalence of type 2 diabetes mellitus (T2DM) was 7.1%, while the most frequent comorbidities were hypertension (19%), obesity (18%), and dyslipidaemia (17%). Approximately 4.3% of the total population were receiving secondary prevention. Regarding renal function, 55% of the population had normal or high glomerular filtration rate (eGFR ≥ 90 ml/min/1.73 m^2), while 37% had mildly decreased eGFR (60–89 ml/min/1.73 m^2). More advanced kidney disease (G3b-G5) was relatively rare, affecting less than 3% of the population. Albuminuria was predominantly in the A1 category (89%), indicating normal to mildly increased urinary albumin-to-creatinine ratio, with moderate and severe albuminuria observed in 9.4% and 1.8% of individuals, respectively.

When stratified by sex (Table 1), a higher proportion of females were aged over 60 years (29%) compared with males (25%). Regarding lifestyle factors, 20% of the population were current smokers, with a higher prevalence among males (24%) than females (15%). Ischaemic heart disease was more common in males (3.2%) than in females (1.4%), whereas obesity was more prevalent among females (20%) compared with males (16%). Primary prevention was the predominant preventive strategy, applied to 97% of female participants, while 5.4% of males required secondary prevention due to established cardiovascular disease. Regarding renal function, patterns were similar between males and females, although a higher proportion of males presented with A2 (moderately increased albuminuria). Fig. 1 shows the Venn diagram for different comorbidities in our study population.

Table 1 Clinical characteristics of the population stratified by sex

	Overall, *N* = 230,922	Female *N* = 115,881	Male *N* = 115,041	*p*-value
Age, mean (SD), years	47.26 (19.23)	48.36 (19.74)	46.15 (18.64)	0.001
Age > 60 years, n (%)	62,909 (27)	34,182 (29)	28,727 (25)	0.001
Toxic habits, n (%)				
Current smoker	36,045 (20)	14,842 (15)	21,203 (24)	0.001
Comorbidities, n (%)				
T2D	16,404 (7.1)	7,137 (6.2)	9,267 (8.1)	0.001
T1D	1,034 (0.4)	447 (0.4)	587 (0.5)	0.001
Hypertension	43,297 (19)	21,107 (18)	22,190 (19)	0.001
Dyslipidaemia	39,311 (17)	20,095 (17)	19,216 (17)	0.001
Heart failure	2,935 (1.3)	1,419 (1.2)	1,516 (1.3)	0.048
Ischemic heart disease	5,253 (2.3)	1,570 (1.4)	3,683 (3.2)	0.001
Stroke	4,051 (1.8)	1,976 (1.7)	2,075 (1.8)	0.074
Obesity	41,329 (18)	22,874 (20)	18,455 (16)	0.001
Primary prevention	220,916 (96)	112,042 (97)	108,874 (95)	0.001
Secondary prevention	10,006 (4.3)	3,839 (3.3)	6,167 (5.4)	0.001
Clinical variables				
BMI, media (IQR: Q1-Q3), kg/m^2	25.2 (22.0, 29.0)	25.0 (21.6, 29.3)	25.5 (22.4, 28.7)	0.019
T2D, mean (SD), years	11 (5.17)	11 (5.17)	11 (5.17)	0.005
T1D, mean (SD), years	15 (6.24)	16 (7.24)	14 (6.24)	0.140
GFR categories, n (%)				0.001
G1	89,588 (39)	49,931 (43)	39,657 (34)	
G2	59,542 (26)	30,924 (27)	28,618 (25)	
G3a	8,512 (3.7)	4,533 (3.9)	3,979 (3.5)	
G3b	3,358 (1.5)	1,907 (1.6)	1,451 (1.3)	
G4	965 (0.4)	541 (0.5)	424 (0.4)	
G5	258 (0.1)	102 (< 0.1)	156 (0.1)	
Unknown	68,699 (30)	27,943 (24)	40,756 (35)	
UCAR categories, n (%)				0.001
A1	64,869 (28)	33,528 (29)	31,341 (27)	
A2	6,871 (3.0)	3,137 (2.7)	3,734 (3.2)	
A3	1,318 (0.6)	450 (0.4)	868 (0.8)	
Unknown	157,864(68)	78,766 (68)	79,098 (69)	

GFR Glomerular filtration rate, *G1* Normal or high GFR ≥ 90 ml/min per 1.73 m^2, *G2* Mildly decreased GFR 60–89 ml/min per 1.73 m^2, *G3a* Mildly to moderately decreased: GFR 45–59 ml/min per 1.73 m^2, *G3b*: Moderately to severely decreased GFR 30–44 ml/min per 1.73 m^2, *G4* Severely decreased GFR 15–29 ml/min per 1.73 m2, *G5* Kidney failure GFR < 15 ml/min per 1.73 m2, *A1* Normal to mildly increased UCAR < 30 mg/g, *A2* Moderately increased UCAR 30–300 mg/g, *A3* Severely increased UCAR > 300 mg/g, *BMI* Body mass index, *IQR* Interquartile range, *Q1* First quartile, *Q3* Third quartile, *T2D* type 2 diabetes, *T1D* Type 1 diabetes, *Primary prevention* without any cardiovascular outcomes, *Secondary prevention* Stroke and/or Ischemic heart disease and/or peripheral arteriopathy

Screening for chronic kidney disease and its distribution among different comorbidities and renal protective drugs

Among the total study population of 230,922 individuals, 162,223 (70.2%) had at least one eGFR measurement and 73,058 (31.6%) had at least one UACR determination. Screening for both eGFR and UACR was most frequently performed in individuals with type 2 diabetes, type 1 diabetes of at least 5 years' duration, and hypertension (95.91%, 95.09%, and 92.09%, respectively). In contrast, particularly for combined testing of both markers, lower screening rates were observed among current smokers and individuals with obesity (31.94% and 61.35%, respectively). Screening for eGFR alone was most commonly conducted in people with T2D, whereas UACR testing alone was more prevalent among those with T1D. Table 2 summarizes the screening rates for eGFR and UACR according to different risk factors for chronic kidney disease. Among people with type 2 diabetes, 37.1% met laboratory criteria for CKD and 19.8% had a CKD diagnosis. Over half of those with altered eGFR and/or ACR (53.7%) had no diagnosis, while 10.5% of those diagnosed for CKD showed no renal profile laboratory parameters abnormalities (Supplementary Table 1).

Table 3 presents the KDIGO renal function grade stratification based on glomerular filtration rate (eGFR) and albuminuria, categorised by T2D, hypertension, dyslipidaemia, and obesity. Among individuals with T2D, the majority (59.18%) had normal to mildly decreased eGFR (G1-G2) and normal to mildly increased urine albumin-to-creatinine ratio (A1), whereas only 0.42% had kidney failure (G5) with severely increased albuminuria (A3). Additionally, 0.95% of individuals with T2D had no recorded values for eGFR or albuminuria. A similar distribution was observed among individuals with hypertension, dyslipidaemia, and obesity. The lowest proportion of individuals with kidney failure (G5) and severely increased albuminuria (A3) was seen among those with obesity. Notably, a higher percentage of individuals with obesity had missing values for eGFR and albuminuria compared to the other groups.

Overall, the use of renal protective drugs in the total cohort (*N* = 230,922) was low. SGLT2 inhibitor prescriptions were most frequent among participants with preserved kidney function (G1–G2) and normal albuminuria (A1), decreasing progressively with advancing CKD stages. Conversely, ACE inhibitors and/or ARBs were more commonly prescribed, particularly among individuals with mild to moderate kidney impairment (G2–G3) and increased albuminuria (A2–A3). The prevalence of both drug classes was markedly lower in participants with severe CKD (G4–G5). Table 4 summarises the Glomerular filtration rate, albuminuria distribution, and renal protective drugs. Stratified for people with chronic kidney disease with or without T2DM, low usage of Glucagon-like peptide-1 (GLP-1) analogues was observed among these people. Subjects with CKD and type 2 diabetes received renal-protective drugs more frequently than those without diabetes. Use of SGLT2 inhibitors

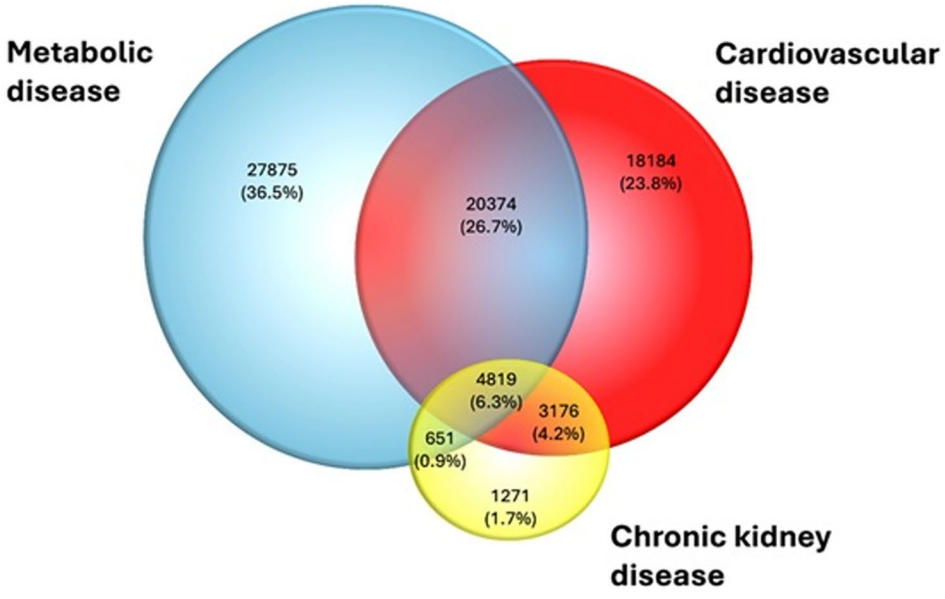

Fig. 1 Venn diagram for different comorbidities

Table 2 Screening for GFR and UCAR among different risk factors for chronic kidney disease

	Number of subjects	Mean GFR, ml/min per 1.73 m2	People screened for GFR (%)	Mean UCAR, mg/g	People screened for UCAR (%)	People screened for GFR and UCAR (%)
Age ≥ 60 years	62,909	72.79	90.61	37.64	68.69	68.48
T2D	16,404	72.77	98.87	76.45	96.09	95.91
Current smoker	36,045	88.88	79.29	33.56	32.11	31.94
T1D duration > 5 years	713	83.70	95.79	62.81	98.04	95.09
Hypertension	43,297	72.33	96.95	46.41	92.36	92.09
Dyslipidaemia	39,311	75.83	94.74	42.98	70.33	70.13
Ischemic heart disease	5253	67.97	98.59	71.61	88.79	88.65
Stroke	4051	69.68	98.52	64.67	84.82	84.79
Obesity	41,329	80.81	89.40	40.51	61.59	61.35
Metabolic disease	53,719	79.87	89.91	46.67	64.77	64.47

GFR Glomerular filtration rate, *T2D* Type 2 diabetes, *T1D* Type 1 diabetes, Urine Albumin-Creatinine Ratio; Metabolic disease: Obesity, Type 1 diabetes, Type 2 diabetes, Dyslipidaemia

and ACE inhibitors/ARBs was higher in the T2DM group across all CKD stages, especially with greater albuminuria (Supplementary Table 2).

Discussion

Our descriptive analysis of the primary health care population from the Girona Sud sanitary region in Northeast Spain indicates that screening for chronic kidney disease, based on glomerular filtration rate and albuminuria, is most frequently performed in individuals with type 2 diabetes, followed by those with hypertension, dyslipidaemia, and obesity. Renal protective drugs such as Sodium-glucose co-transporter 2 inhibitors, ACE inhibitors, and/or Angiotensin II receptor blockers were more frequent among people with early-stage CKD.

CKD is a common complication among people with diabetes and cardiovascular risk factors. The progression of this condition is linked with different metabolic and vascular comorbidities that affect renal function, decrease glomerular filtration, and increase albuminuria. We observed 7.1% of T2D in our cohort of subjects, slightly higher among males. This data is lower than other similar primary care studies from Spain, where the observed prevalence was 11%, where 8.1% of T2D was

Table 3 Glomerular filtration rate and albuminuria distribution in different comorbidity populations

N (%)	Type 2 diabetes N=16,404				Hypertension N=43,297			
	A1	**A2**	**A3**	**NA**	**A1**	**A2**	**A3**	**NA**
G1	3777 (23.02)	709 (4.32)	86 (0.52)	213 (1.30)	8174 (18.88)	858 (1.98)	111 (0.26)	807 (1.86)
G2	5931 (36.16)	1191 (7.26)	168 (1.02)	214 (1.30)	18810 (43.44)	2062 (4.76)	253 (0.58)	995 (2.30)
G3a	1455 (8.87)	541 (3.30)	123 (0.75)	28 (0.17)	4574 (10.56)	1038 (2.40)	199 (0.46)	186 (0.43)
G3b	674 (4.11)	421 (2.57)	143 (0.87)	19 (0.12)	1753 (4.05)	781 (1.80)	232 (0.54)	78 (0.18)
G4	121 (0.74)	176 (1.07)	126 (0.77)	6 (0.04)	325 (0.75)	310 (0.72)	198 (0.46)	22 (0.05)
G5	2 (0.01)	20 (0.12)	69 (0.42)	5 (0.03)	15 (0.03)	52 (0.12)	126 (0.29)	17 (0.04)
NA	27 (0.16)	2 (0.01)	1 (0.01)	156 (0.95)	108 (0.25)	9 (0.02)	3 (0.01)	1201 (2.77)
	Dyslipidaemia N=39,311				Obesity N=41,329			
	A1	A2	A3	NA	A1	A2	A3	NA
G1	5912 (15.04)	598 (1.52)	85 (0.22)	4447 (11.31)	7797 (18.87)	790 (1.91)	89 (0.22)	8080 (19.55)
G2	13453 (34.22)	1300 (3.31)	171 (0.43)	4777 (12.15)	10893 (26.36)	1175 (2.84)	143 (0.35)	3293 (7.97)
G3a	3038 (7.73)	596 (1.52)	114 (0.29)	354 (0.90)	2185 (5.29)	499 (1.21)	90 (0.22)	167 (0.40)
G3b	1082 (2.75)	457 (1.16)	146 (0.37)	68 (0.17)	799 (1.93)	346 (0.84)	118 (0.29)	36 (0.09)
G4	192 (0.49)	184 (0.47)	120 (0.31)	15 (0.04)	133 (0.32)	138 (0.33)	84 (0.20)	10 (0.02)
G5	5 (0.01)	37 (0.09)	78 (0.20)	13 (0.03)	2 (0.00)	22 (0.05)	52 (0.13)	7 (0.02)
NA	75 (0.19)	6 (0.02)	NA	1988 (5.06)	95 (0.23)	3 (0.01)	1 (0.00)	4282 (10.36)

GFR Glomerular filtration rate, *G1* Normal or high GFR ≥90 ml/min per 1.73 m2, *G2* Mildly decreased GFR 60–89 ml/min per 1.73 m2, *G3a* Mildly to moderately decreased: GFR 45–59 ml/min per 1.73 m2, *G3b* Moderately to severely decreased GFR 30–44 ml/min per 1.73 m2, *G4* Severely decreased GFR 15–29 ml/min per 1.73 m2; *G5* Kidney failure GFR <15 ml/min per 1.73 m2, *A1* Normal to mildly increased UCAR <30 mg/g, *A2* Moderately increased UCAR 30–300 mg/g, *A3* Severely increased UCAR>300mg/g, *NA* Not available

Table 4 Glomerular filtration rate and albuminuria distribution and renal protective drugs

	Sodium-glucose co-transporter 2 (SGLT2) inhibitors *N*=230,922				**Ace inhibitors and/or Angiotensin II receptor blockers *N*=230,922**			
	A1	**A2**	**A3**	**NA**	**A1**	**A2**	**A3**	**NA**
G1	808 (0.35)	216 (0.09)	35 (0.02)	42 (0.02)	5616 (2.43)	698 (0.3)	95 (0.04)	589 (0.26)
G2	1244 (0.54)	364 (0.16)	63 (0.03)	75 (0.03)	13,668 (5.92)	1614 (0.7)	208 (0.09)	782 (0.34)
G3a	449 (0.19)	179 (0.08)	66 (0.03)	17 (0.01)	3652 (1.58)	830 (0.36)	166 (0.07)	150 (0.06)
G3b	253 (0.11)	163 (0.07)	88 (0.04)	10 (0)	1415 (0.61)	582 (0.25)	195 (0.08)	57 (0.02)
G4	55 (0.02)	80 (0.03)	55 (0.02)	4 (0)	243 (0.11)	226 (0.1)	152 (0.07)	17 (0.01)
G5	1 (0)	3 (0)	8 (0)	0 (0)	6 (0)	28 (0.01)	82 (0.04)	8 (0)
NA	10 (0)	0 (0)	1 (0)	29 (0.01)	63 (0.03)	4 (0)	2 (0)	599 (0.26)

Percentages are calculated based on the total study population (N = 230,922), allowing comparison of prescribing rates across GFR and albuminuria categories independently of subgroup size

GFR Glomerular filtration rate, *G1* Normal or high GFR ≥ 90 ml/min per 1.73 m2, *G2* Mildly decreased GFR 60–89 ml/min per 1.73 m2, *G3a* Mildly to moderately decreased: GFR 45–59 ml/min per 1.73 m2, *G3b* Moderately to severely decreased GFR 30–44 ml/min per 1.73 m2, *G4* Severely decreased GFR 15–29 ml/min per 1.73 m2, *G5* Kidney failure GFR < 15 ml/min per 1.73 m2, *A1* Normal to mildly increased UCAR < 30 mg/g, *A2* Moderately increased UCAR 30–300 mg/g, *A3* Severely increased UCAR > 300 mg/g, *NA* NNot available

reported and 3% unreported [14]. Regarding hypertension, an earlier published paper reported a prevalence of hypertension in Spain (33%) among adults aged 30 to 79 years [15]; we observed a lower prevalence for hypertension (19%) considering only ICD-10 diagnostic codes registers. There could be an underdiagnosis of this condition in our population. Comparing the observed prevalence for dyslipidaemia (17%) in the current study with the previously published studies from Spain, the same tendency exists. In the study with 33,913 patients with a mean age of 54.6 (± 18.3) years from attending the Spanish health service outpatient clinics, the authors reported a global prevalence of 24.3% [16]. On the other hand, we observed a higher prevalence of obesity (18%) compared with the other recently published study from Spain, where the authors reported an overall prevalence of 15.7% in 2020 [17]. In 2022, a similar study was published using data from Portugal, including 136,993 individuals aged 18 years or older. The authors reported an overall prevalence of CKD of 9.8%, with a higher prevalence among females (5.5%) than males (4.2%). Additionally, the prevalence of hypertension was 42.5%, type 2 diabetes mellitus (T2DM) 23.0%, and obesity was present in 20.3% of the studied population. [18]. Ischemic heart disease was more prevalent among males compared with females; this is in line with results from previously published studies from our group related to the first cardiovascular events, which were more prevalent among males than females (7.48% vs. 5.90%, respectively) [19].

According to the KIDGO classification, most of the screened people in our primary health care settings were in the initial stages of CKD (G1-G2 and A1-A2). As this was a cross-sectional study, longitudinal progression toward ESKD could not be assessed. However, individuals in the advanced stages (G3b–G5) identified in our analysis are at higher risk of progressing to ESKD, highlighting the need for earlier detection and optimized management to prevent future progression. Comparing these data with other similar primary health care studies from Catalonia, Northeast Spain, from 2010 with 97,665 people aged > 60 years, the majority of the people, 72.56% (10.720), had eGFR 45–59 ml/min (Modification of Diet in Renal Diseases-MDRD formula) [20]. The differences observed in the results between these two studies could be due to the differences in the age of the selected population. Compared with similar data from Portugal, authors reported that most patients (27.2%) had an eGFR of 60–89 ml/min/1.73 m2 (G2 grade) for the same eGFR grade. We observed a higher percentage of people (37%) in our analysis [18].

Regarding the renal protective drugs use, such as sodium-glucose co-transporter 2 (SGLT-2) inhibitors, ACE inhibitors (ACEI) and/or Angiotensin II receptor blockers (ARB II) among the different grades of CKD, in our study, the majority of the users of these drugs had initial stages of CKD. The ACEI or ARB II are indicated for patients with all of the stages of CKD, and their use is especially important in the intermediate and advanced stages or patients with significant albuminuria, where it is demonstrated that these drugs can reduce the progression of renal damage and the occurrence of associated cardiovascular events [21]. On the other hand, the SGLT-2i have demonstrated that they are effective in the prevention of the progression of CKD, especially in the early stages (G1-G3) among people with T2D and albuminuria [22]. Comparing the data with previously published studies, SGLT-2i mainly were used among the people with G1 grade eGFR (11.5%), while ACEI among the people with eGFR 30–44 ml/min/1.73 m^2 and ARB II among the people with eGFR < 15 ml/min/1.73 m^2 (66.3%) [18]. In our study, ACEI or ARB II use remains low as the kidney function decreases. Although we observed a general decline in the use of renal-protective drugs with worsening kidney function, the pattern was not consistent across all eGFR and UACR strata. This variability may reflect differences in clinical practice, comorbidity burden, drug contraindications, and prescribing restrictions in subjects with advanced CKD.

In primary care, screening for albuminuria and eGFR is crucial for early detection and management of chronic kidney disease (CKD). However, real-world data indicate suboptimal adherence to these practices. A study across 24 U.S. healthcare organisations revealed that while eGFR testing rates were uniformly high, only 52.9% of patients with type 2 diabetes underwent UACR testing within a year, increasing to 73.7% over three years, leaving a significant portion untested [23]. Similarly, despite an increase in annual albuminuria measurements in Denmark over eight years, nearly half of CKD patients lacked a UACR assessment at the time of diagnosis, underscoring persistent underutilisation [24]. Among our T2D population, albuminuria was usually missing among the subjects with normal to mildly decreased GFR (G1-G2), 1.3% for each grade. This high percentage for albuminuria screening could be due to the local guidelines that recommend initial screening for UACR, eGFR and creatinine at the moment of diagnosis of T2D and annually as part of regular healthcare visits [25]. The availability of local standardized analysis protocols for key comorbidities such as diabetes and hypertension, which are routinely requested by default could be the reason for such high success. This highlights the importance of having protocolized testing for risk comorbidities associated with CKD. Although some relevant parameters may still be missing, the structured approach ensures more consistent detection and monitoring of high-risk conditions.

This study has several limitations that should be considered. First, its cross-sectional design limits the ability to establish causal relationships between clinical variables and chronic kidney disease (CKD) progression. Longitudinal studies would be needed to assess causality and temporal changes. Second, the study relies on routinely collected electronic medical records, which may be subject to missing or incomplete data, particularly for laboratory values such as eGFR and albuminuria. The CKD-EPI equation is validated for adults; however, it was applied to all individuals in our dataset, including those aged 15–18 years, as provided by the reference laboratories. This limitation may have introduced selection bias or misclassification in renal function estimates within this younger subgroup. Third, while our study population is representative of primary care attendees in the Girona Sud region, the findings may not be fully generalisable to other populations with different demographic or healthcare system characteristics. Finally, the assessment of comorbidities and medication use was based on ICD-10 codes and prescriptions recorded in the database, which may not capture adherence to treatment or the complete clinical picture of disease management. Moreover, prescribing patterns should be interpreted considering that, in Spain, GLP-1 receptor agonists are reimbursed only under specific conditions—mainly for patients with a BMI > 30 kg/m^2 or when metformin is not tolerated. This limitation may have influenced their use in routine clinical practice. Despite these limitations, this study underscores the importance of optimising CKD detection and management in primary care. Despite frequent

screening for eGFR and UACR among patients with type 2 diabetes and hypertension, other at-risk groups, such as individuals with obesity or active smoking-remain under-screened.

A more systematic, risk-based approach to CKD screening, coupled with consistent use of evidence-based therapies (ACE inhibitors, ARBs, SGLT2 inhibitors), could promote earlier identification and improved disease control. Embedding structured testing pathways, clinical decision support tools together with electronic health record-based alerts, and targeted professional education within primary care systems would further support these goals. These strategies may reduce CKD underdiagnosis, enhance patient outcomes, and lessen the healthcare and societal burden of CKD.

Conclusions

This real-world data study provides a comprehensive overview of CKD risk factors, associated comorbidities, and renal protective drug use in a primary care population. These results underscore the importance of optimization of early detection and proactive management of CKD in at-risk populations. Future research should prioritise longitudinal analyses to better characterise disease progression and to inform more effective prevention and intervention strategies in primary care.

Abbreviations

ACEI	Angiotensin-Converting Enzyme Inhibitor
ARB II	Angiotensin II Receptor Blocker
BMI	Body Mass Index
CKD	Chronic Kidney Disease
CKD-EPI	Chronic Kidney Disease Epidemiology Collaboration (equation)
ESKD	End-Stage Kidney Disease
eGFR	Estimated Glomerular Filtration Rate
GLP-1	Glucagon-Like Peptide-1
HbA1c	Hemoglobin A1c
ICD-10	International Classification of Diseases, 10th Revision
IQR	Interquartile Range
KDIGO	Kidney Disease: Improving Global Outcomes
SAP	Serveis d'Atenció Primària
SD	Standard Deviation
SGLT2	Sodium-Glucose Co-Transporter 2
T1D	Type 1 Diabetes
UACR	Urine Albumin-to-Creatinine Ratio

Supplementary Information

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Supplementary Material 1.

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Authors' contributions

Conceptualisation, J.B-P; methodology, C.L-A; software, J.B-P and J.F-N; validation, J.B-P and C.L-A; formal analysis, J.B-P; resources, C.L-A; data curation, B.V; writing—original draft preparation, J.B-P, B.V and J.F-N; writing—review and editing, J.B-P and J.F-N; supervision, M. R-G; B.F-C; M.E-P; J.B-P; J.F-N; All authors have read and agreed to the published version of the manuscript.

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Data availability

The data analysed in this study is subject to the following licenses/restrictions: Restrictions apply to the availability of some or all data generated or analysed during this study because they were used under a license. The corresponding author will, on request, detail the restrictions and any conditions under which access to some data may be provided. Requests to access these datasets should be directed to Dr. Joan Barrot email: jfbarrot.girona.ics@gencat.cat.

Declarations

Ethics approval and consent to participate

The study was conducted according to the guidelines of the Declaration of Helsink,1 October 2024. The IDIAP Jordi Gol Ethics Committee approved the study, protocol approval number 23/030-P, on 29/03/2023. The need for informed consent was waived by the Clinical Research Ethics Committee of IDIAP Jordi Gol, as the study involved retrospective analysis of anonymized data. This waiver complies with the national regulations outlined in the Biomedical Research Law 14/2007 (Spain), which allows the use of health data for research purposes without informed consent when data are anonymized and obtaining consent is impracticable.
Not applicable.

Consent for publication

Not applicable.

Competing interests

J. B-P has received speaking fees from Boehringer Ingelheim. Astra-Zeneca. Lilly. MSD. Novo Nordisk. Sanofi. J. F-N has received advisory and or speaking fees from Astra-Zeneca. Ascensia, Boehringer Ingelheim, GSK, Lilly, MSD, Novartis, Novo Nordisk and Sanofi; he has received research grants to the institution from Astra-Zeneca, GSK, Lilly, MSD, Novartis, Novo Nordisk, Sanofi and Boehringer Ingelheim. M. R-G; B.F-C; M.E-P; B.V and J.L-A declare no conflict of interest for this analysis.

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