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Prevalence of chronic kidney disease in the pediatric population: a panel study based on a Colombian national registry

Prevalencia de la enfermedad renal crónica en la población pediátrica: un estudio tipo panel basado en un registro nacional colombiano

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Insuficiencia Renal Crónica, Fallo Renal Crónico, Pediatría, Epidemiología, Prevalencia, Nefrología.

Abstract

Objective

To characterize the epidemiological profile of chronic kidney disease among the pediatric population in Colombia.

Methods

An observational study using panel data from the “Cuenta de Alto Costo” registry was conducted. Patients under 18 years of age with a diagnosis of chronic kidney disease reported between July 2019 and June 2020 were included. Prevalence was calculated and stratified by age, sex, and region. Etiologies were also described.

Results

The prevalence of chronic kidney disease among patients under 18 years was 153.1 cases per million population (pmp), with an upward trend from 2019 to 2023, increasing from 100 to 367.1 pmp. The most frequent etiology was unknown (75.8%), followed by congenital anomalies of the kidney and urinary tract (10.7%) and glomerulonephritis (5.3%).

Conclusions

In Colombia, the prevalence of chronic kidney disease in the pediatric population is higher than that reported globally. However, the high proportion of cases with unknown etiology is notable; among identified etiologies, congenital anomalies of the kidney and urinary tract and glomerulopathies were the most frequent. These findings highlight the need to improve epidemiological records and establish diagnostic guidelines to determine the etiology of chronic kidney disease.

Conflict of interest

The authors declare that they have no conflicts of interest related to the content of this article.

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CRediT authorship contribution statement

I.D.S.: Conceptualization, Writing - original draft, Writing - review & editing. **J.S.S.:** Conceptualization, Writing - original draft, Writing - review & editing. **A.S.C.:** Conceptualization, Writing - original draft, Writing - review & editing. **R.B.R.:** Conceptualization, Investigation (data collection), Writing - review & editing, Supervision. **L.M.S.H.:** Conceptualization, Data curation, Writing - original draft, Writing - review & editing, Supervision.

Data Availability

The data supporting the findings of this study were obtained from the Cuenta de Alto Costo (Colombia) and are not publicly available due to legal and privacy restrictions governing national health data. Data are, however, available from the corresponding author upon reasonable request, subject to formal approval and data-sharing agreements with the Cuenta de Alto Costo.

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Resumen

Objetivo

Caracterizar el perfil epidemiológico de la enfermedad renal crónica en la población pediátrica colombiana.

Métodos

Estudio observacional de datos tipo panel basado en el Registro Colombiano de la Cuenta de Alto Costo. Se incluyeron pacientes menores de 18 años con diagnóstico de enfermedad renal crónica reportados entre julio de 2019 y junio de 2020. Se calcularon prevalencias generales, estratificadas por edad, sexo y región, y se describieron las etiologías reportadas.

Resultados

La prevalencia de la enfermedad renal crónica en menores de 18 años fue de 153.1 por millón de personas (pmp), con una tendencia creciente entre 2019 y 2023 (de 100 a 367.1 pmp). La etiología más frecuentemente reportada fue desconocida (75.8%), seguida de anomalías congénitas del riñón y del tracto urinario (10.7%) y de glomerulonefritis (5.3%).

Conclusiones

En Colombia, la prevalencia de la enfermedad renal crónica en la población pediátrica es superior a la reportada a nivel mundial. Sin embargo, destaca la alta proporción de casos con etiología desconocida; entre las etiologías identificadas, las más frecuentes fueron las anomalías congénitas del riñón y del tracto urinario y las glomerulopatías. Estos hallazgos subrayan la necesidad de mejorar los registros epidemiológicos y de establecer guías diagnósticas que permitan determinar la etiología de la enfermedad renal crónica.

Remark

1) Why was this study conducted?

Epidemiological data on pediatric chronic kidney disease remain fragmented across individual medical centers due to the absence of a unified national registry. This study aimed to characterize pediatric chronic kidney disease in Colombia using data from the Cuenta de Alto Costo.

2) What were the most relevant results of the study?

The prevalence of pediatric chronic kidney disease was higher than that reported in other countries and showed a sustained upward trend. Furthermore, the etiology was unknown in 75.8% of cases, suggesting underdiagnosis of specific underlying causes.

3) What do these results contribute?

This study highlights the need to implement targeted screening programs for the pediatric population, establish standardized diagnostic protocols to identify underlying kidney diseases, and expand regional access to specialized care.

Introduction

Chronic kidney disease (CKD) is characterized by progressive and irreversible structural or functional kidney damage that may advance to end-stage kidney disease (ESKD), requiring kidney replacement therapy (KRT). The estimated global age-adjusted prevalence in pediatric populations ranges from 15 to 74.7 cases per million population (pmp) [1-4]. This wide variability has been attributed to methodological differences among studies [5] and to the limited information available in the literature on the pediatric population compared with adults [4]. CKD is considered a major public health problem because of its substantial morbidity burden and its negative impact on the quality of life of patients and their families [6,7]. In addition, mortality rates have been reported to be up to 150 times higher than those in the general pediatric population [5,6].

In the pediatric population, the leading causes of CKD are congenital anomalies of the kidney and urinary tract (CAKUT) and glomerular diseases [2,4,8]. However, its etiology can vary by geographic region [5]. Globally, although CAKUT is the predominant cause, significant differences exist among international registries. In the United States, according to the North American Pediatric Renal Trials and Collaborative Studies (NAPRTCS) registry, CAKUT accounts for approximately 48% of cases, followed by glomerulopathies, whose incidence increases in individuals over 12 years of age [5,8]. In Europe, a similar trend has been observed according to the European Renal Association-European Dialysis and Transplant Association (ERA-EDTA) registry, although hereditary diseases rank second after CAKUT. In Finland, however, congenital nephrotic syndrome of the Finnish type is the leading cause of end-stage kidney disease (ESKD) among children younger than 15 years [5,9]. In Japan, CAKUT, particularly kidney hypoplasia and dysplasia, is also the most common cause, followed by focal segmental glomerulosclerosis and congenital nephrotic syndrome [10]. In Latin America, epidemiological information is limited; a single-center study with a 50-year follow-up identified CAKUT as the main etiology, followed by glomerulopathies and, to a lesser extent, hereditary nephropathies [11]. Similarly, the transplant registry of the Latin American Association of Pediatric Nephrology (ALANEPE), which integrates data from 12 countries, indicates that CAKUT accounts for 38% of cases (obstructive uropathy/reflux: 27% and hypoplasia/dysplasia: 11%), followed by glomerulopathies at 24% [12]. However, it has been observed that infectious causes may be more relevant in low- and middle-income countries [2].

In Colombia, there is no unified national registry of pediatric patients diagnosed with CKD. Information is fragmented across databases maintained by different renal care units, most of which are privately operated. Nevertheless, all patients receiving care within the healthcare system must be reported to the *Cuenta de Alto Costo* (CAC), which is the country's primary source of information on high-impact diseases, including CKD [3].

This study aims to characterize the epidemiological profile of Colombian pediatric patients diagnosed with CKD using data available from the CAC. Understanding the local epidemiology of this disease can increase awareness of its occurrence in children and strengthen public health decision-making, potentially reducing morbidity and mortality and improving the timely identification of candidates for kidney transplantation.

Materials and Methods

Study design and population

An observational study using panel data was conducted. All patients under 18 years of age who were diagnosed with CKD, received care within Colombia's General System of Social Security in Health (*Sistema General de Seguridad Social en Salud*, SGSSS), and were reported to the CAC between July 1, 2019, and June 30, 2020, were included.

Data source

The CAC is a nongovernmental technical organization affiliated with Colombia's SGSSS. Its role is the collection, validation, and analysis of clinical data from patients with identified high-cost diseases, including CKD and its precursor diseases, such as arterial hypertension (HTN) and diabetes mellitus (DM) [3,13]. Information is reported on a mandatory and periodic basis by Benefit Plan Management Entities (*Entidades Administradoras de Planes de Beneficios*, EAPB) and other insurance entities. The data undergo a verification and auditing process to ensure their quality and consistency.

For this study, the CAC authorized the use of an anonymized database corresponding to patients under 18 years of age reported during the study period. Additionally, CAC reports on the status of CKD in Colombia from 2019 to 2023 were reviewed [3,14-17]. As the data in these reports are stratified into five-year age groups, the population under 20 years of age was included in the evaluation of these periods.

Variables

The following variables were extracted from the database for analysis: age, sex, region of origin, reporting region, CKD stage according to the Kidney Disease: Improving Global Outcomes (KDIGO) 2012 classification [18], etiology, KRT modality (hemodialysis or peritoneal dialysis), and history of kidney transplantation. Prevalence rates of CKD and ESKD among individuals under 20 years of age between 2019 and 2023 were extracted from CAC online publications [3,14-17].

Case definition

For the study period, prevalent cases were defined as all patients under 18 years of age with a diagnosis of CKD, including ESKD, who had been registered by the cutoff date, regardless of their vital status.

To assess CKD trends between 2019 and 2023, the official CAC reports on the status of CKD in Colombia were reviewed [3,14-17]. In these reports, prevalent cases were defined as all individuals under 20 years of age registered with a diagnosis of CKD.

Statistical analysis

A descriptive analysis was conducted using absolute and relative frequencies, stratified by age group (0-1, 2-4, 5-10, and 11-17 years), sex, geographic region, and CKD stage (G1-G5).

For the main study period, crude prevalence was calculated using the projected population under 18 years of age for 2020 as the denominator, according to data from the National Administrative Department of Statistics (*Departamento Administrativo Nacional de Estadística*, DANE) [19].

Additionally, to control the effect of age in each region or department, age-standardized prevalence was estimated using the direct standardization method. The DANE five-year population projections for 2019-2020 (0-4, 5-9, 10-14, and 15-19 years) were used as the reference population [19]. To ensure comparability, the CAC data were grouped using the population under 20 years of age.

Statistical analyses were performed using IBM SPSS Statistics, version 27, and R, version 4.4.

Ethical considerations

This study was approved by the Bioethics and Research Committee of the Universidad de Antioquia on September 25, 2023 (Approval No. 054).

Results

During the study period, 2,182 patients under 18 years of age with a diagnosis of CKD were reported in the CAC database. All cases were included in the statistical analyses. A higher proportion of patients was observed in the 11-17 age group (n= 1,066; 48.9%) compared with the 0-1, 2-4, and 5-10 age groups, which showed lower proportions. The distribution of cases by sex was similar (1,090 females and 1,092 males) (Table 1).

A total of 10.4% (n= 227) of patients were classified as having ESKD. In 5.8% (n= 127) of cases, the disease stage was not specified. As of the cutoff date, 2.6% (n= 57) and 7.2% (n= 157) of cases were on hemodialysis and peritoneal dialysis, respectively. Additionally, 8.85% (n= 193) of patients had received a kidney transplant. In this database, CKD staging (G1-G5) was based on glomerular filtration rate (GFR), regardless of kidney transplantation history. Therefore, kidney transplant recipients were not classified as stage G5 but were distributed across stages G1-G4 (Table 2).

Table 1. Crude prevalence per million population among individuals aged 0-17 years, stratified by age and sex (July 1, 2019 - June 30, 2020).

Age group (years)	Total study population		Female		Male	
	Cases	Crude prevalence	Cases	Crude prevalence	Cases	Crude prevalence
Chronic kidney disease						
0-1	127	82	53	69.7	74	93.1
2-4	306	130	150	130.6	156	129.9
5-10	683	145	345	150.1	338	140.7
11-17	1,066	188.9	542	196	524	182.2
Total	2,182	153.1	1,090	156	1,092	150
End-stage kidney disease (G5*)						
0-1	5	3	1	1	4	5
2-4	17	7	4	3	13	11
5-10	43	9	26	11	17	7
11-17	162	28.7	82	30	80	28
Total	227	16	113	16	114	16
Peritoneal dialysis						
0-1	5	3	1	1.3	4	5
2-4	14	6	3	2.6	11	9.2
5-10	35	7	21	9.1	14	5.8
11-17	103	18	55	19.9	48	16.7
Total	157	11.0	80	11	77	11
Hemodialysis						
0-1	0	0	0	0	0	0
2-4	1	0	0	0	1	0.8
5-10	7	1	4	1.7	3	1.2
11-17	49	9	20	7.2	29	10.1
Total	57	4.0	24	3	33	5
Kidney transplantation						
0-1	0	0	0	0	0	0
2-4	4	2	2	1.7	2	1.7
5-10	39	8	12	5.2	27	11.2
11-17	150	27	65	23.5	85	29.5
Total	193	13.5	79	11	114	16

*: End-stage kidney disease was defined as a glomerular filtration rate of less than 15 mL/min/1.73 m^2.

Table 2. Crude prevalence of chronic kidney disease per million population by disease stage according to the KDIGO 2012 classification in the population aged 0-17 years (July 1, 2019-June 30, 2020).

CKD* stage	Patients	Crude prevalence (pmp)	Kidney transplantation
1	1,591 (72.9)	112	78 (3.6)
2	147 (6.7)	10	68 (3.1)
3	69 (3.2)	5	38 (1.7)
4	21 (0.96)	1	7 (0.3)
5	227 (10.4)	16	0 (0.0)
No information	127 (5.8)	-	2 (0.1)
Total	2,182	-	193

*CKD: chronic kidney disease.

Table 3. Distribution of prevalent cases in the population aged 0-17 years by geographic regions of the country (July 1, 2019 - June 30, 2020).

Region	n (%)	CKD	ESKD G5	Peritoneal dialysis	Hemodialysis	Kidney transplantation
		Standardized prevalence*	n (%)	n (%)	n (%)	n (%)
Amazon/Orinoco	9 (0.4)	23	3 (1.3)	2 (1.3)	0 (0)	2 (1.0)
Bogotá	1,366 (62.6)	783	44 (19.4)	33 (21.0)	6 (10.5)	45 (23.3)
Caribbean	120 (5.5)	44	56 (24.7)	38 (24.2)	17 (29.8)	29 (15.0)
Central Andean	185 (8.5)	80	57 (25.1)	42 (26.8)	12 (21.1)	55 (28.5)
Eastern Andean	382 (17.5)	158	37 (16.3)	24 (15.3)	10 (17.5)	27 (14.0)
Pacific	120 (5.5)	62	30 (13.2)	18 (11.5)	12 (21.1)	35 (18.1)
Total	2,182		227	157	57	193

CKD: chronic kidney disease; ESKD G5: end-stage kidney disease (stage G5).
*Standardized prevalence (per million population) is presented to facilitate comparisons across regions. For this purpose, data for individuals aged 0-19 years were included because the age distribution is available only in five-year age groups.

Table 4. Distribution of prevalent chronic kidney disease cases in the pediatric population by geographic regions of the country and sex per million population (population aged 0-17 years, July 1, 2019 - June 30, 2020).

Region	Sex	CKD		Peritoneal dialysis		Hemodialysis	
		n	Crude prevalence	n	Crude prevalence	n	Crude prevalence
Amazon/Orinoco	Female	4	16	1	4	0	0
	Male	5	19	1	4	0	0
Bogotá	Female	708	809	19	22	1	1
	Male	658	726	14	15	5	6
Caribbean	Female	44	24	14	8	7	4
	Male	76	40	24	13	10	5
Central Andean	Female	102	65	23	15	5	3
	Male	83	51	19	12	7	4
Eastern Andean	Female	171	133	13	10	5	4
	Male	211	156	11	8	5	4
Pacific	Female	61	52	10	9	6	5
	Male	59	49	8	7	6	5

CKD: chronic kidney disease.

Prevalence of CKD in the pediatric population by geographic region

The prevalence of CKD in the population under 18 years of age during the study period was 153.1 cases pmp (Table 1). Of the prevalent CKD cases in the study population aged 0-17 years, 62.6% (n= 1,366) were reported in Bogotá, followed by the Eastern Andean region with 17.5% (n= 382) and the Central Andean region with 8.5% (n= 185). The Central Andean region accounted for the highest proportion of ESKD cases (n= 57; 25.1%) and the highest proportions of patients receiving peritoneal dialysis (n= 42; 26.8%) and those with a history of kidney transplantation (n= 55; 28.5%). Meanwhile, the Caribbean region accounted for the highest proportion of patients receiving hemodialysis (n= 17; 29.8%) (Table 3). To compare across regions, the standardized prevalence stratified by geographic region is presented in Table 3.

Crude prevalence stratified by age group, sex, and geographic region is reported in Tables 4 and 1S. After stratifying the data by department (Table 5), the standardized prevalence was highest in Bogotá, D.C. (783 cases pmp), followed by Cundinamarca (339 cases pmp), Risaralda (116 cases pmp), Boyacá (93 cases pmp), Antioquia (92 cases pmp), and Santander (88 cases pmp). Notably, no cases were recorded in Arauca, Guaviare, Vaupés, or Vichada.

Trends in CKD-related indicators among the population aged 0-19 years (2019-2023)

This analysis included the population under 20 years of age. According to CAC data reported between 2019 and 2023, the prevalence of CKD, regardless of stage, has increased. In 2023, a prevalence of 367.1 pmp was recorded in the population under 20 years of age (Table 6) [3,14-17].

When CKD prevalence was stratified by disease stage, prevalence rates for stages G2 to G4 remained relatively stable, whereas stage G1 showed a peak in 2020 followed by a decrease in 2023. In addition, an increase in the number of patients without an identified CKD stage was observed (Table 6) [3,14-17].

Table 5. Prevalence of chronic kidney disease per million population, stratified by department (population aged 0-17 years; July 1, 2019-June 30, 2020).

Department	Cases	Total population	Crude prevalence	Standardized prevalence*
Amazonas	2	33,751	59	53
Antioquia	121	1,714,888	71	92
Arauca	0	99,887	0	0
Archipiélago San Andrés	1	16,910	59	56
Atlántico	38	808,409	47	61
Bogotá, D.C.	1,366	1,781,424	767	783
Bolívar	27	701,237	39	49.8
Boyacá	21	346,777	61	93
Caldas	12	241,214	50	64
Caquetá	5	147,105	34	45
Casanare	1	141,561	7	20
Cauca	10	443,290	23	30
Cesar	11	451,468	24	38
Chocó	10	214,678	47	48
Cundinamarca	290	871,346	333	339
Córdoba	11	584,461	19	24
Guainía	1	23,761	42	87
Guaviare	0	32,233	0	0
Huila	11	365,931	30	60
La Guajira	9	379,911	24	27
Magdalena	20	484,762	41	56
Meta	11	324,440	34	53
Nariño	18	461,235	39	46
Norte de Santander	14	486,232	29	34
Putumayo	5	120,542	41	45
Quindío	3	124,408	24	47
Risaralda	20	232,748	86	116
Santander	46	606,722	76	88
Sucre	3	303,649	10	27
Tolima	13	363,669	36	56
Valle del Cauca	82	1,265,182	65	82
Vaupés	0	23,533	0	0
Vichada	0	49,765	0	0
Total	2,182	14,247,129		

*Standardized prevalence is presented to facilitate comparisons across departments. For this purpose, data for individuals aged 0-19 years were included because the age distribution is available only in five-year age groups.

Etiology of CKD in the population under 18 years of age (July 1, 2019 - June 30, 2020)

Of the total number of patients diagnosed with CKD (n= 2,182), 75.8% (n= 1,653) were classified under the "unknown etiology" category at the time of reporting. Among the identified causes of CKD, CAKUT accounted for 10.7% (n= 234), followed by glomerulonephritis (5.3%; n= 115), HTN/DM (3.1%; n= 68), vascular disease (2.6%; n= 56), polycystic kidney disease (1.0%; n= 21), hemolytic uremic syndrome (0.5%; n= 12), trauma (0.4%; n= 9), renal carcinoma (0.3%; n= 7), and hereditary diseases (0.3%; n= 7). Glomerulonephritis and hypertension/diabetes mellitus were also found to be more prevalent in the 11-17 age group (8.3% and 5.4%, respectively) than in other age groups (Table 7).

Additionally, a progressive decrease in the frequency of cases of unknown etiology was observed with increasing age (Table 7). CAKUT was reported slightly more frequently among male patients (12.8%) than among female patients (8.6%). Furthermore, the Amazon/Orinoco region reported the fewest specific causes among the country's geographic regions.

Discussion

To our knowledge, this is the first study to analyze the characteristics of CKD in the Colombian pediatric population using a national database. In this study, the prevalence of CKD among patients under 18 years of age during the study period was found to be higher

Table 6. Crude prevalence of CKD in Colombia in the population aged 0 to 19 years per million population, 2019-2023.

CKD*	2019	2020	2021	2022	2023
	n (Crude prevalence pmp)				
Prevalence†	1,588 (100)	2,692 (169.9)	3,394 (214.7)	5,097 (323.9)	5,762 (367.1)
Stratified by CKD classification			n (prevalence pmp)		
1	785 (49.4)	1,849 (116.7)	1,237 (78.2)	1,033 (65.6)	946 (60.3)
2	253 (15.9)	227 (14.3)	243 (15.4)	198 (12.6)	197 (12.6)
3	164 (10.3)	98 (6.2)	112 (7.1)	97 (6.2)	132 (8.4)
4	38 (2.4)	29 (1.8)	26 (1.6)	27 (1.7)	28 (1.8)
5	348 (21.9)	343 (21.6)	332 (21)	364 (23.1)	364 (23.2)
Unclassified‡	0	146	1,444	3,378	4,095

*CKD stratified according to the KDIGO classification. †CKD classification information was not available for all patients. ‡For unclassified cases, only the absolute frequency (n) is presented.

Table 7. Etiology of chronic kidney disease in the population aged 0-17 years, stratified by age, sex, and geographic region.

Variables	CAKUT	Renal Carcinoma	Unknown etiology	Vascular diseases	Familial/ hereditary diseases	Glomerulo-nephritis	HTN/DM	Polycystic kidney disease	HUS	Trauma	Total
By sex											
Female	94 (8.6)	5 (0.5)	843 (77.3)	25 (2.3)	0 (0.0)	64 (5.9)	36 (3.3)	10 (0.9)	10 (0.9)	3 (0.3)	1,090
Male	140 (12.8)	2 (0.2)	810 (74.2)	31 (2.8)	7 (0.6)	51 (4.7)	32 (2.9)	11 (1.0)	2 (0.2)	6 (0.5)	1,092
Total	234	7	1,653	56	7	115	68	21	12	9	2,182
By age group (years)											
0 - 1	10 (7.9)	0 (0.0)	110 (86.6)	2 (1.6)	0 (0.0)	1 (0.8)	0 (0.0)	3 (2.4)	0 (0.0)	1 (0.8)	127
2 - 4	21 (6.9)	0 (0.0)	267 (87.3)	7 (2.3)	0 (0.0)	6 (2.0)	2 (0.7)	2 (0.7)	1 (0.3)	0 (0.0)	306
5 - 10	79 (11.6)	4 (0.6)	551 (80.7)	10 (1.5)	1 (0.1)	20 (2.9)	8 (1.2)	6 (0.9)	4 (0.6)	0 (0.0)	683
11 - 17	124 (11.6)	3 (0.3)	725 (68.0)	37 (3.5)	6 (0.6)	88 (8.3)	58 (5.4)	10 (0.9)	7 (0.7)	8 (0.8)	1,066
Total	234	7	1,653	56	7	115	68	21	12	9	2,182
By region											
Amazon/Orinoco	1 (11.1)	0 (0.0)	3 (33.3)	1 (11.1)	0 (0.0)	2 (22.2)	2 (22.2)	0 (0.0)	0 (0.0)	0 (0.0)	9
Bogotá	158 (11.6)	6 (0.4)	1,073 (78.6)	25 (1.8)	3 (0.2)	58 (4.2)	12 (0.9)	14 (1.0)	10 (0.7)	7 (0.5)	1,366
Caribbean	6 (5.0)	0 (0.0)	81 (67.5)	9 (7.5)	1 (0.8)	10 (8.3)	9 (7.5)	3 (2.5)	1 (0.8)	0 (0.0)	120
Central Andean	23 (12.4)	0 (0.0)	119 (64.3)	12 (6.5)	1 (0.5)	14 (7.6)	15 (8.1)	0 (0.0)	1 (0.5)	0 (0.0)	185
Eastern Andean	28 (7.3)	0 (0.0)	313 (81.9)	6 (1.6)	2 (0.5)	16 (4.2)	13 (3.4)	3 (0.8)	0 (0.0)	1 (0.3)	382
Pacific	18 (15.0)	1 (0.8)	64 (53.3)	3 (2.5)	0 (0.0)	15 (12.5)	17 (14.2)	1 (0.8)	0 (0.0)	1 (0.8)	120
Total	234	7	1,653	56	7	115	68	21	12	9	2,182

Data are presented as n (%). CAKUT: congenital anomalies of the kidney and urinary tract; HTN/DM: hypertension/diabetes mellitus; HUS: hemolytic uremic syndrome.

than the previously reported global range, which ranges from 15 to 74.7 cases pmp [1]. This difference may be explained by methodological variations among studies, including differences in the age groups analyzed, sample size, and the diagnostic criteria used to define CKD [2].

In contrast to the high overall prevalence, the estimated prevalence of CKD in stages G3 to G5 in this study population was lower than that reported in other studies. In 2016, the prevalence of CKD stages G3-G5 in the pediatric population ranged from 50 to 60 cases pmp in Europe [2]. In 2010, Japan reported a prevalence of 29.8 cases pmp for stages G3 to G5 among patients aged 3 months to 15 years [20], while Chile reported a pediatric CKD prevalence of 42.5 cases pmp for stages G3b-G5 in 1996 [21] (Table 8).

Similarly, the prevalence of ESKD estimated in this study was lower than that reported in other international registries. In 2022, the prevalence of stage G5 was 77.5 cases pmp in the United States and 40.6 cases per million age-related population (pmarp) in Europe [22,26]. Australia and New Zealand reported a prevalence of 57.0 cases pmp in 2022 [24] (Table 8). These differences may be attributable to the CKD staging approach used in the CAC database, in which patients with a history of kidney transplantation were classified by GFR and assigned to stages G1 to G4. In other registries, however, they are grouped into stage G5 regardless of kidney graft function.

Consistent with the findings of this study, international registries have also shown an increasing trend in the prevalence of ESKD over time, except in Australia and New Zealand, where the prevalence of ESKD has remained stable [24].

Table 8. Data from different CKD registries and studies.

Database / Registry	Country/Region	Age	Stages	Year	Prevalence (pmp)
Cuenta de Alto Costo [3,14-17]	Colombia	0-19	G1-G5	2019-2023	2019: 100 2020: 169.9 2021: 214.7 2022: 323.9 2023: 367.1
ANZDATA [24]	Australia and New Zealand	0-17	G5	2022	57.0
USRDS* [22]	United States	0-17	G5	2020-2022	2020: 76.5 2021: 77 2022: 77.5
REPIR II [25]	Spain	≤18 years	G2-G5	2008	71.06
ESPN/ERA† [23,26]	Europe	0-14	G5	2020-2022	2020: 39.3 2021: 39.6 2022: 40.6
National Survey [20]	Japan	3 months - 15	G3-G5	2010	29.8
National Survey [21]	Chile	0-17	G3b-G5	1996	42.5

ANZDATA: Australia and New Zealand Dialysis and Transplant Registry; USRDS: United States Renal Data System; REPIR II: Spanish Pediatric Registry of Chronic Kidney Disease II (*Registro Español Pediátrico de Insuficiencia Renal II*); ESPN/ERA: The European Society for Pediatric Nephrology/European Renal Association. Prevalence values are expressed per million population (pmp), unless otherwise indicated; *: Adjusted prevalence as reported by USRDS; †Prevalence per million age-related population (pmarp), as reported by ESPN/ERA.

Regarding the geographic distribution of CKD in Colombia, Bogotá, D.C., had the highest prevalence of CKD in Colombia, followed by several departments in the Central and Eastern Andean regions. In contrast, no cases were reported in certain departments of the Amazon/Orinoco region, which also showed less diversity in the reported causes than other regions of the country. This situation could reflect the centralization of pediatric nephrology services in specific areas, as well as limited access to specialized diagnostic resources elsewhere. In addition, the possibility of geographic misclassification bias cannot be ruled out, given that the recorded location may correspond to the healthcare center where the diagnosis or follow-up occurred, rather than to the patients' usual place of residence.

Regarding the etiology of CKD in the pediatric population, CAKUT has been described as particularly relevant in patients younger than 12 years [27]. In contrast, glomerulopathies become more important from 15 years of age onward [22]. Although infectious causes have been suggested to be more relevant in low-income countries [2], after excluding the high proportion of patients classified as having an "unknown etiology" in this study, the etiological distribution was similar to that reported in other countries. However, the glomerulonephritis category does not distinguish between cases of infectious origin and those of other etiologies.

The high proportion of cases reported as "unknown etiology" decreased with increasing age, highlighting the need for more comprehensive diagnostic workups, particularly in younger patients and those without identifiable risk factors. In this context, genetic testing could play a key role in identifying the underlying causes of CKD in childhood.

Study limitations

This study has several limitations. First, it used a secondary database (CAC) that included patients identified within the Colombian health system. Given that CKD is asymptomatic, especially in early stages, and considering the absence of a universal screening program in the country, underreporting of pediatric CKD is likely, particularly in the initial stages. Additionally, inherent limitations in the amount and scope of available information prevented evaluation of relevant clinical variables, such as disease duration, among others.

Regarding CKD classification, information on the method used to calculate GFR was unavailable, potentially introducing heterogeneity in the results. Likewise, the high proportion of patients classified with "unknown etiology" suggests possible underreporting or limitations in diagnostic characterization, particularly considering that this proportion ranges from 3% to 8% in other studies of pediatric populations [8].

Finally, comparisons with international registries and other national publications may be imprecise due to differences in age cutoffs (e.g., under 15, 18, or 20 years of age) and heterogeneity in the distribution of the age groups used.

Conclusion

Pediatric CKD in Colombia has a higher prevalence than that reported globally and shows an increasing trend. The high proportion of cases with an unknown etiology and the observed disease patterns highlight the urgent need to strengthen epidemiological registries and standardize diagnostic protocols. These findings are key to implementing screening strategies in at-risk populations, developing early intervention programs to delay the progression of kidney damage, and optimizing access to and quality of kidney replacement therapy and transplantation.

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Appendix.

Table 1S. Distribution of prevalent chronic kidney disease cases in the pediatric population by geographic region and age group (pmp) (population aged 0-17 years, July 1, 2019 - June 30, 2020).

Region	Age	CKD*		Peritoneal dialysis†		Hemodialysis†	
		n	Prevalence	n	Prevalence	n	Prevalence
Amazon/Orinoco	0 - 1	0	0	0	0	0	0
	2 - 4	0	0	0	0	0	0
	5 - 10	1	6	0	0	0	0
	11 - 17	8	40	2	10	0	0
Bogotá	0 - 1	100	506	3	15	0	0
	2 - 4	234	801	4	14	0	0
	5 - 10	484	839	8	14	0	0
	11 - 17	548	767	18	25	6	8
Caribbean	0 - 1	1	2	1	2	0	0
	2 - 4	7	11	6	10	1	2
	5 - 10	33	26	7	6	2	2
	11 - 17	79	55	24	17	14	10
Central Andean	0 - 1	1	3	0	0	0	0
	2 - 4	5	10	2	4	0	0
	5 - 10	28	27	9	9	0	0
	11 - 17	151	117	31	24	12	9
Eastern Andean	0 - 1	22	77	0	0	0	0
	2 - 4	52	120	1	2	0	0
	5 - 10	115	132	8	9	3	3
	11 - 17	193	184	15	14	7	7
Pacific	0 - 1	3	12	1	4	0	0
	2 - 4	8	21	1	3	0	0
	5 - 10	22	28	3	4	2	3
	11 - 17	87	91	13	14	10	11
Total		2,182		157		57	

*CKD: Chronic Kidney Disease. †Patients receiving peritoneal dialysis or hemodialysis are included in the total number of patients with CKD.