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Estimated glomerular filtration rate for research into chronic kidney disease from Primary Health Care. A single-center observational study.

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Abstract

Introduction: Primary health care (PHC) is fundamental in preventing and managing chronic kidney disease (CKD). By early detection of kidney disorders and providing comprehensive care to patients, PHC contributes to improving the quality of life of people with kidney disease and reducing the burden that this disease represents for health systems. This study aimed to determine the prevalence of chronic kidney disease in a primary care referral center in Holguín, Cuba.

Methods: This analytical observational study was conducted at the "Máximo Gómez Báez" University Polyclinic, Cuba, from February to November 2021. Patients diagnosed with non-communicable chronic disease without known CKD were included, subsequently Group 1 (G1): patients with CKD. Group 2 (G2): patients without CKD. The estimated glomerular filtration rate, comorbidities, nutritional status, and laboratory variables were recorded.

Results: In Group 1 (CKD), 188 cases, and the control group, 348 cases. The prevalence of chronic kidney disease was 35% (95% CI 31-39%). The age in G1 was 61.6 ± 10.3 years in G2: 59.3 ± 11.6 (P =0.001). Women were the most affected by CKD (P =0.001). Of the total, 76% were hypertensive, with similar distributions between both groups (79% vs 74%). Type 2 diabetes was a risk factor for developing CKD (OR = 5.9; 95% CI: 3.9-8.9). 35%, 37% and 31% had an eGFR ≤ 60 mL/min/1.73 m2, by the CKD-EPI, MDRD-4 and Cockcroft-Gault formulas, respectively. The distributions of CKD stages were 76.1% for 3a, 16.5% for 3b, 6.9% for 4, and 0.5% for 5, by CKD-EPI.

Conclusion: The eGFR by Cockcroft-Gault introduces erroneous results due to the patient's weight. CKD-EPI and MDRD-4 proved to be the most appropriate for diagnosing and staging CKD in the study population.

Keywords:

Chronic kidney disease, Glomerular filtration rate, CKD-EPI, MDRD-4, Cockcroft-Gault, primary health care.

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Primary health care (PHC) is a person's first point of contact with the health system. In nephrology, PHC plays a crucial role in the early detection, diagnosis, and initial management of kidney diseases, especially chronic kidney disease (CKD) [1].

PHC is critical in nephrology because it helps with early detection. Many kidney diseases, especially in their initial stages, are asymptomatic. PHC physicians are in a privileged position to identify risk factors (diabetes, hypertension, family history) and perform simple tests (such as creatinine measurement) to detect possible kidney disorders [2].

PHC allows preventive measures to be implemented, such as controlling blood pressure and blood glucose levels, which are key risk factors for the progression of kidney disease [3].

PHC professionals can educate patients about the importance of leading a healthy lifestyle, which can help prevent or slow the progression of kidney disease [4].

PHC allows for regularly monitoring patients with kidney disease, facilitating early detection of complications and treatment adaptation.

The primary care physician faces chronic kidney disease, mainly due to high rates of hypertension and diabetes, the two most common etiologies of chronic kidney disease [1].

CKD causes substantial global morbidity and increases all-cause cardiovascular mortality. Unlike other chronic diseases for which screening strategies have been established, there is no consensus on whether health systems and governments should prioritize early identification and intervention for CKD [2].

The burden of CKD falls disproportionately on people of lower socioeconomic status, who have a higher incidence of CKD, limited access to treatment, and poorer outcomes. Therefore, identifying and treating CKD early in life is imperative [5].

This study aimed to determine the prevalence of chronic kidney disease in a primary care referral center in Holguín, Cuba.

Materials and methods

Research type

The present study is an analytical observational cross-sectional study. The source was retrospective.

Scenery

The study was carried out at the "Máximo Gómez Báez" University Polyclinic in the Holguín municipality, Cuba. The study period was from February 1, 2021, to November 30, 2021.

Universe and sample

The study universe corresponds to the anonymized documentary records of primary care patients for chronic noncommunicable diseases in the family medicine clinic. Sampling was simply random.

Inclusion criteria

Patients over 18 with a chronic noncommunicable disease who agreed to participate in the study were included. Two groups were formed for the analytical phase: Group 1 included patients with chronic kidney disease, and Group 2 included patients without chronic kidney disease.

Exclusion criteria

Patients with a known diagnosis of chronic kidney disease were excluded. Patients who did not agree to participate in the study were also excluded. Records with incomplete data were removed from the inclusion analysis.

Variables

The estimated glomerular filtration rate was recorded based on serum creatinine, age, and sex. Microalbuminuria was measured. The comorbidities of high blood pressure, diabetes, ischemic heart disease, toxic habits, weight, height, nutritional status, blood pressure, glucose, uric acid, hemoglobin, triglycerides, and cholesterol were recorded.

Data sources/measurements

The source was indirect; the institutional files and family medicine consultation services records were reviewed. Laboratory results were obtained from the laboratory registry. The diagnosis of kidney disease was made with the CKD-EPI formula using the serum creatinine level. The medical calculator calculated by QxMD, which belongs to the QxMD software initiative, was used. To measure RAC, proteinuria in an isolated urine sample was divided by urinary creatinine in the same sample, equating the units to obtain mg/g.

Biases

The leading researcher always safeguarded the data with a guide and records approved in the research protocol to avoid interviewer, information, and memory biases. Observation and selection biases were avoided by applying the participant selection criteria. All clinical and paraclinical variables from the previous period were recorded. Two researchers independently analyzed each record in duplicate, and the variables were recorded in the database once their agreement was verified.

Study size

The sample was probabilistic, with an incidence of 6850 annual cases of different chronic noncommunicable diseases for the study period. With an expected frequency of 50% and a confidence limit of 5%, the sample size with a confidence level of 95% was 537 cases. The StatCaclc program from Epi Info ™ (Version 7.2.6. CDC, Clifton Road, Atlanta, USA) was used for the sample calculations.

Quantitative variables

Descriptive statistics were used. The scaled results are expressed as the means and standard deviations. Categorical data, such as sex, are presented as proportions.

Statistical analysis

Noninferential statistics are used. The confidence interval for the proportion of prevalence data is presented. Student's t-test was used to compare averages between groups, with *P* values <0.05 assumed to be significant. Categorical variables are expressed as absolute and relative frequencies; the chi-square test was used to compare proportions. The odds ratio is presented when there is a statistical association in categorical variables. The data were analyzed via the SPSS 22 statistical program (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp).

Sub- analysis

In a subanalysis, glomerular filtration rates were compared in patients with chronic kidney disease using three types of equations: CKD-EPI, MDRD, and Cockcroft-Gault.

Results

Study participants

A total of 537 patients were included in the study. The prevalence of chronic kidney disease was 188 cases, 35% (95% CI 31–39%).

Characteristics of the study groups

Table 1 shows the distribution of patients with and without CKD according to clinical and laboratory variables. There was a significant age difference; the group without chronic kidney disease was 3.7 years younger. The prevalence of men with chronic kidney disease was lower in group 1 (CKD). The prevalence of patients with type 2 diabetes mellitus was significantly greater in the CKD group, being 37% greater in CKD group 1. There were no differences between the groups of patients with arterial hypertension or ischemic heart disease. Patients with diabetes mellitus were six times more likely to have CKD than nondiabetic patients (OR = 5.9; 95% CI: 3.9–8.9, $P < 0.001$).

Among the laboratory variables, a higher uric acid and microalbuminuria concentration were detected in the CKD group. No differences existed between the hemoglobin, glucose, cholesterol, and triglyceride concentrations (Table 1).

Nutritional status, habits, and blood pressure

The majority of patients with and without chronic kidney disease were overweight and obese (73.91%). There were no differences in nutritional status between the study groups. There was a significantly more significant percentage of smoking patients in the chronic kidney disease group (60.1% versus 37.8% (22.3%)). There were no differences in the presence of alcoholism or blood pressure between the groups (Table 2).

Table 1. Distribution of patients with and without Chronic Kidney Disease according to clinical and laboratory variables.

Variables	Chronic Kidney Disease		
	Group 1 CKD (n = 188)	Group 2 Control (n = 349)	*P*
Age (Years).	61.6±10.3	57.9±12.1	**0.001[a]**
Men (%)	21.8	44.4	**< 0.001[b]**
BMI (kg/m ^{2})	28.8±5.6	28.9±5.6	0.801[a]
Risk factors (%)			
High blood pressure	78.7%	73.9%	0.217[b]
Diabetes Mellitus	53.1%	16.1%	**< 0.001[b]**
Ischemic heart disease	18.6%	15.8%	0.398[b]
Laboratory results *(Mean ± SD)*			
Hemoglobin g/dL	12.9±1.4	13.9±8.5	0.118[a]
Glucose mmol/L	4.7±1.9	4.9±2.1	0.476[a]
Creatinine mg/dL	1.3±0.4	0.9±0.2	**< 0.001[a]**
Cholesterol mmol/L	5.1±1.7	5.1±1.4	0.670[a]
Triglycerides mmol/L	2.2±1.1	2.3±1.0	0.672[a]
Uric acid mmol/L	348.5±99.4	320.3±98.1	**0.003[a]**
Microalbuminuria mg	19.8±33.4	12.4±0.4	**0.002[a]**

BMI: body mass index; [a] *t - Student* test; [b] chi square test.

Table 2. Nutritional status, habits and pressure in the study group.

Variable	Chronic Kidney Disease		
	Group 1 CKD (n = 188)	Group 2 Control (n = 349)	*P*
Underweight, n (%)	2 (1.06%)	3 (0.86%)	0.814[a]
Normal weight, n (%)	53 (28.19%)	77 (22.06%)	0.113[a]
Overweight, n (%)	66 (35.11%)	136 (38.97%)	0.378[a]
Obese, n (%)	67 (35.64%)	133 (38.11%)	0.572[a]
Smoking, n (%)	113 (60.1%)	132 (37.8%)	**< 0.001[a]**
Alcoholism, n (%)	10 (5.3%)	29 (8.3%)	0.202[a]
SBP mmHg (Mean ± SD)	118 ± 10	117 ± 9	0.183[b]
DBP mmHg (Mean ± SD)	75±7	76±6	0.153[b]
BP cm (Mean ± SD)	96±16	98±16	0.218[b]

[a] Comparisons with chi square. [b] Comparisons with student 's T.

Subanalysis

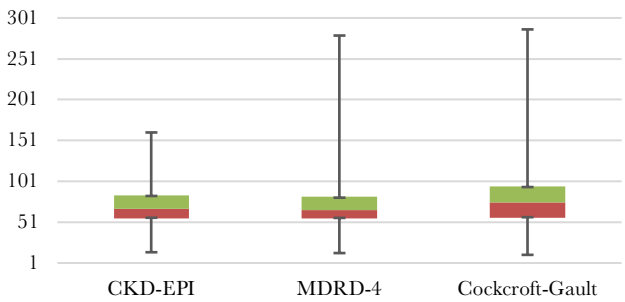
In the classification of chronic kidney disease, the Cockcroft-Gault formula overestimates chronic kidney disease in people over 60. Additionally, it overestimates the glomerular filtration rate in people with obesity based on weight (Table 3 and Figure 1).

Table 3. Subanalysis of chronic kidney disease with 3 predictive equations tives .

Variable	Chronic Kidney Disease		
	CKD-EPI	MDRD-4	Cockcroft- Gault
Frequency of kidney disease by age			
< 41 years	6 (3.1%)	4 (2.0%)	0 (0%)
41-60 years	82 (43.6%)	75 (38.1%)	46 (27.7%)
> 60 years	100 (53.2%)	118 (59.9%)	120 (72.3%)
Frequency of kidney disease by stages			
Grade 3a	143 (76.1%)	156 (79.2%)	113 (68.1%)
Grade 3b	31 (16.5%)	30 (15.2%)	44 (26.5%)

Grade 4	13 (6.9%)	10 (5.1%)	6 (3.6%)
Grade 5	1 (0.5%)	1 (0.5%)	3 (1.8%)
Glomerular filtration rate (ml/min/1.73 m ² sc) by age.			
< 41 years	88.9±31.8	100.7±56.8	128.4±49.1
41-60 years	72.2±21.9	73.1±27.9	89.6±36.2
> 60 years	66.0±18.8	66.1±22.3	64.9±26.9
Glomerular filtration rate (ml/min/1.73 m ² sc) by weight.			
Underweight	75.8±37.3	90.9±75.8	55.2±31.7
Normal weight	68.1±25.4	70.9±36.5	63.7±35.9
Overweight	72.0±19.9	72.6±24.4	75.3±26.3
Obese	70.3±21.2	70.7±26.6	98.7±40.5

Figure 1. Estimated Glomerular Filtration



Discussion

The initial results of this research are highly alarming; in a population of 537 at-risk patients (hypertensive, diabetic, heart disease, smokers, and older adults) without previous chronic kidney disease, after screening, a diagnosis was obtained for 188 patients, accounting for 35% of all patients. This result is much greater than the statistics for undiagnosed CKD in primary health care. The study by Takahashi et al. [6] was very similar to the present study. While 1065 patients with arterial hypertension, diabetes mellitus, or a family history of CKD were studied, only 26.7% of the patients had some degree of chronic kidney disease, which is much lower than the results of this research.

These findings are similar to previous studies [7-10], with frequencies of occult CKD of 13.2%, 14%, and 14%, respectively. On the other hand, Expósito et al. [11] carried out a large-scale study to determine chronic kidney disease in the Spanish population; they studied 2871 individuals using the eGFRs of CKD-EPI and MDRD-4 and reported that 5.5% had early kidney damage from CKD. Finally, Cueto-Manzano et al. [12] obtained much superior results concerning the frequency of CKD; 69% of their patients had some degree of the disease.

10 In a large-scale study of 11,394 patients from China, Mongolia, and Nepal, Sharma et al. [] reported that the estimated glomerular filtration rate was significantly lower among patients older than 60. In other studies, such as those by Takahashi et al. [6], the average age of their participants was 59.7 ± 16.1 years, which coincides with the results of the present investigation. On the other hand, other researchers, such as Liu et al. [9], Cueto-Manzano et al. [12], and Expósito et al. [11], obtained average ages between 49 and 55 years, which is significantly lower than the results of this research.

Finally, Cepoi et al. [13] studied 60,000 people in Romania to detect chronic kidney disease. They reported that the disease frequency by age was 0.95% and 0.64% in people between 18 and 44 years of age. A total of 4.27% of those aged 45--64 years, 15.34% of those aged 65--79 years, and 34.57% of those over 80 were included. This finding demonstrates that the frequency of chronic kidney disease increases with increasing age. Emphasis should be placed on the population over 65 in the search for CKD, especially those with risk factors. Future research should focus on evaluating the effectiveness of intervention strategies in adults with CKD to slow its progression.

As shown in Table 1, male patients represented only 36% of the total patients studied, which shows an apparent prevalence of the female sex above 60%. These results are similar to Expósito et al. [11] and Cueto-Manzano et al. [12], where women represented 57% and 62%, respectively. These investigations were carried out on patients with characteristics similar to those of the Cuban population, which explains the results. Moreover, Ávila-Saldívar [14] carried out a study on 64 participants from a primary care area and reported a 77% frequency of the female sex, which could be related to the small sample size. These results may not be generalizable to the rest of the population. In contrast, Takahashi et al. [6] reported that women represented only 52.9% of patients in a study conducted in Japan to estimate the frequency of CKD in this country. In general terms, and without going into specific figures, Cepoi et al. [13] reported that the prevalence of CKD was higher among women than men in a medium-scale study conducted in Romania.

The above does not explicitly mean that females are the most affected in the general population. Unfortunately, many beliefs in the general population are still based on sexism and other inappropriate behaviors, which means that men visit health services less frequently. The female sector regularly visits health establishments to prevent and treat various diseases. Men very often, owing to their work or other justifications, do not attend, and their illnesses are not diagnosed in time.

In any case, the greater prevalence of the female sex in the general Cuban population is known to be related to a greater life expectancy in this group. There are still many knowledge needs in this regard, and more studies in medicine with a gender focus are necessary; thus, certain groups in a state of vulnerability can be identified, and work can be done with them.

The average body mass index of the participants in this study was 28.9 ± 5.6 kg/m², which was nearly identical between patients with and without chronic kidney disease; therefore, no statistically significant differences were found in this regard. This result is slightly higher than that of Liu et al. [9] in southern China, where the average body mass index was 23.0 ± 3.3 kg/m².

The average Cuban population tends to be overweight and obese, which is similar to the situation in developed countries and is likely due to sedentary behaviors and poor dietary habits. The research consulted confirms this fact and shows evident similarities with

the results of this study. In the study by Ávila-Saldívar [14], patients classified as overweight or obese predominated. Expósito et al. [11] reported that 32% of patients with chronic kidney disease were obese, whereas 41.6% were classified as overweight. Finally, Sharma et al. [10] reported that 20% of their patients were obese.

Conclusions

Biomarkers such as serum creatinine, serum uric acid, and microalbuminuria showed the best predictive results for CKD and should be the main tools used by family doctors and community nephrologists. Estimating the GFR via the Cockcroft-Gault formula introduces erroneous results concerning the significant influence of patient weight. The CKD-EPI and MDRD-4 formulas proved to be the most appropriate for diagnosing and staging chronic kidney disease in the study population.

Abbreviations

CKD: Chronic kidney disease.
DM2: Diabetes mellitus type 2.
BMI: Body mass index.
Me: average.

Supplementary information
The supplementary materials have not been included.

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Not applicable.

Contributions of authors

Leyanis Pérez Gómez: Conceptualization, methodology, research, Writing – Original draft.
Gregorio Hernández Castellanos: Conceptualization, project administration, supervision, validation, visualization, writing – review and editing.
All the authors read and approved the final version of the manuscript.

Financing

The study was self-financed by the authors.

Availability of data or materials

Not applicable.

Statements

Ethics committee approval and consent to participate

The research protocol was approved by the Ethics Committee of the Research Ethics Committee of the "Máximo Gómez Báez" University Polyclinic of the Holguín municipality, Cuba.

Consent for publication

Does not apply when magnets, X-rays, or patient-specific photographs are not published.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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