

Renal Epidemiology

PREVALENCE OF CHRONIC KIDNEY DISEASE AMONG DIABETIC AND/OR HYPERTENSIVE PATIENTS IN THE LAGHOUAT DISTRICT, ALGERIA: A CROSS-SECTIONAL PRIMARY-CARE STUDY

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Received: August 25, 2026 — **Accepted:** September 15, 2026 — **Published:** October 01, 2026

Citation: DJENANE Ahmed. Prevalence of Chronic Kidney Disease among Diabetic and/or Hypertensive Patients in the Laghouat District, Algeria: A Cross-Sectional Primary-Care Study.

OLCIAS Vol. 3, Issue 2.

ABSTRACT

Background: Chronic kidney disease (CKD) is a silent condition of rising global burden, particularly among patients with diabetes and hypertension, the two leading causes of end-stage renal disease worldwide. Data on CKD prevalence among high-risk patients in primary care remain scarce in North Africa.

Objective: To determine the prevalence of CKD, classified according to the 2012 KDIGO criteria, among diabetic and/or hypertensive patients in the Laghouat district of Algeria, and to identify independent factors associated with its presence.

Methods: We conducted a descriptive, cross-sectional prevalence study with prospective random recruitment at the Diabetes Care Centre, Public Hospital Establishment of Laghouat, between January 2018 and January 2019, among patients aged 18–70 years. CKD was defined as an estimated glomerular filtration rate (eGFR, MDRD equation) below 60 mL/min/1.73 m² and/or an abnormal urinary albumin- or protein-to-creatinine ratio, persisting beyond three months. Independent predictors of CKD were identified by multivariable logistic regression (odds ratio [OR], 95% confidence interval). Reporting followed the STROBE guidelines for cross-sectional studies.

Results: Of 420 patients screened, 302 met the inclusion criteria (249 type 2 diabetics, 44 hypertensive patients, 9 type 1 diabetics). Overall CKD prevalence was 40% (121/302): 39% in the diabetes-predominant subgroup and 49% in the hypertension-predominant subgroup. Patients with CKD had significantly higher mean blood pressure, urinary albumin-to-creatinine ratio (ACR), fasting glucose and HbA1c, and significantly lower eGFR and haemoglobin ($p < 0.05$ for all), with no significant difference in age or body mass index. On multivariable analysis, diabetic retinopathy (adjusted OR 13.05, 95% CI 6.84–24.88), anaemia (OR 2.23), a positive urine dipstick (OR 2.18) and antihypertensive treatment intensity (OR 1.52) were independently associated with CKD. Recommended screening measures (urine dipstick, serum creatinine, ACR) remained markedly underused in primary care before the study, having previously been performed in only 31.5%, 49.0% and 28.5% of patients, respectively.

Conclusion: CKD prevalence is high among diabetic and/or hypertensive patients in the Laghouat district, affecting a substantial proportion of relatively young patients. Diabetic retinopathy, anaemia, a positive urine dipstick and antihypertensive treatment intensity are readily identifiable predictors in routine general practice. Systematic, early CKD screening integrated into diabetes and hypertension care pathways, coupled with multidisciplinary management, appears essential to slow disease progression and reduce cardiovascular burden in this setting.

Keywords: chronic kidney disease; prevalence; diabetes mellitus; hypertension; glomerular filtration rate; screening; primary care ; cross-sectional study.

1. INTRODUCTION

Chronic kidney disease (CKD) was long viewed primarily through the lens of its terminal stage, end-stage renal disease requiring renal replacement therapy. The classification proposed by the National Kidney Foundation in 2002, subsequently updated by the Kidney Disease: Improving Global Outcomes (KDIGO) 2012 guidelines, redefined CKD as any structural or functional kidney abnormality persisting for more than three months, stratified into five categories of estimated glomerular filtration rate (eGFR) and three categories of albuminuria [1–3].

This classification revealed the true scale of the problem: CKD affects an estimated 10–14% of adult populations in Western countries and constitutes an independent risk factor for cardiovascular mortality, even at early, asymptomatic stages [2,4]. A comprehensive analysis of the Global Burden of Disease study estimated that CKD affected over 697 million people worldwide in 2017 and was responsible for 1.2 million deaths that year, with its global burden projected to keep rising [5]. Management of CKD, particularly at its terminal stage, represents a considerable financial and human burden for health systems everywhere [6,7].

Diabetes mellitus and hypertension are the two leading causes of CKD worldwide and together account for more than half of all incident end-stage renal disease [3,5]. Because both conditions are most commonly followed in general practice, primary care represents the most logical setting for early, simple and low-cost screening, capable of triggering therapeutic measures that slow renal progression and improve cardiovascular prognosis.

Laghouat province, on the High Plateaus of Algeria some 400 km south of Algiers, illustrates the epidemiological transition under way across the country: communicable diseases historically linked to the region's pastoral vocation and climate are increasingly giving way to a rapid rise in non-communicable disease. In 2018, the province had approximately 12,000 known diabetic patients and 15,000 known hypertensive patients, and 37 patients started dialysis in 2017, 80% of them as unplanned emergencies without prior vascular access, with diabetes and hypertension implicated in 80% of cases [24]. This observation prompted a community-based screening survey targeting these high-risk populations.

The primary objective of this study was to estimate the prevalence of CKD, according to the 2012 KDIGO classification, among diabetic and/or hypertensive patients in the Laghouat district. Secondary objectives were to classify CKD by stage and to identify renal risk factors independently associated with its presence.

2. MATERIALS AND METHODS

2.1 Study design and setting

This was a descriptive, cross-sectional prevalence study with prospective, random recruitment, conducted over one year (January 2018 – January 2019) in a primary-care general medicine clinic at the Diabetes Care Centre, Public Hospital Establishment of Laghouat, a single-centre primary-care facility. Reporting follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies [7].

2.2 Study population

The minimum sample size was calculated assuming a theoretical CKD prevalence of 25% among diabetic and/or hypertensive patients, with a 5% alpha risk and 5% precision, according to the formula $N = \epsilon^2 \times P \times Q / i^2$, yielding a minimum requirement of 300 subjects.

Eligible participants were men and women aged 18–70 years with known diabetes and/or hypertension, resident in the Laghouat district, who provided informed consent. Exclusion criteria were acute kidney injury, prior dialysis or transplantation, pregnancy, and minor age. Of 420 randomly screened patients, 118 were excluded for not meeting these criteria; 302 patients were included in the final analysis.

2.3 Definition of chronic kidney disease

CKD was defined as the persistence, for more than three months, of biological, morphological or histological renal abnormalities and/or reduced kidney function, the latter characterised by an eGFR below 60 mL/min/1.73 m². eGFR was calculated using the four-variable Modification of Diet in Renal Disease (MDRD) equation ($\text{eGFR} = 186 \times \text{serum creatinine}^{-1.154} \times \text{age}^{-0.203} \times k$, with $k = 0.742$ for women), the equation recommended in national guidance at the time of data collection; we acknowledge that the CKD-EPI equation is now considered more accurate, particularly near-normal eGFR values [9]. Proteinuria was screened for by urine dipstick; a positive result prompted quantification of the urinary protein-to-creatinine ratio, while a negative result prompted screening for microalbuminuria by immunoturbidimetric assay with calculation of the albumin-to-creatinine ratio (ACR). Patients screening positive ($\text{eGFR} < 60 \text{ mL/min}$ and/or $\text{ACR} > 30 \text{ mg/g}$) underwent confirmatory testing at three months.

2.4 Data collection

Each participant underwent a structured interview (personal and family history, cardiovascular and renal risk factors, smoking status), clinical examination (weight, height, body mass index [BMI], blood pressure measured with a validated electronic device), fasting biochemistry (venous glucose, lipid profile, serum creatinine, uric acid, urinary sediment) and renal ultrasonography. Target-organ damage was assessed by electrocardiography and echocardiography for left ventricular hypertrophy (LVH), and by fundoscopic examination for diabetic and/or hypertensive retinopathy. For each patient, prior performance of a urine dipstick, serum creatinine and ACR (before study inclusion), together with the usual treating practitioner (general practitioner, nephrologist, endocrinologist, cardiologist), was recorded by interview and medical record review.

2.5 Statistical analysis

Data were entered and analysed using SPSS version 19 and Microsoft Excel. Continuous variables are reported as means with 95% confidence intervals; categorical variables are reported as counts and percentages. Group means were compared using Student's t-test or analysis of variance (ANOVA); categorical variables were compared using the chi-square test (or Fisher's exact test where expected cell counts were below 5). Odds ratios (OR) with 95% confidence intervals were used to evaluate the association between candidate predictors and CKD; an OR was considered significant when its confidence interval excluded 1. Multivariable logistic regression, incorporating sex, age, BMI, diabetes, hypertension and dyslipidaemia treatment, disease duration, smoking status, HbA1c, haemoglobin, urine dipstick result, retinopathy, renal ultrasound findings and LVH, was used to

identify independent predictors of CKD. A two-sided p value < 0.05 was considered statistically significant.

2.6 Ethical considerations

The study was conducted after obtaining written informed consent from each participant, in accordance with the ethical principles applicable to observational clinical research and the Declaration of Helsinki. As an observational, non-interventional study, formal clinical trial registration was not required.

3. RESULTS

3.1 Population characteristics

Of 420 diabetic and/or hypertensive patients randomly screened, 302 met the inclusion criteria and were retained for analysis: 249 type 2 diabetic patients (82.5%), 44 hypertensive patients (14.6%) and 9 type 1 diabetic patients (3.0%). The female-to-male ratio was close to 1 (165 women, 137 men). Baseline characteristics by CKD status are presented in Table 1. CKD was more frequent with advancing age (46.3% among patients aged 50–70 years versus 29.4% among those under 29) and with longer disease duration (57.0% for a duration exceeding 10 years versus 24.0% for a duration under 5 years), yet remained common among younger patients: 56% of patients with CKD were under 50 years of age. No difference in prevalence was observed by sex (40.0% in women versus 40.1% in men).

Table 1. Demographic and disease-duration characteristics of the study population by CKD status (n = 302).

Variable	No CKD n = 181 (%)	CKD n = 121 (%)	Total n = 302 (%)
Female sex	99 (60.0%)	66 (40.0%)	165 (100%)
Male sex	82 (59.9%)	55 (40.1%)	137 (100%)
Age < 29 years	12 (70.6%)	5 (29.4%)	17 (100%)
Age 30–39 years	28 (58.3%)	20 (41.7%)	48 (100%)
Age 40–49 years	76 (65.5%)	40 (34.5%)	116 (100%)
Age 50–70 years	65 (53.7%)	56 (46.3%)	121 (100%)
Diabetes/hypertension duration < 5 years	76 (76.0%)	24 (24.0%)	100 (100%)
Diabetes/hypertension duration 5–10 years	56 (63.6%)	32 (36.4%)	88 (100%)
Diabetes/hypertension duration > 10 years	49 (43.0%)	65 (57.0%)	114 (100%)
Total population	181 (59.9%)	121 (40.1%)	302 (100%)

3.2 Overall prevalence of chronic kidney disease

According to the 2012 KDIGO classification, 121 of 302 patients had CKD, an overall prevalence of 40%. This prevalence was 39% in the diabetes-predominant subgroup (type 2 diabetes and/or hypertension) and 49% in the hypertension-predominant subgroup (hypertension and/or diabetes). The

distribution by KDIGO stage (eGFR category by albuminuria category) is presented in Table 2. Early stages (G1–G2) accounted for 79% of the cohort, while a marked reduction in eGFR (<60 mL/min/1.73 m², stages G3–G5) affected 20% of patients.

Table 2. Classification of 302 patients by 2012 KDIGO stage (eGFR category × albuminuria category).

Stage (eGFR)	A1	A2	A3	Total
G1 (≥90 mL/min/1.73 m ²)	80 (76.2%)	17 (16.2%)	8 (7.6%)	105 (100%)
G2 (60–89 mL/min/1.73 m ²)	101 (75.4%)	16 (11.9%)	17 (12.7%)	134 (100%)
G3a (45–59 mL/min/1.73 m ²)	17 (50.0%)	14 (41.2%)	3 (8.8%)	34 (100%)
G3b (30–44 mL/min/1.73 m ²)	4 (25.0%)	4 (25.0%)	8 (50.0%)	16 (100%)
G4 (15–29 mL/min/1.73 m ²)	5 (41.7%)	2 (16.7%)	5 (41.7%)	12 (100%)
G5 (<15 mL/min/1.73 m ²)	0 (0.0%)	1 (100%)	0 (0.0%)	1 (100%)
Total	207 (68.5%)	54 (17.9%)	41 (13.6%)	302 (100%)

3.3 Comparison of clinical and biological parameters

Compared with patients without CKD, patients with CKD had significantly higher mean systolic and diastolic blood pressure, ACR, fasting glucose, and HbA1c, and significantly lower mean eGFR and haemoglobin (Table 3). No significant difference was found for age or BMI.

Table 3. Comparison of clinical and biological parameters between patients with and without CKD (Student's t-test).

Parameter	CKD patients (n = 121)	No-CKD patients (n = 181)	p value
Age (years)	58.53	56.50	0.070
BMI (kg/m ²)	28.80	28.33	0.417
Systolic BP (mmHg)	147.14	134.17	<0.001
Diastolic BP (mmHg)	85.25	79.39	<0.001
ACR (mg/g)	548.08	9.48	<0.001
Fasting glucose (g/L)	1.85	1.57	<0.001
eGFR (mL/min/1.73 m ²)	64.62	89.26	<0.001
HbA1c (%)	8.22	7.56	0.005
Haemoglobin (g/dL)	11.96	12.97	<0.001

3.4 Independent predictors of chronic kidney disease

On multivariable logistic regression, four variables were retained as independent predictors of CKD: diabetic retinopathy, anaemia (low haemoglobin), a positive urine dipstick, and antihypertensive treatment intensity (Table 4).

Table 4. Independent predictors of CKD after multivariable logistic regression.

Variable	Adjusted OR	95% CI	p value
Antihypertensive treatment	1.52	1.17–1.98	0.002
Positive urine dipstick	2.18	1.20–3.97	0.010
Anaemia (low haemoglobin)	2.23	1.19–4.19	0.013
Diabetic retinopathy	13.05	6.84–24.88	<0.001

3.5 Associated complications and prior screening practices

Inadequate blood pressure control was observed in 82.6% of patients, and 52.9% required at least two antihypertensive drug classes to reach target blood pressure. Glycaemic imbalance (HbA1c > 7%) was present in 71.1% of patients with CKD. Obesity affected 42.1% of patients with CKD and overweight a further 30.6%. Diabetic retinopathy was found in 61.2% of patients with CKD and hypertensive retinopathy in 34.7%; LVH was present in 35.5% of patients. Renal ultrasonography, performed for the first time in the majority of patients, was abnormal in 39.7% of cases.

Recommended CKD screening remained markedly underused before the study: a urine dipstick had previously been performed in only 31.5% of patients (28.9% of those with CKD, 33.1% of those without), serum creatinine in 49.0% (46.3% versus 50.8%), and ACR in 28.5% (29.8% versus 27.6%) — proportions that did not differ meaningfully by eventual CKD status, indicating that prior screening had not been preferentially directed at patients later found to have CKD. Medical follow-up was provided by a general practitioner in 91.1% of patients, by a nephrologist in only 12.6–16.6% (depending on calculation method), by an endocrinologist in 36.8%, and by a cardiologist in 23.8%.

4. DISCUSSION

This community-based, primary-care study, conducted in a southern Algerian region undergoing rapid epidemiological transition, demonstrates a high prevalence of CKD — 40% — among diabetic and/or hypertensive patients, exceeding the theoretical 25% prevalence used for sample-size calculation and figures reported in several Western cohorts, where CKD affects 10–14% of the general population but 25–40% of diabetic or hypertensive subgroups depending on the series [2,4,5,10]. It approaches data reported elsewhere in the Maghreb, notably in Morocco, where Benghanem Gharbi et al. observed a high prevalence of CKD associated with diabetes, hypertension and obesity in the general adult population [11], and is broadly consistent with an Algerian cohort study linking hypertension to diabetic nephropathy [23], as well as with the substantial burden of CKD documented across the Global Burden of Disease framework [5].

The higher prevalence observed in the hypertension-predominant subgroup (49%) than in the diabetes-predominant subgroup (39%) is consistent with literature emphasising the central role of blood pressure control in preserving kidney function, including among diabetic patients [12,13]. That antihypertensive treatment intensity — an indirect marker of hypertension severity and the number of drug classes required for control — emerged as an independent predictor on multivariable analysis supports this interpretation: the more difficult hypertension is to control, the greater the associated risk of renal involvement appears to be, a pattern also demonstrated in landmark trials of intensive blood-pressure control [14].

Diabetic retinopathy was, in our series, the factor most strongly associated with CKD (OR 13.05). This association, extensively documented, reflects the shared microvascular pathophysiology of diabetic retinopathy and nephropathy; the presence of retinopathy can therefore be regarded as a simple clinical marker of systemic microvascular damage, including renal involvement [15]. Similarly, anaemia — common from early CKD stages owing to relative erythropoietin deficiency — emerged as an independent predictor, consistent with established pathophysiology and with evidence that anaemia correction is closely linked to CKD progression [16].

Urine dipstick positivity, a simple, rapid and inexpensive test, also emerged as an independent predictor, underscoring its potential value as a first-line screening tool in general practice — particularly since this test remained markedly underused in our population, performed in fewer than one-third of patients before the study. More broadly, this study reveals a substantial deficit in the application of recommended CKD screening in primary care (urine dipstick, eGFR, ACR), with nephrology follow-up remaining marginal (12.6–16.6% of patients), despite diabetes and hypertension together accounting for the majority of end-stage renal disease causes in the region [8,9]. This pattern is consistent with international evidence that primary-care CKD screening frequently falls short of guideline recommendations and that patient and provider awareness of CKD often remains low even when laboratory markers of dysfunction are present [17–20], despite explicit care-pathway guidance assigning general practitioners a central role in CKD screening and monitoring [22].

These results should be interpreted in light of several methodological limitations. This was a single-centre study conducted in a reference facility for diabetes care, which may introduce selection bias toward patients followed more regularly or with more pronounced comorbidity than the general population of diabetics and hypertensives in the district. The cross-sectional design does not permit causal inference between the identified factors and CKD occurrence, only association. Estimation of eGFR using the MDRD equation, although widely used at the time of data collection, is now recognised as less accurate than the CKD-EPI equation, particularly near-normal eGFR values, which may have led to some misclassification of prevalence across eGFR strata [9]. Finally, confirmation of CKD at three months, although performed for patients screening positive, represents a pragmatic community-based approach rather than strict confirmation against every KDIGO criterion.

Strengths of this work include its community-based, prospective design, random patient recruitment within a primary-care facility, the comprehensiveness of the biological, morphological and target-organ assessment performed, and a sample size exceeding the a priori calculated minimum. These elements lend good internal validity to the prevalence estimates reported for this specific region of Algeria, where epidemiological data on CKD had previously been limited.

5. CONCLUSION

This community-based cross-sectional study shows that CKD prevalence is high — 40% — among diabetic and/or hypertensive patients in the Laghouat district, affecting a substantial proportion of relatively young patients. Diabetic retinopathy, anaemia, urine dipstick positivity, and antihypertensive treatment intensity are independent predictors of CKD, readily identifiable during a routine general practice consultation.

The deficit observed in the application of recommended screening measures (urine dipstick, eGFR, ACR) and in the use of specialised nephrology follow-up underscores the need to integrate systematic, early CKD screening — based on simple, low-cost tools — into diabetes and hypertension

management programmes in primary care. Multidisciplinary care combining general practitioners, nephrologists, diabetologists and cardiologists, supported by nephro-cardioprotective measures, appears essential to slow the progression of chronic kidney disease and reduce its cardiovascular impact and societal cost.

DECLARATIONS

Funding

This work did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of interest

The author declares no conflicts of interest relevant to this article.

Ethics approval and consent to participate

The study was conducted after obtaining written informed consent from each participant, in accordance with the ethical principles applicable to observational clinical research and the Declaration of Helsinki. As an observational, non-interventional study, no clinical trial registration was required.

Availability of data and materials

The datasets analysed during the current study are derived from the author's academic dissertation [23] and are available from the corresponding author on reasonable request.

Acknowledgements

The author thanks the medical and paramedical staff of the Diabetes Care Centre, Public Hospital Establishment of Laghouat, for their assistance with patient recruitment and data collection.

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