Chronic Kidney Disease in Cameroon: A scoping review

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Abstract

Objectives

This scoping review sought to summarize available data on the prevalence, associated factors, etiology, comorbidities, treatment, cost, and mortality of chronic kidney disease (CKD) in Cameroon.

Methods

We searched PubMed, Scopus and African Journals Online from database inception to 31 March, 2020 to identify all studies published on the prevalence, associated factors, etiology, comorbidities, treatment, cost and mortality of CKD in Cameroon.

Results

Thirty studies were included. The population prevalence of CKD varied from 3-14.1% and 10.0%-14.2% in rural and urban areas, respectively. The prevalence of CKD in patients with hypertension, diabetes mellitus, and human immunodeficiency virus was 12.4-50.0%, 18.5%, and 3.0-47.2%, respectively. Hypertension (22.3-59.1%), chronic glomerulonephritis (15.8-56.2%), and diabetes mellitus (15.8-56.2%) were the most common causes of CKD. The cause was unknown in 13.5-17.0% of the cases. Advanced age, hypertension, diabetes mellitus, and obesity were frequent associated factors. Hemodialysis was the main treatment modality in patients with End Stage Renal Disease (ESRD). The monthly cost of management of non-dialyzed CKD was 163 US dollars. The one-year mortality rate of ESRD was 26.8-38.6%.

Conclusion

Chronic kidney disease affects about one in ten adults in the general population in Cameroon. Patients with hypertension, diabetes mellitus, and human immunodeficiency virus bear the greatest burden of CKD in Cameroon. Advanced age, hypertension, diabetes mellitus, and obesity are major factors associated with CKD. Chronic kidney disease in Cameroon is associated with high morbidity and mortality and huge economic cost on the patient.

Introduction

Chronic Kidney Disease (CKD) is an abnormality in kidney structure or function assessed using a matrix of variables including glomerular filtration rate (GFR), thresholds of albuminuria and duration of injury [1]. The global prevalence of CKD in 2015 was estimated at 13.4% [2], with a prevalence as high as 36.1% amongst high-risk populations [3]. Chronic kidney disease poses a serious threat to global health due to its high morbidity and mortality rate [4]. According to the 2015 Global Burden of Disease Study, CKD was the 12th common cause of mortality, accounting for about 1.1 million deaths worldwide [5]. Mortality due to CKD increased by 31.7% over the past decade to represent one of the fastest growing causes of death.
worldwide [5]. Chronic kidney disease is the 17th leading cause of global disability-adjusted life years (DALYs) lost to disease [5].

Chronic kidney disease disproportionately affects low-income and middle-income countries (LMICs) with a prevalence 15% higher than that in high-income countries [3]. In addition to poorly controlled diabetes mellitus and hypertension, infection, and herbal and environmental toxins play an important role in the epidemiology of CKD in these settings [6]. Chronic kidney disease is both a cause and consequence of non-communicable diseases (NCDs) [7,8]. The burden of CKD in LMICs is worsened by limited accessibility to and affordability of renal replacement therapy (RRT) [9]. The number of people requiring RRT worldwide is projected to increase from 3.3 million to 5.4 million people by 2030 with most of this increase in developing countries [10].

High-risk groups for CKD include persons living with hypertension, diabetes mellitus, overweight, obesity [11,12] and human immune deficiency virus (HIV) [13] as well as the elderly. A meta-analysis conducted in 2018 estimated the pooled prevalence of CKD stages 1-5 and 3-5 in the general African population at 15.8% and 4.6%, respectively [13]. Among high-risk populations, the prevalence of CKD stage 1-5 and 3-5 were 32.3% and 13.3%, respectively [13]. Moreover, the prevalence of CKD was about four times higher in Sub-Sahara Africa compared to North Africa. A large-scale population-based study of about 8000 participants aged 40-60 years from six communities in sub-Saharan Africa revealed an age-standardized prevalence of CKD of 2.4% [14]. By 2030, it is estimated that over 70% of people with end-stage kidney disease will be living in developing countries like countries in sub-Saharan Africa [15]. This is due to the rising prevalence of diabetes mellitus, hypertension, obesity, and HIV [16].

The prevalence of CKD in adult Cameroonianians is estimated between 11% and 14.2% [11,17]. The prevalence of hypertension (31%) [18], diabetes mellitus (6%) [19], and obesity (15%) [20] are high with a prevalence of HIV of 4% [21]. Dialysis was introduced in Cameroon in the early 1980s and included both peritoneal and hemodialysis, although for over two decades now hemodialysis has been the only available modality of RRT [22].

This review sought to assess the burden of CKD in Cameroon. Specifically, we summarized data on the prevalence, incidence, risk factors, treatment, cost of treatment, and outcome of patients with CKD in Cameroon. Furthermore, we described economic and comorbidities of patients with CKD, and to identify research gaps.

Methods

This scoping review was conducted according to the approach proposed by Arksey and O'Malley [23].

Literature search

PubMed, Scopus and African Journals Online were searched without language restriction to retrieve all publications on the prevalence, the incidence, comorbidity, risk factors, treatment, economic burden and
outcome (length of hospital stay and mortality rate) of CKD in Cameroon from database inception to May 31, 2019. Table 1 depicts the search strategy for PubMed which was adapted to suit other databases. The reference list of full text articles was searched to identify articles which may have been missed during the search.

Selection of studies for the review

Cross-sectional, cohort, case-control studies and systematic reviews that reported relevant data on CKD in Cameroon were considered for inclusion. For this review, CKD was defined as estimated glomerular filtration rate < 60mL/min/1.73m$^2$ using either the Modification of Diet in Renal Disease (MDRD) study equation, the Cockcroft-Gault (CG) formula, or the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equations or proteinuria > 1+ (or albuminuria > 300mg/g) or patients with known CKD on RRT [17]. Letters, commentaries, case reports, and case series with less than 30 participants were excluded. For duplicate publications, we considered the most comprehensive, recent and/or with the largest sample size.

Two authors independently screened abstracts and citations retrieved from the online search and assessed the full texts of the relevant citations for inclusion in the review, Figure 1. Disagreements during the study selection process were resolved through consensus, or arbitration by a third review author, in case a consensus could not be reached.

Data charting

Relevant data were extracted with the aid of pre-structured abstraction sheets. We abstracted the following information from eligible articles: the surname of the first author of the article, publication year, study design and population studied, study setting (community-based or hospital-based). Study area (rural or urban), percentage of males included in the study, mean or median age of the participants, sample size, measure used to assess kidney damage or function and if these measures were reassessed after three months of measurement, prevalence, comorbidity, treatment rate, median duration of hospital stay and mortality rate of CKD.

Table 1. Search Strategy
Results

In total, 122 records from bibliographic searches. After screening titles and abstracts, 44 full text papers were assessed for eligibility and 29 studies [11,17,24–32,32–49] were retained.

Prevalence of CKD in Cameroon

Table 2 summarizes the studies that reported on the prevalence of CKD in Cameroon. The prevalence of CKD was reported in 11 studies in Cameroon [11,17,24–32]. All studies were cross-sectional studies, 4 (36.4%) were community-based, and 2 (18.2%) were conducted in rural areas. The average age of the participants ranged from 35-61 years.

Overall, the prevalence of CKD in the general population ranged from 10.0-14.2%, [11,17,31]. The prevalence of CKD ranged from 3.4-14.1% and 10.0-14.2% in the general population in rural [17,26] and urban areas [17,31], respectively.

The prevalence of CKD among patients with hypertension ranged from 12.4-52.1% [27,28,30], Table 2. Thirty percent of hypertensive patients on treatment in a community-based study were diagnosed with CKD [27], and 12.4% in treatment naïve patients [28]. One study reported a prevalence of CKD of 18.5% among patients with type 2 diabetes mellitus [25]. Two studies evaluated the prevalence of CKD among persons living with HIV/AIDS (PLWHA). The prevalence of CKD in PLWHA ranged from 3.0-47.2% [24,32].

The prevalence of CKD among sugarcane plantation workers was 3.4% [26]. The prevalence of CKD among first-degree family relatives of persons living with CKD on hemodialysis was 15.9% [29].

Factors associated with CKD
Table 3 depicts the factors associated with CKD. Advanced age [11,26–28,30,32], female sex [27,29], obesity/adiposity [27,30,50], hyperuricemia/gout [27,30,31], longer duration of HIV [32], CD4 count less than 200 cells/mL [32], hyperkalemia [28], dyslipidemia [28,30], hypertension, diabetes mellitus [11,30,50], smoking [30,50], consumption of alcohol [30,50] and herbal medication [50], self-medication [30] were associated with increased odds of CKD.

Table 2: Prevalence of CKD in Cameroon
| First Author | Year of publication | Study Design | Study Setting | Study Area | Disease Specific Population | Mean Age (in years) | Male (%) | Sample Size | Measure of Kidney Damage or Function | Prevalence of CKD |
|--------------|---------------------|--------------|---------------|------------|-----------------------------|---------------------|----------|-------------|---------------------------------|-----------------|
| Kaze [24]    | 2013                | Cross-sectional | Hospital-based | Urban     | HAAR T-naïve PLWH A | 35.0              | 32.0%   | 104         | eGFR < 60 based on MDR D and CG or at least 1+ proteinuria | 3%              |
| Kaze [17]    | 2015                | Cross-sectional | Community-based | Urban     | General adult population | 36.5              | 48.7%  | 119         | eGFR < 60 based on MDR D, CG and CKD-EPI or albuminuria > 30mg/g | 10.9%           |
| Kaze [17]    | 2015                | Cross-sectional | Community-based | Rural     | General adult population | 51                 | 39.7%  | 320         | eGFR < 60 based on MDR D, CG and CKD-EPI or albuminuria > 30mg/g | 14.1%           |
| Kaze [11]    | 2015                | Cross-sectional | Community-based | Urban     | General adult population | 45.3              | 53.4%  | 500         | eGFR < 60 based on MDR D, CG and | 10.0, 11.0 and 14.2% using CKD-EPI, |
| Study          | Year | Study Type   | Setting       | Population Characteristics                          | eGFR < 60 (%) Based on MDR D | MDR D and CG, Respectively (% gn |
|---------------|------|--------------|---------------|--------------------------------------------------|-----------------------------|---------------------------------|
| Feteh [25]    | 2016 | Cross-sectional | Hospital-based | Patients with type 2 diabetes mellitus             | 56.5                        | 53.1%                           |
|               |      |              | Urban         |                                                   |                             | 636                             | 18.5%                           |
| Kaze [30]     | 2016 | Cross-sectional | Hospital-based | Hypertensive adult                                | 60.9                        | 36.6%                           |
|               |      |              | Urban         |                                                   |                             | 336                             | 49.7% and 50.0% and 52.1%       |
| Kamdem [28]   | 2017 | Cross-sectional | Hospital-based | newly diagnosed and untreated hypertensive patients | 51.0                        | 49.1%                           |
|               |      |              | Urban         |                                                   |                             | 839                             | 12.4%                           |
| Hama dou [27]  | 2017 | Cross-sectional | Hospital-based | Hypertensive patients                             | 54.2                        | 33%                             |
|               |      |              | Urban         |                                                   |                             | 400                             | 32.3%                           |
| Ekiti [26]    | 2018 | Cross-sectional | Rural Sugar cane |                                                      | 39.0                        | 75%                             |
|               |      |              |               |                                                   |                             | 204                             | 3.4%                            |
| Study          | Year | Design          | Setting                  | Population Description                                                                 | eGFR < 60 based on: | eGFR < 60 based on: | Prevalence | N     |
|---------------|------|-----------------|--------------------------|-----------------------------------------------------------------------------------------|---------------------|---------------------|-------------|-------|
| Halle [32]    | 2018 | Cross-sectional | Hospital-based           | PLWH attending HIV day clinic                                                             | CKD-EPI or at least 1+ proteinuria | CKD-EPI or at least 1+ proteinuria | 26.7%       | 709   |
| Kaze [31]     | 2019 | Cross-sectional | Community-based          | General adult population                                                                 | CKD-EPI or albuminuria > 30mg/g | CKD-EPI or at least 1+ proteinuria | 48.7%       | 433   |
| Temgoua [29]  | 2019 | Cross-sectional | Hospital-based           | First-degree family relatives of HDP                                                     | MDR or at least 1+ proteinuria or diagnosis by a Nephrologist | MDR or at least 1+ proteinuria | 28.0%       | 82    |

NR; Not Reported, NA; Not Available; HIV: Human immunodeficiency virus; AIDS: Acquired immune deficiency syndrome; HAART: Highly active antiretroviral therapy; PLWHA: Persons living with HIV/AIDS,
OR: odds ratio, CI: confidence interval, GFR: Glomerular Filtration Rate; HDP: Hemodialysis patients; MDRD: Modification of Diet in Renal Disease; CG: Cockcroft-Gault; CKD-EPI: Chronic Kidney Disease Epidemiology

**Table 3: Factors associated factors of chronic kidney disease in Cameroon**
| First Author | Year of publication | Study Design | Study Setting | Disease specific population | Mean Age (in years) | Sample Size | Associated Factors (adjusted Odds Ratio; 95% Confidence Interval) |
|--------------|---------------------|--------------|---------------|-----------------------------|---------------------|-------------|---------------------------------------------------------------|
| Kaze [17]    | 2015                | Cross-sectional | Community-based | General adult population | 47.0                | 439         | History of hypertension (aOR: 3.95; 95% CI, 2.09-7.46),     |
|              |                     |              |               |                             |                     |             | History of diabetes mellitus (aOR: 6.64; 95% CI: 2.63-16.75) |
|              |                     |              |               |                             |                     |             | Elevated systolic blood pressure (aOR: 1.01; 95% CI, 1.00-1.02) |
| Kaze [11]    | 2015                | Cross-sectional | Community-based | General adult population | 45.3                | 500         | Advanced age (aOR: 1.09; 95% CI, 1.07-1.12),                |
|              |                     |              |               |                             |                     |             | Known hypertension (aOR: 2.40; 95% CI, 1.19-4.82)            |
|              |                     |              |               |                             |                     |             | Existing diabetes mellitus (aOR: 3.36; 95% CI, 1.02-11.07),  |
|              |                     |              |               |                             |                     |             | Overweight/obesity (aOR:                                      |
| Study          | Year | Study Design                | Setting      | Population Description                           | Mean Age | N   | Odds Ratio (95% CI)  |
|---------------|------|-----------------------------|--------------|-------------------------------------------------|----------|-----|---------------------|
| Kaze [30]     | 2016 | Cross-sectional Hospital-based Hypertensive adult | 60.9 | 336 | Advance d age (aOR: 1.05; 95% CI, 1.02-1.07) Raised systolic blood pressure (aOR: 1.01; 95% CI, 1.00-1.02) |
| Hamadou [27]  | 2017 | Cross-sectional Hospital-based Hypertensive patients | 54.2 | 400 | Age > 50 years (aOR: 1.75; 95% CI: 1.06-2.89), Females (aOR: 2.21; 95% CI: 1.29-3.78), obesity (aOR: 1.58; 95% CI: 1.36-1.95), hyperuricemia (aOR: 3.67; 95% CI: 1.78-7.58) |
| Kamdem [28]   | 2017 | Cross-sectional Hospital-based newly diagnosed and untreated hypertensive patients | 51.0 | 839 | Age=55 years (aOR: 5.29; 95% CI, 3.33-8.42), obesity (aOR: 0.15; 95% CI, 0.10-0.26) |
| Study  | Year | Study Design          | Setting          | Population Description | Mean Age (SD) | Sample Size | Associated Risk Factors                                                                 |
|--------|------|-----------------------|------------------|-------------------------|---------------|-------------|-----------------------------------------------------------------------------------------|
| Ekiti  | 2018 | Cross-sectional       | Community-based  | Sugarcane plantation workers | 39.0          | 204         | Age ≥ 40 years (aOR: 1.33; 95% CI, 1.03-1.72)                                             |
| Halle  | 2018 | Cross-sectional       | Hospital-based   | PLWHA attending HIV day clinic | 37.1          | 709         | Age > 35 years (aOR: 1.04; 95% CI: 1.02 to 1.06), longer duration of HIV (aOR: 2.60; 95% CI: 1.53 to 3.95), history of Hepatitis B (aOR: 3.04; 95% CI: 1.08 to 8.54), CD4 count less than 200 cells/mL (aOR: 3.64; 95% CI: 2.55 to 5.21) |
| Kaze   | 2019 | Cross-sectional       | Community-based  | General adult population  | 45.0          | 433         | Increased systolic blood pressure (aOR: 1.02; 95% CI, 1.00-1.04) per mmHg higher SBP), hyperglycemia (aOR: 3.04; 95% CI, 1.32-7.07) |
HIV: Human immunodeficiency virus; AIDS: Acquired immune deficiency syndrome; HAART: Highly active antiretroviral therapy; PLWHA: Persons living with HIV/AIDS, aOR: adjusted odds ratio, CI: confidence interval, GFR: Glomerular Filtration Rate, CKD-EPI: Chronic Kidney Disease Epidemiology; SBP: systolic blood pressure

**Etiologies of chronic kidney disease in Cameroon**

Eight studies reported on the etiologies of CKD in Cameroon, Table 4. Overall, hypertension (22.3-59.1%), chronic glomerulonephritis (15.8-56.2%), diabetes mellitus (7.3-24.0%) and HIV (6.6-11.5%) were the main etiological factors of CKD. The etiology was unknown in 13.5%-17.0% of cases [35–42]. Halle et al. 2016 reported hypertension (30.9%), glomerulonephritis (15.8%), diabetes mellitus (15.9%) and HIV (6.6%) as the major etiologies of CKD in a chart review of 863 medical records [37]. About 14.7% of the etiologies of CKD was unknown. In a prospective study of 661 patients, the major etiologies of CKD were hypertension (28.3%), chronic glomerulonephritis (17.5%), diabetes mellitus (13.9%), HIV (6.7%) [39].

**Table 4: Etiology of CKD in Cameroon**
| First author | Year of publication | Study area | Study Design | Study setting | Study population | Mean age (in years) | Male (%) | Sample size | Etiologies |
|--------------|---------------------|------------|--------------|---------------|------------------|--------------------|----------|-------------|------------|
| Halle [35]   | 2014                | Urban      | Cross-sectional | Hospital-based | Patients on maintenance hemodialysis | 49.4               | 66.4     | 113         | Hypertension (25.6%), Chronic glomerulonephritis (20.6%), diabetes mellitus (17.4%) |
| Kaze [36]    | 2014                | Urban      | Cross-sectional | Hospital-based | Patients on maintenance hemodialysis | 52.7               | 64.0     | 45          | Hypertension (29%), Chronic glomerulonephritis (24%), Diabetes mellitus (24%) |
| Halle [37]   | 2015                | Urban      | Retrospective cohort | Hospital-based | Patients with ESRD | 47.4               | 66.0     | 863         | Hypertension (30.9%), glomerulonephritis (15.8%), diabetes mellitus (15.9%), HIV (6.6%), unknown |
| Study | Year | Setting | Design | Cohort | Type of patients | Number | Age | Follow-up | Conditions |
|-------|------|---------|--------|--------|-----------------|--------|-----|-----------|------------|
| Kaze  | 2015 | Urban   | Retrospective cohort | Hospital-based | Patients admitted in the nephrology unit | 44.8  | 60.0 | 225 | Chronic glomerulonephritis (25.9%), hypertension (22.3%), diabetes mellitus (20.1%) |
| Halle | 2016 | Urban   | Prospective cohort | Hospital-based | Patients on maintenance hemodialysis | 46.3  | 66.0 | 661 | Hypertension (28.3%), chronic glomerulonephritis (17.5%), diabetes mellitus (13.9%), hypertension and diabetes (7.3%), HIV (6.7%), unknown (16.9%) |
| Halle | 2016 | Urban   | Cross-sectional | Hospital-based | Maintenance hemodialysis | 51    | 66.0 | 97  | Chronic glomerulonephritis (25.8%) |
hritis (20.6%)

Diabetes mellitus (17.5%)

| Location   | Year | Setting       | Study Type    | Patients | Age Mean | Age SD | Population Size |
|------------|------|---------------|---------------|----------|----------|--------|-----------------|
| Luma [41]  | 2017 | Semi-urban    | Cross-sectional | Hospital-based | 48       | 65.4   | 104             |
| Moor [42]  | 2017 | Urban         | Cross-sectional | Hospital-based | 55       | 75.0   | 44              |

NR; Not Reported, ESRD; End stage renal disease

**Major comorbidities in CKD patients in Cameroon**
Thirteen studies discussed the comorbidities of CKD in Cameroon, Table 5. Ten or more of these studies reported hypertension and diabetes mellitus as major comorbidities of CKD. Also, viral infections such as HIV, Hepatitis B and Hepatitis C infections in were also important comorbidities associated with CKD. Furthermore, hyperuricemia, obesity, previous cardiovascular events, malnutrition, anemia, smoking, and alcohol use were major comorbidities.

Table 5: Major comorbidities in Chronic Kidney Disease patients in Cameroon
| First author | Year of publication | Study area | Study population | Mean age (in years) | Sample size | Comorbidities |
|--------------|---------------------|------------|------------------|-------------------|-------------|---------------|
| Halle [43]   | 2009                | Urban      | Patients with CKD| 50.1              | 140         | Hypertension (62.1%); diabetes mellitus (25.0%); gout (7.1%); HIV (6.4%) |
| Halle [35]   | 2014                | Urban      | ESRD patients on dialysis | 49.4 | 113 | Mid-arm muscle circumference (23.9%); heart failure (22.1%); diabetes mellitus (20.3%); HIV (4.4%) |
| Kaze [36]    | 2014                | Urban      | Patients on maintenance hemodialysis | 52.7 | 45 | Hypertension (95.6%); anemia (42%); left ventricular hypertrophy (60%); valvular heart disease (51.1%); heart failure (33.3%); dyslipidemia (33.3%); diabetes mellitus (24%); tobacco use (22.2%); obesity (4%) |
| Kaze [38]    | 2015                | Urban      | Patients with CKD | 44.8 | 139 | Hypertension (81.3%); diabetes mellitus (32.2%); tobacco use (15.1%); |
| Study          | Year | Location      | Diagnostic Category | Hemodialysis Rate | Hypertension Rate | Hypertension Risk Factors |
|---------------|------|---------------|---------------------|-------------------|------------------|--------------------------|
| Mbouembo [44] | 2016 | Semi-urban    | ESRD                | 45.0              | 35               | Anemia (Females [100%]; Males [92%]) |
| Halle [40]    | 2016 | Urban         | Maintenance hemodialysis | 51.0            | 97               | Hypertension (25.8%); Diabetes mellitus (17.5%); HCV (20.6%); HIV (8.2%); HBV (6.2%) |
| Kouotou [45]  | 2016 | Urban         | Hemodialyzed patients | 48.6            | 112              | Hypertension (66.1%); Diabetes mellitus (25.9%); HCV (26.8%) |
| Hamadou [27]  | 2017 | Urban         | Patients diagnosed with CKD | 54.2            | 400              | Anemia (44.5%), Obesity (39.75%), Diabetes mellitus (32%); hyperuricemia (10.75%); tobacco use (0.8%) |
| Moor [42]     | 2017 | Urban         | Patients on maintenance hemodialysis | 55.0            | 44               | Hypertension (59.1%); Diabetes mellitus (11.4%); alcohol use (11.4%); tobacco use (4.5%) |
| Luma [41]     | 2017 | Semi-urban    | Patients on maintenance hemodialysis | 48.0            | 104              | Hypertension (84.6%); HCV (19.2%); HIV (13.5%); HBV (10.6%) |
| Lemogoum      | 2018 | Urban         | Patients            | 52.0             | 150              | Hypertension |
with CKD

|                        | Year | Area  | Status | Category             | Number | Diagnosis                          |
|------------------------|------|-------|--------|----------------------|--------|------------------------------------|
| Doualla [47]           | 2018 | Urban | Non-dialysed | CKD patients        | 55.8   | Hypertension (87.4%); Diabetes mellitus (34.0%); gout (21.4%); HIV (12.6%) |
| Halle [34]             | 2019 | Urban | Patients with CKD |                  | 53.1   | Hypertension (70.77%); diabetes mellitus (41.54%); HIV (8.5%); gout (6.9%) |

CKD = Chronic kidney disease; ESRD = End-stage renal disease; CRF = Chronic renal failure; HIV = Human immunodeficiency syndrome; HBV = Hepatitis B; HCV = Hepatitis C

Treatment of CKD in Cameroon

Most of the CKD patients required hospitalization and eventual dialysis. However, the hospitalization rate was 42.2% in patients referred late and 33.6% of these late referrals were proposed emergency dialysis [43]. Emergency unplanned dialysis on a temporary catheter was required in 88.3% of 863 adult patients with CKD [37].

Cost of CKD management in Cameroon

Data on CKD’s economic burden is scarce in Cameroon. In a one-month retrospective cost analysis of non-dialysis CKD patients in Yaoundé, Cameroon; the total cost for management of CKD was 163 USD
with direct medical cost accounting for 86.4% of this and only 1.4% of the 69 participants (median monthly salary of 162 USD) had full health insurance coverage [33].

**Mortality of CKD in Cameroon**

The mortality rate of CKD in Cameroon ranged between 26.8% and 58.0% during a period of 1 to 10 years of follow up, Table 6 [39,48,49]. An audit of 661 medical records reported a 10-year mortality rate of 44.9% [39]. The highest mortality rate of 58.0% was reported in a 15 months’ prospective study in 197 ESRD patients. Furthermore, the one-year mortality rate of hemodialyzed patients in a retrospective study was 29.8% [49]

**Table 6: Mortality of CKD in Cameroon**

| First author, publication year | Study area | Study Design | Study setting | Study population | Median age | Sample size | Mortality rate |
|-------------------------------|------------|--------------|---------------|------------------|------------|-------------|---------------|
| Halle 2016 [41]               | Urban      | Retrospective cohort | Hospital-based | ESRD patients on hemodialysis | 46.3       | 661         | 12-month mortality = 26.8% |
|                               |            |              |               |                  |            |             | 10-year mortality = 44.9% |
| Fouda 2017 [48]              | Urban      | Prospective cohort | Hospital-based | ESRD patients on dialysis | 48.0       | 197         | 15-month mortality = 58.0% |
| Halle 2018 [43]              | Urban      | Retrospective cohort | Hospital-based | PLHIV with ESRD on hemodialysis | 46.0       | 57          | 12-month mortality = 38.6% |

NR; Not Reported, ESRD; End stage renal disease, PLHIV; People living with Human Immunodeficiency Virus

**Discussion**

This scoping review systematically summarizes data on the prevalence, associated factors, etiology, comorbidities, treatment and its cost, and mortality of CKD in Cameroon. The prevalence of CKD was high, ranging from about 1 in every 10 people in the general population to about 1 in every 2 persons in high-risk groups. Hypertension, diabetes mellitus and chronic glomerulonephritis were the most common causes of CKD, while the cause was unknown in a significant proportion of patients. Hypertension,
diabetes mellitus, obesity, advanced age and female gender were some factors associated with developing CKD in Cameroon. The treatment of these patients was mainly management of comorbidities, progression factors and hemodialysis in those with ESRD. Despite these treatment measures, mortality from CKD remains high with a 1-year mortality rate of more than 25% among hemodialyzed patients. However, treatment costs proved quite prohibitive to the access of these treatments.

The prevalence of CKD was reported in both the general population and in high-risk populations (persons with hypertension, diabetes mellitus, obesity, and HIV) applying various estimators of GFR. The prevalence in the general population ranged from 10% to 14.2% which is similar to the overall prevalence of 15.8% in the African adult population [13]. In rural areas, the prevalence was higher compared to urban areas which in keeping with Stanifer et al [15]. This can be attributed to the low awareness of CKD risk factors such as consumption of nephrotoxic herbal concoctions and alcohol in rural settings. In the high-risk population, the prevalence of CKD was higher and this was convergent with the findings of Kaze et al. [13]. Furthermore, in hospital-based studies which dwelled on these high-risk individuals, the prevalence was also seen to be higher than in community-based studies.

About a third to half of patients with hypertension in Cameroon had CKD [27] which varied from that which Bahrey et al. reported (about 1 in 5 hypertensives) in Ethiopia [51]. This discrepancy can be attributed to the difference in study population as the latter study was performed in North Africa. Newly diagnosed hypertensives in Cameroon had a prevalence of CKD of 12.4% which was much lower when compared to their counterparts (cohort of hypertensives with and without treatment) which ranged between 32.3% and 52.1%. Compared to patients with hypertension and who are on treatment, those newly diagnosed with hypertension are more likely to have had the disease for a relatively shorter time, and hence experience a lesser burden of the disease on the kidneys. The prevalence of CKD in PLWHA was 3%, comparable to that of PLWHA in another West African setting [52]. In a systematic review in Africa, the prevalence of CKD among diabetics varied between 11% and 83.7% [53], a range which includes the 18.7% in type 2 diabetics in our setting. The duration of diagnosis and comorbidities played a significant role on the prevalence of CKD among patients with diabetes mellitus.

Advanced age and hypertension were strong predictors of CKD in Cameroon and similar in other Africa settings [14,54]. Overweight and diabetes were independent associated factors which is in line with a study in Ethiopia [51]. Kaze et al. [50] reported history of diabetes mellitus as a strong associated factor to CKD which was convergent to the findings of Bahrey et al. [51]. Female sex was also an associated factor of CKD and this was comparable to findings in a study in Uganda [55]. Although hypertension and diabetes mellitus were notable associated factors, these were also identified as main etiological factors along with chronic glomerulonephritis and HIV. However, in some cases no etiological factor was identified.

The most common comorbidities were hypertension, diabetes mellitus, anemia, obesity, and cardiac diseases. Fraser et al. [56] put forth hypertension, diabetes mellitus, anemia and ischemic heart disease as comorbidities. Cardiovascular and bone diseases are established comorbidities. Furthermore,
cardiovascular diseases were twice more common in CKD patients and advances at twice the rate [57]. Additionally, hyperuricemia was identified in non-dialyzed CKD patients followed in referral centers and as a factor of progression of CKD [47]. Bruggeman et al. [58] discussed the mechanism of viral replication in CKD patients, implying viral infections as a comorbid condition in CKD. The seroprevalence of HIV, hepatitis B surface antigen and hepatitis C virus was reported to be high in hemodialysis centers in Cameroon as well [40,41].

The growing burden of CKD is paralleled by the need to curtail those who end up in ESRD requiring renal replacement therapy (RRT). Effective and practical therapies for CKD remain a challenge even in developed countries [59]. Little is known about the cost of management of CKD in Cameroon. Though it is estimated that these patients have to pay about US$ 12 per dialysis session and this is in addition to the cost for the management of comorbidities [22]. Ngeugoue et al. [33] reviewed this cost and despite government 95% subsidization of hemodialysis, the management of CKD and eventually ESRD remains costly and unaffordable for most patients especially in populations with limited health insurance. In the USA, the cost of medical care of CKD patients even doubled when there were comorbid conditions [60]. As such there is an enormous economic burden in the management of these patients in low-income settings with treatment centers essentially hemodialysis centers located sparingly in urban areas. Consequently, there is a high mortality rate among those with ESRD.

Over a quarter of patients starting hemodialysis die within the first year with about half within the first 6 months and those with co-existing hypertension and diabetes mellitus conveyed the poorest prognosis. Late presentation of CKD and affordability are were cited as major drivers of high early mortality [39]. Slowing CKD’s progression to ESRD is hampered significantly in our setting by late presentation of CKD which reflect in the high rate of unplanned dialysis. In much developed settings, there are prompt referral strategies to nephrologists and quick management of complications/comorbidities of CKD [61]. With the demonstrated high level of morbidity and mortality associated with CKD in Cameroon; instituting a screening program and national CKD registry, improving the availability, accessibility, and affordability of dialysis care in Cameroon is crucial.

The prevalence of CKD reported by studies with a single time-point assessment of kidney function or damage is likely to lead to errors in estimating of the true value. Since serum creatinine has a high inter-person variability, a single time point measurement will lead to random misclassification of participants as cases or non-cases. This error is worse in small studies. Having a large enough sample size with control measurement of serum creatinine levels after three months is important to account for this random error by regression to the mean. The fact that the formulae used to estimate glomerular filtration rate have not be validated in the African population further complicates efforts to estimate the incidence and prevalence of CKD in this population. In addition, limited financial and human resources are major barriers to ascertain the diagnosis of CKD in epidemiological studies, especially in Cameroon. There was substantial degree of heterogeneity across in participants of studies included in this review. Studies reporting on the causes of CKD were cross-sectional which prevented the researcher from establishing temporality. Therefore, it is impossible to know if, for example, hypertension labelled as a cause is rather
a consequence of CKD. These limitations highlight the need for collaborative efforts to better understand the epidemiological profile of CKD in Cameroon.

**Conclusion**

Chronic kidney disease represents a significant cause of morbidity and mortality in Cameroon. The prevalence of CKD was highest among patients with hypertension, diabetes mellitus, and HIV. The main causes include hypertension, diabetes mellitus, chronic glomerulonephritis, HIV and unknown in some cases. Most of these patients present late to the hospitals and require hemodialysis. Financial constraint is the main reason why most do not undergo dialysis despite state subsidies. The mortality rate of patients with ESRD on maintenance hemodialysis is high. Potential actions to curb this mortality could include sensitization of health practitioners to improve early referrals to nephrologist, increasing the availability of treatment centers and encourage health insurance to cover some of the cost of care.

**Research Perspective**

There is limited data on the incidence and prevalence of CKD in the general population. Factors associated with CKD has been generated mostly from cross sectional studies with possibility of reverse causation. There is a need for population-based cohort studies to assess the incidence and risk factors of CKD in Cameroon. A less costly approach to assess the risk factors of CKD would be to conduct a case-control study using population-based controls. In addition, more research is needed to assess the mortality rate of CKD and its predictors in patients with ESRD. Studies evaluating the economic burden of CKD in Cameroon. Creation of a national registry for CKD patients may help foster research in CKD in Cameroon and improve on its management and survival rate.

**Abbreviations**

| Abbreviation | Description                      |
|--------------|----------------------------------|
| CKD          | Chronic Kidney Disease           |
| DALYs        | Disability-adjusted life years   |
| ESRD         | End Stage Renal Disease          |
| GFR          | Glomerular Filtration Rate       |
| HDP          | Hemodialysis patient             |
| HAART        | Highly active anti-retroviral therapy |
| NCD          | Non-communicable disease         |
| PLWHA        | People living with HIV/AIDS      |
| RRT          | Renal Replacement Therapy        |
Declarations

Ethics approval and consent to participate: Not applicable

Consent for publication: Not applicable

Availability of data and materials: Available data can be obtained by contacting the corresponding author.

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Authors’ contributions: VNA conceived the study. VNA did the literature search. JBA, SM and VNA selected studies. JBA and SM collected data. JBA and VNA summarized and interpreted the data. JBA and VNA drafted the manuscript. JBA, SM, NME, DSME, BAK and VNA revised the manuscript. All authors read and approved the final manuscript. VNA is the guarantor of this manuscript.

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Figures
Figure 1

Flow diagram for study screening, selection and inclusion