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# Epidemiologic and Clinical Aspects of Hemodialysis Patients in a Semi-Rural Setting at the Franceville Hemodialysis Center

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## Abstract

**Introduction:** Hemodialysis has evolved significantly, allowing better management of patients with chronic renal failure. This progress has led to an increase in the life expectancy of these patients. Therefore, we conducted this study to evaluate the epidemiologic and clinical aspects of acute and chronic hemodialysis patients at the Franceville hemodialysis center in Gabon. **Patients and Methods:** This was a prospective, descriptive study covering a 3-year period from October 2021 to September 2024 at the Franceville Hemodialysis Center. All hemodialysis patients who voluntarily agreed to participate in the study were included. Epidemiologic, clinical, paraclinical and evolutionary data were collected for each hemodialysis patient. The statistical study was performed using Epi info 7.2.6 software. **Results:** One hundred and fifty-six patients were included in the study, with a male predominance (62.8%). The mean age was 49.92 years (05 - 81 years). The majority of patients had chronic renal insufficiency (63.46%). The underlying nephropathy of chronic renal failure (CRF) was dominated by nephroangiosclerosis (68.69%) and diabetes (21.21%). Acute renal failure (ARF) of infectious origin, including malaria (36.84%) and human immunodeficiency virus infection (19.3%), was the most common. Most patients (83.33%) underwent emergency dialysis. The most common biological disorders were anemia (95.5%) and hyperkalemia (47.44%). The most commonly used vascular access was the temporary catheter (78.4%). The outcome of patients with AKI and CKD was unfavorable in 29.82% and 45.45% of cases, respectively. **Conclusions:** Our study reveals several epidemio-clinical aspects of hemodialysis patients in a semi-rural setting. It calls

for the implementation of necessary accompanying measures, such as the availability of certain drugs and examinations essential for the better management of hemodialysis patients at the Franceville hemodialysis center.

## Keywords

Chronic Renal Failure, Acute Renal Failure, Hemodialysis, Franceville

## 1. Introduction

Around 750 million people worldwide suffer from chronic kidney disease (CKD), an advanced stage of kidney disease [1]. It is a significant public health issue in Africa due to its prevalence, lethality, and the high cost of care [2] [3]. Its incidence is steadily rising in developed countries [4]. In developing countries, CKD is often discovered at an advanced stage [4] [5].

However, there are notable variations in the prevalence and risk of CKD between North Africa, South Africa, and sub-Saharan Africa. Indeed, estimates of the CKD burden have shown significant variability depending on the assessment methods and populations studied [6] [7]. Kaze *et al.* conducted a meta-analysis in Africa in 2018 and reported an overall prevalence of CKD stages 1 - 5 of 15.8% and a prevalence of CKD stages 3 - 5 of 4.6% (3.3 - 6.1) in the general population. Their survey also revealed that the prevalence of CKD was higher in studies conducted in sub-Saharan Africa than in those conducted in North Africa [8].

CKD in Africa is usually caused by a combination of genetic and environmental factors. These factors include persistent or reemerging communicable diseases such as malaria, filariasis, onchocerciasis, schistosomiasis, tuberculosis, leprosy, HIV, HBV, and HCV. On the other hand, they include non-communicable diseases (NCDs), such as diabetes, hypertension, obesity, sickle cell disease, heart disease, collagen vascular disease, and APOL1 nephropathy [9]. Recently added to this non-exhaustive list is SARS-COV2 infection, which causes both acute kidney injury and CKD [10].

Renal disease is also poorly documented in Gabon. The available data on the disease are the results of studies conducted only in the capital city [11] [12]. Of the eleven renal replacement centers in Gabon, two are public and located in the provinces of Port-Gentil and Franceville. The Franceville Hemodialysis Center, which opened on October 21, 2021, serves the entire population of the southeastern region of the country. In this semi-rural environment, diagnosing and managing hemodialysis patients remains difficult. This can increase the morbidity and mortality of hemodialysis patients due to problems with the supply of consumables, drugs, and medical equipment. These problems rapidly lead to stockouts in hospitals and pharmacies. The regular use of traditional medicine and decoctions, as well as low socioeconomic status, have a significant impact on the consistent follow-up of nephrology patients in this setting. Patients generally arrive at the

hospital at an advanced stage of CKD complications, and death is common. The characteristics of hemodialysis patients in semi-rural areas differ greatly from those in urban areas. To address this scientific gap, we conducted a study to describe the epidemiological and clinical aspects of hemodialysis patients at the hemodialysis center in Franceville, Gabon.

## 2. Patients and Methods

### 2.1. Description of the Study Site

The province of Haut Ogooué is located in the southeastern part of the Republic of Gabon, with Franceville as its capital. It is bordered to the north by the province of Ogooué Ivindo, to the east and south by the Republic of Congo, and to the west by the province of Ogooué Lolo. With a surface of about 36,550 km$^2$, it covers 13.6% of the total surface of the country. Franceville is home to the Centre International de Recherche Médical (CIRMF), the Université des Sciences et Techniques de Masuku (USTM), the École Doctorale Régionale (EDR) d'Afrique Centrale de Franceville en Infectiologie Tropicale and the Centre Hospitalier Universitaire Amissa Bongo (CHUAB). The CHUAB is located in the 3rd arrondissement of Franceville and was inaugurated on May 08, 2003. The Hemodialysis Center is attached to the CHUAB.

More than 90% of our hemodialysis patients are covered by the Caisse Nationale d'Assurances Maladie et de Garantie Sociale (CNAMGS), which pays 100% of the cost of hemodialysis sessions.

The Hemodialysis Center is an autonomous unit that has been operational and functional since October 2021, serving the entire population of the southeastern part of the country. It has a capacity of 10 beds, for 10 dialysis generators (Fresenius 4008S), a pre-treatment and water treatment room and a dialysate composed as follows (Table 1):

**Table 1.** Dialysate composed.

| Item Number | Composition | |
|---|---|---|
| Acid concentrates for hemodialysis (dialysis baths) | | |
| Acid concentrate (1 + 44) | Na+ | 138 mmol/L |
| 4.7 L canister | Mg2 | 0.5 mmol/L |
| Fresenius | K+ | 3 mmol/L |
| | Cl | 110 mmol/L |
| | CHC00- | 3 mmol/L |
| | HCO3- | 32 mmol/L |
| | Glucose | 1 g/L - 6.6 mmol/L |
| AC-F313/1 (7.8 L)<br>AC-F311.5 (4.2 L) | Ca2+ | 1.5 mmol/L |
| Sodium Bicarbonate Concentrates (Cartridge) | | |
| Bibag® Fresenius | NaHCO3: 650 g | |

- Organization

The hemodialysis center is open from 6:30 a.m. to 10 p.m. on Mondays, Wednesdays and Fridays and from 6:30 a.m. to 10 p.m. on Tuesdays, Thursdays and Saturdays. A nurse and physician are on call outside of these hours.

- Number and Length of Sessions

Patients typically have 3 dialysis sessions per week, either on Mondays, Wednesdays and Fridays or Tuesdays, Thursdays and Saturdays. Each session lasts 4 hours on average.

- The course of a dialysis session

The patient arrives in comfortable clothes, accompanied by an ambulance driver or a relative.

Weighing: The physician determines the dry weight of each patient. Therefore, before each dialysis session, the patient must be weighed in the presence of a member of the paramedical staff in order to calculate the weight to be lost during the session.

Connection: If the patient has an arteriovenous fistula (AVF) and is physically able, he washes his fistula arm with soap and water. The patient is then placed in the bed indicated by the paramedical staff. If necessary, the fistula arm is attached and washed by the paramedical staff. The various session data are then entered into the generator. Blood pressure is then taken. When the machine is ready, the nurse connects the patient to the dialysis machine, either through the FAV or the catheter.

The dialysis session itself: The length of the dialysis session is determined by the physician based on the patient's needs. During the session, the nurse monitors various parameters such as blood pressure, facial expressions, the patient's feelings and machine parameters.

Disconnection: Before disconnecting the patient from the generator, the paramedical staff will read the generator's various parameters and take the patient's blood pressure.

For fistula disconnection, the nurse removes the needles from the fistula and compresses the puncture point. Once the fistula is disconnected, the nurse applies a dressing to it. The dressing must remain in place until the evening of dialysis after morning sessions and until the following morning after evening sessions.

Catheter Disconnection: For patients with a catheter, a nurse disconnects the catheter and applies an occlusive dressing. The patient may then stand up in the presence of a staff member.

Post-treatment weighing: Before leaving the clinic, patients weigh themselves to see if they have met their weight loss goal set at the beginning of treatment.

## 2.2. Type and Period of Study

We conducted a prospective, descriptive study over a period of 35 months, from October 2021 to September 2024.

### 2.3. Study Population and Inclusion Criteria

The study population consisted of all acute and chronic hemodialysis patients hospitalized and monitored on an outpatient basis at the Franceville hemodialysis center during the study period, *i.e.* a population of 156 hemodialysis patients.

We used an exhaustive sample.

All acute and chronic hemodialysis patients at the Franceville hemodialysis center at the time of the study, whether emergency or scheduled, with or without prior nephrologic follow-up, who agreed to participate in the study by giving verbal consent, were included in the study. Parental consent was obtained for children under 18 years of age. We excluded all non-dialyzed renal failure patients and hemodialysis patients who refused to participate in the study.

### 2.4. Variables Studied

- Sociodemographic data included age, sex, socioeconomic level, place of residence, nationality, whether the patient was under care or not.
- Clinical data included gastrointestinal, cardiovascular, respiratory, urinary, and neurological symptoms.
- Comorbidities and lifestyle habits included hypertension, diabetes, heart disease, stroke, hepatitis B, hepatitis C, HIV, prostatic hypertrophy, obesity, menopause, alcohol, tobacco, and herbal medicine, while CKD-specific risk factors included fluid retention, phosphocalcium disorders, anemia, left ventricular hypertrophy, AVF, and catheterization.
- Biological tests included hemogram, urea, creatinemia, uric acid, ionogram, phosphocalcium balance, transaminases, infectious diseases. The standards used were those of the Franceville Laboratories.
- Vascular access data included type of vascular access, number of catheters, and number of AVFs.
- Information on hemodialysis sessions, including frequency, duration, and regularity.
- Patient outcomes included death, survival on hemodialysis, temporary withdrawal from dialysis, and number of days on hemodialysis.

### 2.5. Equipment Used

- Renal ultrasound was used to assess size, cortico-medullary differentiation, and the presence or absence of renal dilatation. Chest radiography was used to assess for signs of acute pulmonary oedema (APO), pleurisy, cardiomegaly, and pulmonary infection. Abdominal ultrasound was performed using a SIEMENS HEALTHINEERS (ACUSON NX3 ELITE) machine coupled to a SONY (UPP-110) DIGITAL printer
- Electrocardiogram (ECG) and echocardiography were used to detect various cardiac abnormalities. These consisted of a 12-lead resting electrocardiogram using a SCHILLER CARDIOVIT-AT-102 G2 device and a resting transthoracic cardiac Doppler echocardiogram using a SIEMENS HEALTHINEERS

(ACUSON NX3 ELITE) device coupled to a SONY (UPP-110) DIGITAL printer. The results were validated by the CHUAB cardiology team.

- All laboratory tests were performed before patients were started on dialysis. All viral serologies were performed using rapid diagnostic tests: Hbs antigen was detected by a third-generation Murex HBsAg enzyme-linked immunosorbent assay (EIA, Mediff, Aubagne, France). Anti-HCV antibodies were detected with the ImmunocombII HCV kit (Alere S.A.S. Jouy En Josas, France). Anti-HIV-1 & 2 antibodies were detected by a highly sensitive enzyme immunoassay (EIA) test kit using the Murex HIV Ag/Ab Combination (EIA 1, Mediff, Aubagne, France). Confirmatory testing was performed using ImmunocombII HIV-1 & 2 Bispot (Orgenics, Yavne, Israel). Fasting blood glucose and C-reactive protein tests were performed using a HUMASTAR 100 device. A HUMACOUNT 5 D device was used for infectious disease blood count. All these tests were performed according to the manufacturer's recommendations.
- Biological tests, *i.e.*: biochemistry (transaminases, creatinine, uremia) were performed on a HUMASTAR 100, blood ionogram on a HUMALYTE PLUS, hematology (blood count) on a HUMACOUNT 5 D, serology (C-reactive protein) on a HUMASTAR 100.

### 2.6. Data Collection

Data were collected from patients' individual medical records and during direct interviews with patients for those who were stable. For patients with dialysis emergencies or hemodynamic instability, data were collected from relatives and/or after patients were stabilized.

Data were collected from individual patient records. Each patient's file was analyzed according to a specific grid containing the parameters to be studied.

### 2.7. Definition Criteria

- Emergency hemodialysis was defined in a patient as "the very first hemodialysis session performed immediately within 24 hours of a nephrologic evaluation, due to a risk considered vital, after impending hyperhydration, hyperkalemia, acidosis, poorly tolerated anemia, pericarditis, or uremic confusion" [13].
- The chronic nature of renal failure was evoked in the presence of anamnestic criteria (history of elevated creatinine levels, known general illnesses), morphologic criteria (decrease in kidney size on renal ultrasound) and/or biological criteria (hypercreatininemia with glomerular filtration rate (GFR) < 60 ml/min, normochromic normocytic anemia with degenerative effects, hypocalcemia). Chronic kidney disease (CKD) was classified into 5 stages according to the KDIGO (Kidney disease Improving Global Outcomes) classification. The race-calibrated Modification of Diet in Renal Disease (MDRD) equation was used to estimate GFR [14].

- Acute kidney injury (AKI) was defined on the basis of serum creatinine levels measured during hospitalization. The highest serum creatinine level was used to stage AKI according to the Acute Kidney Injury Network (AKIN) with different stages (AKI 1, AKI 2, and AKI 3) [15].
- Diuresis volume abnormalities were defined as anuria (diuresis less than 100 ml/24h), oliguria (diuresis less than 400 ml/24h) and polyuria (diuresis more than 3 l/24h) [13].
- Anemia was defined by a hemoglobin level; 12 g/dl and was considered severe for a hemoglobin level; 8 g/dl. It was considered regenerative if the reticulocyte count was > 120 giga/l [14] [16].
- The term "hemodynamic instability" refers to a combination of clinical symptoms, vital signs, and laboratory results. The main symptom is usually arterial hypotension, defined as a systolic pressure below 90 mmHg or a mean arterial pressure (MAP) below 65 mmHg. Other symptoms include tachycardia and tachypnea. In patients with chronic hypertension, a reduction in blood pressure of more than 40 to 50 mmHg is considered significant [17].
- With regard to nephrological follow-up, the aim is to treat, prevent, and compensate for the disease by focusing on three main objectives:
  - Treat the cause. For hypertension, cardiovascular disease, and diabetes, follow-up is carried out jointly with the cardiologist and endocrinologist.
  - Adopt hygienic and dietary measures by avoiding certain drugs, stopping harmful substances, limiting salt and protein intake, and ensuring adequate water intake to avoid dehydration.
  - The third objective is to treat complications by correcting cardiovascular complications, reducing anemia, combating the risk of infection, and correcting nutritional deficiencies, such as vitamin D and calcium deficiencies, as well as abnormalities in blood chemistry.

## 2.8. Data Entry and Analysis

Data were analyzed using Epi info 7.2.6 software. Descriptive results were expressed as numbers and percentages for qualitative variables. Quantitative variables were expressed by calculating the mean, standard deviation and extreme values (minimum and maximum). Tables and graphs were generated using Microsoft Office Excel 2016 (Microsoft Corporation, Redmond, WA, USA).

## 2.9. Ethical Considerations

The respect and dignity of all study participants were respected. An anonymous questionnaire was used. The work described does not involve experiments on patients, human subjects or animals. The study was approved by the Medical Committee and the General Management of CHUAB. All the tenets of the Declaration of Helsinki regarding human subjects in research were followed during data collection. Ethical approval was obtained from the Regional Ethics Committee of the Province of Haut-Ogooué (PROT N°20/2021/MSAS/DRSSEF).

## 3. Results

### 3.1. Sociodemographic Characteristics of the Study Participants

During the study period, we studied 156 hemodialysis patients. The sample was predominantly male (62.8%). The mean age of our patients at the start of dialysis was 49.92 ± 14.97 years [05 - 81 years], with the age group [30 - 65 years] being the most represented (60.9%). Many of our patients were unemployed (37.8%). In the majority of cases (91.03%), patients were covered by health insurance (Table 2).

Table 2. Sociodemographic characteristics of study participants.

| Gender | Numbers (N) | Percentage (%) |
|---|---|---|
| **Female** | 58 | 37.2 |
| **Male** | 98 | 62.8 |
| **Nationality** | | |
| **Gabonese** | 142 | 91.03 |
| **Non-Gabonese** | 14 | 8.97 |
| **Age groups** | | |
| **<18 years** | 14 | 9 |
| **18 - 30 years** | 19 | 12.2 |
| **30 - 50 years** | 47 | 30.1 |
| **51 - 65 years** | 48 | 30.8 |
| **65 years and older** | 28 | 17.9 |
| **Provenance by province** | | |
| **Haut Ogooué** | 120 | 76.9 |
| **Estuaire** | 20 | 12.8 |
| **Ogooué lolo** | 15 | 9.6 |
| **Ogooué Ivindo** | 1 | 0.6 |
| **Profession** | | |
| **students** | 25 | 16.0 |
| **pensioners** | 15 | 9.6 |
| **without** | 59 | 37.8 |
| **workers** | 57 | 36.5 |
| **Financing of care** | | |
| **Insurance** | 142 | 91.03 |
| **family** | 5 | 3.21 |
| **Association** | 8 | 5.13 |
| **Non-Governmental Organization (NGO)** | 1 | 0.64 |

### 3.2. Clinical and Paraclinical Data of the Study Participants

Use hypertension was found in 46.2% of the patients and diabetes in 17.3%. Menopause was found in 18.6% of cases, alcohol in 17.3%, herbal medicine and maraboutage in 12.8%. HIV-positive serologic status was found in 11.54% of cases, positive Hbs antigen in 5.13% and anti-HCV antibodies in 7.1%. Co-infection with HIV and hepatitis C was found in 1.3% of cases.

Clinical and paraclinical parameters at the first dialysis session were predominantly hypertension (31.41%), with a predominance of grade 3, acute pulmonary edema (37.82%) and uremic encephalopathy (23.08%), and creatinine levels at the first hemodialysis session ranged from 400 µmol/L to 2807 µmol/L. We note that 13.31% (n = 27) had azotemia greater than or equal to 50 mmol/L and 82.69% (n = 129) less than 50 mmol/L.

The most common biological disorders were anemia (95.5%), followed by hyperkalemia (47.44%) and acidosis (30.77%). The mean hemoglobin level was 7.96 g/dl, with extremes of 2.70 and 15.90 g/dl. Ninety patients with CKD (90.91%) were treated with erythropoietin. Only 86 patients with AKI and CKD (55.1%) received blood transfusion.

No patient in the CKD group benefited from parathyroid hormone (PTH) or vitamin D testing, as these were not available.

Ninety-nine patients had CKD, including 73 with end-stage CKD (46.79%) and 57 with AKI (36.54%). Causal nephropathy was dominated by nephroangiosclerosis and diabetic nephropathy in 68.69% and 21.21%, respectively. Nephropathy was of undetermined etiology in 9 cases (0.91%). AKI was of infectious origin with malaria predominating in 36.84%, followed by secondary HIV in 19.3% and urinary tract infection in 8.77%. Obstetric causes were found in 7.02%. Of the 156 patients, 130 underwent emergency hemodialysis, including 74 with CKD and 56 with AKI.

The first hemodialysis session was performed through a central venous catheter in all patients. 78.4% of patients had a temporary catheter and 16.2% had an arteriovenous fistula (AVF) (Table 3).

Table 3. Clinical and paraclinical data for study participants.

| Comorbidity and lifestyle | Numbers (N) | Percentage (%) |
|---|---|---|
| **HTA** | 72 | 46.2 |
| **Diabetes** | 27 | 17.3 |
| **Heart disease** | 13 | 8.3 |
| **Stroke and subdural hematoma** | 4 | 2.6 |
| **Alcohol** | 27 | 17.3 |
| **Tobacco** | 12 | 7.7 |
| **Obesity** | 9 | 5.8 |

Continued

| | | |
|---|---|---|
| **Menopause** | **29** | **18.6** |
| **CKD** | 23 | 14.7 |
| **HIV** | 18 | 11.5 |
| **Hepatitis C** | 11 | 7.1 |
| **Herbal medicine and/or maraboutage** | 20 | 12.8 |
| **Prostate hypertrophy** | 4 | 2.6 |
| **Serologic status** | | |
| **HIV** | 19 | 11.54 |
| **Hpatitis B** | 8 | 5.13 |
| **Hepatitis C** | 11 | 7.1 |
| **Coinfection HIV + hepatitis C** | 2 | 1.28 |
| **Parameters at first dialysis** | | |
| **HTA GRADE 1** | 3 | 1.9 |
| **HTA GRADE 2** | 15 | 9.6 |
| **HTA GRADE 3** | 31 | 19.9 |
| **No HTA** | 107 | 68.6 |
| **Acute pulmonary edema** | 59 | 37.8 |
| **Uremic encephalopathy** | 36 | 23.1 |
| **Digestive disorders** | 42 | 26.9 |
| **Anuria** | 32 | 20.5 |
| **Anemia** | 149 | 95.5 |
| **hyponatremia** | 27 | 28.7 |
| **Hyperkaliemia** | 74 | 47.44 |
| **Hypocalcemia** | 33 | 21.15 |
| **Hyperphosphoremia** | 24 | 15.4 |
| **Acidosis** | 48 | 30.77 |
| **Transfusion** | | |
| **No** | 70 | 44.9 |
| **Yes** | 86 | 55.1 |
| **Access** | | |
| **Temporary catheters** | 218 | 78.4 |
| **Tunneled catheters** | 15 | 5.4 |
| **Arteriovenous fistulas** | 45 | 16.2 |

The mean duration of CKD on hemodialysis was 12 months, with extremes of 1 and 96 months. The mean duration of AKI was 11 days, ranging from 3 to 45 days.

The duration of hemodialysis sessions ranged from eight to twelve hours per week, with two to three sessions per week. The majority of patients (89.10%) received three sessions per week. Of the 156 patients, 74.36% attended regularly.

The outcome of AKI was favorable in 40 patients (70.18%), with complete recovery of renal function, and unfavorable in 17 patients (29.82%), all of whom died of multivisceral failure. In our study, the evolution of CKD was marked by the occurrence of 45 deaths (45.45%) (Table 4).

Table 4. Development of clinical and paraclinical data.

| Evolution | Numbers (N) | Percentage (%) |
|---|---|---|
| **CKD end stage** | 73 | 41.0 |
| **AKI/Kidney function recovery** | 57 | 28.8 |
| **CKD** | 26 | 19.9 |
| **Temporary cessation of dialysis** | 20 | 12.82 |
| **Mortality** | 62 | 39.7 |
| **AKI** | 17 | 54.55 |
| **CKD** | 45 | 45.45 |
| **Live patients** | 94 | 60.3 |
| **Duration on dialysis (days)** | | |
| **0 - 30** | 93 | 59.6 |
| **30 - 60** | 13 | 8.3 |
| **60 - 180** | 17 | 10.9 |
| **180 - 365** | 5 | 3.2 |
| **>365** | 28 | 18 |

## 4. Discussion

Our work has allowed us to evaluate the epidemio-clinical aspects of acute and chronic hemodialysis patients at the Franceville hemodialysis center in a semi-rural area. The results show that the causes and risk factors of renal failure are the same as those found in the literature, and more specifically, in sub-Saharan areas, morbidity remains high and there is still a long way to go in terms of management.

### 4.1. Study Limitations

The number of participants over a 4-year period may be a weakness of the study. Confounding and selection bias are other limitations that may have occurred in our work. However, this work highlights several epidemiologic data in semi-rural

settings that may help in the management of these particular patient populations.

### 4.2. Sociodemographic Characteristics

Headings, Our results show a mean age of 49.92 ± 14.97 years, corresponding to young adults on hemodialysis. Our data were consistent with those reported in the African literature. Indeed, Eyeni DT *et al.* in 2019 in Brazzaville, evaluating AVF punctures from a dialysis center, reported a mean age of HDCs of 53.87 ± 15.27 years [18]. Oumarou Keita also found a mean age of 44.7 years [19]. Hermine Fouda in Cameroon reported a mean age of 47.97 years [20]. However, in economically developed countries, 50% of chronic hemodialysis patients were older than 60 years [21]. This discrepancy could be explained by better access to care and the aging of the Western population, in contrast to the youthfulness of the African population reported in all data in the literature.

In our study, we found a male predominance of 62.8%. Our results were almost similar to those reported by Diarra et al in Bamako, who found a predominance of 57.6% [22]. However, our results were higher than those of Hermine Fouda et al who reported a male predominance of 55% [20]. The high frequency of CKD in men may be explained by the rapid progression of chronic kidney disease (CKD) in this population [22]. This difference could be due to the influence of male hormones and lifestyle (alcohol, tobacco and herbal medicine) [23] [24].

The most represented socioeconomic level is unemployed (37.8%). Our results were consistent with those reported in the African literature. Indeed, several authors in West and Central Africa have reported an association between low socioeconomic status and chronic hemodialysis patients [20] [25] [26]. In addition, Diallo D *et al.* reported a low socioeconomic level, very high in the order of 60% [27]. The frequent reports in the literature of a higher prevalence of chronic kidney disease in populations with low socioeconomic status could be explained by the frequent use of prohibited drugs on the parallel market, herbal medicine and late consultation of specialists [27] [28].

### 4.3. Hemodialysis Patients and Comorbidities

We found arterial hypertension to be the most common comorbidity in chronic hemodialysis patients: 46.2% in our study. Our results were significantly lower than those reported by A. Al Adloui *et al.* and W. Berrachdi, who reported frequencies of 89.7% and 84.30%, respectively [23] [29]. On the other hand, our results were close to those of Diarra M. *et al.* and Diallo D. *et al.* in Mali, with frequencies of 44.10% and 42%, respectively [22] [27]. Hypertension was followed by diabetes (17.3%) and heart disease (4.3%). Hemodialysis patients in Gabon have a high cardiovascular risk, as reported in other sub-Saharan African countries [22] [29] [30].

### 4.4. Kidney Disease as a Cause of Renal Failure

Ninety-nine patients had chronic renal failure, 73 of them end-stage (46.79%),

and 57 patients had acute renal failure (36.54%).

The causative nephropathy of CKD was dominated by nephroangiosclerosis and diabetes in 68.69% and 21.21%, respectively. Our results were consistent with those reported in the African literature [22] [29] [30]. However, Diarra M. *et al.* and Diallo D. *et al.* in Mali reported hypertension as the main cause of CKD with lower frequencies of 44.10% and 42% respectively [22] [27].

The role of hypertension in the development of vascular nephropathy is well established in the international literature. The relative risk of progression to cirrhosis is multiplied by eight when hypertension is severe in blacks, a genetic predisposition of the black race to develop cirrhosis more rapidly [31] [32].

This is due to an increase in behavioral changes, where the population indulges in a diet copied from the West and poorly controlled (excessive sugar, salt, polysaturated fats, etc.); and bad habits and lifestyles such as smoking, alcoholism, etc. There is also poor control and therapeutic follow-up of most of our patients, who disappear into thin air or go to traditional practitioners for treatment.

The incidence of autosomal dominant polycystic kidney disease (ADPKD), which is responsible for chronic renal failure, was relatively low in our study: 2% of cases. Our results were similar to those reported by Diarra *et al.* in Mali, who found 1.7% of PKRAD in the hemodialysis unit of CHU du Point-G [22]. In addition, Aichât O KEITA in Côte d'Ivoire also reported results similar to ours, in the order of 2.50% cases of polycystic kidney disease [20].

ARIs were of infectious origin, with malaria predominant in 36.84%, followed by secondary HIV in 19.3%. The causes were mainly infectious and toxic, as reported in the study by Guei *et al.* [33]. Malaria was the most common infectious cause. Malaria-related AKI mainly affects adults and older children, with a prevalence ranging from 1% to 4% [34] [35].

Progression was favorable in 28.8% of cases. However, the mortality rate was 39.7%. Our results differed from those reported by Tia *et al.*, who found a mortality rate of 21.9% in hemodialysis patients over three decades. They also differed from those reported by Bensalem *et al.* in Tunisia in 2015, who found a mortality rate of 4% [36]. The higher percentage of patients who died could be explained by a late consultation and a long therapeutic course. In fact, the majority of patients resort to self-medication, sometimes combined with traditional therapy, from the onset of symptoms. They only go to the hospital when the symptoms worsen.

This is the first descriptive study to assess the epidemiologic profile of hemodialysis patients in a semi-rural area of Gabon. It thus provides a basis for evaluating the implementation of hemodialysis units in rural and semi-rural areas and strategies for managing these populations.

## 4.5. Conclusions

In Gabon, dialysis has developed significantly in recent years, with the opening of centers in the provinces (Haut Ogooué and Ogooué Maritime, whose main cities are Franceville and Port-Gentil). Despite the difficulties of remoteness and supply

of consumables, our research has shown the social and economic benefits of opening hemodialysis centers in the provinces. However, we recommend that the country's health authorities facilitate access to certain drugs and paraclinical tests essential for monitoring nephrology patients (cardiovascular check-up, martial check-up, parathormone dosage, vitamin D dosage).

In rural or semi-rural areas, it would also be useful to develop cost-effectiveness strategies, partnerships and/or awareness and training programs for local health care providers.

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## Author Contributions

All authors participated in the drafting of the manuscript. They have read and approved the final version.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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