Scientific Research Publishing

Open Journal of Nephrology, 2026, 16(1), 72-88
https://www.scirp.org/journal/ojneph
ISSN Online: 2164-2869
ISSN Print: 2164-2842

# Prevalence and Factors Increasing the Risk of Sarcopenia among Patients with Kidney Disease Followed up at the Douala General Hospital, Cameroon

**Elimby Ngande Lionel Patrick Joel[1,2,3*], Nguea Ndjame Arlette[4,5], Fouda Menye Epouse Ebana Hermine Danielle[1,2]**

[1]Faculty of Medicine and Biomedical Sciences, University of Yaoundé I, Yaoundé, Cameroon
[2]General Douala Hospital, Douala, Cameroon
[3]Yaounde University Teaching Hospital, Yaoundé, Cameroon
[4]Faculty of Medicine and Pharmaceutical Sciences, University of Douala, Douala, Cameroon
[5]Yaoundé Central Hospital, Yaoundé, Cameroon
Email: *lionel.elimby@fmsb-uy1.cm

**How to cite this paper:** Joel, E.N.L.P., Arlette, N.N., and Danielle, F.M.E.E.H. (2026) Prevalence and Factors Increasing the Risk of Sarcopenia among Patients with Kidney Disease Followed up at the Douala General Hospital, Cameroon. *Open Journal of Nephrology*, **16**, 72-88.
https://doi.org/10.4236/ojneph.2026.161008

**Received:** August 24, 2025
**Accepted:** January 18, 2026
**Published:** January 21, 2026



## Abstract

**Background:** Sarcopenia is an important prognostic factor for patients with kidney disease. In a context marked by the poor prognosis of these patients, we aimed to explore the factors that could potentially worsen outcomes. The objective of our study was to determine the prevalence and identify factors increasing the risk of sarcopenia among patients with kidney disease followed up at Douala General Hospital (DGH). **Methods:** We conducted a cross-sectional study in the nephrology department of DGH over a 6-month period, including 302 patients with kidney disease. Sociodemographic and clinical data were collected from each participant using a structured questionnaire and their medical records. The diagnosis of sarcopenia was made according to the EWGSOP2 recommendations. Univariate and multivariate logistic regressions were performed to identify factors associated with an increased risk of sarcopenia. **Results:** The mean age of patients was 61 ± 13 years, with most being in the 50 - 64-year age group (n = 127, 42%) and male (n = 159, 53%). The prevalence of sarcopenia was 28.8%. Probable sarcopenia was observed in 50 patients (16.6%), confirmed sarcopenia in 9.3% and severe sarcopenia in 3%. The risk of sarcopenia increased among patients older than 65 years (aOR = 19.4, 95% CI: 2.25 - 445; p = 0.017), those consuming alcohol (aOR = 7.88, 95% CI: 2.82 - 25.1; p < 0.001), with type II diabetes (aOR = 83.1, 95% CI: 22.9

- 411; p < 0.001), with advanced CKD stages—G3 (aOR = 13.9, 95% CI: 2.73 - 100; p = 0.004), G4 (aOR = 149, 95% CI: 22.2 - 1571; p < 0.001) and G5 (aOR = 736, 95% CI: 93.9 - 9414; p < 0.001)—, and those with elevated serum IL-6 concentrations (aOR = 54.6, 95% CI: 16.3 - 238; p < 0.001). **Conclusion:** The prevalence of sarcopenia was substantial in our sample, and its risk was increased by older age, type II diabetes, alcohol consumption, advanced CKD stage, and elevated serum IL-6 levels.

## Keywords

Kidney Disease, Sarcopenia, Prevalence, Risk, Douala General Hospital

## 1. Introduction

Sarcopenia is a musculoskeletal syndrome defined by reduced muscle strength as the primary criterion, confirmed by low muscle mass; impaired physical performance indicates a severe form [1]-[3]. In patients with kidney disease (KD), sarcopenia is driven by mechanisms specific to uremia—dysregulation of protein metabolism, chronic inflammation, insulin resistance, metabolic acidosis, and hormonal disturbances—that fall within the broader framework of protein-energy wasting (PEW) [4] [5]-[7].

From an epidemiological standpoint, a recent global meta-analysis including 140 studies (42,041 patients) estimated the prevalence of sarcopenia at 24.5% across the CKD spectrum, with higher rates among dialysis patients (around 26%) and a prevalence of severe sarcopenia of about 21% [8]. In dialysis patients, systematic reviews and meta-analyses report prevalence rates of 25% - 29% and confirm the association with increased mortality and higher rates of cardiovascular events [9] [10]. Beyond dialysis populations, sarcopenia has also been linked to progression to end-stage renal disease (ESRD) and higher mortality among individuals with CKD [11] [12].

The clinical consequences in CKD patients are multiple: decreased functional capacity and quality of life, increased risk of adverse events and death, and unfavorable interactions with PEW that worsen prognosis [4] [13]. Therapeutically, the presence of sarcopenia complicates nutritional management and rehabilitation and requires integrated strategies (physical activity, correction of metabolic disturbances, and nutritional optimization) [5]-[7].

In Cameroon, and specifically at Douala General Hospital (DGH), the mortality of patients on hemodialysis remains high: a 10-year audit at DGH reported a 12-month mortality rate of 26.8% [14], and a nationwide scoping review confirmed one-year mortality rates of 26.8% - 38.6% among patients with end-stage renal disease [15]. To our knowledge, no study has yet described the prevalence of sarcopenia or its associated factors among CKD patients followed at DGH—even though this comorbidity, while not the sole explanation, could contribute to the high mortality rate. Documenting the local epidemiology of sarcopenia is there-

fore crucial to guide screening and targeted interventions. The general objective of our study was to estimate the prevalence of sarcopenia and identify its associated factors among patients with kidney disease followed at Douala General Hospital.

## 2. Patients and Methods

### 2.1. Study Design

Because the diagnosis of sarcopenia is not routinely included in the management of patients with kidney disease in Cameroon, we initiated a survey to assess this condition in the nephrology department of Douala General Hospital (DGH). A cross-sectional study was conducted over a six-month period, from March to September 2024. The objective of the study was explained to each patient, and those who consented were screened for sarcopenia risk using the SARC-F questionnaire during a one-on-one interview of approximately ten minutes. A SARC-F score of ≥ 4 indicated a risk of sarcopenia [16] [17]. Subsequently, impedance parameters and handgrip strength were measured to confirm the diagnosis of sarcopenia.

### 2.2. Study Population

All patients diagnosed with kidney disease according to KDIGO criteria (eGFR < 60 mL/min/1.73 $m^2$ for ≥ 3 months and/or persistent markers, or on chronic dialysis for ≥ 3 months), followed up in the nephrology unit, attending hemodialysis sessions, or hospitalized in the service, who consented to participate and were eligible for sarcopenia assessment (strength, mass, performance) were included. Patients with severe neuromuscular disorders, pregnancy, cognitive impairment without a legal representative, or those who refused to participate were excluded.

Due to the absence of prevalence data on sarcopenia in Cameroon, and more specifically among kidney disease patients, it was impossible to estimate the minimum sample size based on prior studies [18]. Therefore, the sample size was determined by convenience, and a total of 302 patients with kidney disease were included.

### 2.3. Data Collection

Data were collected using a structured, pre-tested, and validated questionnaire developed by the research team. The first section gathered sociodemographic and anthropometric data, including age, height, weight, and body mass index (BMI). The second section recorded clinical data related to the disease, such as stage of kidney disease, inflammation (assessed by serum interleukin-6 levels), and comorbidities (diabetes, hypertension). The final section collected information required for the diagnosis of sarcopenia, including SARC-F scores, handgrip strength, appendicular skeletal muscle mass (ASM), and physical performance [2].

### 2.4. Measurement of Sarcopenia Parameters

- **Handgrip strength**

  Muscle strength was measured using an electronic dynamometer, following the

protocol proposed by Roberts *et al.* [19].

- **Muscle mass**

Muscle mass was assessed as appendicular skeletal muscle mass (ASM) using bioelectrical impedance analysis (BIA; [*device/model*], *manufacturer, city, country*). ASM was estimated with the device's built-in prediction equations calibrated against dual-energy X-ray absorptiometry (DXA), following the approach proposed by Janssen *et al.* [20]. BIA was selected for its practicality and its documented agreement with DXA in clinical and epidemiological settings. No study-specific recalibration was performed; the manufacturer's DXA-validated internal equations were applied uniformly to all participants.

- **Physical performance**

Physical performance was evaluated by measuring 10-meter gait speed, following the recommendations of the European Working Group on Sarcopenia in Older People (EWGSOP2) [21].

## 2.5. Diagnosis of Sarcopenia

According to EWGSOP2, diagnosis follows the F-A-C-S algorithm: sarcopenia is considered probable when muscle strength is reduced (handgrip < 27 kg in men, < 16 kg in women, or a 5-times chair stand test > 15 s); it is confirmed by low muscle quantity/quality (DXA/BIA: ASM < 20 kg (men), <15 kg (women) or ASM/height$^2$ < 7.0 kg/m$^2$ (men), <6.0 kg/m$^2$ (women)); and it is severe when physical performance is impaired (gait speed ≤ 0.8 m/s, SPPB ≤ 8, TUG ≥ 20 s, or inability to complete or ≥6 min on the 400-m walk) [1].

## 2.6. Ethical Considerations

The study was conducted in compliance with the ethical guidelines for clinical research involving humans, as recommended by the Ministry of Public Health of Cameroon. Administrative approvals were obtained from the Institutional Research Ethics Committee of the University of Douala (N˚ 3050 CEI-Udo) and the Douala General Hospital (N˚ 458 AR/MINSANTE/HGD). The objectives and purpose of the study were clearly explained to each participant in the language they understood best (French or English). Only patients who signed informed consent forms were enrolled. Participation was entirely voluntary, and patients could refuse to answer any question or withdraw at any time without any impact on their medical care. Participants were also sensitized on the importance of maintaining physical activity throughout their treatment.

## 2.7. Statistical Analysis

Data were entered into Excel and analyzed using R software version 4.4.2 for Windows 11 and GraphPad version 8.3.4. Qualitative variables were summarized as frequencies (n) and percentages (%), while quantitative variables were expressed as means ± standard deviation. Univariate and multivariate logistic regression analyses were performed to identify factors associated with sarcopenia, calculating

Odds Ratios (OR, aOR) with 95% confidence intervals (95% CI). A p-value < 0.05 was considered statistically significant.

## 3. Results

### 3.1. General Characteristics of the Study Population

The mean age of patients was 61 ± 13 years, with most aged between 50 and 64 years (n = 127, 42%). The majority were male (n = 159, 53%), resided in Nkongsamba (n = 49, 16%), were single (n = 107, 35%), and worked in the informal sector (n = 67, 22%). Regarding comorbidities, most patients were hypertensive (n = 192, 64%), and 31% (n = 93) were diabetic. Additionally, 25% (n = 75) consumed alcohol, and 17% (n = 52) were smokers. More than half (n = 158, 52%) had a sedentary lifestyle, and stage G3 of kidney disease was the most common (n = 111, 37%) (Table 1).

Table 1. General characteristics of the study population.

| Characteristics | sarcopenic | | | p-value |
|---|---|---|---|---|
| | Total (N = 302) | No (N = 215) | Yes (N = 87) | |
| **Mean age ± SD (years)** | 61 ± 13 | 58 ± 12 | 70 ± 12 | **<0.001** |
| **age_group (years)** | | | | **<0.001** |
| [50, 65[ | 127 (42%) | 101 (33%) | 26 (8.6%) | |
| >65 | 115 (38%) | 57 (19%) | 58 (19%) | |
| [35 - 50[ | 52 (17%) | 50 (17%) | 2 (0.7%) | |
| [23 - 35[ | 8 (2.6%) | 7 (2.3%) | 1 (0.3%) | |
| **Gender** | | | | **<0.001** |
| Male | 159 (53%) | 98 (32%) | 61 (20%) | |
| Female | 143 (47%) | 117 (39%) | 26 (8.6%) | |
| **Residence** | | | | |
| nkongsamba | 49 (16%) | 33 (11%) | 16 (5.3%) | |
| mbanga | 45 (15%) | 31 (10%) | 14 (4.6%) | |
| kribi | 38 (13%) | 28 (9.3%) | 10 (3.3%) | |
| Batouri | 23 (7.6%) | 14 (4.6%) | 9 (3.0%) | |
| foumban | 21 (7.0%) | 11 (3.6%) | 10 (3.3%) | |
| souza | 21 (7.0%) | 14 (4.6%) | 7 (2.3%) | |
| bafoussam | 20 (6.6%) | 17 (5.6%) | 3 (1.0%) | |
| Yaoundé | 20 (6.6%) | 17 (5.6%) | 3 (1.0%) | |
| Douala | 19 (6.3%) | 16 (5.3%) | 3 (1.0%) | |
| ndobo | 19 (6.3%) | 15 (5.0%) | 4 (1.3%) | |
| Mbouda | 15 (5.0%) | 12 (4.0%) | 3 (1.0%) | |

**Continued**

| | | | | |
|---|---|---|---|---|
| nJombe | 12 (4.0%) | 7 (2.3%) | 5 (1.7%) | |
| **Marital status** | | | | 0.6 |
| Single | 107 (35%) | 75 (25%) | 32 (11%) | |
| Married | 106 (35%) | 73 (24%) | 33 (11%) | |
| Widowed | 89 (29%) | 67 (22%) | 22 (7.3%) | |
| **Occupation (sector)** | | | | 0.6 |
| Informal sector | 67 (22%) | 47 (16%) | 20 (6.6%) | |
| Private sector | 66 (22%) | 52 (17%) | 14 (4.6%) | |
| Retired | 57 (19%) | 40 (13%) | 17 (5.6%) | |
| Public sector | 57 (19%) | 38 (13%) | 19 (6.3%) | |
| Liberal profession | 55 (18%) | 38 (13%) | 17 (5.6%) | |
| **Diabete** | | | | **<0.001** |
| No | 209 (69%) | 169 (56%) | 40 (13%) | |
| Yes | 93 (31%) | 46 (15%) | 47 (16%) | |
| **Hypertension** | | | | 0.7 |
| Yes | 192 (64%) | 135 (45%) | 57 (19%) | |
| No | 110 (36%) | 80 (26%) | 30 (9.9%) | |
| **Alcohol consumption** | | | | **0.006** |
| No | 227 (75%) | 171 (57%) | 56 (19%) | |
| Yes | 75 (25%) | 44 (15%) | 31 (10%) | |
| **Smoking** | | | | 0.5 |
| No | 250 (83%) | 176 (58%) | 74 (25%) | |
| Yes | 52 (17%) | 39 (13%) | 13 (4.3%) | |
| **Sedentary lifestyle** | | | | 0.4 |
| Yes | 158 (52%) | 116 (38%) | 42 (14%) | |
| No | 144 (48%) | 99 (33%) | 45 (15%) | |
| **Chronic kidney disease stage** | | | | **<0.001** |
| G3 | 111 (37%) | 83 (27%) | 28 (9.3%) | |
| G4 | 74 (25%) | 47 (16%) | 27 (8.9%) | |
| G5 | 61 (20%) | 33 (11%) | 28 (9.3%) | |
| G2 | 56 (19%) | 52 (17%) | 4 (1.3%) | |

Data are presented as mean ± standard deviation, frequency (n), and percentage (%). For comparisons between sarcopenic and non-sarcopenic patients, the Wilcoxon rank-sum test, Fisher's exact test, and Pearson's chi-squared test were used as appropriate; statistical significance was defined as $p < 0.05$.

### 3.2. Prevalence of Sarcopenia

The prevalence of sarcopenia in our sample was 28.8%. The majority of patients had probable sarcopenia (16.6%), while only 3% presented with severe sarcopenia (Figure 1 and Figure 2).

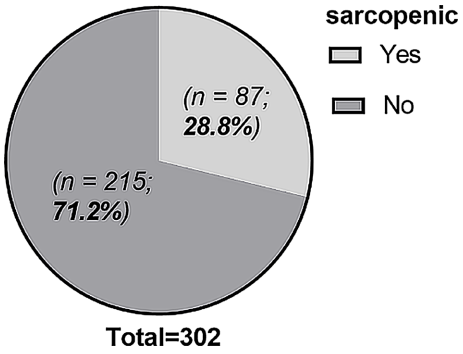


Figure 1. Prevalence of sarcopenia among patients with kidney disease.

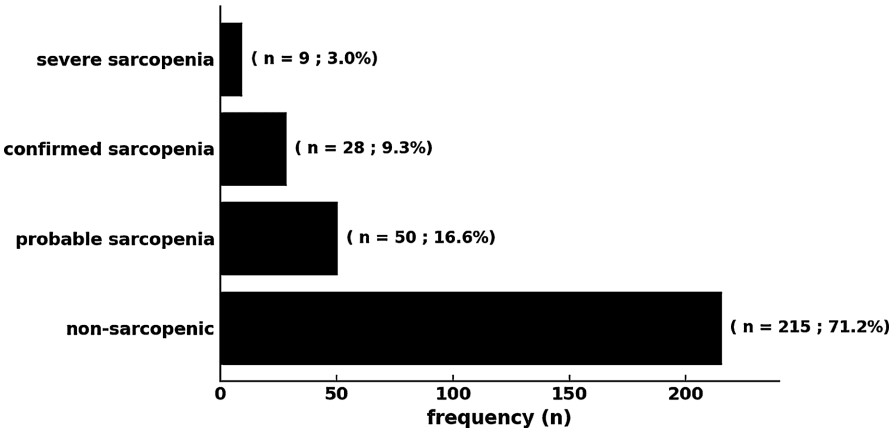


Figure 2. Categories of sarcopenia.

### 3.3. Body Composition and Physical Activity

The mean body mass was 68 ± 13 kg (range 35 - 118). According to BMI, the majority were overweight (121, 40%) or obese (97, 32%), while 24% (72) had a normal body weight and 3.7% (11) were underweight. The fat mass index was high in 96% (291) and normal in 3.7% (11). Muscle mass was low in 68% (205) and normal in 32% (97). Handgrip strength was normal in 39% (119), low in 35% (97), and high in 25% (77). Finally, 65% (196) of participants reported not engaging in physical activity, compared to 35% (106) who did (Table 2).

### 3.4. Factors Increasing the Risk of Sarcopenia

In multivariate analysis, the risk of sarcopenia increased in patients over 65 years (aOR = 19.4, 95% CI: 2.25 - 445; p = 0.017), in those with alcohol consumption (aOR = 7.88, 95% CI: 2.82 - 25.1; p < 0.001), and diabetes (aOR = 83.1, 95% CI: 22.9 - 411; p < 0.001). The risk also increased with the severity of CKD stage—G3 (aOR = 13.9, 95% CI: 2.73 - 100; p = 0.004), G4 (aOR = 149, 95% CI: 22.2 -

Table 2. Composition corporelle et activité physique.

| Body composition parameters | N (%) |
|---|---|
| Body mass (Kg) | 68 ± 13 [35 - 118] |
| **Body Mass Index (Kg/m²)** | |
| overweight | 121(40%) |
| obese | 97 (32%) |
| normal | 72 (24%) |
| thin | 11 (3.7%) |
| **Fat mass index (%)** | |
| high | 291 (96%) |
| normal | 11 (3.7%) |
| **Muscle mass (Kg)** | |
| low | 205 (68%) |
| normal | 97 (32%) |
| **Hand grip strength (Kg)** | |
| normal | 119 (39%) |
| low | 97 (35%) |
| high | 77 (25%) |
| **Physical activity** | |
| no | 196 (65%) |
| yes | 106 (35%) |

1571; p < 0.001), and G5 (aOR = 736, 95% CI: 93.9 - 9414; p < 0.001)—as well as in the presence of elevated serum IL-6 concentrations (aOR = 54.6, 95% CI: 16.3 - 238; p < 0.001) (Table 3).

Table 3. Univariate and multivariate logistic regression showing factors increasing the risk of sarcopenia.

| Factors | Sarcopenic | | Univariate regression | | | Multivariate regression | | |
|---|---|---|---|---|---|---|---|---|
| | No (n = 215) | Yes (n = 87) | OR | 95% CI | p-value | ORa | 95% CI | p-value |
| **age_group (years)** | | | | | <0.001 | | | <0.001 |
| [23 - 35[ | 7 (3.3%) | 1 (1.1%) | Reference | | | | | |
| [35 - 50[ | 50 (23%) | 2 (2.3%) | 0.28 | 0.02, 6.48 | 0.32 | 0.01 | 0.00, 0.37 | 0.006 |
| [50 - 65[ | 101 (47%) | 26 (30%) | 1.80 | 0.30, 34.5 | 0.59 | 0.48 | 0.04, 11.6 | 0.57 |
| >65 | 57 (27%) | 58 (67%) | 7.12 | 1.21, 135 | 0.070 | 19.4 | 2.25, 445 | **0.017** |
| **Sedentary lifestyle** | | | | | 0.37 | | | 0.90 |
| No | 99 (46%) | 45 (52%) | Reference | | | | | |
| Yes | 116 (54%) | 42 (48%) | 0.80 | 0.48, 1.31 | 0.37 | 0.95 | 0.42, 2.15 | 0.90 |

**Continued**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Smoking** | | | | | 0.50 | | | 0.67 |
| No | 176 (82%) | 74 (85%) | Reference | | | | | |
| Yes | 39 (18%) | 13 (15%) | 0.79 | 0.39, 1.54 | 0.51 | 0.78 | 0.25, 2.40 | 0.67 |
| **Alcohol consumption** | | | | | 0.007 | | | <0.001 |
| No | 171 (80%) | 56 (64%) | Reference | | | | | |
| Yes | 44 (20%) | 31 (36%) | 2.15 | 1.24, 3.73 | 0.006 | 7.88 | 2.82, 25.1 | **<0.001** |
| **Diabete** | | | | | <0.001 | | | <0.001 |
| No | 169 (79%) | 40 (46%) | Reference | | | | | |
| Yes | 46 (21%) | 47 (54%) | 4.32 | 2.54, 7.40 | <0.001 | 83.1 | 22.9, 411 | **<0.001** |
| **Hypertension** | | | | | 0.65 | | | 0.75 |
| No | 80 (37%) | 30 (34%) | Reference | | | | | |
| Yes | 135 (63%) | 57 (66%) | 1.13 | 0.67, 1.91 | 0.66 | 0.86 | 0.34, 2.16 | 0.75 |
| **Chronic kidney disease stage** | | | | | <0.001 | | | <0.001 |
| G2 | 52 (24%) | 4 (4.6%) | Reference | | | | | |
| G3 | 83 (39%) | 28 (32%) | 4.39 | 1.61, 15.4 | 0.009 | 13.9 | 2.73, 100 | **0.004** |
| G4 | 47 (22%) | 27 (31%) | 7.47 | 2.68, 26.7 | <0.001 | 149 | 22.2, 1571 | **<0.001** |
| G5 | 33 (15%) | 28 (32%) | 11.0 | 3.90, 39.8 | <0.001 | 736 | 93.9, 9414 | **<0.001** |
| **Serum concentrations of IL-6** | | | | | <0.001 | | | <0.001 |
| Normal | 164 (76%) | 41 (47%) | Reference | | | | | |
| Elevated | 51 (24%) | 46 (53%) | 3.61 | 2.14, 6.13 | <0.001 | 54.6 | 16.3, 238 | **<0.001** |

IL-6: Interleukin-6; OR: Odds Ratio; ORa: Adjusted odds ratio, 95%CI: Confidence interval.

## 4. Discussion

In patients with kidney disease, sarcopenia manifests as increased frailty, falls and fractures, reduced functional capacity and quality of life, intolerance to exertion and dialysis, repeated hospitalizations, increased infection risk, poorer postoperative recovery, reduced treatment dose intensity, and, overall, excess mortality. Against this backdrop, our work investigated the prevalence and risk factors of sarcopenia in patients followed at Douala General Hospital (DGH).

In Cameroon, sarcopenia diagnosis is rarely or not performed in routine practice—screening is not systematic (SARC-F, handgrip strength), morpho-functional evaluation is infrequent (BIA/DXA), and local reference values are lacking—although this comorbidity could worsen renal and overall prognosis. Measuring its frequency and clarifying its determinants in our setting is therefore critical to justify the integration of structured screening in nephrology, guide multimodal interventions (nutritional optimization, resistance and aerobic exercise, correction of acidosis and anemia), and ultimately improve clinical outcomes in this population.

In our sample, several sociodemographic and clinical characteristics (**Table 1**) converged toward a setting highly conducive to sarcopenia in patients with kidney disease: the elevated mean age (61 ± 13 years, 42% aged 50 - 64 years) favors loss of muscle strength and mass, a phenomenon strongly associated with kidney disease and its complications [8] [22]. The male predominance (53%) also pointed in the same direction: indeed, male sex has been identified as an independent risk factor for sarcopenia in pre-dialysis CKD [23] [24]. The very common sedentariness in our study population (52%) reinforced this risk, as physical inactivity is a central determinant of sarcopenia and reduced performance in CKD patients [25] [26]. The major comorbidities—hypertension (64%) and diabetes (31%)—were likely to amplify sarcopenia prevalence: hypertension is positively associated with sarcopenia in older adults, and diabetes approximately doubles sarcopenia risk through insulin resistance and inflammation [27] [28]. Behavioral exposures pointed in the same direction: smoking (17%) is associated with an excess risk of sarcopenia, while alcohol (25%) shows an overall inconclusive relationship but potentially deleterious effects at high consumption levels, justifying reduction messaging [29]-[31]. Finally, the fact that stage G3 was the most represented (37%) reminds us that sarcopenia sets in early in CKD, well before dialysis, and is linked to a worse prognosis—hence the value of systematic screening from moderate stages onward [8] [32]. Social dimensions (35% single, 22% in the informal sector, residence concentrated in Nkongsamba) may also weigh in: disadvantaged socioeconomic position and social isolation are associated with sarcopenia through poorer diet quality and reduced physical activity, in a Cameroonian context where access to CKD care remains limited [15] [33] [34]. Taken together, these elements explain and contextualize an expectedly high prevalence of sarcopenia in our kidney-disease population at Douala General Hospital, and justify early screening and management strategies targeting age, sex, inactivity, cardio-metabolic comorbidities, and social factors.

Sarcopenia—generally defined as a muscle disease characterized by reduced muscle strength, confirmed by a reduction in muscle quantity or quality, with the "severe" form added when physical performance is impaired—was the central issue in our study of 302 patients with kidney disease followed at HGD (overall prevalence: 28.8%; 16.6% had a moderate form, 9.3% a confirmed form, 3% a severe form, according to EWGSOP2 diagnostic criteria [1]). This frequency falls within international ranges reported in CKD patients: 4% - 42% depending on criteria and stage (reviews/meta-analyses), with generally higher levels on dialysis and lower in pre-dialysis [8] [35] [36]. Furthermore, we observed a notable gap between the prevalence of low muscle mass (68%) and low handgrip strength (35%). This discrepancy suggests a high burden of dynapenia and/or sarcopenic obesity in our cohort; it may also reflect, in CKD, the combined effects of increased adiposity/myosteatosis and fluid disturbances that can influence BIA-based mass estimation, leading to a more pronounced "low mass > low strength" discordance than in non-CKD populations.

As benchmarks, meta-analyses and series show highly variable prevalences on hemodialysis (≈16% - 64%) and often lower values in non-dialysis CKD (≈6 - 29%), which placed our 28.8% toward the upper end of the pre-dialysis spectrum and within the expected interval for mixed cohorts [9] [34] [37]-[39]. Several contextual factors may explain this level in Cameroon: an advanced mean age, frequent sedentariness, cardio-metabolic comorbidities, and the nutritional/inflammatory constraints specific to CKD, well documented in the region [15] [22] [35] [40]. Beyond frequency, the prognostic stakes fully justify systematic screening in nephrology: handgrip strength and/or diagnosed sarcopenia have been associated with mortality, cardiovascular events, hospitalizations, and poorer therapeutic tolerance [9] [32] [41]. In our resource-limited context, a simple and robust pathway is feasible: initial screening with SARC-F (despite its moderate sensitivity in CKD), handgrip strength measurement, assessment of mass (BIA) and performance (gait speed), in line with the EWGSOP2 algorithm; the objective is to identify "probable" patients early, confirm, and treat (progressive exercise, protein-energy optimization, correction of acidosis/anemia) to improve prognosis and clinical outcomes.

The "risk of sarcopenia" corresponds to the probability that a patient meets diagnostic criteria (muscle weakness in the foreground, confirmed by reduced muscle mass/quality and, at the severe stage, by impaired muscle/physical performance), commonly assessed in clinical research by adjusted odds ratios (aOR) from multivariable logistic regressions (EWGSOP2 algorithm: SARC-F screening, handgrip strength, body composition, gait speed) [1]. In our study, the marked increase in risk beyond 65 years (aOR = 19.4) fits within the well-established pathophysiological framework of muscle aging: anabolic resistance, motor unit loss, hormonal dysregulation, and low-grade inflammation that accelerate declines in strength and mass [42] [43]. The very strong association with type 2 diabetes (aOR = 83.1) is consistent with meta-analyses showing an excess risk of sarcopenia in diabetics (≈OR 1.5 - 2.1) through insulin resistance, glucotoxicity, microangiopathy, peripheral neuropathy, and mitochondrial dysfunction [27] [44]. Alcohol consumption (aOR = 7.88) shows heterogeneous results in the literature: some meta-analyses do not find an overall association, but subgroups (younger/high consumption) show excess risk; recent population data also suggest a dose-dependent deleterious effect on muscle mass and function [29] [31] [45]. In the CKD context, alcohol can potentiate malnutrition, deficiencies, inflammation, and sedentariness, reinforcing the effect observed locally. The progression of sarcopenia risk with CKD severity—already elevated at stage G3 (aOR = 13.9), then soaring at stages G4 (aOR = 149) and G5 (aOR = 736)—is consistent with the described trajectory: declining GFR is accompanied by a more catabolic milieu (uremic toxins, chronic metabolic acidosis, inflammation, vitamin D/testosterone deficiency), functional deconditioning, and uremic anorexia (reviews and meta-analyses) [8] [39] [46] [47]. Elevated IL-6 (aOR = 54.6) fits with data linking inflammation to the sarcopenic phenotype: IL-6 activates catabolic pathways (STAT3/ubiquitin-pro-

teasome), inhibits anabolism, and is longitudinally associated with declines in strength and performance; in CKD, this inflammatory state is frequent and linked to the accumulation of uremic toxins [48] [49]. However, the exceptionally high aORs for type 2 diabetes (83.1) and for advanced CKD stages (up to 736) should be interpreted with caution: the large width of the confidence intervals suggests imprecision and possible model instability (sparse cells in some strata, collinearity and/or residual confounding), which can inflate estimates despite true associations of more moderate magnitude. These values should therefore be viewed as directional signals rather than definitive quantifications of effect.

In the Cameroonian context (where CKD is frequent, often associated with hypertension and diabetes, and where access to specialized care remains constrained), the conjunction of high sedentariness, delayed care, nutritional constraints, and infectious/inflammatory episodes may amplify these associations and explain high aORs [15] [40]. These elements argue for early and systematic screening and management of sarcopenia within nephrology clinics.

We believe that instituting routine screening at each visit or after a defined number of hemodialysis sessions; prescribing progressive exercise programs (endurance + resistance), including intradialytic or home-based models; optimizing protein-energy intake; correcting metabolic acidosis; strictly controlling diabetes; reducing alcohol consumption; and targeting inflammation are, among others, measures that could reduce sarcopenia prevalence in this population and are implementable at low cost (hand dynamometer, chair/walk tests, therapeutic education, body-weight strength sessions).

## 5. Limitations

Our study had certain limitations, notably its single-center and cross-sectional design, which does not allow causal inference or capture of temporal trajectories. We also used a convenience sampling strategy (non-probability), which may introduce selection bias and limit the generalizability of our prevalence estimate to all CKD patients in the country. Finally, the diagnosis of sarcopenia relied on accessible clinical tools (SARC-F, handgrip strength, ± BIA) without systematic use of reference methods (DXA) or locally validated normative thresholds, which have not yet been established, exposing the study to a risk of misclassification

## 6. Conclusion

In summary, sarcopenia was frequent among CKD patients followed at Douala General Hospital, and its risk increased significantly with older age (especially > 65 years), alcohol consumption, type 2 diabetes, advanced CKD stages (from G3 upward), and elevated IL-6 levels, suggesting a marked catabolic and inflammatory profile in our resource-limited setting. These findings highlight the need for systematic and early sarcopenia screening in nephrology to identify at-risk patients and promptly initiate pragmatic interventions (resistance and endurance exercise, protein-energy optimization adapted to eGFR, correction of acidosis, strict diabe-

tes control, alcohol reduction, prevention/management of inflammation). Implementing such a care pathway, supported by staff training and simple monitoring tools, could improve functional and survival outcomes, while longitudinal local studies and validation of Cameroonian normative thresholds would strengthen evidence and guide targeted strategies.

## Funding

The authors state that the research was conducted in the absence of any external funding.

## Authors' Contributions

ENLPJ and ENFG designed the experimental approach and the writing plan. ENLPJ and NNE recruited the participants and conducted the laboratory analyses. ENLPJ performed the statistical analysis and prepared all the figures. ENLPJ drafted the manuscript. ENLPJ, ENFG, NNA, and FMEHD reviewed the manuscript. All the authors made substantial, direct, and intellectual contributions to the work and approved it for publication

## Conflicts of Interest

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

## References

[1] Cruz-Jentoft, A.J., Bahat, G., Bauer, J., Boirie, Y., Bruyère, O., Cederholm, T., *et al.* (2019) Sarcopenia: Revised European Consensus on Definition and Diagnosis. *Age and Ageing*, **48**, 601-601. https://doi.org/10.1093/ageing/afz046

[2] Cruz-Jentoft, A.J., Baeyens, J.P., Bauer, J.M., Boirie, Y., Cederholm, T., Landi, F., *et al.* (2010) Sarcopenia: European Consensus on Definition and Diagnosis. *Age and Ageing*, **39**, 412-423. https://doi.org/10.1093/ageing/afq034

[3] Sayer, A.A. and Cruz-Jentoft, A. (2022) Sarcopenia Definition, Diagnosis and Treatment: Consensus Is Growing. *Age and Ageing*, **51**, afac220. https://doi.org/10.1093/ageing/afac220

[4] Workeneh, B.T. and Mitch, W.E. (2010) Review of Muscle Wasting Associated with Chronic Kidney Disease. *The American Journal of Clinical Nutrition*, **91**, 1128S-1132S. https://doi.org/10.3945/ajcn.2010.28608b

[5] Liao, M., Sung, C., Hung, K., Wu, C., Lo, L. and Lu, K. (2012) Insulin Resistance in Patients with Chronic Kidney Disease. *Journal of Biomedicine and Biotechnology*, **2012**, Article ID: 691369. https://doi.org/10.1155/2012/691369

[6] Carrero, J.J., Stenvinkel, P., Cuppari, L., Ikizler, T.A., Kalantar-Zadeh, K., Kaysen, G., *et al.* (2013) Etiology of the Protein-Energy Wasting Syndrome in Chronic Kidney Disease: A Consensus Statement from the International Society of Renal Nutrition and Metabolism (ISRNM). *Journal of Renal Nutrition*, **23**, 77-90. https://doi.org/10.1053/j.jrn.2013.01.001

[7] Kadatane, S.P., Satariano, M., Massey, M., Mongan, K. and Raina, R. (2023) The Role of Inflammation in CKD. *Cells*, **12**, Article 1581. https://doi.org/10.3390/cells12121581

[8] Duarte, M.P., Almeida, L.S., Neri, S.G.R., Oliveira, J.S., Wilkinson, T.J., Ribeiro, H.S., *et al.* (2024) Prevalence of Sarcopenia in Patients with Chronic Kidney Disease: A Global Systematic Review and Meta-Analysis. Jo*urnal of Cachexia*, *Sarcopenia and Muscle*, **15**, 501-512. https://doi.org/10.1002/jcsm.13425

[9] Wathanavasin, W., Banjongjit, A., Avihingsanon, Y., Praditpornsilpa, K., Tungsanga, K., Eiam-Ong, S., *et al.* (2022) Prevalence of Sarcopenia and Its Impact on Cardiovascular Events and Mortality among Dialysis Patients: A Systematic Review and Meta-Analysis. *Nutrients*, **14**, Article 4077. https://doi.org/10.3390/nu14194077

[10] Shu, X., Lin, T., Wang, H., Zhao, Y., Jiang, T., Peng, X., *et al.* (2022) Diagnosis, Prevalence, and Mortality of Sarcopenia in Dialysis Patients: A Systematic Review and Meta-Analysis. *Journal of Cachexia*, *Sarcopenia and Muscle*, **13**, 145-158. https://doi.org/10.1002/jcsm.12890

[11] Wilkinson, T.J., Miksza, J., Yates, T., Lightfoot, C.J., Baker, L.A., Watson, E.L., *et al.* (2021) Association of Sarcopenia with Mortality and End-Stage Renal Disease in Those with Chronic Kidney Disease: A UK Biobank Study. *Journal of Cachexia*, *Sarcopenia and Muscle*, **12**, 586-598. https://doi.org/10.1002/jcsm.12705

[12] Santana Gomes, T., Espirito Santo Silva, D.D., Xavier Junior, G.F., de Farias Costa, P.R., Gusmão Sena, M.H.L. and Barreto Medeiros, J.M. (2022) Sarcopenia and Mortality in Patients with Chronic Non-Dialytic Renal Disease: Systematic Review and Meta-Analysis. *Journal of Renal Nutrition*, **32**, 135-143. https://doi.org/10.1053/j.jrn.2021.02.004

[13] Bonanni, A., Mannucci, I., Verzola, D., Sofia, A., Saffioti, S., Gianetta, E., *et al.* (2011) Protein-Energy Wasting and Mortality in Chronic Kidney Disease. *International Journal of Environmental Research and Public Health*, **8**, 1631-1654. https://doi.org/10.3390/ijerph8051631

[14] Halle, M.P., Ashuntantang, G., Kaze, F.F., Takongue, C. and Kengne, A. (2016) Fatal Outcomes among Patients on Maintenance Haemodialysis in Sub-Saharan Africa: A 10-Year Audit from the Douala General Hospital in Cameroon. *BMC Nephrology*, **17**, Article No. 165. https://doi.org/10.1186/s12882-016-0377-5

[15] Aseneh, J.B., Kemah, B.A., Mabouna, S., Njang, M.E., Ekane, D.S.M. and Agbor, V.N. (2020) Chronic Kidney Disease in Cameroon: A Scoping Review. *BMC Nephrology*, **21**, Article No. 409. https://doi.org/10.1186/s12882-020-02072-5

[16] Malmstrom, T.K., Miller, D.K., Simonsick, E.M., Ferrucci, L. and Morley, J.E. (2015) SARC-F: A Symptom Score to Predict Persons with Sarcopenia at Risk for Poor Functional Outcomes. *Journal of Cachexia*, *Sarcopenia and Muscle*, **7**, 28-36. https://doi.org/10.1002/jcsm.12048

[17] Bahat, G., Yilmaz, O., KiliÃ§, C., Oren, M.M. and Karan, M.A. (2018) Performance of SARC-F in Regard to Sarcopenia Definitions, Muscle Mass and Functional Measures. *The Journal of nutrition*, *health and aging*, **22**, 898-903. https://doi.org/10.1007/s12603-018-1067-8

[18] Pourhoseingholi, M.A., Vahedi, M. and Rahimzadeh, M. (2013) Sample Size Calculation in Medical Studies. *Gastroenterol Hepatol Bed Bench*, **6**, 14-17.

[19] Roberts, H.C., Denison, H.J., Martin, H.J., Patel, H.P., Syddall, H., Cooper, C., *et al.* (2011) A Review of the Measurement of Grip Strength in Clinical and Epidemiological Studies: Towards a Standardised Approach. *Age and Ageing*, **40**, 423-429. https://doi.org/10.1093/ageing/afr051

[20] Janssen, I., Heymsfield, S.B., Wang, Z. and Ross, R. (2000) Skeletal Muscle Mass and Distribution in 468 Men and Women Aged 18-88 Yr. *Journal of Applied Physiology*, **89**, 81-88. https://doi.org/10.1152/jappl.2000.89.1.81

[21] Morley, J.E., Abbatecola, A.M., Argilés, J.M., Baracos, V., Bauer, J., Bhasin, S., *et al.* (2011) Sarcopenia with Limited Mobility: An International Consensus. *Journal of the American Medical Directors Association*, **12**, 403-409. https://doi.org/10.1016/j.jamda.2011.04.014

[22] Moorthi, R.N. and Avin, K.G. (2017) Clinical Relevance of Sarcopenia in Chronic Kidney Disease. *Current Opinion in Nephrology and Hypertension*, **26**, 219-228. https://doi.org/10.1097/mnh.0000000000000318

[23] Gulcicek, S. and Seyahi, N. (2023) Factors Associated with Sarcopenia in Patients with Chronic Kidney Disease: A Cross-Sectional Single-Center Study. *Medical Science Monitor*, **29**, e939457. https://doi.org/10.12659/msm.939457

[24] Huang, Y., Liu, S., Muo, C., Lai, C. and Chang, C. (2024) Male Sex and Ageing Are Independent Risk Factors for Sarcopenia Stage in Patients with Chronic Kidney Disease Not Yet on Dialysis. *Journal of Cachexia, Sarcopenia and Muscle*, **15**, 2684-2692. https://doi.org/10.1002/jcsm.13612

[25] Hirai, K., Ookawara, S. and Morishita, Y. (2016) Sarcopenia and Physical Inactivity in Patients with Chronic Kidney Disease. *Nephro-Urology Monthly*, **8**, e37443. https://doi.org/10.5812/numonthly.37443

[26] Chatzipetrou, V., Bégin, M., Hars, M. and Trombetti, A. (2021) Sarcopenia in Chronic Kidney Disease: A Scoping Review of Prevalence, Risk Factors, Association with Outcomes, and Treatment. *Calcified Tissue International*, **110**, 1-31. https://doi.org/10.1007/s00223-021-00898-1

[27] Veronese, N., Pizzol, D., Demurtas, J., Soysal, P., Smith, L., Sieber, C., *et al.* (2019) Association between Sarcopenia and Diabetes: A Systematic Review and Meta-Analysis of Observational Studies. *European Geriatric Medicine*, **10**, 685-696. https://doi.org/10.1007/s41999-019-00216-x

[28] Quan, Y., Wang, C., Wang, L. and Li, G. (2023) Geriatric Sarcopenia Is Associated with Hypertension: A Systematic Review and Meta-Analysis. *The Journal of Clinical Hypertension*, **25**, 808-816. https://doi.org/10.1111/jch.14714

[29] Bu, Y., Wang, C., Zhao, C., Lu, X. and Gao, W. (2024) The Association of Alcohol Consumption with the Risk of Sarcopenia: A Dose-Response Meta-Analysis. *The American Journal of Drug and Alcohol Abuse*, **50**, 305-320. https://doi.org/10.1080/00952990.2023.2300049

[30] Steffl, M., Bohannon, R.W., Petr, M., Kohlikova, E. and Holmerova, I. (2015) Relation between Cigarette Smoking and Sarcopenia: Meta-Analysis. *Physiological Research*, **64**, 419-426. https://doi.org/10.33549/physiolres.932802

[31] Hong, S. and Bae, Y. (2022) Association between Alcohol Consumption and the Risk of Sarcopenia: A Systematic Review and Meta-Analysis. *Nutrients*, **14**, Article 3266. https://doi.org/10.3390/nu14163266

[32] Pereira, R.A., Cordeiro, A.C., Avesani, C.M., Carrero, J.J., Lindholm, B., Amparo, F.C., *et al.* (2015) Sarcopenia in Chronic Kidney Disease on Conservative Therapy: Prevalence and Association with Mortality. *Nephrology Dialysis Transplantation*, **30**, 1718-1725. https://doi.org/10.1093/ndt/gfv133

[33] Swan, L., Warters, A. and O'Sullivan, M. (2021) Socioeconomic Inequality and Risk of Sarcopenia in Community-Dwelling Older Adults. *Clinical Interventions in Aging*, **16**, 1119-1129. https://doi.org/10.2147/cia.s310774

[34] Yang, J., Huang, J., Yang, X., Li, S., Wu, X. and Ma, X. (2023) The Association of Living Alone and Social Isolation with Sarcopenia: A Systematic Review and Meta-Analysis. *Ageing Research Reviews*, **91**, Article ID: 102043. https://doi.org/10.1016/j.arr.2023.102043

[35] Sabatino, A., Cuppari, L., Stenvinkel, P., Lindholm, B. and Avesani, C.M. (2020) Sarcopenia in Chronic Kidney Disease: What Have We Learned So Far? *Journal of Nephrology*, **34**, 1347-1372. https://doi.org/10.1007/s40620-020-00840-y

[36] Otobe, Y., Rhee, C.M., Nguyen, M., Kalantar-Zadeh, K. and Kopple, J.D. (2021) Current Status of the Assessment of Sarcopenia, Frailty, Physical Performance and Functional Status in Chronic Kidney Disease Patients. *Current Opinion in Nephrology & Hypertension*, **31**, 109-128. https://doi.org/10.1097/mnh.0000000000000763

[37] Lamarca, F., Carrero, J.J., Rodrigues, J.C.D., Bigogno, F.G., Fetter, R.L. and Avesani, C.M. (2014) Prevalence of Sarcopenia in Elderly Maintenance Hemodialysis Patients: The Impact of Different Diagnostic Criteria. *The Journal of nutrition, health and aging*, **18**, 710-717. https://doi.org/10.1007/s12603-014-0505-5

[38] Abdala, R., Elena del Valle, E., Negri, A.L., Bridoux, P., Paganti, L.G., Bravo, M., *et al.* (2021) Sarcopenia in Hemodialysis Patients from Buenos Aires, Argentina. *Osteoporosis and Sarcopenia*, **7**, 75-80. https://doi.org/10.1016/j.afos.2021.04.001

[39] de Amorim, G.J., Calado, C.K.M., Souza de Oliveira, B.C., Araujo, R.P.O., Filgueira, T.O., de Sousa Fernandes, M.S., *et al.* (2022) Sarcopenia in Non-Dialysis Chronic Kidney Disease Patients: Prevalence and Associated Factors. *Frontiers in Medicine*, **9**, Article 854410. https://doi.org/10.3389/fmed.2022.854410

[40] Kaze, A.D., Ilori, T., Jaar, B.G. and Echouffo-Tcheugui, J.B. (2018) Burden of Chronic Kidney Disease on the African Continent: A Systematic Review and Meta-Analysis. *BMC Nephrology*, **19**, Article No. 125. https://doi.org/10.1186/s12882-018-0930-5

[41] Isoyama, N., Qureshi, A.R., Avesani, C.M., Lindholm, B., Bàràny, P., Heimbürger, O., *et al.* (2014) Comparative Associations of Muscle Mass and Muscle Strength with Mortality in Dialysis Patients. *Clinical Journal of the American Society of Nephrology*, **9**, 1720-1728. https://doi.org/10.2215/cjn.10261013

[42] McCormick, R. and Vasilaki, A. (2018) Age-Related Changes in Skeletal Muscle: Changes to Life-Style as a Therapy. *Biogerontology*, **19**, 519-536. https://doi.org/10.1007/s10522-018-9775-3

[43] Morton, R.W., Traylor, D.A., Weijs, P.J.M. and Phillips, S.M. (2018) Defining Anabolic Resistance: Implications for Delivery of Clinical Care Nutrition. *Current Opinion in Critical Care*, **24**, 124-130. https://doi.org/10.1097/mcc.0000000000000488

[44] Ai, Y., Xu, R. and Liu, L. (2021) The Prevalence and Risk Factors of Sarcopenia in Patients with Type 2 Diabetes Mellitus: A Systematic Review and Meta-Analysis. *Diabetology & Metabolic Syndrome*, **13**, Article No. 93. https://doi.org/10.1186/s13098-021-00707-7

[45] Skinner, J., Shepstone, L., Hickson, M. and Welch, A.A. (2023) Alcohol Consumption and Measures of Sarcopenic Muscle Risk: Cross-Sectional and Prospective Associations within the UK Biobank Study. *Calcified Tissue International*, **113**, 143-156. https://doi.org/10.1007/s00223-023-01081-4

[46] Choi, Y.S., An, J.N., Kim, J., Kim, S.G. and Song, Y.R. (2021) Late Stage 3 CKD Is an Independent Risk Factor for Sarcopenia, but Not Proteinuria. *Journal of the American Society of Nephrology*, **32**, 540-540. https://doi.org/10.1681/asn.20213210s1540c

[47] Kim, D.W. and Song, S.H. (2023) Sarcopenia in Chronic Kidney Disease: From Bench to Bedside. *The Korean Journal of Internal Medicine*, **38**, 303-321. https://doi.org/10.3904/kjim.2022.338

[48] Wang, K., Liu, Q., Tang, M., Qi, G., Qiu, C., Huang, Y., *et al.* (2023) Chronic Kidney Disease-Induced Muscle Atrophy: Molecular Mechanisms and Promising Therapies. *Biochemical Pharmacology*, **208**, Article ID: 115407.

https://doi.org/10.1016/j.bcp.2022.115407

[49] Schaap, L.A., Pluijm, S.M.F., Deeg, D.J.H. and Visser, M. (2006) Inflammatory Markers and Loss of Muscle Mass (Sarcopenia) and Strength. *The American Journal of Medicine*, **119**, 526.e9-526.e17. https://doi.org/10.1016/j.amjmed.2005.10.049