nutrición clínica y Dietética Hospitalaria

Artículo Original

Nutr Clín Diet Hosp. 2026; 46(1):123-133
DOI: 10.12873/461jsantos

Estimated glomerular filtration rate and its association with sarcopenia in elderly people living in the community

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Recibido: 15/diciembre/2025. Aceptado: 29/enero/2026.

ABSTRACT

Introduction: Factors such as chronic non-communicable diseases and sarcopenia are frequently associated with reduced estimated glomerular filtration rate (eGFR) and lower longevity in older adults.

Objective: To evaluate the eGFR and its association with sarcopenia in community-dwelling elderly individuals.

Methods: This population-based cross-sectional study included 548 older adults (≥ 60 years) living in 11 municipalities in the State of Alagoas, Brazil. eGFR was calculated using the Chronic Kidney Disease Epidemiology Collaboration 2021 equation and classified according to kidney disease: Improving Global Outcomes 2024. Sarcopenia was defined based on the European Working Group on Sarcopenia in Older People 2019 criteria.

Results: The mean age was 71.5 ± 8.6 years; 67.7% were women, 50.0% were overweight, 67.7% had hypertension, and 32.6% had diabetes. Reduced eGFR (<60 mL/min/1.73 m²) was observed in 19.5% of the sample. Probable sarcopenia was identified in 21.7%, with confirmed sarcopenia in 7.6%, but no association with eGFR was found. Age, sex, hypertension, number of medications, and waist circumference were significantly associated with reduced eGFR ($p < 0.005$). In the linear and logistic regression analyses, no association was observed between the diagnosis of sarcopenia and eGFR ($p > 0.050$).

Conclusion: Sarcopenia was not directly associated with eGFR, although shared factors such as advanced age, hypertension, abdominal fat accumulation, and reduced muscle strength were observed. The characteristics of community-dwelling older adults may have influenced the absence of sarcopenia diagnosis. Nevertheless, the findings highlight relevant risk factors for chronic kidney disease in this population. Preventive strategies should prioritize individuals with abdominal obesity, hypertension, and women.

KEYWORDS

Aging, renal function, muscle mass, hand-grip strength, abdominal obesity, chronic kidney disease, community population.

INTRODUCTION

Aging is known to be a dynamic, progressive, and physiological process involving morphofunctional changes in the body that increase susceptibility to intrinsic and extrinsic aggressions, potentially predisposing older people to chronic diseases and geriatric syndromes[1]. Globally, chronic non-communicable diseases are considered a major public health concern, accounting for 72% of all deaths, with emphasis on circulatory system diseases, high blood pressure, cancer, diabetes, and chronic respiratory and kidney diseases[2].

The chronic kidney disease (CKD) is defined as abnormalities of kidney structure or function, present for a minimum of 3 months, with implications for health. The progression in the CKD is asymptomatic, making early detection difficult; as

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a result, patients are often diagnosed at more advanced stages, significantly reducing the likelihood of definitive treatment[3]. The primary causes are diabetes mellitus (DM) and systemic arterial hypertension (SAH), with older people generally being the most vulnerable to the main risk factors for this condition[4].

CKD is known to be associated with a systemic catabolic state, placing patients at high risk for sarcopenia. Sarcopenia represents a significant public health issue and is expected to become even more prominent as the population continues to age[5]. Loss of muscle mass and strength is known to reduce mobility and increase functional disability and dependence in affected individuals, strongly affecting health, well-being, and quality of life, particularly among older people[6].

The diagnosis of CKD in older adults remains a challenge and requires further investigation, particularly when based on indirect formulas that rely on serum creatinine. Age-related changes in muscle mass, often intensified by sarcopenia, may influence the accuracy of these estimates. In this context, understanding the profile of CKD among community-dwelling older adults in Alagoas and its association with sarcopenia is essential to explore the relationship between muscle mass and the underdiagnosis of CKD.

METHODS

Kind of Study

This is an observational, analytical, and descriptive population-based cross-sectional study, which is part of a broader project entitled "I Diagnostico Alagoano de Saúde, Nutrição e Qualidade de vida da Pessoa idosa". This study was submitted to the Research Ethics Committee involving Human Subjects.

Study Population

The population of this study consists of older people of both sexes, aged 60 years or older, who were able to understand the instructions or were accompanied by a caregiver or responsible family member during the home visit to assist with comprehension and who agreed to participate by signing the Free and Informed Consent Form, and were permanent residents of the municipality.

Inclusion and Exclusion Criteria

The sample in this study is a subsample of the main study. Therefore, for convenience, all older people from the main dataset who had the variables of interest for this research (serum creatinine, body composition, handgrip strength, walking speed, and Timed Up and Go test) were included, totaling 548 individuals. A total of 605 older people were excluded for not allowing the assessment of body composition needed to identify muscle mass and provide an effective diagnosis of sarcopenia, or for not undergoing blood collection necessary for evaluating kidney function. Older people previously diagnosed with CKD (dialysis), liver failure, cancer, advanced-stage dementia, or any other chronic degenerative disease were also excluded.

Data Collection

Data collection was conducted by properly trained and qualified researchers. Data were gathered through home visits using printed questionnaires covering sociodemographic variables, current and past health conditions, number of medications, lifestyle, nutritional status, cognitive capacity, and functional capacity.

Sociodemographic and Economic Conditions

Data were collected to characterize the study population, including sex (female or male), age (< 80 years [non-long-lived] and ≥80 years [long-lived]), and self-declared ethnicity (with Black individuals defined as those who self-identified as Black or mixed-race). Additional variables included marital status and years of schooling (≤ 4 years or >4 years of education).

Lifestyle, Health Conditions and Number of Medications

Individuals who reported consuming alcohol in the past month, even if infrequently (<1 time/month), were classified as alcohol consumers. Those who reported never consuming alcohol or who had abstained for more than 30 days were classified as non-consumers. Regarding smoking, individuals who reported smoking within the last month, regardless of frequency, were classified as smokers, while those who never used tobacco or had quit smoking for more than 30 days were considered non-smokers.

To assess physical activity level (active or insufficiently active), the International Physical Activity Questionnaire (IPAQ) was used. Individuals were considered physically active if they reported engaging in moderate-intensity aerobic activity for at least 30 minutes per day on five days per week, or in vigorous activity for at least 20 minutes per day on three days per week. Those who engaged in physical activity for less than 30 minutes per day were classified as insufficiently active, according to criteria from the American College of Sports Medicine and the American Heart Association[7].

Older people were asked about clinical diagnoses of type 2 diabetes mellitus (T2DM) or systemic arterial hypertension (SAH).

Number of Medications use was categorized as polypharmacy (5 medications) or non-polypharmacy (0-4 medications), according to the World Health Organization[8].

Anthropometric Assessment

To assess anthropometric nutritional status, the following parameters were evaluated: Body Mass Index (BMI) (kg/m²), calf circumference (CC), and waist circumference (WC). BMI was classified as underweight (< 22.00 kg/m²), normal weight (22.00–27.00 kg/m²), or overweight (> 27.00 kg/m²) [9].

The CC was measured using a non-elastic tape at the point of greatest calf girth, ensuring the tape was level and firm without compressing the skin. CC was considered adequate if > 34.00 cm in men and > 33.00 cm in women, based on validated Brazilian reference values[10].

WC was measured using a non-elastic tape placed horizontally at the midpoint between the lower margin of the last rib and the iliac crest, with participants standing upright, feet together, arms relaxed, and at the end of a normal exhalation. A high risk of metabolic complications related to abdominal obesity was defined as WC ≥102 cm for men and ≥88 cm for women[11].

Body composition (fat-free mass and body fat percentage) was assessed using a tetrapolar bioelectrical impedance analysis (BIA) scale (Tanita Corporation, model BC601G, Japan). The Fat-Free Mass Index (FFMI) was calculated as the fat-free mass divided by height squared (FFM/height²). Low FFMI was defined according to cutoff points established by Kawakami *et al.*[12]. Body fat percentage was considered excessive if >27% for men and >38% for women[13].

To assess functional capacity for daily activities, walking speed (WS) was measured based on the average time to walk 4.6 meters at a usual pace on a flat surface, repeated three times. A cutoff point of ≤0.8 m/s indicated preserved walking speed, and >0.8 m/s indicated reduced speed[14].

Estimated Glomerular Filtration Rate (eGFR)

The estimated Glomerular Filtration Rate (eGFR) was using the CKD-EPI (Chronic Kidney Disease Epidemiology Collaboration) equation, which is based on serum creatinine, and classified according to the Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines.

eGFR stages were categorized as follows: G1 = ≥90 mL/min/1.73 m² and G2 = 60–89 mL/min/1.73 m² (forming the eGFR ≥ 60 mL/min/1.73 m² group); G3a = 45–59 mL/min/1.73 m², G3b = 30–44 mL/min/1.73 m², G4 = 15–29 mL/min/1.73 m², and G5 = <15 mL/min/1.73 m² (forming the eGFR <60 mL/min/1.73 m² group)[15,16].

Criteria and Cutoff Points for Defining Sarcopenia

Sarcopenia was defined according to the European Working Group on Sarcopenia in Older People (EWGSOP2), which includes the SARC-F questionnaire (risk assessment), handgrip strength (considered low when < 16 kg/f for women and < 27 kg/f for men), and muscle mass. Muscle mass was indirectly assessed by FFMI, as suggested by Kawakami et al.[12] for sarcopenia screening in population-based studies, with cutoff points of ≤15 kg/m² for women and ≤ 18 kg/m² for men. Sarcopenia severity was determined by poor physical performance on the gait speed test[17].

Statistical Analysis

Statistical analyses were conducted using the Jamovi® software version 2.3.28 for Windows, encompassing procedures ranging from data description to predictive modeling.

Descriptive statistics were performed, with variables categorized and presented in absolute and percentage values, accompanied by their respective confidence intervals (95% CI) and odds ratios (OR). Pearson's Chi-square test was used to assess associations with categorized eGFR. Continuous variables were characterized using means and standard deviations (SD), assuming normality. The normality assumption was evaluated using the Kolmogorov–Smirnov test with Lilliefors correction. Comparisons of means were performed using the independent t-test.

Linear and logistic regression models were performed using a backward elimination strategy, considering an inclusion criterion of $p < 0.20$ in the univariate analyses of Tables 1 and 2. Linear regression models were conducted by groups of variables (sociodemographic; clinical; body composition and strength; functional capacity; and diagnosis of sarcopenia) to investigate their relationships with eGFR (continuous variable). Model 1, composed of sociodemographic and lifestyle variables, was conducted independently and without adjustments. The remaining models (Models 2, 3, 4, and 5) were adjusted for Model 1. The final model (Model 6 – grouped) included sex and all other variables that showed statistical significance in the previous models ($p < 0.050$). Regression coefficients, p-values, and 95% CI were reported to describe the estimated effects.

Multivariable logistic regression models were constructed to explain the association between the study variables and glomerular filtration rate (categorized as <60 mL/min/1.73 m² = 1). Due to multicollinearity among measures of body composition, functional capacity, and diagnosis of sarcopenia, some combinations were required, and five different models were constructed to avoid the simultaneous inclusion of these variables. Model 1 included sex, age, diagnosis of hypertension, and number of medications in use. The remaining models consisted of possible combinations (respecting the multicollinearity assumption), adjusted for Model 1.

Regression coefficients were interpreted as odds ratios (ORs), accompanied by their respective 95% CI. A significant level of 5% ($p < 0.05$) was adopted for all tests.

RESULTS

The final sample of this study consisted of 548 older people, of whom 21.7% had a probable diagnosis of sarcopenia and 7.6% had confirmed sarcopenia **(Figure 1)**. The mean age was 71.5 ± 8.6 years; most participants were women (67.7%), overweight (50.0%), and had high blood pressure (67.9%). Being long-lived, number of medications and female were associated with eGFR ($p < 0.05$). Data on the association between sociodemographic characteristics, lifestyle habits, and health conditions with eGFR are presented in **Table 1**.

The mean eGFR for the group was 79.4 ± 20 mL/min/1.73 m², with 19.5% exhibiting decreased eGFR (< 60 mL/min/1.73 m²). When evaluated according to the Human Development Index (HDI), those with renal impairment comprised 7.1% of residents from municipalities classified as having a high HDI, 0.4% from medium HDI, and 12% from low HDI. eGFR was associated with HDI, years of education ($p <0.001$), and hypertension ($p = 0.018$) **(Table 1)**.

In the univariate analysis, older people with a high body fat percentage ($p = 0.039$) and greater waist circumference were more likely to exhibit reduced kidney function **(Table 2)**.

Table 3 presents the linear regression coefficients for the correlation between eGFR and other independent variables. When all health indicators were analyzed together, significant correlations were found between eGFR and age ($p <0.001$), number of medications used ($p=0.036$), waist circumference ($p = 0.045$), and handgrip strength ($p = 0.038$).

In the multivariable logistic regression analysis, the variables sex, age, hypertension, number of medications, and waist circumference were associated with reduced eGFR (<60 mL/min/1.73 m²), Female sex nearly doubled the likelihood of presenting reduced eGFR (OR = 1.978; $p = 0.028$), and with each additional year of life, the odds of having low eGFR increased by approximately 1.08 times ($p <0.001$). Similarly, a diagnosis of hypertension (OR = 2.345; $p = 0.031$), medication use (OR = 1.137; $p = 0.036$), and accumulation of abdominal adipose tissue (OR = 3.37; $p = 0.030$) were also associated with an increased likelihood of reduced eGFR (Table 4).

On the other hand, no association was found between impairment of strength, muscle mass, or diagnosis of sarcopenia and reduced eGFR **(Table 4)**.

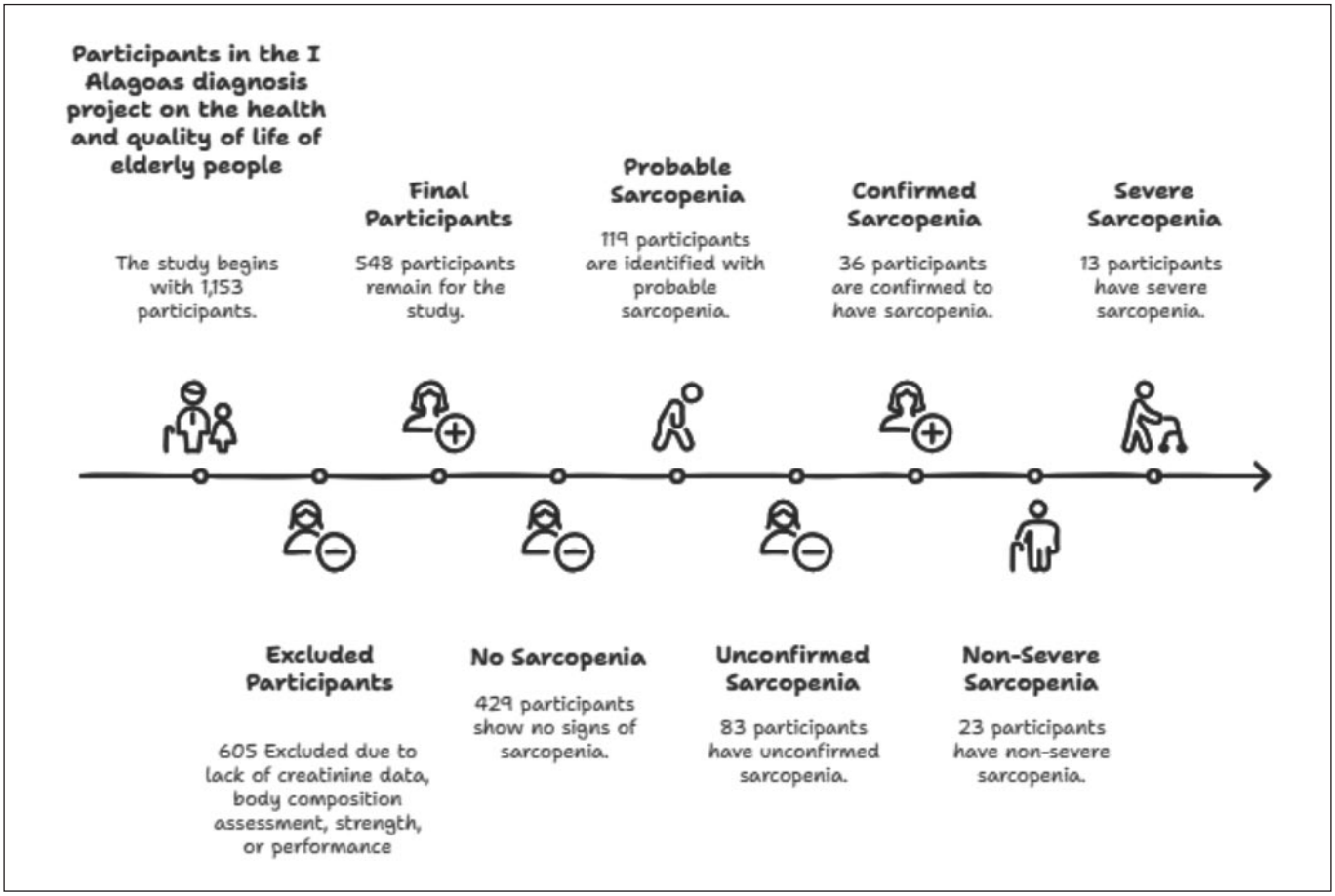

Figure 1. Sarcopenia classification flowchart in the elderly assessed, 2023

Table 1. Association of sociodemographic characteristics, lifestyle factors and health conditions with estimated glomerular filtration rate in community-dwelling older adults in Alagoas

Variables (n total)	eGFR ≥60mL/min/1.73m	eGFR <60mL/min/1.73m²	IC95%	OR	p*
Age (n=548)					
≥ 80 years	65 (63.1%)	38 (36.9%)	1.98 - 5.13	3.19	<0.001
<80 years	376 (84.5%)	69 (15.5%)			
Sex (n=548)					
Feminine	287 (77.4%)	84 (22.6%)	1.19 - 3.23	1.96	0.008
Masculine	154 (87.0%)	23 (13.0%)			
Marital status (n=535)					
No spouse	227 (78.5%)	62 (21.5%)	0.84 - 1.99	1.29	0.249
With spouse	203 (82.5%)	43 (17.5%)			
Years of study (n=530)					
≤ 4 years	287 (78.6%)	78 (21.4%)	0.93 - 2.49	1.52	0.094
5 years or more	140 (84.8%)	25 (15.2%)			
Family arrangement (n=543)					
Live alone	68 (81.0%)	16 (19.0%)	0.53 - 1.74	0.965	0.905
Lives with someone	369 (80.4%)	90 (19.6%)			
Family income (n=451)					
≤ 1 Minimum wage	154 (81.5%)	35 (18.5%)	0.58 - 1.52	0.94	0.801
>1 Minimum wages	211 (80.5%)	51 (19.5%)			
Alcoholism (n=546)					
Yes	64 (88.9%)	8 (11.1%)	0.22 - 1.02	0.473	0.052
No	375 (79.1%)	99 (20.9%)			
Smoking (n=546)					
Yes	70 (86.4%)	11 (13.6%)	0.31 - 1.19	0.604	0.139
No	369 (79.4%)	96 (20.6%)			
Number of medications (n = 525)					
< 5 medications	319 (83.1%)	65 (16.9%)	1.06 - 2.67	1.68	0.027
≥ 5 medications	105 (74.5%)	36 (25.5%)			
Presence of NCD					
Diabetes (n=174/534)	137 (78.7%)	37 (21.3%)	0.75 - 1.85	1.18	0.468
Hypertension (n=364/507)	284 (78.0%)	80 (22.0%)	0.97 - 2.57	1.58	0.063

Pearson's Chi-square test; OR: odds ratio; IC: confidence interval; eGFR: estimated glomerular filtration rate; NCD: chronic non-communicable disease.

Table 2. Association of body composition and functional capacity indicators with estimated glomerular filtration rate in community-dwelling older adults

Variables (n total)	eGFR ≥60mL/min/1.73m²	eGFR <60mL/min/1.73m²	IC95%	OR	p
BMI (n=526)					
Underweight	71 (87.7%)	10 (12.3%)	-	-	0.246
Normal weight	146 (80.2%)	36 (19.8%)			
Overweight	209 (79.5%)	54 (20.5%)			
WC (n=516)					
High risk	323 (78.8%)	87 (21.2%)	1.03 - 3.61	1.93	0.038
Low risk	93 (87.7%)	13 (12.3%)			
CC (n=524)					
Inadequate	352 (80%)	88 (20.0%)	0.673 - 2.32	1.25	0.480
Adequate	70 (83.3%)	14 (16.7%)			
FFMI (n=441)					
Low	97 (83.6%)	19 (16.4%)	0.482 - 1.49	0.848	0.566
Normal	264 (81.2%)	61 (18.8%)			
% fat (n=446)					
High	229 (79.2%)	60 (20.8%)	1.040 - 2.74	1.61	0.039
Normal	135 (86.0%)	22 (14.0%)			
HGS (n=490)					
Low	94 (79.0%)	25 (21.0%)	0.804 - 2.27	1.35	0.255
Adequate	310 (83.6%)	61 (16.4%)			
WS (n=376)					
Undesirable	70 (92.1%)	6 (7.9%)	0.215 - 1.29	0.527	0.154
Desirable	258 (86.0%)	42 (14.0%)			

Pearson's Chi-square test; OR: odds ratio; IC95%: confidence interval; eGFR = estimated glomerular filtration rate; BMI: Body Mass Index; CC: calf circumference; FFMI: Fat-Free Mass Index; HGS: handgrip strength; WS: walking speed; WC: waist circumference.

DISCUSSION

Nearly 20% of the older population in Alagoas participating in this study exhibited reduced eGFR, a decline in renal function that was proportional to age and associated with sex, presence of hypertension, number of medications of in used, and waist circumference, factors that increased the risk of impairment. Sarcopenia was not associated with decreased eGFR.

Several hypotheses may explain the absence of an association between sarcopenia and reduced eGFR in this study. The diagnostic criteria for sarcopenia may have limited sensitivity in community-dwelling older adults. Additionally, the preserved muscle reserve assessed by the Fat-Free Mass Index and calf circumference suggests a low prevalence of sarcopenia in the study population, which may have reduced the ability to detect a significant association. Finally, more advanced stages of chronic kidney disease may be necessary for sarcopenia-related changes in muscle mass and strength to become evident.

The prevalence of CKD increases with advancing age, and its association with reduced glomerular filtration rate is well-documented in the literature[18]. Other population-based studies

Table 3. Linear regression analysis of factors associated with continuous estimated glomerular filtration rate in community-dwelling older adults

	β [a]	p [b]	IC95%
Model 1 - Sociodemographic and lifestyle			
Sex	-0.055	0.213	-6.129 - 1.369
Age	-0.400	<0.001	-1.152 - -0.727
Education	0.061	0.191	-0.589 - 2.937
Smoking	0.073	0.108	-0.901 - 9.060
Alcoholism	0.008	0.868	-4.726 - 5.599
Model 2 – Clinics			
Hypertension	-0.102	0.031	-9.602 - -0.417
Diabetes	0.033	0.486	-2.514 - 5.217
Number of medications	-0.122	0.013	-2.240 - -0.253
Model 3 - Body composition and strength			
BMI	0.005	0.924	-1.965 - 2.166
CC	-0.016	0.800	-7.125 - 5.499
WC	-0.127	0.019	-11.333 - -1.041
%Fat	-0.030	0.582	-5.481 - 3.082
MM²	-0.101	0.134	-1.870 - 0.270
Model 4 – Functional capacity			
HGS	0.126	0.005	0.085 - 0.477
WS	-0.103	0.045	-7.759 - -0.072
Model 5 – Diagnosis of Sarcopenia			
Sarcopenia	0.052	0.228	-1.722 - 7.212
Model 6 – Grouped			
Sex	-0.013	0.796	-1.086 - -0.635
Age	-0.400	<0.001	-1.152 - -0.727
Hypertension	-0.082	0.093	-8.643 - 0.673
Number of medications	-0.103	0.036	-1.975 - -0.064
WC	-0.097	0.045	-10.242 - -0.106
HGS	-0.094	0.038	-8.066 - -0.240
WS	-0.068	0.227	-8.514 - 2.031

[a] Regressor coefficients (Beta) estimated by OLS/Backward option; [b] Linear regression for the glomerular filtration rate outcome. BMI: body mass index; CC: calf circumference; IC95%: confidence interval; MM²: muscle mass; HGS: handgrip strength; WS: walking speed; WC: waist circumference.
Model 1: Gross without adjustment.
Model 2, 3, 4 and 5: Adjusted for education, age and sex, constructed by variable group.
Model 6: Main model, including the main variables from previous models, without adjustment.

conducted in various regions of Brazil have reported similar rates of renal impairment among older people. The Health, Well-being, and Aging (SABE) study in São Paulo found a prevalence of 17.3%, while studies in the North (Acre) and South (Santa Catarina) reported rates of 13% and 13.6%, respectively - all using the CKD-EPI 2009 equation[19,20].

The scarcity of studies evaluating renal function in older people makes it difficult to accurately estimate reduced eGFR. Accelerated population aging, combined with an increase in chronic non-communicable diseases, such as hypertension and diabetes, the primary risk factors for kidney disease, suggests that the frequency of reduced glomerular filtration rate and CKD in Brazil is likely high[21]. The absence of early screening often leads to late diagnoses due to the lack of basic clinical monitoring.

The decline in kidney function is linked to age-related structural changes in the kidneys[18]. The kidneys are particularly susceptible to aging, as evidenced by hemodynamic and vascular structural alterations throughout the renal vascular tree, from the renal arteries to the glomerular capillaries, and a reduction in the number of renal filtration units (nephrons), as well as decreased GFR[22]. These changes are further exacerbated by the presence of chronic non-communicable diseases.

In this study, hypertension was the most prevalent comorbidity among older people and increased the risk of renal impairment by 2.3 times. Unexpectedly, diabetes was not significantly associated with reduced eGFR but still increased the risk by 1.18 times. This finding is consistent with previous literature indicating that hypertension affects 60-80% of older people and, along with diabetes, is one of the most prevalent comorbidities associated with CKD[23]. Furthermore, the association and correlation observed between medication use and eGFR strengthen the well-established evidence that polyphar-

Table 4. Multivariable logistic regression analysis of factors associated with reduced estimated glomerular filtration rate (<60 mL/min/1.73 m²) in community-dwelling older adults

	OR	p [b]	IC95%
Model 1			
Sex	1.978	0.028	1.077 - 3.634
Age	1.078	<0.001	1.047 - 1.110
Hypertension	2.345	0.031	1.079 - 5.096
Number of medicines	1.137	0.036	1.008 - 1.283
Model 2			
WS	0.922	0.848	0.403 - 2.112
MM²	1.172	0.111	0.964 - 1.424
Model 3			
WS	0.890	0.762	0.421 - 1.885
CC	0.539	0.429	0.117 - 2.494
Model 4			
HGS	1.129	0.707	0.599 - 2.130
WC	3.370	0.030	1.128 - 10.074
Model 5			
Sarcopenia	1.342	0.720	0.304 – 2.274

[a] Odds ration; [b] p-value. CC = calf circumference; IC95%: confidence interval; MM² = muscle mass; HGS = handgrip strength; WS = walking speed; WC = waist circumference.
Model 1: Gross without adjustment.
Model 2, 3, 4 and 5: Adjusted by model 1.

macy is associated with poorer clinical outcomes and exerts a direct negative impact on patients' quality of life, underscoring the need for careful pharmacological management and individualized therapeutic strategies in older adults with CKD.

Obesity predisposes older people to several diseases that worsen glomerular filtration rate and CKD progression. Excess weight and obesity lead to hemodynamic, structural, histological, metabolic, and biochemical alterations in the kidneys[24]. In this study, half of the older participants were overweight, and a significant portion of them had reduced eGFR, although this association was not statistically significant. However, waist circumference was a relevant factor, increasing the risk by 3.3 times and remaining significantly associated with eGFR. According to Vilela et al.[18], BMI is an important indicator of CKD risk, especially when coupled with increased waist circumference, although no direct association with glomerular filtration rate decline was found.

The meta-analysis by Zimmermann et al.[25] confirmed the existence of the obesity paradox in patients with CKD, with measures of total adiposity, such as skinfold thickness, DEXA, bioimpedance, and BMI, showing an association between higher body fat and lower mortality, suggesting a protective effect of obesity in this population. In contrast, indicators of central obesity, such as waist circumference and waist-to-hip ratio, were associated with a higher risk of mortality. These findings highlight that, although total adiposity may confer some prognostic benefit in advanced CKD, abdominal fat distribution remains a significant mortality risk factor.

The accumulation of adipose tissue, particularly visceral fat, can contribute to renal compression and increased intrarenal pressure. Another important factor in the development of obesity-related kidney injury is lipotoxicity, which refers to damage caused by excessive fatty acid metabolism in non-adipose tissues, including skeletal muscle, pancreatic islets, the myocardium, and possibly the kidneys. Three main mechanisms have been proposed to explain the link between obesity and kidney disease: hemodynamic changes, the effects of adipose tissue, and insulin resistance. These pathways are interconnected, promoting the release of pro-inflammatory adipokines and cytokines, activation of the sympathetic nervous system, and pathological stimulation of the renin–angiotensin–aldosterone system (RAAS). Collectively, these processes create a chronic pro-inflammatory and profibrotic environment that drives glomerular hyperfiltration, endothelial injury, podocyte damage, and tubular impairment, ultimately leading to increased albumin excretion[24].

Several studies have demonstrated a strong association between obesity and kidney disease, largely due to its close relationship with diabetes mellitus and hypertension, both of which remain highly prevalent and continue to rise globally[24]. The prevalence of obesity is increasing among older people, often due to age-related musculoskeletal changes known as sarcopenia[26]. The coexistence of obesity and sarcopenia can lead to higher mortality, worsening disability, increased fall risk, reduced cognitive and physical performance, disease progression, and more frequent hospitalizations[27].

Direct components of sarcopenia, such as handgrip strength and gait speed, were correlated with eGFR. However, when assessed independently among those with reduced eGFR, no significant associations remained.

Handgrip strength is a simple and reliable measure of skeletal muscle strength and is useful for the early detection of functional decline[28]. Evidence shows that, in older adults, muscle strength declines more rapidly than muscle mass, indicating deterioration in muscle quality and suggesting that gains in muscle mass alone may not be sufficient to preserve strength[29-31].

The Global Leadership Initiative on Sarcopenia (GLIS)[32] sought to establish a global conceptual definition of sarcopenia. The proposed definition is based on three main components: muscle mass, muscle strength (assessed by handgrip strength in our study), and specific muscle strength (the relationship between strength and muscle size).

Another important parameter is physical performance, which in this study was assessed by gait speed, a key indicator of overall health and one of the main measures of functional capacity in older adults[33]. In the GLIS 2024 consensus[32], participants agreed that sarcopenia has multiple adverse health consequences, including impaired physical performance and mobility limitations (e.g., walking and transfers). In the previous definition adopted by the EWGSOP[17] and used in the present study, gait speed was considered a measure of physical performance and an indicator of sarcopenia severity. However, in the new GLIS framework, the panel did not support including disease severity or severity-specific statements in the conceptual definition[32]. Consequently, impaired physical performance was accepted as an outcome of sarcopenia, supported by 97.9% of respondents, rather than as a component of the definition itself, which only 79.4% endorsed.

Although sarcopenia was not directly associated with eGFR, associations were observed with factors that influence both outcomes, such as advanced age, presence of chronic comorbidities, particularly hypertension, greater abdominal fat deposition, and changes in muscle strength and functionality. This finding is relevant as it suggests that the characteristics of the study population, community-dwelling older adults, may have contributed to the lack of sarcopenia diagnosis. Nevertheless, the results remain relevant, as they can guide preventive actions targeting individuals at higher risk of developing Chronic Kidney Disease in this population, particularly those with abdominal obesity, hypertension, and female sex.

Finally, it should be noted that this study has some limitations regarding the interpretation of its results. The first limitation relates to the method used to estimate muscle mass, namely the fat-free mass index obtained by bioelectrical impedance analysis, particularly given that glomerular filtration rate was assessed. However, to minimize this limitation, well-defined criteria for body composition assessment were rigorously followed; all participants were instructed to empty their bladder prior to the evaluation, and none of the participants showed signs of fluid retention or edema.

On the other hand, in population-based studies with large samples, the assessment of muscle composition using more precise methods, such as DXA, becomes unfeasible due to both the high cost and the logistical challenges associated with transporting the equipment or the individuals for assessment. Another limitation may be related to the use of the fat-free mass index as an indirect parameter for evaluating muscle mass, which may underestimate or overestimate the prevalence of sarcopenia.

Nevertheless, to mitigate this limitation, we adopted the FFMI cutoff points established by Kawakami[12], who reported an excellent and strong correlation between FFMI and muscle mass assessed by DXA ($r = 0.95$; $p < 0.001$), as well as a high area under the ROC curve (AUC = 0.95 for men and 0.91 for women). These authors recommended the safe use of FFMI as a substitute for DXA in population-based studies, as it is easier to assess, low-cost, and demonstrates accuracy very similar to that of DXA for detecting low muscle mass.

CONCLUSIONS

Changes in glomerular filtration rate often occur silently. Sociodemographic and clinical factors, particularly the high prevalence of comorbidities, significantly contribute to reduced estimated glomerular filtration rate. Although no association was observed between estimated glomerular filtration rate and diagnosed sarcopenia, this does not diminish its relevance, especially given the high number of older adults with probable sarcopenia.

Patients with lower estimated glomerular filtration rate were at higher risk of elevated waist circumference, systemic arterial hypertension, polypharmacy, and female sex. Negative correlations were also observed with age, woman sex, hypertension, number of medications, waist circumference, and gait speed.

These findings can inform the planning and implementation of health strategies for older adults in Alagoas. State and municipal health authorities should prioritize training professionals and optimizing services with accessible and effective interventions. Understanding the factors associated with declining estimated glomerular filtration rate allows for early diagnosis and management of chronic kidney disease, helping to prevent complications and improve quality of life in older populations

FUNDING

This study was funded by the Foundation for Research Support of the State of Alagoas through the resource from CHAMADA FAPEAL 06/2020 – PPSUS - Research Program for SUS: Shared Management in Health - DecitSCTIE-MS/CNPq/ FAPEAL/ SESAU-AL

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