

Kidney function & Sarcopenia in the United States general population: The NHANES III Study

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Introduction

- Sarcopenia (reduced muscle mass) is common in older populations and leads to functional disability and higher mortality rates.
- Sarcopenia in earlier-stage CKD is poorly characterized, which is surprising, especially considering that muscle wasting is a cardinal feature of untreated end-stage renal disease.
- The objectives of this study were to assess the associations between CKD and sarcopenia in a nationally-representative sample of community-dwelling adults.

Methods

- The Third National Health and Nutrition Examination Survey (NHANES III, 1988 to 1994) used stratified, multistage, probability sampling methods to assemble a nationally-representative sample of the non-institutionalized population of the US.
- Whole-body bioimpedance analyses (BIA) between the right wrist and ankle were performed, with the subject in a supine position.
- Skeletal muscle mass was calculated using a validated BIA equation and indexed to body mass. Class I and Class II sarcopenia were present with Skeletal Muscle Index (SMI) between 1 and 2 and more than 2 standard deviations, respectively, below gender-specific values seen in 18 to 39 year old participants in NHANES III (Janssen et al.)
- SUDAAN software was used to incorporate the complex survey design.

Results

- Of the 13,770 subjects, 27.2% had Class I sarcopenia and 4.5% had Class II sarcopenia. For GFR 60-89, the corresponding values were 33.6% and 5.3% and for GFR <60, 50.7% and 9.4% (P < 0.0001)
- Figure 1 shows associations between the prevalence of sarcopenia and kidney function. Although a stepwise increase in the prevalence of sarcopenia was seen with declining level of GFR in unadjusted analysis, the association dissipated when adjustment was made for age, demography and comorbid medical conditions.
- Table 2 shows adjusted associations of sarcopenia in subjects with CKD. These included older age, low income-to-poverty ratio, lack of exercise, low dietary intake of protein, fat and carbohydrate, high serum calcium levels, low vitamin D levels, high total cholesterol levels, high diastolic blood pressure levels, and high glycosylated hemoglobin and increasing degrees of insulin resistance in non-diabetic subjects.

Table 1. Population Characteristics

Characteristic	Percent
Class I sarcopenia	27.2%
Class II sarcopenia	4.5%
Glomerular filtration rate (ml/min per 1.73 m ²)	
> 90	64.8%
60-89	31.5%
< 60	3.7%
Urinary ACR 30 mg/g	7.9%
Age (years)	
20-39	45.8%
40-59	33.3%
60-69	11.8%
70	9.5%
Female gender	56.7%
Ethnicity	
White	76.9%
African American	16.2%
Hispanic American	5.0%
Other	8.0%
School education < 12 years	23.8%
Income-poverty ratio < 1	17.0%
Body mass index < 25	55.9%
Self-reported conditions	
Diabetes mellitus	5.1%
Cardiovascular disease	5.0%
Hypertension	23.2%

Figure 1. Sarcopenia and GFR: Logistic Regression.

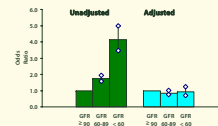


Table 2. Multivariate Associations of Sarcopenia in Subjects with CKD (GFR < 60 or ACR ≥ 30)

Variable	Adjusted odds ratio	P Value
Age (years)		< 0.0001
20-39	1 (reference)	
40-59	2.74 (1.55, 7.24)	
60-69	4.19 (2.36, 11.08)	
70	5.99 (3.71, 11.31)	
Income-poverty ratio < 1	1.51 (1.01, 2.24)	0.0448
BMI < 25	0.67 (0.71, 1.16)	< 0.0001
Exercise (hrs/week)	0.89 (0.76, 0.83)	0.0012
Protein intake (g/kg/day)	0.89 (0.86, 0.94)	0.004
Fat intake (g/kg/day)	0.87 (0.76, 0.97)	0.0097
Carbohydrate intake (g/kg/day)	0.92 (0.86, 0.98)	0.0006
Serum calcium (mg/dl)	1.13 (1.02, 1.24)	0.0176
Serum 25-OH Vitamin D3 (ng/mL)	0.95 (0.91, 0.99)	0.0218
Cholesterol (mg/dL)	1.59 (1.07, 1.33)	0.0019
Diastolic blood pressure (mm Hg)	1.13 (1.02, 1.24)	0.0133
Among subjects without diabetes:		
Glycosylated hemoglobin (%)	1.26 (1.07, 1.49)	0.0071
HOMA insulin resistance	1.45 (1.17, 1.80)	0.0012

Adjustment variables for multivariate analysis: age, sex, ethnicity, education, income-poverty ratio, body mass index, diabetes, cardiovascular disease, hypertension.

Conclusions

- Sarcopenia is common in community dwelling adults with CKD.
- The high prevalence of sarcopenia appears related to the older age and greater comorbidity of the CKD population.
- Although causality cannot be assumed, several associations may be susceptible to intervention.