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Original Study

Body Composition, IGF1 Status, and Physical Functionality in Nonagenarians: Implications for Osteosarcopenia

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A B S T R A C T

Objectives: Body composition alterations occur during aging. The purpose of the present analysis was to explore the functional consequences of the overlap of sarcopenia and osteoporosis, and the potential role of insulin-like growth factor 1 (IGF1) in their development in the oldest old.
Setting and Participants: Eighty-seven nonagenarians from the Louisiana Healthy Aging Study were included.
Measures: The definition of sarcopenia was based on appendicular lean mass (ALM). Osteoporosis was diagnosed based on bone mineral density (BMD) T score. Four phenotypes were compared: (1) healthy body composition, that is, nonosteoporotic nonsarcopenic (CO, control group), (2) osteoporotic (O, low BMD T score), (3) sarcopenic (S, low ALM), and (4) osteosarcopenic (OS, low BMD T score and low ALM). Sex- and age-specific IGF1—Standard Deviation Scores (SDS) were calculated. The Continuous Scale—Physical Functional Performance (CS-PFP) test was performed.
Results: In OS men, IGF1-SDS values (-0.61 ± 0.37 vs -0.04 ± 0.52, $P = .02$) were lower than those in CO males (control group), whereas IGF1-SDS were similar in the 4 body composition phenotypes in women. In men only, ALM was positively associated with IGF1-SDS values ($P = .01$) independent of age and C-reactive protein concentration. Regarding bone health, we found no association between IGF1-SDS values and BMD. IGF1-SDS was not associated with functional performance (CS-PFP) in men and women.
Conclusions/Implications: IGF1 sensitivity in skeletal muscle and bone may differ by sex in the oldest old. IGF1 status did not appear to affect physical functionality. Determinants and clinical and functional characteristics of osteosarcopenia need to be further investigated in order to define conclusive diagnostic criteria.

The aging process is characterized by deleterious alterations in body composition including declines in lean body mass (LBM; sarcopenia) and bone mineral density (BMD; osteopenia and osteoporosis) with a concomitant increase in relative body fat.[1,2] Because bone health has been shown to be involved in a complex interplay between skeletal muscle and adipose tissue, the term "osteosarcopenic obesity" has been coined[1] to indicate the concurrence of high body fat, low LBM, and low BMD. Currently, however, a universally accepted definition of sarcopenia is lacking, leading to a difficult and quite variable diagnostic.[3] Both hormonal status and systemic inflammation have

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been postulated to play a pivotal role in the age-related impaired body composition.[1,4]

Among endocrine contributors, a low somatotropic axis activity (also called somatopause) is recognized as a trigger of age-related disturbances in body composition and is now suggested as a target for anti-aging treatment.[5] However, results from randomized clinical trials with administration of recombinant growth hormone (GH) have not been conclusive about its beneficial impact on body composition and physical functionality and some trials have been associated with significant adverse side effects.[6] Cross-sectional studies showed a positive association between plasma insulin-like growth factor 1 (IGF1) concentration and healthier body composition.[4,5] However, the combination of the newly described body composition phenotypes with functional status and endocrine health have not been explored in the oldest old population. The aims of the present study were therefore to assess the prevalence of body composition phenotypes (sarcopenia, osteoporosis, and their overlaps) in nonagenarians, and to examine their relationships with IGF1 status and physical functionality.

Methods

Study Participants

The Louisiana Healthy Aging Study (LHAS) has been previously described.[7,8] Participants aged >89 years living within the Greater Baton Rouge Area, were recruited as a community representative cohort. A total of 275 nonagenarians were enrolled in the LHAS, of whom 103 were included in a substudy and underwent a thorough assessment of metabolic and endocrine health, according to criteria described elsewhere.[7,8] Data from 87 subjects (37 men and 50 women) out of 103 nonagenarians were included in this analysis. Altogether, 16 participants were excluded because of the use of medications potentially affecting body composition (ie, corticosteroids for systemic use, hormone replacement therapy and insulin administration) or clinical conditions making them unable to accomplish the required testing. The study was approved by the Institutional Review Board of the Pennington Biomedical Research Center and the LSU Health Science Center. Written informed consent was provided by all participants.

Anthropometrics

Body weight was measured to the nearest ±0.1 kg with an electronic scale (Detecto, Webb City, MO), and height was measured to the nearest ±0.5 cm with a stadiometer (Holtain; Crymych, Dyfed, UK). Body mass index (BMI) was calculated as weight divided by height squared (kg/m^2). Underweight was defined as BMI ≤18.5, normal weight as BMI>18.5 and < 25, overweight as BMI ≥25 but <30, and obesity as BMI ≥30.

Body Composition

LBM, body fat, and BMD were measured by dual energy x-ray absorptiometry (DXA) on a QDA 4500A instrument (Hologic, Bedford, MA). Appendicular lean mass (ALM) was obtained as the sum of lean mass of arms and legs. Osteopenia and osteoporosis were diagnosed when BMD T score was ≤1.0 or ≤2.5, respectively, for at least at one of the following segments of the skeleton: femoral neck or lumbar spine.[1,9–11] Because of the lack of standardization criteria, several indices of sarcopenia (eg, appendicular skeletal muscle mass index, here indicated as ALM/height^2, ALM/BMI, ALM/weight, and ALM as absolute value; Supplemental Table 1) were first used to evaluate the prevalence of sarcopenia and its overlap with osteoporosis and/or obesity. The 4 cutpoints for sarcopenia were as follows: ALM/height^2 of ≤7.26 in men or ≤5.45 in women[12]; ALM/weight (percentage) of <25.72% in men or <19.43% in women[13]; ALM/BMI of <0.789 in men or <0.512 in women[14]; ALM (kilograms) of <19.75 kg in men or <15.02 kg in women[14]; ALM (kilograms) adjusted for height (meters) and fat mass (kilograms) of <20th percentile of the distribution of residuals.[15]

Because the prevalence of sarcopenia based on different definitions was highly variable, and the vast majority of participants were at least osteopenic, we used a modified approach as in Drey et al,[16] relying on the sex-specific median values of ALM and BMD T score (at either femoral neck or lumbar spine, or both) to divide participants into 4 body composition phenotypes: (1) nonosteo-nonsarcopenic phenotype, without osteoporosis or sarcopenia (controls: high ALM and high BMD T score), (2) osteoporosis only (low BMD T score and high ALM), (3) sarcopenia only (low ALM and high BMD T score), and (4) osteosarcopenia (low ALM and low BMD T scores).

Physical Activity

Total daily energy expenditure and resting metabolic rate (RMR) were measured as previously described.[8] The level of physical activity (PAL) was calculated as previously described: TEE/(RMR + 0.1*TEE).[8]

Physical Functionality

The short version of the Continuous Scale—Physical Functional Performance (CS-PFP-10) test was used to assess physical functional capacity. CS-PFP-10 consists of 10 tasks examining 5 domains: upper-body strength, upper-body flexibility, lower-body strength, balance/coordination, and endurance. Scores range from 0 to 100, with higher scores mirroring higher functional ability.[7,17] A score of 57 has been considered as the threshold of physical independence.[18]

Frailty, Biological Age, and Polypharmacy

The Frailty Index "FI34," including 34 health variables, was used as a measure of frailty and biological age.[19] According to the medical history and medication counting, polypharmacy was defined in case of use of ≥5 medications.[20]

IGF1, Albumin, and C-Reactive Protein Assays

Blood samples were drawn after an overnight fast. Serum concentrations of IGF1 were determined using enzyme-linked immunosorbent assay (Diagnostic System Laboratories, Webster, TX). Given that IGF1 concentrations are related to age or sex, we calculated the standard deviation score (SDS) of IGF1 according to age and sex.[21] The SDS of IGF1 levels were calculated as follows: SDS = (measurement − mean)/SD. Means and SDs of IGF1 levels were obtained from NHANES III participants aged ≥89 years (26 women and 14 men). No participant, among our nonagenarians, had an IGF1-SDS value below 2, a threshold considered as IGF1 deficiency. Serum albumin levels were measured by a timed endpoint method, on a Synchron CX7 (Beckman Coulter, Brea, CA). C-reactive protein (CRP) levels were measured by immunoassays on a DPC 2000 (Diagnostic Product Corporation, Los Angeles, CA). The CRP/albumin ratio was calculated.[22]

Statistical Analysis

Data are presented as means ± SD. Data analyses were performed using IBM SPSS Statistics, version 23 (IBM Corp, Armonk, NY). Distributions of continuous variables were examined for skewness and kurtosis, and were logarithmically transformed when appropriate. Log-transformed variables are presented as untransformed values for ease of reading. Chi-square test, 1-way analysis of variance, and analysis of covariance with post hoc multiple comparisons with

Bonferroni correction were used. Pearson correlation was used to examine the relationship between variables, and multiple linear regression analysis was performed to investigate the independent association of the response variable with the selected explanatory variable. Log-ALM and log-L1-L4-BMD were used as dependent variables in multiple regression analyses. The covariates included in the models were chosen a priori among those factors expected to influence the dependent variable, based on biological mechanisms or evidence from research; they are specified in the Results section. The level of significance for all statistical tests was set at $P < .05$.

Results

Study Participants

Eighty seven nonagenarians were included in the present analysis (37 men and 50 women; age: 92 ± 2 years, BMI: 24.8 ± 3.9). Participants' medical history, use of medications, and metabolic health are described in Supplemental Table 2. Polypharmacy was observed in 42.5% of participants.

Body Composition

Supplemental Figure 1 presents the prevalence rates of BMI categories (panel A), of osteopenia and osteoporosis for femoral neck and lumbar spine (panel B), and of sarcopenia according to different criteria (panel C). Overall, 2.3% of study participants were underweight (women only), 8% were obese, whereas the majority had normal weight (50.6%) or overweight (39.1%) BMIs. Osteoporosis in any segment (femoral neck or lumbar spine) was present in 48% of the study population (64% of women and in 27% of men). The prevalence of sarcopenia ranged from 1.2%, when using the accepted cutoff values for the index of ALM divided by weight (ALM/weight; %) to 34.5% according to the ALM alone (kg).

Body Composition Phenotypes

To overcome the highly variable prevalence of sarcopenia according to different published criteria, we classified study participants in 4 phenotypes based on median ALM and median BMD T scores, as described in the Methods section and in line with the approach by Drey et al[16] (Table 1): 16% of the participants were nonosteoporotic and nonsarcopenic (CO for controls), 35% had only osteoporosis (O), and 18% had only sarcopenia (S), whereas the remaining 31% had both osteoporosis and sarcopenia (OS). Demographics, anthropometrics, adiposity, LBM, and BMD in different body composition phenotypes are described in Table 1. Age was not different in the 4 body composition phenotypic groups. BMI was significantly lower in sarcopenic and osteosarcopenic groups when compared to subjects with normal body composition (CO). Furthermore, subjects with osteosarcopenia had a lower BMI than osteoporotic individuals ($P < .05$). Body fat percentage was not different across the 4 body composition phenotypes, whereas fat mass in absolute value was significantly lower in OS older adults than in the group with normal body composition ($P < .05$). By definition, LBM and ALM were significantly lower in both sarcopenic and osteosarcopenic subjects compared to individuals with normal body composition or with osteoporosis ($P < .01$). Similarly, BMD at the lumbar spine and at the femoral neck was significantly lower in the group with both osteoporosis and sarcopenia (OS) when compared to the nonosteo-nonsarcopenic and sarcopenic groups ($P < .01$). No differences were observed between groups regarding the prevalence of smoking, alcohol intake, or use of osteoporosis medications.

Multiple regression analysis did not reveal any significant association between log-ALM and femoral neck BMD ($P = .93$) or lumbar spine BMD ($P = .16$) with or without adjustment for age, sex, CRP levels, body fat (percentage), smoking status, alcohol intake, and use of osteoporosis medications. Similarly, when stratified by sex, no significant association was observed between log-ALM and femoral neck or lumbar spine BMD adjusting the models for age, body fat percentage, and CRP levels in either males or in females.

Body Composition Phenotypes and IGF1

IGF1 levels and IGF1-SDS values were compared in the 4 body composition phenotypes according to sex (males: CO, n = 6; S, n = 7; O, n = 13; OS, n = 11; and females: CO, n = 8; S, n = 9; O, n = 17; OS, n = 16).

Men with both osteoporosis and sarcopenia (OS) were older than men with only sarcopenia (94 ± 3 vs 91 ± 1 years, $P = .02$) and tended to be older than osteoporotic men (94 ± 3 vs 92 ± 1 years, $P = .06$). Neither body fat percentage nor fat mass were different between groups in men. In OS men, log-IGF1 concentrations (non-log-

Table 1
Demographics, Anthropometrics, and Body Composition

	Nonosteoporotic-Nonsarcopenic Control Group (CO), n = 14	Sarcopenic Group (S), n = 16	Osteoporotic Group (O), n = 30	Osteosarcopenic Group (OS), n = 27	*P*
M/F, n	6/8	7/9	13/17	11/16	.99
W/AA/Other, n	12/1/1	12/0/4	27/1/2	25/0/2	.32
Age, y*	92 ± 2	91 ± 1	92 ± 2	93 ± 2	.12
Weight, kg	74.7 ± 10.4	61.4 ± 9.2 a†	69.6 ± 11.5 d†	58.6 ± 11.3 c†, e†	**<.001**
Height, m*	1.65 ± 0.08	1.62± 0.08	1.64 ± 0.09	1.58 ± 0.09	.06
BMI*	27.3 ± 3.2	23.2 ± 2.7 b‡	26.0 ± 4.5	23.1 ± 3.1 c†, e†	**.001**
Body fat, %	34 ± 5	33 ± 7	31 ± 8	31 ± 7	.66§
FM, kg	25.1 ± 5.2	19.9 ± 5.5	21.8 ± 8.2	18.3 ± 6.1 c‡	**.02**§
LBM, kg*	49.3 ± 2.1	41.0 ± 2.0 a‡	47.5 ± 1.5 d‡	39.9 ± 1.5 c†, e†	**<.001**§
ALM, kg*	20.9 ± 4.2	16.7 ± 3.2 a‡	20.5 ± 3.9 d†	16.5 ± 3.6 c†, e†	**<.001**§
ALM/height^2, kg/m^2*	7.6 ± 1.0	6.4 ± 0.8 a†	7.6 ± 1.1 d†	6.5 ± 0.9 c†, e†	**<.001**§
ALM/BMI*	0.76 ± 0.14	0.72 ± 0.13	0.80 ± 0.17	0.71 ± 0.15	.14§
(ALM/weight) × 100	28 ± 3	27 ± 3	30 ± 4	29 ± 4	.27§
L1-L4 BMD, g/cm^2*	1.15 ± 0.13	1.23 ± 0.22	0.87 ± 0.12 b†, d†	0.90 ± 0.19 c†, f†	**<.001**§
Femoral neck BMD, g/cm^2	0.65 ± 0.07	0.71 ± 0.11	0.56 ± 0.09 b†, d†	0.52 ± 0.09 c†, f†	**<.001**§

AA, African American; F, females; FM, fat mass; L1-L4, lumbar spine; M, males; Other, other ethnicities; W, white.
Boldface indicates significance.
*Log-transformed variables; a: CO vs S; b: CO vs O; c: CO vs OS; d: O vs S; e: O vs OS; f: S vs OS.
†$P < .01$.
‡$P < .05$.
§Adjustment for CRP levels.

transformed levels: 115 ± 57 vs 203 ± 81, $P = .04$) and IGF1-SDS values (−0.61 ± 37 vs −0.04 ± 0.52, $P = .02$) were significantly lower than in men with normal body composition (CO) after adjustment for age (Figure 1). There was, however, no difference in log-IGF1 levels ($P = .36$) or IGF1-SDS values ($P = .52$) between the 4 body composition phenotypes in women (Figure 1).

ALM, BMD, and IGF1

A positive correlation was observed between log-ALM and IGF1-SDS values in men (r = 0.45, $P = .005$) but not in women (r = 0.22, $P = .13$). We performed multiple linear regression analyses to investigate the independent association of ALM with IGF1-SDS values. Independent of age and CRP concentrations, log-ALM was positively associated with IGF1-SDS values in men (beta: 0.11, SE: 0.04, $P = .01$), even after adjusting for body fat (percentage) ($P = .01$) or for PAL ($P = .02$), confirming the positive association between ALM and IGF1-SDS (Figure 2). BMD at the femoral neck or lumbar spine was not associated with IGF1-SDS values with or without adjustment for age, CRP levels, percentage body fat and smoking status either in men or in women.

Physical Functionality, PAL, and IGF1

Data from the CS-PFP test were available in a subset of 72 participants. Except for 2 men and 1 woman, all participants were below the threshold of physical reserve corresponding to a score equal to 57 at the CS-PFP test. There was no difference in PAL or functionality scores among the 4 different body composition phenotypes (Supplemental Table 3). Furthermore, no significant correlation was observed between the CS-PFP score and IGF1-SDS values or between PAL and IGF1-SDS values by sex (data not shown).

ALM and Physical Functionality

Despite the lack of difference in PAL and physical functionality between the 4 body composition groups, by multiple linear regression analyses the CS-PFP score was positively associated with ALM (beta: 2.06, SE: 0.91, $P = .03$) in men, but not in women, after adjustment for age and the frailty index (FI34 score).

Body Composition Phenotypes and Inflammation

After adjustment for body fat, CRP levels and CRP/albumin ratio were higher in sarcopenic individuals compared with their osteoporotic counterparts ($P < .05$). No correlation emerged between inflammatory biomarkers and IGF1-SDS (data not shown).

Discussion

In our community-based cohort of nonagenarians, men with osteosarcopenia, but not women, exhibited lower IGF1-SDS values than the control (CO) group; moreover, increased IGF1-SDS values were associated with larger ALM in men only. Conversely, the coexistence of sarcopenia and osteoporosis in a unique phenotype named osteosarcopenia did not result in a more deleterious impact on functional status than each clinical condition considered separately. Finally, body composition in men, but not IGF1 status, were related to physical functionality.

BMD and ALM were not associated in our study population, even when taking into account the potential interference of body fat in that association, suggesting that the presence of reduced lean mass was not detrimental to bone health. Our observations appear to be in disagreement with findings from Drey et al,[16] showing increased bone turnover markers in older adults aged 65-94 years with osteosarcopenia compared to controls. Our findings also seem to contradict the "bone-muscle unit" model,[23] suggesting that the crosstalk between bone and skeletal muscle may be impaired in late life. In a recent study by Di Monaco et al,[24] the association between sarcopenia and osteoporosis largely varied depending on the definition and index adopted to describe low LBM. The variability of the different indices of sarcopenia to capture concomitant disproportions in body compartments between groups needs to be further tested in larger cohorts.[3]

The positive association between ALM and IGF1-SDS values was present in men only, whereas no association between BMD and IGF1-SDS was found in men or women. Our findings are consistent with many studies showing the role of IGF1 as a major mediator of growth hormone action in protein metabolism in skeletal muscle.[4,5] IGF1 acts as a key upstream regulator of the mammalian target of rapamycin (mTOR), a serine/threonine kinase playing a pivotal role in the anabolic signaling in skeletal muscle by[25] promoting muscle cell growth (hypertrophy) and inhibiting apoptosis.[26] Gender differences have been reported in the response to GH replacement therapy in adults with GH deficiency.[27] In fact, short-term as well as long-term studies provide evidence of a reduced IGF1 responsivity in GH-deficient women compared to men when treated with rhGH. Indeed, body composition changes in response to rhGH therapy (ie, increase in LBM and reduction in adiposity) were more pronounced in men, indicating a relative GH resistance in women.[27–29] Larger size studies are needed to confirm a potential sexual dimorphism on the

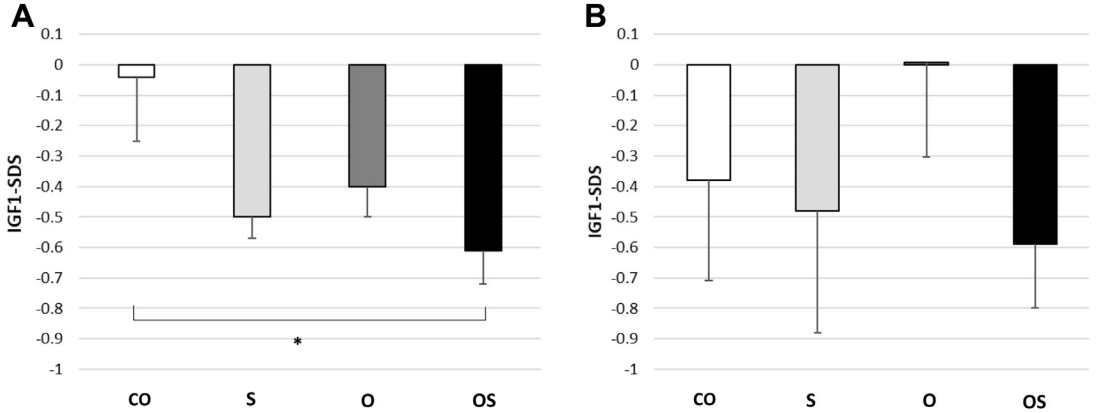

Fig. 1. IGF1-SDS values in men (A) and women (B) in different body composition phenotypes. CO (control group), nonosteoporotic nonsarcopenic group; S, sarcopenic group; O, osteoporotic group; OS, osteosarcopenic group. *OS vs CO: $P = .02$.

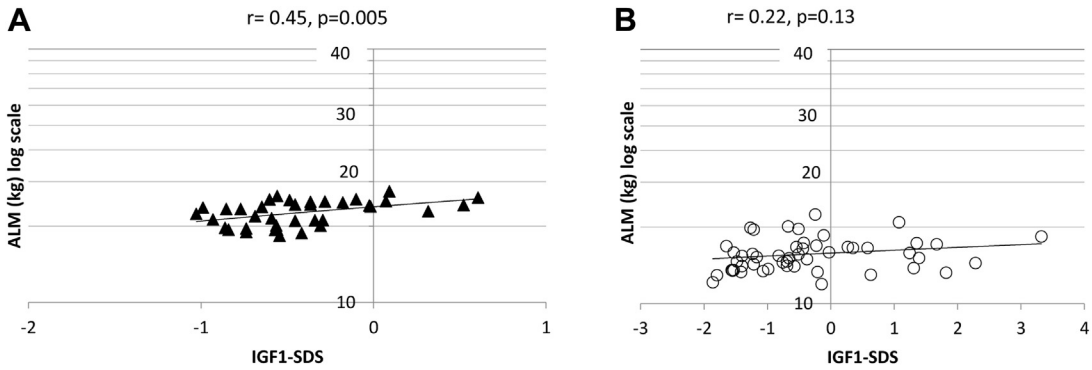

Fig. 2. Relationship between ALM and IGF1-SDS in men (A; n = 37) and in women (B; n = 50).

effect of IGF1 on skeletal muscle mass and the role of sex steroid pattern in the oldest old.

The lack of association between BMD and IGF1 in our study is in agreement with several studies showing no association between BMD and IGF1 levels in either sex.[30,31] In addition, in older men and postmenopausal women, GH replacement therapy resulted in discordant or nonsignificant improvement in BMD.[32,33] One can hypothesize that at the extreme end of the age span, skeletal muscle and bone could respond differently to the anabolic stimuli of IGF1.

Nonagenarians with different body composition phenotypes had similar CS-PFP test scores, and osteosarcopenic subjects did not exhibit a poorer functional status than subjects with sarcopenia or osteoporosis alone. The lack of differences in PAL among groups may suggest a floor effect in the oldest old. Notably, in 97% of study participants, CS-PFP test scores were below the 57, a threshold usually predicting older adults with functional limitations.[18]

Data concerning functional ability and physical performance from studies based on rhGH therapy are conflicting.[34,35] Despite some studies demonstrating beneficial effects on muscle performance potentially mediated by IGF1,[34] short-term GH administration in healthy adult and older subjects failed to improve skeletal muscle contractility or physical performance,[34,36] even after an increase in LBM.[37] Our findings of no association between CS-PFP score and IGF1 appear to be in line with this body of evidence; however, they disagree with other studies.[35]

In our study cohort, ALM was a determinant of the physical functionality scores obtained by the CS-PFP test in men, but not in women. Our results suggest that age-related changes in body composition only are not sufficient to thoroughly characterize the physical functional status, underlying the need of a multidimensional evaluation in the oldest old.

The major strength of the present study is the investigation of determinants of body composition and physical functionality in a unique community-based cohort of exceptional survivors. However, some limitations need to be acknowledged: because of the low prevalence of obesity in our cohort, we were unable to evaluate thoroughly the relationship between body compartments in the complex phenotype of osteosarcopenic obesity because BMI may not be accurate for diagnosing obesity in older adults[38]; the small sample size in group comparisons may affect the generalizability of findings; and finally, the observational nature of our study prevents us from disentangling the potential causative relationship between the GH/IGF1 status and the evaluated outcomes.

Conclusions/Relevance

Our findings support the potential role of IGF1 action in the maintenance of skeletal muscle, but not bone mass, in nonagenarians, though gender differences in the relationship between body compartments and IGF1 status deserve to be investigated in the oldest old. We can assume that the 2 tissues may have a differential responsivity to IGF1 in late life, in contrast with evidence from younger cohorts. Determinants of the phenotype of osteosarcopenia need to be further explored in late life, and clear-cut diagnostic criteria await to be defined conclusively.

Supplementary Data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jamda.2018.07.007.

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Appendix

Supplemental Table 1
Indices of Sarcopenia

Indices of Sarcopenia	Authors	Approaches	Cutpoints
ASM/h^2	Baumgartner et al, Rosetta study	2 SD below the mean of a young reference population (gender- specific)	$\leq$7.26 kg/m^2 in men or $\leq$5.45 kg/m^2 in women
(ASM/weight) $\times$ 100	Levine et al, NHANES	2 SD below the mean of a young reference population (gender-specific)	<25.72% in men or <19.43% in women
ALM/BMI	Cawthon et al, FNIH project	Clinically significant weakness or slowness (CART model; gender-specific)	<0.789 in men or <0.512 in women
ALM (kg)	Cawthon et al, FNIH project	Clinically significant weakness or slowness (CART model; gender-specific)	<19.75 kg in men or <15.02 kg in women
ALM (kg) adjusted for height and fat mass	Newman et al, Health ABC study	<20th percentile of the distribution of the residuals (gender-specific)	<20th percentile of the distribution of residuals

ASM, Appendicular Skeletal Muscle Mass; CART, classification and regression trees; FNIH, Foundation for the National Institutes of Health; NHANES, National Health and Nutrition Examination Survey.
ASM and ALM are used as synonyms, according to the nomenclature chosen by the authors.

Supplemental Table 2
Medical History and Use of Medications Potentially Affecting Metabolic Health and Body Composition

	Men, n = 37	Women, n = 50	All, n = 87
Ethnicity: W/AA/Other (n)	29/1/7	47/1/2	76/2/9
Age, y, mean $\pm$ SD	92 $\pm$ 2	92 $\pm$ 2	92 $\pm$ 2
History of cancer	21.6	22.0	21.8
Metabolic syndrome	32.4	50.0	42.5
Major CV events*	21.6	28.0	25.3
Congestive heart failure	13.5	6.0	9.2
Peripheral vascular disease	2.7	6.0	4.0
Rheumatoid arthritis	3.0	11.1	7.3
Kidney disease	10.8	8.0	9.2
Smoking status: never/former/current	40.5/56.8/2.7	70/30/0	57.5/41.4/1.1
Alcohol use: never/former/current	13.5/32.4/54.1	44/8/48	31/18.4/50.6
Use of hypolipidemic agents	18.9	24.0	21.8
Use of antihypertensive agents	75.7	80.0	78.2
Use of antiaggregant/anticoagulant agents	59.5	66.0	63.2
Use of osteoporosis medications	2.7	28.0	17.2
Polypharmacy ($\geq$5 medications)	40.5	44.0	42.5

AA, African American; CV, cardiovascular; Other, other ethnicities; SD, standard deviation; W, white.
Values are percentages unless otherwise noted.
*Myocardial infarction, stroke, or transient ischemic attack.

Supplemental Table 3
IGF1 Status, Inflammation, Physical Functionality, and Frailty

	Variables	Nonsarcopenic Nonosteoporotic Control Group (CO), n = 14	Sarcopenic Group (S), n = 16	Osteoporotic Group (O), n = 30	Osteosarcopenic Group (OS), n = 27	*P*
IGF1 status	IGF1,* μg/L	163 ± 75	130 ± 56	153 ± 67	119 ± 65	.06
	IGF1-SDS	−0.23 ± 0.79	−0.48 ± 0.89	−0.17 ± 0.99	−0.60 ± 0.92	.31
Inflammation	CRP,* μg/L	0.48 ± 0.95	0.71 ± 0.60 †d	0.42 ± 0.75	0.70 ± 1.88	**.03**‡
	CRP/albumin*	0.13 ± 0.25	0.19 ± 0.16 †d	0.11 ± 0.20	0.21 ± 0.63	**.04**‡
Protein status	Albumin, g/dL	3.8 ± 0.2	3.9 ± 0.3	3.8 ± 0.3	3.8 ± 0.4	.76
Physical activity	PAL, n = 81	1.43 ± 0.09	1.41 ± 0.16	1.39 ± 0.25	1.37 ± 0.20	.72
Physical functionality	CS-PFP score, n = 72	24 ± 11	29 ± 16	32 ± 18	23 ± 16	.24
Frailty index	FI34 score	0.21 ± 0.04	0.19 ± 0.07	0.19 ± 0.07	0.22 ± 0.08	.30

*Log-transformed variables. a: CO vs S; b: CO vs O; c: CO vs OS; d:O vs S; e: O vs OS; f: S vs OS.
†$P < .05$.
‡After adjustment for fat mass.