

# Prestroke Sarcopenia and Stroke Severity in Elderly Patients with Acute Stroke

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*Objective:* The association between prestroke sarcopenia and stroke severity has not been evaluated previously. The purpose of this study was to determine whether prestroke sarcopenia is associated with stroke severity in elderly patients with acute stroke. *Methods:* We assessed prestroke sarcopenia of elderly patients with acute stroke by using a questionnaire for sarcopenia (SARC-F). Patients were divided into groups according to their SARC-F score: SARC-F score less than 4 (nonsarcopenia) and SARC-F score  $\geq 4$  (prestroke sarcopenia). Stroke severity was assessed according to the National Institute of Health Stroke Scale. Logistic regression was used to derive crude and adjusted odds ratio for the presence of prestroke sarcopenia and stroke severity. *Results:* Among the 183 patients enrolled (age, median [interquartile range]: 75 [11] years; 103 men), the prevalence of prestroke sarcopenia was 15% ( $n = 27$ ). Crude odds ratio for the presence of prestroke sarcopenia and moderate-to-severe stroke (National Institute of Health Stroke Scale score  $> 5$ ) was 4.00 (95% confidence interval, 1.68-9.53;  $P = .002$ ). After adjusting for confounding variables (age, sex, and stroke risk factors), the presence of prestroke sarcopenia remained an independent predictor of severe stroke, with an odds ratio of 3.54 (95% confidence interval, 1.32-9.49;  $P = .01$ ). *Conclusions:* Prestroke sarcopenia can predict moderate to severe stroke in elderly patients with acute stroke.

**Key Words:** Aging—elderly—sarcopenia—stroke  
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## Introduction

Stroke often leads to disability and decreased quality of life,<sup>1</sup> particularly in patients with severe neurologic symptoms.<sup>2</sup> The National Institute of Health Stroke Scale (NIHSS) is a neurologic severity scale that is valid,

reliable, and reproducible.<sup>3-6</sup> It has been previously reported that the baseline NIHSS is also a powerful predictor for poor functional outcome in patients with elderly stroke.<sup>7</sup> As such, the baseline NIHSS may be an important parameter for studying the characteristics of severe neurological stroke patients upon admission to prevent further disability or decreased quality of life.

Sarcopenia is defined as an age-related loss of muscle mass and muscle weakness, or functional decline.<sup>8</sup> Sarcopenia is a major clinical problem because it often causes disability, increases the incidence of cardiovascular disease, and affects mortality.<sup>9,10</sup> A cross-sectional study has also shown that there is an impact of sarcopenia on the occurrence of stroke in elderly patients<sup>11</sup>; however, there is no previous study that evaluate the association between prestroke sarcopenia and stroke severity.

Physical activity (PA) has been recently reported as an important factor not only for the occurrence of stroke,<sup>12,13</sup> but also for stroke severity.<sup>14</sup> Moreover, PA is also related to the incidence and development of sarcopenia.<sup>15</sup> Therefore, sarcopenia may be related to acute stroke severity through PA in elderly patients.

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The purpose of this study was to investigate the effects of prestroke sarcopenia on stroke severity in elderly patients with acute stroke.

## Methods

### Subjects

In this cross-sectional study, elderly patients with stroke admitted to the Itami Kousei Neurosurgical Hospital between August 2017 and September 2018 were recruited within 48 hours of the onset of the stroke symptoms. Inclusion criteria were<sup>1</sup> age  $\geq 65$  years; and<sup>2</sup> evidence of cerebral infarction or intracerebral hemorrhage on computed tomography or magnetic resonance imaging scans. Exclusion criteria were<sup>1</sup> prestroke functional limitation (modified Rankin Scale score  $\geq 3$ <sup>2</sup>; subarachnoid hemorrhage<sup>3</sup>; major concurrent illness, including chronic obstructive pulmonary disease, renal failure, and active malignancy; and<sup>4</sup> patients who could not complete the questionnaires because of impaired consciousness, cognitive dysfunction, or language disorder, such as aphasia. Ethical approval was obtained from the Research Ethics Committee of the Konan Women's University, and informed consent was obtained from all patients.

### Dependent Variable

Stroke severity was assessed according to the NIHSS (0-42) on admission.<sup>16</sup> The NIHSS was dichotomized into mild stroke (NIHSS score 0-5) and moderate to severe stroke (NIHSS score 6-42) in the regression analysis.<sup>16</sup>

### Independent Variables

Patients' characteristics, including age, sex, body mass index, stroke type, lesion laterality, and stroke risk factors (hypertension, diabetes, previous stroke, hypercholesterolemia, ischemic heart disease, atrial fibrillation, and smoking) were collected from electronic medical records. Patients were asked to complete the SARC-F questionnaire within 3 days of admission. The SARC-F questionnaire was originally adapted for use in the Japanese population and has 5 components: strength, assistance in walking, rising from a chair, climbing stairs, and falls.<sup>17</sup> The SARC-F scores range from 0 to 10, with 0-2 points for each component (0=best, 10=worst). Patients with a total score of  $\geq 4$  were classified as having a risk of sarcopenia.<sup>17</sup>

### Statistical Analysis

Results were presented as medians with interquartile range, and categorical variables were expressed as numbers and percentages. Patients were divided according to their SARC-F score into nonsarcopenia and prestroke sarcopenia groups: SARC-F score less than 4 (nonsarcopenia) and SARC-F score  $\geq 4$  (prestroke sarcopenia). The Mann-

Whitney  $U$ , Pearson  $\chi^2$ , and Fisher's exact tests were used to compare patients' baseline characteristics and clinical outcomes between the groups, as appropriate. Stepwise logistic regression analyses were conducted to investigate the association between the presence or absence of prestroke sarcopenia or baseline characteristic and moderate to severe stroke (NIHSS score 6-42). All statistical analyses were performed with SPSS software version 20.0 (IBM, New York, NY).  $P$ value less than .05 was considered statistically significant.

## Results

A total of 316 elderly patients with stroke were hospitalized during the study inclusion period. Three patients were admitted 48 hours after stroke symptom onset, 40 had prestroke functional limitation (mRS score  $\geq 3$ ), 3 had major concurrent illnesses, 20 had disordered consciousness, 38 had cognitive dysfunction, and 14 had aphasia; in total, 118 patients were excluded from this study. Subsequently, 12 patients refused to participate, and 3 patients did not provide informed consent.

Among the 183 patients enrolled (age, median [interquartile range]: 75 [11] years; 103 men), the prevalence of prestroke sarcopenia was 15% ( $n = 27$ ). Compared with the nonsarcopenia group, the prestroke sarcopenia group was older ( $P = .007$ ), more likely to be female ( $P = .01$ ), and demonstrate higher NIHSS score ( $P = .002$ ). The crude odds ratio for the presence of prestroke sarcopenia and moderate to severe stroke (NIHSS score  $> 5$ ) was 4.00 (95% confidence interval, 1.68-9.53;  $P = .002$ ). After adjusting for confounding variables (age, sex, and stroke risk factors) the presence of prestroke sarcopenia remained an independent predictor of moderate to severe stroke, with an odds ratio of 3.54 (95% confidence interval, 1.32-9.49;  $P = .01$ ) [Tables 1 and 2](#).

## Discussion

We studied the relationship between prestroke sarcopenia and acute stroke severity. We showed that prestroke sarcopenia is an independent predictor of moderate to severe stroke in elderly patients with acute stroke.

Previous studies showed that the presence of sarcopenia is a risk factor for cardiovascular disease.<sup>10</sup> Park et al. also showed the relationships between sarcopenia and prevalence of stroke in a cross-sectional study,<sup>11</sup> and Minn et al. studied the relationships between skeletal muscle mass and brain white matter changes or silent infarction.<sup>18</sup> However, there is no previous study that evaluates the association between prestroke sarcopenia and stroke severity.

There are several possible explanations for the adverse effect of prestroke sarcopenia on stroke severity. The patients with prestroke sarcopenia may have decreased muscle function, which may make it more difficult to move their arms or legs. As a result, their paralysis may

**Table 1.** Patients' baseline characteristics

	All stroke (n = 183)	Nonsarcopenia (n = 156)	Prestroke sarcopenia (n = 27)	P value
Age (years)	75 (11)	75 (10)	80 (14)	.007
Gender (men/female)	103/80	94/62	9/18	.01
Body mass index (kg/m <sup>2</sup> )	23 (4)	23 (4)	23 (4)	.81
NIHSS score	2 (3)	2 (3)	4 (7)	.002
Stroke type (infarct/hemorrhage)	150/33	126/30	24/3	.42
Stroke risk factors (%)				
Hypertension	86 (47)	74 (47)	12 (44)	.84
Diabetes	49 (27)	39 (25)	10 (37)	.24
Previous stroke	59 (32)	46 (30)	13 (48)	.07
Hypercholesterolemia	52 (28)	47 (30)	5 (19)	.26
Ischemic heart disease	19 (10)	16 (10)	3 (11)	1.00
Atrial fibrillation	19 (10)	16 (10)	3 (11)	1.00
Smoking	28 (15)	25 (16)	3 (11)	.77
Laterality of the lesion (right/left/both)	90/89/4	78/74/4	12/15/0	.56

NIHSS, National Institutes of Health Stroke Scale.

be evaluated as more severe. Other studies have demonstrated the role of inflammation in sarcopenia.<sup>19</sup> They showed that chronic low-grade inflammation contributes to the loss of muscle mass, strength, and functionality.<sup>19</sup> It was also reported that inflammation in acute ischemic stroke exacerbates the spread of damage to the ischemic penumbra.<sup>20</sup> Based on these findings, the neurological severity in elderly patients with stroke may be due to the negative effects of sarcopenia-related inflammation. Another study showed that a higher amount of moderate–vigorous PA seems to contribute to counteracting the development of sarcopenia<sup>15</sup>; as such, our prestroke sarcopenia patients may also be less active than nonsarcopenia patients. One recent study showed a causal relationship between less PA and higher NIHSS score on admission in patients with elderly stroke.<sup>14</sup> It seems that sarcopenia-related inflammation or low PA level may be an intermediary factor for severe neurological symptoms in these patients. However, we could not prove whether these associations are truly caused by sarcopenia in this

study. Further studies are needed to investigate these causal relationships with stroke severity.

This study has several limitations. First, it was single-centered and small sample study. Second, the SARC-F, a screening tool for detecting sarcopenia, has a low sensitivity but a high specificity<sup>17</sup>; thus, the prestroke sarcopenia severity may have been underestimated. Third, we could not measure prestroke PA. A relationship between PA and stroke severity has been reported in a recent study,<sup>14</sup> and therefore, the level of prestroke PA might have confounded our results. Fourth, we could not include the renal dysfunction<sup>21</sup> or peripheral artery disease<sup>22</sup> such as other risk factors for stroke because of our small sample study. Fifth, we did not include the stroke type (infarction or hemorrhage) as an independent variable for logistic analysis, even though hemorrhagic stroke patients are often more severe than ischemic stroke patients in the acute phase.<sup>23</sup> We chose the independent variables from the “prestroke” status because our aim was to detect the effect of “prestroke” sarcopenia on neurological disease severity. Future community-based prospective cohort

**Table 2.** Logistic regression analyses for moderate to severe stroke

	Crude		Adjusted	
	Odds ratio (95% CI)	P value	Odds ratio (95% CI)	P value
Prestroke sarcopenia	4.00 (1.68-9.53)	.002	3.54 (1.32-9.49)	.01
Age	1.03 (.98-1.09)	.22	1.00 (.94-1.06)	.94
Gender	.73 (.35-1.49)	.38	.78 (.33-1.83)	.57
Hypertension	1.75 (.85-3.57)	.13	1.83 (.82-4.09)	.14
Diabetes	1.15 (.52-2.56)	.73	1.01 (.41-2.52)	.98
Previous stroke	1.25 (1.09-1.45)	.002	1.35 (.58-3.15)	.49
Hypercholesterolemia	.32 (.12-.86)	.02	.34 (.12-.99)	.048
Ischemic heart disease	1.89 (.67-5.26)	.23	1.85 (.55-6.22)	.32
Atrial fibrillation	2.50 (.91-6.67)	.08	2.66 (.87-8.14)	.09
Smoking	.81 (.28-2.27)	.68	1.04 (.32-3.31)	.95

studies should further investigate whether the presence of sarcopenia is a risk factor for occurrence of stroke or for its severity.

## Conclusions

Our findings show that the presence of prestroke sarcopenia predicts moderate to severe stroke in elderly patients with acute stroke. As such, the prevention of sarcopenia may contribute to protecting against severe neurological symptoms in these subjects.

## Disclosures

None.

## Conflicts of Interest

There are no conflicts of interest to declare.

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