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Risk of Exclusion From Stroke Rehabilitation in the Oldest Old

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Running Head: Stroke rehabilitation in the oldest-old

Risk of exclusion from stroke rehabilitation in the oldest-old

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1 Risk of exclusion from stroke rehabilitation in the oldest-old

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4 Abstract

5 **Objective:** To investigate whether oldest-old age (≥ 85 yr) is an independent predictor of exclusion
6 from stroke rehabilitation.

7 **Design:** Retrospective cohort study.

8 **Setting:** Stroke Unit (SU) of an Italian tertiary hospital.

9 **Participants:** 1055 elderly patients (age 65-74 yr, n=230; age, 75-84 yr, n=432; age ≥ 85 yr,
10 n=393), who, between 2009 and 2012, were admitted to SU with acute stroke and evaluated by a
11 multiprofessional team for access to rehabilitation. The study excluded patients for whom
12 rehabilitation was unnecessary or inappropriate.

13 **Interventions:** Not applicable.

14 **Main Outcome Measures:** Access to an early mobilization (EM) protocol during SU stay and
15 subsequent access to post-acute rehabilitation after SU discharge. Analyses were adjusted for
16 prestroke and stroke-related characteristics.

17 **Results:** 32.2% of patients were excluded from EM. Multivariable-adjusted Odds Ratio (OR) of
18 EM exclusion was 1.30 (95% CI: 0.76, 2.21) for age 75-84 yr and 2.07 (95% CI: 1.19, 3.59) for age
19 ≥ 85 yr compared to age 65-74 yr. Of 656 patients admitted to EM and who, at SU discharge, had
20 not yet fully recovered their prestroke functional status, 18.4% were excluded from post-acute
21 rehabilitation. For patients able to walk unassisted at SU discharge, probability of exclusion did not
22 change across age groups. For patients unable to walk unassisted at SU discharge, OR of exclusion
23 from post-acute rehabilitation was 3.74 (95% CI: 1.26, 11.13) for age 75-84 yr and 9.15 (95% CI:
24 3.05, 27.46) for age ≥ 85 yr compared to age 65-74 yr.

25 **Conclusion:** Oldest-old age is an independent predictor of exclusion from stroke rehabilitation.

26

27 **MeSH Keywords:**

28 Aged, 80 and over

29 Stroke, Rehabilitation

30 Ageism

31 Cohort Studies

32

33

34 **List of Abbreviations:**

35 EM, early mobilization

36 ICH, intracerebral hemorrhage

37 IS, ischemic stroke

38 mRS, modified Rankin Scale

39 NHS, National Health System

40 SU, Stroke Unit

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55 Stroke incidence is high in the elderly (age ≥ 65 yr) and reaches a peak in the oldest-old (age ≥ 85
56 yr).^{1,2} Oldest-old persons represent the fastest growing segment of the population in developed
57 countries and are characterized by a great heterogeneity in their health status and ability to
58 withstand acute illnesses.³

59

60 Compared to younger elderly patients, stroke in the oldest-old is associated with higher severity and
61 worse outcomes.^{1,4} However, the oldest-old can benefit from early organized multidisciplinary
62 stroke care (Stroke Unit [SU]) as effectively as younger stroke patients⁵

63

64 Post-acute rehabilitation is a major component of SU care.⁶⁻⁸ A growing literature also supports the
65 safety and efficacy of early mobilization (EM).⁶ The term EM broadly refers to any rehabilitation
66 intervention aimed at getting the patients out of bed already within the first 24 to 72 hours after an
67 acute stroke.⁶

68

69 According to current evidence, age per se is not considered a reason for exclusion from stroke
70 rehabilitation.⁹⁻¹² However, studies of hospital resource use in Western countries show that oldest-
71 old patients admitted to SU are not investigated nor provided medical treatment as actively as
72 younger elderly patients because of age discrimination.^{13,14} Existing literature suggests that ageism
73 also influences access to stroke rehabilitation, but specific information about oldest-old is scant.¹⁵⁻¹⁸

74

75 An Australian¹⁵ and an European study¹⁶ reported an inverse association between age and access to
76 stroke rehabilitation. Both studies were multicentric but neither provided age-specific rates of
77 exclusion and one did not even include oldest-old patients.¹⁶ In a study of Italian patients admitted
78 to hospital with acute stroke, risk of exclusion from rehabilitation was higher for those aged ≥ 80 yr
compared to younger patients.¹⁷ Similar findings were reported in a French population-based study

79 based on data from a stroke registry.¹⁸ None of these studies, however made any attempt to identify
80 those patients for whom rehabilitation would be unnecessary or inappropriate. Therefore, risk of
81 exclusion for the oldest-old might have been overestimated, because prevalence of many conditions
82 that can actually impede rehabilitation increases with age.¹⁹⁻²²

83

84 The present study investigated whether, in a cohort of elderly stroke patients admitted to an Italian
85 SU, oldest-old age was a predictor of exclusion from EM and post-acute rehabilitation independent
86 of confounding from prestroke and stroke-related conditions.

87

88 **Methods**

89

90

91 *Design and Setting*

92 Data for this study were drawn from a prospective computer-based registry of 1514 patients aged \geq
93 65 who, between 2007 and 2012, were consecutively admitted to the Stroke Unit of the Maggiore
94 Hospital (20 beds) with diagnosis of acute stroke.^{23,24} The Maggiore Hospital is a tertiary hospital,
95 located in Bologna, Emilia Romagna Region, Italy. Stroke diagnosis (either ischemic stroke or
96 spontaneous intracerebral hemorrhage) was based on clinical criteria²⁵ and at least one brain CT-
97 scan performed within 24 hours after hospital admission. The registry did not include: (1) patients
98 with ischemic stroke who underwent thrombolysis (in Italy, this treatment has been licensed for age
99 \geq 80 yr only since April 2016); (2) patients with hemorrhagic stroke due to trauma, brain tumor,
100 infections, vascular malformations, vasculitis, and hemorrhagic transformation of ischemic stroke.
101 Data about rehabilitation decisions during SU stay were regularly recorded in medical charts
102 starting from January 1, 2009. Therefore, we considered eligible for the present study only the 1395
103 patients admitted to the Maggiore SU after this date. Of these, we excluded: (1) patients for whom
104 any rehabilitation intervention would be inappropriate because of severe prestroke disability, defined

105 as score 5 at the modified Rankin Scale²⁶ ([mRS], n=47); (2) patients with concurrent bone
106 fractures impeding mobilization (n=6); (3) patients who did not need any rehabilitation because
107 admitted to SU with minimal neurologic impairment (n=267). Italy has a publicly financed National
108 Health System (NHS) that fully covers rehabilitation expenses for all stroke patients discharged
109 with a rehabilitation plan. Inpatient stroke rehabilitation is provided in rehabilitation wards of public
110 or private accredited hospital facilities. However, the Italian NIHSS does not cover rehabilitation
111 expenses for stroke patients already institutionalized before stroke. Therefore, for the purposes of
112 this study we additionally patients living in institution before SU admission (n=20). The Maggiore
113 Hospital Ethics Committee approved the study. All subjects (or their legally authorized
114 representatives) provided written informed consent.

115

116 *Rehabilitation triage process*

117 The multiprofessional team of the Maggiore SU included a neurologist, a geriatrician, a physiatrist,
118 nurses, and physiotherapists. Within 48 hours from SU admission all patients were evaluated by the
119 SU-team to identify those who could benefit from an early mobilization (EM) protocol under the
120 physiotherapists' supervision. The EM protocol aimed to assist the patient to be out of bed (sitting,
121 standing, or walking as able) as soon as 24 hours after stroke onset. Before SU discharge, patients
122 admitted to EM were reassessed by the SU team to identify those who could benefit from a post-
123 acute rehabilitation plan (either home-based or inpatient). According to available literature for
124 selection of potential rehabilitation patients in acute hospitals,¹⁹⁻²² EM and post-acute rehabilitation
125 were considered inappropriate for SU patients with the following conditions: medical instability due
126 to organ failure or severe sepsis; life expectancy < 3 months; severe prestroke disability; and severe
127 dementia with behavioral disorders.

128

129 ***Covariates***

130 Covariates for multivariable-adjusted analyses involving EM included a large number of prestroke
131 and stroke-related characteristics (listed and defined in **Table 1**). According to existing literature,
132 all of these characteristics are associated with poor functional prognosis and may influence the
133 stroke rehabilitation triage.^{21,22,27-29} Multivariable-adjusted analyses involving post-acute
134 rehabilitation additionally included mRS score at SU discharge as a measure of post-stroke
135 functional damage, which is known to affect decisions about post-acute rehabilitation.⁸ All
136 information was derived from SU medical records. Data about aphasia and weekend admission or
137 discharge were also available but we chose to not include them in the present report because
138 corollary analyses showed that these covariates did not modify results.

139

140 ***Statistical analyses***

141 Age was analyzed as a categorical variable (65-74, 75-84, and ≥ 85 yr).³ Univariate associations of
142 the covariates with admission to EM and post-acute rehabilitation were assessed using χ^2 -test for
143 categorical predictors and Student t-test for continuous variables. The association of age with
144 exclusion from EM and post-acute rehabilitation was investigated using logistic regression.
145 Analyses for post-acute rehabilitation were limited to patients admitted to EM who, at SU
146 discharge, had not yet fully recovered to their prestroke functional status. All analyses were
147 performed using SPSS software.⁴⁰ Models were tested for interactions. Significance tests were 2-
148 tailed. Significance was set at $p < 0.05$ for univariate analyses and $p < 0.025$ for logistic regression
149 (Bonferroni's adjustment for two sets of models). Study power was 0.85 to identify an Odds Ratio
150 (OR) of 1.3 at $p = 0.05$.

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153

154

Results

156

157

EM protocol

159 The final study sample included 1055 patients (all of white race; age range 65-103 yr). Of these,
160 340 (32.2%) were excluded from EM after the first evaluation by the SU team. Univariate analyses
161 (**Table 2**) showed that excluded patients were older (84 ± 7 yr vs 80 ± 7 yr, $p < 0.001$) and more likely
162 to have unfavorable prestroke characteristics, ICH, and more severe stroke on admission. The most
163 frequently reported reason for exclusion was medical instability (93.2%), followed by dementia
164 (5.5%) and prestroke disability (4.3%). Of those excluded because of medical instability, 61.9%
165 died during SU stay.

166 In logistic regression analyses using age 65-74 yr as the reference group, (**Table 3**), unadjusted
167 odds of EM exclusion were significantly increased for both age 75-84 and ≥ 85 yr; the increase
168 remained statistically significant after adjustment for prestroke characteristics. After further
169 adjustment for stroke-related characteristics, odds of EM exclusion with respect to age 65-74 yr did
170 not vary for age 75-74 yr but doubled for age ≥ 85 yr. Results for age ≥ 85 yr did not change after
171 exclusion of patients who died in SU (OR: 4.14; 95% CI: 1.78, 9.58).

172

Post-acute rehabilitation

174 Of the 715 patients admitted to EM, two died in SU, three were transferred to other acute care
175 settings because of complications, and 41 fully recovered to prestroke functional status during SU
176 stay and were directly discharged home. Of the remaining 656 patients, 121 (18.4%) were excluded
177 from post-acute rehabilitation. Noteworthy, none of these patients had developed major conditions
178 impeding rehabilitation and the final decision of the SU team, as recorded in the patients' medical
179 record, did not state a specific reason for rehabilitation exclusion. Among patients admitted to post-
180 acute rehabilitation, 94.2% were transferred to inpatient facilities and only a minority ($n=31$) were

181 discharged with an outpatient rehabilitation plan. Among patients excluded from post-acute
182 rehabilitation, 55.4% (n=67) went back home (17 after a temporary stay in long-term care services)
183 and 44.6% were transferred to long-term-care services for definitive institutionalization. Univariate
184 analyses (**Table 4**) showed that patients excluded from post-acute rehabilitation were older (83 ± 8 yr
185 vs 79 ± 7 yr, $p < 0.001$) and more likely to have prestroke urinary incontinence, diabetes mellitus,
186 more severe stroke-related characteristics, and higher mRS both prestroke and at SU discharge.
187 Multivariable-adjusted logistic regression analyses for exclusion from post-acute rehabilitation
188 showed a significant interaction of age with discharge mRS (p-value = 0.006). To explore the nature
189 of this interaction, we graphed predicted probabilities of exclusion from post-acute rehabilitation by
190 discharge mRS and age group. **Figure 1** shows how, for age 65-74 yr, probability of exclusion
191 decreased across increasing levels of discharge mRS. The corresponding OR for increase in one
192 level of discharge mRS was 0.42; 95% CI: 0.30,0.59. A similar association found for age 75-84 yr
193 (OR: 0.56; 95% CI: 0.43,0.72), although average probability of exclusion tended to be higher than
194 age 64-75 yr. By contrast, no association between probability of exclusion and discharge mRS was
195 found for age ≥ 85 yr (OR: 0.81; 95% CI: 0.56,1.19). **Table 5** further illustrates how odds of
196 exclusion did not vary across age groups among patients able to walk unassisted at SU discharge
197 (mRS ≤ 3) but increased with age and were highest for age ≥ 85 yr among patients unable to walk
198 unassisted at SU discharge (mRS > 3).

199

200 Discussion

201

202

203 This study shows that, in an elderly cohort with acute stroke admitted to an Italian SU, oldest-old
204 age was a predictor of exclusion from both EM and post-acute rehabilitation. The association was
205 independent of several socio-demographic and medical characteristics known to affect the stroke
206 rehabilitation triage.^{21,22,27-29} Our findings contrasts with growing evidence that rehabilitation

207 should not be denied based on age alone.⁹⁻¹² However, they agree with existing evidence of ageism
208 for other core elements of stroke treatment in SU of Western countries.^{13,14} Previous studies of
209 ageism and stroke rehabilitation are few, circumscribed to post-acute rehabilitation, and lacking
210 specific and reliable information about the oldest-old.¹⁵⁻¹⁸ Therefore, our findings may be useful to
211 promote equal access to all aspects of specialized stroke care regardless of age.

212
213 A first result of our study is that risk of EM exclusion doubled for age ≥ 85 yr compared to age 65-
214 74 yr. The most frequently reported reason for EM exclusion was medical instability and only a few
215 patients were excluded because of prestroke geriatric conditions such as disability and dementia.
216 There is agreement that rehabilitation is inappropriate for medically unstable patients.^{6,20} Our
217 findings for EM, however, did not change when excluding from analysis the patients who died
218 during SU stay. Therefore, some of our oldest-old stroke patients might have been denied EM
219 because age per se negatively influenced the decision of the SU team about the patient's potential
220 for functional improvement.

221
222 A second result is that, among the elderly stroke patients who, at SU discharge, had not yet
223 recovered their prestroke functional level, age modified the association between risk of exclusion
224 from post-acute rehabilitation and level of post-stroke functional damage as measured by mRS at
225 SU discharge. For both age 65-74 yr and 75-84 yr, probability of exclusion decreased with
226 increasing discharge mRS. This inverse association reflects a basic concept of stroke rehabilitation:
227 the expected functional gain is highest for patients with severe disability and lowest for those with
228 mild disability because of a "ceiling effect".⁸ Therefore, in a real-world clinical practice with
229 limited resources, patients with more severe disability are likely to be favored over patients with
230 minimal disability. The inverse association between probability of exclusion and discharge mRS,
231 however, disappeared for age ≥ 85 yr. This suggests that oldest-old patients did not receive post-
232 acute rehabilitation according to their actual poststroke disability level. In particular, among patients

233 unable to walk unassisted at SU discharge, risk of exclusion from post-acute rehabilitation was
234 highest for age ≥ 85 yr. Absolute values for risk estimates should be taken with caution, because of
235 the wide confidence intervals, but they clearly suggest an increase across age groups.

236 Our findings for post-acute rehabilitation can be explained by several factors. First, limited
237 availability of beds in inpatients rehabilitation facilities might favor younger patients over the
238 oldest-old. Second, although the SU multidisciplinary team included a geriatrician and conducted a
239 joint evaluation, in Italy only the physiatrist can actually plan a rehabilitation intervention and
240 authorize transfer to a rehabilitation facility. Age is allegedly one of the lower ranked prognostic
241 features in studies investigating decision-making by rehabilitation assessors.²⁹ However, an analysis
242 of responses to simulated case scenarios showed that advanced age of the patients was associated
243 with the highest variability in the physiatrists' final decision about rehabilitation potential after
244 stroke.⁴¹ Moreover, older age is still frequently an explicit exclusion factor in stroke rehabilitation
245 studies.⁴² Third, in order to be feasible and effective, rehabilitation interventions for oldest-old
246 stroke patients should be highly customized. The rehabilitation plan should take into account the
247 patient's strengths and limitations across multiple (clinical, functional, psycho-cognitive, social)
248 dimensions and target the problem that can mostly jeopardize the patient's vitality and ability to
249 return home.⁴³ This level of personalization, however, is not currently attained in most rehabilitation
250 services with financial coverage from the Italian NHS. Although elderly stroke patients admitted to
251 Italian rehabilitation services usually undergo shorter daily therapy sessions than young patients
252 (only one hour instead of three), some of the oldest-old patients of this cohort may have been
253 deemed too frail even to sustain a standard low intensity regimen. Fourth, programs to promote
254 health and wellbeing of oldest-old persons represent a significant part of the Italian public welfare
255 expenditures,⁴⁴ but Italian society is not immune from negative stereotypes of aging that may
256 influence the rehabilitation triage of oldest-old persons.⁴⁵ Finally, we cannot exclude that our
257 findings reflect a failure of our study design to adequately measure and account for all the age-
258 related conditions that, in the individual patient, can justify exclusion from rehabilitation. This is

259 currently an intrinsic bias of all rehabilitation studies because there is no standardized model for
260 objectively determining a patient's potential to benefit from rehabilitation.^{29,46} Our study, however,
261 took into account a large number of prestroke and stroke-related characteristics known to influence
262 access to rehabilitation in clinical practice.^{21,22,27-29} Moreover, analyses for risk of exclusion from
263 post-acute rehabilitation were performed on a subset of patients who had been previously admitted
264 to EM and, therefore, had already been screened for major conditions precluding rehabilitation.

265

266 *Limitations of the Study*

267 This study has several limitations. First, this was a retrospective, single center study and the results
268 may not apply outside of Italy because provision of stroke rehabilitation by different national
269 healthcare systems strongly depends on local organization and resources.¹⁶ However, our data are of
270 interest because they provide a contemporary representation of the stroke rehabilitation triage
271 process in elderly patients admitted to the SU of a tertiary hospital. Second, reasons for exclusion
272 from post-acute rehabilitation were not recorded in the patients' medical charts and we cannot
273 exclude confounding from unmeasured covariates. Socio-demographic information was limited to
274 prestroke living situation and we lack information about the actual willingness and ability of
275 existing relatives to take care of the patients after hospital discharge. This information is relevant
276 because the Italian NHS does not cover rehabilitation expenses when stroke patients are discharged
277 with a plan of definitive institutionalization. Therefore, for these patients, we ignore whether the
278 actual reason for exclusion from post-acute rehabilitation was lack of rehabilitation potential or lack
279 of alternatives to institutionalization because of an insufficient social network. Moreover, the
280 Maggiore SU did not perform any formal assessment of balance and cognitive impairment, which
281 are included in some rehabilitation scales for elderly persons,⁴⁶ The stroke scales used in this study
282 are well validated in both clinical and research settings but mostly focus on walking and motor
283 ability. Moreover, we lack information about need for a walking device and the patient's ability to
284 use it, which may also have influenced the final decisions of the SU team. However, our analyses

285 took into account prestroke diagnosis of dementia. Finally, we defined prestroke malnutrition based
286 upon serum albumin, which is an acknowledged indicator of nutritional status in the elderly, but did
287 not include information about anthropometric parameters such as body mass index.³⁵ A third reason
288 for caution in the interpretation of our findings is the uncertainty still surrounding determinants and
289 predictors of EM.⁶ Fourth, our exclusion criteria may have penalized older patients and lead to
290 underestimation of the association between age and exclusion from stroke rehabilitation. Finally,
291 the study design does not allow inferences about the cost-effectiveness of EM and post-acute
292 rehabilitation in our cohort.

293

294 ***Conclusions***

295 This study shows that, among patients admitted to SU with acute stroke, oldest-old age is an
296 independent predictor of exclusion from EM. Moreover, among stroke patients who at SU discharge
297 are unable to walk unassisted, older age per se is associated with a higher probability of not
298 accessing post-acute rehabilitation. Currently, the stroke rehabilitation triage process mainly relies
299 on subjective clinical judgment.^{20,41,47} A strong argument has been made for the viewpoint that
300 defining formal criteria for access to rehabilitation may either increase stroke costs (by selecting
301 inappropriate patients) or create self-fulfilling prophecies (by excluding appropriate patients).^{47,48}
302 However, when oldest-old stroke patients are concerned, lack of explicit guidelines often lead to
303 therapeutic inertia.⁴⁹ We hypothesize that the current lack of evidence-based recommendations for
304 rehabilitation of oldest-old stroke patients is likely to favor age discrimination for access to
305 rehabilitation interventions.

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Figure 1. Probability of exclusion from post-acute rehabilitation by age groups and modified Rankin Scale score at discharge from Stroke Unit.

Estimates are from a logistic regression model adjusted for prestroke and stroke-related characteristics (see Table 1 for a detailed list of covariates). The model included 656 patients admitted to early mobilization and who had not yet recovered their prestroke functional level at discharge from Stroke Unit. Number of patients was 171 for age 65-74 yr, 281 for age 75-84 yr, and 204 for age ≥ 85 yr.

Table 1. Characteristics of patients admitted to Stroke Unit with acute stroke

Characteristics	Definition
<i>Prestroke</i>	
Sex, race, living alone	
Disability	Modified Rankin Scale ²⁶ in the week before SU admission. Full range for this scale is 0-5 (no symptoms-severe disability requiring constant nursing care and attention, bedridden, incontinent) but patients with severe prestroke disability (score 5) were considered ineligible for this study.
Urinary incontinence	Bladder item of Barthel Index Score < 10 ³⁰ in the week before SU admission
Heart failure, hypertension	Documented prior diagnosis or current specific treatment
Atrial fibrillation	Documented prior diagnosis of chronic/paroxysmal atrial fibrillation or positive EKG during SU stay
Diabetes mellitus	Documented prior diagnosis, current treatment, or glycated hemoglobin $\geq 6.5\%$ ³¹ (routine blood tests at SU admission)
Dementia	Documented prior diagnosis, current treatment, or clinical criteria ³² for at least six months before SU admission
Comorbidity	Charlson Comorbidity Index (CCI) ³³ ≥ 2 ³⁴ (range 0-37, no comorbidity, very severe comorbidity)
Malnutrition	Serum albumin < 3.5 mg/dl ³⁵ (routine blood tests at SU admission)
<i>Stroke-related</i>	
Stroke type	Categorized as lacunar ischemic stroke, non-lacunar ischemic stroke, and intracerebral hemorrhage ³⁶
Stroke severity	National Institutes of Health Stroke Scale score ³⁷ on Stroke Unit

admission, categorized as 0-6, 7-15, ≥ 16 ³⁸ (range, 0-42, no stroke symptoms-very severe stroke)

Coma Glasgow Coma Scale score 3-8³⁹ on Stroke Unit admission

Severe dysphagia Need for nasogastric tube during Stroke Unit stay

All information was derived from the patients' medical records. For prestroke characteristics, information was recorded as provided by the patient or their primary caregiver unless otherwise specified.

Table 2. Characteristics of elderly stroke patients by access to early mobilization

Characteristics	Admitted (n = 715)	Excluded (n = 340)	P-value
<i>Prestroke</i>			
Age group, yr			<0.001
65-74	184 (25.7)	46 (13.5)	
75-74	301 (42.1)	131 (38.5)	
≥85	230 (32.3)	163 (47.9)	
Female sex	404 (56.5)	209 (61.5)	0.126
Living alone	216 (30.2)	77 (22.6)	0.010
Modified Rankin Scale score			<0.001
0	437 (61.1)	141 (41.5)	
1	89 (12.4)	44 (12.9)	
2	71 (9.9)	25 (7.4)	
3	79 (11.0)	78 (22.9)	
4	39 (5.5)	52 (15.3)	
Urinary incontinence	39 (5.5)	37 (10.9)	0.001
Charlson Comorbidity Index ≥2	278 (38.9)	165 (48.5)	0.003
Chronic heart failure	42 (5.9)	34 (10.0)	0.015
Diabetes mellitus	223 (31.2)	97 (28.5)	0.380
Hypertension	549 (76.8)	248 (72.9)	0.175
Dementia	99 (13.8)	96 (28.2)	<0.001
Atrial fibrillation	175 (24.8)	127 (37.4)	<0.001
Serum albumin < 3.5 gr/dl	321 (44.9)	172 (50.6)	0.083

Stroke-related

Stroke type			<0.001
Lacunar ischemic stroke	159 (22.5)	3 (0.9)	
Non-lacunar ischemic stroke	347 (48.5)	161 (47.4)	
Intracerebral Hemorrhage	209 (29.2)	176 (51.8)	
Coma	24 (3.4)	136 (40.0)	< 0.001
National Institutes of Health Stroke Scale score			< 0.001
0-6	314 (43.9)	22 (6.5)	
7-15	241 (33.7)	45 (13.2)	
≥16	160 (22.5)	273 (80.3)	
Severe dysphagia	157 (22.0)	247 (72.6)	0.001

Data are reported as number (%). P-values are for χ^2 -test. Abbreviations NIHSS, National Institutes of Health Stroke Scale, SU, stroke unit.

Table 3. Association of age with exclusion from an early mobilization protocol in elderly stroke patients

	65-74 yr	75-84 yr	≥85 yr
	(n=230)	(n=432)	(n=393)
Excluded, n (%)	46 (13.5)	131 (38.5)	163 (47.9)
Unadjusted OR (95% CI)	1.00	1.74 (1.19-2.55)	2.84 (1.94-4.15)
Model 1 OR (95% CI)	1.00	1.58 (1.05-2.36)	2.26 (1.49-3.41)
Model 2 OR (95% CI)	1.00	1.30 (0.76-2.21)	2.07 (1.19-3.59)

Odds Ratios (OR) and 95% Confidence Intervals (CI) are from logistic regression. Model 1 was adjusted for prestroke characteristics whereas Model 2 was additionally adjusted for stroke-related characteristics on SU admission (see Table 1 for a detailed list of covariates).

Table 4. Characteristics of elderly stroke patients by admission to post-acute rehabilitation

Characteristics	Admitted (n = 535)	Excluded (n = 121)	P-value
<i>Prestroke</i>			
Age group, yr			<0.001
65-74	153 (28.6)	18 (14.9)	
75-74	234 (43.7)	47 (38.8)	
≥85	148 (27.7)	56 (46.3)	
Female sex	297 (55.5)	72 (59.5)	0.424
Living alone	167 (31.2)	32 (26.4)	0.303
Modified Rankin Scale score			0.147
0	348 (65.0)	66 (54.5)	
1	60 (11.2)	21 (17.4)	
2	50 (9.3)	10 (8.3)	
3	53 (9.9)	17 (14.0)	
4	24 (4.5)	7 (5.8)	
Urinary incontinence	20 (3.7)	11 (9.1)	0.012
Charlson Comorbidity Index ≥ 2	209 (39.1)	46 (38.0)	0.831
Chronic heart failure	33 (6.4)	3 (2.5)	0.095
Diabetes	182 (34.0)	28 (23.1)	0.021
Hypertension	419 (78.3)	87 (71.9)	0.129
Dementia	68 (12.7)	17 (14.0)	0.692
Atrial fibrillation	128 (23.9)	36 (29.8)	0.181
Serum albumin < 3.5 gr/dl	230 (43.0)	57 (47.1)	0.410

Stroke-related

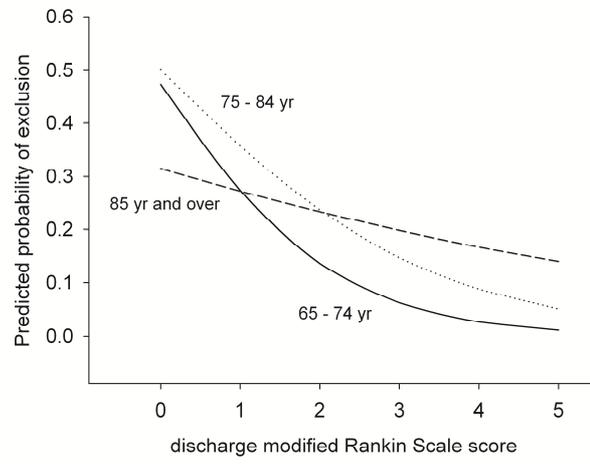
Stroke type			0.140
Lacunar ischemic stroke	109 (20.4)	31 (25.6)	
Non-lacunar ischemic stroke	261 (48.8)	63 (52.1)	
Intracerebral hemorrhage	165 (30.8)	27 (22.3)	
Coma	12 (2.2)	11 (9.1)	0.001
National Institutes of Health Stroke Scale score			0.023
0-6	227 (42.4)	50 (41.3)	
7-15	193 (36.1)	32 (26.4)	
≥ 16	115 (21.5)	39 (32.2)	
Severe dysphagia	105 (19.6)	39 (32.2)	0.002
Modified Rankin Scale score at discharge from Stroke Unit			<0.001
0	10 (1.9)	2 (1.7)	
1	20 (3.7)	22 (18.2)	
2	25 (4.7)	10 (8.3)	
3	84 (15.7)	11 (9.1)	
4	230 (43.0)	28 (23.1)	
5	166 (31.0)	48 (39.7)	

Data are reported as number (%) unless otherwise specified. P-values are for χ^2 -test.

Table 5. Association of age with exclusion from post-acute rehabilitation in elderly stroke patients stratified by ability to walk unassisted at discharge from Stroke Unit

	65-74 yr	75-84 yr	≥85 yr
Able to walk unassisted	(n=68)	(n=81)	(n=35)
Excluded, n (%)	13 (19.1)	21 (25.9.5)	11 (31.4)
OR (95% CI)	1.00	1.93 (0.77-4.83)	1.70 (0.52-5.58)
Unable to walk unassisted	(n=103)	(n=200)	(n=169)
Excluded, n (%)	5 (4.8)	26 (13.0)	45 (26.6)
OR (95% CI)	1.00	3.74 (1.26-11.13)	9.15 (3.05-27.46)

Odds Ratios (OR) and 95% Confidence Intervals (CI) are from logistic regression. The final model was adjusted for prestroke and stroke-related characteristics on Stroke Unit admission (see Table 1 for a detailed list of covariates). According to their modified Rankin Scale score at Stroke Unit discharge, patients were stratified as able (score 0-3) or unable to walk unassisted (score 4-5).



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