A population-based study of determinants of initial secondary care costs of acute stroke in the UK

Ramon Luengo-Fernandez, **Alastair M. Gray, Peter M. Rothwell**

Ramon Luengo-Fernandez MSc: **Alastair M. Gray** PhD, Health Economics Research Centre, Department of Public Health, University of Oxford; **Peter M. Rothwell** FRCP, Stroke Prevention Research Unit, Department of Clinical Neurology, University of Oxford.

Abstract

Background and Purpose

To determine the cost-effectiveness of specific interventions to prevent or treat acute stroke, it is necessary to know the costs of stroke according to patient characteristics and stroke subtype and aetiology. However, very few such data are available and none from population-based studies. We determined the predictors of resource use and acute care costs of stroke using data from a population-based study.

Methods

Data were obtained from the Oxford Vascular study, a population-based cohort of all individuals in nine general practices in Oxfordshire, UK, which identified 346 patients with a first or recurrent stroke during 01/04/2002 to 31/03/04. Univariate and multivariate analyses were performed to identify the main predictors of resource use and costs.

Results

Acute care costs ranged from £326 (lower decile) to £19,901 (upper decile). There were multiple important univariate interrelations of patient characteristics, stroke subtype and stroke aetiology with hospital admission, length of stay, and 30-day case-fatality. For example, patients with primary intracerebral haemorrhage were more likely to be admitted than patients with partial anterior circulation ischaemic stroke and less likely to survive without disability, but length of stay was reduced due to high early case-fatality, such that cost was substantially less. However, the majority of univariate predictors of resource use, cost and outcome were confounded by initial stroke severity as measured by the NIHSS score, which accounted for about half of the predicted variance in cost. Cost increased approximately linearly up to an NIHSS score of 18 and then fell steeply at higher scores due to rising early case-fatality.

Conclusion

Several patient and event-related characteristics explained the wide range of initial secondary care costs of acute stroke, but stroke severity was by far the most important independent predictor.

Background

Stroke is the second leading cause of death worldwide[1] and the major cause of neurological disability in adults, with stroke patients accounting for more hospital and care-home bed days than any other condition,[2] and a recent estimate of healthcare costs in the UK of €5.7 billion.[3] Previous studies have estimated the average cost per stroke in the UK,[4-7] and these costs are often used to estimate the cost-effectiveness of specific interventions to prevent or treat stroke. However, cost varies substantially between individuals and is likely to depend on the pathological subtype of stroke,[8] the particular aetiology and other patient-related characteristics, such as age, sex, and comorbidity,[9;10] all of which are likely to be relevant to estimates of cost-effectiveness of specific interventions. For instance, the cost-effectiveness of anticoagulation and carotid endarterectomy will be influenced by both the characteristics of patients in whom the treatments are used and the type or severity of strokes that are caused and prevented. More detailed data on the drivers of cost are therefore required.

Although reliable data on the overall cost of stroke are available from a recent population-based study in Australia, [8] previous studies of the predictors of resource use and stroke costs have been based on data derived from trials with strict inclusion criteria[10] or from hospital-based studies of ischaemic stroke only and with various additional exclusions.[9;11] To reliably determine the predictors of stroke resource use and costs, population-based studies with full case ascertainment (i.e. including minor strokes not admitted to hospital and strokes resulting in death prior to, or soon after, hospital-admission) are ideally required.[12] We therefore studied hospitalisation, subsequent length of stay and acute care costs during the 12 months following any first incident or recurrent stroke in a population-based study in relation to baseline patient characteristics, comorbidity, pre-morbid handicap, pathological subtype, aetiological factors, and severity of the neurological deficit at first assessment.

Methods

Study population: The (Oxford Vascular Study - OXVASC) study population comprised 91,106 individuals registered with 63 family physicians in nine Oxfordshire practices. The population was 94% white, higher than the UK average (92%), but had a similar age-sex structure to that of the UK.[13] Although the electoral wards containing the nine practices were less deprived than the rest of England,[13] two practices were based in wards ranked in the lower third nationally in terms of deprivation. Registration of patients into the study began on 1st April 2002 and this analysis includes all cases ascertained with stroke occurring prior to 31st March 2004. Comprehensive over-lapping methods of stroke ascertainment were used,[13] with direct assessments of ascertainment suggesting that it was near complete.[14]

Patients were assessed by a study clinician as soon as possible after stroke (median delay: 2 days, IQR= 1-4) either in hospital, in a dedicated daily clinic or at home. Diagnoses of stroke were verified by computed tomography (CT) or magnetic resonance imaging (MRI), with the rate of brain imaging or autopsy in OXVASC being 97%.[14] Neurological impairment was measured using the National Institutes of Health Stroke Scale (NIHSS)[15] to determine stroke severity at baseline. Clinical subtype of ischaemic stroke was categorised with the Oxford Community Stroke Project (OCSP) classificiation.[16] Stenosis of the symptomatic carotid artery was measured with Duplex ultrasound of the carotid bifurcation and categorised as 0-49%, 50-99% and occlusion – using scales based on the North American Symptomatic Carotid Endarterectomy Trial method of measurement of degree of stenosis.[17] Stroke severity at one month was classified according to handicap as measured by Rankin score,[18] and for the purposes of this analysis a non-fatal disabling stroke was classified as one-month Rankin score 3-5.

Resource use and costs: The study provided information on resource use. Diagnostic test costs were derived from national reference costs,[19] including: CT (£67), MRI (£313), electrocardiogram (ECG) (£25), echocardiogram (Echo) (£59), and carotid Doppler (£99). We assumed that those patients not requiring hospitalisation or being hospitalised more than 48 hours after initial stroke visited their GP on the day of the stroke. Unit costs for GP (£24) and out-patient (£111) visits, and emergency ambulance services (£237) were derived from Netten et al. (2005).[20] Hospital stay costs were derived and attached to each day spent in each of the following wards: general and long term care (£269),[21] stroke unit (£331),[21] and rehabilitation ward (£213).[19] Initial assessment at hospital was costed as an emergency visit (£112).[19] The perspective of the UK National Health Service (NHS) was adopted in the study. All costs were standardised to 2004/05 prices by use of the NHS hospital and community health services inflation index.[20]

Statistical Analysis: Outcome measures included the proportion of patients admitted to hospital, subsequent length of stay, and total acute care costs. We also estimated the proportion of patients with substantial disability (as measured with Rankin score 3-5 at 30-days), and death within 30-days after stroke onset. Resource use and total costs were reported as means. To account for the skewed nature of resource use and cost data, 95% CIs were calculated from 1000 bootstrap estimates.[22] Categorical outcomes are reported as proportions and exact 95% CIs computed.

Follow-up data up to 31 March 2004 were used; therefore, for those patients still in hospital it was not possible to determine when they were discharged, or if they were still alive after this date. We therefore examined the effect of censoring on our cost results using the method developed by Bang and Tsiatis.[23] This method partitions the study period (in our case one year after stroke) into smaller time periods, within each of which the total cost incurred for all patients alive at the beginning of the period is calculated. The estimated costs of patients with complete costs for each time period were weighted by the Kaplan Meier Sample Average (KMSA) estimator, using reverse censoring (i.e. the probability of not being censored at the beginning of each period), which were then summed over all periods and divided by the total number of patients to obtain an estimate of the mean total study cost. In our study we partitioned periods by days, making 365 different time periods. 95% CIs were reported around the mean censored adjusted costs using 1000 bootstrap estimates.

All predictor variables were first examined by means of univariate analysis to assess the importance of each on outcomes. For all continuous variables (NIHSS score, age, and degree of carotid stenosis) appropriate cut-off points were used to stratify patients in order to detect non-linear relations. Subsequent analysis of any linear or non-linear associations was done using the continuous variables as appropriate. All comparisons for categorical variables between groups were performed using chi-square tests. As length of stay in hospital, conditional on hospital admission, and total costs were not normally distributed, all comparisons between groups were performed using

Mann-Whitney U or the Kruskal-Wallis test to examine the differences between/among stratified groups. Statistical significance was set at $p<0.05$ level.

Multiple regression analyses were then performed. Only age was initially entered as a continuous variable, whilst NIHSS score, and degree of carotid stenosis were stratified into the same groups as those used in the univariate analysis. To determine the predictors of case-fatality and disability at one-month, logistic regressions were used. To assess the main predictors of admission and length of stay, a two-part model was used. A logistic regression model was used to assess the predictors of hospital admission, and conditional on admission, the length of hospital stay was logarithmically transformed, in order to normalise the distribution, and regressed over the same variables.

As with length of stay, total costs were logarithmically transformed. We then assessed the significance (F-test) and effect of each predictor variable on log total costs, adjusting by stroke severity (as determined by NIHSS score). Secondly, the log total costs were regressed using White's robust standard errors over all predictor variables. As we found a non-linear relationship between log total costs and NIHSS score, we decided to perform a further regression model combining all the effects of predictor variables, but including NIHSS score as a continuous variable, and also including the quadratic term of the initial NIHSS score.

Results

A total of 346 patients had either a first-ever or recurrent stroke during the study period (280 ischaemic strokes, 21 primary intracerebral haemorrhages – PICH; 17 subarachnoid haemorrhages (SAH); 28 undetermined pathology). Patients were followed-up for a minimum of one month and a maximum of two years (mean 394 (S.D. 209) days). Baseline characteristics and risk factors are reported in Table 1. NIHSS scores at baseline were available in 333 (96%) patients. Of the13 patients without an NIHSS score, 11 died shortly after stroke onset.

A total of 42 (12%) patients had a recurrent stroke during the study period, and a further 6 (2%) had two recurrences. The mean time between the first stroke in the study period and the second and third recurrent strokes were 54 (S.D. 93) and 214 (S.D. 122) days respectively. Our aim was to report only the costs associated with the first stroke in the study period, but for those patients already hospitalised when a second stroke occurred, it was not possible to separately attribute costs to the multiple strokes, and so all costs were combined together as part of the initial event.

A total of 215 (62%, 95% CI: 57%-67%) patients were admitted to hospital, with 131 (38%) being managed in the community. There were significant differences in rates of hospital admission according to stroke severity, degree of carotid stenosis, presence of atrial fibrillation, and stroke subtype groups (Table 2). Patients with a total anterior circulation ischaemic (TACI) (93%, 78-99%), PICH (95%, 76-100%) and SAH (88%, 64-99%) were the most likely to be admitted. Logistic regression showed that significant independent predictors of hospital admission were initial stroke severity (NIHSS score, p<0.001), PICH (p=0.022), and SAH (p=0.028). Patients with previous history of atrial fibrillation tended to have higher hospital admission rates than those without (p=0.085), as did patients with previous history of hypertension (p=0.096).

Conditional on admission, mean length of stay was 41 (35 to 48) days. The majority of bed-days were spent in the rehabilitation ward (53%), whilst 27% were spent in the general wards, and 12% in a stroke unit. There were significant differences in length of stay between groups in terms of stroke subtype, stroke severity and degree of carotid stenosis (Table 2). Patients suffering partial anterior circulation ischaemic stroke (PACI) and TACI had the longest length of stay conditional on hospital admission (56 days; 43-71, and 44 days; 28-65, respectively). However, after adjusting for all variables, the only significant predictor of length of stay was initial stroke severity (NIHSS score). The association with NIHSS score was non-linear and was best modelled as a quadratic expression ($p<0.001$). Although carotid occlusion did not predict length of stay in hospital, such patients tended to spend more days in hospital than those with 0-49% stenosis: 117 vs. 37 days, $p=0.066$).

The average acute care cost per patient was £6,607 (5,597-7,882) (Table 3). Inpatient rehabilitation was the major cost component, accounting for 44% of costs. Initial GP and outpatient assessment, initial investigations and ambulance services represented only around 5% of costs in the acute treatment phase. Adjusting for censoring increased the mean cost per patient to £6,906 (5,707-8,109) an increase of 4.5% when compared to mean unadjusted costs (Table 3). However, there was very considerable variation between patients in the total acute care cost of stroke (£326 in lower decile versus £19,901 in upper decile), mainly due to lower costs in patients with minor stroke, who were often not admitted to hospital, and to the wide range of severity of stroke, and hence length of stay, in patients who were admitted.

Univariate analysis showed that patients with history of atrial fibrillation incurred significantly higher costs (£9,667 vs. £5,824, $p<0.001$). There were also significant differences in total costs according to stroke severity, degree of carotid stenosis and stroke subtype (Table 4). By OCSP classification, patients suffering a TACI incurred the highest mean costs (£10,782; 6,549-16,429) whilst patients suffering a lacunar infarct (LACI) incurred the lowest mean costs (£3,426; 2,004-5,272). However, after adjusting for stroke severity, the only variable that significantly predicted total costs was degree of carotid stenosis (Table 4). Similar results were found when adjusting for all baseline variables, with carotid occlusion and stroke severity being the only significant a priori predictors of cost (Table 4).

As with length of stay, NIHSS score between 3 and 20 was the main cost predictor (Table 4). Patients with NIHSS scores of 3-10 incurred mean costs of £9,284 (6,897-12,547) and those with scores of 11-20 incurred mean costs of £13,694 (10,649-17,257). When NIHSS score was included as a continuous variable together with its quadratic form, log total cost increased linearly up to a score of 18 ($p<0.0001$), and then fell at higher scores ($p<0.0001$).

The non-linear association between NIHSS and costs is explained by the increase in admission, length of stay and survival with disability (Table 5) with increasing scores in the range of 0-20, and the sharp increase in case-fatality at scores above 20 (Table 5) with the corresponding reduction in length of stay and longer-term hospital rehabilitation. As a consequence, although only 8% of patients with primary intracerebral haemorrhage (PICH) had no disability at one month (Table 5), costs were less than those for PACI strokes because of the higher early case-fatality and short mean length of stay in patients with PICH.

Discussion

Ours is the first population-based study to estimate the predictors of hospital admission, length of stay and acute care costs of first or recurrent stroke in relation to baseline characteristics, stroke subtype, aetiology and measures of initial stroke severity. Most recent studies estimating and predicting the acute costs of stroke have either been based on data derived from trials with strict inclusion criteria or from hospitalised series, usually including only patients with ischaemic strokes and excluding patients with less severe strokes.[9;10] The only previous population-based study of the cost of stroke was done in Melbourne, Australia, which has a different healthcare system with higher rates of hospital admission, and only looked at cost in relation to OCSP subtype of stroke and stroke recurrence.[8]

Previous studies have also documented the association between cost and severity of stroke. In their study, Caro and colleagues[10] concluded that severity of stroke was the strongest predictor of treatment costs after acute ischaemic stroke. However, they studied a trial population, severity of stroke was assessed with the Barthel Index five days after the stroke, which is not the best measure of stroke severity, they did not adjust for pre-morbid Barthel, and less severe strokes (NIHHS<7) were excluded from the trial. In a hospital-based study, Diringer and colleagues[9] found that the main predictors of costs included NIHSS score, heparin treatment, presence of atrial fibrillation, female sex and presence of ischaemic heart disease. Other studies predicting in-patient length of stay, generally in rehabilitation settings, have also found stroke severity and neurological impairment to be significant predictors of subsequent length of stay[11;24;25] However, our analysis included all types of inpatient and outpatient care, and was part of a two-part model, which first assessed the characteristics predicting hospital admission, which none of these studies did.

In the UK, a large proportion of patients with minor stroke are managed in the community and investigated only in outpatient clinics. The high levels of ascertainment of such cases in OXVASC[14] allowed us to determine the proportion of patients not admitted to hospital reliably and to study the predictors of hospital admission in the UK. The detailed investigation of strokes in OXVASC also allowed us to determine the costs of stroke for different clinical and aetiological subtypes, as well as for disease severity, presence of co-morbidities and by age and sex, with our study also including resource use for patients dying shortly after stroke onset.

Our study showed that there was very considerable variation between patients in the total acute care cost of stroke. As a result, reporting the average cost of stroke, without taking into account its severity or subtype, may be meaningless when assessing the cost-effectiveness of stroke prevention or treatment interventions. For example, we found that strokes in patients with atrial fibrillation incurred more costs than those who did not as they tended to suffer from more severe strokes. Therefore, if we were to use our results to assess the cost-effectiveness of stroke prevention in patients with atrial fibrillation, using the average cost of a stroke would bias the results against prevention, as the savings generated from preventing strokes in such patients would be higher than those for preventing the "average" stroke.

Our study showed that the main baseline determinant of acute care resource use and costs of stroke was the severity of the neurological deficit (NIHSS score) at initial assessment. Although severity of carotid disease was also an independent predictor of cost, interpretation is difficult due to the non-imaging of patients with severe ischaemic stroke, either due to death soon after admission or on the basis that the patient was not a candidate for endarterectomy, usually because their stroke was too severe. The apparently low costs of stroke in patients with symptomatic carotid stenosis are therefore likely to be at least partly an artefact.

Our study had some additional limitations. First, it did not include the costs of ongoing care after the acute phase, such as subsequent carotid endarterectomy or readmission to hospital due to late complications of the stroke. Although acute treatment costs are a major cost component, subsequent out-patient and community care also account for a substantial proportion of costs.[16] Secondly, we only quantified the costs of a patient's first stroke during the study period, and did not include the costs of any recurrent stroke following discharge. Since the risk of recurrence is highest after a minor stroke or stroke due to carotid stenosis,[26;27] including the costs of recurrence may affect the estimates of the predictors. Thirdly, our results are, of course, only applicable to the UK and possibly to similar healthcare systems in which a high proportion of patients with minor stroke are investigated and treated in the outpatient setting.

In summary, our study reports up-to-date estimates of the predictors of acute care resource use and costs associated with stroke in the UK, using data from a well conducted population-based study. Our results highlight the importance initial stroke severity as a predictor of resource us and cost, and should be of use to analysts assessing the burden of stroke and the cost-effectiveness of interventions for prevention of particular subtypes of stroke.

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Table 1. Patient characteristics

Age, mean(SD)	74.7(11.5)
<65, n(%)	63(18)
65-74	89(26)
≥ 75	194(56)
Gender, n(%)	
Female	176(51)
Male	170(49)
Pre-morbid Rankin, mean(SD)	1.33(1.19)
median(IQR)	1(0-2)
Score 0, n(%)	100(29)
Score 1	114(33)
Score 2	54(16)
Score 3	58(17)
Score 4	15(4)
Previous stroke, n(%)	75(22)
History of atrial fibrillation, n(%)	72(21)
History of hypertension, n(%)	199(58)
History of CHD, n(%)	80(23)
History of diabetes, n(%)	31(9)
Stroke subtype, n(%)	
All infarcts	308(89)
LACI	66(19)
PACI	134(39)
TACI	30(9)
POCI	50(15)
PICH	21(6)
SAH	17(5)
Carotid investigation, n(%)	
Yes	177(51)
Not investigated	73(21)
Not clinically relevant (haemorrhage or POCI)	96(28)
Degree of carotid stenosis	
0% to 49%	148(84)
50% to 99%	19(11)
Total occlusion(100%)	10(6)
NIHSS score, mean(SD)	6.7(8.6)
median(IQR)	3(1-9)
Unknown, n(%)	13(4)
≤ 2	148(43)
3 to 10	109(32)
> 10 to 20	44(13)
>20	32(9)

Table 2. Predictors of stroke admission and subsequent length of stay (LOS)

Variable	% admitted (95%CI)	Univariate analysis (P>|z|)	LOS (days) (95%CI)	Univariate analysis (P>|z|)
Age		0.083		0.692
<65	56(42-68)		29(20-39)	
65-74	55(44-66)		41(28-58)	
≥75	67(60-74)		44(35-55)	
Gender		0.635		0.119
Female	63(55-70)		45(36-57)	
Male	61(53-68)		36(27-45)	
Pre-morbid Rankin		0.056		0.588
Score 0	54(44-64)		35(23-52)	
Score 1	58(48-67)		43(33-57)	
Score 2	65(51-77)		37(23-53)	
Score 3	76(63-86)		52(37-74)	
Score 4	73(45-92)		37(20-58)	
Previous stroke		0.521		0.791
Yes	59(47-70)		52(32-78)	
No	63(57-69)		38(32-44)	
History of atrial fibrillation		0.001		0.526
Yes	79(68-88)		47(34-64)	
No	58(51-63)		39(31-47)	
History of hypertension		0.121		0.588
Yes	65(58-72)		41(33-51)	
No	57(49-65)		40(32-50)	
History of CHD		0.588		0.165
Yes	65(54-75)		33(23-45)	
No	61(55-67)		43(37-52)	
History of diabetes		0.679		0.408
Yes	58(39-75)		45(27-71)	
No	62(56-67)		41(35-48)	
Degree of carotid stenosis		<0.001		0.018
0%-49%	45(36-53)		37(28-50)	
50%-99%	42(20-67)		41(22-63)	
Total occlusion(100%)	70(35-93)		117(47-212)	
Not investigated	90(81-96)		48(36-65)	
Not relevant	70(60-79)		30(22-40)	
Stroke subtype		<0.001		0.004
LACI	40(29-54)		30(17-45)	
PACI	59(50-67)		56(43-71)	
TACI	93(78-99)		44(28-65)	
POCI	56(41-70)		31(17-45)	
PICH	95(76-100)		28(12-51)	
SAH	88(64-99)		32(17-50)	
NIHSS score		<0.001		<0.001
≤2	39(31-48)		30(21-40)	
3-10	70(60-78)		51(38-67)	
>10-20	95(85-99)		56(44-69)	
>20	88(71-96)		22(11-44)	
Unknown	77(46-95)		14(2-29)	

Table 3. Total acute care costs

	All patients Cost (£) per patient (95%CI)	Hospitalised patients Cost (£) per patient (95%CI)
Hospitalisation		
General ward	1,867(1,511-2,477)	3,019(2,464-3,927)
Stroke unit	1,018(747-1,412)	1,646(1,195-2,226)
Rehabilitation ward	2,878 (2,227-3,736)	4,653(3,647-5,889)
Long term NHS care	483(163-897)	781(322-1,469)
TOTAL	6,246(5,056-7,366)	10,099(8,513-11,747)
Diagnostic tests	171(163-179)	150(140-159)
Other	190(183-197)	225(214-234)
TOTAL	6,607(5,597-7,882)	10,474(8,891-12,251)
Censor adjusted	6,906(5,707-8,109)	11,051(9,296-12,831)

Table 4. Acute care costs one year after stroke in relation to baseline characteristics, severity and subtype.

Variable	Mean cost, £ (95%CI)	Univariate analysis (P>|z|)	Adjusted for severity (P>|z|)	Multivariate analysis (P>|z|)
Age		0.120	0.878	0.796
<65	4,548(2,972-6,544)			
65-74	6,063(3,933-8,448)			
≥75	7,524(6,004-9,340)			
Gender		0.258	0.093	
Female	7,354(5,854-9,330)			
Male	5,833(4,449-7,361)			0.348
Pre-morbid Rankin		0.078	0.146	
Score 0	5,015(3,308-7,302)			
Score 1	6,384(4,717-8,411)			0.955
Score 2	6,560(4,248-9,754)			0.720
Score 3	10,223(6,847-15,204)			0.356
Score 4	6,813(3,681-10,627)			0.804
Previous stroke		0.908	0.607	
Yes	7,957(4,848-11,985)			0.955
No	6,233(5,140-7,380)			
History of atrial fibrillation		<0.001	0.109	
Yes	9,667(7,145-13,365)			0.344
No	5,824(4,696-6,997)			
History of hypertension		0.340	0.838	
Yes	7,073(5,570-8,899)			0.526
No	5,976(4,624-7,551)			
History of CHD		0.804	0.728	
Yes	5,812(3,992-8,133)			0.779
No	6,846(5,684-8,220)			
History of diabetes		0.862	0.652	
Yes	7,090(3,841-11,649)			0.275
No	6,521(5,266-7,669)			
Degree of carotid stenosis		<0.001	0.002	
0%-49%	4,497(3,319-5,946)			
50%-99%	4,403(1,939-7,670)			0.992
Total occlusion(100%)	20,722(6,969-37,570)			0.039
Not investigated	10,953(8,011-14,511)			<0.001
Not relevant	5,520(4,026-7,524)			0.649
Stroke subtype		<0.001	0.029	
LACI	3,426(2,004-5,272)			
PACI	8,343(6,274-10,798)			0.162
TACI	10,782(6,549-16,429)			0.707
POCI	4,605(2,602-7,025)			0.812
PICH	7,041(3,100-12,736)			0.905
SAH	7,233(4,135-10,741)			0.146
NIHSS score		<0.001		
≤2	3,185(2,307-4,457)			<0.001
3-10	9,284(6,897-12,547)			<0.001
>10-20	13,694(10,649-17,257)			0.365
>20	5,150(2,748-8,688)			0.585
Unknown	3,010(730-6,228)			
			Constant	<0.001
			Number	313
			Prob>F	<0.001
			R^2	0.313

Table 5. Predictors of disability (Rankin>2) and fatality one month after acute stroke.

Variable	% Non-disabled (95%CI)	% Disabled (95%CI)	Univariate analysis (P>|z|)	% Fatal (95%CI)	Univariate analysis (P>|z|)
Age			0.011		0.052
<65	57(44-70)	25(15-38)		17(9-29)	
65-74	60(49-70)	29(20-40)		10(5-18)	
≥75	35(28-42)	43(36-51)		22(164-29)	
Gender			0.164		0.273
Female	44(36-51)	40(32-47)		16(11-22)	
Male	47(39-55)	33(25-40)		20(15-27)	
Pre-morbid Rankin			<0.001		0.047
Score 0	70(61-79)	20(13-29)		9(4-17)	
Score 1	53(43-62)	32(23-41)		16(10-24)	
Score 2	34(22-48)	43(30-58)		23(12-36)	
Score 3	11(4-22)	61(47-74)		27(16-40)	
Score 4	7(0-32)	73(45-92)		20(4-48)	
Stroke history			0.238		0.461
Yes	37(25-49)	42(31-55)		21(12-32)	
No	48(42-54)	35(29-41)		17(13-22)	
History of atrial fibrillation			0.002		0.047
Yes	22(13-33)	52(40-64)		26(16-38)	
No	52(45-58)	32(27-38)		16(12-21)	
History of hypertension			0.720		0.223
Yes	42(35-49)	37(30-44)		20(15-27)	
No	50(41-58)	35(27-44)		15(10-22)	
History of CHD			0.789		0.031
Yes	39(28-50)	35(25-46)		26(17-37)	
No	47(41-54)	37(31-43)		16(11-21)	
History of diabetes			0.492		0.193
Yes	48(30-67)	42(25-61)		10(2-26)	
No	45(39-51)	36(30-41)		19(15-24)	
Degree of carotid stenosis			0.017		<0.001
0%-49%	65(56-72)	35(26-42)		0(0-3)	
50%-99%	53(29-76)	42(20-67)		5(0-26)	
Total occlusion(100%)	20(3-56)	70(35-93)		10(0-45)	
Not investigated	11(5-21)	46(35-59)		42(31-55)	
Not relevant	42(32-53)	27(19-37)		31(21-41)	
Stroke subtype			0.011		<0.001
All infarcts	49(43-54)	38(32-43)		13(10-18)	
LACI	74(62-84)	25(15-37)		2(0-8)	
PACI	47(39-56)	47(39-56)		5(2-10)	
TACI	3(0-17)	40(23-59)		57(37-75)	
POCI	58(43-72)	28(16-42)		14(6-27)	
PICH	5(0-25)	25(9-49)		70(46-88)	
SAH	35(14-62)	24(7-50)		41(18-67)	
NIHSS score			<0.001		<0.001
≤2	71(62-78)	25(18-33)		4(2-9)	
3-10	44(34-53)	49(39-59)		6(3-13)	
>10-20	7(1-19)	65(49-79)		28(15-44)	
>20	6(1-21)	13(4-29)		81(64-93)	
Unknown	0(0-25)	15(2-45)		85(55-98)	