**Pre-stroke disability predicts adverse post-stroke outcome: a registry-based prospective cohort study of acute stroke**

Thang S Han1, Christopher H Fry2, Giosue Gulli2, Brendan Affley3, Jonathan Robin4, Melanie Irvin-Sellers4, David Fluck5, Puneet Kakar6, Sapna Sharma1, Pankaj Sharma1,7

1Institute of Cardiovascular Research, Royal Holloway University of London, Egham, TW20 0EX, UK

2School of Physiology, Pharmacology and Neuroscience, University of Bristol, Bristol, BS8 1TD UK

3Department of Stroke, Ashford and St Peter’s NHS Foundation Trust, Chertsey, GU9 0PZ, UK

4Department of Cardiology, Ashford and St Peter’s NHS Foundation Trust, Chertsey, GU9 0PZ, UK

5Department of Acute Medicine, Ashford and St Peter’s NHS Foundation Trust, Chertsey, GU9 0PZ, UK

6Department of Stroke, Epsom and St Helier University Hospitals, Epsom KT18 7EG, UK

7Department of Clinical Neuroscience, Imperial College Healthcare NHS Trust, London W6 8RF, UK

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**Corresponding author:**

TS Han, MA, MB BChir, PhD, FRCP

Telephone: 01784443807, Email:thang.han@rhul.ac.uk

**ABSTRACT (243 words)**

**Background and Purpose**: Information on what effect disability prior to stroke can have on stroke outcome is lacking. We assessed pre-stroke disability in relation to post-stroke hospital outcome.

**Methods**: Analysis of prospectively collected data from the Sentinel Stroke National Audit Programme (SSNAP) A total of 1656 men (mean age ±SD=73.1yrs ±13.2) and 1653 women (79.3yrs ±13.0) were admitted to hyperacute stroke units (HASUs) with acute stroke in four major UK between 2014 and 2016. Pre-stroke disability, assessed by modified Rankin Scale (mRS), was tested against post-stroke adverse outcomes, adjusted for age, sex and coexisting morbidities.

**Results**: Compared with patients with pre-stroke mRS score=0, individuals with pre-stroke mRS scores=3, 4 or 5 had greater adjusted risks of: moderately-severe or severe stroke on arrival (4.4% *vs* 16.7%, OR=3.2, 95%CI=2.3-4.6, p<0.001); urinary tract infection and/or pneumonia within seven days of admission (9.6% *vs* 35.9%, OR=3.7, 95%CI=2.8-4.8, p<0.001); mortality (7.2% *vs* 37.1%, OR=4.9, 95%CI=3.7-6.5, p<0.001); requiring help with activities of daily living on discharge (12.3% *vs* 26.7%, OR=3.1, 95%CI=2.3-4.1, p<0.001); and transferred to new care home (2.4% *vs* 9.4%, OR=2.1, 95%CI=1.3-3.3, p=0.002). Patients with mRS scores=1 or 2 had intermediate risk of adverse outcomes. Overall, those with a mRS=1 or 2 had LOS on HASUs extended by 5.3days (95%CI=2.8-7.7, p<0.001), mRS=3,4 or 5 by 7.2days (95%CI=4.0-10.5, p<0.001).



**Conclusions**: Individuals with evidence of pre-stroke disability, assessed by mRS, had significantly increased risk of post-stroke adverse outcomes and longer LOS on HASUs, and higher level of care on discharge.

**INTRODUCTION**

In line with an increasingly ageing population in industrialised nations over the past century,1,2 the number of adults living with age-related conditions such as stroke, has risen dramatically3 which result in long-term poor health and disability.4 Information on the severity of post-stroke disability allows healthcare teams to arrange appropriate levels of care for patients upon discharge to the community,5 and also provides prognosis on stroke outcomes6 and recovery.7-10 The ability to predict post-stroke complications on admission provides important data that can be used to formulate clinical plans for the patient earlier in the care pathway and allows hospital to strategically organise their day-to-day operational matters with more certainty.

The modified Rankin Scale (mRS) is a widely accepted instrument used to assess disability after stroke as well as endpoints for research trials.11 Because many people who developed an acute stroke already had pre-existing morbidities and associated poor physical function, there is now increasing interest in the use of pre-stroke disability assessed by mRS as a prognostic tool for stroke outcomes.12 Pre-stroke mRS would therefore valuably provide the earliest available information on patients who are at increased risk of post-stroke complications. This will enable healthcare teams to provide suitable clinical management to improve the rates of stroke recovery, minimise adverse outcomes and direct appropriate resources to rehabilitation and level of care in hospital and the community. However, there is a paucity of published data on pre-stroke mRS in relation to post-stroke adverse outcomes in hospital. Pre-stroke mRS was recently adopted by Sentinel Stroke National Audit Programme (SSNAP) in England and Wales and provides us the opportunity to address our research hypothesis that pre-stroke disability may determine post-stroke outcomes.

In the present study, we assessed the relationship between pre-stroke disability assessed by mRS and a number of post-stroke outcomes during hospitalisation including: severity of stroke, intracranial haemorrhagic stroke (ICH), nosocomial infections, length-of-stay (LOS) in hyperacute stroke units (HASUs) and in-patient mortality. In addition, we also examined never before reported associations of pre-stroke disability with thrombolysis and post-thrombolysis complications and mortality, rehabilitation conditions, level of support on discharge including help with activities of daily living, new care home arrangement and palliation.

**METHODS**

**Study design, participants and setting**

Because of the sensitive nature of the data collected for this study, we cannot make our data available to other researchers. We performed analysis of prospectively collected data from the UK national register of stroke care (Sentinel Stroke National Audit Programme, SSNAP). The data comprise clinical characteristics and care quality of patients admitted to acute care hospitals in England and Wales.13 Data from the present study were gathered from the time of admission up to six months after stroke in patients admitted to four major UK hyperacute stroke centres in South East England between January 2014 and February 2016.14,15 Only outcome data in hospital were analysed in the present study.

SSNAP has approval from the Confidentiality Advisory Group of the Health Research Authority to collect patient data under section 251 of the National Health Service Act 2006, so that no additional ethical approval was required.9

**Socio-demographic factors and medical history**

Demographic data were collected and documented by stroke consultants and nurse specialists; including age at arrival, gender and coexisting morbidities (atrial fibrillation, hypertension, congestive heart failure, diabetes mellitus and previous stroke).13-15

**Pre-stroke disability**

The patients’ degree of disability or dependence on daily activities prior to the occurrence of stroke was evaluated within the first 24 hours of hospital admission using mRS,9 that ranged from no symptoms to severe symptoms: 0 = no symptoms at all; 1 = no significant disability despite symptoms, able to carry out all usual duties and activities; 2 = slight disability, unable to carry out all previous activities but able to look after their own affairs without assistance; 3 = moderate disability; requiring some help, but able to walk without assistance; 4 = moderately severe disability, unable to walk without assistance and unable to attend to own bodily needs without assistance; 5 = severe disability, bedridden, incontinent and requiring constant nursing care and attention.16

**Stroke diagnosis and severity**

Stroke was diagnosed based on clinical presentation and brain imaging.14,15 The severity of stroke symptoms at arrival was assessed by the National Institutes of Health for Stroke Scale (NIHSS) with a score range from no symptoms to severe stroke symptoms (NIHSS score=0 to 42).

**Thrombolysis**

Thrombolysis using the fibrinolytic agent alteplase (rtPA) was performed in patients who fulfilled criteria for therapy including confirmed diagnosis of ischaemic stroke (IS), time from onset and without contra-indications.15

**In-patient infections, length of stay and mortality**

Details of new cases of urinary tract infection (UTI) and pneumonia acquired in hospital within seven days of admission, length of stay on HASUs and in-patient mortality were documented. Post-thrombolysis mortality and complications (such as severe hypertension, acute angioedema and hyperacute haemorrhage) were also recorded.

**Inpatient rehabilitation assessment**

The time to agree on rehabilitation goals and the duration of rehabilitation in hospital were recorded. The time that patients received (number of days or minutes) for physiotherapy, occupational therapy, speech and language therapy was documented.

**Level of support on discharge**

Details of the planned level of support were documented, including help for activities of daily living and number of home visits, as well as joint care-planning between health and social care for post discharge management. Information on discharge to a new care home, either on a temporarily or permanent basis, as well as decision on palliative care was also recorded.

**Categorisation of variables**

Dichotomisation was applied for atrial fibrillation, congestive heart failure, hypertension and diabetes, type of stroke, and in-patient infections and mortality according to the presence or absence of history of the condition. Pre-stroke mRS was categorised into three groups: group 1, mRS score = 0; group 2, mRS score = 1 or 2; and group 3, mRS score = 3, 4 or 5 (these last three mRS categories were grouped together due to limited numbers). Moderately-severe to severe stroke on arrival was defined as an NIHSS score ≥16.

**Statistical analysis**

Chi-squared test was used to assess the proportions individuals with adverse outcomes in relation to different pre-stroke mRS scores, and one-way analysis of variance (ANOVA) with *post hoc* analysis by Dunnett’s tests used to assess LOS on HASUs in different pre-stroke mRS scores. Multivariable logistic regression analysis was conducted to estimate the risk of severe stroke at admission, ICH, in-patient mortality, UTI and pneumonia within seven days of admission and level of support at discharge (dependent variables) from pre-stroke disability using patients with mRS score = 0 as the reference group (independent variable). The results are presented as two models: model 1, unadjusted; model 2, adjusted for age, sex and co-morbidities (atrial fibrillation, congestive heart failure, hypertension, diabetes and previous stroke). Results are expressed as odds ratios (OR) and 95% confidence intervals (CI). Analyses were performed using IBM SPSS Statistics for Windows, V.23.0 (IBM Corp., Armonk, NY, USA). The null hypothesis was rejected when *p* <0.05.

**RESULTS**

A total of 3309 patients were admitted with an acute stroke, 1656 men (mean age ±SD = 73.1 yr ±13.2) and 1653 women (79.3 yr ±13.0). From these 2758 (83.3%) patients presented with IS; of the remainder 518 (15.7%) patients had an ICH and 33 (1.0%) were unspecified. Among patients with IS, thrombolysis using the fibrinolytic agent alteplase (rtPA) was given to 451 (16.4%), 431 admitted from the community and 20 inpatients. The mean LOS on HASU was 16.1 days (±21.2). There were 480 (14.5%) patients who died during admission. The prevalence of co-existing morbidities including atrial fibrillation, congestive heart failure, hypertension and previous stroke rose progressively with increasing severity of pre-stroke mRS scores: there was no such relationship for diabetes. The proportions of individuals with adverse post-stroke outcomes also increased progressively with increasing severity of pre-stroke disability. These included moderately-severe to severe stroke on admission, UTI and pneumonia within seven days of admission, as well as mortality in hospital (all strokes and subtypes of stroke) and post-thrombolysis mortality and complications. There was also greater requirements for increased levels of support at discharge, including help for activities of daily living, joint care planning, discharge to a care home and palliative care (**Table 1**). At the point of discharge, the median numbers of visits per week provided by social services for those who needed this support were 14, 18 and 24 times respectively, for patients with pre-stroke mRS = 0, mRS = 1 or 2 and mRS = 3, 4 or 5.

**Table 2** shows that patients with pre-stroke mRS score = 1 or 2 received the longest time for physiotherapy and occupational therapy while there were no differences between pre-stroke mRS scores and the time spent with speech and language therapy. The time taken from the point of admission to agree on rehabilitation goals was 1.8 ±3.3 days for those with pre-stroke mRS = 0 while those with pre-stroke mRS = 1 or 2 took 0.5 days (95%CI = 0.1-0.9, p = 0.009) longer, and those with mRS = 3, 4 or 5 took 0.6 days (95%CI = 0.0-1.2, p = 0.045) longer to reach this decision. Compared with patients with pre-stroke mRS = 0 who received 12.9 ±20.4 days of rehabilitation, those with mRS = 1 or 2 required 6.1 days (95%CI = 3.4-8.8, p <0.001) and those with mRS = 3, 4 or 5 required 6.9 days (95%CI = 3.6-10.1, p <0.001) longer. Inpatient rehabilitation correlated directly with inpatient LOS (r = 0.982, p <0.001).

Compared with LOS on HASUs of 14.1 ±20.5 days for patients with a pre-stroke mRS score = 0 (reference group), those with a pre-stroke mRS score = 1 or 2 stayed 5.3 days (95% CI: 2.8-7.7 days, p <0.001) longer, and pre-stroke mRS score = 3, 4 or 5 stayed 7.2 days (95% CI: 4.0-10.5 days, p <0.001) longer **(Figure 1**).

Logistic regression showed progressive increase in the risk of having adverse outcomes with increasing pre-stroke mRS (**Table 3**). After adjustment for age, sex and co-morbidities, compared with patients with mRS scores = 0 (reference group), individuals with mRS scores = 3, 4 or 5 had greater adjusted risks of: ICH (15.0% *vs* 19.6%, OR = 1.6, 95%CI = 1.2-2.1, p <0.001), moderately-severe or severe stroke on arrival (4.4% *vs* 16.7%, OR = 3.2, 95%CI = 2.3-4.6, p <0.001); UTI (4.6% *vs* 19.9%, OR = 3.4, 95%CI = 2.4-4.9, p<0.001), pneumonia within seven days of admission (6.7% *vs* 28.6%, OR = 4.1, 95%CI = 3.0-5.5, p <0.001), UTI and/or pneumonia (9.6% *vs* 35.9%, OR = 3.7, 95%CI = 2.8-4.8, p <0.001) within seven days of admission.

Compared with the reference group (pre-stroke mRS = 0), patients with all types of strokes and with mRS in the highest category (mRS = 3, 4 or 5) had significant increased risk of mortality in hospital (7.2% *vs* 37.1%, OR = 4.9, 95%CI = 3.7-6.5, p <0.001). An increased risk of mortality in hospital was also observed among patients with IS in the highest pre-stroke mRS category (5.0% *vs* 33.2%, OR = 5.4 (95%CI = 3.9-5.6, p <0.001), and among patients with ICH in the highest pre-stroke mRS category (19.8% *vs* 50.5%, OR = 3.2 (95%CI = 1.9-5.6, p <0.001) (**Table 3**). Mortality was also raised among patients with IS with pre-stroke mRS = 3, 4 or 5 who received thrombolysis (8.1% *vs* 39.0%, OR = 4.9 (95%CI = 2.2-11.0, p <0.001).

Compared with the reference group (pre-stroke mRS = 0), patients in the highest pre-stroke mRS category had increased risk of malnutrition at discharge (8.1% *vs* 39.0%, OR = 2.9, 95%CI = 2.2-3.9, p <0.001) and the need for assistance with activities of daily living (12.3% *vs* 26.7%, OR = 3.1, 95%CI = 2.3-4.1, p <0.001), discharge visits (7.9% *vs* 15.9%, OR = 1.6, 95%CI = 1.2-2.2, p = 0.005), discharge to care home on a permanent basis (2.4% *vs* 9.4%, OR = 2.1, 95%CI = 1.3-3.3, p = 0.002) and palliative care (3.7% *vs* 19.4%, OR = 4.2, 95%CI = 2.9-6.0, p <0.001) (**Table 3**).

**DISCUSSION**

Most studies concerning the management of patients with stroke focus on post-stroke disabilities assessed by various scales such as mRS. By contrast, there are few data on the use of a pre-stroke mRS score as a prognostic indicator of stroke outcomes. We show that for individuals with moderate to severe pre-stroke disabilities (mRS score = 3, 4 or 5) there was a 3- to 4-fold increase in the risk for having severe stroke itself, nosocomial infections and in-patient mortality; all these outcomes were independent of age, sex and a range of major co-existing morbidities.

Our findings support the important role of pre-stroke functional level, assessed by the validated mRS, as a clinical indicator for identifying patients who are at high risk of post-stroke complications, in order to increase focus on treatment and planning for community-based rehabilitation and support. Given the increasing life expectancy of the population in the UK and other industrialised nations,1,2 more people are living after stroke, and their adverse health outcomes, and this will continue to raise personal and healthcare costs. Therefore, it is valuable to have an early indicator that can reduce the risk of adverse complications arising from stroke, including nosocomial infections, increased LOS and mortality, as well as a more accurate prognosis for the need of palliative and nursing care.

We found the severity of pre-stroke disability related co-dominantly with all of the post-stroke outcomes including the severity of stroke at admission, nosocomial infections and in-patient mortality. We extended further analysis of mortality in relation to pre-stroke mRS within each subtypes of stroke and found higher rates of death among patients with ICH than those with IS which is consistent with previous literature.17 However, the adjusted ORs of death were higher among IS than ICH for those with pre-stroke mRS score = 1 or 2 (2.9 *vs* 1.0) and those with pre-stroke mRS score = 3, 4 or 5 (5.4 *vs* 3.2). These differences may in part be due to survival bias of ICH patients with higher pre-stroke mRS who died before hospital admission. We found significantly higher proportions of patients with IS than patients with ICS to have co-existing morbidities including congestive heart failure (6.2% *vs* 4.2%, p = 0.047) and diabetes (16.8% *vs* 12.5%, p = 0.008) which is perhaps paradoxical given the lower rates of death among patients with IS, but may be explained by more intensive cardiovascular medications. There were no differences between these two subtypes of stroke with respect to age at admission, sex distribution, hypertension or previous history of stroke. The observation of increased post-thrombolysis mortality among those with high pre-stroke mRS scores provides caution on the risk of this procedure on those with high pre-stroke disability.

Although effort was made to adjust for major co-existing morbidities in our analysis, the risk of pre-stroke mRS with post-stroke adverse outcomes suggests that patients with pre-existing disabilities are likely to be more frail and susceptible to common infections with diminished ability to recover from an illness18,19 leading to increased risk of mortality and longer stay on HASUs. Our observations are consistent with a previous study on the associations between pre-stroke mRS scores and adverse outcomes.12

**Strengths and limitations**

The strengths of the present study lie in its large cohort of patients derived from one of the largest NHS regions in the UK and who have similar characteristics to the rest of the UK.18,20,21 The data were collected in accordance with the national SSNAP protocol and analysis took a range of confounding factors known to associate with stroke outcomes into account. We chose a cut-off point for NIHSS scores of ≥16 (moderately-severe to severe stroke) based on previous studies that demonstrated a strong prediction of mortality or severe disability,22 while cut-off intervals for mRS score at 0, 1, 2, 3, and 4 or 5 indicated worsening functional disability due to increasing severity of stroke.23

In conclusion, individuals with increasing pre-stroke disability assessed by mRS were at greater risk of post-stroke adverse outcomes, independent of age, sex and coexisting morbidities.

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**LEGENDS**

**Figure 1.** Plot showing mean LOS on HASUs in relation to different level of pre-stroke disability assessed by mRS scores. One-way ANOVA showed significant differences in LOS on HASUs between mRS groups (F = 24.4, p <0.001) therefore *post hoc* analysis was conducted using Dunnett’s test: \*Significances from pre-stroke mRS score = 0 (reference group).

**Table 1.** Proportions of patients admitted with first stroke with co-existing morbidities and outcomes in hospital.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Pre-stroke mRS score | | | Group differences | |
|  | 0 | 1 or 2 | 3, 4 or 5 |
|  | *n* = 2003 | *n* = 816 | *n* = 490 |
| **Co-existing morbidities** | % | % | % | χ2 | p |
| Atrial fibrillation | 15.6 | 24.8 | 31.0 | 72.8 | <0.001 |
| Congestive heart failure | 3.6 | 8.8 | 10.2 | 48.4 | <0.001 |
| Hypertension | 50.4 | 57.4 | 51.4 | 11.5 | 0.003 |
| Diabetes mellitus | 15.0 | 17.2 | 18.6 | 4.8 | 0.092 |
| Previous stroke | 16.4 | 31.1 | 37.3 | 135.6 | <0.001 |
| **Post-stroke adverse outcomes in hospital** |  |  |  |  |  |
| Haemorrhagic stroke | 15.0 | 15.5 | 19.6 | 6.3 | 0.043 |
| NIHSS ≥16 on arrival | 4.4 | 7.0 | 16.7 | 93.9 | <0.001 |
| UTI within 7 days of admission | 4.6 | 7.6 | 19.9 | 122.9 | <0.001 |
| Pneumonia within 7 days of admission | 6.7 | 11.8 | 28.6 | 182.5 | <0.001 |
| UTI and/or pneumonia within 7 days of admission | 9.6 | 15.6 | 35.9 | 207.3 | <0.001 |
| Mortality in hospital (all strokes) | 7.2 | 18.8 | 37.1 | 299.6 | <0.001 |
| Mortality in hospital (ischaemic stroke) | 5.0 | 17.4 | 33.2 | 295.9 | <0.001 |
| Mortality in hospital (intracranial haemorrhagic stroke) | 19.8 | 26.4 | 50.5 | 34.5 | <0.001 |
| Thrombolysis for ischaemic stroke (n=451/2758) | 19.0 | 13.2 | 10.5 | 25.6 | <0.001 |
| Post-thrombolysis complications in hospital (n=29/451) | 5.6 | 8.7 | 12.2 | 2.6 | 0.270 |
| Post-thrombolysis mortality in hospital (n=67/451) | 8.1 | 27.8 | 39.0 | 42.3 | <0.001 |
| Risk of malnutrition at discharge | 16.2 | 25.7 | 39.3 | 92.3 | <0.001 |
| **Rehabilitation assessment** |  |  |  |  |  |
| Physiotherapy | 86.4 | 91.1 | 93.4 | 19.7 | <0.001 |
| Occupational therapy | 87.2 | 90.1 | 90.9 | 6.1 | 0.048 |
| Speech and language therapy | 45.1 | 51.0 | 64.2 | 38.7 | <0.001 |
| Psychology | 5.4 | 4.9 | 7.8 | 3.4 | 0.187 |
| Swallow screen within 72 hours of admission | 98.8 | 96.8 | 96.1 | 1.3 | 0.513 |
| Mood screen | 81.0 | 84.7 | 87.8 | 10.8 | 0.005 |
| Cognition screen | 91.3 | 93.2 | 85.8 | 13.8 | 0.001 |
| Intermittent pneumatic compression | 16.8 | 19.0 | 23.3 | 27.2 | <0.001 |
| **Level of support planned at discharge** |  |  |  |  |  |
| Activities of daily living support required by patients | 12.3 | 20.5 | 26.7 | 328.9 | <0.001 |
| Informal care | 1.5 | 1.7 | 1.8 |  |  |
| Paid care | 9.2 | 16.7 | 22.0 |  |  |
| Informal care and paid care | 1.2 | 1.7 | 2.2 |  |  |
| Patient refused | 0.3 | 0.2 | 0.4 |  |  |
| Paid care services unavailable | 0.0 | 0.1 | 0.2 |  |  |
| Discharge visits | 7.9 | 14.7 | 15.9 | 42.4 | <0.001 |
| Joint care planning between health and social care for post discharge management | 21.2 | 25.5 | 28.0 | 272.0 | <0.001 |
| Discharge to care home (all cases) | 4.2 | 12.4 | 27.6 | 665.9 | <0.001 |
| New discharge to care home | 3.2 | 7.1 | 11.0 | 295.6 | <0.001 |
| Permanent care home residents | 2.4 | 4.3 | 9.4 |  |  |
| Temporary care home residents | 0.8 | 2.8 | 1.6 |  |  |
| Palliative care | 3.7 | 10.3 | 19.4 | 248.6 | <0.001 |

**Table 2.** Rehabilitation conditions during hospital admission.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **mRS = 0** | **mRS = 1 or 2** | **mRS = 3, 4 or 5** | **ANOVA for group differences** |
| Number of days received from physiotherapy | 8.1 (11.1) | 11.2 (11.6) | 9.6 (11.9) | F = 10.7, p <0.001 |
| Mean (95%CI) difference from mRS = 0\* | -- | 2.5 (1.1 to 3.8)  p <0.001 | 1.5 (-0.2 to 3.2)  p = 0.101 |  |
| Number of minutes received from physiotherapy | 356.4 (538.6) | 432.6 (515.0) | 379.8 (510.7) | F = 4.3, p = 0.013 |
| Mean (95%CI) difference from mRS = 0\* | -- | 76.1 (15 to 173.3)  p = 0.009 | 14.3 (-66.2 to 94.8)  p = 0.964 |  |
| Number of days received from occupational therapy | 6.3 (7.8) | 7.6 (8.2) | 7.0 (7.9) | F = 5.6, p = 0.004 |
| Mean (95%CI) difference from mRS = 0\* | -- | 1.3 (0.3 to 2.2)  p = 0.004 | 0.7 (-0.5 to 2.0)  p = 0.416 |  |
| Number of minutes received from occupational therapy | 287.6 (377.0) | 323.8 (361.1) | 283.0 (388.1) | F = 2.1, p = 0.121 |
|  |  |  |  |  |
| Number of days received from SALT | 5.8 (8.2) | 5.9 (6.0) | 5.4 (5.2) | F = 0.3, p = 0.752 |
| Number of minutes received from SALT | 215.6 (414.4) | 210.7 (236.8) | 163.7 (169.8) | F = 1.7, p = 0.182 |
|  |  |  |  |  |
| Time to rehabilitation goals agreed (days) | 1.8 (3.3) | 2.4 (4.0) | 2.4 (4.5) | F = 7.2, p =0.001 |
| Mean (95%CI) difference from mRS = 0\* | -- | 0.5 (0.1 to 0.9)  p = 0.009 | 0.6 (0.0 to 1.2)  p = 0.045 |  |
| Duration of inpatient rehabilitation (days) | 12.9 (20.4) | 18.9 (22.5) | 19.7 (20.6) | F = 23.3, p <0.001 |
| Mean (95%CI) difference from mRS = 0\* | -- | 6.1 (3.4 to 8.8)  p <0.001 | 6.9 (3.6 to 10.1)  p <0.001 |  |

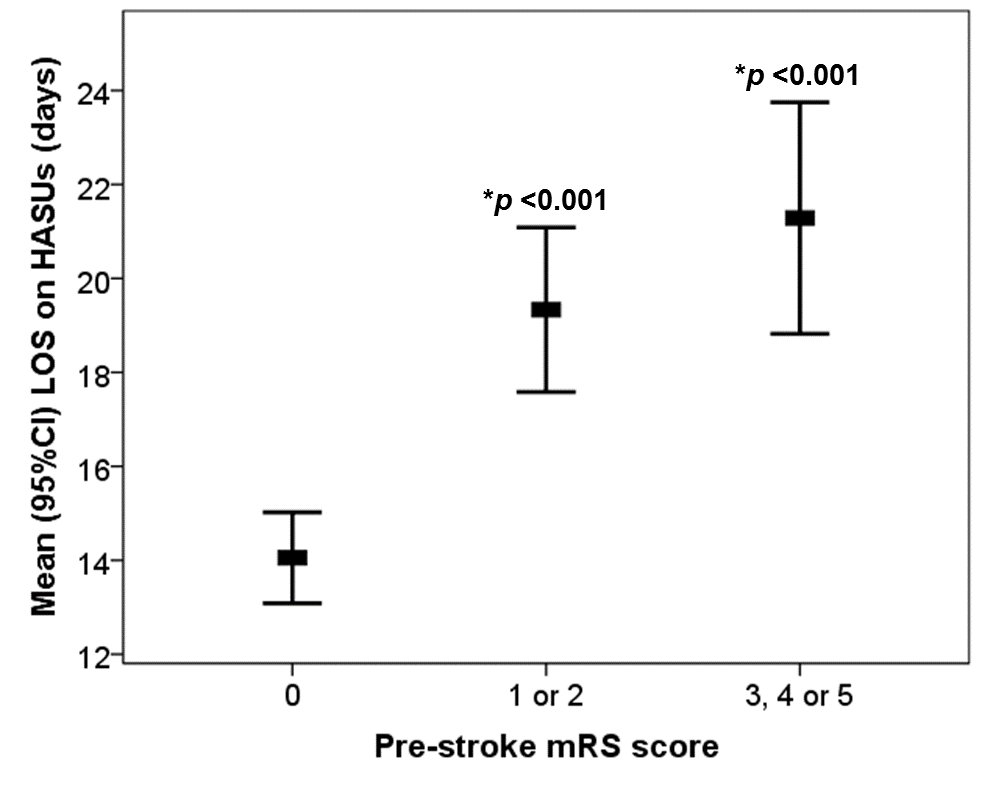
\*Post hoc analysis using Dunnett’s test for those with significant ANOVA (mRS = 0 as reference group).

**Table 3**. Logistic regression to assess the association pre-stroke mRS score with post-stroke outcomes in hospital among patients admitted with acute stroke.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Pre-stroke mRS = 1 or 2**  **(*n* = 816)\*** | | | **Pre-stroke mRS = 3, 4 or 5**  **(*n* = 490)\*** | | |
| **Unadjusted** | OR | 95% CI | *p* | OR | 95% CI | *p* |
| Intracranial haemorrhagic stroke | 1.04 | 0.83-1.30 | 0.764 | 1.38 | 1.07-1.79 | 0.013 |
| NIHSS ≥16 on arrival | 1.63 | 1.16-2.30 | 0.005 | 4.37 | 3.18-6.02 | <0.001 |
| UTI within 7 days of admission | 1.70 | 1.21-2.38 | 0.002 | 5.55 | 4.25-7.25 | <0.001 |
| Pneumonia within 7days of admission | 1.86 | 1.41-2.46 | <0.001 | 5.05 | 3.46-7.38 | <0.001 |
| UTI and/or pneumonia within 7days of admission | 1.75 | 1.37-2.23 | <0.001 | 5.28 | 4.15-6.72 | <0.001 |
| Mortality in hospital (all type of stroke) | 2.96 | 2.32-3.77 | <0.001 | 7.57 | 5.90-9.72 | <0.001 |
| Mortality in hospital (ischaemic stroke) | 3.97 | 2.96-5.34 | <0.001 | 9.35 | 6.90-12.66 | <0.001 |
| Mortality in hospital (intracranial haemorrhagic stroke) | 1.45 | 0.89-2.37 | 0.134 | 4.14 | 2.53-6.77 | <0.001 |
| Thrombolysis in ischaemic stroke patients | 0.65 | 0.50-0.83 | 0.001 | 0.50 | 0.36-0.71 | <0.001 |
| Post-thrombolysis mortality in hospital | 4.35 | 2.36-8.01 | <0.001 | 7.24 | 3.44-15.24 | <0.001 |
| Risk of malnutrition at discharge | 1.79 | 1.44-2.22 | <0.001 | 3.34 | 2.56-4.36 | <0.001 |
| Activities of daily living support required by patients | 2.21 | 1.77-2.77 | <0.001 | 4.86 | 3.72-6.34 | <0.001 |
| Discharge visit | 2.02 | 1.56-2.61 | <0.001 | 2.21 | 1.64-2.97 | <0.001 |
| Joint care planning between health and social care for post discharge management | 1.27 | 1.05-1.53 | 0.015 | 1.44 | 1.15-1.89 | 0.002 |
| New care home (permanent and temporary) | 2.28 | 1.59-3.28 | <0.001 | 3.69 | 2.54-5.38 | <0.001 |
| New care home (permanent) | 1.83 | 1.17-2.84 | 0.008 | 4.22 | 2.78-6.41 | <0.001 |
| Palliative care | 3.15 | 2.28-4.36 | <0.001 | 7.73 | 5.57-10.73 | <0.001 |
| **Adjusted**† |  |  |  |  |  |  |
| Intracranial haemorrhagic stroke | 1.14 | 0.90-1.44 | 0.292 | 1.61 | 1.21-2.13 | 0.001 |
| NIHSS ≥16 on arrival | 1.35 | 0.95-1.94 | 0.098 | 3.22 | 2.26-4.59 | <0.001 |
| UTI within 7 days of admission | 1.32 | 0.92-1.89 | 0.130 | 3.44 | 2.43-4.87 | <0.001 |
| Pneumonia within 7 days of admission | 1.48 | 1.10-1.99 | 0.009 | 4.10 | 3.04-5.53 | <0.001 |
| UTI and/or pneumonia within 7days of admission | 1.34 | 1.04-1.74 | 0.025 | 3.69 | 2.82-4.82 | <0.001 |
| Mortality in hospital (all types of stroke) | 2.26 | 1.75-2.92 | <0.001 | 4.92 | 3.74-6.46 | <0.001 |
| Mortality in hospital (ischaemic stroke) | 2.94 | 2.16-3.99 | <0.001 | 5.40 | 3.88-7.52 | <0.001 |
| Mortality in hospital (intracranial haemorrhagic stroke) | 0.97 | 0.57-1.67 | 0.919 | 3.23 | 1.85-5.63 | <0.001 |
| Thrombolysis in ischaemic stroke patients | 0.66 | 0.50-0.85 | 0.002 | 0.52 | 0.36-0.75 | <0.001 |
| Post-thrombolysis mortality in hospital | 3.82 | 2.01-7.30 | <0.001 | 4.93 | 2.21-11.02 | <0.001 |
| Risk of malnutrition at discharge | 1.67 | 1.33-2.10 | <0.001 | 2.89 | 2.17-3.86 | <0.001 |
| Activities of daily living support required by patients | 1.70 | 1.34-2.15 | <0.001 | 3.08 | 2.31-4.11 | <0.001 |
| Discharge visits | 1.64 | 1.25-2.15 | <0.001 | 1.58 | 1.15-2.19 | 0.005 |
| Joint care planning between health and social care for post discharge management | 1.13 | 0.93-1.38 | 0.224 | 1.21 | 0.95-1.54 | 0.129 |
| New care home (as permanent or temporary residents) | 1.60 | 1.10-2.34 | 0.015 | 2.09 | 1.38-3.15 | <0.001 |
| New care home (as permanent residents) | 1.18 | 0.75-1.87 | 0.477 | 2.07 | 1.31-3.28 | 0.002 |
| Palliative care | 2.21 | 1.58-3.11 | <0.001 | 4.20 | 2.94-6.01 | <0.001 |

\*Pre-stroke mRS = 0 as reference group (n = 2003); †Adjusted for age, sex and co-existing morbidities (AF, CHF, HT, diabetes and previous stroke).

**Figure 1.**

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