Supplemental Online Content

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eFigure. Flowchart of Participants

eMethods.

eTable 1. Multifaceted Functional Outcomes at Each Assessment Point in Survivors of First-Time Stroke

eTable 2. Generalized Estimating Equations for Functional Outcomes by Subgroup

eTable 3. Univariable Regression Analyses for Factors Potentially Associated With Functional Outcomes at 60 mo After First-Time Stroke

eTable 4. Multivariable Regression Analyses for Factors Potentially Associated With Functional Outcomes at 60 mo After First-Time Stroke

This supplemental material has been provided by the authors to give readers additional information about their work.
eFigure. Flowchart of Participants

Acute first-ever stroke patients admitted to the nine participating hospitals from August 2012 to May 2015 (n=10,636)

Excluded (n= 2,778)
- Death before participate (n=351)
- Declined to participate (n=2,275)
- Reversed to participate during the 1st admission (n=152)

Those who agreed to participate in repeated long-term follow up after discharge (n=7,858)

Ischemic stroke (n=6,253)

Excluded (n=2,745)
- Death (n=1,416)
- Lost to follow-up (n=1,329)

Follow-up at 60 months after stroke onset (n =3,508)

Hemorrhagic stroke (n=1,605)

Excluded (n=670)
- Death (n=258)
- Lost to follow-up (n=412)

Follow-up at 60 months after stroke onset (n =935)
eMethods

Definitions of risk factors
Hypertension: systolic blood pressure > 160 mm Hg, diastolic blood pressure > 90 mm Hg, or history of hypertension or medical treatment
Diabetes mellitus (DM): elevated blood glucose level >126 mg/d or history of DM or medical treatment
Coronary disease: documented by standard electrocardiogram (ECG) or coronary imaging study or history of coronary disease or medical treatment
Atrial fibrillation: documented by standard ECG, long-term ECG, or history of atrial fibrillation or medical treatment
Hyperlipidemia: elevated low-density lipoprotein cholesterol level >160 mg/dL, elevated total cholesterol level > 240 mg/dL, or history of hyperlipidemia or medical treatment.

Covariate variables used in generalized estimating equations (GEEs)
The GEE analyses in this study were performed using the following covariate variables:

a. Comparison according to age: stroke type, sex, body mass index (BMI), smoking and alcohol use, education level, marital status, hypertension, diabetes mellitus (DM), coronary heart disease, atrial fibrillation, hyperlipidemia, combined condition- and age-related score in the Charlson comorbidity index (CCAS), premorbid modified Rankin Scale (mRS), 7-day National Institutes of Health Stroke Scale (NIHSS) score, duration of first hospitalization, and inpatient rehabilitation.
b. Comparison according to stroke severity: stroke type, sex, BMI, education level, marital status, DM, hyperlipidemia, premorbid mRS, pneumonia and UTI during hospitalization, duration of first hospitalization, and inpatient rehabilitation.
c. Comparison according to stroke type: age, sex, BMI, smoking, education level, hypertension, DM, coronary heart disease, atrial fibrillation, hyperlipidemia, CCAS, premorbid mRS, pneumonia and UTI during hospitalization, duration of first hospitalization, and inpatient rehabilitation.
### eTable 1. Multifaceted Functional Outcomes at Each Assessment Point in Survivors of First-Time Stroke

|                          | 7 days     | 3 months   | 6 months   | 12 months  | 18 months  | 24 months  | 30 months  | 36 months  | 48 months  | 60 months  |
|--------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| **FMA**                  |            |            |            |            |            |            |            |            |            |            |
| Total stroke             | 81.21±30.73| 89.23±23.47| 90.01±22.60| 90.75±21.59| 91.14±21.29| 91.11±21.48| 90.66±21.99| 90.39±22.00| 90.24±22.22| 89.44±23.07*|
| Ischemic stroke          | 84.46±27.59| 90.41±21.83| 91.20±20.88| 91.85±20.10| 92.11±20.03| 92.15±19.97| 91.69±20.67| 91.50±20.53| 91.15±21.02*| 90.24±22.08*|
| Hemorrhagic stroke       | 69.02±37.99| 84.85±28.33| 85.51±27.70| 86.55±26.12| 87.45±25.22| 87.08±26.16| 86.72±26.12| 86.21±26.45| 86.81±26.02| 86.44±26.23|
| **FAC**                  |            |            |            |            |            |            |            |            |            |            |
| Total stroke             | 3.03±1.88  | 4.26±1.39  | 4.36±1.31  | 4.44±1.23  | 4.49±1.19  | 4.50±1.18  | 4.47±1.23  | 4.45±1.24  | 4.44±1.26  | 4.36±1.34* |
| Ischemic stroke          | 3.34±1.74  | 4.34±1.29  | 4.43±1.22  | 4.49±1.16  | 4.54±1.12  | 4.55±1.13  | 4.51±1.18  | 4.49±1.20  | 4.47±1.23* | 4.38±1.32* |
| Hemorrhagic stroke       | 1.86±1.95  | 3.93±1.67  | 4.10±1.59  | 4.23±1.46  | 4.29±1.38  | 4.31±1.36  | 4.28±1.41  | 4.29±1.38  | 4.31±1.37  | 4.27±1.42  |
| **K-MMSE**               |            |            |            |            |            |            |            |            |            |            |
| Total stroke             | 22.89±7.89 | 25.48±5.71 | 25.89±5.54 | 26.03±5.48 | 26.05±5.78 | 25.97±5.85 | 26.03±5.84 | 26.02±5.82*| 25.90±5.96 |            |
| Ischemic stroke          | 23.80±7.02 | 25.62±5.48 | 26.01±5.23 | 26.04±5.34 | 26.02±5.52 | 25.97±5.72 | 26.05±5.66 | 25.94±5.84*| 25.79±5.98*|            |
| Hemorrhagic stroke       | 19.21±9.90 | 24.95±6.49 | 25.45±6.58 | 25.99±5.97*| 25.97±6.10 | 26.14±6.04 | 25.95±6.35 | 25.95±6.48 | 26.33±5.73 | 26.33±5.85 |
| **Short K-FAST**         |            |            |            |            |            |            |            |            |            |            |
| Total stroke             | 14.18±5.71 | 15.66±4.94*| 16.12±4.71 | 16.36±4.66*| 16.47±4.67 | 16.42±4.78 | 16.44±4.74 | 16.38±4.79*| 16.31±4.84*| 16.22±4.96 |
| Ischemic stroke          | 14.74±5.18 | 15.71±4.83 | 16.16±5.58 | 16.37±4.55*| 16.44±4.63 | 16.37±4.72 | 16.38±4.70 | 16.31±4.74*| 16.23±4.84*| 16.13±4.96 |
| Hemorrhagic stroke       | 11.87±7.05 | 15.47±5.33*| 15.96±5.20*| 16.35±5.06*| 16.57±4.83 | 16.63±5.00 | 16.68±4.90 | 16.66±4.98 | 16.61±4.83*| 16.56±4.96 |
| **AHSANOMS**             |            |            |            |            |            |            |            |            |            |            |
| Total stroke             | 6.08±1.79  | 6.74±.87   | 6.78±.76   | 6.80±.66   | 6.81±.63   | 6.78±.71   | 6.76±.73   | 6.76±.74   | 6.73±.84   | 6.73±.84   |
| Ischemic stroke          | 6.31±1.55  | 6.78±.74   | 6.80±.70   | 6.80±.61   | 6.82±.56   | 6.78±.68   | 6.77±.67   | 6.76±.71   | 6.73±.82   | 6.73±.82   |
| Hemorrhagic stroke       | 5.25±2.31  | 6.59±1.23* | 6.70±1.02* | 6.76±.88   | 6.79±.78   | 6.76±.84   | 6.77±.81   | 6.73±.90   | 6.73±.84   | 6.71±.91   |
| **K-MBI**                |            |            |            |            |            |            |            |            |            |            |
| Total stroke             | ...        | 89.33±21.08| 90.67±20.91*| 91.97±19.74*| 92.56±19.02*| 92.64±19.50*| 92.14±20.39| 92.12±20.41*| 91.72±21.06*| 90.61±22.85*|
| Ischemic stroke          | ...        | 90.77±19.64| 91.91±19.02*| 92.94±18.30| 93.36±17.96*| 93.45±18.48| 92.96±19.40| 92.82±19.61| 92.27±20.47*| 91.07±22.36*|
| Hemorrhagic stroke       | ...        | 84.00±27.34| 85.99±26.34*| 88.22±24.11*| 89.48±22.35*| 89.50±22.78*| 89.01±23.54| 89.46±23.00| 89.63±23.09| 88.88±24.55|

*P < .05 compared with previous assessment point after Bonferroni correction.

Abbreviations: FMA, Fugl-Meyer Assessment; FAC, Functional Ambulatory Category; K-MMSE, Korean Mini-Mental State Examination; Short K-FAST, Short Korean version of the Frenchay Aphasia Screening Test; AHSA-NOMS, American Speech-Language-Hearing Association National Outcome Measurement System Swallowing Scale; K-MBI, Korean modified Barthel Index.
**eTable 2. Generalized Estimating Equations for Functional Outcomes by Subgroup**

|                  | Adjusted P Value | Stroke severity | Stroke type |
|------------------|------------------|-----------------|-------------|
| **Age** a        | <.001            | <.001           | <.001       |
| FMA              | <.001            | <.001           | <.001       |
| FAC              | <.001            | <.001           | <.001       |
| K-MMSE           | <.001            | <.001           | <.001       |
| Short K-FAST     | <.001            | <.001           | <.001       |
| ASHA-NOMS        | <.001            | <.001           | <.001       |
| K-MBI            | <.001            | <.001           | <.001       |

* Older than or younger than 65 years.
* Stroke severity: mild; NIHSS 0–4, moderate; NIHSS 5–15, severe; NIHSS 16–42.
* Ischemic or hemorrhagic.

Abbreviations: FMA, Fugl-Meyer Assessment; FAC, Functional Ambulatory Category; K-MMSE, Korean Mini-Mental State Examination; Short K-FAST, Short Korean version of the Frenchay Aphasia Screening Test; AHSA-NOMS, American Speech-Language-Hearing Association National Outcome Measurement System Swallowing Scale; K-MBI, Korean modified Barthel Index.
**eTable 3. Univariable Regression Analyses for Factors Potentially Associated With Functional Outcomes at 60 mo After First-Time Stroke**

|                      | FMA     | FAC     | K-MMSE  | Short K-FAST | AHSA-NOMS | K-MBI   |
|----------------------|---------|---------|---------|--------------|-----------|---------|
| **β (SE)**           | **P**   | **β (SE)** | **P**   | **β (SE)** | **P**    | **β (SE)** | **P** |
| **Medical history**  |         |         |         |              |           |         |
| Stroke type, hemorrhagic | -3.78 (0.86) | <.001  | -0.11 (0.05) | .03  | 0.54 (0.23) | .02  | 0.43 (0.19) | .02  | -0.02 (0.03) | .46  | -2.18 (0.85) | .016 |
| Age                  | -0.29 (0.03) | <.001  | -0.03 (0.002) | <.001 | -0.2 (0.01) | <.001 | -0.18 (0.01) | <.001 | -0.02 (0.001) | <.001 | -0.5 (0.03) | <.001 |
| Sex, male            | 4.32 (0.71) | <.001  | 0.44 (0.04) | <.001 | 2.56 (0.19) | <.001 | 2.19 (0.15) | <.001 | 0.17 (0.03) | <.001 | 6.51 (0.7) | <.001 |
| Body mass index      | 0.34 (0.11) | .002  | 0.03 (0.006) | <.001 | 0.17 (0.03) | <.001 | 0.15 (0.02) | <.001 | 0.02 (0.004) | <.001 | 0.56 (0.11) | <.001 |
| Smoking, current     | 3.13 (0.79) | <.001  | 0.34 (0.05) | <.001 | 1.71 (0.21) | <.001 | 1.49 (0.17) | <.001 | 0.15 (0.03) | <.001 | 5.15 (0.78) | <.001 |
| Alcohol, current     | 4.34 (0.71) | <.001  | 0.39 (0.04) | <.001 | 2.06 (0.19) | <.001 | 1.83 (0.15) | <.001 | 0.19 (0.03) | <.001 | 6.33 (0.7) | <.001 |
| Education years      | 0.83 (0.08) | <.001  | 0.07 (0.004) | <.001 | 0.54 (0.02) | <.001 | 0.52 (0.01) | <.001 | 0.03 (0.003) | <.001 | 1.08 (0.07) | <.001 |
| **Functional levels at day 7** |         |         |         |              |           |         |
| Hypertension         | -2.16 (0.71) | .002  | -0.22 (0.04) | <.001 | -1.35 (0.19) | <.001 | -1.05 (0.16) | <.001 | -0.08 (0.03) | .002  | -3.04 (0.71) | <.001 |
| Diabetes mellitus    | -2.23 (0.87) | .01  | -0.2 (0.05) | .0001 | -0.64 (0.23) | .005  | -0.66 (0.19) | .0006 | -0.04 (0.03) | .18   | -2.16 (0.87) | .0128 |
| Coronary heart disease | -0.16 (1.59) | .92  | -0.04 (0.09) | .704  | -0.68 (0.42) | .11  | -0.16 (0.35) | .64  | -0.07 (0.06) | .24   | -0.08 (1.57) | .961 |
| Atrial fibrillation  | -6.07 (1.45) | <.001  | -0.39 (0.08) | <.001 | -2.41 (0.39) | <.001 | -1.63 (0.32) | <.001 | -0.23 (0.05) | <.001 | -6.38 (1.43) | <.001 |
| Hyperlipidemia       | 0.35 (1.21) | .772  | -0.05 (0.07) | .51  | 0.49 (0.32) | .13  | 0.56 (0.27) | .04  | -0.07 (0.04) | .15   | 0.04 (1.21) | .975 |
| CCAS                 | -0.92 (0.22) | <.001  | -0.08 (0.01) | <.001 | -0.67 (0.06) | <.001 | -0.6 (0.05) | <.001 | -0.03 (0.01) | .004  | -1.07 (0.22) | <.001 |
| Premorbid mRS        | -1.09 (0.28) | <.001  | -0.07 (0.02) | <.001 | -0.1 (0.07) | .17  | -0.1 (0.06) | .1   | -0.01 (0.01) | .14   | -1.26 (0.27) | <.001 |
| 7-day NIHSS          | -2.36 (0.05) | <.001  | -0.12 (0.003) | <.001 | -0.39 (0.02) | <.001 | -0.34 (0.01) | <.001 | -0.05 (0.002) | <.001 | -1.99 (0.05) | <.001 |
| **Abbreviations:** SE, Standard Error; FMA, Fugl-Meyer Assessment; FAC, Functional Ambulatory Category; K-MMSE, Korean Mini-Mental State Examination; Short K-FAST, Short Korean version of the Frenchay Aphasia Screening Test; AHSA-NOMS, American Speech-Language-Hearing Association National Outcome Measurement System Swallowing Scale; K-MBI, Korean modified Barthel Index; CCAS, combined condition- and age-related score in the Charlson comorbidity index; mRS, modified Rankin scale; NIHSS, National Institutes of Health Stroke Scale. |
### eTable 4. Multivariable Regression Analyses for Factors Potentially Associated With Functional Outcomes at 60 mo After First-Time Stroke

|                  | FMA        | FAC        | K-MMSE     | Short K-FAST | AHSA-NOMS   | K-MBI      |
|------------------|------------|------------|------------|--------------|-------------|------------|
|                  | β (SE)     | P Value    | β (SE)     | P Value      | β (SE)      | P Value    | β (SE)     | P Value      | β (SE)      | P Value |
| Stroke type, hemorrhagic | 2.51 (0.74) | <.001      | 0.14 (0.05) | .004          | 1.21 (0.2)  | <.001      | 0.88 (0.17) | <.001        | 0.13 (0.21) | <.001   |
| Age              | -0.16 (0.03) | <.001      | -0.02 (0.002) | <.001         | -0.11 (0.01) | <.001      | -0.1 (0.01) | <.001        | -0.01 (0.001) | <.001   |
| Sex, male        | 0.9 (0.67)  | .18         | 0.17 (0.04) | <.001        | 0.74 (0.18) | <.001      | 0.47 (0.15) | .002          | 0.05 (0.03) | .07      |
| Body mass index  | -0.03 (0.09) | .73         | -0.01 (0.01) | .44          | 0.02 (0.02) | <.001      | 0.02 (0.02) | .25          | -0.002 (0.004) | .58      |
| Smoking, current | 0.02 (0.68)  | .97         | -0.002 (0.004) | .96         | -0.1 (0.19) | .47        | 0.09 (0.15) | .57          | 0.004 (0.03) | .90      |
| Alcohol, current | 0.82 (0.62)  | .19         | 0.04 (0.04) | .30          | 0.12 (0.17) | .59        | 0.13 (0.14) | .37          | 0.04 (0.03) | .17      |
| Education years  | 0.19 (0.07)  | .007        | 0.01 (0.004) | .003         | 0.22 (0.02) | .47        | 0.24 (0.02) | <.001        | 0.003 (0.003) | .26      |
| Medical history  |            |            |            |              |            |            |            |              |            | .06     |
| Hypertension     | -0.27 (0.57) | .63        | -0.02 (0.04) | .67          | -0.24 (0.16) | .13        | -0.02 (0.13) | .88          | 0.003 (0.02) | .91      |
| Diabetes mellitus| -1.75 (0.68) | .01        | -0.16 (0.04) | <.001        | -0.24 (0.19) | .20        | -0.24 (0.16) | .12          | -1.82 (0.75) | .02      |
| Atrial fibrillation| -2.14 (1.09) | .05        | -0.12 (0.07) | .08          | -0.93 (0.3)  | .002       | -0.61 (0.25) | .01*         | -0.1 (0.05) | .03      |
| Hyperlipidemia   |            |            |            |              |            |            |            |              |            | .16     |
| CCAS             | 0.41 (0.2)  | .04         | 0.07 (0.01) | <.001        | 0.22 (0.06) | <.001      | 0.23 (0.05) | <.001        | 0.02 (0.01) | .005*    |
| Premorbid mRS    | 0.13 (0.21)  | .54        | -0.004 (0.01) | .79         | -                 | -                 | 0.13 (0.22) | <.001      | 1.13 (0.22) | <.001   |
| 7-day NIHSS      | -0.08 (0.12) | <.001      | -0.06 (0.01) | <.001        | -0.09 (0.03) | .01*       | -0.09 (0.03) | .001         | -0.03 (0.01) | <.001   |
| Functional levels at day 7 |            |            |            |              |            |            |            |              |            |        |
| FMA              | 0.28 (0.02)  | <.001      | 0.01 (0.001) | <.001        | 0.003 (0.005) | .46        | 0.01 (0.004) | .04          | -0.0003 (0.001) | .68      |
| K-MMSE           | 0.16 (0.07)  | .03        | 0.02 (0.005) | <.001        | 0.24 (0.02) | <.001      | 0.14 (0.02) | <.001        | 0.01 (0.003) | <.001   |
| FAC              | 0.42 (0.21)  | .048       | 0.04 (0.01) | .004         | 0.07 (0.06) | .23        | 0.02 (0.05) | 64.00        | 0.01 (0.01) | .11      |
| AHSA-NOMS        | 0.4 (0.23)   | .08        | 0.002 (0.01) | .92          | -0.11 (0.06) | .09        | -0.05 (0.05) | .30          | 0.02 (0.01) | .03      |
| Short K-FAST     | -0.09 (0.09)  | .32        | -0.002 (0.006) | .70          | 0.07 (0.02) | .008       | 0.12 (0.02) | <.001        | -0.01 (0.004) | .008    |

**Abbreviations:** SE, Standard Error; FMA, Fugl-Meyer Assessment; FAC, Functional Ambulatory Category; K-MMSE, Korean Mini-Mental State Examination; Short K-FAST, Short Korean version of the Frenchay Aphasia Screening Test; AHSA-NOMS, American Speech-Language-Hearing Association National Outcome Measurement System Swallowing Scale; K-MBI, Korean modified Barthel Index; CCAS, combined condition- and age-related score in the Charlson comorbidity index; mRS, modified Rankin scale; NIHSS, National Institutes of Health Stroke Scale.