Brief Reports

Distribution of National Institutes of Health Stroke Scale in the Cincinnati/Northern Kentucky Stroke Study

Mathew Reeves, PhD; Jane Khoury, PhD; Kathleen Alwell, BSN; Charles Moomaw, PhD; Matthew Flaherty, MD; Daniel Woo, MD; Pooja Khatri, MD; Opeolu Adeoye, MD; Simona Ferioli, MD; Brett Kissela, MD; Dawn Kleindorfer, MD

Background and Purpose—Little is known about the distribution of National Institutes of Health Stroke Scale (NIHSS) scores from patients with ischemic stroke sampled from population-based studies. We describe the distribution of NIHSS in ischemic stroke cases from the Cincinnati/Northern Kentucky Stroke Study.

Methods—Within a biracial population of 1.3 million, all strokes among area residents in 2005 were ascertained by screening discharge records at local hospitals and outpatient clinics. A sampling scheme was developed to ascertain additional cases presenting to physician offices and nursing homes, not identified through the other sources. All confirmed ischemic stroke cases underwent chart abstraction, and a retrospective NIHSS (rNIHSS) score (range, 0–42) was generated on the basis of initial physician examination findings.

Results—There were 2233 ischemic stroke cases identified during the 12-month study. The overall median rNIHSS score was 3 (interquartile range, 1–7). Median rNIHSS score was 3, 7, and 1, respectively, for stroke cases ascertained through the admitted, in-hospital, and out-of-hospital sources. Median rNIHSS was significantly higher in subjects ≥80 years compared with younger cases (4 versus 3).

Conclusions—More than half of all ischemic stroke cases have mild symptom severity on initial presentation (ie, rNIHSS≤3). Monitoring trends in NIHSS represents a legitimate target for population-based surveillance efforts. (Stroke. 2013;44:3211-3213.)

Key Words: severity stroke

The National Institutes of Health Stroke Scale (NIHSS) is widely used as a measure of stroke severity and is a strong predictor of patient outcome.1–3 However, NIHSS data from representative samples of patients with acute ischemic stroke are lacking; NIHSS is frequently missing in clinical registries, and more complete data are usually limited to clinical trial settings. Thus, there are few sources of data that illustrate the distribution of NIHSS in representative population-based samples of patients with ischemic stroke. We, therefore, describe the distribution of NIHSS in ischemic stroke cases from a nationally representative population-based stroke study.

Methods
Details of the design and conduct of the Greater Cincinnati/Northern Kentucky (GCNK) Stroke Study have been described elsewhere.4 Briefly, in the calendar year 2005, all acute ischemic stroke events among the 1.3 million residents of the GCNK region were ascertained by identifying inpatient discharge International Classification of Diseases-Ninth Revision codes 430 to 436 at 17 area hospitals. Additional screenings for stroke-related visits occurred in all area hospital emergency departments, hospital-based outpatient clinics, public health clinics, in sample of 51 of 832 physician offices, and 25 of 126 nursing.4 Trained research nurses then undertook an extensive chart abstraction of all suspected stroke cases that included a retrospective NIHSS (rNIHSS) score (0–42) on the basis of physician findings at the initial physical examination.5–6 Final confirmation of acute ischemic stroke was based on physician review of the complete medical record and neuroimaging results.

Descriptive statistics of rNIHSS (median, interquartile range) were generated by demographic subgroups and location of case ascertainment (ie, hospital admission, in-hospital stroke, or out-of-hospital). Out-of-hospital data were weighted to account for the different sampling fractions used in physician offices and nursing homes. To account for the sampling design and multiple stroke events within some subjects, significant differences in log-transformed rNIHSS were tested using age-adjusted generalized linear models.

Results
There were 2233 ischemic stroke cases identified during the 12-month study period. The overall distribution of the rNIHSS is shown in the Figure. The overall median rNIHSS score was 3 (interquartile range, 1–7). The distribution of rNIHSS by age, sex, race, and location of ascertainment are summarized in the Table. The rNIHSS scores were statistically significantly higher in older age groups, and they also differed according to ascertainment location; in-hospital strokes had higher rNIHSS scores (median=7), whereas out-of-hospital strokes had lower scores (median=1), compared with cases

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admitted to the hospital (median=3). There were no significant differences by sex or race.

Discussion
In this population-based representative sample of acute ischemic strokes, more than half had mild symptom severity at initial presentation (ie, rNIHSS≤3). We think this mild spectrum of stroke severity in patients with contemporary ischemic stroke is not widely recognized, in part, because most published studies that report NIHSS data are based on selected patient populations enrolled in randomized trials or case series from academic settings. Our findings are in general agreement with the handful of other reports that have presented NIHSS data from community- or population-based stroke studies. For example, the Northern Manhattan Study demonstrated that about 50% of ischemic stroke cases had a NIHSS of 0 to 5.7
In a community-based acute stroke study in Corpus Christi, TX, the median NIHSS was 3 in a population of ≈1800 ischemic stroke and transient ischemic attack cases admitted to 1 of 6 area hospitals.9 The NIHSS will typically be higher in reports where cases are enrolled on the basis of specific clinical inclusion criteria or where there is incomplete (ie, selective) reporting of NIHSS. For example, in a report from the Get-With-the-Guidelines-Stroke registry, NIHSS was documented in 40% of hospitalized cases, and the median NIHSS score was 5 (interquartile range, 2–12).9 In Get-With-the-Guidelines-Stroke, NIHSS scores were more likely to be documented in patients who were younger, male and arrived by ambulance.3

As expected, stroke severity varied markedly depending on the location where cases were first identified; rNIHSS scores of patients with in-hospital strokes were substantially higher than those of patients who were admitted to the hospital through the emergency department, a finding that has been reported previously.10,11 Unsurprisingly, the severity of stroke cases identified in the out-of-hospital setting was noticeably milder than those admitted to the hospital. Fifteen percent of the cases in this study had a rNIHSS score of 1, and 11% had a rNIHSS of 0, which is much higher than previous estimates.12

The strengths of this study include its population-based approach that is based on well-validated methods that include both in-hospital and out-of-hospital case ascertainment. One limitation is that NIHSS data were collected using retrospective methods, which, although shown to be valid across the entire spectrum of scores,5,6 is not as preferable as data collected in real-time by clinical experts; however, such data are difficult to collect across multiple different clinical settings. We also note that it should not be assumed that patients with low NIHSS scores achieve a full recovery; studies show important long-term deficits in function and quality-of-life after mild stroke events.13

In summary, on the basis of a representative population-based sampling of ischemic stroke cases, the spectrum of stroke severity as measured by the NIHSS is surprisingly mild. Given the potential for secular changes in the both natural history and clinical history of ischemic stroke,4,14 the monitoring of secular trends in NIHSS scores in stroke populations represents a legitimate target for future population-based
surveillance efforts. In addition, awareness of the underlying distribution of NIHSS scores may be useful in the planning of future clinical studies.

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**Disclosures**

None.

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### Table. Distribution of Retrospective National Institutes of Health Stroke Scale scores by Demographic Subgroup and Location of Ascertainment (N=2233)

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>n</th>
<th>Median</th>
<th>25 Percentile</th>
<th>75 Percentile</th>
<th>(P\text{Value})*</th>
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<tr>
<td>Total</td>
<td>2233</td>
<td>3.0</td>
<td>1.0</td>
<td>7.0</td>
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<tr>
<td>Age, y</td>
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<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
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<tr>
<td>&lt;65</td>
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<tr>
<td>65–79</td>
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<td>1.0</td>
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<td>≥80</td>
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<td>4.0</td>
<td>2.0</td>
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<td>Women</td>
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<td>1.0</td>
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<td>Men</td>
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<tr>
<td>Black</td>
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<td>Other</td>
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<td>In-hospital onset‡</td>
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<td>4.0</td>
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<td>Out-of-hospital§</td>
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<td>0.0</td>
<td>3.0</td>
<td></td>
</tr>
</tbody>
</table>

*Generated from age-adjusted generalized linear models.

†Cases admitted from the community.

‡Cases developed in patients hospitalized for another reason.

§Cases found in outpatient clinics, physician offices, and nursing homes.

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### References

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