Long-Term Outcome After Stroke in Belarus
The Grodno Stroke Study

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Background and Purpose—Data concerning the long-term prognosis after stroke in low-income and middle-income countries are limited. We aimed to establish survival and dependency at 5 years after a first-ever-in-a-lifetime stroke in Grodno, Belarus.

Methods—All residents of Grodno with a suspected acute stroke were registered prospectively and assessed over a period of 12 months in 2001. Patients were followed-up prospectively at 3 and 12 months, and then annually up to 5 years after the index event.

Results—There were 671 cases of first-ever-in-a-lifetime stroke, and follow-up data after 5 years were available for 653 of these patients (97.3%); 18 people (2.7%) were lost to follow-up. One hundred ninety patients (29.1%) died during the first 28 days of stroke. The case fatality rate at 3 months was 32.2% (210/653), at 12 months it was 37.4% (244/653), and at 5 years it was 58.8% (384/653). Of the 269 survivors at 5 years, 130 (48.3%) were independent (modified Rankin score, 0–2), and 139 (51.7%) were disabled (modified Rankin score, ≥3). At 5 years, the cumulative risk of death or disability after first-ever-in-a-lifetime stroke was 80.1% (523/653).

Conclusions—Stroke in Belarus is associated with a very high risk of death or dependency at 5 years. (Stroke. 2011; 42:00-00.)

Key Words: disability ■ long-term survival ■ stroke ■ outcome

Countries of low and middle incomes have the largest burden of stroke, accounting for >85% of stroke mortality worldwide,1 but few reliable data on long-term outcome are available in most of these regions. In this study, we aimed to follow-up for 5 years stroke patients who participated in the first year of the Grodno Stroke Study (GROSS).2

Subjects and Methods
The GROSS registered all strokes among 311 134 residents of the city of Grodno, Belarus, during a 3-year period from 2001 to 2003.3

A cohort of patients with a nonfatal first-ever-in-a-lifetime stroke (FELS) registered in 2001 was followed-up prospectively at 3 and 12 months, and then annually for up to 5 years after the index event for survival, recurrent strokes, and disability (Supplemental Methods, http://stroke.ahajournals.org).

Results
Six hundred seventy-one cases of FELS were registered in the GROSS during 2001. After 5 years, 18 people (2.7%) were lost, and complete follow-up data were available for 653 patients (97.3%). The mean (±SD) age of these patients at baseline was 65.4±11.4 years. The 5-year cumulative risk of death (Figure and Supplemental Table I) was 58.8% (95% confidence interval [CI], 53.3%–64.7%). The risk of death was greatest during the first year after stroke (37.4%; 95% CI, 33.0%–42.3%) and, particularly, during the first 28 days after stroke (29.1%; 95% CI, 25.2%–33.6%). Stratification by age showed (Supplemental Figure I) that older patients had a worse prognosis ($\chi^2$ trend, 65.3; $P<0.000001$). Over the whole follow-up period there were 104 recurrent strokes (22.5%) among the 463 survivors of 28 days, with the case-fatality of 43.3% (45/104).

Data on the functional outcome 5 years after FELS by modified Rankin score (mRS) are presented in the Table. The proportion of disabled patients (mRS, ≥3) among all the survivors increased stepwise with age from 30.8% in the age group younger than 45 years to 90.5% in the age group of those aged 75 to 84 years. Of the survivors, <50% of the

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patients were functionally independent (mRS, <3). The mean (±SD) value of mRS for all 5-year survivors (n=269) was 2.52±1.28. The cumulative risk of death or disability after a first-ever stroke at 5 years was 80.1% (523/653; 95% CI, 73.3%–87.3%).

Discussion

We conducted a community-based study of 5-year outcome after FELS in a large defined urban population of the east European non-European Union countries. Our study provides prognostic data from a large, unselected, community-based inception cohort of patients with FELS diagnosed prospectively after a standardized neurological assessment and using standardized diagnostic criteria. The outcome events were carefully defined, and only 2.7% of patients were lost to follow-up.

Our study has several limitations. Because of the low rate of imaging-autopsy at baseline (37.1%; 242/653), we could not perform stratification of outcomes by the type of stroke. Data on clinical features of FELS were not registered, and functional outcome estimates were limited to poststroke mRS value.

The cumulative risk of death at 5 years after FELS of 59% (95% CI, 53.3%–64.7%) in the Belarusian urban population is significantly higher than in Framingham, Massachusetts, United States (45%; 95% CI, 38.8%–52.2%),1 Auckland, New Zealand (49%; 95% CI, 46.2%–52.9%),4 Martinique, French West Indies (50%; 95% CI, 44.2%–55.4%),5 Oxford, United Kingdom (50%; 95% CI, 45.0%–55.6%),8 and 6 communities in Japan (52%; 95% CI, 44.5%–61.0%),7 but similar to those in Rochester, Minnesota, United States (56%; 95% CI, 48.3%–66.1%),8 and Perth, Australia (58%; 95% CI, 50.3%–66.7%).9 Mean age at baseline of patients in Grodno (65.4 years) was the lowest compared to that of other studies (70.1–73.0 years4,8,9). Five years after the FELS, 48.3% (130/269) of the survivors in Grodno were functionally independent (mRS, <3); it is significantly lower than in Rochester (65.2%; 75/115),4 Martinique (66.4%; 174/262),5 and Auckland (68.8%; 287/418).4 At the same time, the mean mRS score among 5-year survivors in the GROSS of 2.52±1.28 is 1.5-times higher compared to the corresponding index in the ASTRO (1.7±1.5; P<0.00001).4 In our opinion, these findings reflect greater severity of stroke in the Belarusian urban population and are in agreement with high incidence, case fatality, and prevalence of vascular risk factors in Grodno.2

Our findings of 59% cumulative risk of death at 5 years after FELS for the younger mean age at baseline of the initial cohort compared to other studies and the <50% rate of functionally independent survivors demonstrate a clear need for active and prolonged secondary prevention. Our data on the long-term stroke outcomes are important for public health prevention programs as well as for evidence-based rehabilitation service planning and health resource allocation.

Table. Rate of Disability (Modified Rankin Score ≥3) Among 5-Year Survivors After First-Ever-in-a-Lifetime Stroke

<table>
<thead>
<tr>
<th>Age, y</th>
<th>No. Disabled/No. Survived</th>
<th>Rate of Disability, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Younger than 45</td>
<td>4/13</td>
<td>30.8</td>
</tr>
<tr>
<td>45–54</td>
<td>21/55</td>
<td>38.2</td>
</tr>
<tr>
<td>55–64</td>
<td>47/99</td>
<td>47.5</td>
</tr>
<tr>
<td>65–74</td>
<td>47/80</td>
<td>58.8</td>
</tr>
<tr>
<td>75–84</td>
<td>19/21</td>
<td>90.5</td>
</tr>
<tr>
<td>85 or older</td>
<td>1/1</td>
<td>100</td>
</tr>
<tr>
<td>All ages</td>
<td>139/269</td>
<td>51.7</td>
</tr>
</tbody>
</table>

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Disclosures
None.

References
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Supplemental Methods
Stroke was defined with the use of the standard World Health Organization definition,\(^1\) and each event was classified as being the patient’s first-ever-in-a-lifetime (FELS) or recurrent stroke. A fatal event was defined as death within 28 days after the onset of an acute stroke. During the follow-up all patients were assessed for recurrent stroke; for this analysis it was defined as any recurrent stroke occurring >28 days after the incident stroke (definition C by Coull and Rothwell\(^2\)). Data on the death of patient from the cohort of 2001 non-fatal stroke patients were ascertained initially by screening of regional outpatient clinic’s databases, which are formed using the register of death certificates issue and information of the regional registry office. 5-year survivors were classified according to their modified Rankin Scale\(^3\) (mRS) score as functionally independent (mRS<3) or disabled (mRS\(\geq\)3).

The Kaplan-Meier product limit technique was used to generate survival probabilities and survival curves based on the 384 deaths within the 5 years. We also compared the cumulative incidence of deaths over 5 years of follow-up (observed deaths) with the expected incidence of deaths in the general population (expected deaths), derived from the age- and sex-specific rates of death according to the official mortality statistics for Grodno from the Regional Statistical Department. 95% CIs for the risk of death were calculated from the Poisson distribution for the number of events. Analyses were processed using the STATISTICA (data analysis software system), version 6.0 (StatSoft, Inc., Tulsa, OK, USA).
**Supplemental Tables**

**Table S1.** Kaplan-Meier Estimates of the Risk of Death within Different Time Intervals after FELS in Grodno, Belarus 2001

<table>
<thead>
<tr>
<th></th>
<th>0-28 d</th>
<th>1-3 mo</th>
<th>3-12 mo</th>
<th>1-2 y</th>
<th>2-3 y</th>
<th>3-4 y</th>
<th>4-5 y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk, %</td>
<td>29.1</td>
<td>4.3</td>
<td>7.7</td>
<td>8.8</td>
<td>9.7</td>
<td>11.3</td>
<td>10.0</td>
</tr>
<tr>
<td>95% CI</td>
<td>25.2–33.6</td>
<td>2.6–6.6</td>
<td>5.4–10.7</td>
<td>6.1–12.2</td>
<td>6.8–13.5</td>
<td>8.1–15.4</td>
<td>6.8–14.3</td>
</tr>
<tr>
<td>Cumulative risk, %</td>
<td>29.1</td>
<td>32.2</td>
<td>37.4</td>
<td>42.9</td>
<td>48.4</td>
<td>54.2</td>
<td>58.8</td>
</tr>
<tr>
<td>95% CI</td>
<td>25.2–33.6</td>
<td>27.9–37.0</td>
<td>33.0–42.3</td>
<td>38.3–48.0</td>
<td>43.2–54.2</td>
<td>48.7–60.2</td>
<td>53.3–64.7</td>
</tr>
<tr>
<td>No. at risk</td>
<td>653</td>
<td>463</td>
<td>443</td>
<td>409</td>
<td>373</td>
<td>337</td>
<td>299</td>
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<tr>
<td>No. of deaths</td>
<td>190</td>
<td>20</td>
<td>34</td>
<td>36</td>
<td>36</td>
<td>38</td>
<td>30</td>
</tr>
<tr>
<td>Cumulative deaths</td>
<td>190</td>
<td>210</td>
<td>244</td>
<td>280</td>
<td>316</td>
<td>354</td>
<td>384</td>
</tr>
</tbody>
</table>

*d* indicates days; *mo* indicates months; *y* indicates years.
Figure S1. Kaplan-Meier curves showing the probability of survival in patients with a FELS in 2001, stratified by age.

Supplemental References