Falls After Stroke

Results From the Auckland Regional Community Stroke (ARCOS) Study, 2002 to 2003

Ngaire Kerse, PhD; Varsha Parag, MSc; Valery L. Feigin, PhD; Harry McNaughton, PhD; Maree L. Hackett, PhD; Derrick A. Bennett, PhD; Craig S. Anderson, PhD; and the Auckland Regional Community Stroke (ARCOS) Study Group

Background and Purpose—Falls are an important issue in older people. We aimed to determine the incidence, circumstances, and predictors of falls in patients with recent acute stroke.

Methods—The Auckland Regional Community Stroke (ARCOS) study was a prospective population-based stroke incidence study conducted in Auckland, New Zealand (NZ) during 2002 to 2003. Among 6-month survivors, the location and consequences of any falls were ascertained by self-report as part of a structured interview. Multivariable logistic regression was used to establish associations between risk factors and “any” and “injurious” falls.

Results—Of 1104 stroke survivors who completed an interview, 407 (37%) reported at least 1 fall, 151 (37% of fallers, 14% of stroke survivors) sustained an injury that required medical treatment, and 31 (8% of fallers, 3% of stroke survivors) sustained a fracture. The majority of falls occurred indoors at home. Independent factors associated with falls were depressive symptoms, disability, previous falls, and older age. For injurious falls, the positively associated factors were female sex and NZ/European ethnicity and dependence before the stroke, whereas higher levels of activity and normal cognition were negatively associated factors.

Conclusions—Falls are common after stroke, and their predictive factors are similar to those for older people in general. Falls prevention programs require implementation in stroke services. (Stroke. 2008;39:1890-1893.)

Key Words: falls ■ injury ■ stroke ■ risk factors

Falls are an important public health issue, with 30% of all older people falling and 10% sustaining injury.1 For those who have a stroke, the consequences of falls add to their morbidity.2 Preventative strategies including activity programs and home hazard assessments reduce the risk of falls in community dwelling individuals.3 We aimed to determine the frequency, circumstances, and predictors of falls and fall-related injury after stroke.

Methods

The Auckland Regional Community Stroke (ARCOS) study details have been described elsewhere.4 In brief, multiple overlapping sources were used to ascertain all first-ever and recurrent cases of stroke among residents (aged ≥15 years) of Auckland, NZ over 12-month calendar period in 2002 to 2003. The Auckland Ethics Committee approved the study.

Measures

All patients (or their proxy) were interviewed by a trained research nurse after onset and at 1 and 6 months poststroke. Baseline information included demographics, medical history, history of falls, and use of psychotropic medication. Each stroke was categorized into a major underlying pathological type (neuroimaging was used in over 90%). Level of severity was based on the Barthel index in the week after onset categorised as “independent” (score 20), “intermediate” (scores 10 to 19), and “dependent” (scores 0 to 10) for analyses.

During follow-up, “cognitively competent” patients were defined on the basis of them scoring greater than 6 on the Hodkinson Mental Test (HMT). Higher levels of functioning were assessed using the Frenchay Activities Index (FAI), scored from 15 (“low”) to 45 (“high”). Mood was evaluated using a single question “Do you often feel sad or depressed?”.

Falls and Injury

The question: “Have you fallen in the last 6 months?” and “if so how many times?” and the question “Have you received medical treatment for a fall?” were answered. The location of the fall(s) was also recorded and receipt of medical treatment was a proxy for injury.

Statistical Analyses

All analyses were restricted to patients who survived to 6 months poststroke and completed the interview questions. Exposure vari-
ables were compared between patients with and without falls, and with and without “injurious falls.” In univariate logistic regression models, the significance of independent variables (including all demographic, health, medication, physical, and psychological function) and dependent outcome (falls) were determined. Variables that demonstrated significant association (P < 0.2) with the outcome in univariate models were considered for inclusion in a multivariable model. The initial covariate selection procedure for multiple logistic regression used the backward selection algorithm available in SAS 9.1 using complete participant analysis. The following variables were forced into all models: age, sex, prestroke history of falls, previous stroke at baseline, and cognition (HMT) score. When there was considerable correlation between variables, the variable with the most significant contribution to the model was included. Variables were retained in the final model if they remained significant (P < 0.05). A sensitivity analysis compared those sustaining injury with those who had not fallen (excluding those who fell but did not sustain injury).

**Results**

Of a total of 1938 stroke patients registered initially, 608 had died and 158 were unavailable for interview at 6 months. Of 1172 6-month stroke survivors, 1104 answered the questions about falls; those unable to contribute such information were more dependent but had similar age, sex, and stroke subtype profile to those with this information. Before their stroke 314 (28%) participants had fallen. Of the 407 (37% of participants, 34% of all survivors) who reported a fall in the 6 months since their stroke, 149 (37%) had fallen before the stroke. Almost a half of fallers fell only once (196, 48%), and 43 (12%) fell more than 5 times. Of those who had fallen since the stroke, one third (51, 37% of fallers) reported receiving medical treatment and 31 (8% of fallers, 3% of stroke survivors) sustained a fracture. Most patients had
sustained their fall at home (77%), and 77% of the falls had occurred indoors. Of the 93 patients who fell away from home, 42 (45%) had fallen indoors.

Table 1 shows a comparison between fallers and nonfallers. Age, prior fall, previous stroke, premorbid dependency, medication use, poor cognitive status, abnormal mood, and high levels of activity were associated with falls after stroke. Table 2 shows that sex was, and premorbid dependency was not, associated with fall-related injury after stroke.

Table 3 shows that in a multivariable model, prior falls, increased age, low levels of functioning, and abnormal mood were independent risk factors for falls. Sustaining an injurious fall was related to female sex, NZ/European ethnicity and poor cognitive function, whereas high FAI levels and premorbid dependency were negatively associated. Our sensitivity analysis achieved similar results.

**Discussion**

This large population-based study has shown that stroke patients are at high risk of falls and injury. Our finding, that 37% of stroke patients fall in 6 months, is much higher than reported previously, and is higher than for older people in long-term residential care. These findings emphasize the need to incorporate falls prevention strategies in stroke services.

We found a high frequency of fractures (3% overall; 8% of fallers in 6 months), which is greater than seen among people in long-term residential care over 12 months (3% to 5%).
### Table 3. Independent Risk Factors for Falls and Injurious Falls Among Stroke Survivors at 6 Months

<table>
<thead>
<tr>
<th>Outcome: fallen vs not fallen since stroke</th>
<th>Odds Ratio (95% CI)</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at stroke, 5 year increase</td>
<td>1.06 (1.00, 1.12)</td>
<td>0.03</td>
</tr>
<tr>
<td>Female</td>
<td>0.99 (0.75, 1.32)</td>
<td>0.96</td>
</tr>
<tr>
<td>Fall in last year before stroke</td>
<td>1.60 (1.19, 2.16)</td>
<td>0.002</td>
</tr>
<tr>
<td>Previous stroke at baseline</td>
<td>1.16 (0.83, 1.61)</td>
<td>0.38</td>
</tr>
<tr>
<td>6 month normal cognition, HMT&gt;6</td>
<td>0.81 (0.55, 1.18)</td>
<td>0.27</td>
</tr>
<tr>
<td>Baseline Barthel Index score</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Baseline Barthel Index score 10–19</td>
<td>1.72 (1.25, 2.36)</td>
<td>0.001</td>
</tr>
<tr>
<td>Baseline Barthel Index score 0–9 (dependent)</td>
<td>2.09 (1.40, 3.12)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>6 month often feel sad/depressed</td>
<td>1.48 (1.09, 2.01)</td>
<td>0.011</td>
</tr>
<tr>
<td>C-statistic</td>
<td>0.62</td>
<td></td>
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</tbody>
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<table>
<thead>
<tr>
<th>Outcome: fallen and sustained injury vs other since stroke</th>
<th>Odds Ratio (95% CI)</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at stroke, 5 year increase</td>
<td>1.07 (0.97, 1.17)</td>
<td>0.18</td>
</tr>
<tr>
<td>Female</td>
<td>1.75 (1.15, 2.64)</td>
<td>0.01</td>
</tr>
<tr>
<td>Fall in last year before stroke</td>
<td>1.33 (0.89, 2.00)</td>
<td>0.17</td>
</tr>
<tr>
<td>Previous stroke at baseline</td>
<td>1.52 (0.98, 2.35)</td>
<td>0.06</td>
</tr>
<tr>
<td>6 month normal cognition, HMT&gt;6</td>
<td>0.53 (0.32, 0.86)</td>
<td>0.01</td>
</tr>
<tr>
<td>New Zealand/European ethnicity</td>
<td>1.94 (1.11, 3.41)</td>
<td>0.02</td>
</tr>
<tr>
<td>Pre-morbid dependency</td>
<td>0.46 (0.26, 0.82)</td>
<td>0.01</td>
</tr>
<tr>
<td>6 month total FAI score (5 point increase)</td>
<td>0.80 (0.72, 0.89)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>C-statistic</td>
<td>0.73</td>
<td></td>
</tr>
</tbody>
</table>

*The following variables were controlled for in both multivariable regression models: age at stroke, sex, fall in year before stroke, previous stroke at baseline, and normal cognition, ie 6-month HMT score>6. HMT indicates Hodkinson Mental Test.

Interestingly, type of stroke was not related to fall risk. The factors associated with falls observed here are similar to those identified in residential care and community populations. As home hazard assessment prevents falls, it would seem reasonable for such strategies to be incorporated in resettlement at home. Although the relationship between mobility and falls is complex, fall prevention activity programs are effective and should be considered as part of rehabilitation after stroke.

Stroke survivors with abnormal mood were more likely to have sustained a fall. However, as mood was ascertained cross-sectionally, it is possible that falls themselves triggered the onset of depression. Other studies have shown an association between abnormal gait pattern and depression in older people, suggesting that falls are based more on abnormal physiology than abnormal psychology. Depression is also an independent risk factor for fractures. Falls and depression will complicate recovery from stroke, and irrespective of the direction of causality, both require appropriate prevention, early recognition, and nonpharmacological intervention.

A limitation of this study is that some patients were unable to participate in the follow-up assessments. Nonparticipants had higher levels of disability than participants, suggesting that we may have underestimated the frequency of falls and the impact of functional status as a risk factor. Furthermore, we were unable to obtain specific physical performance measures. Our use of patient recall to ascertain falls was less accurate than using calendar diaries and almost certainly underestimated frequency of falls.

In summary, our study confirms that falls and fall-related injury are major morbidity issues among patients with stroke. Falls prevention interventions should be emphasized as part of routine stroke rehabilitation services.

### Acknowledgments

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### Disclosures

None.

### References


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