Trends in Survival Following First Hemorrhagic or Ischemic Stroke over 25-years of Follow-up in the General Population

Findings from the Rotterdam Study

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Disclosures

• None
Between 1990 and 2000, important advances in stroke management were introduced in the Netherlands.
Aims

- Do advances in stroke management translate to a reduced stroke burden in the general population?
Study design and methods

- All Rotterdam Study participants at baseline in 1990
- EU standard population

First-ever hemorrhagic or ischemic stroke

1:1 Matching* on year of birth (+/-1) and sex

Death, loss to follow-up or end of study

Stroke free controls

Age Standardization*

<table>
<thead>
<tr>
<th></th>
<th>hemorrhagic stroke</th>
<th>ischemic stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N</strong></td>
<td>162</td>
<td>988</td>
</tr>
<tr>
<td>Age at stroke date, years</td>
<td>79.6 (12.8)</td>
<td>78.2 (11.7)</td>
</tr>
<tr>
<td>Women</td>
<td>96 (59.3)</td>
<td>556 (56.3)</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>26.1 (4.9)</td>
<td>26.9 (4.4)</td>
</tr>
<tr>
<td>Cholesterol, mmol/L</td>
<td>5.8 (1.2)</td>
<td>5.9 (1.6)</td>
</tr>
<tr>
<td>Diabetes mellitus type 2</td>
<td>30 (28.6)</td>
<td>192 (29.1)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>123 (82.6)</td>
<td>767 (83.9)</td>
</tr>
<tr>
<td><strong>Smoking</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>32 (21.2)</td>
<td>232 (25.0)</td>
</tr>
<tr>
<td>Former</td>
<td>75 (49.7)</td>
<td>387 (41.7)</td>
</tr>
<tr>
<td>Never</td>
<td>44 (29.1)</td>
<td>308 (33.2)</td>
</tr>
</tbody>
</table>
Results

[A] Hemorrhagic stroke

P = 0.08

[B] Ischemic stroke

P < 0.001
<table>
<thead>
<tr>
<th>Study period</th>
<th>Deaths, n</th>
<th>Person-years ¹</th>
<th>aHR (95% CI)</th>
<th>P</th>
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<th>Person-years ¹</th>
<th>aHR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991-1998</td>
<td>30</td>
<td>38</td>
<td>--</td>
<td>--</td>
<td>110</td>
<td>635</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>1999-2007</td>
<td>60</td>
<td>163</td>
<td>0.88 (0.56, 1.38)</td>
<td>0.60</td>
<td>294</td>
<td>2031</td>
<td>0.85 (0.67, 1.06)</td>
<td>0.16</td>
</tr>
<tr>
<td>2008-2015</td>
<td>54</td>
<td>184</td>
<td>0.98 (0.61, 1.57)</td>
<td>0.93</td>
<td>307</td>
<td>2230</td>
<td>0.71 (0.56, 0.90)</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

¹ person-years represent the unit for the population in each calendar period in a time varying fashion.
Results

<table>
<thead>
<tr>
<th>Time</th>
<th>Hemorrhagic stroke</th>
<th>Ischemic stroke</th>
<th>Control group*</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 months</td>
<td>36% (28% - 43%)</td>
<td>81% (78% - 83%)</td>
<td>96% (94% - 97%)</td>
</tr>
<tr>
<td>1 year</td>
<td>34% (27% - 41%)</td>
<td>76% (73% - 78%)</td>
<td>93% (92% - 95%)</td>
</tr>
<tr>
<td>2 years</td>
<td>31% (24% - 38%)</td>
<td>68% (65% - 71%)</td>
<td>87% (85% - 89%)</td>
</tr>
<tr>
<td>3 years</td>
<td>27% (20% - 33%)</td>
<td>61% (58% - 64%)</td>
<td>82% (80% - 84%)</td>
</tr>
</tbody>
</table>

*Controls and stroke cases were matched on year of birth and sex, each control was used only once.
Mortality rates in the literature

3-6 months mortality rates

ICH

ATACH II
INTERACT II
MISTIE
STICH

3 months mortality rates

IS

EXTEND
DEFUSE III
DAWN

Swedish Stroke Register
Rotterdam Study

Swedish-stroke register
Rotterdam Study
Limitations

• Limited power among cases with identified location or cause hindered subgroup analysis

• Exclusion of those with unspecified strokes

• The population is composed mainly of elderly stroke survivors
Strengths

• Long follow-up

• State-of-the-art clinical examinations

• Unselected sample of participants who were followed-up prospectively

• These factors all together provide a close reflection of the current disease burden in the population
Conclusions

• Marked improvement in survival following ischemic stroke since early 2000s was observed

• In contrast no improvement in survival following hemorrhagic stroke was observed
• Frank J.A. van Rooij data manager of the Rotterdam Study
• Department of Epidemiology, Erasmus University Medical Center
• Deborah Rose Harvard School of Public Health fellowship
Thank You!

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Location of hemorrhagic stroke

- Lobar
- Deep
- Ventricular
- Brainstem
- Cerebellum
- Combination
- Missing
Supplementary

- All-cause death in the Netherlands between 1990-2008
Death from ischemic heart disease (A) and cerebrovascular disease (B) in the Netherlands between 1990-2008

1 Mackenbach et al EJE. 2011. 26:903–914