21
Rehabilitation of Younger Patients
Post Stroke
Evidence Tables

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## 21.1 Incidence

### Table 21.1 Studies Evaluating the Incidence of Stroke in Younger Individuals

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<tr>
<th>Author, Year Country</th>
<th>Study Design</th>
<th>Time Post Stroke Sample Size</th>
<th>Methods</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Abu-Zeid et al.</strong> (1975) Canada <strong>Observational</strong> TPS=NA N=1367</td>
<td></td>
<td>Patients in the Manitoba area were included in this study over an 18-month period.</td>
<td></td>
<td>The incidence rate of ischemic stroke (IS) and hemorrhagic stroke for patients under 50 years of age was similar for men and women. With age, the incidence of IS increased more rapidly than did hemorrhagic stroke.</td>
</tr>
<tr>
<td><strong>Bonita et al.</strong> (1984) New Zealand <strong>Observational</strong> TPS=NA N=680</td>
<td></td>
<td>All stroke patients over the age of 15 in the area of Central Auckland were included in this study.</td>
<td></td>
<td>Men on average had higher age-specific event rates compared to women, except in the oldest age-group (&gt;85 years). Incidence rates of stroke for the various age-groups were as follows: 15-24 years of age, 6.4/100 000; 25-34, 9.0/100 000; 35-44, 44.3/100 000; 45-54, 114.3/100 000; 55-64, 262.8/100 000; 65-74, 682.5/100 000; 75-84, 2081.3/100 000; and 85+ years of age, 3034.3/100 000.</td>
</tr>
<tr>
<td><strong>Nencini et al.</strong> (1988) Italy <strong>Observational</strong> TPS=NA N=47</td>
<td></td>
<td>Patients with a first-ever stroke, ages of 15 to 44 years, from Florence were followed over a 3-year period.</td>
<td></td>
<td>The incidence rate for all annual stroke events per 100 000 was 8.7 (95% C. I. 5.5-13.9) for women and 9.0 (95% C.I. 5.8-13.4) for men. Stroke subtype annual incidence rates were as follows: 3.4 for cerebral infarction, 3.2 for subarachnoid hemorrhage and 1.9 for intracerebral hemorrhage.</td>
</tr>
<tr>
<td><strong>Koul et al.</strong> (1990) India <strong>Observational</strong> TPS=NA N=91</td>
<td></td>
<td>Patients in the rural northwest India area were included in this survey study.</td>
<td></td>
<td>Ninety-one patients from a surveyed population of 63,645 people. The crude prevalence of stroke was 143/100 000. Ten stroke patients were between the ages of 15-39, giving a prevalence rate of 41/100 000.</td>
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<tr>
<td><strong>Mayo et al.</strong> (1991) Canada <strong>Case Series</strong> TPS=NA N=37,000</td>
<td></td>
<td>Patients in the province of Quebec were included.</td>
<td></td>
<td>From 1981 to 1988 incidence rates of intracerebral hemorrhagic stroke for men aged 50-64 and 65-79 significantly increased by about 50%, and for men aged over 50 it increased by about 128%. Whereas the incidence rate for intracerebral hemorrhage in women increased in only the 2 older age groups (ages 65-79 years, 38%; aged &gt;80 years, 84%). The annual incidence rates for other intracranial hemorrhagic strokes increased significantly by 40% for men aged 65-79 and 204% for men over 80 years old. Incidence rates for occlusion of the precerebral arteries decreased significantly for men in the two youngest aged groups but a significant increase was noted in the two oldest age groups.</td>
</tr>
<tr>
<td>Study Description</td>
<td>Study Details</td>
<td>Findings</td>
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<tr>
<td><strong>Kittner et al.</strong> (1993) USA Case Series TPS=NA N=117</td>
<td>Patients aged 15 to 44 years from the Baltimore area in 1988.</td>
<td>Ischemic stroke incidence rates for a population of 100 000 were 10.3 for white men, 22.8 for black men, 10.8 for white women, and 20.7 for black women. Intracerebral hemorrhage incidence rates for a population of 100 000 were 4.6 for white men, 14.2 for black men, 1.5 for white women and 4.8 for black women.</td>
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<tr>
<td><strong>Rozenthal-Sorokin et al.</strong> (1996) Israel Observational TPS=NA N=253</td>
<td>Patients with first stroke (ages 17-49) admitted to all hospitals in Israel over the course of 1 year.</td>
<td>The incidence rate for young stroke patients per 100 000 population was 10.36 after age-and sex-adjustments. The incidence of stroke in females was almost half that of males.</td>
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<tr>
<td><strong>Johansson et al.</strong> (2000) Sweden Case Series TPS=NA N=2316</td>
<td>Patients with first-ever stroke (median age of 76.3 years) from the University Hospital of Lund were included.</td>
<td>After age- and sex-adjustments the stroke incidence rate for patients under the age of 75 years was 94/100 000 person-years in 1983-1985. The incidence rate increased to 117/100 000 person-years in 1993-1995. The incidence rate for stroke patients over the age of 75 years was 1477/100 000 person-years in 1983-1985, which increased to 1560/100 000 person-years in 1993-1995.</td>
<td></td>
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</tr>
<tr>
<td><strong>Marini et al.</strong> (2001) Italy Observational TPS=NA N=4353</td>
<td>Patients younger than 45 years of age with first-ever stroke were included in this 5-year study.</td>
<td>The crude annual incidence rate for stroke in young patients was 10.18/100 000 (95% CI, 8.14 to 12.57). With increasing age, stroke incidence rates greatly increased. Thirty percent of strokes occurred in patients under the age of 35 years. The crude annual incidence of stroke for the various stroke types was as follows: subarachnoid hemorrhage, 2.29/100,000; intracerebral hemorrhage, 2.06/100,000; and cerebral infarction 5.83/100,000.</td>
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<tr>
<td><strong>Jacobs et al.</strong> (2002) USA Observational TPS=NA N=74</td>
<td>Patients with first stroke, aged 20 to 44 years old were included.</td>
<td>The incidence rate for stroke in young adults was 23/100 000.</td>
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</tr>
<tr>
<td><strong>Naess et al.</strong> (2002) Norway Case Series TPS=NA N=232</td>
<td>Patients, ages 15-49, diagnosed with first-ever cerebral infarction during 1988-1997 in Hordaland County, Norway.</td>
<td>The average annual incidence rate was 11.4/100 000. For men, the average annual incidence rate was 12.9/100 000 and for women it was 9.7/100 000.</td>
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</tr>
<tr>
<td><strong>Di Carlo et al.</strong> (2003) Italy Observational TPS=NA N=179,186</td>
<td>Residents of the province of Vibo Valentia that experienced a first-ever stroke were followed and the incidence evaluated.</td>
<td>Crude incidence rate of total stroke per 1000 inhabitants per year in adults aged 0-44 was 0.10, in adults 45-54 was 0.69, and in adults 55-64 it was 1.49. Up to age 85, with every 10 years the frequency of first-ever stroke approximately doubled.</td>
<td></td>
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</tr>
<tr>
<td><strong>Medin et al.</strong> (2004)</td>
<td>Patients between the ages of 30-65 discharged</td>
<td>Crude total incidence was 117.1/100 000 for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=43,389</td>
<td>from a public hospital in Sweden with the diagnosis of first-ever stroke from 1989 until 2000 were included.</td>
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<tr>
<td><strong>Rasura et al.</strong> (2006)</td>
<td>Italy</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=394</td>
</tr>
<tr>
<td><strong>Ghandehari &amp; Izadi-Mood</strong> (2006)</td>
<td>Iran</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=124</td>
</tr>
<tr>
<td><strong>Bejot et al.</strong> (2008)</td>
<td>France</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=715</td>
</tr>
<tr>
<td><strong>Cabral et al.</strong> (2009)</td>
<td>Brazil</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=1323</td>
</tr>
<tr>
<td><strong>Harmsen et al.</strong> (2009)</td>
<td>Sweden</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N=28,154</td>
</tr>
<tr>
<td><strong>Lewsey et al.</strong> (2009)</td>
<td>Scotland</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N=213,358</td>
</tr>
<tr>
<td><strong>Onwuchekwa et al.</strong> (2009)</td>
<td>Nigeria</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N=611</td>
</tr>
<tr>
<td><strong>Vega et al.</strong> (2009)</td>
<td></td>
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<td>Patients 14 years and older were recorded by 3</td>
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<tr>
<td>Country</td>
<td>Study Type</td>
<td>TPS</td>
<td>N</td>
<td>Description</td>
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</tr>
<tr>
<td>Spain</td>
<td>Observational</td>
<td>NA</td>
<td>201,025</td>
<td>Spanish health sentinel networks.</td>
</tr>
<tr>
<td>Italy</td>
<td>Case Series</td>
<td>NA</td>
<td>1024</td>
<td>Patients from the Valley of Aosta with stroke onset during 2004 and 2008 were included.</td>
</tr>
<tr>
<td>Finland</td>
<td>Case Series</td>
<td>NA</td>
<td>1008</td>
<td>Patients with first ever ischemic stroke patients between the ages of 15-49 during 1994 to 2007 were evaluated.</td>
</tr>
<tr>
<td>India</td>
<td>Observational</td>
<td>NA</td>
<td>541</td>
<td>The incidence of first-ever ischemic stroke was found for patients in a South Indian community using a standardized questionnaire about stroke events as well as using multiple overlapping supplementary methods (n=541).</td>
</tr>
<tr>
<td>Italy</td>
<td>Observational</td>
<td>NA</td>
<td>127</td>
<td>Patients that experienced first ever stroke were identified in order to determine age-specific incidence of stroke subtypes.</td>
</tr>
<tr>
<td>China</td>
<td>Case Series</td>
<td>NA</td>
<td>81,298</td>
<td>Patients older than 18 years of age from the City Staff Medical Insurance Registry in Lhasa between October 2006 and October 2008 were included.</td>
</tr>
<tr>
<td>Belarus</td>
<td>Case Series</td>
<td>NA</td>
<td>2069</td>
<td>Patients of all ages who had first-ever stroke between January 2001 and December 2003.</td>
</tr>
<tr>
<td>South Korea</td>
<td>Case Series</td>
<td>NA</td>
<td>NA</td>
<td>Patients aged 45 to 54 with or without prior stroke. Results were derived from the national epidemiologic data of the Korean Health Disease study.</td>
</tr>
</tbody>
</table>
| Norway       | Population  | NA  | NA   | Population: Mean age=NA; Gender: Males=74, Females=82.                                                                                                                                                     | 1. Stroke incidence per 100,000 person-years across age groups was as follows: 8 for 25-
<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Study Design</th>
<th>TPS</th>
<th>N Start</th>
<th>N End</th>
<th>Population</th>
<th>Gender</th>
<th>Intervention</th>
<th>Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greenland</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N Start=156</td>
<td>N End=156</td>
<td>The incidence rate of stroke in stroke survivors discharged from 2011-2012 was determined.</td>
<td></td>
<td>Stroke incidence rates.</td>
<td></td>
<td>34yr, 104 for 35-44yr, 166 for 45-54yr, 559 for 55-64yr, 891 for 65-74yr, and 832 for 75-84yr.</td>
<td></td>
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<tr>
<td>Copstein et al. (2013)</td>
<td>Brazil</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N Start=3391</td>
<td>N End=3391</td>
<td>Mean age=NA; Gender: Males=1496, Females=1895.</td>
<td></td>
<td>The prevalence of stroke was determined in a vulnerable community.</td>
<td>Stroke prevalence; Smoking prevalence in stroke participants; Hypertension prevalence in stroke participants.</td>
<td>1. The prevalence of stroke was 3.4% for 20-39yr, 9.2% for 40-59yr, 18.4% for 60-79yr, and 14.5% for ≥80yr; the prevalence of stroke was significantly different across age groups (p&lt;0.001).</td>
</tr>
<tr>
<td>Janes et al. (2013)</td>
<td>Italy</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N Start=153,312</td>
<td>N End=153,312</td>
<td>Mean age=NA; Gender: Males=72963, Females=80349.</td>
<td></td>
<td>The incidence rate of stroke from 2007 to 2009 was determined in a population of 153312.</td>
<td>Stroke incidence; Case fatality rate for first ever stroke: 28d, 90d, 180d.</td>
<td></td>
</tr>
<tr>
<td>Kim et al. (2013)</td>
<td>South Korea</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N Start=102,210</td>
<td>N End=102,210</td>
<td>Mean age=66.7±13.3yr; Gender: Males=51718, Females=50492.</td>
<td></td>
<td>Data from health insurance claims from 2006 to 2010 was analyzed.</td>
<td>Stroke incidence rates: Crude, Age-standardized; Readmission rates.</td>
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</tr>
<tr>
<td>Gonzalez-Perez et al.</td>
<td>Population: Mean age=NA; Gender: NA.</td>
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<td>1. Over the 6yr study period, the standardized...</td>
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<tr>
<td>Study</td>
<td>Country</td>
<td>Study Type</td>
<td>TPS</td>
<td>N_Start</td>
<td>N_End</td>
<td>Population:</td>
<td>Intervention:</td>
<td>Outcomes:</td>
<td>Results:</td>
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<tr>
<td>(2013) UK Observational</td>
<td></td>
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<td></td>
<td>3036</td>
<td>3036</td>
<td></td>
<td>Individuals 20-89yr with a record on The Health Improvement Network (THIN) UK were followed until intracerebral hemorrhage (ICH), subarachnoid hemorrhage (SAH), or death was recorded. Data was collected from 2000 to 2008. The number of confirmed cases of hemorrhagic stroke was 1797 for ICH and 1340 for SAH.</td>
<td>30d case fatality following stroke; Excess mortality rate: &lt;1yr, &gt;1yr, Overall.</td>
<td>incidence for hemorrhagic stroke within the THIN database (N=2,110,327) was 22.5 per 100,000 person-years.</td>
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</tr>
<tr>
<td>Rosengren et al. (2013) Sweden Case Series</td>
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<td>391,081</td>
<td>391,081</td>
<td></td>
<td>Participants with an ischemic stroke from 1987-2010 were retrospectively analyzed. Patients were divided into three age groups: 18-44yr (1.6%), 45-64yr (16.7%), and 65-84yr (81.7%).</td>
<td>Incidence of stroke; Mortality.</td>
<td>1. The incidence of ischemic stroke per 100,000 person-years for the 18-44yr group increased from 7.17 in 1987-1992 to 9.55 in 2005-2010. 2. The incidence of ischemic stroke per 100,000 person-years for the 45-54yr group increased from 51.3 in 1987-1992 to 61.4 in 2005-2010 3. There was a continuous increase in the incidence of stroke in the 18-44yr group of 1.3% per year for men and 1.6% per year for women.</td>
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</tr>
<tr>
<td>Rutten-Jacobs et al. (2013b) Netherlands Observational</td>
<td></td>
<td></td>
<td></td>
<td>724</td>
<td>724</td>
<td></td>
<td>Patients with a first ever stroke from 1980-2010 were assessed during follow-up assessments from 2009-2012.</td>
<td>Cumulative 20yr risk of stroke; Cumulative 20yr risk of any vascular event; Stroke etiology; Incidence rate of any vascular event and recurrent stroke; Demographic variables.</td>
<td>1. The incidence rate of any vascular event per 1000 person-years was 14.6% in participants with an intracerebral hemorrhage, 22.7% with a TIA, and 27.6 with an ischemic stroke. 2. The incidence rate of stroke per 1000 person-years was 13.4% in participants with a TIA and 16.1% with an ischemic stroke.</td>
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</tr>
<tr>
<td>Béjot et al. (2014) France Case Series</td>
<td></td>
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<td></td>
<td>4506</td>
<td>4506</td>
<td></td>
<td>Patients with a stroke from 1985 to 2011 were included.</td>
<td>Incidence rates of stroke; Prevalence of risk factors.</td>
<td>1. The incidence rate of stroke was not significantly different between 1985-1993 (76.6/100000) and 1994-2002 (80.7/100000) (p=0.43), but significantly increased from 1994-2002 to 2003-2011 (88.5 /100000) (p=0.009). 2. The incidence rate of stroke for participants &lt;55yr non-significantly increased from 1985-1993 (11.6/100000) to 1994-2002 (12.7/100000), and significantly increased from 1994-2002 to 2003-2011 (20.2/100000) (p&lt;0.001). 3. The incidence rate of stroke for participants 55-64yr significantly increased from 1985-1993 (115/100000) to 1994-2002 (147/100000) (p&lt;0.05), and non-significantly decreased from 1994-2002 to 2003-2011 (130/100000). 4. The incidence rates for participants 65-74yr, 75-84yr, and &gt;85yr did not...</td>
<td></td>
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</tbody>
</table>
5. The incidence rate of ischemic stroke in participants <55yr increased non-significantly from 1985-1993 (8.1/100000) to 1994-2002 (10.7/100000), and increased significantly from 1994-2002 to 2003-2011 (18.1/100000) (p<0.001).

6. The incidence rates of hemorrhagic and undetermined stroke did not significantly change between time periods.

### Koton et al. (2014)
Israel Case Series  
TPS=NA  
N<sub>start</sub>=14,357  
N<sub>end</sub>=14,357  
**Population:** Mean age=54.1±5.8yr; Gender: Males=6402, Females=7955.  
**Intervention:** The incidence rate of stroke from 2007 to 2009 was determined in a population.  
**Outcomes:** Stroke incidence rate; Crude cumulative incidence of mortality.

1. The stroke incidence rate per 100,000 person-years was 2.19 for the <65yr group and 5.29 for the ≥65yr group.

### Schnitzler et al. (2014)
France Observational  
TPS=NA  
N<sub>start</sub>=33,896  
N<sub>end</sub>=33,896  
**Population:** Mean age=NA; Gender: Males=15092, Females=18804.  
**Intervention:** A survey was administered to participants with and without stroke in 2007.  
**Outcomes:** Stroke incidence rate; Institutionalization; Modified Rankin Scale (mRS).

1. The stroke incidence rate was 3.2 for participants ≤50yr, 0.4 for 18-59yr and 2.9 for 60-74yr.
2. Stroke incidence in the ≤50yr group was significantly greater for males compared to females (3.6 vs 2.9) (p<0.05).

### Bensenor et al. (2015)
Brazil Case Series  
TPS=NA  
N<sub>start</sub>=2,231,000  
N<sub>end</sub>=2,231,000  
**Population:** Mean age=NA; Gender: Males=1117000, Females=1115000.  
**Intervention:** The incidence rate of stroke in a general population >18yr was assessed.  
**Outcomes:** Stroke incidence rates.

1. Stroke incidence rates were 1.6% for males and 1.4% for females.
2. The stroke incidence rates across age groups were as follows: 0.1% for 18-29yr, 1.1% for 30-59yr, 2.9% for 60-64yr, 5.1% for 65-75yr, and 7.3% for ≥75yr.
3. Intracerebral hemorrhage incidence rates per 100,000 person-years in participants <45yr significantly increased from 1992 to 2012 (1992-1998=3.4, 1999-2005=6.9, 2006-2012=19.4) (p<0.05).
4. Intracerebral hemorrhage incidence rates per 100,000 person-years in participants 45-64yr significantly increased from 1992 to 2012 (1992-1998=47.8, 1999-2005=80.3, 2006-2012=185.2) (p<0.05).
6. Ischemic stroke incidence rates per 100,000 person-years in participants 45-64yr significantly increased from 1992 to 2012 (1992-1998=137.4, 1999-2005=199.1, 2006-2012=484.6) (p<0.05).

### Li et al. (2015)
China Case Series  
TPS=NA  
N<sub>start</sub>=14,538  
N<sub>end</sub>=14,538  
**Population:** Mean age=NA; Gender: Males=NA, Females=NA.  
**Intervention:** The incidence rate of stroke from 1992 to 2012 was determined in a population.  
**Outcomes:** Stroke incidence rates.

1. Intracerebral hemorrhage incidence rates per 100,000 person-years in participants <45yr significantly increased from 1992 to 2012 (1992-1998=3.4, 1999-2005=6.9, 2006-2012=19.4) (p<0.05).
2. Intracerebral hemorrhage incidence rates per 100,000 person-years in participants 45-64yr significantly increased from 1992 to 2012 (1992-1998=47.8, 1999-2005=80.3, 2006-2012=185.2) (p<0.05).
4. Ischemic stroke incidence rates per 100,000 person-years in participants 45-64yr significantly increased from 1992 to 2012 (1992-1998=137.4, 1999-2005=199.1, 2006-2012=484.6) (p<0.05).

### Okon et al. (2015)
Nigeria  
**Population:** Mean age=NA; Gender: Males=184, Females=114.  
**Outcomes:** Stroke incidence rate per 100,000 person-years was 4.04 for participants 0-
**Intervention:** The incidence rate of first ever stroke from 2010 to 2011 was determined in a population.  
**Outcomes:** Stroke incidence rates.

<table>
<thead>
<tr>
<th>Case Series</th>
<th>Population</th>
<th>Intervention</th>
<th>Outcomes</th>
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<tbody>
<tr>
<td><strong>Ozer et al.</strong> (2015)</td>
<td>Younger Group (YG; n=32): Mean age=37.7±6.1; Gender: Male=13, Female=19. Older Group (OL; n=587): Mean age=71.2±11.3; Gender: Male=271, Female=316.</td>
<td>Hospital records of patients who had acute ischemic stroke from January 2007 to November 2014 were retrospectively analyzed by age.</td>
<td>1. Incidence of stroke in YG group compared to the overall sample size was 5.2%.</td>
</tr>
</tbody>
</table>
| **Tan et al.** (2015) | Mean age=NA; Gender: Males=15092, Females=18804. | Patients ≥15yr with a stroke from 2006 to 2012 were included. | 1. The annual percentage change in the stroke incidence rate over the study period was 3.33 for participants <50yr, -1.26 for 50-64yr and -3.62 for ≥65yr.  
2. The annual percentage change in the stroke incidence rate over the study period was more negative in females compared to males (-2.94 vs. -1.80). |
| **Vangen-Lønne et al.** (2015) | Mean age=NA; Gender: Males=NA, Females=NA. | Individuals ≥30yr without a previous ischemic or unclassifiable stroke were included. | 1. The stroke incidence rate for women 30-49yr per 100,000 person-years significantly increased from 1986-1990 to 2006-2010 (1986-1990=0.09, 2006-2010=0.19) (p=0.0033).  
2. The stroke incidence rate for men 30-49yr per 100,000 person-years increased non significantly from 1977-1980 to 2006-2010 (1977-1980=0.11, 2006-2010=0.67) (p=0.135).  
3. The stroke incidence rate for women 50-64yr per 100,000 person-years significantly increased from 1991-1995 to 2006-2010 (1991-1995=1.96, 2006-2010=0.93) (p=0.028).  
4. The stroke incidence rate for men 50-64yr per 100,000 person-years significantly increased from 1989-1990 to 2006-2010 (1989-1990=0.55, 2006-2010=2.22) (p<0.0001). |
| **Wang et al.** (2015) | Mean age=NA; Gender: | | 1. The stroke incidence rate per 100,000 |
Taiwan Case Series  
TPS=NA  
N_{Start}=14,830  
N_{End}=14,830  
Males=7686, Females=7144.  
**Intervention:** Stroke incidence was determined in a population from 1992-2012.  
**Outcomes:** Stroke incidence rate.

| **González-Gómez et al. (2016)** Spain Case Series TPS=NA  
N_{Start}=110  
N_{End}=110  
Population: Mean age=46.4±8.1yr; Gender: Males=67, Females=43.  
**Intervention:** Younger patients (<55yr) who were admitted to a stroke unit in Spain in 2014 were retrospectively analyzed.  
**Outcomes:** Incidence. |
<table>
<thead>
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<tbody>
<tr>
<td>1. There were 110 strokes suffered by patients &lt;55yr out of a total of 830 stroke admissions (13.3%).</td>
</tr>
</tbody>
</table>

### 21.2 Etiology

**Table 21.2 Studies Evaluating Stroke Etiologies in Younger Individuals**

<table>
<thead>
<tr>
<th>Author, Year Country Study Design Time Post Stroke Sample Size</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Snyder &amp; Ramirez-Lassepas (1980)</strong> USA Case Series TPS=NA N=61</td>
<td>Patients ages 16-49 (38 men and 23 women), with cerebral infarction. Mean follow-up 2.4 years.</td>
<td>Premature atherosclerosis was the cause of stroke in 29 patients. Patients with atherosclerosis tended to have high frequency of risk factors, mortality rate of 23.9%, recurrence rate of cerebrovascular disease of 41.6% and tended to be male. Seven women were taking hormonal contraceptives at the time of cerebral infarction. Cardiac embolism was the cause of stroke for seven patients and five had “other causes” of stroke. Etiology remained unknown for 13 patients at follow-up.</td>
</tr>
<tr>
<td><strong>Adams et al. (1986)</strong> USA Case Series TPS=NA N=144</td>
<td>Patients aged 15-45 with cerebral infarction.</td>
<td>10 patients were dead within 30 days of stroke onset. 38 had atherosclerosis. Risk factors for atherosclerosis included: hypertension in 22, smoking in 21, diabetes mellitus in 15, transient ischemic attack in 14, coronary heart disease in 2 and leg claudication in 3 patients. Mitral valve prolapse was determined to not be a cause of cerebral infarction. The study found over 40 possible causes of cerebral infarction.</td>
</tr>
<tr>
<td><strong>Ferro &amp; Crespo (1988)</strong> Portugal Case Series</td>
<td>Patients between 15 and 50 years old post stroke.</td>
<td>Eight etiological categories were identified. Stroke was the result of cerebral atherosclerosis for 89 (35.0%) patients, cardiac emboli for 78</td>
</tr>
<tr>
<td>Study</td>
<td>Location</td>
<td>Study Type</td>
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<tr>
<td>-------</td>
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</tr>
<tr>
<td>Federico et al. (1990)</td>
<td>Italy</td>
<td>Case Series</td>
</tr>
<tr>
<td>Love &amp; Biller (1990)</td>
<td>USA</td>
<td>Observational</td>
</tr>
<tr>
<td>Bevan et al. (1990)</td>
<td>USA</td>
<td>Case Series</td>
</tr>
<tr>
<td>Awada (1994)</td>
<td>Saudi Arabia</td>
<td>Case Series</td>
</tr>
<tr>
<td>Ferro &amp; Crespo (1994)</td>
<td>Portugal</td>
<td>Observational</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Study Design</td>
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<tr>
<td>Adams et al. (1995)</td>
<td>USA</td>
<td>Case Series</td>
</tr>
<tr>
<td>Barinagarre-Menteria et al. (1996)</td>
<td>Mexico</td>
<td>Observational</td>
</tr>
<tr>
<td>Siqueira Neto et al. (1996)</td>
<td>Brazil</td>
<td>Observational</td>
</tr>
<tr>
<td>You et al. (1997)</td>
<td>Australia</td>
<td>Observational</td>
</tr>
<tr>
<td>Kristensen et al. (1997)</td>
<td>Sweden</td>
<td>Observational</td>
</tr>
<tr>
<td>Kittner et al. (1998)</td>
<td>USA</td>
<td>Case Series</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Type</td>
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<tr>
<td>Ruiz-Sandoval et al. (1999)</td>
<td>Mexico</td>
<td>Observational</td>
</tr>
<tr>
<td>Kittner et al. (1999)</td>
<td>USA</td>
<td>Observational</td>
</tr>
<tr>
<td>Gilon et al. (1999)</td>
<td>USA</td>
<td>Observational</td>
</tr>
<tr>
<td>Camerlingo et al. (2000)</td>
<td>Italy</td>
<td>Observational</td>
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<tr>
<td>Kwon et al. (2000)</td>
<td>South Korea</td>
<td>Observational</td>
</tr>
<tr>
<td>Chan et al. (2000)</td>
<td>Canada</td>
<td>Case Series</td>
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<tr>
<td>Study</td>
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<td>Study Type</td>
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<tr>
<td>Wityk et al. (2000)</td>
<td>USA</td>
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<tr>
<td>Lee et al. (2002)</td>
<td>Taiwan</td>
<td>Observational</td>
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<tr>
<td>Jacobs et al. (2002)</td>
<td>USA</td>
<td>Case Series</td>
</tr>
<tr>
<td>Tan et al. (2002)</td>
<td>Singapore</td>
<td>Observational</td>
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<tr>
<td>Anzini et al. (2004)</td>
<td>Italy</td>
<td>Observational</td>
</tr>
<tr>
<td>Mehndiratta et al. (2004)</td>
<td>India</td>
<td>Observational</td>
</tr>
<tr>
<td>Study</td>
<td>Location</td>
<td>Study Type</td>
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<tr>
<td>Caso Series</td>
<td>NA</td>
<td>Case Series</td>
</tr>
<tr>
<td>Bos et al. (2005)</td>
<td>Netherlands</td>
<td>Observational</td>
</tr>
<tr>
<td>Carod-Artal et al. (2005)</td>
<td>Brazil</td>
<td>Observational</td>
</tr>
<tr>
<td>Lai et al. (2005)</td>
<td>Taiwan</td>
<td>Case Series</td>
</tr>
<tr>
<td>Rasura et al. (2006)</td>
<td>Italy</td>
<td>Observational</td>
</tr>
<tr>
<td>Authors</td>
<td>Country</td>
<td>Study Type</td>
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<tr>
<td>Ghandehari &amp; Izadi-Mood</td>
<td>Iran</td>
<td>Case Series</td>
</tr>
<tr>
<td>Piechowski-Jozwiak et al.</td>
<td>Poland</td>
<td>Observational</td>
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<tr>
<td>Lipska et al.</td>
<td>India</td>
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<tr>
<td>Varona et al.</td>
<td>Spain</td>
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<tr>
<td>Arnold et al.</td>
<td>Switzerland</td>
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<tr>
<td>Jovanović et al.</td>
<td>Serbia</td>
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<tr>
<td>Putala et al.</td>
<td>Finland</td>
<td>Observational</td>
</tr>
<tr>
<td>Country</td>
<td>Study Type</td>
<td>TPS</td>
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<td>-------------</td>
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</tr>
<tr>
<td>India</td>
<td>Observational</td>
<td>TPS=NA</td>
</tr>
<tr>
<td>Athens</td>
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<tr>
<td>Malaysia</td>
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<td>TPS=NA</td>
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<td>Turkey</td>
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<td>TPS=NA</td>
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<tr>
<td>Thailand</td>
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<td>TPS=NA</td>
</tr>
<tr>
<td>Norway</td>
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<td>TPS=NA</td>
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<td>Study</td>
<td>Country</td>
<td>Design</td>
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<tr>
<td>Larrue et al. (2011)</td>
<td>France</td>
<td>Observational</td>
</tr>
<tr>
<td>Martinez-Sánchez et al. (2011)</td>
<td>Spain</td>
<td>Case Series</td>
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<tr>
<td>Munshi et al. (2011)</td>
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<tr>
<td>Patella et al. (2011)</td>
<td>Italy</td>
<td>Observational</td>
</tr>
<tr>
<td>Wolff et al. (2011)</td>
<td>France</td>
<td>Observational</td>
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<tr>
<td>Study</td>
<td>Location</td>
<td>Study Type</td>
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<tr>
<td>Zhang et al. (2011)</td>
<td>China</td>
<td>Case Series</td>
</tr>
<tr>
<td>Hankey (2012)</td>
<td>Australia</td>
<td>Observational</td>
</tr>
<tr>
<td>Arntz et al. (2013)</td>
<td>Netherlands</td>
<td>Observational</td>
</tr>
<tr>
<td>Barlas et al. (2013)</td>
<td>Turkey</td>
<td>Case Series</td>
</tr>
</tbody>
</table>
### Population:

**Chen et al. (2013)**
Taiwan
Case Series
TPS=NA
N<sub>Start</sub>=973
N<sub>End</sub>=973

**Population:** Young Participants (N=368): Mean age=53.9y; Gender: Males=261, Females=107;
Older Participants (N=605): Mean age=75.8, Gender: Males=306, Females=299.

**Intervention:** Patients with an ischemic stroke from 2005 to 2008 were included. Patients were divided between <65yr and ≥65yr.

**Outcomes:** Stroke etiology; Prevalence of risk factors; Modified Rankin Scale (mRS); Barthel Index (BI).

1. In the younger group, strokes were classified as large vessel in 138 (37.5%) participants, cardioembolism in 23 (6.3%), small vessel disease in 152 (41.3%), other in 32 (8.7%), and undetermined in 23 (6.3%).

2. Stroke etiology was significantly different between groups in regards to small vessel disease (<65yr=41.3%, ≥65yr=34.0%; p=0.02), lacunar infarct (<65yr=41.3%, ≥65yr=34.5%; p=0.03), other determined etiology (<65yr=8.7%, ≥65yr=2.1%; p<0.001), cardioembolism (<65yr=6.3%, ≥65yr=16.7%; p<0.001) and total anterior circulation infarct (<65yr=12.2%, ≥65yr=22.8%; p<0.001).

### Population:

**Dharmasaroja et al. (2013)**
Thailand
Observational
TPS=NA
N<sub>Start</sub>=261
N<sub>End</sub>=261

**Population:** Mean age=63y; Gender: Males=147, Females=114.

**Intervention:** Patients with an ischemic stroke treated with an intravenous recombinant tissue plasminogen activator from 2007 to 2010 were included.

**Outcomes:** Stroke etiology; Prevalent risk factors; Mortality rate; Modified Rankin Scale (mRS).

1. Stroke etiology in participants ≤60yr was determined to be large artery atherosclerosis in 31 (29%) participants, cardioembolic in 26 (24%), small artery occlusion in 48 (44%), and undetermined in 3 (3%).

### Population:

**Dubuc et al. (2013)**
Canada
Case Series
TPS=NA
N<sub>Start</sub>=100
N<sub>End</sub>=100

**Population:** Mean age=40.5y; Gender: Males=55, Females=45.

**Intervention:** Patients 16-55yr with an ischemic stroke with an undetermined etiology from 2002 to 2010 were included.

**Outcomes:** Stroke etiology; Fabry disease prevalence; Prevalence of alpha-galactosidase A gene mutations.

1. Stroke etiology was determined to be non-lacunar in the carotid artery in 52 (52%) participants, cardioembolic in 26 (24%), small artery occlusion in 48 (44%), and undetermined in 3 (3%).

### Population:

**Eun et al. (2013)**
South Korea
Case Series
TPS>26.4mo
N<sub>Start</sub>=551
N<sub>End</sub>=551

**Population:** Mean age=66.0y; Gender: Males=55, Females=45.

**Intervention:** Patients >40yr with a first ever ischemic stroke from 2007 to 2009 were included. Patients were divided into age groups of 40-64yr (N=235) and ≥65yr (N=316).

**Outcomes:** Stroke etiology; Prevalent risk factors; Mortality; Major adverse cardiovascular events; Prevalence of recurrent stroke; Risk of stroke.

1. Stroke etiology in participants 40-64yr was determined to be large artery atherosclerosis in 73 (31.3%) participants, cardioembolic in 28 (11.9%), small artery occlusion 72 (30.6%), other in 13 (5.5%) and undetermined in 49 (20.9%).

2. The proportion of participants with an undetermined etiology was significantly greater in the 40-64yr group compared to the ≥65yr group (p=0.014).

### Population:

**Naess et al. (2013)**
Population:

**Deceased at Follow-up: Mean**

1. Stroke etiology was classified as
### Norway

**Observational**

TPS:<br>Mean = 18.3 yr  
N<sub>Start</sub> = 224  
N<sub>End</sub> = 224

*Population:* Mean age = 43.1±7.9 yr; Alive at follow-up: Mean age = 41.1±6.6 yr; Gender: Males = 133, Females = 91.

**Intervention:** Patients 15-49 yr with a first ever ischemic stroke from 1988 to 1997 were followed up at a mean of 18.3 yr post-stroke.

**Outcomes:** Prevalence of risk factors; Stroke etiology.

atherosclerosis in 33 (14.7%) participants, cardioembolism in 16 (7.1%), small vessel disease in 34 (15.2%), dissection in 14 (6.2%), prothrombotic state in 16 (7.1%), and unknown in 99 (44.2%).

### Nakagawa et al. (2013)

**USA**

**Case Series**

TPS = NA  
N<sub>Start</sub> = 511  
N<sub>End</sub> = 511

*Population:* Mean age = 39.8 yr; Gender: Males = 242, Females = 269.

**Intervention:** Patients 18-49 yr with a stroke from 2002 to 2006 were included.

**Outcomes:** Stroke etiology.

1. Stroke etiology was significantly different between males and females for cardioembolism (males = 26, females = 16) (p = 0.05), miscellaneous vasculopathy (males = 14, females = 38) (p = 0.01), migraine related (males = 1, females = 10) (p = 0.02), vasculitis (males = 4, females = 8) (p = 0.001) cerebral venous thrombosis (males = 4, females = 15) (p = 0.001), substance abuse related (males = 26, females = 15) (p = 0.05), and intracerebral hemorrhage (males = 63, females = 43) (p = 0.01).

2. Stroke etiology was not significantly different between males and females for large vessel disease (males = 19, females = 24) and small vessel disease (males = 25, females = 30).

### Rolfs et al. (2013)

**Germany**

**Observational**

TPS = NA  
N<sub>Start</sub> = 3396  
N<sub>End</sub> = 3396

*Population:* Median age = 46 yr; Gender: NA.

**Intervention:** Patient charts from individuals with stroke 18-55 yr from 47 centres across 15 European countries were evaluated.

**Outcomes:** Demographical variables; Clinical variables.

1. Stroke etiology was classified as atherosclerosis in 18.6% of participants, cardiac embolic origin in 16.7%, small artery occlusion in 13.5%, other determined cause in 17.8%, and undetermined in 33.4%.

2. In the strata from 18-24 yr and 25-34 yr, there was a greater proportion of females suffering from an acute cerebrovascular event (65.3%; 54.1%), whereas a greater proportion of males were suffering from an acute cerebrovascular event in the age groups of 35-44 yr and 45-55 yr (57.1%; 63.2%).

3. There were significant differences in the classification of stroke between males and females (p = 0.020) and between different age groups (p = 0.024).

### Rutten-Jacobs et al. (2013b)

**Netherlands**

**Observational**

TPS = NA  
N<sub>Start</sub> = 724  
N<sub>End</sub> = 724

*Population:* Mean age = 40.5±7.8 yr; Gender: Males = 344, Females = 380.

**Intervention:** Patients with a first ever stroke from 1980-2010 were assessed during follow-up assessments from 2009-2012.

**Outcomes:** Cumulative 20 yr risk of stroke; Cumulative 20 yr risk of any vascular event; Stroke etiology; Incidence rate of any vascular event and recurrent stroke; Demographic

1. The etiology of intracerebral hemorrhage was hypertension for 23.5% of participants, arteriovenous malformation (AVM) in 20.6%, cavernous angioma in 4.4%, medication use in 5.9%, bleeding disorder in 5.9%, substance abuse in 1.5%, septic embolism in 1.5%, and unknown in 36.7%.

2. Stroke subtypes of artherothrombotic stroke, cardioembolic stroke, and lacunar
variables.

stroke were associated with recurrent stroke (HR=2.72; 2.49; 2.92).

1. Subarachnoid hemorrhages were more frequent in young adults compared with older participants (22.1% vs. 3.5%; p<0.0001), intracerebral hemorrhages were similarly frequent in both groups (16.9% vs. 15.8%; p=0.17), and ischemic strokes were the predominant stroke type in the older group (61% vs. 73.8%; p=0.0004).

2. Young participants had more frequent lacunar strokes (26.6% vs. 16.1%; p=0.01), and stroke due to other etiology (8.5% vs. 1.8%; p=0.0004) and less frequent atherothrombotic (14.9% vs. 28.7%; p=0.002) and cardioembolic stroke (9.6% vs. 19.2%; p=0.01) than older participants; no significant difference was observed in the frequency of strokes with undetermined etiology (40.4% vs. 34.2%; p=0.2).

1. Stroke etiology was determined to be total anterior circulation infarction in 1 (1.0%) participant, partial anterior circulation infarction in 21 (32.3%), lacunar infarction in 33 (34.4%), and posterior circulation infarction in 31 (32.3%).

1. Stroke etiology was classified as large-artery atherosclerosis in 7 (7%) participants, cardiac embolism in 13 (13%), lacunar in 8 (8%), other in 12 (12%), and an undetermined cause in 325 (33.5%).

1. All strokes were caused by a non-atherosclerotic unilateral intracranial arteriopathy of the proximal MCA or distal internal carotid artery.

2. Severe arteriopathy of the MCA occurred in
<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Study Type</th>
<th>TPS</th>
<th>N Start</th>
<th>N End</th>
<th>Population</th>
<th>Intervention</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chraa et al. (2014)</td>
<td>Morocco</td>
<td>Observational</td>
<td>NA</td>
<td>128</td>
<td>128</td>
<td>Mean age=28.3yr; Gender: Males=76, Females=52.</td>
<td>Patients 18-45yr with an ischemic stroke from 2007 to 2010 were assessed from 3-82mo post-stroke.</td>
<td>Outcomes: Stroke etiology; Modified Rankin Scale (mRS).</td>
</tr>
<tr>
<td>Dash et al. (2014)</td>
<td>India</td>
<td>Case Series</td>
<td>NA</td>
<td>440</td>
<td>440</td>
<td>Mean age=38.9yr; Gender: Males=367, Females=73.</td>
<td>Patients 18-45yr with an ischemic stroke from 2005 to 2010 were included.</td>
<td>Outcomes: Stroke etiology; Prevalence of risk factors; Stroke etiology.</td>
</tr>
<tr>
<td>Kalita et al. (2014)</td>
<td>India</td>
<td>Case Series</td>
<td>NA</td>
<td>404</td>
<td>404</td>
<td>Mean age=41.6yr; Gender: Males=308, Females=96.</td>
<td>Patients 16-50yr with an intracerebral hemorrhage (ICH) with a stroke from 2001-2010 were retrospectively analyzed.</td>
<td>Prevalent risk factors; ICH etiology; Glasgow Outcome Scale (GOS); 1mo mortality.</td>
</tr>
<tr>
<td>Khealani et al. (2014)</td>
<td>Pakistan</td>
<td>Case Series</td>
<td>NA</td>
<td>529</td>
<td>345</td>
<td>Mean age=59.7yr; Gender: Males=529, Females=345.</td>
<td>Patients &gt;14yr with an ischemic stroke</td>
<td>Stroke etiology was significantly different between age groups (p=0.001) with a greater proportion of strokes in</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Study Type</td>
<td>TPS</td>
<td>N Start</td>
<td>N End</td>
<td>Population</td>
<td>Intervention</td>
<td>Outcomes</td>
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<tr>
<td>Renna et al. (2014)</td>
<td>Italy</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N Start=150</td>
<td>N End=150</td>
<td>Mean age=41.3±8yr; Gender: Males=98, Females=52.</td>
<td>Retrospective analysis of data from stroke participants younger than 50yr.</td>
<td>Outcomes: Prevalent risk factors; In-hospital complications; Modified Rankin Scale (mRS); Stroke etiology.</td>
</tr>
<tr>
<td>Aarnio et al. (2015)</td>
<td>Finland</td>
<td>Observational</td>
<td>TPS=10.0yr</td>
<td>N Start=1002</td>
<td>N End=1002</td>
<td>Median age=44yr; Gender: Males=626, Females=376.</td>
<td>Follow-up data from young adults (15-49yr) with a first ever ischemic stroke from 1969 to 2011 were included. The mean follow-up time was 10.0yr.</td>
<td>Outcomes: Mortality; Risk factors; Stroke etiology; Cancer prevalence.</td>
</tr>
<tr>
<td>de Bruijn et al. (2015)</td>
<td>Netherlands</td>
<td>Case Series</td>
<td>TPS&gt;4.9yr</td>
<td>N Start=170</td>
<td>N End=170</td>
<td>Mean age=41.4yr; Gender: Males=75, Females=95.</td>
<td>Patients with a first ever ischemic stroke from 2000 to 2010 were included. Patients were also compared to healthy controls (n=61).</td>
<td>Outcomes: Employment rate; Modified Rankin Scale (mRS); Hospital Anxiety and Depression Scale (HADS): Depression, Anxiety; Stroke etiology.</td>
</tr>
<tr>
<td>Cruz-Herranz et al. (2015)</td>
<td>Spain</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N Start=102</td>
<td>N End=102</td>
<td>Mean age=35yr; Gender: Males=0, Females=102.</td>
<td>Women &lt;45yr with a stroke from 1996 to 2011 were included. Telephone surveys recording reproductive history post-stroke were conducted in 2011 with a median follow-up time of 7.4yr post-stroke.</td>
<td>Outcomes: Stroke etiology; Modified Rankin Scale (mRS); Prevalent risk factors; Pregnancy following stroke;</td>
</tr>
<tr>
<td>Fazekas et al. (2015)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fabry Disease (EG; n=34): Median</td>
<td></td>
<td>1. Presence or extent of white matter</td>
</tr>
<tr>
<td>Country</td>
<td>Case Series</td>
<td>TPS</td>
<td>N&lt;sub&gt;Start&lt;/sub&gt;</td>
<td>N&lt;sub&gt;End&lt;/sub&gt;</td>
<td>Population</td>
<td>Intervention</td>
<td>Outcomes</td>
<td></td>
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<tr>
<td>Austria</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N&lt;sub&gt;Start&lt;/sub&gt;=3203</td>
<td>N&lt;sub&gt;End&lt;/sub&gt;=3203</td>
<td>age=45yr (33-49); Gender: Males=10, Females=24. Non-Fabry Disease (CG; n=3169): Median age=46yr (40-51); Gender: Males=1880, Females=1289. <strong>Intervention:</strong> Younger patients who suffered a stroke was compared between those who had Fabry disease (EG) and those who did not (CG).</td>
<td>MRI Findings.</td>
<td>Younger patients with FD from non-FD cerebrovascular event patients (all p&lt;0.05).</td>
<td></td>
</tr>
<tr>
<td>Jaffre et al. (2015)</td>
<td>France Case Series</td>
<td>TPS=NA</td>
<td>N&lt;sub&gt;Start&lt;/sub&gt;=436</td>
<td>N&lt;sub&gt;End&lt;/sub&gt;=400</td>
<td>Population: Mean age=44.5±8.5yr; Gender: Males=244, Females=156. <strong>Intervention:</strong> Patients 18-54yr treated for first-ever ischemic stroke from 2006-2012 were included.</td>
<td>Stroke etiology; Risks associated with cryptogenic stroke.</td>
<td>1. Identifiable potential causes of stroke were found in 48.7% of participants. The potential causes are listed as follows: atherosclerosis (16.3%), small-vessel disease (7.0%), cardiac pathology (9.3%), and other potential cause of stroke (65 participants, 16.3%), including 11% with artery dissection. 2. Multivariable analyses showed that cryptogenic stroke was significantly associated with current tobacco use (p=0.002), low LDL cholesterol (p=0.001), and elevated triglycerides (p=0.001). 3. Among participants with carotid stroke, non-obstructive carotid atherosclerosis was not more frequent on the symptomatic side (23.8%) compared to the asymptomatic side (21.9%). 4. Current tobacco use was significantly associated with non-obstructive carotid plaque and thrombus in a univariable analysis, and remained statistically significant in the multivariable analysis for each carotid plaque (p =0.001) and carotid thrombosis (p =0.03).</td>
<td></td>
</tr>
<tr>
<td>Koivunen et al. (2015)</td>
<td>Finland Case Series</td>
<td>TPS=NA</td>
<td>N&lt;sub&gt;Start&lt;/sub&gt;=1257</td>
<td>N&lt;sub&gt;End&lt;/sub&gt;=1257</td>
<td>Population: Younger Patients (YG; n=336): Median age=42yr; Gender: Male=200, Female=136. Older Patients (OL; n=921): Age range≥50yr. <strong>Intervention:</strong> Young patients (&lt;50yr) diagnosed with a first-ever intracranial hemorrhage in Helsinki University Central Hospital between January 2000 and March 2010 (YG) were analyzed retrospectively. Comparisons were performed amongst demographic subgroups and with patients over ≥50yr of age enrolled between January 2005 and March 2010 (OL).</td>
<td>Etiology.</td>
<td>1. Structural lesions were more common among the YG group compared to the OL group (p&lt;0.001). 2. The cause remained unknown in 32.1% of all YG and in 22.5% of those who underwent MRI and any angiography (n=89, p=0.023).</td>
<td></td>
</tr>
<tr>
<td>Ozer et al. (2015)</td>
<td>Turkey Case Series</td>
<td>TPS=NA</td>
<td>N&lt;sub&gt;Start&lt;/sub&gt;=619</td>
<td>N&lt;sub&gt;End&lt;/sub&gt;=619</td>
<td>Population: Younger Group (YG; n=32): Mean age=37.7±6.1; Gender: Male=13, Female=19. Older Group (OL; n=587): Mean age=71.2±11.3; Gender: Male=271, Female=316. <strong>Intervention:</strong> Hospital records of patients who had acute ischemic stroke from January 2007 to</td>
<td>Etiology.</td>
<td>1. Cardioaortic embolism was the most common etiologic stroke subtype in both groups; however, other causes were significantly more frequent in the YG group compared with OL group.</td>
<td></td>
</tr>
</tbody>
</table>
November 2014 were retrospectively analyzed by age.

**Outcomes:** Etiology.

<table>
<thead>
<tr>
<th>Studyauthors</th>
<th>Country</th>
<th>Study Design</th>
<th>NStart</th>
<th>NEnd</th>
<th>Population</th>
<th>Intervention</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simonetti et al. (2015)</td>
<td>Switzerland</td>
<td>Case Series</td>
<td>249</td>
<td>249</td>
<td>Mean age=NA; Gender: Males=133, Females=116.</td>
<td>Patients 1mo-45yr with an ischemic stroke from 2000 to 2008 were included. Patients were divided between age groups: children 1mo-16yr (N=95) and young adults 16-45yr (N=154).</td>
<td>Outcomes: Prevalent risk factors; Stroke etiology; Recurrent stroke; Modified Rankin Scale (mRS); Mortality; Psychological outcomes: Psychological and psychiatric disorders, Behavioural disturbances, Fatigue. Difficulty concentrating or memory problems; Residence; Return to work or school; Self-reported impact of stroke on life: Everyday life, Social life, Social activities.</td>
</tr>
<tr>
<td>Trivedi et al. (2015)</td>
<td>USA</td>
<td>Observational</td>
<td>950</td>
<td>950</td>
<td>Mean age=40yr; Gender: Males=509, Females=441.</td>
<td>Fifty nine hospitals recruited young women and men with strokes to determine risk factor profiles between young African-American (AA) and European-Americans (EA). Participants were stratified according to the TOAST subtype of stroke.</td>
<td>Outcomes: Risk factors; Stroke etiology.</td>
</tr>
<tr>
<td>Fromm et al. (2016)</td>
<td>Norway</td>
<td>Observational</td>
<td>150</td>
<td>150</td>
<td>Stroke Patients (EG; n=150): Mean age=48.5yr; Gender: Males=101, Females=49.</td>
<td>Younger patients who suffered a stroke (EG) were compared to those who did not (CG) in a population from Norway.</td>
<td>Outcomes: Stroke Etiology; Carotid Intima-Media Thickness (cIMT).</td>
</tr>
<tr>
<td>González-Gómez et al. (2016)</td>
<td>Spain</td>
<td>Case Series</td>
<td>110</td>
<td>110</td>
<td>Mean age=46.4±8.1yr; Gender: Males=67, Females=43.</td>
<td>Younger patients (&lt;55yr) who were admitted to a stroke unit in Spain in 2014 were retrospectively analyzed.</td>
<td>Outcomes: Etiology.</td>
</tr>
</tbody>
</table>

1. Stroke etiology in young adults was determined to be large artery disease in 5 (3%) participants, cardioembolic in 57 (37%), small artery disease in 4 (3%), other in 45 (29%), multiple causes in 2 (1%), and undetermined in 41 (27%).

2. No statistically significant differences in sex were observed between TOAST subtypes.

3. AA were more likely to have a lacunar stroke than EA (p=0.011) when controlling for sex and age.

4. Hypertension was found to significantly increase the risk of lacunar stroke (p=0.0003) and atherosclerotic stroke (p=0.048).

5. Patients >40yr were more likely to have a lacunar stroke (p=0.006), while those <40yr were more likely to have a cardioembolic stroke (p=0.024).

6. Smokers were more likely to have an atherosclerotic stroke than non-smokers (p=0.024).

7. The causes of stroke in the EG group were 5.3% large-artery atherosclerosis (LAA), 26.7% cardioembolism, 21.3% small-artery occlusion (SAO), 10% stroke of other determined cause, and 36.7% stroke of undetermined cause (SUC).

8. cIMT was increased in patients with LAA (1.56mm, p=0.002), SAO (1.11mm, p=0.006), and SUC (1.10mm, p=0.004) compared to the CG group (cIMT 0.86mm).

9. 83.6% of the stroke cases were ischaemic (30.4% were cryptogenic, 23.9% were lacunar, 16.3% were from uncommon causes, 15.2% were atherothrombotic and 14.1% were cardioembolic), 12.7% were haemorrhagic (78.6% were hypertensive), and 3.6% were venous sinus thrombosis.
21.3 Risk Factors

Table 21.3 Studies Evaluating Risk Factors of Stroke in Younger Individuals

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Country</th>
<th>Study Design</th>
<th>Time Post Stroke</th>
<th>Sample Size</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ilincu et al. (2016)</td>
<td>Sweden</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>NStart=426</td>
<td>Population: Ages≤55yr. Intervention: Younger patients (&lt;55yr) who were registered in the Lund Stroke Register (LSR) between 2004 and 2013 were retrospectively analyzed.</td>
<td>1. Out of the 4103 patients registered in the LSR, 426 patients were ≤55yr (10.4%); 286 (67.1%) had ischemic stroke, 68 (16.0%) intracranial hemorrhage, and 70 (16.4%) had subarachnoid hemorrhage, while 0.5% were unknown.</td>
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<tr>
<td></td>
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<td>NEnd=338</td>
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<tr>
<td>Nacu et al. (2016)</td>
<td>Norway</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>NStart=228</td>
<td>Population: Age Range=15-49yr; Gender: Male=152, Female=76. Intervention: Patients consecutively admitted to a neurovascular centre in Norway with acute ischaemic stroke between 2006 and 2012 were included and retrospectively analyzed.</td>
<td>1. There were significantly greater rates of cardioembolism (p&lt;0.001) or undetermined cause (p&lt;0.001) stroke subtype.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NEnd=228</td>
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<tr>
<td>Calviere et al. (2013)</td>
<td>France</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>NStart=100</td>
<td>Population: Mean age=44.8yr; Gender: Males=60, Females=40. Intervention: Patients aged 16-55yr with an ischemic from 2006 to 2012 were included.</td>
<td>1. Prevalent risk factors included hypertension in 18 (18%) participants, diabetes in 3 (3%), smoking in 45 (45%), and hypercholesterolemia in 46 (46%).</td>
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<td></td>
<td></td>
<td></td>
<td>NEnd=100</td>
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<td></td>
<td>Outcomes: Stroke etiology; Prevalence of risk factors.</td>
<td>2. Migraines were diagnosed in 35 (35%) participants.</td>
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<td></td>
<td>3. &gt;1 silent brain infarcts found in 36 (36%) participants with 23 having a cerebellar infarct, 8 cortical, and lacunar in 9.</td>
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<td></td>
<td>4. Migraines with aura were significantly more prevalent in participants with a silent brain infarct compared to those without (25% vs. 6.3%; p=0.01).</td>
</tr>
<tr>
<td>Chen et al. (2013)</td>
<td>Taiwan</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>NStart=973</td>
<td>Population: Young Participants (N=368): Mean age=53.9yr; Gender: Males=261, Females=107; Older Participants (N=605): Mean age=75.8, Gender: Males=306, Females=299. Intervention: Patients with an Ischemic from 2005 to 2008 were included. Patients were divided between &lt;65yr and ≥65yr.</td>
<td>1. Young participants were significantly more likely to smoke (&lt;65yr=44.8%, ≥65yr=23.8%; p&lt;0.001), have hypercholesterolemia (&lt;65yr=41.5%, ≥65yr=31.6%; p=0.002), and have hypertriglyceridemia (&lt;65yr=41.3%, ≥65yr=23.9; p&lt;0.001).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NEnd=973</td>
<td></td>
<td>Outcomes: Stroke etiology; Prevalence of risk factors; Modified Rankin Scale (mRS); Barthel Index (BI)</td>
<td>2. Young participants were significantly less likely to have atrial fibrillation (&lt;65yr=8.2%, ≥65yr=24.1%: p&lt;0.001) and a previous stroke (&lt;65yr=47.3%, ≥65yr=58.0%; p=0.001).</td>
</tr>
<tr>
<td>Naess et al. (2013)</td>
<td>Norway</td>
<td></td>
<td></td>
<td></td>
<td>Population: Deceased at Follow-up: Mean age=43.1±7.9yr; Alive at Follow-up: Mean age=43.1±7.9yr</td>
<td>1. Diabetes mellitus on admittance was more prevalent in participants deceased at</td>
</tr>
</tbody>
</table>
Observational TPS = Mean 18.3y
N\_{Start} = 224
N\_{End} = 224

<table>
<thead>
<tr>
<th>Population: Young Participants (N=154): Mean age=38.8±5.7y; Gender: Males=82, Females=72; Older Participants (N=3710): Age&gt;45y.</th>
<th>age=41.1±6.6yr; Gender: Males=133, Females=91.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention: Data from young adults admitted with a first-ever stroke from 2001 to 2005 was retrospectively analyzed.</td>
<td>Intervention: Patients 15-49yr with a first ever ischemic stroke from 1988 to 1997 were followed-up at a mean of 18.3yr post-stroke.</td>
</tr>
<tr>
<td>Outcomes: Risk factors; Stroke severity; Mortality; One month outcome; Modified Rankin Scale (mRS).</td>
<td>Outcomes: Prevalence of risk factors; Stroke etiology.</td>
</tr>
</tbody>
</table>

1. Significant differences were found in the frequency of risk factors in younger vs. older participants for hypertension (44.8% vs. 75.4%), heart disease (14.3% vs. 42.9%), atrial fibrillation (1.3% vs. 16.1%), diabetes mellitus (3.9% vs. 24.5%), and current smoking (55.8% vs. 28.4%) \( (p<0.0001 \text{ for all}) \); no significant differences in younger vs. older participants was found for alcohol overuse (7.1% vs. 8.8%), dyslipidemia (12.3% vs. 11.0%) and the proportion of women (46.8% vs. 53.2%).

2. Across genders, males were significantly more likely to consume alcohol (Males=11.4%, Females=0%; \( p=0.000 \)), smoke (Males=10.9%, Females=2.7%; \( p=0.000 \)), have a family history of cerebrovascular disease (Males=18.2%, Females=2.7%; \( p=0.001 \)), have hypertension (Males=47.7%, Females=28.7%; \( p=0.003 \)) coronary artery disease (Males=6.5%, Females=0%; \( p=0.000 \)), and use illicit drugs (Males=11.9%, Females=0%; \( p=0.000 \)).

3. Across genders, females were significantly more likely to have valvular heart disease (Males=9.2%, Females=30.1%; \( p=0.000 \)) and atrial fibrillation (Males=11.4%, Females=0%; \( p=0.000 \)).

**Smajlovic et al.** (2013)
Bosnia & Herzegovina
Case Series
TPS=NA
N\_{Start} = 3864
N\_{End} = 3864

<table>
<thead>
<tr>
<th>Population: Mean age=38.9yr; Gender: Males=367, Females=73.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention: Patients 18-45yr with an Ischemic from 2005 to 2010 were included.</td>
<td></td>
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<tr>
<td>Outcomes: Prevalence of risk factors; Stroke etiology.</td>
<td></td>
</tr>
</tbody>
</table>

1. Prevalent risk factors included hypertension in 196 (44.5%) participants, smoking in 42 (9.5%), diabetes mellitus in 61 (13.9%), alcohol consumption in 42 (9.5%), hyperlipidemia in 10 (7.8%), heart disease in 56 (12.7%), atrial fibrillation in 29 (6.6%) previous stroke in 117 (26%), drug abuse in 44 (10%), and family history of a cerebrovascular disease in 69 (15.7%).

2. Across genders, males were significantly more likely to consume alcohol (Males=11.4%, Females=0%; \( p=0.000 \)), smoke (Males=10.9%, Females=2.7%; \( p=0.000 \)), have a family history of cerebrovascular disease (Males=18.2%, Females=2.7%; \( p=0.001 \)), have hypertension (Males=47.7%, Females=28.7%; \( p=0.003 \)) coronary artery disease (Males=6.5%, Females=0%; \( p=0.000 \)), and use illicit drugs (Males=11.9%, Females=0%; \( p=0.000 \)).

3. Across genders, females were significantly more likely to have valvular heart disease (Males=9.2%, Females=30.1%; \( p=0.000 \)) and atrial fibrillation (Males=11.4%, Females=0%; \( p=0.000 \)).

**Dash et al.** (2014)
India
Case Series
TPS=NA
N\_{Start} = 440
N\_{End} = 440

1. Significant differences were found in the frequency of risk factors in younger vs. older participants for hypertension (44.8% vs. 75.4%), heart disease (14.3% vs. 42.9%), atrial fibrillation (1.3% vs. 16.1%), diabetes mellitus (3.9% vs. 24.5%), and current smoking (55.8% vs. 28.4%) \( (p<0.0001 \text{ for all}) \); no significant differences in younger vs. older participants was found for alcohol overuse (7.1% vs. 8.8%), dyslipidemia (12.3% vs. 11.0%) and the proportion of women (46.8% vs. 53.2%).

2. Across genders, males were significantly more likely to consume alcohol (Males=11.4%, Females=0%; \( p=0.000 \)), smoke (Males=10.9%, Females=2.7%; \( p=0.000 \)), have a family history of cerebrovascular disease (Males=18.2%, Females=2.7%; \( p=0.001 \)), have hypertension (Males=47.7%, Females=28.7%; \( p=0.003 \)) coronary artery disease (Males=6.5%, Females=0%; \( p=0.000 \)), and use illicit drugs (Males=11.9%, Females=0%; \( p=0.000 \)).

3. Across genders, females were significantly more likely to have valvular heart disease (Males=9.2%, Females=30.1%; \( p=0.000 \)) and atrial fibrillation (Males=11.4%, Females=0%; \( p=0.000 \)).
<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Study Type</th>
<th>TPS</th>
<th>N Start</th>
<th>N End</th>
<th>Population:</th>
<th>Mean age</th>
<th>Gender:</th>
<th>Intervention:</th>
<th>Outcomes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khealani et al. (2014)</td>
<td>Pakistan</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N Start=874</td>
<td>N End=874</td>
<td>Mean age=59.7yr; Gender: Males=529, Females=345.</td>
<td></td>
<td></td>
<td>Patients &gt;14yr with an Ischemic in 2007 were included.</td>
<td>Prevalent risk factors; In-hospital complications; Stroke etiology.</td>
</tr>
<tr>
<td>Park et al. (2014)</td>
<td>South Korea</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N Start=25,818</td>
<td>N End=25,818</td>
<td>Young Adults (YA; N=1431): Mean age=38.5±6.3yr; Gender: Males=1017, Females=414; Elderly Adults (EA; N=24387): Mean age=68.9±10.6yr; Gender: Males=13998, Females=10389.</td>
<td></td>
<td></td>
<td>Epidemiological data and outcomes were examined in young adults (15-45yr) and elderly (≥46yr) individuals with stroke. Data was obtained from 29 participating emergency departments.</td>
<td>Demographic variables; Socioeconomic factors; Time variables related with event and process of care; Clinical parameters; Emergency care procedures; Mortality at discharge; Modified Rankin Scale (mRS).</td>
</tr>
<tr>
<td>Renna et al. (2014)</td>
<td>Italy</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N Start=150</td>
<td>N End=150</td>
<td>Mean age=41.3±8yr; Gender: Males=98, Females=52.</td>
<td></td>
<td></td>
<td>Retrospective analysis of data from stroke participants younger than 50yr.</td>
<td>Anamnesis examinations; Laboratory examinations; Radiologic examinations; Cardiologic examinations; Clinical evaluations.</td>
</tr>
<tr>
<td>Shi et al. (2014)</td>
<td>China</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td></td>
<td></td>
<td>Patients with Intracranial Large Artery Stenosis (ILAS; N=121): Mean age=48.1±7.1yr; Gender: Males=84, Females=37; Patients without ILAS (non-ILAS;</td>
<td></td>
<td></td>
<td></td>
<td>ILAS participants had lower prevalence of AF (p=0.04) compared with non-ILAS participants.</td>
</tr>
</tbody>
</table>

1. Risk factors were significantly different between age groups with a significantly greater proportion of participants >45yr vs. 16-45yr having diabetes mellitus (18.0% vs. 8.6%) (p<0.025), previous stroke (20.2% vs. 6.5%) (p=0.002), and ischemic heart disease (18.6% vs. 7.5%) (p=0.01).
2. No significant difference between participants >45yr compared to 16-45yr were observed for hypertension (45.9% vs. 37.6%), smoking (14.4% vs. 18.3%), and atrial fibrillation (6.2% vs. 4.3%).

1. Compared to EA, YA showed significantly higher proportions of being male, having a high body mass index, having a higher education level, holding a professional and business job, and having national health insurance (p<0.001 for all).
2. The number of participants with a history of cardiovascular and cerebrovascular diseases was significantly higher in EA than YA (p<0.001).
3. Compared to EA, the proportion of participants exercising, smoking, and consuming alcohol was significantly higher in YA (p<0.001).
4. The most prevalent risk factors in YA participants were diabetes mellitus (7.8%), hypertension (18.0%), cerebrovascular disease (7.2%), cardiovascular disease (4.0%), alcohol drinking (53.1%), current smoker (47.8%), and former smoker (9.2%).

1. The most prevalent risk factors in the entire population were dyslipidemia (52.7%), smoking (47.3%), hypertension (39.3%), and patent foramen ovale (32.8%).
2. Other risk factors included alcohol consumption (8.3%), migraine with aura (5.7%), hyperhomocysteinemia (15.7%), obesity (16%), and history of TIA/stroke (12.7%).
3. Comparing risk factors between age groups revealed significant differences in hypertension (p<0.0001), dyslipidemia (p=0.001), smoking (p=0.034), and obesity (p=0.009); a higher proportion of participants >35yr compared to ≤35yr was observed for each factor.
### Zhang et al. (2014)  
**China**  
**Observational**  
**TPS=NA**  
**NStart=381**  
**NEnd=381**  
**Population:** Mean age=38.26±6.351yr; Gender: Males=170, Females=53.  
**Intervention:** Patients 18-45yr admitted to Puyang People’s hospital from 2011 to 2013 with first ever Ischemic were selected for prospective analysis. Stroke participants were also compared to a young healthy control group (N=158).  
**Outcomes:** Risk factors; National Institute of Health Stroke Scale (NIHSS); Modified Rankin Scale (mRS).  
1. The following risk factors were significantly more prevalent in the young stroke group vs. healthy controls: hypertension (46.6% vs. 19.0%; p=0.000), hyperlipidemia (33.2% vs. 20.9%; p=0.009), smoking history (43.5% vs. 22.8%; p=0.000), high homocysteine (41.3% vs. 21.5%; p=0.000), poor sleep quality (47.1% vs. 29.1%; p=0.000), family history of stroke (35.4% vs. 20.9%; p=0.002), diabetes (19.7% vs. 11.4%; p=0.030), and drinking history (49.8% vs. 32.9%; p=0.001); the proportion of females was not significantly different between stroke and control groups (13.8% vs. 19.8%; p=0.191).  
2. Statistically significant variables associated with young stroke were hypertension (p=0.000), hyperlipidemia (p=0.003), smoking history (p=0.004), high homocysteine (p=0.006), poor sleep quality (p=0.016), family history of stroke (p=0.039), and drinking history (p=0.024).  
3. The following prognostic factors were significantly different between self-care patients (mRS<3) vs. dependent patients (mRS>3): NIHSS (p=0.000), high homocysteine (34.5% vs. 57.5%; p=0.001), and poor sleep quality (41.3% vs. 58.9%; p=0.014).  
4. Statistically significant prognostic factors associated with young stroke were NIHSS (p=0.02), poor sleep quality (p=0.045), and high homocysteine (p=0.009).
### Observational Study

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Population</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intervention</strong>: Childhood cancer survivors with a stroke were included. Median time between first stroke and cancer diagnosis was 10yr. Patients with a recurrent stroke (n=52) were compared with non-recurrent stroke patients (n=161).</td>
<td><strong>Population</strong>: Ischemic (N=6180): Mean age=18.6±1.0yr; Gender: Males=6180, Females=0; Hemorrhagic stroke (N=2104): Mean age=18.5±1.0yr; Gender: Males=2104, Females=0. <strong>Intervention</strong>: Males that participated in compulsory Swedish military conscription from 1969 to 1986 that developed an ischemic or hemorrhagic stroke during the median follow-up period of 33.2±5.3yr were included.</td>
<td>a greater proportion of recurrent stroke participants having hypertension (recurrent=46%, non-recurrent=30%; p&lt;0.0001) 2. The prevalence of diabetes mellitus was not significantly different between groups (recurrent=10%, non-recurrent=7%). 3. The prevalence of smoking was not significantly different between groups (recurrent=13%, non-recurrent=27%).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Observation</th>
<th>TPS=NA</th>
<th>N&lt;sub&gt;Start&lt;/sub&gt;=271</th>
<th>N&lt;sub&gt;End&lt;/sub&gt;=213</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TPS=NA</strong></td>
<td><strong>N&lt;sub&gt;Start&lt;/sub&gt;=271</strong></td>
<td><strong>N&lt;sub&gt;End&lt;/sub&gt;=213</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Högström et al.** (2015)  
Sweden  
Observational  
TPS=NA  
N<sub>Start</sub>=8284  
N<sub>End</sub>=8284

1. Using a significance level of p<0.000006, the strongest risk factors associated with Ischemic were low aerobic fitness at conscription (Hazard ratio (HR)=0.84; 95% Confidence Interval (CI) 0.81–0.88 per standard deviation (SD) increase), high BMI at conscription (HR=1.15; 95% CI 1.12–1.18 per SD increase), maternal history of stroke (HR=1.31; 95% CI 1.21–1.42), low annual income 15yr post-conscription (HR=0.85; 95% CI 0.82–0.88 per SD increase), alcohol intoxication at follow-up (HR=1.93; 95% CI 1.74–2.13), and diabetes at follow-up (HR=2.85; 95% CI 2.56–3.18 per SD increase). All risk factors were significantly associated with a total population attributable risk (PAR) for Ischemic of 0.69 (95% CI 0.55–0.80).  
2. Similar risk factors were also found for hemorrhagic stroke including aerobic fitness at conscription (HR=0.82 per SD increase), high BMI at conscription (HR=1.18 per SD increase), alcohol intoxication at follow-up (HR=2.92), diabetes at follow-up (HR=2.06) and low annual income 15yr post-conscription (HR=0.75). All risk factors were significantly associated with a total population attributable risk (PAR) of 0.88% for hemorrhagic stroke (95% CI 0.74–0.95; p<0.001).  
3. Compared to healthy controls, a significantly greater proportion of individuals with Ischemic had a father with stroke (12.1% vs. 9.5%; p<0.05) and a mother with stroke (12.1% vs. 7.6%; p<0.05).  
4. Compared to healthy controls, a significantly greater proportion of individuals with hemorrhagic stroke had a father with stroke (11.8% vs. 9.5%; p<0.05) and a mother with stroke (11.6% vs. 7.6%;
### Koivunen et al. (2015) Finland

**Case Series**  
TPS=NA  
N\text{Start}=1257  
N\text{End}=1257

**Population:** Younger Patients (YG; n=336); Median age=42yr; Gender: Male=200, Female=136. Older Patients (OL; n=921); Age range≥50yr.

**Intervention:** Young patients (<50yr) diagnosed with a first-ever intracranial hemorrhage in Helsinki University Central Hospital between January 2000 and March 2010 (YG) were analyzed retrospectively. Comparisons were performed amongst demographic subgroups and with patients over ≥50yr of age enrolled between January 2005 and March 2010 (OL).

**Outcomes:** Risk Factors.

1. The most prevalent risk factors in the YG group were hypertension (29.8%) and smoking (22.3%).

### Ozer et al. (2015) Turkey

**Case Series**  
TPS=NA  
N\text{Start}=619  
N\text{End}=619

**Population:** Younger Group (YG; n=32); Mean age=37.7±6.1; Gender: Male=13, Female=19. Older Group (OL; n=587); Mean age=71.2±11.3; Gender: Male=271, Female=316.

**Intervention:** Hospital records of patients who had acute ischemic stroke from January 2007 to November 2014 were retrospectively analyzed by age.

**Outcomes:** Risk Factors.

1. The rates of hypertension, diabetes mellitus, atrial fibrillation, and coronary artery disease were significantly lower in YG group compared with the OL group (all p<0.05).

### Pezzini et al. (2015) Italy

**Case Series**  
TPS=NA  
N\text{Start}=1881  
N\text{End}=1881

**Population:** Age range: 18-45yr; Gender: Unreported

**Intervention:** Hospital records of patients who had acute ischemic stroke from January 2000 to January 2012 were retrospectively analyzed. Patients were analyzed by family history of arterial thrombosis (FH; n=85).

**Outcomes:** Risk Factors.

1. Compared with patients without FH of premature arterial thrombosis, those with FH were more often smokers and carriers of procoagulant abnormalities.
2. Smoking, the A1691 mutation in factor V gene, and the A20210 mutation in the prothrombin gene were associated with FH of premature stroke.
3. Recurrent events occurred more frequently in the subgroup of patients with FH of premature stroke (p=0.051) compared to patients without such a FH.

### Simonetti et al. (2015) Switzerland

**Observational**  
TPS=NA  
N\text{Start}=624  
N\text{End}=624

**Population:** Median age=46yr; Gender: Males=374, Females=250.

**Intervention:** Young participants (16-55yr) with stroke were prospectively recruited in a multicentre study.

**Outcomes:** Risk factors; Mortality at 3mo follow-up; Stroke etiology; Recurrence of cerebrovascular events; Modified Rankin Scale (mRS);

1. 96% of participants had ≥1 vascular risk factor while 73% of participants had ≥1 modifiable vascular risk factor.
2. In terms of risk factors for participants 16-45yr (N=284), 35% had hypercholesterolemia, 41% smoked, 21% had hypertension, 13% had a prior stroke or TIA, 2.5% had diabetes, 2.5% had coronary heart disease, 1.8% had atrial fibrillation, 12% had thrombophilia, 31% of women were taking oral contraceptives, 1.5% of women were on hormone replacement therapy, and 18% have a family history of stroke.
3. In terms of risk factors for participants 46-55yr (N=340), 58% had hypercholesterolemia, 45% smoked, 46%
had hypertension, 14% had a prior stroke or TIA, 13% had diabetes, 8% had coronary heart disease, 5% had atrial fibrillation, 4.3% had thrombophilia, 3.7% of women were on oral contraceptives, 0.9% of women were on hormone replacement therapy, and 30% have a family history of stroke.

4. The frequency of risk factors was significantly different between age groups (p<0.05 for all) for all factors except smoking and prior stroke or TIA; the 46-55yr group had higher frequencies for all risk factors except for thrombophilia and women with oestrogen intake.

5. The 46-55yr age group had a significantly higher number of modifiable risk factors compared to younger participants (p<0.001).

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Study Type</th>
<th>TPS</th>
<th>N&lt;sub&gt;Start&lt;/sub&gt;</th>
<th>N&lt;sub&gt;End&lt;/sub&gt;</th>
<th>Population:</th>
<th>Intervention:</th>
<th>Outcomes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thijs et al. (2015)</td>
<td>Belgium</td>
<td>Case Series</td>
<td>NA</td>
<td>4232</td>
<td>4232</td>
<td>Age range&lt;55yr.</td>
<td>Data from the Stroke in Fabry Patients study was retrospectively analyzed.</td>
<td>Risk Factors.</td>
</tr>
<tr>
<td>González-Gómez et al. (2016)</td>
<td>Spain</td>
<td>Case Series</td>
<td>NA</td>
<td>110</td>
<td>110</td>
<td>Mean age=46.4±8.1yr; Gender: Males=67, Females=43.</td>
<td>Younger patients (&lt;55yr) who were admitted to a stroke unit in Spain in 2014 were retrospectively analyzed.</td>
<td>Risk Factors.</td>
</tr>
<tr>
<td>Ilinca et al. (2016)</td>
<td>Sweden</td>
<td>Case Series</td>
<td>NA</td>
<td>426</td>
<td>338</td>
<td>Ages&lt;55yr.</td>
<td>Younger patients (&lt;55yr) who were registered in the Lund Stroke Register (LSR) between 2004 and 2013 were retrospectively analyzed.</td>
<td>Family History Questionnaire.</td>
</tr>
<tr>
<td>Nacu et al. (2016)</td>
<td>Norway</td>
<td>Case Series</td>
<td>NA</td>
<td>228</td>
<td>228</td>
<td>Age Range=15-49yr; Gender: Male=152, Female=76.</td>
<td>Patients consecutively admitted to a neurovascular centre in Norway with acute ischaemic stroke between 2006 and 2012 were included and retrospectively analyzed.</td>
<td>Risk Factors.</td>
</tr>
</tbody>
</table>
### 21.4 Recovery and Prognosis

#### Table 21.4 Studies Evaluating Recovery and Prognosis in Younger Individuals Post Stroke

<table>
<thead>
<tr>
<th>Author, Year Country</th>
<th>Study Design</th>
<th>Time Post Stroke</th>
<th>Sample Size</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hindfelt &amp; Nilsson</strong> (1977) Sweden Case Series TPS=NA N=60</td>
<td>Patients (age 16-40 years, mean age at stroke onset 30.85 years) who suffered an acute ischemic stroke were included. Patients were followed an average of 51 months.</td>
<td>In total eight patients died, two as a direct result of stroke, and six from other causes. At follow-up information of the neurological deficits was available for only 52 patients, 20 of whom had no deficits, 24 had minor to moderate deficits and 8 had major deficits. Four patients experienced re-infarctions.</td>
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<tr>
<td><strong>Coughlan &amp; Humphreys</strong> (1982) UK Observational TPS=3-Byr N=170</td>
<td>Spouses of patients completed postal questionnaires. All patients were under the age of 65 at the time of their stroke.</td>
<td>About half the patients reported at least one mobility problem and used mobility aids such as a wheelchair, walking frame or stick. Women had significantly more mobility problems than men (P&lt;0.05). Assistance with self-care was necessary for approximately 2/3rds of patients. Hemiplegics reported many mobility and self-care problems, whereas non-hemiplegics reported few.</td>
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<tr>
<td><strong>Ferro &amp; Crespo</strong> (1988) Portugal Observational TPS=NA N=254</td>
<td>Patients between the ages of 15 and 50 were included.</td>
<td>About 30% of young aphasic stroke patients made a full recovery, 33% showed improvement, and 33% remained significantly “unresolved” in their language impairment. 5% of patients had a recurrent stroke. The younger stroke population had better recovery than reported for the aphasia population where age was not selected. In contrast to older stroke patients, this young stroke population showed complete recovery and significant improvement 6-month following stroke onset.</td>
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<tr>
<td><strong>Bogousslavsky &amp; Regli</strong> (1987) Switzerland Observational TPS=NA N=41</td>
<td>Patients with ischemic stroke under 30 years of age were included. Mean follow-up was 46 months post stroke.</td>
<td>3 patients died acutely. Annual incidence of death was 0.7% and that of recurrent stroke was 0.7%. One patient who survived the acute phase died during follow-up. This patient died of renal failure due to systemic lupus erythematosus, 48 months after stroke. One patient with intracerebral arteritis suffered another stroke 10 months after the initial event. The authors noted that subacute prognosis was good.</td>
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<tr>
<td><strong>Chancellor et al.</strong> (1989) New Zealand Observational TPS=NA N=66</td>
<td>Patients (&lt;40 years old) with acute non-hemorrhagic cerebral infarction (n=63) or transient ischemic attack (n=3) included. Follow-up was a mean of 3 years following the initial presentation.</td>
<td>Follow-up information was available for patients. 3 patients died, 46 (78%) patients made a full recovery or had minor disabilities, whereas 10 patients had a moderate disability. All long-term survivors were able to perform ADLs without assistance from others.</td>
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<tr>
<td><strong>Adunsky et al.</strong> (1992)</td>
<td>Patients aged 18 to 40 years old admitted to an</td>
<td>Mean time to admission was almost 1 month</td>
<td></td>
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<tr>
<td>Study</td>
<td>Country</td>
<td>Study Design</td>
<td>TPS</td>
<td>N</td>
<td>Patients Description</td>
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<tr>
<td>Israel Observational</td>
<td></td>
<td>NA</td>
<td></td>
<td>35</td>
<td>Israeli rehabilitation facility were included.</td>
</tr>
<tr>
<td>Hindfelt &amp; Nilsson (1992)</td>
<td>Sweden</td>
<td>Observational</td>
<td>&gt;1mo</td>
<td>74</td>
<td>Patients with ischemic stroke between the ages of 16 and 40 were included. Follow up ranged from 13-26 years following stroke onset.</td>
</tr>
<tr>
<td>Lindberg et al. (1992)</td>
<td>USA</td>
<td>Observational</td>
<td>NA</td>
<td>324</td>
<td>Patients with long-term subarachnoid hemorrhage were included.</td>
</tr>
<tr>
<td>Falconer et al. (1994)</td>
<td>USA</td>
<td>Observational</td>
<td>&lt;120d</td>
<td>260</td>
<td>Patients with acute stroke (&lt;120 days) admitted to inpatient stroke rehabilitation with LOS more than 7 days included. Patients categorized into 3 groups: 1) &lt;65 years old (n=100), 2) 65-74 years old (n=75) or 3) ≥75 years old (n=85).</td>
</tr>
<tr>
<td>Ferro &amp; Crespo (1994)</td>
<td>Portugal</td>
<td>Observational</td>
<td>NA</td>
<td>215</td>
<td>Patients under the age of 45 years to describe their functional and vocational positions after a long-term follow up, a mean of 43.1 months.</td>
</tr>
<tr>
<td>Kappelle et al. (1994)</td>
<td>Sweden</td>
<td>Observational</td>
<td>NA</td>
<td>296</td>
<td>Patients with ischemic stroke between the ages of 15 to 45 years who had been referred to a tertiary medical center underwent a follow-up assessment.</td>
</tr>
<tr>
<td>Barinagarrementeria et al. (1996)</td>
<td>Mexico</td>
<td>Observational</td>
<td>&lt;3mo</td>
<td>215</td>
<td>Patients younger than 40 years with the cerebral infarction were included.</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Study Design</td>
<td>N</td>
<td>Data Description</td>
<td>Outcome</td>
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</tr>
<tr>
<td>Rozenthul-Sorokin et al. (1996)</td>
<td>Israel</td>
<td>Observational</td>
<td>253</td>
<td>Patients with first stroke (ages 17-49) were admitted to hospitals in Israel over 1 year. A questionnaire containing 88 questions was used for evaluation of the patients.</td>
<td>25 stroke patients died. The case-fatality rate for all stroke types within the first 4 weeks post stroke was 9.9%, with the rate for hemorrhagic strokes being much greater than ischemic strokes. Of the young stroke survivors, 7 gained complete recovery, 15 had minimal deficits, which did not prevent them from returning to all their pre-stroke activities, 96 had minor deficits, 38 had moderate deficits and 38 had severe deficits.</td>
</tr>
<tr>
<td>Neau et al. (1998)</td>
<td>France</td>
<td>Observational</td>
<td>71</td>
<td>Patients aged 15 to 45 years old experienced a cerebral infarction. Follow-up was done by interview and with neurological examination for 65 of the patients a mean of 31.7 months.</td>
<td>At follow-up 2 patients were dead, 7 experienced post-stroke seizures and 4 patients had recurrent strokes. Post-stroke depression occurred in 48.3% of patients and it was found to be significantly associated with severe disability and a bad general outcome. No problems were reported by 69.8% of patients, 11.1% reported a moderate handicap and 20% reported having a major handicap. 73% of patients returned to work at a mean of 8mo post-stroke.</td>
</tr>
<tr>
<td>Marini et al. (1999)</td>
<td>Italy</td>
<td>Observational</td>
<td>333</td>
<td>Patients with first-ever transient ischemic attack or ischemic stroke aged 15 to 44 years were prospectively followed up.</td>
<td>96 months was the average follow-up period for 330 patients. Patients with TIA at entry were more likely to survive than patients with stroke on entry. During the follow-up period a total of 26 did not survive, and 10 had a recurrent stroke. 16% of surviving patients remained dependent at follow-up.</td>
</tr>
<tr>
<td>Camerlingo et al. (2000)</td>
<td>Italy</td>
<td>Observational</td>
<td>135</td>
<td>Patients with first-ever cerebral infarction, aged 16 to 45 years old, were evaluated and followed up for a mean of 68.8 months.</td>
<td>At 12 months 8 patients were dead, 40 had mild to moderate handicaps, and 4 were completely disabled. 83 patients were working and active and 15 experienced recurrent stroke 3 to 76 months following the first stroke.</td>
</tr>
<tr>
<td>Marini et al. (2001)</td>
<td>Italy</td>
<td>Case Series</td>
<td>89</td>
<td>Patients younger than 45 years of age with first-ever stroke were included.</td>
<td>Stroke classification for patients included 57.3% with cerebral infarction, 22.5% with subarachnoid haemorrhage and 20.2% with intracerebral haemorrhage. Patients with the highest proportion of severe disability (47%), mortality (44%) and good recovery (60%) were patients suffering from cerebral infarction, intracerebral haemorrhage and subarachnoid haemorrhage respectively. Thirty days post-stroke 10 patients died. Patients under 45 years of age had a better chance of long-term survival compared to patients over 45 years of age (P&lt;0.0001).</td>
</tr>
<tr>
<td>Kersten et al. (2002)</td>
<td>UK</td>
<td>Southampton Needs Assessment Questionnaires were distributed to people with stroke for 2 age</td>
<td></td>
<td>Good levels of mobility (able to walk 10 meters independently inside and unaided outside) were</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Study Design</td>
<td>TPS</td>
<td>N</td>
<td>Participants</td>
</tr>
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<tr>
<td>Leys et al. (2002)</td>
<td>France</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=287</td>
<td>Patients with ischemic stroke aged 15 to 45 years old were included.</td>
</tr>
<tr>
<td>Black-Schaffer &amp; Winston (2004)</td>
<td>USA</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=979</td>
<td>Patients were assessed using the Functional Independence Measure (FIM) at admission and discharge. Age, length of stay, severity of stroke, and amount returning home post-discharge were measured.</td>
</tr>
<tr>
<td>Varona et al. (2004)</td>
<td>Spain</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N=272</td>
<td>Patients with ischemic stroke were reviewed over 27 years to identify potential predictors of mortality, recurrence of stroke and poor functional recovery.</td>
</tr>
<tr>
<td>Naess et al. (2004)</td>
<td>Norway</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=232</td>
<td>Patients who experienced a first-ever cerebral infarction that were between the ages of 15 and 49 were included in this study.</td>
</tr>
<tr>
<td>Naess et al. (2005b)</td>
<td>Norway</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=192</td>
<td>Patients aged 15 to 49 years old experienced cerebral infarction and 212 controls were interviewed.</td>
</tr>
<tr>
<td>Naess et al. (2005a)</td>
<td>Norway</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=232</td>
<td>Patients aged 15 to 49 years old with first-ever ischemic stroke were included.</td>
</tr>
<tr>
<td>Nedeltchev et al. (2005)</td>
<td>Switzerland</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=203</td>
<td>Patients with ischemic stroke (aged 16-45) were included. Outcomes were assessed three months after admission. Risk factors and stroke etiology were determined, and the Modified Rankin Scale (mRS) was used to classify 68% of patients had a favourable outcome (mRS 0-1), 29% unfavourable (mRS 2-5), and 3% died (mRS 6). Diabetes mellitus was associated an unfavourable clinical outcome. The annual risk of stroke recurrence was 3% for all patients and...</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Study Design</td>
<td>TPS</td>
<td>N</td>
<td>Patient Characteristics</td>
</tr>
<tr>
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<tr>
<td>Naess et al. (2006)</td>
<td>Norway</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>232</td>
<td>Patients aged 15 to 49 years with first-ever cerebral infarction and 215 control subjects were included.</td>
</tr>
<tr>
<td>Cabral et al. (2009)</td>
<td>Brazil</td>
<td>Observational</td>
<td>TPS&lt;1yr</td>
<td>1323</td>
<td>Patients (759 first ever strokes) occurring in Joinville, Brazil were prospectively ascertained.</td>
</tr>
<tr>
<td>Putaala et al. (2009b)</td>
<td>Finland</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>1008</td>
<td>Patients with first-ever ischemic stroke, aged 15-49, were registered in the Helsinki Young Stroke Registry and followed using the mortality registry of Statistics Finland.</td>
</tr>
<tr>
<td>Naess et al. (2009)</td>
<td>Norway</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>195</td>
<td>Patients between the ages of 15-49 who suffered from first ever ischemic stroke during 1988-1997 were reviewed to evaluate aphasia among young patients.</td>
</tr>
<tr>
<td>Röding et al. (2009)</td>
<td>Sweden</td>
<td>Observational</td>
<td>TPS=8-36mo</td>
<td>1068</td>
<td>Patients 18–55 years of age with first-ever stroke answered questions about their physical and cognitive abilities before and after the stroke.</td>
</tr>
<tr>
<td>Röding et al. (2010)</td>
<td>Sweden</td>
<td>Observational</td>
<td>TPS=8-36mo</td>
<td>1068</td>
<td>Patients registered in the Swedish National Quality Register for Stroke Care, between the ages of 18-55, were sent a questionnaire to describe their satisfaction with life following a stroke.</td>
</tr>
<tr>
<td>Reference</td>
<td>Country</td>
<td>Study Type</td>
<td>TPS</td>
<td>N</td>
<td>Summary</td>
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<td>------------------------------------------------------------------------</td>
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<tr>
<td>Ellis (2010)</td>
<td>USA</td>
<td>Case Series</td>
<td>NA</td>
<td>41,587</td>
<td>Patients from a national data set (the Nationwide Inpatient Sample) between the ages of 18-44 were identified (5% of all stroke patients). Discharge disposition and type of stroke was recorded.</td>
</tr>
<tr>
<td>Putaala et al. (2010)</td>
<td>Finland</td>
<td>Case Series</td>
<td>NA</td>
<td>807</td>
<td>Patients registered in the Helenski Young Stroke Registry comprised of first ever ischemic stroke survivors between the ages of 15 and 49 were included in the analysis. Rates of recurrence stroke were examined.</td>
</tr>
<tr>
<td>Spengos &amp; Vemmos (2010)</td>
<td>Greece</td>
<td>Observational</td>
<td>NA</td>
<td>253</td>
<td>Patients with ischemic stroke were prospectively enrolled in the Athens Young Stroke Registry. Patients were 45 years of age or younger.</td>
</tr>
<tr>
<td>Greisenegger et al. (2011)</td>
<td>Austria</td>
<td>Case Series</td>
<td>NA</td>
<td>677</td>
<td>Patients with ischemic stroke or transient ischemic attack between the ages of 18 and 59 were identified in the Vienna Stroke Registry.</td>
</tr>
<tr>
<td>Knoflach et al. (2012)</td>
<td>Austria</td>
<td>Case Series</td>
<td>NA</td>
<td></td>
<td>Patients with acute ischemic stroke, functionally independent before stroke, recorded in the Austrian Stroke Unit Registry with 3-month</td>
</tr>
</tbody>
</table>
21. Rehabilitation of Younger Patients Post Stroke

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Study Type</th>
<th>Sample Size</th>
<th>Follow-up</th>
<th>Results/Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palmcrantz et al. (2012)</td>
<td>Sweden</td>
<td>Case Series</td>
<td>N=192</td>
<td>Follow-up</td>
<td>Younger stroke patients spent a significantly greater number of days in stroke unit care, rehabilitation unit care, and hospital out-patient care compared to older stroke patients. Younger stroke patients rated less disability (via the Stroke Impact Scale) compared to their older counterparts in terms of strength, self-care and domestic life, and mobility.</td>
</tr>
<tr>
<td>Toni et al. (2012)</td>
<td>Italy</td>
<td>Case Series</td>
<td>N=27671</td>
<td>Follow-up</td>
<td>Younger patients had a lower symptomatic intracranial hemorrhage (SICH) rate, lower fatality, and higher functional independence, at 3-months compared to older patients. Among the young patients, several significant predictors of SICH, mortality, and functional independence were found using multivariable analysis (e.g., NIH stroke scale score, independence before stroke).</td>
</tr>
<tr>
<td>Vibo et al. (2012)</td>
<td>Estonia</td>
<td>Observational</td>
<td>N=1206</td>
<td>Follow-up</td>
<td>Increasing age (0-44 years versus 45-54 years) and hemorrhagic stroke subtype were associated with lower long-term survival rates.</td>
</tr>
</tbody>
</table>
| Arntz et al. (2013)                        | Netherlands | Observational     | Start N=697, End N=697 | Follow-up | 1. 206 (29.6%) participants had a TIA, 425 (61.0%) had an ischemic stroke and 66 (9.5%) had a hemorrhagic stroke.  
2. Death had occurred in 160 (23.0%) participants at follow-up with 21 (3.0%) of deaths occurring in ischemic and TIA participants <30d post-stroke.  
3. Mortality at <30d post-stroke for TIA and ischemic stroke participants was significantly higher in participants with post-stroke epilepsy compared to without epilepsy (27.4% vs. 2.1%; p<0.0001).  
4. Cumulative 20yr mortality for TIA and ischemic stroke participants was significantly greater in participants with post-stroke epilepsy compared to participants without epilepsy (56.5% vs. 32.6%; p=0.007).  
5. Post stroke epilepsy occurred in 79 (11.3%) participants with an incidence rate of 16.7% in hemorrhagic stroke, 14.4% in ischemic stroke, and 3.4% in TIA.  
6. Seizures occurred <1wk post-stroke in 25 participants and >1wk post-stroke in 54 |
7. Recurrent seizures were significantly more prevalent in the late seizure group compared to participants who had seizures <1wk post-stroke (57.4% vs. 32.0%; p=0.04).
8. Antiepileptic drugs were started significantly more frequently in participants that had seizures >1wk post-stroke compared to seizures <1wk post-stroke (87% vs. 52%; p<0.01).
9. The proportion of participants with poor functional outcomes (mRS>2) was significantly greater in ischemic participants with epilepsy compared to ischemic participants without epilepsy (27.5% vs. 9.8%; p=0.001).
10. No participants with poor functional outcomes (mRS>2) had epilepsy after a TIA or hemorrhagic stroke.
11. The proportion of participants with poor functional outcomes (IADL<8) was significantly greater in ischemic participants with epilepsy compared to ischemic participants without epilepsy (27.8% vs. 12.6%; p=0.02).
12. No significant differences on the EQ-5D were observed between participants with and without epilepsy.

| Dharmasaroja et al. (2013) | Population: Mean age=63yr; Gender: Males=147, Females=114. | 1. The mortality rate was lowest in participants ≤60yr and increased with age (≤60yr=3%, 61-70=8%, 71-80=20%, ≥81=21%).
| Thailand Observational | Intervention: Patients with an ischemic stroke treated with an intravenous recombinant tissue plasminogen activator from 2007 to 2010 were included. | 2. Favourable outcomes (mRS<2) were more frequent in participants ≤60yr compared to other age groups at 3mo (≤60yr=59%, 61-70=50%, 71-80=37%, ≥81=43%).
| TPS=NA | Outcomes: Stroke etiology; Prevalent risk factors; Mortality rate; Modified Rankin Scale (mRS). | 3. Major adverse cardiovascular events were significantly more prevalent in the 40-64yr group compared to the ≥65yr group (3.8% vs. 21.7%; p<0.001).
| NStart=261 | 4. Mortality was significantly higher in the | 4. No participants with poor functional outcomes (mRS>2) had epilepsy after a TIA or hemorrhagic stroke.
| NEnd=261 | 5. The cumulative risk of stroke was significantly lower in the 40-64yr group compared to the ≥65yr group at 1yr (1.7% vs. 7.3%; p<0.05) and at 3yr (2.6% vs. 12.0%; p<0.05).
| 21. Rehabilitation of Younger Patients Post Stroke | 6. Major adverse cardiovascular events were significantly more prevalent in the ≥65yr group compared to the 40-64yr group (20.6% vs. 7.2%; p<0.001).
| www.ebrsr.com | 7. Recurrent strokes were significantly more prevalent in the ≥65yr group compared to the 40-64yr group (3.8% vs. 21.7%; p<0.001).
| Eun et al. (2013) | Population: Mean age=66.0yr; Gender: Males=55, Females=45. | 8. The cumulative risk of stroke was significantly lower in the 40-64yr group compared to the ≥65yr group at 1yr (1.7% vs. 7.3%; p<0.05) and at 3yr (2.6% vs. 12.0%; p<0.05).
| South Korea Case Series | Intervention: Patients >40yr with a first ever ischemic stroke from 2007 to 2009 were included. Patients were divided into age groups of 40-64yr (N=235) and ≥65yr (N=316). | 9. Major adverse cardiovascular events were significantly more prevalent in the ≥65yr group compared to the 40-64yr group (20.6% vs. 7.2%; p<0.001).
| TPS>26.4mo | Outcomes: Stroke etiology; Prevalent risk factors; Mortality; Major adverse cardiovascular events; Prevalence of recurrent stroke; Risk of stroke. | 10. No participants with poor functional outcomes (mRS>2) had epilepsy after a TIA or hemorrhagic stroke.
| NStart=551 | 11. The proportion of participants with poor functional outcomes (IADL<8) was significantly greater in ischemic participants with epilepsy compared to ischemic participants without epilepsy (27.8% vs. 12.6%; p=0.02). | 12. No significant differences on the EQ-5D were observed between participants with and without epilepsy.
| NEnd=551 | 13. No participants with poor functional outcomes (mRS>2) had epilepsy after a TIA or hemorrhagic stroke. |
### Giang et al. (2013)
**Sweden**
Observational
TPS=NA
N<sub>Start</sub>=17,149
N<sub>End</sub>=17,149

**Population:** Mean age=NA; Gender: Males=10739, Females=6410.

**Intervention:** Patients 18-54yr with an ischemic stroke from 1987 to 2006 were included.

**Outcomes:** Prevalent risk factors; Standardized Mortality Ratio (observed deaths over expected deaths); Cause of death; 4yr mortality rate.

1. Death occurred in 1265 participants within 4yr post-stroke.
2. Standardized mortality ratios were higher in the 18-44yr group compared to the 45-54yr group in both males (18-44yr=9.15, 45-54yr=5.11) and females (18-44yr=12.12, 45-54yr=6.37).
5. The 4yr mortality risk from 1987-2006 decreased by 32% in males and 45% in women.
6. The cause of death was stroke in 418 (33%) participants, coronary heart disease in 249 (19.7%), other cardiovascular diseases in 125 (9.88%), malignancies in 244 (19.3%), and other causes in 438 (34.6%).
7. The cause of death was significantly different between males and females in regards to cardiovascular diseases (males=50.3%, females=36.4%; p<0.0001) and malignancies (males=15.3%, females=28.4%; p<0.0001).

### Gonzalez-Perez et al. (2013)
**UK**
Observational
TPS=NA
N<sub>Start</sub>=3036
N<sub>End</sub>=3036

**Population:** Mean age=NA; Gender: NA.

**Intervention:** Individuals 20-89yr with a record on The Health Improvement Network (THIN) UK were followed until intracerebral hemorrhage (ICH), subarachnoid hemorrhage (SAH), or death was recorded. Data was collected from 2000 to 2008. The number of confirmed cases of hemorrhagic stroke was 1797 for ICH and 1340 for SAH.

**Outcomes:** 30d case fatality following stroke; Excess mortality rate: &lt;1yr, &gt;1yr, Overall.

1. Over the 6yr study period, the standardized incidence for hemorrhagic stroke within the THIN database (N=2,110,327) was 22.5 per 100,000 person-years.
2. Overall, the 30d case-fatality for hemorrhagic stroke for this population was 36.3%. Case fatality after ICH was 42.0%, compared with 28.7% after SAH. However, this difference between the two stroke groups was not significant (p=0.05). For both groups, the case fatality rate increased with age (ICH: 29.7% for 20–49yr, 54.6% for 80–89yr; SAH: 20.3% for 20–49yr, 56.7% for 80–89yr; p<0.001 for both trends), and decreased over the period 2000–2001 to 2006–2008 (ICH: from 53.1% to 35.8%, p=0.001; SAH: from 33.3% to 24.7%, p=0.02).
3. The excess mortality &lt;1yr post-stroke was significantly higher for ICH and SAH survivors compared to healthy controls.
21. Rehabilitation of Younger Patients Post Stroke

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Design</th>
<th>TPS</th>
<th>N_Start</th>
<th>N_End</th>
<th>Population</th>
<th>Intervention</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hansen et al. (2013)</td>
<td>Sweden</td>
<td>Observational</td>
<td>NA</td>
<td>323</td>
<td>172</td>
<td>Mean age=70.4yr; Gender: Males=178, Females=145.</td>
<td>A long-term follow-up of intracerebral hemorrhage (ICH) patients 18-75yr registered during 1996 was conducted.</td>
<td>1-year survival after ICH onset.</td>
</tr>
<tr>
<td>Heikinheimo et al. (2013)</td>
<td>Finland</td>
<td>Observational</td>
<td>NA</td>
<td>681</td>
<td>70</td>
<td>Mean age= 44yr; Gender: Males=424; Females=257.</td>
<td>Patients 18-49yr with a stroke diagnosed between 1994 and 2007 were evaluated for infections preceding and post-stroke. The mean follow-up duration was 7.8±4.0yr.</td>
<td>Modified Rankin Scale (mRS); Prevalence of infections preceding and post-stroke; All-cause mortality.</td>
</tr>
</tbody>
</table>

- **1.** Of 323 participants with ICH, 172 (53%) survived after 1 year, 127 (39%) after 5 years and 57 (18%) after 13 years.
- **2.** The proportion of patients surviving 1yr post ICH was greatest in patients 18-54yr (72.3%), compared to 55-74yr (56.8%) and ≥75yr (43.1%).
- **3.** Multivariate analyses revealed that age was an independent risk factor for long term mortality in 1yr ICH survivors (Hazard ratio=1.08 per each year of increasing age; p<0.001).

- **4.** The excess mortality >1yr post-stroke was significantly higher for ICH and SAH survivors compared to healthy controls (Hazard ratio: ICH=2.02, p<0.01; SAH=1.32, p=0.03); excess mortality >1yr post-stroke was not significantly different between ICH and SAH survivors or between men and women.
- **5.** The overall excess mortality post-stroke was significantly higher for ICH and SAH survivors compared to healthy controls (Hazard ratio=2.19 and 1.70 respectively; p<0.01 for both); overall excess mortality post-stroke was not significantly different between ICH and SAH survivors or between men and women; the overall increased risk of death was highest for ICH survivors 20-49yr (Hazard ratio=14.61; p<0.01).

**Hansen et al.** (2013)

**Sweden**

Observational

TPS=NA

N_Start=323

N_End=172

**Heikinheimo et al.** (2013)

**Finland**

Observational

TPS=NA

N_Start=681

N_End=70
significantly higher risk of an unfavorable outcome at 3mo compared to individuals without PSI (mRS>2) (p=0.031).

4. Results showed that PIs were not associated with recurrent ischemic stroke (p=0.323) or composite of vascular end points (p=0.157). Similarly, PSI was not significantly associated with the risk of recurrent ischemic stroke (p=0.124).

5. An increased risk of all-cause mortality was not found to be impacted by PIs (p=0.124) however, individuals with PSI had a higher mortality during the follow-up period.

<table>
<thead>
<tr>
<th>Study (2013)</th>
<th>Population</th>
<th>Intervention</th>
<th>Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Janes et al.</strong></td>
<td>Mean age=NA; Gender: Males=72963, Females=80349</td>
<td>The incidence rate of stroke from 2007 to 2009 was determined in a population of 153312.</td>
<td>Stroke incidence; Case fatality rate for first ever stroke: 28d, 90d, 180d.</td>
<td>1. The total case fatality rate for a first ever stroke was 20.6 at 28d, 25.8 at 90d, and 30.0 at 180d.</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td>2. Case fatality was higher for a first ever intracerebral hemorrhage (ICH) compared to a first ever ischemic stroke (IS) at all time points (28d: ICH=31.6, IS=16.8; 90d: ICH=36.8, IS=22.9; 180d: ICH=37.9, IS=27.3).</td>
</tr>
<tr>
<td><strong>Kim et al.</strong></td>
<td>Mean age=66.7±13.3yr; Gender: Males=51718, Females=50492</td>
<td>Data from health insurance claims from 2006 to 2010 was analyzed.</td>
<td>Stroke incidence rates: Crude, Age-standardized; Readmission rates.</td>
<td>1. Readmission following stroke in the 0-29yr group was 6.14% after 1yr, 2.82% after 2yr, 2.67% after 3yr, and 1.49% after 4yr.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. Readmission following a stroke in the 30-44yr group was 6.80% after 1yr, 3.17% after 2yr, 2.27% after 3yr, and 2.02% after 4yr.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3. Readmission following a stroke in the 45-54yr group was 8.21% after 1yr, 4.59% after 2yr, 3.57% after 3yr and 2.89% after 4yr.</td>
</tr>
<tr>
<td><strong>Kropp et al.</strong></td>
<td>Mean age=44.7±8.1yr; Gender: Males=2,630, Females=1,801</td>
<td>Patients 18-55yr with a transient ischemic attack (TIA) or ischemic stroke (IS) were included in this multicenter observational study.</td>
<td>Occurrence of a headache during a cerebrovascular event (CVE); Lesion size; Lesion location.</td>
<td>1. Increasing age was associated with a slightly lower risk of suffering from a headache during CVE (p&lt;0.001).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2. In all statistical models examined, female patients had a higher risk of suffering from a headache during CVE (p&lt;0.001 for all).</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td>3. There was no significant effect of the type of CVA (TIA vs. IS) on headache during CVE after controlling for age, gender and centre heterogeneity.</td>
</tr>
<tr>
<td></td>
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<td>4. Logistic regression analyses showed that the odds of a headache increased among participants who had an increasing size of the lesion (p&lt;0.001) and the involvement of the middle (p&lt;0.05) or vertebrobasilar territories (p&lt;0.001).</td>
</tr>
<tr>
<td><strong>Kuptniratsaikul et al.</strong></td>
<td>Mean age=62.1±12.5yr; Gender: Males=124, Females=90</td>
<td>A multicenter analysis of long-</td>
<td>Physical complications (mainly pain) at 1yr post-stroke were present in a significantly greater proportion of participants ≥60yr.</td>
<td></td>
</tr>
</tbody>
</table>
### Observational
TPS=NA  
N<sub>Start</sub>=214  
N<sub>End</sub>=214

Term morbidities in participants with stroke was conducted. Follow-up assessments were conducted for at least 1 yr post-stroke.  
**Outcomes:** Complications 1 yr post-stroke: Physical, Psychological.

| Martirosyan & Krupskaya (2013) | Population: Mean age=NA; Gender: Males=NA, Females=NA.  
Intervention: Patients who died of cerebral stroke were included.  
Outcomes: Mortality rate. |
|---|---|
| Russia Case Series  
TPS=NA  
N<sub>Start</sub>=1135  
N<sub>End</sub>=1135 |
| 1. Patients <45 yr accounted for 34 (3.0%) cases of death from 2000-2002 and from 2008-2010 compared to 200 (17.6%) in participants 45-59 yr, 540 (47.6%) in participants 60-74 yr, 356 (31.4%) in participants 75-89 yr, and 5 (0.4%) in participants >90 yr.  
2. The mortality rate following stroke decreased from 5.3% in 2000 to 2.1% in 2010 in participants <45 yr and from 21.1% to 12.4% in participants 45-59 yr. |

| Rutten-Jacobs et al. (2013b) | Population: Mean age=40.5±7.8 yr; Gender: Males=344, Females=380.  
Intervention: Patients 18-50 yr with a first ever stroke from 1980-2010 were assessed during follow-up assessments from 2009-2012.  
Outcomes: Cumulative 20 yr risk of stroke; Cumulative 20 yr risk of any vascular event; Stroke etiology; Incidence rate of any vascular event and recurrent stroke; Demographic variables. |
|---|---|
| Netherlands Observational  
TPS=NA  
N<sub>Start</sub>=724  
N<sub>End</sub>=724 |
| 1. During a mean follow-up of 9.1 yr, 19.6% of participants had at least 1 vascular event.  
2. The cumulative 20 yr risk of stroke was 17.3% in participants with a TIA, 19.4% in participants with an ischemic stroke, and 9.8% in participants with an intracerebral hemorrhage.  
3. The cumulative 20 yr risk of any vascular event was 27.7% in participants with a TIA and 32.8% in participants with an ischemic stroke.  
4. The annual risk of any vascular event in participants with a TIA or ischemic stroke was highest ≤1 yr post-stroke (7.0%; 6.6%) and decreased to about 2% 5 yr post-stroke.  
5. The risk of another arterial event was significantly greater in males compared to females (p=0.004) but the risk of a recurrent stroke was not significantly different between gender groups (p=0.94).  
6. The risk of another arterial event was significantly different between age groups (p=0.006): 2.5% for 18-29 yr; 12.3% for 30-39 yr; and 21.7% for 40-50 yr.  
7. The risk of a recurrent stroke was not significantly different between age groups (p=0.44): 18.6% for 18-29 yr; 14.8% for 30-39 yr; and 20.8% for 40-50 yr.  
8. Stroke subtypes of artherothrombotic stroke, cardioembolic stroke, and lacunar stroke were associated with recurrent stroke (HR=2.72; 2.49; 2.92). |
### Rutten-Jacobs et al. (2013a)

**Population:** Mean age=40.1±7.9yr; Gender: Males=446, Females=513.

**Intervention:** Patients with a first ever stroke from 1980-2010 were assessed during follow-up assessments from 2009-2012.

**Outcomes:** Survival; Standardized mortality rates; Cumulative mortality.

1. By the follow-up date, 20.0% of participants had died with an overall 30d case-fatality rate of 4.5%.
2. The cumulative 1yr mortality was 1.2% in participants with TIA, 2.4% with ischemic stroke, and 2.9% with intracerebral hemorrhage.
3. The cumulative 20yr mortality was 24.9% for those with TIA, 26.8% for those with ischemic stroke, and 13.7% for those with intracerebral hemorrhage.
4. The standardized mortality rate was 3.5 for the general population, 2.6 for participants with TIA, 3.9 for ischemic stroke, and 3.9 or intracerebral hemorrhage.
5. The cumulative 20yr mortality among participants with ischemic stroke was significantly higher in men than in women (p=0.03) (33.7% vs. 19.8%), with a standard mortality ratio of 4.3 for women and 3.6 for men.
6. Cumulative 20yr mortality was significantly different between age groups in participants with an ischemic stroke (p=0.002): 10.2% for 18-29yr; 23.9% for 30-39yr; and 32.9% for 40-50yr.
7. Cumulative 20yr mortality was not significantly different between age groups in participants with a TIA: 17.0% for 18-29yr; 27.0% for 30-39yr; and 25.5% for 40-50yr.

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### Schaapsmeersders et al. (2013)

**Population:** Participants with stroke (N=277): Mean age=40±7.7yr; Gender: males=123, Females=154.

**Intervention:** Patients with a first ever ischemic stroke from 1980-2010 were assessed during follow-up assessments from 2009-2011. Participants were also compared to a group of healthy controls (N=146).

**Outcomes:** Processing speed: Symbol-Digit Modalities Test, Abbreviated Stroop Color Word Test; Visuo-construction: Rey-Osterrieth Complex Figure copy; Working memory: Paper and Pencil Memory Scanning Test; Immediate memory: Rey Auditory Verbal Learning Test, Rey-Osterrieth Complex Figure immediate recall; Delayed memory: Rey Auditory Verbal Learning Test delayed recall, Rey-Osterrieth Complex Figure delayed recall; Attention: Verbal Seres Attention Test; Executive Functioning: Verbal Fluency, Stroop Interference.

1. Participants with ischemic stroke had a worse cognitive performance on six domains after a mean follow-up of 11yr compared with controls (processing speed: p<0.0001; working memory: p<0.0001; immediate memory: p=0.0002; delayed memory: p<0.0001; executive functioning: p<0.0001); visuo-construction was not significantly different between groups.
2. Longer follow-up duration was associated with a lower scores for immediate memory (p=0.001), delayed memory (p<0.0001), and executive functioning (p=0.004); however, after exclusion of participants with recurrent stroke, there was no longer a significant negative relation between follow-up duration and executive functioning score in participants with ischemic stroke.
3. The proportion of participants with a below average performance or a cognitive
impairment on a cognitive domain was significantly higher in the stroke group compared to the healthy group for all 7 cognitive domains (p<0.0071 for all).

4. Up to 50% of all participants with ischemic stroke had a below average performance or cognitive impairment. Cognitive impairment affected ≤34.5% of participants.

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Study Type</th>
<th>TPS</th>
<th>Start</th>
<th>End</th>
<th>Population:</th>
<th>Intervention:</th>
<th>Outcomes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smajlovic et al. (2013)</td>
<td>Bosnia &amp; Herzegovina</td>
<td>Case Series</td>
<td>NA</td>
<td>3864</td>
<td>3864</td>
<td>Young Participants (N=154): Mean age=38.8±5.7yr; Gender: Males=82, Females=72; Older Participants (N=3710): Age&gt;45yr.</td>
<td>Data from young adults admitted with a first-ever stroke from 2001 to 2005 was retrospectively analyzed.</td>
<td>Risk factors; Stroke types; Stroke severity; Mortality; One month outcome; Modified Rankin Scale (mRS).</td>
</tr>
<tr>
<td>Tiamkao et al. (2013)</td>
<td>Thailand</td>
<td>Observational</td>
<td>NA</td>
<td>85</td>
<td>85</td>
<td>Mean age=35.9±6.2yr; Gender: Males=47, Females=38.</td>
<td>All participants &lt;45yr who were diagnosed with stroke between 1996 and 2010 and had completed workshops for causes of stroke in the young were analysed and followed up a year after.</td>
<td>Outcomes were defined as favorable (i.e. if participant had normal functional ability or mild disability but the participant was employed) or non-favorable; Risk factors; Stroke etiology; Survival rate; Return to work.</td>
</tr>
<tr>
<td>Waje-Andreasen et al. (2013)</td>
<td>Norway</td>
<td>Observational</td>
<td>NA</td>
<td>232</td>
<td>232</td>
<td>Patients (N=232): Mean age=41.1±7.5yr; Gender: NA.</td>
<td>Patients with an index-stroke between 1988 and 1997 were retrospectively selected and compared with age and sex-matched controls (N=167). Follow-up assessments were conducted from 2004-2005 where participants were clinically examined.</td>
<td>Modified Rankin Scale (mRS); Memory problems; Risk factors; Work status.</td>
</tr>
</tbody>
</table>

1. Mortality rate was significantly lower in young adults (11% vs. 30%; p<0.0001).
2. Favourable outcomes at one month according to mRS scores ≥2 were significantly more prevalent in younger participants than older participants (71%, vs. 53%; p=0.0004).
3. 52.9% were found to have a cardiac cause of stroke, 68% were found to have rheumatic mitral stenosis, and 45% having atrial fibrillation.
4. The overall survival rate was 95.3%, 23.5% of participants had no disability, 55.5% had returned to work and were fully employed with minor neurologic deficits, and 21% were disabled.
5. Mitral stenosis and alcohol intake were significantly correlated with a non-favorable outcome (p=0.0357; p=0.0135).
6. Patients compared with controls had more memory problems (41.0% vs. 5.4%; p<0.001), anxiety (19.4% vs. 9%; p=0.009), depression (29.2% vs. 13.2%; p=0.001), and sleeping problems (36.1% vs. 19.2%; p=0.001).
7. After a mean observation time of 18.3yr, 27.2% of 232 participants had died.
8. Epileptic seizures were developed by 12 patients and 1 control after inclusion.
9. High blood pressure (<140/90mmHg) was present in 39% of participants, statins were used by 38.2% of participants, and 49% had stopped smoking.
10. Patients and controls did not differ concerning gender (p=0.65), and education (p=0.38).
11. Multiple regression analysis revealed that male gender (p=0.002), normal memory (p<0.001), and a good functional outcome (mRS<2) (p<0.001) were significant factors.
### Wu et al. (2013)  
China  
Case Series  
TPS=NA  
N_{Start}=NA  
N_{End}=NA  

**Population:** Mean age=NA; Gender: Males=NA, Females=NA.  
**Intervention:** Stroke mortality was determined for individuals 45-54yr in 1999.  
**Outcomes:** Stroke mortality rate.  

1. The mean stroke mortality rate per 100,000 per year in 1999 for males 45-54yr was 35.43 in South America, 28.37 in Asia, 98.53 in Africa, 21.43 in Europe, and 12.87 in Canada, USA, Australia and New Zealand.  
2. The mean stroke mortality rate per 100,000 per year in 1999 for females 45-54yr was 29.75 in South America, 14.99 in Asia, 56.07 in Africa, 13.61 in Europe, and 11.28 in Canada, USA, Australia and New Zealand.

### Aarnio et al. (2015)  
Finland  
Observational  
TPS=NA  
N_{Start}=970  
N_{End}=970  

**Population:** Median age=44yr; Gender: Males=608, Females=362.  
**Intervention:** Follow-up data from young adults (15-49yr) with a first ever ischemic from 1994 to 2011 who survived ≥30d were included. The mean follow-up time was 10.2yr.  
**Outcomes:** Mortality; Risk factors; Stroke etiology; Standardized mortality ratio (observed deaths over expected deaths); Absolute risk of death; Absolute excess risk of death.  

1. At follow-up, 152 (15.7%) patients had died with death in 15 (9.9%) due to ischemic stroke, 8 (5.3%) due to hemorrhagic stroke, 45 (29.6%) due to a cardioaortic cause, 29 (19.1%) due to malignancy, 10 (6.6%) due to infection, and 45 (29.6%) due to other causes.  
2. Death occurred in 22 participants 15-39 and in 130 participants aged 40-49.  
3. The standardized mortality ratio was 5.42 in participants 15-39yr and 6.94 in participants 40-49yr; the absolute risk of death per 1000 person-years was 6.87 in the 15-39yr group and 19.42 in the 40-49yr group; the absolute excess risk of death per 1000 person-years was 5.60 in the 15-39yr group and 15.05 in the 40-49yr group.  
4. Recurrent strokes occurred in 132 (13.6%) participants with 117 experiencing ischemic stroke and 13 experiencing hemorrhagic stroke.  
5. The median recurrent stroke time was 3.7yr.

### de Bruin et al. (2014)  
Netherlands  
Observational  
TPS>1yr  
N_{Start}=96  
N_{End}=96  

**Population:** Median age=43.0yr; Gender: Males=44, Females=52.  
**Intervention:** Patients 18-49yr with a first ever ischemic stroke from 2000 to 2010 were included and underwent a neuropsychological examination between April and June 2011. Patients were also compared to healthy controls (N=61).  

1. Compared to healthy controls, patients performed significantly worse on the Stroop Color-Word Test Part 1 (stroke=52.4±16.3, no stroke=40.5±7.1; p<0.001), the Symbol-Digit Substitution Task (stroke=63.8±18.3, no stroke=79.6±13.5; p<0.001), and the learning slope component of the Word Pair for full-time work.  
7. When comparing patients with good vs. poor functional outcomes (mRS<2 vs. mRS≥2), the following outcomes were significantly different: memory problems (34.3% vs. 57.1%; p=0.015), depression (23.5% vs. 42.9%; p=0.027), recurrent stroke (20.6% vs. 40.5%; p=0.021), epilepsy (7.8% vs. 23.8%; p=0.013), full-time work (58.8% vs. 2.4%; p<0.001), and use of statin (29.4% vs. 59.5%; p=0.001).
### Bulder et al. (2014)
**Netherlands**  
**Case Series**  
**TPS:** Mean = 6 yr  
**NStart:** 17  
**NEnd:** 17

**Population:** Mean age = 19.3 yr; Gender: Males = 5, Females = 12.  
**Intervention:** Patients aged 5-50 yr with a first ever ischemic stroke in the middle cerebral artery (MCA) from 1994 to 2011 were included.  
**Outcomes:** Stroke etiology; Modified Rankin Scale (mRS).

1. All strokes were caused by a non-atherosclerotic unilateral intracranial arteriopathy of the proximal MCA or distal internal carotid artery.  
2. Severe arteriopathy of the MCA occurred in 9 participants and in the internal carotid artery of 1 participant; 7 participants had mild arteriopathy.  
3. Poor functional outcomes (mRS>2) were observed in 4 participants, 8 had a mRS score of 2, 3 had a score of 1, and 2 had a score of 0.

### Chraa et al. (2014)
**Morocco**  
**Observational**  
**TPS:** NA  
**NStart:** 128  
**NEnd:** 128

**Population:** Mean age = 28.3 yr; Gender: Males = 76, Females = 52.  
**Intervention:** Patients 18-45 yr with an ischemic stroke from 2007 to 2010 were assessed from 3-82 mo post-stroke.  
**Outcomes:** Prevalence of risk factors; Stroke etiology; Outcomes at follow-up; Modified Rankin Scale (mRS).

1. Outcomes observed at the follow-up assessment included death in 21 (16.4%) participants, full recovery in 49 (38.2%), a residual motor defect in 38 (29.6%), epilepsy in 7 (5.5%), vascular dementia in 2 (1.6%), poor functional outcomes (mRS>2) in 49 (38.2%), and 11 (8.6%) were lost to follow-up.

### Ghatan et al. (2014)
**USA**  
**Observational**  
**TPS:** NA  
**NStart:** 19  
**NEnd:** 19

**Population:** Mean age = 12.3 yr; Gender: Males = 13, Females = 6.  
**Intervention:** Patients with a stroke who underwent surgery for epilepsy from 2005 to 2012 were included. The mean follow-up duration was 4.5 yr.  
**Outcomes:** Epilepsy duration; Modified Rankin Scale (mRS); Functional improvement: Cognition, Behaviour, Quality of life.

1. Epilepsy duration was a mean of 9.3 yr.  
2. Poor functional outcomes (mRS>2) were observed in 11 (57.9%) participants.  
3. Functional improvement in terms of cognition, behaviour, and quality of life was observed in all participants with 4 participants showing mild to moderate improvement and 15 participants showing marked improvement.

### Ghatanatti et al. (2014)
**India**  
**Case Series**  
**TPS:** NA  
**NStart:** 4  
**NEnd:** 4

**Population:** Mean age = 27.2 yr; Gender: Males = 1, Females = 3.  
**Intervention:** Patients who experienced a stroke following a valvular surgery and anticoagulant use were included.  
**Outcomes:** Stroke etiology; Mortality; Surgical operation.

1. Stroke was classified as hemorrhagic in 3 participants and thromboembolic in 1 participant.  
2. 2 participants with a hemorrhagic stroke died at a mean of 3.5d post-stroke and the other 2 participants were revived.  
3. Both participants that received a mitral valve replacement expired and both participants that received a double valve replacement were revived.

### Kalita et al. (2014)
**India**  
**Case Series**  
**TPS:** NA  
**NStart:** 434  
**NEnd:** 434

**Population:** Mean age = 41.6 yr; Gender: Males = 308, Females = 96.  
**Intervention:** Patients 16-50 yr with an

1. At 1 mo, 102 (25.2%) patients died, 161 (39.9%) had a poor outcome (GOS 2-3), and 141 (34.9%) had a good outcome (GOS 4-5).

---

**Outcomes:** Prevalence of risk factors; Stroke etiology; Rey-Osterrieth Complex Figure (ROCF): Copy, Direct recall, Late recall; Stroop Color-Word Test: Part 1, Part 2; Symbol-Digit Substitution Task; Word Pair Test: Learning slope, Direct recall, Delayed recall, Percentage recall.

2. Compared to healthy controls, participants performed significantly better on the ROCF Copy component (median: stroke=34, no stroke=36; p<0.001).

3. No other significant differences between groups were observed in the other cognitive outcomes.
<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Study Type</th>
<th>TPS</th>
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<th>Population</th>
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<th>Intervention</th>
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<tbody>
<tr>
<td>Khealiani et al. (2014)</td>
<td>Pakistan</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N_Start=874</td>
<td>N_End=874</td>
<td>Mean age=59.7yr; Gender: Males=529, Females=345.</td>
<td></td>
<td>Patients &gt;14yr with an ischemic stroke in 2007 were included.</td>
</tr>
<tr>
<td>Koton et al. (2014)</td>
<td>Israel</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N_Start=14,357</td>
<td>N_End=14,357</td>
<td>Mean age=54.1±5.8yr; Gender: Males=6402, Females=7955.</td>
<td></td>
<td>The incidence rate of stroke from 2007 to 2009 was determined in a population.</td>
</tr>
<tr>
<td>Liu et al. (2015)</td>
<td>China</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N_Start=179</td>
<td>N_End=179</td>
<td>Mean age=37.6±6.2yr; Gender: Males=134, Females=45.</td>
<td></td>
<td>Patients &lt;45yr with an ischemic stroke from 2005 to 2012 that had received either aggressive (AMM) or routine medical management (RMM) were included. RMM participants received antplatelet therapy, a cholesterol-lowering agent, and intravenous penicillin for 10-14d. AMM participants received high-dose methylprednisolone pulse therapy for 5d in addition to oral prednisone sequential therapy for &gt;3mo. A follow-up assessment was conducted at a median of 25mo.</td>
</tr>
<tr>
<td>Lindmark et al. (2014)</td>
<td>Sweden</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N_Start=62,497</td>
<td>N_End=62,497</td>
<td>Mean age=NA; Gender: Males=NA, Females=NA.</td>
<td></td>
<td>The fatality rate of stroke participants from 2001 to 2009 was determined.</td>
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</table>

**Outcomes:**
- **Prevalent risk factors**
- **ICH etiology**
- **Glasgow Outcome Scale (GOS)**
- **1mo mortality**

**Results:**
1. In-hospital complications were not significantly different between age groups with participants <45yr reporting 10 cases of pneumonia, 3 cases of urinary tract infections and 1 case of gastrointestinal bleeding.
2. mRS scores at discharge were not significantly different between age groups with participants <45yr showing a poor functional outcome (mRS>2) in 81 (65.8%) cases compared to 64.8% for >45yr.

**Liu et al. (2015)**
- **China**
- **Observational**
- **TPS=NA**
- **N_Start=179**
- **N_End=179**

**Population:** Mean age=37.6±6.2yr; Gender: Males=134, Females=45.

**Intervention:** Patients <45yr with an ischemic stroke from 2005 to 2012 that had received either aggressive (AMM) or routine medical management (RMM) were included. RMM participants received antplatelet therapy, a cholesterol-lowering agent, and intravenous penicillin for 10-14d. AMM participants received high-dose methylprednisolone pulse therapy for 5d in addition to oral prednisone sequential therapy for >3mo. A follow-up assessment was conducted at a median of 25mo.

**Outcomes:** Angiographic outcomes at follow-up; 2yr cumulative stroke-free survival rate; Recurrent stroke rate.

**Results:**
1. Angiographic outcomes at follow-up were significantly different between groups with more RMM participants showing cases of progression (RMM=20.9%, AMM=5.6%), no change (RMM =39.5%, AMM=31.0%) or a new lesion (RMM=16.3%, AMM=1.4%); a greater proportion of AMM showed improvement (RMM=23.3%, AMM=62.0%) (p=0.002).
2. The 2yr cumulative stroke-free survival rate was significantly greater in the AMM group compared to RMM (92.6% vs. 86.3%) (p=0.006).
3. Recurrent strokes occurred in a significantly greater proportion of RMM participants compared to AMM (18.9% vs. 1.7%) (p=0.001).

**Lindmark et al. (2014)**
- **Sweden**
- **Case Series**
- **TPS=NA**
- **N_Start=62,497**
- **N_End=62,497**

**Population:** Mean age=NA; Gender: Males=NA, Females=NA.

**Intervention:** The fatality rate of stroke participants from 2001 to 2009 was determined.

**Outcomes:** Case fatality rates.

**Results:**
1. The case fatality rate for participants 8-28d post-stroke was 1.1% for the 18-54yr group, 1.4% for the 55-64yr group, and 2.2% for the 65-74yr group.
2. The case fatality rate for participants 28d-1yr post-stroke was 1.9% for the 18-54yr group, 3.3% for the 55-64yr group, and
5.9% for the 65-74yr group.

3. Survival probability curves show a higher probability of survival associated with higher education and higher income.

4. Associations between socioeconomic status and case fatality were significant for education, income, cohabitation (p<0.001 for all) and country of birth (p<0.05); a lower case fatality was associated with a higher level of education, a higher level of income and with cohabitation vs. living alone.

5. Multivariate analyses revealed significant associations between case fatality and the following factors: highest attained education 29d-1yr post-stroke (p=0.046) but not 8d-28d post-stroke, income group for both 8d-28d (p=0.001) and 29d-1yr post-stroke (p<0.001), cohabitation for both 8d-28d (p=0.04) and 29d-1yr post-stroke (p<0.001); a lower case fatality was associated with a higher level of education, a higher level of income, and with cohabitation vs. living alone.

---

**Population:** Mean age: TIA: 40.9±8.0yr, Ischemic Stroke: 40.0±7.7yr; Gender: Males=198, Females=239.

**Intervention:** Patients 18-50yr with a first ever stroke from 1980 to 2010 were included. Ischemic stroke participants were also compared to healthy controls.

**Outcomes:** Prevalence of subjective executive and memory failures; Prevalent risk factors.

---

**Population:** Young Adults (YA; N=1431): Mean age=38.5±6.3yr; Gender: Males=1017, Females=414; Elderly Adults (EA; N=24387): Mean age=68.9±10.6yr; Gender: Males=13998, Females=10389.

**Intervention:** Epidemiological data and outcomes were examined in young adults (15-45yr) and elderly (≥46yr) individuals with stroke. Data was obtained from 29 participating emergency departments.

**Outcomes:** Demographic variables; Socioeconomic factors; Time variables related

---

1. Compared to EA, YA showed significantly higher proportions of being male, having a high body mass index, having a higher education level, holding a professional and business job, and having national health insurance (p<0.001 for all).

2. The utilization of emergency medical services was significantly different between groups for ambulance utilization (p<0.001), time to 911 call (p=0.039), time to hospital arrival <3hr (p=0.003), interhospital transport via another hospital (p<0.001),
21. Rehabilitation of Younger Patients Post Stroke

- Reoabilitation of Younger Patients Post Stroke
- With event and process of care; Clinical parameters; Laboratory and radiologic examinations; Emergency care procedures; Mortality at discharge; Modified Rankin Scale (mRS).
- Receiving anticoagulant therapy and an operation at another hospital (p=0.011; p=0.028), median time to a brain CT scan (p=0.015), emergency department image <10min (p=0.016), and the proportion of participants who received an operation at their hospital of care (p=0.002); all variables were greater in the EA group except for the median time to a brain CT scan.

3. Overall hospital mortality was higher in EA at 3.1% compared to 1.1% in YA (p<0.001).

4. mRS scores before the event were significantly higher in EA compared to YA with 9.4% and 3.3% of elderly and young adults in the moderate to severe disability category (p<0.001).

5. The change in mRS scores from before the event to discharge was significantly different between groups with a greater proportion of EA participants having a worsened score and a greater proportion of YA participants with an unchanged score (p<0.001).

Rutten-Jacobs et al. (2014)
Netherlands Observational TPS=NA
N\text{Start}=427
N\text{End}=427

| Population | Mean age=40.3±7.9yr; Gender: Males=190, Females=71. | Intervention | Patients with a first ever stroke from 1980-2010 were assessed during follow-up assessments from 2009-2012. |
| Outcomes | Incidence of diabetes; Fasting venous plasma glucose; Risk of recurrent vascular events. |

1. Diabetes was diagnosed in 7.1% of TIA participants and 8.5% in ischemic stroke participants, resulting in an incidence rate of 7.9 and 7.8 per 1000 person years.

2. Among those without diabetes at follow-up, 21.1% had impaired fasting glucose (IFG) and 78.9% had normal blood glucose values.

3. Patients with diabetes and IFG were more likely to have experienced any vascular event during follow-up than those with normal fasting blood glucose values.

4. The risk for the recurrence of stroke was not different for participants with incident diabetes and IFG compared with those with normal fasting blood glucose values.

5. The risk of other arterial events was increased in participants with diabetes and IFG compared with those with normal fasting blood glucose levels.

Synhaeve et al. (2014)
Netherlands Observational TPS=NA
N\text{Start}=722
N\text{End}=722

| Population | Mean age=40.5±7.8yr; Gender: Males=344, Females=378. | Intervention | Patients with first-ever stroke admitted between 1980 and 2010 were followed for an average of 9.1yr. |
| Outcomes | Modified Rankin Scale (mRS); Instrumental Activities of Daily Living Scale (iADL). |

1. At discharge, 2.4% of participants with TIA, 30.2% of participants with ischemic stroke (IS), and 69.7% with intracerebral hemorrhage (ICH) had a poor functional outcome according to mRS scores >2. After a mean follow-up of 9.1yr, a poor mRS outcome was present in 16.8% of participants with TIA, 36.5% with IS and
1. White participants had lower stroke severity according to NIHSS scores at hospital admission than Black and Asian participants (p<0.017 for both).
2. Intracerebral hemorrhage was more common in Blacks (26.6%) than in the combined subgroup of Whites and Asians (10.4%, p<0.001).
3. The 30d mortality rate was 5.8% for the entire population and was significantly different across the three races (p<0.001): Blacks 10.0%, Whites 6.0%, Asians 1.9%.
4. Race (p=0.026), admission NIHSS score (p<0.001), coronary artery disease (p=0.012), and history of congestive heart failure (p=0.021) were found to be independent predictors of 30d mortality.
5. Blacks and Whites had a higher likelihood of 30d mortality in comparison to Asians (p=0.021; p=0.023).
6. The rates of 30d favorable functional outcome differed (p<0.001) across the racial groups, with 63.5% of Whites, 41.8% of Blacks, and 39.9% of Asians

Tsivgoulis et al. (2014)  
Greece  
Case Series  
TPS=NA  
NStart=1134  
NEnd=1134

Population: Mean age=37.4±7.0yr; Gender: Males=667, Females=467.  
Intervention: Data from participants 18-45yr admitted to an international multicentre study with first-ever acute stroke was retrospectively assessed for risk factors associated with several outcomes.  
Outcomes: Mortality; Modified Rankin Scale (mRS); Risk factors; National Institute of Health Stroke Scale (NIHSS).
7. Race ($p=0.043$), admission stroke severity ($p<0.001$), and admission serum blood glucose ($p=0.041$) were found to independently predict favorable functional outcome at 30d.
8. According to associations between baseline characteristics and functional ability revealed that Blacks had a lower odds of 30d favorable functional outcome in comparison to Whites ($p=0.018$); Asians had non-significantly lower odds than Whites ($p=0.103$).

<table>
<thead>
<tr>
<th>Source</th>
<th>Country</th>
<th>Study Type</th>
<th>TPS</th>
<th>N Start</th>
<th>N End</th>
<th>Population: Mean age</th>
<th>Gender:</th>
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<tr>
<td>Zanaty et al. (2014)</td>
<td>USA</td>
<td>Observational</td>
<td>NA</td>
<td>15</td>
<td>15</td>
<td>27.93±6.75yr</td>
<td>Males=6</td>
<td>Females=9</td>
<td>Modified Rankin Scale (mRS); Recanalization outcome; Morbidity at 90d; Mortality at 90d; Mechanical thrombectomy system: Penumbra system, Merci Retriever, Solitaire FR device.</td>
</tr>
<tr>
<td>Aarnio et al. (2015)</td>
<td>Finland</td>
<td>Observational</td>
<td>NA</td>
<td>1002</td>
<td>1002</td>
<td>44yr</td>
<td>Males=626</td>
<td>Females=376</td>
<td>Follow-up data from young adults (15-49yr) with a first ever ischemic stroke from 1969 to 2011 were included. The mean follow-up time was 10.0yr. Mortality; Risk factors; Stroke etiology; Cancer prevalence.</td>
</tr>
<tr>
<td>de Bruijn et al. (2015)</td>
<td>Netherlands</td>
<td>Case Series</td>
<td>&gt;4.9yr</td>
<td>170</td>
<td>170</td>
<td>41.4yr</td>
<td>Males=75</td>
<td>Females=95</td>
<td>Employment rate; Modified Rankin Scale (mRS); Hospital Anxiety and Depression Scale (HADS): Depression, Anxiety; Stroke etiology.</td>
</tr>
<tr>
<td>Fullerton et al. (2015)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>19yr</td>
<td></td>
<td></td>
<td>Recurrent strokes occurred in 52 (19.2%)</td>
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<tr>
<th>Study</th>
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<tr>
<td>USA</td>
<td></td>
<td>Observational</td>
<td>NA</td>
<td>271</td>
<td>213</td>
<td>Males=111, Females=102.</td>
<td>Childhood cancer survivors with a stroke were included. Median time between first stroke and cancer diagnosis was 10yr. Patients with a recurrent stroke (n=52) were compared with non-recurrent stroke patients (n=161).</td>
<td>Prevalent risk factors; Recurrent stroke characteristics.</td>
</tr>
<tr>
<td><strong>Huang et al.</strong> (2015)</td>
<td>China</td>
<td>Observational</td>
<td>NA</td>
<td>431</td>
<td>150</td>
<td>Mean age=41.0±6.8yr; Gender: Males=69.7%; Females=30.3%.</td>
<td>Patients 18-45yr with a first-ever ischemic stroke from 2006 to 2010 were included. A follow-up assessment was conducted at a mean of 5.8±3.2yr.</td>
<td>Post-stroke cognitive impairment/cognition.</td>
</tr>
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</table>

1. ***At follow-up, the prevalence of cognitive impairment was 39.4%.***
2. Advanced age, stroke severity at admission, history of atrial fibrillation, poor functional outcome at discharge (mRS>2), left anterior circulation syndrome, stroke recurrence, and large artery atherosclerosis and undetermined etiology stroke classifications were significantly associated with cognitive impairment at follow-up (all p<0.001).
3. Multivariable analyses showed that stroke severity on admission, poor functional outcome at discharge (mRS>2), left anterior circulation syndrome, and stroke recurrence were significantly associated with subsequent cognitive impairment.
4. Post-stroke cognition was also significantly related to mRS at follow-up (p<0.001) with a greater proportion of individuals with cognitive impairment having a poor functional outcome (mRS>2) compared to individuals without cognitive impairment (63.0% vs. 24.5%).

| **Kato et al.** (2015)       | Japan   | Case Series   | NA  | 78,096  | 78,096| Mean age: Females=75.5±12.1yr, Males=69.7±11.6yr; Gender: Males=47,465, Females=30,631. | Patients with an ischemic stroke from 2000 to 2012 were included. | mRS scores at discharge indicated poorer functional outcomes (mRS>2) in older age groups compared to participants <50yr. |

1. Initial NIHSS scores were lowest in participants <50yr and increased with age.

| **Krishnamurthi et al.** (2015) | US      | Case Series   | NA  | NA      | NA    | Mean age=NA; Gender: NA. | The global prevalence of stroke, mortality, disability-adjusted life years and their trends for ischemic and hemorrhagic stroke was assessed for individuals 20-64yr. | Disability-adjusted life years (DALYs); |

1. Among adults 20-64yr, the global prevalence of hemorrhagic stroke (HS) in 2013 was 3,725,085 and prevalence of ischemic stroke (IS) was 7,258,216.
2. There were 1,483,707 stroke deaths globally among young adults but the participating.
<table>
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<tr>
<th>Study</th>
<th>Country</th>
<th>Study Design</th>
<th>TPS</th>
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<th>Outcomes</th>
<th>Results</th>
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<tr>
<td>Koivunen et al. (2015)</td>
<td>Finland</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N\textsubscript{Start}=1257</td>
<td>N\textsubscript{End}=1257</td>
<td>Younger Patients (YG; n=336): Median age=42yr; Gender: Male=200, Female=136. Older Patients (OL; n=921): Age range≥50yr. Young patients (&lt;50yr) diagnosed with a first-ever intracranial hemorrhage in Helsinki University Central Hospital between January 2000 and March 2010 (YG) were analyzed retrospectively. Comparisons were performed amongst demographic subgroups and with patients over ≥50yr of age enrolled between January 2005 and March 2010 (OL).</td>
<td></td>
<td>Stroke mortality; Prevalence of stroke.</td>
<td>Number of deaths from HS (1,047,735) was noticeably higher than the number of deaths from IS (435,972). 3. Death rates for all strokes among young adults also declined noticeably in developed countries from 33.3 in 1990 to 23.5 in 2013. 4. A noticeable decrease in HS death rates from 19.8 to 13.7 per 100,000 was found for young adults between 1990 and 2013 only in developed countries. 5. No noticeable change was detected in IS death rates among young adults. The total DALYs from all strokes in those 20–64yr was 51,429,440. 6. Globally, there was a 24.4% increase in total DALY numbers for this age group, with a 20% and 37.3% increase in HS and IS numbers, respectively.</td>
</tr>
<tr>
<td>Maaijwee et al. (2015)</td>
<td>Netherlands</td>
<td>Case Series</td>
<td>TPS&gt;8.3yr</td>
<td>N\textsubscript{Start}=511</td>
<td>N\textsubscript{End}=511</td>
<td>Population: Mean age: TIA=40.5±8.1yr, Ischemic Stroke=40.1±7.8yr; Gender: Males=198, Females=239. Patients 18-50yr with a first ever stroke from 1980 to 2010 were included.</td>
<td></td>
<td>3mo mortality rate was lower in YG group compared with OL group (17.0% vs. 32.7%, p&lt;0.001).</td>
<td>1. Fatigue was prevalent in significantly more stroke participants compared to healthy controls (41% vs. 18.4%) (p=0.0005). 2. Fatigue did not significantly differ with the location of the index event. 3. Fatigue was associated with a poor functional outcome according to the mRS and IADL, depressive symptoms, and anxiety symptoms.</td>
</tr>
<tr>
<td>Man et al. (2015)</td>
<td>China</td>
<td>Observational</td>
<td>TPS&gt;6mo</td>
<td>N\textsubscript{Start}=105</td>
<td>N\textsubscript{End}=105</td>
<td>Population: Young Stroke (YS; N=29): Mean age=49.28±5.11yr; Gender: Males=17, Females=12; Old Stroke (OS; N=76): Mean age=67.07±6.92yr; Gender: Males=54, Females=22. Patients with stroke were recruited and administered a survey. Participants were divided between age: &lt;55yr (YS) and ≥55yr (OS).</td>
<td></td>
<td>BAPM Instrumental activities of daily living scores were significantly different between groups with the OS group reporting more frequent prospective memory failure than the YS group (p=0.029). 2. BAPM total scores were significantly different between groups with the OS group reporting more frequent prospective memory failure than the YS group (p&lt;0.001). 3. No significant differences between OS and</td>
<td>1. BAPM Instrumental activities of daily living scores were significantly different between groups with the OS group reporting more frequent prospective memory failure than the YS group (p=0.029). 2. BAPM total scores were significantly different between groups with the OS group reporting more frequent prospective memory failure than the YS group (p&lt;0.001). 3. No significant differences between OS and</td>
</tr>
</tbody>
</table>
Basic activities of daily living, Instrumental activities of daily living.

YS groups were observed on the BAPM Basic activities of daily living.

4. BAPM scores for all domains in the YS group were not significantly different between scores reported by the participant compared to scores reported by relatives rating the participants.

**Ojha et al.** (2015)
China
Case Series
TPS=NA
N_{Start}=123
N_{End}=123

**Population:** Age Range: <46yr(n=51), 46-50yr(n=72); Gender: Male=98, Female=25.

**Intervention:** Younger patients who had acute ischemic stroke from January 2007 to July 2012 were retrospectively analyzed.

**Outcomes:** Risk Factors.

1. Risk factors were hypertension (72.4 %), dyslipidemia (55.3 %), smoking (54.4 %) and diabetes (33.3 %).
2. Small artery atherosclerosis was found in 54 patients (43.9 %), with higher prevalence in patients of 46-50yr.

**Ozer et al.** (2015)
Turkey
Case Series
TPS=NA
N_{Start}=619
N_{End}=619

**Population:** Younger Group (YG; n=32): Mean age=37.7±6.1; Gender: Male=13, Female=19. Older Group (OL; n=587): Mean age=71.2±11.3; Gender: Male=271, Female=316.

**Intervention:** Hospital records of patients who had acute ischemic stroke from January 2007 to November 2014 were retrospectively analyzed by age.

**Outcomes:** National Institute of Health Stroke Scale (NIHSS); Modified Rankin Scale (mRS).

1. The mean NIHSS score at admission and hospital mortality was significantly lower in YG group compared with OL group (p=0.006 and p=0.043 respectively).
2. The median follow-up mRS was significantly lower in YG group compared with OL group (p<0.001).

**Reuter et al.**
Germany
Case Series
TPS=NA
N_{Start}=51,735
N_{End}=51,735

**Population:** Younger Patients (YG; n=4,140): Age range: 18-50yr; Gender: Male=2,481, Female=1,659. Older Patients (OL; n=47,595): Age range: 18-50yr; Gender: Male=28,201, Female=19,394.

**Intervention:** Hospital records of patients who had acute ischemic stroke and underwent intravenous thrombosis (IVT) from January 2008 to December 2012 were retrospectively analyzed by age.

**Outcomes:** Modified Rankin Scale (mRS); Mortality.

1. Both YG and OL groups showed similar numbers of patients with mRS of 0-1 at discharge (p=0.003 vs. p<0.001, respectively).
2. Both YG and OL groups showed similar numbers of in-hospital mortality (p=0.33 vs. p=0.22, respectively).

**Rutten-Jacobs et al.**
(2015)
Netherlands
Observational
TPS=NA
N_{Start}=845
N_{End}=845

**Population:** Mean age=40.3±7.9yr; Gender: Males=388, Females=457.

**Intervention:** Data from young participants with a first ever transient ischemic attack or ischemic stroke admitted between 1980 and 2010 was evaluated.

**Outcomes:** Cause-specific mortality; Survival status; Expected mortality.

1. The mean follow-up time was 12yr, during which 146 participants died.
2. The cause-specific observed 20yr cumulative mortality rate was 5.3% for stroke.
3. The absolute excess risk of all cause death was highest at 10-15yr after the index event and was mainly attributed to a vascular disease and most pronounced in men.

**Simonetti et al.** (2015)
Switzerland
Observational
TPS=NA
N_{Start}=624
N_{End}=624

**Population:** Median age=46yr; Gender: Males=374, Females=250.

**Intervention:** Young participants (16-55yr) with stroke were prospectively recruited in a multicentre study.

**Outcomes:** Risk factors; Mortality at 3mo

1. At the 3mo follow-up assessment, 61% of participants had a favourable outcome according to mRS scores of 0-1, 2.9% of participants had died, and 2.7% had a recurrent cerebrovascular event (1.2% for ischemic stroke, and 1.5% for TIA).
### 21. Rehabilitation of Younger Patients Post Stroke

#### Follow-up; Stroke etiology; Recurrence of cerebrovascular events; Modified Rankin Scale (mRS);

<table>
<thead>
<tr>
<th><strong>Simonetti et al. (2015)</strong></th>
<th><strong>Population:</strong> Mean age=NA; Gender: Males=133, Females=116. <strong>Intervention:</strong> Patients 1mo-45yr with an ischemic stroke from 2000 to 2008 were included. Patients were divided between age groups: children 1mo-16yr (N=95) and young adults 16-45yr (N=154). <strong>Outcomes:</strong> Prevalent risk factors; Stroke etiology; Recurrent stroke; Modified Rankin Scale (mRS); Mortality; Psychological outcomes: Psychological and psychiatric disorders, Behavioural disturbances, Fatigue. Difficulty concentrating or memory problems; Residence; Return to work or school; Self-reported impact of stroke on life: Everyday life, Social life, Social activities.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switzerland Case Series TPS=NA N&lt;sub&gt;Start&lt;/sub&gt;=249 N&lt;sub&gt;End&lt;/sub&gt;=249</td>
<td>1. Recurrent stroke occurred in 5 (6%) children and 7 (5%) young adults. 2. The proportion of favourable long term outcomes (mRS&lt;2) were not significantly different between age groups (children=53%, young adults=55%) (p=0.0896). 3. Mortality was not significantly different between age groups (children=14%, young adults=7%) (p=0.121). 4. Functional outcomes were not significantly different between groups in regards to having some form of paresis (children=55%, young adults=48%; p=0.330), impaired balance (children=10%, young adults=11%; p=1.000), visual disturbances (children=5%, young adults=8%; p=0.581), language difficulties (children=21%, young adults=26%; p=0.421), seizures (children=15%, young adults=11%; p=0.403), and headaches (children=4%, young adults=7%; p=0.381). 5. Psychological outcomes were not significantly different between groups in regards to having a psychological/psychiatric disorder (children=15%, young adults=19%; p=0.466), fatigue (children=13%, young adults=18%; p=0.452), and difficulty concentrating or memory problems (children=10%, young adults=11%; p=1.00). 6. Behavioural disturbances were significantly more prevalent in children (children=13%, young adults=5%; p=0.040). 7. Young adults reported living at home without special care in 127 (89%) cases, at home with special care in 11 (8%), and at a nursing home in 4 (3%). 8. Young adults reported returning to work or regular schooling in 93 (68%) cases, special needs schooling or part-time work/work training in 29 (21%), and being unable to work or read in 15 (11%).</td>
</tr>
</tbody>
</table>

2. Diabetes mellitus (p=0.023) and NIHSS scores on admission (p<0.001) were independent predictors of outcome.
3. NIHSS on admission was identified as an independent predictor of survival (p=0.044).
4. Previous stroke or TIA was found to be the only variable to significantly predict recurrence of stroke or TIA (p=0.012).
Stroke in young adults was reported to impact everyday life in 88 (64%) cases, social life in 64 (46%), and social activities in 10 (7%).

Stroke impact in everyday life was reported by a significantly greater proportion of young adults compared to children (64% vs. 27%; p<0.001).

Synhaeve et al. (2015) Netherlands Observational TPS=NA NStart=277 NEnd=277

Population: Mean age=40.0±7.7yr; Gender: Males=123, Females=154.

Intervention: Patients with first ever stroke admitted between 1980 and 2010 were followed-up and assessed between 2009 and 2012 with a mean follow-up time of 11.0yr.

Outcomes: Modified Rankin Scale (mRS); Instrumental Activities of Daily Living Scale (iADL); Hospital Anxiety and Depression Scale (HADS); Cognitive domains: Processing speed, Working memory, Immediate memory, Delayed memory, Visuocconstruction, Attention, Executive functioning, Global cognitive function.

1. At follow-up, a poor functional outcome according to mRS score >2 was observed in 8.3% of participants and a poor iADL outcome (score <8) was found in 13.7% of participants.
2. According to the HADS, 19.3% of participants had scores suggestive of depression at follow-up.
3. Working memory was significantly associated with a poor functional outcome according to the mRS (p=0.001); each z score increase in working memory performance was related to a decreased risk of poor functional outcome.
4. Working memory and processing speed were significantly associated with a poor functional outcome according to the iADL (p=0.001 for both); each z score increase in working memory performance and processing speed (was related to a decreased risk of poor functional outcome.
5. The presence of impairments on any of the individual cognitive domains did not significantly influence poor functional outcomes according to the mRS; impairment in Global cognitive function was significantly associated with a poor functional outcome according to the iADL (p=0.004).

Tan et al. (2015) Singapore Case Series TPS=NA NStart=40,623 NEnd=40,623

Population: Mean age=NA; Gender: Males=15092, Females=18804.

Intervention: Patients ≥15yr with a stroke from 2006 to 2012 were included.

Outcomes: Stroke incidence rate; 28d case fatality rate.

1. The annual percentage change in the 28d case fatality rate over the study period was -2.45 for participants <50yr, -3.66 for 50-64yr and -2.84 for ≥65yr.
2. The annual percentage change in the 28d case fatality rate over the study period was more negative in females compared to males (-4.11 vs. -1.91).

Vangen-Lønne et al. (2015) Norway Case Series TPS=NA NStart=36,575 NEnd=36,575

Population: Mean age=NA; Gender: Males=NA, Females=NA.

Intervention: Individuals ≥30yr without a previous ischemic or unclassifiable stroke were included.

Outcomes: Stroke incidence rate; 30d case fatality rate.

1. The 30d case fatality rate for ischemic strokes was 8% in participants 30-84yr and 23% in participants ≥85yr.
2. The 30d case fatality rate for unclassifiable strokes was 30% in participants 30-84yr and 63% in participants ≥85yr.
3. The 30d case fatality rate for ischemic...
21. Rehabilitation

Table 21.5.1 Studies Evaluating the Rehabilitation of Younger Individuals Post Stroke

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Country</th>
<th>Study Design</th>
<th>Time Post Stroke</th>
<th>Sample Size</th>
<th>Methods</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kappelle et al. (1994)</td>
<td>Sweden</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=212</td>
<td>Patients (aged 15-45 years) with ischemic stroke received quality of life scores obtained after a mean follow-up of 6 years.</td>
<td>Physical therapy was given to 40% of the patients and 94% indicated that the treatment was useful. Ninety-two percent of patients who judged speech therapy and 89% of patients who judged occupational therapy reported the treatments as beneficial. The subtype of stroke had no influence of patients’ opinion in regards</td>
</tr>
</tbody>
</table>
### Kersten et al. (2002)
**UK**
**Observational**
**TPS=NA**
**N=313**

Southampton Needs Assessment Questionnaires were distributed to people with stroke for two age groups (18-45 years; 46-65 years) suffering from chronic stroke. Patients reported services they received 12-months prior to the survey.

38% (119) saw physiotherapists, 23% (74) were treated by a nurse, 19% (60) saw an occupational therapist, 18% (58) saw a dietician, 15% (47) saw a speech-language therapist and 15% (47) saw a social worker.

### Low et al. (2003)
**UK**
**Observational**
**TPS=NA**
**N=135**

Southampton Needs Assessment Questionnaires were distributed to young stroke patients.

Unmet needs included intellectual fulfillment for 44 (34%) of patients, physiotherapy for 43 (33%), and help with activities of non-care in 43 (33%).

### Röding et al. (2003)
**Sweden**
**Observational**
**TPS=NA**
**N=5**

Qualitative interview of 2 women and 3 men from age 37 to 54 years who suffered from stroke.

Fatigue interfered with the ability to participate in daily activities. Informants reported a lack of participation during their hospital stay and rehabilitation program. They felt as though they were walking alongside the process. The patients wanted more information regarding the goal of rehabilitation. They also found that rehabilitation was focused on older patients. They expressed a desire to have age-adapted rehabilitation programs.

### Hama et al. (2007)
**Japan**
**Observational**
**TPS=NA**
**N=452**

Patients were examined for effect of sitting balance on activities of daily living (ADL). Sample was divided to compare young patients (<65) with older patients (≥65). Depression relating to sitting balance was also evaluated.

Young patients made up 39.6% of the sample. 24.5% of those needing assistance maintaining a 10-minute sitting position were young. 81.6% of those young patients needing assistance had improved at discharge, compared to only 56.4% of elderly patients who improved. Older patients generally were associated with higher incidence of physical impairment and functional disability, poorer outcomes, more occurrences of depression, and longer hospitalization.

### Muller et al. (2014)
**USA**
**Pre-Post**
**TPS>1.4yr**
**NStart=13**
**NEnd=13**

**Population:** Mean age=45.8yr; Gender: Males=10, Females=3.

**Intervention:** Patients 18-65yr attended the young empowerment stroke support program for a mean of 7 times over 18wk. Meetings were for 90min each and provided support and education on topics including driving and communication strategies post-stroke.

**Outcomes:** Employment status; Community Integration Questionnaire (CIQ): Home integration, Social integration, Productivity integration; Stroke Impact Scale (SIS): Handicap, Emotion, Communication, Memory, Impaired activities of daily living (ADL), Mobility, Hand

1. 12 participants reported working pre-stroke, 1 participant reported being retired, and only 1 participant returned to work post-stroke.
2. SIS Handicap domain increased significantly post-intervention (ΔM=12.3) (p=0.034).
3. CIQ Home integration score increased significantly post-intervention (ΔM=3.35) (p=0.028).
4. CIQ total score increased significantly post-intervention (ΔM=1.74) (p=0.002).
5. No other significant changes were observed in domains of the SIS and CIQ.
6. Positive changes on the SIS were observed
function, Strength, Self-perceived recovery. in 9 participants on the Handicap domain, 8 on the ADL domain, 7 on Communication, 7 on Self-perceived recovery, 6 for Strength, and 5 for Emotion; clinically important differences were observed in 2 participants on the ADL domain, in 6 on Self-perceived recovery, and in 4 on Strength.

7. Positive changes on the CIQ were observed in 10 participants on CIQ total score, 12 on Home integration, 7 on Social integration, and 4 on Productivity integration; no participants demonstrated clinically important differences on the CIQ.

### 21.6 Family Stress

#### Table 21.6 Studies Evaluating Family Stress for Younger Individuals Post Stroke

<table>
<thead>
<tr>
<th>Author, Year Country Study Design Time Post Stroke Sample Size</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hindfelt &amp; Nilsson</strong> (1977) Sweden Case Series TPS=NA N=60</td>
<td>Patients (age 16-40 years, mean age at stroke onset 30.85 years) who suffered an acute ischemic stroke were included. Patients were followed an average of 51 months.</td>
<td>Of the 44 young stroke patients who returned to work, none required assistance from another person and there was limited need for special devices to help with everyday living. No social complications existed amongst family relations and only one patient experienced divorce as a consequence of the stroke.</td>
</tr>
<tr>
<td><strong>MacKay &amp; Nias</strong> (1979) UK Case Series TPS=NA N=90</td>
<td>Patients under the age of 65 years included.</td>
<td>28 of the 90 patients returned home to be cared for by their relatives. Of the 28 relatives (19 wives, 3 husbands, 4 daughters, 1 sister, 1 brother) 8 had to abandon their jobs to care for the patient, 2 had to work reduced hours and 2 others were unable to work normal hours; the remaining 16 relatives were not working previously. 25 of the 28 relatives had to spend most or all of their time at home. 2 had to move into alternative housing to accommodate the patient. 12 abandoned their usual summer holiday. 8 of the relatives were reported to be feeling emotionally depressed.</td>
</tr>
<tr>
<td><strong>Coughlan &amp; Humphreys</strong> (1982) UK Observational TPS=3-8yr N=170</td>
<td>Spouses of patients completed postal questionnaires. All patients were under the age of 65 at the time of their stroke.</td>
<td>Before stroke, 29 wives of the stroke patients were working full-time, 37 were working part-time, and 37 were housewives. At follow-up 12 wives were working full-time and 31 were working part-time. 18 wives stopped working after their husbands’ stroke. Before the stroke, all but 5 husbands (7%) of the stroke patients were working full-time. Following stroke 44...</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Study Design</td>
</tr>
<tr>
<td>-----------------------</td>
<td>---------</td>
<td>--------------</td>
</tr>
<tr>
<td>Hindfelt &amp; Nilsson</td>
<td>Sweden</td>
<td>Observational</td>
</tr>
<tr>
<td>Teassell et al.</td>
<td>Canada</td>
<td>Observational</td>
</tr>
<tr>
<td>Lackey &amp; Gates</td>
<td>USA</td>
<td>Case Series</td>
</tr>
<tr>
<td>Kersten et al.</td>
<td>UK</td>
<td>Observational</td>
</tr>
<tr>
<td>Leys et al.</td>
<td>France</td>
<td>Observational</td>
</tr>
<tr>
<td>Röding et al.</td>
<td>Sweden</td>
<td>Observational</td>
</tr>
</tbody>
</table>
In rehabilitation were most important. There is a need for specific gender modified rehabilitation.

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Study Design</th>
<th>TPS</th>
<th>Participants</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rodriguez et al. (2004)</td>
<td>Spain</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=111</td>
<td>Patients (15-55 years) discharged from a hospital with a cerebrovascular diagnosis included. Of the 111 patients, 22.5% had to deal with loss of friends after stroke, and most of these patients had significantly poorer functional recovery. A total of 57% were unable to stay involved in previous recreational activities. In most cases, marital status stayed the same.</td>
</tr>
<tr>
<td>Visser-Meily et al. (2005a)</td>
<td>Netherlands</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=77</td>
<td>Patients 18 years and younger were admitted to an inpatient rehabilitation unit. The amount of support provided by rehabilitation teams for children whose parent(s) had experienced a stroke was investigated. Children with parents who had suffered a more severe stroke received the most support, but health and behavioral problems that presented in a child were disregarded. 54% of the children showed clinical or subclinical problems. This was in response to the strain put on the spouse of their parent with stroke, as determined 2 months after discharge. Support is needed for children based on the experience the children have with stroke patient.</td>
</tr>
<tr>
<td>Visser-Meily et al. (2005b)</td>
<td>Netherlands</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=82</td>
<td>Patients (4-18 years of age) and their parents were interviewed to determine change in mood, behaviour problems, and health status over a 1 year period. Children’s outcome after 1 year could be predicted by their functioning at the start of the rehabilitation process. Spousal depression and marital relationships were also related to their pre-rehabilitation states. Depression in parents was an important factor in children’s adjustment to life with a post-stroke parent. The severity of stroke appeared to have minor importance on final health outcomes in children and spouse.</td>
</tr>
<tr>
<td>Cameron et al. (2011)</td>
<td>Canada</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=399</td>
<td>Patients who have survived their first stroke and their caregivers were included. Patients completed standardized measures by telephone interviews at 1, 3, 6, and 12 months post-stroke. A subsample completed additional assessments 18 and 24 months post-stroke. Overall, caregivers reported more emotional distress when caring for SSs exhibiting more depressive symptoms and more cognitive impairment and when caregivers were younger, female, in poorer physical health, experienced more lifestyle interference, and reported less mastery. SSs’ physical disability, stroke severity, and comorbidity were not significant. The set of significant predictors remained consistent when examined in the subsample followed for 2 years (except SS cognitive impairment).</td>
</tr>
<tr>
<td>Martinsen et al. (2012)</td>
<td>Norway</td>
<td>Observational</td>
<td>TPS=6mo-9yr</td>
<td>N=22</td>
<td>Patients were divided into three social groups: (1) young non-established participants, (2) participants living together/caring for children, with or without a partner, and (3) participants without children at home, with or without a partner. SS completed an in-depth interview focusing on the experiences of living a life after stroke and interpreted using a three-step hermeneutic phenomenological analysis. The challenges the SS experienced could be summarized in two main themes: (1) struggling to re-enter the family and (2) screaming for acceptance.</td>
</tr>
<tr>
<td>Jones &amp; Morris (2013)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Patients with parents as their caregiver. A high degree of concordance was found</td>
</tr>
</tbody>
</table>
between the SS and caregiver responses, which were grouped into four broad superordinate themes, (1) emotional turmoil, (2) significance of parents, (2) negotiating independence versus dependence, and (4) changed relationships.

| Lawrence & Kinn (2013) | UK Observational TPS=3mo-2yr N_Start=11 N_End=11 | Population: Mean age=41.3yr; Gender: Males=6, Females=5. | 1. Family members reported fearing a recurrent stroke in the young adult on a daily basis.  
2. Family members described their experience as hard due to their relationship with the young adult being altered in addition to having to manage new physical and emotional demands.  
3. Family members reported that the young adult’s tiredness negatively affected their daily activities including family activities.  
4. Family members reported frustration felt by both the young adult and themselves.  
5. Family members reported a sense of dislocation and disorientation following stroke and attempted to make adjustments in order to return to normality. |

| Quinn et al. (2014) | UK Case Series TPS_{mean}=4.6±2.8yr N_Start=8 N_End=8 | Population: Mean age=51±8.75yr; Gender: Males=7, Females=1. | 1. When couples attempted to make sense of the stroke both during the early stage of diagnosis and after on during the course of recovery, a sense of disbelief was often compounded by the misconception that strokes could only happen either to older people or those engaged in negative health-related behaviors.  
2. Although some partners had an initial reluctance to accept themselves as carers, they appeared to have moved on from this. However, some patients were still reluctant to accept that they were no longer their pre-stroke selves who did not have to be cared for.  
3. Relationships changed from ones with equal and romantic engagements to those which echoed elements of a parent-child relationship. This new dynamic was often motivated by the healthy partner’s inclination to protect but often led to stroke survivors feeling treated like a little child and infantilised. |

### 21.7 Institutionalization

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
</table>
| Quinn et al. (2014) | UK Case Series TPS_{mean}=4.6±2.8yr N_Start=8 N_End=8 | Population: Mean age=51±8.75yr; Gender: Males=7, Females=1. | 1. When couples attempted to make sense of the stroke both during the early stage of diagnosis and after on during the course of recovery, a sense of disbelief was often compounded by the misconception that strokes could only happen either to older people or those engaged in negative health-related behaviors.  
2. Although some partners had an initial reluctance to accept themselves as carers, they appeared to have moved on from this. However, some patients were still reluctant to accept that they were no longer their pre-stroke selves who did not have to be cared for.  
3. Relationships changed from ones with equal and romantic engagements to those which echoed elements of a parent-child relationship. This new dynamic was often motivated by the healthy partner’s inclination to protect but often led to stroke survivors feeling treated like a little child and infantilised. |
<table>
<thead>
<tr>
<th>Country</th>
<th>Study Design</th>
<th>Time Post Stroke</th>
<th>Sample Size</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>MacKay &amp; Nias (1979) UK Case Series</td>
<td>90 stroke patients under the age of 65 were included.</td>
<td>At six months 27 of 90 patients had died. Of the 63 survivors, only 2 had to be institutionalized. Twenty-eight returned home to be cared for by their relatives.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hindfelt &amp; Nilsson (1992) Sweden Observational</td>
<td>Patient (age 16-40 years, mean age at stroke onset was 29.5 years) suffered a chronic ischemic stroke. Patients were followed for 13-26 years.</td>
<td>Most of these patients had minor needs. Only one of them was institutionalized.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adunsky et al. (1992) Israel Observational</td>
<td>Patients 18 to 40 years old admitted to an Israeli rehabilitation facility were included.</td>
<td>All patients went home, although their average length of stay was very long (87 ± 17 days). These patients achieved relatively high levels of functional independence at discharge when compared to elderly stroke patients. The former was attributed to the relative absence of previous and coexisting medical problems and &quot;organic intellectual impairment.&quot;</td>
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<tr>
<td>Lindberg et al. (1992) USA Observational</td>
<td>Patients with subarachnoid hemorrhage were included.</td>
<td>10 (3%) were institutionalized to a long-term care facility. Of these 10 patients, all had motor impairment and all were dependent for personal ADLs. Aphasia was present in 7 of the 10 patients institutionalized. Ninety-four percent (296) of patients were not institutionalized.</td>
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<tr>
<td>Falconer et al. (1994) USA Observational</td>
<td>Patients admitted to inpatient stroke rehabilitation with a length of stay more than 7 days were included. Patients were categorized into 3 groups: 1) &lt;65 years old (n=100), 2) 65-74 years old (n=75) or 3) ≥75 years old (n=85).</td>
<td>Older patients had significantly earlier admission times and poorer motor function compared to the younger stroke patient groups. At discharge older stroke patients continued to have poorer motor function and were institutionalized more often than the younger stroke patient groups.</td>
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<tr>
<td>Teasell et al. (2000) Canada Observational</td>
<td>Patients younger than 30 and admitted to rehabilitation in a Canadian tertiary-care hospital were included.</td>
<td>Institutionalization following formal rehabilitation occurred in 4 (5%) of 83 patients less than 50 years of age. The common feature to each of these four cases was a severe disabling stroke(s) occurring in association with poor social supports.</td>
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<tr>
<td>Schnitzler et al. (2014) France Observational</td>
<td>Population: Mean age=NA; Gender: Males=15092, Females=18804. Intervention: A survey was administered to participants with and without stroke in 2007. Outcomes: Stroke incidence rate; Institutionalization; Modified Rankin Scale (mRS).</td>
<td>1. The percentage of institutionalized participants with stroke was 2.0% for the 18-59yr group and 3.7% for 60-74yr. 2. mRS scores showed favourable functional outcomes (mRS&lt;2) in 60.3% of stroke participants 18-59yr and in 67.8% of stroke participants 60-74yr. 3. mRS scores of institutionalized participants showed favourable outcomes (mRS&lt;2) in 10.0% of stroke participants 18-59yr and in</td>
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</table>
3.1% of stroke participants 60-74yr.  

4. mRS scores of home living participants showed favourable outcomes (mRS<2) in 61.3% of stroke participants 18-59yr and in 70.3% of stroke participants 60-74yr.

21.7 Return to Work

Table 21.8.1 Studies Evaluating Return to Work for Younger Individuals Post Stroke

<table>
<thead>
<tr>
<th>Author, Year Country Study Design Time Post Stroke Sample Size</th>
<th>Methods</th>
<th>Outcomes</th>
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</thead>
<tbody>
<tr>
<td>Isaac et al. (1976) UK Case Series TPS=NA N=29</td>
<td>Patients admitted to a stroke rehabilitation ward were followed at home for a period of 3 years, or until death.</td>
<td>Of the 18 patients that survived the 3-year study most of them were younger stroke patients. Eleven patients had full time employment and 8 had full household duties prior to the stroke. Following discharge, no patients returned to any form of employment while 1 returned to full and 2 to partial household duties.</td>
</tr>
<tr>
<td>Hindfelt &amp; Nilsson (1977) Sweden Case Series TPS=NA N=60</td>
<td>Patients (age 16-40 years, mean age at stroke onset 30.85 years) who suffered an acute ischemic stroke were included. Patients were followed an average of 51 months.</td>
<td>Over a period of 5-months 35 of the 52 surviving patients were able to return to work. Nine young stroke patients found part-time employment, 5 of these patients received training to overcome their handicaps at work. Only 8 patients were unable to return to work.</td>
</tr>
<tr>
<td>MacKay &amp; Nias (1979) UK Case Series TPS=NA N=90</td>
<td>Patients under the age of 65 years included.</td>
<td>45 of the 90 patients were working at the time of their stroke. However, only 17 had returned to work within 6 months post-stroke and of these there was a mean loss of 111 working days per patient. At 6 months, 27 of the patients had died.</td>
</tr>
<tr>
<td>Coughlan &amp; Humphreys (1982) UK Observational TPS=3-8yr N=170</td>
<td>Spouses of patients completed postal questionnaires. All patients were under the age of 65 at the time of their stroke.</td>
<td>Of those men still under 65 years of age at follow-up, only 30% (21) returned to paid employment, and 11 of these patients had reduced their number of hours worked or had changed the nature of their work. Of those 42 women under 60 years of age at the time of follow-up, only 17% were in paid employment. Patients without hemiplegia were employed significantly more often (11 of 18, 61%) than those with left hemiplegia (9 of 32, 28%) or right hemiplegia (2 of 37, 5%).</td>
</tr>
<tr>
<td>Sjogren (1982) Sweden Observational TPS=NA N=51</td>
<td>Patients with hemiplegia younger than 65 years of age were consecutively admitted to the department of physical medicine and rehabilitation.</td>
<td>47 of the 51 stroke patients were occupationally active until the day of their stroke. However, following stroke only 17% of patients had returned to gainful employment and all of these had only “part-time” work. Approximately 75% of all patients’ frequency of leisure time was</td>
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<tr>
<td>Study (Year)</td>
<td>Country</td>
<td>Study Type</td>
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<tr>
<td>Bogousslavsky &amp; Regli (1987)</td>
<td>Switzerland</td>
<td>Observational</td>
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<tr>
<td>Black-Schaffer &amp; Osberg (1990)</td>
<td>USA</td>
<td>Observational</td>
</tr>
<tr>
<td>Hindfelt &amp; Nilsson (1992)</td>
<td>Sweden</td>
<td>Observational</td>
</tr>
<tr>
<td>Lindberg et al. (1992)</td>
<td>USA</td>
<td>Observational</td>
</tr>
<tr>
<td>Saeki et al. (1993)</td>
<td>Japan</td>
<td>Observational</td>
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</table>
blue-collar workers were 3 times less likely to return to work compared to white-collar.

<table>
<thead>
<tr>
<th>Study</th>
<th>Country/Region</th>
<th>Study Design</th>
<th>TPS</th>
<th>N</th>
<th>Study Description</th>
<th>Results/Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferro &amp; Crespo (1994)</td>
<td>Portugal</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=215</td>
<td>Patients under the age of 45 years to describe their functional and vocational positions after a long-term follow up, a mean of 43.1 months.</td>
<td>73% of the survivors had returned to work (including all housewives, students, and full or part-time workers) and 18% retired. Therefore, most of the patients returned to an active working life. Patients who drank alcohol (more than 60 g/d), who were disabled at follow-up, who had a major stroke or who were male were significantly more likely to retire.</td>
</tr>
<tr>
<td>Kappelle et al. (1994)</td>
<td>Sweden</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=296</td>
<td>Patients with ischemic stroke between the ages of 15 to 45 years who had been referred to a tertiary medical center.</td>
<td>42% of patients had a job and of these 23% required an occupational adjustment. Sixty-one percent of the unemployed patients were unable to return to work due to a disability.</td>
</tr>
<tr>
<td>Saeki et al. (1995)</td>
<td>Japan</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>N=183</td>
<td>Patients younger than 65 years who experienced first-ever stroke and were working at the time of the stroke. The longitudinal trends of patients returning to work after stroke as well as predictors for return to work were evaluated.</td>
<td>It was found that the curve of proportion of return to work was nonlinear. Two steep slopes emerged, one during the first six months and the other from 12 to 18 months. It was also found that patients were more likely to return to work if they had less impaired muscle strength, no apraxia, and if they worked at a white collar job.</td>
</tr>
<tr>
<td>Malm et al. (1998)</td>
<td>Sweden</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=24</td>
<td>Patients (12 women and 12 men) between the ages of 18 and 44 years with a brainstem or cerebellar infarction included. Follow-up was completed at 4 and 12 months.</td>
<td>Outcomes were favorable for 22 (92%) of the patients at 4 and 12 months follow-up as seen from the Modified Rankin Scale. At 4 months post-stroke 12 (52%) patients were on sick leave regardless of residual functional deficits. By 12 months follow-up the corresponding figure moved to 10 (43%) patients. One year following stroke 57% of patients were working full-time. Headache, tiredness, anxiety, irritation and memory problems prevented the remaining patients from returning to previous employment in spite of adjustments made to their previous job credited. These symptoms were aggravated by functional or cognitive activities and were often ignored by medical doctors and therapists.</td>
</tr>
<tr>
<td>Neau et al. (1998)</td>
<td>France</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=71</td>
<td>Young adults aged 15 to 45 years old with cerebral infarction. Follow-up was done by interview and with neurological examination for 65 of the patients a mean of 31.7 months post-stroke.</td>
<td>46 (73%) patients returned to previous employment, however, 12 (26.1%) required occupational adjustments.</td>
</tr>
<tr>
<td>Marini et al. (1999)</td>
<td>Italy</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=333</td>
<td>Patients with first-ever transient ischemic attack or ischemic stroke aged 15 to 44 years were followed up.</td>
<td>At follow-up, 169 (55.6%) returned to previous employment, and 86 (28.3%) remained unemployed in spite of recovery.</td>
</tr>
</tbody>
</table>

21. Rehabilitation of Younger Patients Post Stroke  

[www.ebrsr.com](http://www.ebrsr.com)
<table>
<thead>
<tr>
<th>Study (Year)</th>
<th>Country</th>
<th>Study Type</th>
<th>TPS</th>
<th>N</th>
<th>Sample Description</th>
<th>Findings</th>
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<tbody>
<tr>
<td>Teasell et al. (2000)</td>
<td>Canada</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>83</td>
<td>Patients younger than 30 admitted to Canadian tertiary-care hospital rehabilitation.</td>
<td>64 (77%) of the patients had a previous job or were a student before the onset of stroke. 3 months following discharge 13 (20%) of them went back to being a student or returned to work. Only 2 of the 7 students returned to school, and 1 started working part-time. Only 5 of the 53 patients who were working full-time prior to stroke returned to full-time work.</td>
</tr>
<tr>
<td>Kersten et al. (2002)</td>
<td>UK</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>315</td>
<td>Southampton Needs Assessment Questionnaires were distributed to two age groups (18-45 years; 46-65 years) after chronic stroke.</td>
<td>315 returned the questionnaire, of which 65% had to give up their prior job and 14% required an adjustment in the number of hours they worked. Patients unable to return to work had significantly more unmet needs than patients with reduced hours, and those patients had significantly more unmet needs than patients who returned to their previous employment with unchanged working hours.</td>
</tr>
<tr>
<td>Leys et al. (2002)</td>
<td>France</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>287</td>
<td>Patients with ischemic stroke aged 15 to 45 years old were included.</td>
<td>After 3 years, 12 (4.2%) lost their job regardless of the fact that their mRS score was ≤1.22. Almost 8% of patients died at follow-up, and of those 265 surviving patient 8 (3%) did not return to work because of personal reasons. 142 (49.5%) returned to their previous job, with 10 of them needing work adjustments. Thirty (10.5%) of the patients obtained a new job, social insurance deemed 43 (15%) unable to return to work due to medical conditions, 42 patients were unable to find employment and 12 patients lost their job post-stroke.</td>
</tr>
<tr>
<td>Musolino et al. (2003)</td>
<td>Italy</td>
<td>Observational</td>
<td>TPS=24hr</td>
<td>60</td>
<td>Patients (ages 17 to 45 years old) with either ischemic stroke (n=55) or TIA (n=5) at admission to the hospital were included. A follow-up was done a year after discharge from the hospital.</td>
<td>37 (68.5%) patients had returned to work, however adjustments to amount of time worked and type of job were necessary for 10 (27%) of the patients.</td>
</tr>
<tr>
<td>Vestling et al. (2003)</td>
<td>Sweden</td>
<td>Case Series</td>
<td>TPSmean=2.7yr</td>
<td>12</td>
<td>Data was collected regarding return to work for patients 60 years or younger following a stroke. Medical records and postal questionnaires were used for data collection.</td>
<td>41% of patients returned to work following stroke, a greater proportion of that number being males. Sixty-one percent of those who returned to work had decreased their hours. Those who returned to work reported being more satisfied with life.</td>
</tr>
<tr>
<td>Röding et al. (2003)</td>
<td>Sweden</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>5</td>
<td>Qualitative interview for 2 women and 3 men from 37 to 54 years old who suffered from stroke.</td>
<td>Participants felt that the most difficult stroke deficit they had to endure was fatigue. It was overwhelming and they felt they had no control over their fatigue; rather it affected their entire being. Fatigue hindered these individuals return to full-time employment and had a negative effect on family and social situations. Women felt it was difficult to keep up with housework with cognitive deficits. The consequences of...</td>
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<tr>
<td>Study</td>
<td>Country</td>
<td>Design</td>
<td>TPS</td>
<td>N</td>
<td>Description</td>
<td>Findings</td>
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<tr>
<td><strong>Rodríguez et al. (2004)</strong></td>
<td>Spain</td>
<td>Observational</td>
<td>NA</td>
<td>111</td>
<td>Patients (15-55 years) discharged from a Hospital with a cerebrovascular diagnosis included.</td>
<td>Nearly 80% of all patients were employed prior to stroke, but only 50.2% returned to work post-stroke. Patients who had no vascular risk factors and those that suffered from an ischemic stroke had a better functional recovery and were more likely to return to work. Statistical significance was seen with the Barthel Index and Modified Rankin Scale scores for patients that returned to work in comparison with patients who did not.</td>
</tr>
<tr>
<td><strong>Varona et al. (2004)</strong></td>
<td>Spain</td>
<td>Case Series</td>
<td>NA</td>
<td>272</td>
<td>Patients with ischemic stroke were reviewed over 27 years to identify potential predictors of mortality, reoccurrence of stroke and poor functional recovery.</td>
<td>128 (53%) were able to return to work. Occupational adjustments (hours worked or another job) were necessary for 23% of those who returned to work. Eighty-four patients (35%) received a permanent retirement pensions because they were medically incapable of working despite the fact that only 77% of patients were not performing work activities following stroke. The 28 (12%) patients did not work pre-stroke and therefore were ineligible for a pension.</td>
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<tr>
<td><strong>Hofgren et al. (2007)</strong></td>
<td>Sweden</td>
<td>Observational</td>
<td>NA</td>
<td>58</td>
<td>Information about vocational status before and after first ever stroke of patients below the age of 65 was gathered.</td>
<td>Fifty-five patients were recorded as working prior to their stroke. One year following rehabilitation, 7% of these patients had returned to work. Three years following rehabilitation, 20% of patients were working. Patients with aphasia had a much lower rate of return to work.</td>
</tr>
<tr>
<td><strong>Glozier et al. (2008)</strong></td>
<td>New Zealand</td>
<td>Observational</td>
<td>NA</td>
<td>210</td>
<td>Patients (mean age 55) were interviewed regarding previous paid employment, income, psychiatric history, hospitalization, medical history, and severity of disability at 6 months follow-up. Part of ARCOS community stroke study.</td>
<td>Non-white ethnicity, part-time employment prior to stroke, increased stroke severity, psychiatric morbidity were all independently associated with a lower likelihood of returning to work post stroke. Patients who completed a general health questionnaire were associated with shorter hospitalization, less inpatient rehabilitation, and more likely to be discharged home.</td>
</tr>
<tr>
<td><strong>Gabriele &amp; Renate (2009)</strong></td>
<td>Germany</td>
<td>Observational</td>
<td>NA</td>
<td>70</td>
<td>Patients younger than 65 that were employed prior to their stroke were examined regarding their employment. Patients were examined a year following the first interview.</td>
<td>26.7% of the patients had returned to work. The patient’s perceived functional ability was found to be the best predictor of return to work. Females and patients with higher income jobs were more likely to return to work. In addition, admission Barthel indices were higher for those who returned to work than those who did not. Localisation, primary education and white vs. blue-collar occupation groups were not significantly different.</td>
</tr>
<tr>
<td><strong>Lindström et al. (2009)</strong></td>
<td>Sweden</td>
<td>Observational</td>
<td>NA</td>
<td>70</td>
<td>Patients between the ages of 18-55 years who experienced first ever stroke were contacted to gain information about their life following</td>
<td>82% were working at the time of their stroke and 65% returned to work post-stroke, with no significant difference between males and</td>
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<tr>
<td>Study</td>
<td>Country/Region</td>
<td>Study Design</td>
<td>TPS</td>
<td>N</td>
<td>Details</td>
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<tr>
<td>Saeki &amp; Toyonaga (2010)</td>
<td>Japan</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=325</td>
<td>Patients 15-64 years of age after first ever stroke who had an active employment status at the time of stroke were collected. 55% of patients reported successful return to work by 18 months after stroke onset. 50% of those returned within 100 days from onset. Function of the hand and leg with hemiplegia, an ability to perform ADLs independently and gender all impacted early return to work.</td>
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<tr>
<td>Hackett et al. (2012)</td>
<td>Australia</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=271</td>
<td>Individuals post stroke (72% male; mean age 51±10 years) who were in full-time or part-time paid employment immediately before stroke. First ever stroke survivors (N=109) were matched by age, sex, and functional impairment with injured individuals (N=429). Function of the hand and leg with hemiplegia, an ability to perform ADLs independently and gender all impacted early return to work. 75% of patients returned to part-time or full-time paid work during the first year. Key variables identifying those most likely to return to work within 12 months following stroke included independent ADLs at 28 days after stroke, having health insurance, age (younger), male, and female without prior activity restricting illness.</td>
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<tr>
<td>Peters et al. (2013)</td>
<td>Nigeria</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=101</td>
<td>Community-dwelling individuals post stroke (56% male; mean age of 47.2±12.3 years) who had been in paid employment before their stroke and not suffering from any clinically diagnosed ailment that limits their ability to work. More than half (55%) of patients returned to work after the stroke event. Overall, functional status (no significant disability or mild disability) and post-stroke duration (3-12 months) were significant predictors of return to work.</td>
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<tr>
<td>McAllister et al. (2013)</td>
<td>New Zealand</td>
<td>Observational</td>
<td>TPS=NA</td>
<td>N=109</td>
<td>Comparative study between people unable to work (on no-fault Accident Compensation Corporation) due to stroke versus another illness. The odds of returning to work were significantly lower for participants in the stroke group compared to the injury group. The odds were still reduced when taking into account possible confounding factor (e.g., cognitive impairment) and ‘Low’ or ‘High’ personal income at baseline.</td>
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<tr>
<td>Kaurenanen et al. (2013)</td>
<td>Finland</td>
<td>Case Series</td>
<td>TPS=NA</td>
<td>NStart= 140 NEnd=140</td>
<td>Population: Mean age=52yr±10.5yr; Gender: Males=83, Females=57. Intervention: Patients 18-65yr with a first-ever ischemic stroke who were working full-time prior to the stroke were included. Outcomes: Return to work; Cognitive deficits: Executive function, Psychomotor speed, Episodic memory, Working memory, Language, Visual spatial and constructional skills, Motor skills; Glasgow Coma Scale (GCS); National Institute Health Stroke Scale (NIHSS). 1. Cognitive deficits (≥1) were prevalent in 53.6% of the population at the initial assessment and in 42.1% at the 6mo follow-up; the prevalence of cognitive deficits was significantly different between the initial and follow-up assessment (p&lt;0.001). 2. At 6mo post-stroke, 41.4% of participants had succeeded in returning to work, 6.4% were on sick leave and 2.9% were on a disability pension. 3. The main cause of sick leave and disability pension was stroke. 4. Significant associations were observed between the inability to return to work at 6mo and age (p&lt;0.01), education (p&lt;0.05),</td>
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NIHSS at admission (p=0.000), NIHSS at discharge (p=0.000), GCS at admission (p=0.003), GCS at discharge (p=0.006), all cognitive deficits at the initial assessment (p=0.000 for all except for working memory: p=0.002), and all cognitive deficits at follow-up (p<0.016) except for deficits in Visual spatial and constructional skills (p=0.413).

5. Multivariable associations showed that after adjusting for all other variables, only the number of initial cognitive deficits (p<0.01) was a statistically significant independent predictor of the inability to return to work. Compared to a participant with no initial cognitive deficit, a participant with cognitive deficit had twice the likelihood of being unable to return to work.

### Maaijwee et al. (2014)
Netherlands Case Series
TPS>8.1yr
N<sub>Start</sub>=694
N<sub>End</sub>=694

**Population:** Mean age=NA; Gender: Males=296, Females=398.
**Intervention:** Patients 18-50yr with a first ever stroke from 1980 to 2010 were included. A follow-up assessment was conducted at a mean of 8yr.
**Outcomes:** Unemployment rate.

1. Unemployment post-stroke was reported by 202 (29.1%) participants in 2010.
2. Full and partial unemployment in women 35-44yr was significantly more prevalent compared to the general population (26.8% vs. 7.3%) (p<0.0001).
3. Full and partial unemployment in women 45-54yr was significantly more prevalent compared to the general population (25.9% vs. 11.9%) (p<0.0001).
4. Full and partial unemployment in men 35-44yr was significantly more prevalent compared to the general population (32.9% vs. 5.0%) (p<0.0001).
5. Full and partial unemployment in men 45-54yr was significantly more prevalent compared to the general population (26.6% vs. 9.4%) (p<0.0001).

### de Bruijn et al. (2015)
Netherlands Case Series
TPS>4.9yr
N<sub>Start</sub>=170
N<sub>End</sub>=170

**Population:** Mean age=41.4yr; Gender: Males=75, Females=95.
**Intervention:** Patients with a first ever ischemic stroke from 2000 to 2010 were included. Patients were also compared to healthy controls (n=61).
**Outcomes:** Employment rate; Modified Rankin Scale (mRS); Hospital Anxiety and Depression Scale (HADS): Depression, Anxiety; Stroke etiology; World Health Organization Quality of Life Scale (WHOQOL): Physical health, Psychological functioning, Social relationships, Environment, General QoL; Fatigue Assessment Scale (FAS).

1. Poor functional outcomes (mRS>2) were observed in 10.6% of participants.
2. The current employment rate was significantly greater in healthy controls compared to post-stroke participants (stroke=63.5%, no stroke=95.1%; p<0.001).
3. Anxiety was prevalent in 53 (31.9%) patients.
4. Depression was prevalent in 61 (37.2%) patients.
5. Unemployment at follow-up was significantly correlated with the Physical health domain of the WHOQOL (p=0.01), fatigue (p<0.001), a higher mRS score (p<0.001), and presence of depression.
## 21.9 Ongoing Care

### Table 21.9.1 Studies Evaluating Ongoing Care of Younger Individuals Post Stroke

<table>
<thead>
<tr>
<th>Author, Year Country Study Design Time Post Stroke Sample Size</th>
<th>Methods</th>
<th>Outcomes</th>
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<tbody>
<tr>
<td>Hartke &amp; Brashler (1994) USA Observational TPS=4yr N=100</td>
<td>Patients were on average 44 years (range 21-57) of age.</td>
<td>The majority (78%) of the survivors lived with another person, usually a spouse or other family member, while 22% lived alone. Eighty-nine percent reported a substantial level of ambulation while 71% were independent in self-care. Seventy-four percent reported making daily trips into the community while 27% were driving a car. Twenty-seven percent indicated they were engaged in some form of school attendance, employment, or job training.</td>
</tr>
<tr>
<td>Röding et al. (2003) Sweden Observational TPS=NA N=5</td>
<td>Qualitative interviews from 2 women and 3 men, ages 37-54, who suffered from a stroke.</td>
<td>Fatigue interfered with the ability to participate in daily activities. Informants reported a lack of participation during their hospital stay and rehabilitation program. They felt as though they were walking alongside the process. The patients wanted more information regarding what rehabilitation was supposed to accomplish. They also found that rehabilitation was focused on older patients. They expressed a desire to have age-adapted rehabilitation programs.</td>
</tr>
<tr>
<td>Stone (2005) Canada Observational N=22</td>
<td>Female patients with hemorrhagic stroke, aged 19-57, were interviewed. Content was analyzed for common issues and themes.</td>
<td>Stroke events ranged from 3-30 years ago. Concerns were expressed regarding others view of their ‘invisible disability.’ Participants found it difficult to cope with society’s view of stroke as an ailment of the elderly. They also found that physical disabilities are more quickly understood and adapted to, than post-stroke cognitive disabilities.</td>
</tr>
<tr>
<td>Naess et al. (2005b) Norway Observational TPS=6yr N=196</td>
<td>Patients (aged 15-49) were studied after their first stroke for post-stroke depression (PSD), etiology, and risk factors.</td>
<td>PSD appeared to be a milder in young stroke patients compared with older patients. Gender had no effect on PSD. Participants with a history of depression, excessive alcohol consumption, or severe neurological deficits upon hospital admission were considered at risk for developing PSD.</td>
</tr>
<tr>
<td>Naess et al. (2006) Norway Observational TPS=NA N=232</td>
<td>Patients aged 15 to 49 years with first-ever cerebral infarction and 215 control subjects were included.</td>
<td>The stroke patients had significantly lower scores on the HRQoL for physical functioning, general health and social functioning in comparison to the control subjects (P&lt;0.001). Also, stroke patient who were depressed, unemployed or...</td>
</tr>
<tr>
<td>Study</td>
<td>Country/Region</td>
<td>Design</td>
</tr>
<tr>
<td>-------------------------------</td>
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</tr>
<tr>
<td>Stone (2007)</td>
<td>Canada</td>
<td>Observational</td>
</tr>
<tr>
<td>Snögren et al. (2009)</td>
<td>Sweden</td>
<td>Observational</td>
</tr>
<tr>
<td>Bugnicourt et al. (2014)</td>
<td>France</td>
<td>Observational</td>
</tr>
<tr>
<td>Chen et al. (2014)</td>
<td></td>
<td>Population: Mean age=65.71yr; Gender:</td>
</tr>
</tbody>
</table>
Taiwan  
Case Series  
TPS=NA  
N<sub>Start</sub>=568  
N<sub>End</sub>=568

| Males=283, Females=285. | hospitalization was not significantly different between age groups (<65yr=5.5%, 65-75=9.2%, ≥75=5.2%) (p=0.214). |
| **Intervention:** Patients <65yr, 65-75yr and ≥75yr with a stroke admitted for rehabilitation between 2002 and 2012 were retrospectively reviewed. | 2. The prevalence of anxiety at the initial hospitalization was not significantly different between age groups (<65yr=1.8%, 65-75=1.5%, ≥75=5.0%) (p=0.255). |
| **Outcomes:** Stroke characteristics; Prevalence of depression and anxiety; Prevalence of risk factors. | 1. Prevalent self-reported impairments included fatigue in 67 (45%) participants, anxiety in 27 (18%), depression in 27 (18%), and pain in 28 (19%). |
| Palmcrantz et al. (2014)  
Sweden  
Observational  
TPS=NA  
N<sub>Start</sub>=150  
N<sub>End</sub>=150 |
| **Population:** Mean age=57±6yr; Gender: Males=100, Females=50. | 1. Retardation domain of HAM-D-31 was associated with poor performance on the FAS (p=0.003) |
| **Intervention:** Patients 18-64yr with a stroke from 2000 to 2006 were administered a survey in 2007. | 2. Significant associations were observed between Retardation and FAS performance (p=0.003) and between Fatigue/Interest and Stroop interference (p=0.003); no other significant associations were found between the performance on neuropsychological tests with total HAM-D-31 scores or with other HAM-D-31 domains. |
| **Outcomes:** Prevalence of risk factors; Prevalence of post-stroke impairments; Support; Anxiety or depression. | 3. Anxiety or depression was significantly more prevalent in young stroke participants compared to an aged and geographically matched healthy population (53% vs. 36%) (p=0.0156). |
| Sobreiro et al. (2014)  
Brazil  
Observational  
TPS=NA  
Mean=12±3.8d  
N<sub>Start</sub>=87  
N<sub>End</sub>=87 |
| **Population:** Mean age=50.7±14.5yr; Gender: Males=54, Females=33. | 1. Fatigue was prevalent in significantly more stroke participants compared to healthy controls (41% vs. 18.4%) (p=0.0005). |
| **Intervention:** Data from participants admitted with a first ever ischemic stroke was prospectively analyzed. | 2. Fatigue did not significantly differ with the location of the index event. |
| **Outcomes:** Hamilton Rating Scale for Depression (HAM-D-31): Retardation, Fatigue/Interest; Wechsler Digit Span Task; Wechsler Adult Intelligence Scale-Revised; Verbal Fluency Test (FAS); Victoria Stroop Test: Dots stoop (D), Color stoop (C), Stroop interference. | 3. Fatigue was associated with a poor functional outcome according to the mRS and IADL, depressive symptoms, and anxiety symptoms. |
| Maaijwee et al. (2015)  
Netherlands  
Case Series  
TPS=NA  
Mean=8.3yr  
N<sub>Start</sub>=511  
N<sub>End</sub>=511 |
| **Population:** Mean age: TIA=40.5±8.1yr, Ischemic Stroke=40.1±7.8yr; Gender: Males=198, Females=239. | 1. Recurrent stroke occurred in 5 (6%) children and 7 (5%) young adults. |
| **Intervention:** Patients 18-50yr with a first ever stroke from 1980 to 2010 were included. | 2. The proportion of favourable long term outcomes (mRS<2) were not significantly different between age groups (children=53%, young adults=55%). |
| **Outcomes:** Prevalence of fatigue; Prevalent risk factors; Instrumental Activities of Daily Living (IADL); Modified Rankin Scale (mRS). | 1. Fatigue was prevalent in significantly more stroke participants compared to healthy controls (41% vs. 18.4%) (p=0.0005). |
| Simonetti et al. (2015)  
Switzerland  
Case Series  
TPS=NA  
N<sub>Start</sub>=249  
N<sub>End</sub>=249 |
| **Population:** Mean age=NA; Gender: Males=133, Females=116. | 1. Recurrent stroke occurred in 5 (6%) children and 7 (5%) young adults. |
| **Intervention:** Patients 1mo-45yr with an ischemic stroke from 2000 to 2008 were included. Patients were divided between age groups: children 1mo-16yr (N=95) and young | 2. The proportion of favourable long term outcomes (mRS<2) were not significantly different between age groups (children=53%, young adults=55%). |

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Outcomes: Prevalent risk factors; Stroke etiology; Recurrent stroke; Modified Rankin Scale (mRS); Mortality; Psychological outcomes: Psychological and psychiatric disorders, Behavioural disturbances, Fatigue. Difficulty concentrating or memory problems; Residence; Return to work or school; Self-reported impact of stroke on life: Everyday life, Social life, Social activities.

1. CRDS were present in 202 (10.1%) participants with significantly more females having CRDS compared to males (12.6% vs. 8.2%) (p<0.001)

2. The proportion of participants with CRDS was significantly different between age groups with 1.0% being between 18-24yr, 6.9% between 25-34yr, 25.7% between 35-
| Institute of Health and Stroke Scale (NIHSS); Prevalence of common stroke risk factors. | 44yr, and 66.3% between 45-55yr (p=0.024).  
3. NIHSS scores were not significantly different between participants with and without CRDS (p=0.130).  
4. CRDS participants more often had arterial hypertension (58.0% vs. 47.1%) (p=0.017), diabetes mellitus (17.9% vs. 8.9%) (p<0.001), and dyslipidemia (40.5% vs. 32.3%) (p=0.012).  
5. Multiple logistic regression analysis of participants with TIA or ischemic stroke showed associations between CRDS and female sex (p=0.001) and CRDS and diabetes mellitus (p<0.001). |
References


Lawrence, M., & Kinn, S. (2013). Needs, priorities, and desired rehabilitation outcomes of family members of young adults who have had a stroke: findings from a phenomenological study. Disabil Rehabil, 35(7), 586-595.


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