The Rehabilitation of Younger Stroke Patients

Evidence Tables

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## 21.1 Incidence of Stroke in Young Patients

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

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<th>Methods</th>
<th>Outcomes</th>
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</thead>
<tbody>
<tr>
<td><strong>Abu-Zeid et al. (1975)</strong> Canada No Score</td>
<td>1367 stroke cases in the Manitoba area were included in this study over an 18-month period.</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. (1984)</strong> New Zealand No Score</td>
<td>All stroke patients over the age of 15 in the area of Central Auckland were included in this study.</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. (1988)</strong> Italy No Score</td>
<td>47 patients with a first-ever stroke, ages of 15 to 44 years, from Florence were followed over a 3-year period.</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. (1990)</strong> India No Score</td>
<td>Stroke patients in the rural North-west India area were included in this survey study.</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>
</tr>
<tr>
<td><strong>Mayo et al. (1991)</strong> Canada No Score</td>
<td>Stroke patients in the province of Quebec were included.</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>Author(s)</td>
<td>Year</td>
<td>Country</td>
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<tr>
<td>Kittner et al. (1993)</td>
<td>1993</td>
<td>USA</td>
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<td>Rozenthul-Sorokin et al. (1996)</td>
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<td>Israel</td>
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<td>Johansson et al. (2000)</td>
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<td>Marini et al. (2001)</td>
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<td>Jacobs et al. (2002)</td>
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<td>Di Carlo et al. (2003)</td>
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<td>Medin et al. (2004)</td>
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<td>Sweden</td>
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<td>Study</td>
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<td>Methodology</td>
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<tr>
<td>Rasura et al. (2006)</td>
<td>Italy</td>
<td>394 ischemic stroke patients aged 14-47 years were included. Incidence of cerebral ischemia and risk factors in young adults were evaluated.</td>
</tr>
<tr>
<td>Ghandehari &amp; Izadi-Mood. (2006)</td>
<td>Iran</td>
<td>124 young adult ischemic stroke patients aged 15–45 years were registered in Southern Khorasan stroke data bank over a 5-year period.</td>
</tr>
<tr>
<td>Bejot et al. (2008)</td>
<td>France</td>
<td>715 patients with lacunar strokes were examined over a period of 17 years. Participants were stratified according to age, gender, and etiology.</td>
</tr>
<tr>
<td>Cabral et al. (2009)</td>
<td>Brazil</td>
<td>All stroke cases (1323 registered; 759 were first every strokes) within one year occurring in Joinville, Brazil were prospectively ascertained.</td>
</tr>
<tr>
<td>Harmsen et al. (2009)</td>
<td>Sweden</td>
<td>Patients with first stroke were detected during the period of 1987-2006 through the National Hospital Discharge Register and the Cause of Death Register in Gothenburg, Sweden. Incidence and mortality rates were evaluated.</td>
</tr>
<tr>
<td>Lewsey et al. (2009)</td>
<td>Scotland</td>
<td>All 213,358 individuals who experienced a stroke during 1986 to 2005 in Scotland were identified and incidence rates were evaluated.</td>
</tr>
<tr>
<td>Onwuchekwa et al. (2009)</td>
<td>Nigeria</td>
<td>Stroke patients between the ages of 18-45 who were admitted to the medical wards of the University of Port Harcourt Teaching Hospital between 2003 and 2008 were identified through retrospective review of medical records.</td>
</tr>
<tr>
<td>Vega et al. (2009)</td>
<td>Spain</td>
<td>Episodes of stroke in patients 14 years and older were recorded by 3 Spanish health sentinel networks in 2005 (n=201,025).</td>
</tr>
<tr>
<td>Corso et al. (2009)</td>
<td>Italy</td>
<td>Residents from the Valley of Aosta region in Italy with stroke onset during 2004 and 2008 were included (n=1024).</td>
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<tr>
<td>Study (Year)</td>
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<td>Score</td>
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<td>Putaala et al. (2009)</td>
<td>Finland</td>
<td>No Score</td>
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<td>Sridharan et al. (2009)</td>
<td>India</td>
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<td>Manobianca et al. (2010)</td>
<td>Italy</td>
<td>No Score</td>
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<td>Zhao et al. (2010)</td>
<td>China</td>
<td>No Score</td>
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<tr>
<td>Kulesh et al. (2010)</td>
<td>Belarus</td>
<td>No Score</td>
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<tr>
<td>Kang et al. (2011)</td>
<td>South Korea</td>
<td>No Score</td>
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<tr>
<td>Bjorn-Mortensen et al. (2013)</td>
<td>Greenland</td>
<td>Retrospective</td>
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<tr>
<td>Copstein et al. (2013)</td>
<td>Brazil</td>
<td>Retrospective</td>
</tr>
</tbody>
</table>
### Outcomes

**Janes et al. (2013)**

**Population:** Mean age=NA; Gender: Males=72963, Females=80349.
**Intervention:** The incidence rate of stroke from 2007 to 2009 was determined in a population of 153312.
**Outcomes:** Stroke incidence; Case fatality rate for first ever stroke: 28d, 90d, 180d.

1. Stroke incidence per 100,000 person-years across age groups was as follows: 12 for 0-44yr, 59 for 45-54yr, 135 for 55-64yr, 368 for 65-74yr, 904 for 75-84yr, and 2041 for ≥85yr.

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**Kim et al. (2013)**

**Population:** Mean age=66.7±13.3yr; Gender: Males=51718, Females=50492.
**Intervention:** Data from health insurance claims from 2006 to 2010 was analyzed.
**Outcomes:** Stroke incidence rates: Crude, Age-standardized; Readmission rates.

1. The crude stroke incidence rate per a population of 100,000 for the 0-29yr group was significantly different from 2006-2010 (p<0.001) with a decreasing incidence rate over time (2006=5.1, 2007=4.8, 2008=4.6, 2009=4.7, 2010=4.3); the age-standardized incidence rate was not significantly different from 2006-2010 (p=0.105) (2006=5.1, 2007=4.9, 2008=4.6, 2009=4.7, 2010=4.3).
2. The crude stroke incidence rate per a population of 100,000 for the 30-44yr group was significantly different from 2006-2010 (p<0.001) with a decreasing incidence rate over time (2006=38.3, 2007=35.9, 2008=34.9, 2009=34.1, 2010=29.0); the age-standardized incidence rate was also significantly different from 2006-2010 (p<0.001) (2006=38.7, 2007=36.3, 2008=34.9, 2009=33.7, 2010=28.6).
3. The crude stroke incidence rate per a population of 100,000 for the 45-54yr group was significantly from 2006-2010 (p<0.001) with a decreasing incidence rate over time (2006=175.5, 2007=151.1, 2008=141.5, 2009=135.6, 2010=115.9); the age-standardized incidence rate was also significantly different from 2006-2010 (p<0.001) (2006=177.6, 2007=152.1, 2008=141.5, 2009=134.4, 2010=114.0).

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**Gonzalez-Perez et al. (2013)**

**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.

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.
<table>
<thead>
<tr>
<th>Study Source</th>
<th>Country</th>
<th>Study Design</th>
<th>Score</th>
<th>TPS</th>
<th>Mean</th>
<th>N Start</th>
<th>N End</th>
<th>Population</th>
<th>Intervention</th>
<th>Outcomes</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rosengren et al. (2013)</td>
<td>Sweden</td>
<td>Retrospective</td>
<td>No Score</td>
<td>TPS Mean=NA</td>
<td>N start=391,081</td>
<td>N end=391,081</td>
<td>Mean age=72.5±9.8yr; Gender: Males=208900, Females=18218.</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>Outcomes: 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>
<td>Rutten-Jacobs et al. (2013)</td>
<td>Netherlands</td>
<td>Prospective</td>
<td>No Score</td>
<td>TPS Mean=NA</td>
<td>N start=724</td>
<td>N end=724</td>
<td>Mean age=40.5±7.8yr; Gender: Males=344, Females=380.</td>
<td>Patients with a first ever stroke from 1980-2010 were assessed during follow-up assessments from 2009-2012.</td>
<td>Outcomes: 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)</td>
<td>France</td>
<td>Retrospective</td>
<td>No Score</td>
<td>TPS Mean=NA</td>
<td>N start=4506</td>
<td>N end=4506</td>
<td>Median age=42yr; Gender: Males=1908, Females=1423.</td>
<td>Patients with a stroke from 1985 to 2011 were included.</td>
<td>Outcomes: 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 significantly change between time periods. 5. The incidence rate of ischemic stroke in participants &lt;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&lt;0.001).</td>
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</tbody>
</table>
The incidence rates of hemorrhagic and undetermined stroke did not significantly change between time periods.

**Koton et al.** (2014)  
Israel  
Retrospective  
No Score  
TPSMean=NA  
NStart=14,357  
NEnd=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  
Prospective  
No Score  
TPSMean=NA  
NStart=33,896  
NEnd=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  
Retrospective  
No Score  
TPSMean=NA  
NStart=2,231,000  
NEnd=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 65-74yr, and 7.3% for ≥75yr.

**Li et al.** (2015)  
China  
Retrospective  
No Score  
TPSMean=NA  
NStart=14,538  
NEnd=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  
Retrospective  
No Score  
TPSMean=NA  
NStart=298  
NEnd=298  
**Population:** Mean age=NA; Gender: Males=184, Females=114.  
**Intervention:** The incidence rate of first ever stroke from 2010 to 2011 was determined in a population.  
**Outcomes:** Stroke incidence rates.

1. The stroke incidence rate per 100,000 person-years was 4.04 for participants 0-34yr, 4.54 for 35-44yr, and 21.95 for 55-64yr.
2. The rate of infarctions per 100,000 person-years was 1.61 for participants 0-34yr, 2.27...
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).

3. 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).

4. 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).

5. 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).

6. 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).

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Design</th>
<th>Score</th>
<th>Mean Age</th>
<th>Gender</th>
<th>Intervention</th>
<th>Outcomes</th>
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<tbody>
<tr>
<td>Tan et al. (2015)</td>
<td>Singapore</td>
<td>Retrospective</td>
<td>No Score</td>
<td>Mean age=NA; Gender: Males=15092, Females=18804.</td>
<td>Individuals ≥15yr with a stroke from 2006 to 2012 were included.</td>
<td>Stroke incidence rate; 28d case fatality rate.</td>
<td>1. The annual percentage change in the stroke incidence rate over the study period was 3.33 for participants &lt;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).</td>
</tr>
<tr>
<td>Vangen-Lønne et al. (2015)</td>
<td>Norway</td>
<td>Retrospective</td>
<td>No Score</td>
<td>Mean age=NA; Gender: Males=NA, Females=NA.</td>
<td>Individuals ≥30yr without a previous ischemic or unclassifiable stroke were included.</td>
<td>Stroke incidence rate; 30d case fatality rate.</td>
<td>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&lt;0.0001).</td>
</tr>
<tr>
<td>Wang et al. (2015)</td>
<td>Taiwan</td>
<td>Retrospective</td>
<td>No Score</td>
<td>Mean age=NA; Gender: Males=7686, Females=7144.</td>
<td>Stroke incidence was determined in a population from 1992-2012.</td>
<td>Stroke incidence rate.</td>
<td>1. The stroke incidence rate per 100,000 person-years between 1992-1998 and 2006-2012 increased 2.3 fold for the &lt;45yr group (p&lt;0.05), 2.6 fold for the 45-64yr group (p&lt;0.05), and 1.1 fold for the ≥65yr group (p&lt;0.05). 2. The age standardized incidence rate of stroke from 1992-2012 increased annually by 5.6% for participants &lt;45yr (p&lt;0.05), 10.7% for 45-64yr (p&lt;0.05), and 4.3% for ≥65yr (p&lt;0.05).</td>
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<td>No Score</td>
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<td>Individuals ≥15yr with a stroke from 2006 to 2012 were included.</td>
<td>Stroke incidence rate; 28d case fatality rate.</td>
<td>1. The annual percentage change in the stroke incidence rate over the study period was 3.33 for participants &lt;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).</td>
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<td>Mean age=NA; Gender: Males=NA, Females=NA.</td>
<td>Individuals ≥30yr without a previous ischemic or unclassifiable stroke were included.</td>
<td>Stroke incidence rate; 30d case fatality rate.</td>
<td>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&lt;0.0001).</td>
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<td>Wang et al. (2015)</td>
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<td>No Score</td>
<td>Mean age=NA; Gender: Males=7686, Females=7144.</td>
<td>Stroke incidence was determined in a population from 1992-2012.</td>
<td>Stroke incidence rate.</td>
<td>1. The stroke incidence rate per 100,000 person-years between 1992-1998 and 2006-2012 increased 2.3 fold for the &lt;45yr group (p&lt;0.05), 2.6 fold for the 45-64yr group (p&lt;0.05), and 1.1 fold for the ≥65yr group (p&lt;0.05). 2. The age standardized incidence rate of stroke from 1992-2012 increased annually by 5.6% for participants &lt;45yr (p&lt;0.05), 10.7% for 45-64yr (p&lt;0.05), and 4.3% for ≥65yr (p&lt;0.05).</td>
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</table>
### 21.2 Stroke Etiology

#### Table 21.2 Studies Evaluating Stroke Etiologies of Young Stroke Patients

<table>
<thead>
<tr>
<th>Author, Year Country PEDro Score</th>
<th>Methods</th>
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<tbody>
<tr>
<td><strong>Snyder &amp; Ramirez-Lassepas</strong> &lt;br&gt; (1980) USA No Score</td>
<td>A retrospective study of 61 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.</strong> &lt;br&gt; (1986) USA No Score</td>
<td>144 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</strong> &lt;br&gt; (1988) Portugal No Score</td>
<td>A retrospective study of 254 young stroke patients between 15 and 50 years old.</td>
<td>Eight etiological categories were identified. Stroke was the result of cerebral atherosclerosis for 89 (35.0%) patients, cardiac emboli for 78 (30.7%), intracerebral hemorrhage for 21 (8.3%), vasospasm for 14 (5.5%), hematologic diseases for 5 (2.0%), occurring during puerperium or pregnancy or during the use of oral contraceptives for 9 (3.5%), nonatherosclerotic cerebral vasculopathy for 8 (3.1%), and unknown etiology for 39 (15.4%). Most common cause of stroke for patients &lt;40 yrs old was cardiac embolism and for 41-50 yrs old was atherosclerosis.</td>
</tr>
<tr>
<td><strong>Federico et al.</strong> &lt;br&gt; (1990) Italy No Score</td>
<td>56 acute ischemic stroke patients included between the ages of 17 to 45 years old.</td>
<td>Of 56 stroke patients, etiologies or predisposing factors were as follows: 21 had juvenile atherosclerosis, 13 had cerebral embolism, 4 had secondary coagulopathies, 6 had non atherosclerotic vasculopathies, 3 had traumas of the skull and neck, 2 had migraines, 1 used oral contraceptive and 6 were unknown.</td>
</tr>
<tr>
<td><strong>Love &amp; Biller</strong> &lt;br&gt; (1990) USA No Score</td>
<td>Prospective registry of cerebral infarction in young adults in an Iowa university hospital studied 286 patients between the ages of 15-45 years.</td>
<td>Atherosclerotic etiology was implicated in 26.9%, a nonatherosclerotic vasculopathy in 23.1%, cardioembolic cause in 21.7%, hematologic etiology in 12.2% and undetermined causes in 16.1%. Atherosclerosis</td>
</tr>
</tbody>
</table>
was a more common etiology. Difference may be attributable to greater predominance of atherosclerosis in patients between the ages of 40-45 years as atherosclerotic stroke increases almost exponentially with increasing age.

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Score</th>
<th>Patients Description</th>
<th>Causes of Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bevan et al. (1990)</td>
<td>USA</td>
<td>No Score</td>
<td>113 young stroke patients between the ages of 15-45, admitted to a Vermont hospital were included.</td>
<td>Intracerebral hemorrhage accounted for 41% (n=46) of young strokes; these had a variety of etiologies. Subarachnoid hemorrhage was the cause of stroke in 17% (n=14), while cerebral infarctions accounted for 42% (n=48), which was attributed to cardiac emboli and premature atherosclerosis for the majority of cases. Mitral valve prolapse, use of oral contraceptives, alcohol drinking and migraines were uncommon causes of cerebral infarction when other risk factors were not present.</td>
</tr>
<tr>
<td>Awada (1994)</td>
<td>Saudi Arabia</td>
<td>No Score</td>
<td>Etiologies for 120 patients with stroke between the ages of 15 and 45 years old were evaluated.</td>
<td>Cerebral infarction accounted for 58.5% of strokes and the remaining were hemorrhagic stroke, 41.5%. Main causes of cerebral infarction included atherosclerosis in 28%, cardiac embolism in 19.5, “other causes” in 34.5% and unknown causes in 18%. Distribution of risk factors was: hypertension, 32%; Diabetes, 16%; smoking, 26%; cardiac disorders, 17%; previous TIA or stroke, 6%; and cervical bruit, 1%.</td>
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<tr>
<td>Ferro &amp; Crespo (1994)</td>
<td>Portugal</td>
<td>No Score</td>
<td>Etiologies that were more commonly identified were: cardioembolic (19%), large-vessel atheromatous disease (15%), single-perforator disease (10%), multiple causes (3%), dissection (7%), arteritis (5%), hematologic disorder (1%) and other rare conditions (7%).</td>
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</tr>
<tr>
<td>Adams et al. (1995)</td>
<td>USA</td>
<td>No Score</td>
<td>Causes of stroke from 329 patients ages 15-45 were evaluated during a 15.5 year period.</td>
<td>A total of 60 different potential causes were identified. When classified according to the author’s own criteria, proportions of causes of stroke were as follows: large-artery atherosclerosis, 21.6%; Cardioembolism, 19.5%; small-artery occlusion, 8.2%, hematologic disorder, 5.8%; other causes, 30.4%; undetermined, 14.6%. When classified according to the TOAST criteria, etiology was as follows: large-artery atherosclerosis, 9.7%; cardioembolism, 17.6%; small artery occlusion, 7.9%; other causes, 30.4%; and undetermined causes, 34.3%.</td>
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<tr>
<td>Study</td>
<td>Country</td>
<td>Score</td>
<td>Total Patients</td>
<td>Age Range</td>
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<tr>
<td>Barinagarre-menteria et al.</td>
<td>Mexico</td>
<td>No</td>
<td>300</td>
<td>Younger than 40</td>
</tr>
<tr>
<td>Siqueira Neto et al.</td>
<td>Brazil</td>
<td>No</td>
<td>106</td>
<td>15 to 40 years</td>
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<tr>
<td>You et al.</td>
<td>Australia</td>
<td>No</td>
<td>201</td>
<td>15 to 55 years</td>
</tr>
<tr>
<td>Kristensen et al.</td>
<td>Sweden</td>
<td>No</td>
<td>88</td>
<td>&lt;3 months post-stroke</td>
</tr>
<tr>
<td>Kittner et al.</td>
<td>USA</td>
<td>No</td>
<td>428</td>
<td>15 to 44 years</td>
</tr>
<tr>
<td>Ruiz-Sandoval et al.</td>
<td>Mexico</td>
<td>No</td>
<td>200</td>
<td>ICH age 15-40</td>
</tr>
<tr>
<td>Kittner et al.</td>
<td>USA</td>
<td>No</td>
<td>167</td>
<td>15 to 44 years</td>
</tr>
<tr>
<td>Gilon et al.</td>
<td>USA</td>
<td>No</td>
<td>213</td>
<td>Under age of 45</td>
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<tr>
<td>No Score</td>
<td>compared to 263 control patients without heart disease.</td>
<td>71 cases. 93 were a result of disease of the carotid or vertebral system and 49 were caused by a cardiac source of embolism. Only 4 (1.9%) had mitral-valve prolapse compared with 7 controls.</td>
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<tr>
<td><strong>Camerlingo et al. (2000)</strong>&lt;br&gt;Italy&lt;br&gt;No Score</td>
<td>135 consecutive first-ever cerebral infarction patients, aged 16 to 45 years old, were evaluated and followed up a mean of 68.8 months.</td>
<td>Stroke type included 11.8% with atherothrombotic stroke, 20% with cardioembolic stroke, 10.4% with small vessel disease, 11.1% with haematological stroke, 25.2% with other causes, and 21.5% with unknown causes. Risk factors included 25.9% with hypertension, 5.2% with diabetes, 5.9% with hypercholesterolemia, 20.7% with migraine, 23.7% current smokers, 8.1% current drinkers, 26.6% of women using oral contraceptives, and 14.1% with cardiac valvular disease.</td>
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<td><strong>Kwon et al. (2000)</strong>&lt;br&gt;Korea&lt;br&gt;No Score</td>
<td>149 patients aged 15 to 44 years old with first-ever ischemic stroke.</td>
<td>Stroke subtype was as follows: large artery atherosclerosis, 20.8%; small artery occlusive disease, 17.4%, cardioembolism, 18.1%; other determined etiologies, 26.8%; and undetermined causes 16.8%. Risk factors include 38.8% of patients with hypertension, 10.1% with diabetes mellitus, 51.0% current cigarette smokers, 31.5% with high alcohol consumption and 8.1% with hyperlipidemia.</td>
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<td><strong>Chan et al. (2000)</strong>&lt;br&gt;Canada&lt;br&gt;No Score</td>
<td>Patients’ records ages 15-45 years old with a diagnosis of ischemic stroke were retrospectively reviewed to determine the etiology of each stroke.</td>
<td>Strokes were classified according to a modified TOAST classification and patients were divided into two age groups. 47% of patients between the ages of 15-30 experienced strokes of an unknown cause, 23% of the stroke resulted from miscellaneous causes, 14% were cardioembolic, 13% were dissection of extracranial artery, 8% were small vessel disease, and 6% were large artery disease. Patients 31-45 years old had 43% unknown causes of stroke, 23% miscellaneous causes, 20% cardioembolic, 20% dissection of extracranial artery, and 1% large artery disease.</td>
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<tr>
<td><strong>Wityk et al. (2000)</strong>&lt;br&gt;USA&lt;br&gt;No Score</td>
<td>110 women with first cerebral infarction aged 15 to 44 years were matched by age and geographic region of residence with 216 patients with no history of stroke (control). Serum &amp; lipoprotein (a) testing was done.</td>
<td>Probable causes of stroke were found in 57 patients. Of these 57, identified etiologies were large artery atherosclerosis (9), cardioembolism (11), lacune (5), and other determined causes (32). 27 patients had at least one possible cause of which were large artery atherosclerosis (6), cardioembolism (15), lacune (1) and other determined causes (5). 26 strokes resulted from undetermined causes.</td>
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<tr>
<td><strong>Lee et al. (2002)</strong>&lt;br&gt;Taiwan&lt;br&gt;No Score</td>
<td>264 stroke patients between 18 to 45 years old. Stroke risk factors and stroke subtype distribution were studied.</td>
<td>Stroke subtype was small-vessel occlusion (20.5%), large-artery atherosclerosis (7.2%), cardioembolism (17.8%) of, other determined etiology (22.3%), and undetermined etiology.</td>
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<tr>
<td>Study</td>
<td>Country</td>
<td>Score</td>
<td>Participants</td>
<td>Findings</td>
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<tr>
<td>Jacobs et al. (2002)</td>
<td>USA</td>
<td>No Score</td>
<td>74 first stroke patients aged 20 to 44 years</td>
<td>Relative Risk (RR) of stroke was calculated for Hispanics and blacks compared to whites. The distribution of stroke type in the young was 45% infarct, 31% intracerebral hemorrhage, and 24% subarachnoid hemorrhage. Risk factors for young stroke patients included: extracranial atherosclerosis (6%), intracranial atherosclerosis (9%), lacunar (18%), cardioembolism (6%), cryptogenic (55%) and other causes (6%). RR of young stroke patients was higher for black and Hispanics compared to whites.</td>
</tr>
<tr>
<td>Tan et al. (2002)</td>
<td>Singapore</td>
<td>No Score</td>
<td>109 consecutive first-ever ischemic stroke patients under the age of 50 and above age 88 and gender matched controls</td>
<td>Hyperlipidemia, diabetes mellitus and hypertension were significantly more prevalent in strokes compared to controls. Strokes had a significantly higher serum homocysteine and significantly lower vitamin B12 level than controls. 48 patients had small-artery/lacunar stroke, 30 had large-artery stroke, 18 had either &quot;other etiologies&quot; or undetermined etiology, and 13 had cardioembolic stroke.</td>
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<tr>
<td>Anzini et al. (2004)</td>
<td>Italy</td>
<td>No Score</td>
<td>141 ischemic strokes (81 males) aged 18-46 paired with 192 sex/age matched controls</td>
<td>Blood samples were taken within 24 hours of stroke event to determine levels of IgA, IgG, IgM antibodies (associated with Chlamydia pneumonia infection). Other risk factors and etiologies were compared. An association between stroke and IgG and IgA antibodies was found (2.2, 95% CI 1.5-3.9; 8.8, 95% CI 3.9-19.1). No difference in IgM level was found between cases and controls. Smoking was the most common risk factor (13.2% higher in patients). Persistent C. pneumoniae infection was associated with stroke and large-vessel atherothrombosis in young patients.</td>
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<tr>
<td>Mehndiratta et al. (2004)</td>
<td>India</td>
<td>No Score</td>
<td>127 stroke patients aged 15 to 40 years old.</td>
<td>Spontaneous intracranial hemorrhagic stroke accounted for 14.2% of patients, whereas ischemic stroke accounted for 85.5% of patients. For patients with cerebral infarction, stroke etiology was: cardioembolic, 29.4%; atherosclerotic occlusive disease, 22%; nonatherosclerotic vascular disease, 15.6%; metabolic etiology, 10.2%; and unknown etiology, 10.1%. 22 patients had no stroke risk factors and 35 patients had several stroke risk factors.</td>
</tr>
<tr>
<td>Bos et al. (2005)</td>
<td>The Netherlands</td>
<td>No Score</td>
<td>161 patients, aged 18 to 45 years, with cerebral infarction or TIA were included.</td>
<td>For young stroke patients homocysteine level was significantly associated with the risk of recurrent vascular events at the 95% confidence level. For patients with homocysteine levels ≤10.7, percentages of patients with presumed etiologies were as follows: large vessel disease, 12%; small vessel disease, 12%; cardio-embolism 10%; other determined causes, 23%; and undetermined, 43%. For patients with homocysteine levels between 10.7 and 13.7,</td>
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</table>
percentages of patients with presumed etiologies were as follows: large vessel disease, 6%; small vessel disease, 16%; cardio-embolism 7%; other determined causes 22%; undetermined 49%. For patients with homocysteine levels ≥13.7, percentages of patients with presumed etiologies were as follows: large vessel disease, 17%; small vessel disease, 4%; cardio-embolism 5%; other determined causes 33%; undetermined 41%.

**Carod-Artal et al. (2005)**  
Brazil  
No score  
- 130 young ischemic stroke patients (age 14-45, mean age 33.8) matched with 200 elderly ischemic stroke registry patients (mean age 61.5) to compare etiologies (using TOAST criteria) and prevalence of thrombophilia. Study conducted from 2002-2004 with consecutive patients.

**Lai et al. (2005)**  
Taiwan  
No Score  
- 296 (224 male, 72 female) spontaneous intracerebral haemorrhage patients aged 15-45 were assessed between 2000 and 2001 to determine ICH location, etiology, and risk factors.

**Rasura et al. (2006)**  
Italy  
No Score  
- 394 ischemic stroke patients aged 14-47 years. Incidence, etiology, and risk factors in young adults were evaluated. Etiologic classification was based on the modified diagnostic Criteria from TOAST and Baltimore-Washington Cooperative Young Stroke Study.

**Ghandehari & Izadi-Mood (2006)**  
Iran  
No Score  
- 124 young adult ischemic stroke patients aged 15-45 years registered in Southern Khorasan stroke data bank over a 5-year period. Etiology classification used TOAST criteria.

**Piechowski-Jozwiak et al. (2007)**  
Poland  
No Score  
- 94 ischemic stroke patients <55 years of age were investigated for anti- Chlamydia pneumonia IgA and IgG antibodies and were divided into subgroups according to TOAST.
<table>
<thead>
<tr>
<th>Study</th>
<th>Location</th>
<th>Description</th>
<th>Results/Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lipska et al. (2007)</td>
<td>South India</td>
<td>214 South Indian patients between the ages of 15-45 were enrolled in this</td>
<td>25.2% of patients had cardioembolic stroke, 12.6% had large artery atherosclerosis and 7.5% had lacunar infarct. 11.2% of strokes were attributed to other determined etiologies and 43.5% were of “indeterminate origin”.</td>
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<tr>
<td></td>
<td>No Score</td>
<td>case-control study determining risk factors for ischemic stroke. Stroke</td>
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<td>causes were categorized according to TOAST criteria.</td>
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<tr>
<td>Varona et al. (2007)</td>
<td>Spain</td>
<td>Longitudinal study of 272 first-ever ischemic stroke patients aged 15-45</td>
<td>Ischemic stroke etiology was undetermined in 98 (36%) of cases, large artery atherosclerosis in 53 (19.5%), cardioembolism in 47 (17.5%), non-atherosclerotic vasculopathy in 45 (17%), lacunar stroke in 14 (5%), and cerebral venous thrombosis in 4 (1%).</td>
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<tr>
<td></td>
<td>No Score</td>
<td>(177 male and 95 female). Etiologic diagnosis made using TOAST criteria.</td>
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<tr>
<td>Arnold et al. (2008)</td>
<td>Switzerland</td>
<td>1004 patients (137 of which were between the ages of 16 and 45) with first</td>
<td>Percentages of etiologies of ischemic stroke according to TOAST: large artery disease, 2%; cardioembolic, 37%; small artery disease, 3%; other determined etiology, 31%; and undetermined (despite complete examination), 27%. Percentages of etiologies of ischemic stroke according to the Oxfordshire Community Stroke Project criteria: total anterior circulation syndrome, 9%; partial anterior circulation syndrome, 53%; lacunar syndrome, 12%; and posterior circulation syndrome, 26%.</td>
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<tr>
<td></td>
<td>No Score</td>
<td>ever acute ischemic stroke were prospectively enrolled in this study.</td>
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<tr>
<td>Jovanović et al. (2008)</td>
<td>Serbia</td>
<td>865 patients between the ages of 15 and 45 who experienced first ever</td>
<td>Results showed: 14% of the strokes were from large artery atherosclerosis, 14% resulted from small artery disease, 20% resulted from embolism, and 20% resulted from other determined causes. 32% of the patients’ stroke had undetermined causes.</td>
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<td></td>
<td>No Score</td>
<td>transitory ischemic attack were prospectively enrolled in a study to</td>
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<td>determine risk factors involved in ischemic attack. TOAST criteria were</td>
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<td></td>
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<td>used to assign the most likely cause of ischemic stroke.</td>
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<tr>
<td>Putala et al. (2009)</td>
<td>Finland</td>
<td>1008 patients aged 15-49 who experienced first-ever ischemic stroke were</td>
<td>According to the TOAST criteria, percentages of patients within each subgroup were as follows: large-artery atherosclerosis, 3.9%; cardioembolism, 21.9%; small-vessel disease, 7.5%; other determined etiology, 30.1%; multiple possible etiologies, 2.6%; undetermined etiology (extensive evaluation), 28.1%; and undetermined etiology (incomplete evaluation), 5.9%.</td>
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<tr>
<td></td>
<td>No Score</td>
<td>admitted to the study. Trends were analyzed.</td>
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<tr>
<td>Samiullah et al. (2010)</td>
<td>Hyderabad</td>
<td>A prospective study was performed on 50 patients between the ages of 15</td>
<td>The most common cause of stroke was found to be infective meningitis which was found in 34% of the cases. Following that causes were cardioembolism for 20% and hypertension for 14%. Other causes were related to pregnancy (12%), systemic lupus erythematosus (4%), nephritic syndrome (4%), and various other causes (12%).</td>
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<td></td>
<td>No Score</td>
<td>and 35 to determine the etiological pattern of strokes in young patients.</td>
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<tr>
<td>Spengos &amp; Vemmos (2010)</td>
<td>Athens</td>
<td>Patients 45 years old and younger who experienced first ever ischemic</td>
<td>252 patients were included. 6.7% experienced a large artery atherosclerosis, 15.8% cardioembolism, 17.4% small-vessel disease, 26.5% had another determined etiology and 33.6% were undetermined.</td>
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<td></td>
<td>No Score</td>
<td>stroke in Athens between 1999 and 2008 were included. Etiology of stroke</td>
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<td></td>
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<td>was classified according to TOAST criteria.</td>
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<tr>
<td>Study</td>
<td>Country</td>
<td>Score</td>
<td>Study Details</td>
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<tr>
<td>Tan et al. (2010)</td>
<td>Malaysia</td>
<td>No Score</td>
<td>61 patients from Australia and 67 patients from Malaysia under the age of 50 who experienced first ever ischemic stroke were recruited.</td>
</tr>
<tr>
<td>Balci et al. (2011)</td>
<td>Turkey</td>
<td>No Score</td>
<td>Ischemic stroke survivors 18-47 years of age were included in this study. A retrospective review occurred and 192 patients (4.7% of all ischemic strokes admitted to the department of neurology) were classified according to criteria based on modified version of the TOAST and Baltimore Classification systems.</td>
</tr>
<tr>
<td>Dharmasaroja et al. (2011)</td>
<td>Thailand</td>
<td>No Score</td>
<td>99 Ischemic stroke and transient ischemic attack survivors between the ages of 15 and 50 were included in this study. Authors looked at etiology by age and stroke subtypes were classified by the TOAST criteria.</td>
</tr>
<tr>
<td>Fromm et al. (2011)</td>
<td>Norway</td>
<td>No Score</td>
<td>Patients with acute cerebral infarction were prospectively enrolled in the Bergen Stroke Study (100 patients out of 1217 involved in the study were &lt;50 years old).</td>
</tr>
<tr>
<td>Larrue et al. (2011)</td>
<td>France</td>
<td>No Score</td>
<td>Consecutive patients aged 16–54 years treated for acute ischemic stroke in a tertiary stroke unit were included in this retrospective analysis.</td>
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<tr>
<td>Authors</td>
<td>Location</td>
<td>Score</td>
<td>Study Population</td>
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<tr>
<td>Martínez-Sánchez et al.</td>
<td>Spain</td>
<td>No Score</td>
<td>A retrospective analysis of 310 patients up to age 50 who experienced first ever cerebral infarction was performed.</td>
</tr>
<tr>
<td>Munshi et al. (2011)</td>
<td>India</td>
<td>No Score</td>
<td>525 ischemic stroke patients were included in this study. The control group consisted of 500 healthy individuals matched for sex and age (male:female = 351:149) and were recruited from the same demographic area.</td>
</tr>
<tr>
<td>Patella et al. (2011)</td>
<td>Italy</td>
<td>No Score</td>
<td>First ever ischemic stroke patients under the age of 45 were prospectively evaluated. All 94 patients’ strokes were classified according to TOAST and Baltimore classification and Bamford criteria.</td>
</tr>
<tr>
<td>Wolff et al. (2011)</td>
<td>France</td>
<td>No Score</td>
<td>From October 2005 to September 2007, 48 consecutive patients younger than 45 years of age who were admitted to stroke unit for ischemic stroke. First-line screening was performed, including blood tests, cardiovascular investigations, and urine analysis for cannabinoids. If no etiology was found, 3D rotational angiography and cerebrospinal fluid analysis were performed. A control was planned through neurovascular imaging within 3 to 6 months.</td>
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<tr>
<td>Zhang et al. (2011)</td>
<td>China</td>
<td>No Score</td>
<td>669 Chinese patients between the ages of 18 and 45 years with cerebral infarction were retrospectively examined. Stroke subtypes were classified according to the TOAST system.</td>
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<tr>
<td>Reference</td>
<td>Region</td>
<td>Study Design</td>
<td>Score</td>
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<tr>
<td>Hankey et al. (2012)</td>
<td>Australia</td>
<td>No Score</td>
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<tr>
<td>Arntz et al. (2013)</td>
<td>Netherlands</td>
<td>Prospective</td>
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<tr>
<td>Arntz et al. (2013)</td>
<td>Netherlands</td>
<td>Prospective</td>
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<tr>
<td>Chen et al. (2013)</td>
<td>Taiwan</td>
<td>Retrospective</td>
<td></td>
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<tr>
<td>Authors</td>
<td>Year</td>
<td>Country</td>
<td>Study Design</td>
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<tr>
<td>Dharmasaroja et al.</td>
<td>2013</td>
<td>Thailand</td>
<td>Prospective</td>
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<tr>
<td>Dubuc et al.</td>
<td>2013</td>
<td>Canada</td>
<td>Retrospective</td>
</tr>
<tr>
<td>Eun et al.</td>
<td>2013</td>
<td>South Korea</td>
<td>Retrospective</td>
</tr>
<tr>
<td>Naess et al.</td>
<td>2013</td>
<td>Norway</td>
<td>Prospective</td>
</tr>
<tr>
<td>Nakagawa et al.</td>
<td>2013</td>
<td>USA</td>
<td>Retrospective</td>
</tr>
</tbody>
</table>
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 18-24yr and 25-34yr, 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 35-44yr and 45-55yr (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).

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 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 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 male

os and females for large vessel disease (males=19, females=24) and small vessel disease (males=25, females=30).

21. The Rehabilitation of Younger Stroke Patients
<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Study Design</th>
<th>Score</th>
<th>TPS</th>
<th>Overall Start</th>
<th>Overall End</th>
</tr>
</thead>
<tbody>
<tr>
<td>de Bruijn et al. (2014)</td>
<td>Netherlands</td>
<td>Prospective</td>
<td>No Score</td>
<td>TPS(_{\text{Overall}}&gt;1\text{yr})</td>
<td>(N_{\text{Start}}=96)</td>
<td>(N_{\text{End}}=96)</td>
</tr>
<tr>
<td>Bugnicourt et al. (2014)</td>
<td>France</td>
<td>Prospective</td>
<td>No Score</td>
<td>TPS(_{\text{Overall}}&gt;13.1\text{mo})</td>
<td>(N_{\text{Start}}=156)</td>
<td>(N_{\text{End}}=104)</td>
</tr>
<tr>
<td>Bulder et al. (2014)</td>
<td>Netherlands</td>
<td>Retrospective</td>
<td>No Score</td>
<td>TPS(_{\text{Mean}}=6\text{yr})</td>
<td>(N_{\text{Start}}=17)</td>
<td>(N_{\text{End}}=17)</td>
</tr>
<tr>
<td>Chraa et al. (2014)</td>
<td>Morocco</td>
<td>Prospective</td>
<td>No Score</td>
<td>TPS(_{\text{Mean}}=\text{NA})</td>
<td>(N_{\text{Start}}=128)</td>
<td>(N_{\text{End}}=128)</td>
</tr>
<tr>
<td>Dash et al. (2014)</td>
<td>India</td>
<td>Retrospective</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Population:**
- Median age=43.0yr; Gender: Males=44, Females=52.
- Mean age=48.0yr; Gender: Males=62, Females=44.
- Mean age=19.3yr; Gender: Males=5, Females=12.
- Mean age=28.3yr; Gender: Males=76, Females=52.
- Mean age=38.9yr; Gender: Males=367, Females=73.

**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).
- A questionnaire relating to sexual function was mailed to participants under 60yr with a first ever ischemic stroke or TIA from 2010 to 2012.
- Patients aged 5-50yr with a first ever ischemic stroke in the middle cerebral artery (MCA) from 1994 to 2011 were included.
- Patients 18-45yr with an ischemic stroke from 2007 to 2010 were assessed from 3-82mo post-stroke.
- Patients 18-45yr with an ischemic stroke from 2007 to 2010 were assessed from 3-82mo post-stroke.

**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.
- Prevalence of sexual impairment post-stroke; Living situation; Prevalence of risk factors; Current drug treatment; Hospital Anxiety and Depression Scale (HADS): Anxiety, Depression.
- Stroke etiology; Modified Rankin Scale (mRS).

**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%).

**2.** 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%).

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

**4.** Severe arteriopathy of the MCA occurred in 9 participants and in the internal carotid artery of 1 participant; 7 participants had mild arteriopathy.

**5.** Stroke etiology was cardioembolic in 43 (33.5%) participants, large artery atherosclerosis or small vessel occlusion in 15 (11.7%), other determined etiology in 18 (14.2%), and was undetermined in 52 (40.6%).

**6.** Stroke etiology was determined to be large vessel atherosclerosis in 21 (4.7%) participants, cardioembolic in 62 (14%), and undetermined in 52 (40.6%).
Intervention: Patients 18-45yr with an ischemic stroke from 2005 to 2010 were included. 
Outcomes: Prevalence of risk factors; Stroke etiology.

Kalita et al. (2014)
India
Retrospective
No Score
TPS\text{Mean}=NA
N_{\text{Start}}=404
N_{\text{End}}=404

Population: Mean age=41.6yr; Gender: Males=308, Females=96.
Intervention: Patients 16-50yr with an intracerebral hemorrhage (ICH) with a stroke from 2001-2010 were retrospectively analyzed.
Outcomes: Prevalent risk factors; ICH etiology; Glasgow Outcome Scale (GOS); 1mo mortality.

1. Etiology of ICH was attributed to hypertension in 79.2%, coagulopathy in 4%, vascular malformation in 4.2%, cerebral venous sinus thrombosis in 2.2%, thrombocytopenia in 0.7%, vasculitis in 0.5%, and cryptogenic in 9.2%. The prevalence of these etiologies differed by decade of life so that arteriovenous malformation, cerebral venous sinus thrombosis, coagulopathy, vasculitis, and cryptogenic etiology were more common in the 2nd and 3rd decades but hypertension had a higher prevalence in the 5th decade.

Khealani et al. (2014)
Pakistan
Retrospective
No Score
TPS\text{Mean}=NA
N_{\text{Start}}=874
N_{\text{End}}=874

Population: Mean age=59.7yr; Gender: Males=529, Females=345.
Intervention: Patients >14yr with an ischemic stroke in 2007 were included.
Outcomes: Prevalent risk factors; In-hospital complications; Modified Rankin Scale (mRS); Stroke etiology.

1. Stroke etiology was significantly different between age groups (p=0.001) with a greater proportion of strokes in participants >45yr vs. 16-45yr classified as large vessel (31.9% vs. 30.7%) and small vessel (28.2% vs. 14.4%), and a greater proportion of strokes in participants <45yr classified as cardioembolic (15.7% vs. 9.3%) and undetermined or other (39.2% vs. 30.7%).

Renna et al. (2014)
Italy
Retrospective
No Score
TPS\text{Mean}=NA
N_{\text{Start}}=150
N_{\text{End}}=150

Population: Mean age=41.3±8yr; Gender: Males=98, Females=52.
Intervention: Retrospective analysis of data from stroke participants younger than 50yr.
Outcomes: Anamnesis examinations; Laboratory examinations; Radiologic

1. Stroke etiology was classified as large-artery atherosclerosis in 1.3%, cardioembolism in 24%, small-vessel occlusion in 8%, other in 27.3%, and undetermined in 29.3%.
2. Comparing etiology between subgroups revealed a significant difference between age groups with a greater proportion of...
examinations; Cardiologic examinations; Clinical evaluations.

strokes with an undetermined origin in ≤35yr participants compared to >35yr (p=0.028); no significant differences were observed between males and females.

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Study Design</th>
<th>TPS/Score</th>
<th>Median Age (yr)</th>
<th>Gender</th>
<th>Intervention</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aarnio et al. (2015)</td>
<td>Finland</td>
<td>Prospective</td>
<td>No Score</td>
<td>Median=44</td>
<td>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>Mortality; Risk factors; Stroke etiology; Cancer prevalence.</td>
</tr>
<tr>
<td>de Bruijn et al. (2015)</td>
<td>Netherlands</td>
<td>Retrospective</td>
<td>No Score</td>
<td>Mean=41.4</td>
<td>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>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>Prospective</td>
<td>No Score</td>
<td>Mean=35</td>
<td>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>Cerebral infarction in 64 (62.7%) participants, large vessel disease in 4 (3.9%), cardioembolic in 14 (13.7%), small vessel disease in 12 (11.8%), other in 17 (16.6%), TIA in 24 (23.5%), cerebral venous thrombosis in 12 (11.8%), hemorrhagic in 2 (2%), and undetermined in 17 (16.6%).</td>
</tr>
<tr>
<td>Jaffre et al. (2015)</td>
<td>France</td>
<td>Case-Control study</td>
<td>No Score</td>
<td>Mean=44.5±8.5</td>
<td>Males=244, Females=156</td>
<td>Patients 18-54yr treated for first-ever ischemic stroke from 2006-2012 were included.</td>
<td>Stroke etiology; Risks associated with cryptogenic stroke.</td>
</tr>
</tbody>
</table>

1. Stroke etiology was determined to be total anterior circulation infarction in 9 (5.3%) participants, partial anterior circulation infarction in 56 (32.9%), lacunar infarction in 52 (30.6%), and posterior circulation infarction in 53 (31.2%).

2. No significant differences were observed between women with and without a post-stroke pregnancy in regards to risk factors, previous treatments, or stroke etiology.

3. The cerebrovascular event was classified as cerebral infarction in 64 (62.7%) participants, large vessel disease in 4 (3.9%), cardioembolic in 14 (13.7%), small vessel disease in 12 (11.8%), other in 17 (16.6%), TIA in 24 (23.5%), cerebral venous thrombosis in 12 (11.8%), hemorrhagic in 2 (2%), and undetermined in 17 (16.6%).

4. 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).

5. 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).

Simonetti et al. (2015)
Switzerland
Retrospective
No Score
TPS Mean = NA
N Start = 249
N End = 249

Population: Mean age = NA; Gender: Males = 133, Females = 116.
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 adults 16-45yr (N=154).
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. 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%).

Trivedi et al. (2015)
USA
Prospective
No Score
TPS Mean = NA
N Start = 950
N End = 950

Population: Mean age = 40yr; Gender: Males = 509, Females = 441.
Intervention: 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.
Outcomes: Risk factors; Stroke etiology.

1. No statistically significant differences in sex were observed between TOAST subtypes.
2. AA were more likely to have a lacunar stroke than EA (p=0.011) when controlling for sex and age.
3. Hypertension was found to significantly increase the risk of lacunar stroke (p=0.0003) and atherosclerotic stroke (p=0.048).
4. 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).
5. Smokers were more likely to have a atherosclerotic stroke than non-smokers (p=0.024).

21.3 Risk Factors

Table 21.3 Studies Investigating Risk Factors of Stroke in Young Patients

<table>
<thead>
<tr>
<th>Author, Year Country PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calviere et al. (2013) France</td>
<td>Population: Mean age=44.8yr; Gender: Males=60, Females=40.</td>
<td>1. Prevalent risk factors included hypertension in 18 (18%) participants,</td>
</tr>
</tbody>
</table>
### Retrospective Study

**Population:** Young Participants (N=368): Mean age=53.9 yr; 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 <65yr and ≥65yr.

**Outcomes:**
1. Young participants were significantly more likely to smoke (<65yr=44.8%, ≥65yr=23.8%; p<0.001), have hypercholesterolemia (<65yr=41.5%, ≥65yr=31.6%; p=0.002), and have hypertriglyceridemia (<65yr=41.3%, ≥65yr=23.9; p<0.001).
2. Young participants were significantly less likely to have atrial fibrillation (<65yr=8.2%, ≥65yr=24.1%; p<0.001) and a previous stroke (<65yr=47.3%, ≥65yr=58.0%; p=0.001).

### Chen et al. (2013)

**Taiwan Retrospective**

**Population:** Young Participants (N=368): Mean age=53.9 yr; 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 <65yr and ≥65yr.

**Outcomes:**
1. Young participants were significantly more likely to smoke (<65yr=44.8%, ≥65yr=23.8%; p<0.001), have hypercholesterolemia (<65yr=41.5%, ≥65yr=31.6%; p=0.002), and have hypertriglyceridemia (<65yr=41.3%, ≥65yr=23.9; p<0.001).

### Naess et al. (2013)

**Norway Prospective**

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

**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.

**Outcomes:**
1. Diabetes mellitus on admittance was more prevalent in participants deceased at follow-up compared to participants that survived (24.1% vs. 8.8%).
2. Hypertension on admittance was more prevalent in participants deceased at follow-up compared to participants that survived (35.2% vs. 31.8%).
3. Smoking on admittance was more prevalent in participants deceased at follow-up compared to participants that survived (61.1% vs. 60.6%).
4. Alcoholism on admittance was more prevalent in participants deceased at follow-up compared to participants that survived (24.1% vs. 2.9%).

### Smajlovic et al. (2013)

**Bosnia and Herzegovina Retrospective**

**Population:** Young Participants (N=154): Mean age=38.8±5.7yr; Gender: Males=82, Females=72; Older Participants (N=3710): Age>45yr.

**Intervention:** Data from young adults admitted with a first-ever stroke from 2001 to 2005 was retrospectively analyzed.

**Outcomes:**
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 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%).

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**21. The Rehabilitation of Younger Stroke Patients**

[www.ebrsr.com](http://www.ebrsr.com)
<table>
<thead>
<tr>
<th>Author et al. (2014)</th>
<th>Country</th>
<th>Study Design</th>
<th>Score</th>
<th>TPS</th>
<th>Mean</th>
<th>Start</th>
<th>End</th>
<th>Population:</th>
<th>Intervention:</th>
<th>Outcomes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dash et al.</td>
<td>India</td>
<td>Retrospective</td>
<td>No Score</td>
<td>TPS</td>
<td>Mean = NA</td>
<td>Start = 440</td>
<td>End = 440</td>
<td>Mean age = 38.9yr; Gender: Males = 367, Females = 73.</td>
<td>Patients 18-45yr with an Ischemic from 2005 to 2010 were included.</td>
<td>Prevalence of risk factors; Stroke etiology.</td>
</tr>
<tr>
<td>Khealani et al.</td>
<td>Pakistan</td>
<td>Retrospective</td>
<td>No Score</td>
<td>TPS</td>
<td>Mean = NA</td>
<td>Start = 874</td>
<td>End = 874</td>
<td>Mean age = 59.7yr; Gender: Males = 529, Females = 345.</td>
<td>Patients &gt; 14yr with an Ischemic in 2007 were included.</td>
<td>Prevalent risk factors; In-hospital complications; Modified Rankin Scale (mRS); Stroke etiology.</td>
</tr>
<tr>
<td>Park et al.</td>
<td>South Korea</td>
<td>Case Series</td>
<td>No Score</td>
<td>TPS</td>
<td>Young = NA, Elderly = NA</td>
<td>Start = 25818</td>
<td>End = 25818</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>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; Laboratory and radiologic examinations; Emergency care.</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).

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%).

3. Compared to EA, YA showed significantly higher proportions of being male, having a high body mass index, having a professional and business job, and 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).
21. The Rehabilitation of Younger Stroke Patients

**Renna et al.** (2014)  
Italy  
Retrospective  
No Score  
TPS\_Mean=NA  
N\_Start=150  
N\_End=150

**Population:** Mean age=41.3±8yr; Gender: Males=98, Females=52.  
**Intervention:** Retrospective analysis of data from stroke participants younger than 50yr.  
**Outcomes:** Anamnesis examinations; Laboratory examinations; Radiologic examinations; Cardiologic examinations; Clinical evaluations.

1. 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%).

**Shi et al.** (2014)  
China  
Retrospective  
No Score  
TPS\_Mean=NA  
N\_Start=351  
N\_End=351

**Population:** 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; N=230): Mean age=46.5±8.0; Gender: Males=168, Females=62.  
**Intervention:** Patients (<55yr) with a first ever Ischemic from 2010-2012 were retrospectively assessed.  
**Outcomes:** Risk factors for Ischemic including hypertension, diabetes mellitus, atrial fibrillation (AF), hyperlipidemia, current smoking status; Frequency of elevated antithyroperoxidase.

1. ILAS participants had lower prevalence of AF (p=0.04) compared with non-ILAS participants.
2. In terms of risk factors in ILAS participants, 57.9% had hypertension, 22.3% had diabetes, 29.8% had hyperlipidemia, 0.8% had atrial fibrillation and 35.5% were current smokers.
3. In terms of risk factors in non-ILAS participants, 53.5% had hypertension, 20.9% had diabetes, 31.3% had hyperlipidemia, 5.7% had atrial fibrillation and 44.8% were current smokers.
4. There was no difference between the two groups regarding the incidence of diabetes (p=0.754), hypertension (p=0.434), hyperlipidemia (p=0.765), or current smoking status (p=0.095).
5. ILAS participants had a significantly higher frequency of elevated antithyroperoxidase compared to non-ILAS (p<.001).

**Zhang et al.** (2014)  
China  
Prospective  
No Score  
TPS\_Mean=NA  
N\_Start=381  
N\_End=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).

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),
### Outcomes:

- Risk factors; National Institute of Health Stroke Scale (NIHSS); Modified Rankin Scale (mRS).

### Risk factors associated with young stroke:

1. 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).

### Prognostic factors associated with young stroke:

1. 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).

### Population:

**Fullerton et al. (2015)**

- **USA**
- **Prospective**
- **No Score**
- **TPS Mean = NA**
- **N Start = 271**
- **N End = 213**

**Intervention:** 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).

**Outcomes:** Prevalent risk factors; Recurrent stroke characteristics.

1. The prevalence of hypertension was significantly different between groups with a greater proportion of recurrent stroke participants having hypertension (recurrent=46%, non-recurrent=30%; p<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%).

**Högström et al. (2015)**

- **Sweden**
- **Prospective**
- **No Score**
- **TPS Mean = NA**
- **N Start = 8284**
- **N End = 8284**

**Intervention:** 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.

**Outcomes:** Prevalent risk factors.

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.
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%; p<0.05).

### 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);
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).

21.4 Recovery and Prognosis

Table 21.4 Studies Evaluating Recovery and Prognosis in Young Strokes

<table>
<thead>
<tr>
<th>Author, Year Country PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hindfelt and Nilsson (1977)</strong> Sweden No Score</td>
<td>Included 60 young adults (age 16-40 years, mean age at stroke onset was 30.85 years) who suffered an acute ischemic stroke. 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>
</tr>
<tr>
<td><strong>Coughlan and Humphreys (1982)</strong> UK No Score</td>
<td>The spouses of 170 surviving stroke patients 3 to 8 years after having suffered a stroke completed postal questionnaires. All patients were under the age of 65 at stroke onset.</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>
</tr>
<tr>
<td><strong>Ferro &amp; Crespo (1988)</strong> Portugal No Score</td>
<td>254 young stroke 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>
</tr>
<tr>
<td><strong>Bogousslavsky and Regli (1987)</strong> Switzerland No Score</td>
<td>41 ischemic stroke patients under 30 years of age 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...</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Country</th>
<th>Score</th>
<th>Young Stroke Patients Included</th>
<th>Follow-up Information</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chancellor et al. (1989)</td>
<td>New Zealand</td>
<td>No Score</td>
<td>66 young patients (&lt;40 years old) with acute nonhemorrhagic 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>
<td></td>
</tr>
<tr>
<td>Adunsky et al. (1992)</td>
<td>Israel</td>
<td>No Score</td>
<td>35 young stroke patients aged 18 to 40 years old admitted to an Israeli rehabilitation facility were included.</td>
<td>Mean time to admission was almost 1 month and patients remained in rehabilitation an average of almost 3 months. Nevertheless, a significant difference between ADL scores at admission and discharge was noted (p&lt;0.01), but not between discharge and follow-up. Young stroke patients significantly improved in standing, sitting, transfer and walking abilities (p&lt;0.02) during hospitalization. At follow-up significant improvements remained for standing and walking ability (p&lt;0.01). There were no deaths during the study period.</td>
<td></td>
</tr>
<tr>
<td>Hindfelt and Nilsson (1992)</td>
<td>Sweden</td>
<td>No Score</td>
<td>74 young ischemic stroke patients between the ages of 16 and 40 (&gt;1 month post stroke) included. Follow-up ranged from 13-26 years following stroke onset.</td>
<td>12 patients were dead at follow-up. Death of 3 patients was unrelated to ischemic stroke. Of the 62 patients remaining, 7 patients who had risk factors for cerebrovascular disease at stroke onset suffered from recurrent ischemic events. Young stroke patients were found to have a favourable long-term prognosis.</td>
<td></td>
</tr>
<tr>
<td>Lindberg et al. (1992)</td>
<td>USA</td>
<td>No Score</td>
<td>324 consecutive long-term survivors of subarachnoid hemorrhage (SAH) included.</td>
<td>31% had motor and/or language deficits. Ninety-one percent of patients were independent in personal ADL. Of these only 14% needed ADL assistance from relatives and/or home-help (9%). 66% of the patients were unimpaired and/or had no ADL disability.</td>
<td></td>
</tr>
<tr>
<td>Falconer et al. (1994)</td>
<td>USA</td>
<td>No Score</td>
<td>260 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>
<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 they were institutionalized more often than the younger stroke patient groups.</td>
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<tr>
<td>Ferro &amp; Crespo (1994)</td>
<td>Portugal</td>
<td>No Score</td>
<td>215 patients under the age of 45 described their functional and vocational positions after a long-term follow-up, a mean of 43.1 months.</td>
<td>88% patients completely recovered at the end of follow-up, 21 patients were handicapped. Disability was significantly more common among patients with major strokes compared to minor strokes (P&lt;0.0001). 4 patients died at follow-up, all had a major stroke.</td>
<td></td>
</tr>
</tbody>
</table>
| **Kappelle et al.**  
| (1994)  
| Sweden  
| No Score | 296 ischemic stroke patients between the ages of 15 to 45 years who had been referred to a tertiary medical center underwent a follow-up assessment.  
| The calculated annual mortality from vascular death was 1.7% during follow-up. Young patients, especially those with small-vessel stroke or stroke of unknown etiology, did significantly better than those older or who had large-vessel strokes of known etiology. On the GOS scale 76% of patients were found to have minimal or no problems, 17% had minor handicaps, and 16% had major handicaps. |
| **Barinagarrementeria et al.**  
| (1996)  
| Mexico  
| No Score | 300 consecutive patients younger than 40 years with the cerebral infarction (<3 months post-stroke) included. The Glasgow Outcome Scale (GOS) measure was used for measuring handicap and outcome overall.  
| In this study 25% of patients made a full recovery, 47% made a partial but non-disabling recovery, 26% had a disabling stroke after a partial recovery and 1% died. 85% of the patients were followed for at least 3 months. 13 patients (4%) suffered from recurrent cerebral infarctions. |
| **Rozenthul-Sorokin et al.**  
| (1996)  
| Israel  
| No Score | 253 first stroke victims (ages 17-49) were admitted to hospitals in Israel over 1 year. A questionnaire containing 88 questions was used for evaluation of the patients.  
| 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. |
| **Neau et al.**  
| (1998)  
| France  
| No Score | 71 young adults 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.  
| 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 8 mo post-stroke. |
| **Marini et al.**  
| (1999)  
| Italy  
| No Score | 333 patients with first-ever transient ischemic attack or ischemic stroke aged 15 to 44 years were prospectively followed up.  
| 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. |
| **Camerlingo et al.**  
| (2000)  
| Italy  
| No Score | 135 consecutive first-ever cerebral infarction patients, aged 16 to 45 years old, were evaluated and followed up a mean of 68.8 months.  
<p>| 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. |</p>
<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Score</th>
<th>Participants</th>
<th>Stroke Classification</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marini et al. (2001)</td>
<td>Italy</td>
<td>No Score</td>
<td>89 patients of a population of 4353 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>
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<tr>
<td>Kersten et al. (2002)</td>
<td>UK</td>
<td>No Score</td>
<td>639 Southampton Needs Assessment Questionnaires were distributed to people with stroke for 2 age groups (18-45 years; 46-65 years) suffering from chronic stroke.</td>
<td>Good levels of mobility (able to walk 10 meters independently inside and unaided outside) were reported in 60% of patients. 23% of patients could not walk 10-meters independently indoors or outdoors and 13% of patients could walk 10-meters independently indoors but not outdoors.</td>
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</tr>
<tr>
<td>Leys et al. (2002)</td>
<td>France</td>
<td>No Score</td>
<td>287 ischemic stroke patients aged 15 to 45 years old were included to determine the 3-year outcome.</td>
<td>After a 3-year period 22 patients were dead, 10 experienced recurrent stroke, 2 had myocardial infarction and 19 experienced seizures. 209 of the 265 survivors were independent at follow-up.</td>
<td></td>
</tr>
<tr>
<td><strong>Naess et al.</strong> (2005a)</td>
<td>Norway</td>
<td>No Score</td>
<td>192 patients aged 15 to 49 years old experienced cerebral infarction and 212 controls were interviewed.</td>
<td>53% of stroke patients and 31% of controls reported fatigue ($P&lt;0.001$). There were significant associations between fatigue and poor functional outcome ($P=0.001$), and fatigue and depression ($P&lt;0.001$).</td>
<td></td>
</tr>
<tr>
<td><strong>Naess et al.</strong> (2005b)</td>
<td>Norway</td>
<td>No Score</td>
<td>232 patients aged 15 to 49 years old with first-ever ischemic stroke were included.</td>
<td>There were 8 patients who died during hospital stay and 15 who died following hospital discharge. 21 (9.4%) patients experienced recurrent stroke and 10 (9.4%) had a myocardial infarction.</td>
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</tr>
<tr>
<td><strong>Nedeltchev et al.</strong> (2005)</td>
<td>Switzerland</td>
<td>No Score</td>
<td>Information on 203 consecutive ischemic stroke patients (aged 16-45) was collected prospectively. Outcomes were assessed three months after admission. Risk factors and stroke etiology were determined, and the Modified Rankin Scale (mRS) was used to classify recovery.</td>
<td>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 11.7% for patients with a history of TIA. Most common risk factors included smoking (46%), hypercholesterolemia (39%), and hypertension (19%).</td>
<td></td>
</tr>
<tr>
<td><strong>Naess et al.</strong> (2006)</td>
<td>Norway</td>
<td>No Score</td>
<td>232 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 fatigued had significantly reduced score for all the items of the SF-36.</td>
<td></td>
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<tr>
<td><strong>Cabral et al.</strong> (2009)</td>
<td>Brazil</td>
<td>No Score</td>
<td>All stroke cases (1323 registered 759 were first every strokes) within one year occurring in Joinville, Brazil were prospectively ascertained.</td>
<td>Crude mortality rates for men who suffered a stroke during 2005 and 2006 per 100,000 were as follows: &lt;24 years, 0; 25-34 years, 0; 35-44 years, 6.6; 45-54 years, 6.7; 55-64, 71.1. Crude mortality rates for women who suffered a stroke during 2005 and 2006 per 100,000 were as follows: &lt;24 years, 0; 25-34 years, 1.1; 35-44 years, 9.1; 45-54 years, 27.9; 55-64, 35.0.</td>
<td></td>
</tr>
<tr>
<td><strong>Putaala et al.</strong> (2009)</td>
<td>Finland</td>
<td>No Score</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>
<td>Cumulative morality risk for one-year was 4.7%, and for 5-years was 10.7%. Factors most likely to predict death in the long-term were malignancy, heart failure, large artery atherosclerosis, peripheral arterial disease, heavy drinking preceding infection and being over the age of 45.</td>
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<tr>
<td><strong>Naess et al.</strong> (2009)</td>
<td>Norway</td>
<td>No Score</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>
<td>On long-term follow up, relatively few patients had clinically significant aphasia. Patients with aphasia were more likely to have neurological deficits on admission than those without.</td>
<td></td>
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<tr>
<td><strong>Röding et al.</strong> (2009)</td>
<td>Sweden</td>
<td>No Score</td>
<td>A questionnaire was sent out to patients 18–55 years of age with first-ever stroke containing questions about their physical and cognitive abilities before and after the stroke. 1068 patients returned the questionnaire 8-36 months post-stroke.</td>
<td>Young stroke patients that can independently perform personal activities of daily living still experience cognitive and physical difficulties 1-2 years after a stroke. Patients were also worried about the effect of physical exertion following a stroke. Women were found to suffer from...</td>
<td></td>
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</tbody>
</table>
21. The Rehabilitation of Younger Stroke Patients

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Score</th>
<th>Patients Description</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Röding et al. (2010)</td>
<td>Sweden</td>
<td>No Score</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. It was returned by 1068 participants.</td>
<td>97% of the participants were living at home. 53% were unsatisfied with their life as a whole following stroke. Percentages of participants who were not satisfied with specific categories were as follows: personal activities of daily living, 21%; leisure situation, 48%; vocational situation, 66%; financial situation, 63%; sexual life, 68%; partnership relation, 42%; family life, 35%; contact with friends/acquaintances, 41%. The most important factor for not being satisfied with life as a whole for women was a diagnosis of haemorrhagic stroke and for men was living with a significant other.</td>
</tr>
<tr>
<td>Ellis (2010)</td>
<td>USA</td>
<td>No Score</td>
<td>Using a national data set (the Nationwide Inpatient Sample), 41 587 patients between the ages of 18-44 were identified (5% of all stroke patients). Discharge disposition and type of stroke was recorded.</td>
<td>Percentage of the total ischemic stroke survivor population for each discharge disposition that were young stroke were as follows, 2.3% of the deaths, 5.6% that had routine discharge, 6.1% of those that had another short term hospital stay, 1.9% of those discharged to a rehabilitation enter or nursing home, 2.1% of those that had home health, and 1.5% of those that had a disposition not included above. Percentage of the total subarachnoid hemorrhage survivor population for each discharge disposition that were young stroke were as follows, 12.1% of the deaths, 28.9% that had routine discharge, 15.0% of those that had another short term hospital stay, 13.8% of those discharged to a rehabilitation enter or nursing home, 12.2% of those that had home health, and 50.5% of those that had a disposition not included above. Percentage of the total intracerebral hemorrhage stroke survivor population for each discharge disposition that were young stroke were as follows, 5.0% of the deaths, 14.1% that had routine discharge, 11.5% of those that had another short term hospital stay, 4.6% of those discharged to a rehabilitation enter or nursing home, 5.0% of those that had home health, and 23.0% of those that had a disposition not included above.</td>
</tr>
<tr>
<td>Putaala et al. (2010)</td>
<td>Finland</td>
<td>No Score</td>
<td>807 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>
<td>Of the 807 patient, 17.9% died during follow up period (5 years) and 10.9% had at least 1 arterial event. Patients with a stroke subtype of large artery atherosclerosis had an increased risk of ischemic stroke and composite endpoint when compared to other etiologies.</td>
</tr>
<tr>
<td>Spengos and Vemmos (2010)</td>
<td>Greece</td>
<td>No Score</td>
<td>253 ischemic stroke patients were prospectively enrolled in the Athens Young Stroke Registry. Patients were 45 years of age or younger.</td>
<td>Overall probability of ten year survival following stroke was 86.3% (95% CI: 79.1-93.6). Stroke subtype did not result in a significant difference</td>
</tr>
<tr>
<td>Study Authors</td>
<td>Year</td>
<td>Location</td>
<td>Study Description</td>
<td>Outcome Measures</td>
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<tr>
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<tr>
<td>Greisenegger et al.</td>
<td>2011</td>
<td>Vienna</td>
<td>677 patients who endured ischemic stroke or transient ischemic attack between the ages of 18 and 59 were identified in the Vienna Stroke Registry.</td>
<td>Cumulative mortality rates are as follows: 1-year, 2.4%; 5-year, 7.8%; overall (mean follow-up period of 6.5 years), 12%. The most frequent cause of death was cardioaortic causes, followed by malignancies and recurrent stroke.</td>
</tr>
<tr>
<td>Knoflach et al.</td>
<td>2012</td>
<td>Austria</td>
<td>14,256 adult actue ischemic stroke patients, functionally independent before stroke, recorded in the Austrian Stroke Unit Registry with 3-month follow-up data.</td>
<td>Good outcome scores (modified Rankin Scale score ≤2) was more common among young stroke patients (92.1% and 88.2% in the age ranges 18-45 and 18-55 years). Up to age 75, the probability of good outcome decreased by 3.1%-4.2% for each 10-year increase in chronological age. After age 75 the probability for good functional outcome declined ~ 10% per 10-year increment in age.</td>
</tr>
<tr>
<td>Palmcrantz et al.</td>
<td>2012</td>
<td>Sweden</td>
<td>A 1 year prospective longitudinal study including 192 stroke patients [63 younger stroke patients (&lt; 65 years)] with 12-month follow-up data.</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.</td>
<td>2012</td>
<td>Italy</td>
<td>A post-hoc analysis to evaluate the clinical course and factors associated with intravenous thrombolysis. The study included stroke patients aged 18-50 years (n=3246) and 51-80 (n=24425), from the Safe Implementation of Thrombolysis in Stroke-International Stroke Thrombolysis Register (SITS-ISTR).</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.</td>
<td>2012</td>
<td>Estonia</td>
<td>A prospective population study including 1206 young (&lt; 55 years) first ever stroke patients, investigating long-term survival rates.</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) and (2015) Netherlands Prospective No Score **Population:** Mean age=40.5yr; Gender: Males=369, Females=328. **Intervention:** Young adults (18-50yr) hospitalized for a stroke from 1980 to 2010 were followed up between 2009 and 2012. The mean follow-up time was 9.1±8.2yr. **Outcomes:** Mortality; Risk factors; Stroke etiology; Incidence of post-stroke epilepsy; Instrumental Activities of Daily Living (IADL); Modified Rankin Scale (mRS); Antiepileptic drug use; EuroQol-5D (EQ-5D) quality of living questionnaire.

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 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 participants.
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)
**Thailand**

**Population:** Mean age=63yr; 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).

<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Intervention</th>
<th>Outcomes</th>
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<tbody>
<tr>
<td>Dharmasaroja et al. (2013)</td>
<td>Thailand Prospective No Score TPS&lt;sub&gt;Mean&lt;/sub&gt;=NA N&lt;sub&gt;Start&lt;/sub&gt;=261 N&lt;sub&gt;End&lt;/sub&gt;=261</td>
<td>Patients with an ischemic stroke treated with an intravenous recombinant tissue plasminogen activator from 2007 to 2010 were included.</td>
<td>Stroke etiology; Prevalent risk factors; Mortality rate; Modified Rankin Scale (mRS).</td>
</tr>
</tbody>
</table>

1. The mortality rate was lowest in participants ≤60yr and increased with age (≤60yr=3%, 61-70=8%, 71-80=20%, ≥81=21%).
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%).

### Eun et al. (2013)
**South Korea**

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

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<th>Study</th>
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<th>Outcomes</th>
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<td>Eun et al. (2013)</td>
<td>South Korea</td>
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</table>

1. Recurrent strokes were significantly more prevalent in the 40–64yr group compared
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<th>Study Type</th>
<th>Score</th>
<th>TPS</th>
<th>Start N</th>
<th>End N</th>
<th>Intervention</th>
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<tr>
<td>Retrospective</td>
<td>No Score</td>
<td>Retrospective</td>
<td>No Score</td>
<td>TPS</td>
<td>Overall $&gt;26.4$mo</td>
<td>Start $N=551$</td>
<td>End $N=551$</td>
<td>Patients $&gt;40$yr with a first ever ischemic stroke from 2007 to 2009 were included. Patients were divided into age groups of 40-64yr ($N=235$) and $\geq65$yr ($N=316$).</td>
</tr>
<tr>
<td>Giang et al. (2013)</td>
<td>Sweden</td>
<td>Prospective</td>
<td>No Score</td>
<td>TPS</td>
<td>Mean $=NA$</td>
<td>Start $N=17,149$</td>
<td>End $N=17,149$</td>
<td>Patients 18-54yr with an ischemic stroke from 1987 to 2006 were included.</td>
</tr>
<tr>
<td>Gonzalez-Perez et al. (2013)</td>
<td>UK</td>
<td>Prospective</td>
<td>No Score</td>
<td>TPS</td>
<td>Mean $=NA$</td>
<td>Start $N=3036$</td>
<td>End $N=3036$</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>
</tr>
</tbody>
</table>
**Outcomes**: 30d case fatality following stroke; Excess mortality rate: <1yr, >1yr, Overall.

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 <1yr post-stroke was significantly higher for ICH and SAH survivors compared to healthy controls (Hazard ratio=2.60 and 2.87 respectively; p<0.01 for both); excess mortality <1yr post-stroke was not significantly different between ICH and SAH survivors.

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).

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**Hansen et al. (2013)**

**Sweden**

Prospective No Score

TPS\textsubscript{Mean}=NA

N\textsubscript{Start}=323

N\textsubscript{End}=172

**Population**: Mean age=70.4yr; Gender: Males=178, Females=145.

**Intervention**: A long-term follow-up of intracerebral hemorrhage (ICH) patients 18-75yr registered during 1996 was conducted.

**Outcomes**: 1-year survival after ICH onset.

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).

---

**Heikinheimo et al. (2013)**

**Finland**

Prospective No Score

**Population**: Mean age=44yr; Gender: Males=424; Females=257.

**Intervention**: 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.

1. From the 681 participants who met the inclusion criteria for this study, 10.3% had a preceding infection (PI) and 15.1% developed ≥1 post-stroke infection (PSI), most commonly pneumonia. The most
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<th>Study</th>
<th>Country</th>
<th>Study Design</th>
<th>Score</th>
<th>TPS Mean</th>
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<th>N End</th>
<th>Population</th>
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<tbody>
<tr>
<td>Janes et al.</td>
<td>Italy</td>
<td>Retrospective</td>
<td>No Score</td>
<td>TPS Mean=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>The incidence rate of stroke from 2007 to 2009 was determined in a population of 153312.</td>
<td>Outcomes: Stroke incidence; Case fatality rate for first ever stroke: 28d, 90d, 180d.</td>
</tr>
<tr>
<td>Kim et al.</td>
<td>South Korea</td>
<td>Retrospective</td>
<td>No Score</td>
<td>TPS Mean=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>Data from health insurance claims from 2006 to 2010 was analyzed.</td>
<td>Outcomes: Stroke incidence rates: Crude, Age-standardized; Readmission rates.</td>
</tr>
<tr>
<td>Kropp et al.</td>
<td>Europe</td>
<td>Retrospective</td>
<td>No Score</td>
<td>TPS Mean=NA</td>
<td>N Start=4431</td>
<td></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>Outcomes: Modified Rankin Scale (mRS); Prevalence of infections preceding and post-stroke; All-cause mortality.</td>
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</table>

**Outcomes:**

1. Increasing age was associated with a slightly lower risk of suffering from a headache during CVE (p<0.001).
2. In all statistical models examined, female patients had a higher risk of suffering from a headache during CVE (p<0.001 for all).
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.

4. Logistic regression analyses showed that the odds of a headache increased among participants who had an increasing size of the lesion (p<0.001) and the involvement of the middle (p<0.05) or vertebrobasilar territories (p<0.001).

Kuptniratsaikul et al. (2013)
Thailand
Prospective
No Score
TPS Mean = NA
N Start = 214
N End = 214

Population: Mean age=62.1±12.5yr; Gender: Males=124, Females=90.
Intervention: A multicenter analysis of long-term morbidities in participants with stroke was conducted. Follow-up assessments were conducted for at least 1yr post-stroke.
Outcomes: Occurrence of a headache during a cerebrovascular event (CVE); Lesion size; Lesion location.

1. Physical complications (mainly pain) at 1yr post-stroke were present in a significantly greater proportion of participants ≥60yr compared to participants <60yr (59.6% vs. 41.7%) (p=0.012).
2. Psychological complications (anxiety and depression) at 1yr post-stroke were not significantly different between age groups (<60yr=22.7%, ≥60yr=22.3%).
3. Age was significantly associated with the presence of complications during the first year post-stroke (p=0.027).

Martirosyan and Krupskaya (2013)
Russia
Retrospective
No Score
TPS Mean = NA
N Start = 1135
N End = 1135

Population: Mean age=NA; Gender: Males=NA, Females=NA.
Intervention: Patients who died of cerebral stroke were included.
Outcomes: Complications 1yr post-stroke: Physical, Psychological.

1. Patients <45yr accounted for 34 (3.0%) cases of death from 2000-2002 and from 2008-2010 compared to 200 (17.6%) in participants 45-59yr, 540 (47.6%) in participants 60-74yr, 356 (31.4%) in participants 75-89yr, and 5 (0.4%) in participants >90yr.
2. The mortality rate following stroke decreased from 5.3% in 2000 to 2.1% in 2010 in participants <45yr and from 21.1% to 12.4% in participants 45-59yr.

Rutten-Jacobs et al. (2013)
Netherlands
Prospective
No Score
TPS Mean = NA
N Start = 724
N End = 724

Population: Mean age=40.5±7.8yr; Gender: Males=344, Females=380.
Intervention: Patients 18-50yr with a first ever stroke from 1980-2010 were assessed during follow-up assessments from 2009-2012.
Outcomes: 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.

1. During a mean follow-up of 9.1yr, 19.6% of participants had at least 1 vascular event.
2. The cumulative 20yr 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 20yr 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 ≤1yr post-stroke (7.0%; 6.6%) and decreased to about 2% 5yr 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 18-29yr; 12.3% for 30-39yr; and 21.7% for 40-50yr.
7. The risk of a recurrent stroke was not significantly different between age groups (p=0.44): 18.6% for 18-29yr; 14.8% for 30-39yr; and 20.8% for 40-50yr.
8. Stroke subtypes of arterial stroke, cardioembolic stroke, and lacunar stroke were associated with recurrent stroke (HR=2.72; 2.49; 2.92).

Rutten-Jacobs et al. (2013) Netherlands Prospective No Score TPS\(\text{Mean}=\text{NA}\) \(N_{\text{Start}}=959\) \(N_{\text{End}}=959\) 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.

Schaapsmeerders et al. (2013) Netherlands Prospective No Score TPS\(\text{Mean}=\text{NA}\) \(N_{\text{Start}}=277\) \(N_{\text{End}}=277\) 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 Series Attention Test; Executive Functioning: Verbal Fluency, Stroop Interference.

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.

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).

52.9% were found to have a cardiac cause of stroke, 68% were found to have rheumatic mitral stenosis, and 45% having atrial fibrillation.

2. 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.

3. Mitral stenosis and alcohol intake were significantly correlated with a non-favorable outcome (p=0.0357; p=0.0135).

1. 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).
2. After a mean observation time of 18.3yr, 27.2% of 232 participants had died.
### Outcomes: Modified Rankin Scale (mRS); Memory problems; Risk factors; Work status.

3. Epileptic seizures were developed by 12 patients and 1 control after inclusion.
4. High blood pressure (<140/90mmHg) was present in 39% of participants, statins were used by 38.2% of participants, and 49% had stopped smoking.
5. Patients and controls did not differ concerning gender (p=0.65), and education (p=0.38).
6. 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 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).

### Wu et al. (2013)
China
Retrospective
No Score
TPS Mean=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. (2014)
Finland
Prospective
No Score
TPS Median>10.2yr
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.

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<th>N End</th>
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<th>Intervention</th>
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<tr>
<td>de Bruin et al. (2014)</td>
<td>Netherlands</td>
<td>Prospective</td>
<td>No Score</td>
<td>TPS_{Overall}&gt;1yr</td>
<td>N\text{Start}=96</td>
<td>N\text{End}=96</td>
<td>Median age=43.0yr; Gender: Males=44, Females=52.</td>
<td>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).</td>
<td>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.</td>
</tr>
<tr>
<td>Bulder et al. (2014)</td>
<td>Netherlands</td>
<td>Retrospective</td>
<td>No Score</td>
<td>TPS_{Mean}=6yr</td>
<td>N\text{Start}=17</td>
<td>N\text{End}=17</td>
<td>Mean age=19.3yr; Gender: Males=5, Females=12.</td>
<td>Patients aged 5-50yr with a first ever ischemic stroke in the middle cerebral artery (MCA) from 1994 to 2011 were included.</td>
<td>Stroke etiology; Modified Rankin Scale (mRS).</td>
</tr>
<tr>
<td>Chraa et al. (2014)</td>
<td>Morocco</td>
<td>Prospective</td>
<td>No Score</td>
<td>TPS_{Mean}=NA</td>
<td>N\text{Start}=128</td>
<td>N\text{End}=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>Prevalence of risk factors; Stroke etiology; Outcomes at follow-up; Modified Rankin Scale (mRS).</td>
</tr>
<tr>
<td>Ghatan et al. (2014)</td>
<td>USA</td>
<td>Prospective</td>
<td>No Score</td>
<td>TPS_{Overall}&gt;53mo</td>
<td>N\text{Start}=19</td>
<td>N\text{End}=19</td>
<td>Mean age=12.3yr; Gender: Males=13, Females=6.</td>
<td>Patients with a stroke who underwent surgery for epilepsy from 2005 to 2012 were included. The mean follow-up duration was 4.5yr.</td>
<td>Epilepsy duration; Modified Rankin Scale (mRS); Functional improvement: Cognition, Behaviour, Quality of life.</td>
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<tr>
<td>Study</td>
<td>Country</td>
<td>Study Design</td>
<td>Score</td>
<td>Mean Age</td>
<td>Gender</td>
<td>Intervention</td>
<td>Outcomes</td>
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<tr>
<td>Ghatanatti et al.</td>
<td>India</td>
<td>Retrospective</td>
<td>No Score</td>
<td>Mean age=27.2yr</td>
<td>Gender: Males=1, Females=3.</td>
<td>Patients who experienced a stroke following a valvular surgery and anticoagulant use were included.</td>
<td>Stroke etiology; Mortality; Surgical operation.</td>
<td>Stroke was classified as hemorrhagic in 3 participants and thromboembolic in 1 participant.</td>
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<td>2 participants with a hemorrhagic stroke died at a mean of 3.5d post-stroke and the other 2 participants were revived.</td>
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<td>Both participants that received a mitral valve replacement expired and both participants that received a double valve replacement were revived.</td>
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</tr>
<tr>
<td>Kalita et al.</td>
<td>India</td>
<td>Retrospective</td>
<td>No Score</td>
<td>Mean age= 41.6yr</td>
<td>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>
<td>1. At 1mo, 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).</td>
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<td>2. A multivariable analysis showed that low GCS (p&lt;0.001), large size ICH (p=0.01), and high leukocyte counts (p=0.03) were significantly associated with 1mo mortality.</td>
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</tr>
<tr>
<td>Khealani et al.</td>
<td>Pakistan</td>
<td>Retrospective</td>
<td>No Score</td>
<td>Mean age=59.7yr</td>
<td>Gender: Males=529, Females=345.</td>
<td>Patients &gt;14yr with an ischemic stroke in 2007 were included.</td>
<td>Prevalent risk factors; In-hospital complications; Modified Rankin Scale (mRS); Stroke etiology.</td>
<td>In-hospital complications were not significantly different between age groups with participants &lt;45yr reporting 10 cases of pneumonia, 3 cases of urinary tract infections and 1 case of gastrointestinal bleeding.</td>
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<td>2. mRS scores at discharge were not significantly different between age groups with participants &lt;45yr showing a poor functional outcome (mRS=2) in 81 (65.8%) cases compared to 64.8% for &gt;45yr.</td>
<td></td>
</tr>
<tr>
<td>Koton et al.</td>
<td>Israel</td>
<td>Retrospective</td>
<td>No Score</td>
<td>Mean age=54.1±5.8yr</td>
<td>Gender: Males=6402, Females=7955.</td>
<td>The incidence rate of stroke from 2007 to 2009 was determined in a population.</td>
<td>Stroke incidence rate; Crude cumulative incidence of mortality.</td>
<td>The crude cumulative incidence of mortality 30d post-stroke was 0.11 for patients &lt;65yr and 0.10 for patients ≥65yr.</td>
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<td>The crude cumulative incidence of mortality 1yr post-stroke was 0.18 for patients &lt;65yr and 0.123 for patients 65yr.</td>
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<td>The crude cumulative incidence of mortality 5yr post-stroke was 0.0.34 for patients&lt;65yr and 0.44 for patients ≥65yr.</td>
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<td>The crude cumulative incidence of mortality at the end of follow-up was 0.49for patients &lt;65yr and 0.66 for patients ≥65yr.</td>
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<tr>
<td>Liu et al.</td>
<td>China</td>
<td>Prospective</td>
<td>No Score</td>
<td>Mean age=37.6±6.2yr</td>
<td>Gender: Males=134, Females=45.</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 antithrombotic 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</td>
<td>Prevalent risk factors; ICH etiology; Glasgow Outcome Scale (GOS); 1mo mortality.</td>
<td>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).</td>
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<td>2. The 2yr cumulative stroke-free survival rate was significantly greater in the AMM group.</td>
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<td>Study</td>
<td>Country</td>
<td>Study Design</td>
<td>No Score</td>
<td>TPS Mean</td>
<td>N Start</td>
<td>N End</td>
<td>Population</td>
<td>Intervention</td>
<td>Outcomes</td>
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<tr>
<td>Lindmark et al.</td>
<td>Sweden</td>
<td>Retrospective</td>
<td>No Score</td>
<td>NA</td>
<td>62,497</td>
<td>62,497</td>
<td>Mean age=NA; Gender: Males=NA, Females=NA</td>
<td>The fatality rate of stroke participants from 2001 to 2009 was determined.</td>
<td>1. Outcomes: Angiographic outcomes at follow-up; 2yr cumulative stroke-free survival rate; Recurrent stroke rate. 2. Outcomes: Case fatality rates. 3. Recurrent strokes occurred in a significantly greater proportion of RMM participants compared to AMM (18.9% vs. 1.7%) (p=0.001).</td>
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<tr>
<td>Maaijwee et al.</td>
<td>Netherlands</td>
<td>Prospective</td>
<td>No Score</td>
<td>NA</td>
<td>437</td>
<td>437</td>
<td>Mean age: TIA: 40.9±8.0yr, Ischemic Stroke: 40.0±7.7yr; Gender: Males=198, Females=239.</td>
<td>Patients 18-50yr with a first ever stroke from 1980 to 2010 were included. Ischemic stroke participants were also compared to healthy controls.</td>
<td>1. Subjective memory failures were prevalent in 378 (86.4%) of participants. 2. Subjective executive failures were prevalent in 294 (67.4%) of participants. 3. The prevalence of subjective executive and memory failures was not significantly different between ischemic stroke and TIA participants. 4. Subjective memory failures were significantly more prevalent in ischemic stroke participants compared to healthy controls (p&lt;0.01). 5. Subjective executive failures were significantly more prevalent in ischemic stroke participants compared to healthy controls (p&lt;0.01).</td>
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21. The Rehabilitation of Younger Stroke Patients

**Park et al. (2014)**
South Korea
Case Series
No Score
TPS\_Young=NA
TPS\_Elderly=NA
N\_Start=25,818
N\_End=25,818

**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 with event and process of care; Clinical parameters; Laboratory and radiologic examinations; Emergency care procedures; Mortality at discharge; Modified Rankin Scale (mRS).

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), 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
Prospective
No Score
TPS\_Mean=NA
N\_Start=427
N\_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.

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<th>Study</th>
<th>Country</th>
<th>Type</th>
<th>Score</th>
<th>TPS</th>
<th>Mean</th>
<th>Start</th>
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<tr>
<td><strong>Synhaeve et al. (2014)</strong></td>
<td>Netherlands</td>
<td>Prospective</td>
<td>No</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Population: Mean age=40.5±7.8yr; Gender: Males=344, Females=378.</td>
<td>Intervention: Patients with first-ever stroke admitted between 1980 and 2010 were followed for an average of 9.1yr.</td>
<td>Outcomes: Modified Rankin Scale (mRS); Instrumental Activities of Daily Living Scale (iADL).</td>
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<td>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 &gt;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 49.3% with ICH.</td>
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<td>2. At follow-up, 10.8% participants with TIA, 14.6% with IS, and 18.2% with ICH had a poor outcome on the iADL (iADL&lt;8).</td>
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<td>3. Patients with an incident stroke (N=91) more often had poor outcomes than participants without a recurrent stroke according to the mRS (54.9% vs. 28.7%; p&lt;0.001) and iADL (33.3% vs. 11.5%; p&lt;0.001).</td>
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<td>4. The proportion of participants with poor functional outcomes was significantly different in participants with the index event before 1990, between 1990 and 2000, and after 2000 (p&lt;0.001).</td>
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<td>5. Patients admitted before 1990 had more incident strokes than those admitted after 2000 (17.0% vs. 10.1%, p=0.036).</td>
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<td>6. Significant predictors of poor functional outcomes according to the mRS were NIHSS at admission (p&lt;0.001), incident stroke (p&lt;0.001), age at baseline (p=0.002), and incident cardiovascular disease (p&lt;0.001).</td>
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<td>7. Significant predictors of poor functional outcomes according to the iADL were NIHSS at admission (p&lt;0.001) and incident stroke (p&lt;0.001).</td>
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<td><strong>Tsivgoulis et al. (2014)</strong></td>
<td>Greece</td>
<td>Retrospective</td>
<td>No</td>
<td>NA</td>
<td>NA</td>
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<td>Population: Mean age=37.4±7.0yr; Gender: Males=667, Females=467.</td>
<td>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.</td>
<td>Outcomes: Mortality; Modified Rankin Scale (mRS); Risk factors; National Institute of Health Stroke Scale (NIHSS).</td>
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<td>1. White participants had lower stroke severity according to NIHSS scores at hospital admission than Black and Asian participants (p&lt;0.017 for both).</td>
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<td>2. Intracerebral hemorrhage was more common in Blacks (26.6%) than in the combined subgroup of Whites and Asians (10.4%, p&lt;0.001).</td>
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<td>3. The 30d mortality rate was 5.8% for the entire population and was significantly different across the three races (p&lt;0.001): Blacks 10.0%, Whites 6.0%, Asians 1.9%.</td>
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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 demonstrating favorable functional outcome.

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).

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**Zanaty et al. (2014)**

USA
Prospective
No Score
TPS Mean = NA
N Start = 15
N End = 15

**Population:** Mean age=27.93±6.75yr; Gender: Males=6, Females=9.

**Intervention:** Young participants from a selected database were prospectively analysed for endovascular treatment.

**Outcomes:** Modified Rankin Scale (mRS); Recanalization outcome; Morbidity at 90d; Mortality at 90d; Mechanical thrombectomy system: Penumbra system, Merci Retriever, Solitaire FR device.

1. Successful recanalization (thrombolysis in cerebral infarction (TICI) of 2-3) was achieved in 93.33% of participants.
2. The rate of 90d favourable outcome according to mRS scores <2 was 86.67%.
3. The 90d overall morbidity rate was 13.33% and the 90d mortality rate was 6.67%.
4. 100% of participants treated with the Solitaire FR device had a mRS score of 0-1.
5. Favorable outcomes (mRS<2) were noted in 81.81% of those treated with the Merci/Penumbra thrombectomy systems.

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**Aarnio et al. (2015)**

Finland
Prospective
No Score
TPS Median > 10.0yr
N Start = 1002
N End = 1002

**Population:** Median age=44yr; Gender: Males=626, Females=376.

**Intervention:** 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.

**Outcomes:** Mortality; Risk factors; Stroke etiology; Cancer prevalence.

1. At follow-up, 177 (17.7%) participants had died.
2. Recurrent strokes had occurred in 134 (13.4%) participants.
3. Cancer was diagnosed in 77 (7.7%) of participants with 36 (3.6%) diagnosed before stroke, 3 during hospitalization and 38 (3.8%) post-stroke.
4. Cancer was diagnosed in 0 participants in the 15-29yr age range, 11 participants in the 30-39yr age range and 66 in the 40-49yr range. The cumulative risk of death was significantly higher in cancer participants vs. non-cancer participants (24.8% vs. 19.7%; p<0.05).
### de Bruijn et al. (2015)

**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.

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.

### Fullerton et al. (2015)

**Population:** Median age=19yr; Gender: Males=111, Females=102.

**Intervention:** 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).

**Outcomes:** Prevalent risk factors; Recurrent stroke characteristics.

1. Recurrent strokes occurred in 52 (19.2%) participants.
2. Age at first stroke was significantly different between groups with a greater proportion of participants with recurrent stroke experiencing a stroke at 18-29yr (recurrent=25%, non-recurrent=17%; p=0.0003), 30-39yr (recurrent=37%, non-recurrent=20%; p<0.0001), and ≥40yr (recurrent=15%, non-recurrent=11%; p=0.0004).
3. A greater proportion of non-recurrent stroke participants experienced a first stroke in the 0-17yr group compared to recurrent stroke participants (recurrent stroke=23%, non-recurrent=53%).

### Huang et al. (2015)

**Population:** Mean age=41.0±6.8yr; Gender: Males=69.7%; Females=30.3%.

**Intervention:** 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.

**Outcomes:** Post-stroke cognitive impairment/cognition.

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
Retrospective
No Score
TPS\(\text{Mean}=\text{NA}\)
\(N_{\text{Start}}=78,096\)
\(N_{\text{End}}=78,096\)

**Population:** Mean age: Females=75.5±12.1yr, Males=69.7±11.6yr; Gender: Males=47465, Females=30631.

**Intervention:** Patients with an ischemic stroke from 2000 to 2012 were included.

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

1. mRS scores at discharge indicated poorer functional outcomes (mRS>2) in older age groups compared to participants <50yr.
2. Initial NIHSS scores were lowest in participants <50yr and increased with age.

### Kristnamurthi et al. (2015)
US
Retrospective
No Score
TPS\(\text{Mean}=\text{NA}\)
\(N_{\text{Start}}=\text{NA}\)
\(N_{\text{End}}=\text{NA}\)

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

**Intervention:** The global prevalence of stroke, mortality, disability-adjusted life years and their trends for ischemic and hemorrhagic stroke was assessed for individuals 20–64yr.

**Outcomes:** Disability-adjusted life years (DALYs); Stroke mortality; Prevalence of stroke.

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 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.

### Maaijwee et al. (2015)
Netherlands
Retrospective
No Score
TPS\(\text{Mean}>8.3\text{yr}\)
\(N_{\text{Start}}=511\)
\(N_{\text{End}}=511\)

**Population:** Mean age: TIA=40.5±8.1yr, Ischemic Stroke=40.1±7.8yr; Gender: Males=198, Females=239.

**Intervention:** Patients 18–50yr with a first ever stroke from 1980 to 2010 were included.

**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%) \((p=0.0005)\).
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.

### Man et al. (2015)
China
Prospective
No Score
TPS\(\text{Overall}>6\text{mo}\)
\(N_{\text{Start}}=105\)
\(N_{\text{End}}=105\)

**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.

**Intervention:** Patients with stroke were recruited and administered a survey. Participants were divided between age: <55yr (YS) and >55yr (OS).

**Outcomes:** Prevalence of risk factors; Brief Assessment of Prospective Memory (BAPM): Basic activities of daily living, Instrumental activities of daily living.

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 \((p<0.001)\).
### Rutten-Jacobs et al. (2015)
**Netherlands**
Prospective
No Score
TPS\(_{\text{Mean}}\)=NA
\(N_{\text{Start}}\)=845
\(N_{\text{End}}\)=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**
Prospective
No Score
TPS\(_{\text{Mean}}\)=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. 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).
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).

### Simonetti et al. (2015)
**Switzerland**
Retrospective
No Score
TPS\(_{\text{Mean}}\)=NA
\(N_{\text{Start}}\)=249
\(N_{\text{End}}\)=249

**Population:** Mean age=NA; Gender: Males=133, Females=116.
**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 adults 16-45yr (N=154).
**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. Recurrent stroke occurred in 5 (6%) children and 7 (5%) young adults.
2. The proportion of favourable long term outcomes (mRS<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%);
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%).

9. 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%).

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

<table>
<thead>
<tr>
<th>Synhaeve et al.</th>
<th>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, Visuoconstruction, Attention, Executive functioning, Global cognitive function.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2015) Netherlands Prospective No Score TPSMean=NA</td>
<td>1. At follow-up, a poor functional outcome according to mRS score &gt;2 was observed in 8.3% of participants and a poor iADL outcome (score &lt;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.</td>
</tr>
<tr>
<td>NStart=277 NEnd=277</td>
<td></td>
</tr>
</tbody>
</table>
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  
Retrospective  
No Score  
TPSMean=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  
Retrospective  
No Score  
TPSMean=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.

21.5 Rehabilitation of Younger Stroke Patients

21.5.1 Perception of Care

<table>
<thead>
<tr>
<th>Author, Year Country PEDro Score</th>
<th>Methods</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kappelle et al. (1994) Sweden No Score</td>
<td>212 ischemic stroke patients (aged 15-45 years) 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 to rehabilitation. About 50% of patients reported residual problems with their physical...</td>
</tr>
</tbody>
</table>
or social functioning. Over 1/4 of the patients rated quality of life poor in these spheres. Almost half were diagnosed as depressed.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Country</th>
<th>Score</th>
<th>Methodology</th>
<th>Study Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kersten et al. (2002)</td>
<td>UK</td>
<td>No Score</td>
<td>Questionnaire Distribution</td>
<td>639 Southampton Needs Assessment Questionnaires were distributed to people with stroke for 2 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.</td>
</tr>
<tr>
<td>Low et al. (2003)</td>
<td>UK</td>
<td>200</td>
<td>Questionnaire Distribution</td>
<td>200 Southampton Needs Assessment Questionnaires were distributed to young stroke patients and 135 (65%) were returned. Unmet needs included intellectual fulfillment for 44 (34%) of patients, physiotherapy for 43 (33%), and help with activities of non-care in 43 (33%).</td>
</tr>
<tr>
<td>Röding et al. (2003)</td>
<td>Sweden</td>
<td>No Score</td>
<td>Qualitative Interview</td>
<td>A 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.</td>
</tr>
<tr>
<td>Dixon et al. (2007)</td>
<td>UK</td>
<td>No Score</td>
<td>Interviews</td>
<td>Interviews conducted with 24 adults with neurologic disabilities regarding experiences in inpatient rehabilitation. 8 stroke patients were included, mean age of all participants was 38.1 (range 17-59). Interviews examined by 3 reviewers and 11 themes identified. Themes identified include self-reliance, independence, importance of determination, working in partnership with the multidisciplinary team, patient’s information needs, goal setting, value of vicarious experiences of other inpatients, self-recognition of progress, and necessity of external reassurance. Rehabilitation difficulties were identified with self-efficacy and time structuring. Two perspectives on rehabilitation were ‘recovery’ and ‘adaptation’.</td>
</tr>
<tr>
<td>Hama et al. (2007)</td>
<td>Japan</td>
<td>No Score</td>
<td>Population and Intervention</td>
<td>452 stroke patients were examined for effect of sitting balance on activities of daily living (ADL). Sample was divided to compare young patients (&lt;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.</td>
</tr>
<tr>
<td>Muller et al. (2014)</td>
<td>USA</td>
<td>Pre-Post</td>
<td>TPS Population and Intervention</td>
<td>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 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 ($\Delta M=12.3$) ($p=0.034$).</td>
</tr>
</tbody>
</table>
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 function, Strength, Self-perceived recovery.

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 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

<table>
<thead>
<tr>
<th>Author, Year Country PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hindfelt and Nilsson (1977)</strong> Sweden No Score</td>
<td>60 young adults (age 16-40 years, mean age at stroke onset was 30.85 years) with acute ischemic stroke were included. Patients were followed for 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 and Nias (1979)</strong> UK No Score</td>
<td>90 stroke 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>Study</strong></td>
<td><strong>Methodology</strong></td>
<td><strong>Results</strong></td>
</tr>
<tr>
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<tr>
<td><strong>Coughlan and Humphreys (1982)</strong>&lt;br&gt;UK&lt;br&gt;No Score</td>
<td>The spouses of 170 surviving stroke patients 3 to 8 years after having suffered a stroke 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 (66%) husbands remained in paid employment.</td>
</tr>
<tr>
<td><strong>Hindfelt and Nilsson (1992)</strong>&lt;br&gt;Sweden&lt;br&gt;No Score</td>
<td>74 young adults (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>7 patients required constant help for their everyday activities from another person. Although, most of these patients had minor needs and only one of them was institutionalized. Children were born in 16 of the families directly affected by stroke. 3 women were pregnant at the time of stroke and 5 patients become pregnant after. 8 men had children following stroke. Only one patient divorced as a consequence of stroke.</td>
</tr>
<tr>
<td><strong>Teasell et al. (2000)</strong>&lt;br&gt;Canada&lt;br&gt;No Score</td>
<td>83 consecutive stroke patients younger than 30 and admitted to a Canadian tertiary-care hospital rehabilitation unit were included.</td>
<td>The main caregivers were spouses of 53% of the patients. Fourteen of the patients younger then 28 years old were cared for mainly by parents or grandparents. Primary caregivers were parents for 24% of the cases and in two cases a 15-year-old daughter became the primary caregiver. In addition, 7 relatives other than spouse or parents were acknowledged to be the primary caregivers. In cases of elderly stroke patients often family roles are switched as children become primary caregiver's to their parents.</td>
</tr>
<tr>
<td><strong>Lackey and Gates (2001)</strong>&lt;br&gt;USA&lt;br&gt;No Score</td>
<td>51 adults, ages 19 to 68 years, who were 3 to 19 years when their parent(s) suffered from a disability or disease including stroke were included in a retrospective study investigating the effects that caregiving has on younger children and how it has affected them as adults.</td>
<td>5 patients were stroke patients. Caregivers reported that caregivers brought their family closer together. Caregivers reported that personal care was the most difficult and home tasks took up the most time. Areas of a caregiver’s life most affected were school, family life and time with friends. Children often helped in caregiving as long as they were not the sole caregiver.</td>
</tr>
<tr>
<td><strong>Leys et al. (2002)</strong>&lt;br&gt;France&lt;br&gt;No Score</td>
<td>287 ischemic stroke patients aged 15 to 45 years were included to determine 3-year relationship outcomes.</td>
<td>At follow-up 20 (7%) patients reported divorce as a result of stroke.</td>
</tr>
<tr>
<td><strong>Kersten et al. (2002)</strong>&lt;br&gt;UK&lt;br&gt;No Score</td>
<td>639 Southampton Needs Assessment Questionnaires were distributed to people with stroke for 2 age groups (18-45 years; 46-65 years) suffering from chronic stroke.</td>
<td>Difficulties in sex life were reported in 64% of the patients who thought questions about the changes in their sex life were appropriate.</td>
</tr>
<tr>
<td><strong>Röding et al. (2003)</strong>&lt;br&gt;Sweden&lt;br&gt;No Score</td>
<td>A qualitative interview for 2 women and 3 men from age 37 to 54 years who suffered from stroke.</td>
<td>Fatigue interfered with the ability to participate in daily activities. In women, fatigue hindered their ability to provide and care for their children’s needs. Since the women had always handled household duties and the needs of their</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Score</td>
</tr>
<tr>
<td>-------------------------------------------</td>
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</tr>
<tr>
<td>Rodriguez et al. (2004)</td>
<td>Spain</td>
<td>No</td>
</tr>
<tr>
<td>Visser-Meily et al. (2005)</td>
<td>The Netherlands</td>
<td>No</td>
</tr>
<tr>
<td>Visser-Meily et al. (2005)</td>
<td>The Netherlands</td>
<td>No</td>
</tr>
<tr>
<td>Cameron et al. (2011)</td>
<td>Canada</td>
<td>No</td>
</tr>
<tr>
<td>Martinsen et al. (2012)</td>
<td>Norway</td>
<td>No</td>
</tr>
<tr>
<td>Jones &amp; Morris (2013)</td>
<td>A qualitative study was conducted with patients who survived a stroke and identified their parents as their carer at some point since stroke. SS/caregiver dyads (n=17; 6 adults stroke survivors, 6 mothers and 5 fathers). This study explored SS’, mothers’, and fathers’ experiences separately. Time since stroke ranged from 1y 7m to 7y 6m.</td>
<td>A high degree of concordance was found 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.</td>
</tr>
</tbody>
</table>
| Lawrence and Kinn et al. (2013) | Population: Mean age=41.3yr; Gender: Males=6, Females=5. Intervention: The family members of young stroke participants underwent one-on-one interviews lasting 15min-1hr for a mean of 2.2 interviews over a mean of 1.3yr. Outcomes: Family members’ responses. | 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) | Population: Mean age=51±8.75yr; Gender: Males=7, Females=1. Intervention: Couples consisting of one individual with stroke and their partner shared experiences of when one partner had a stroke at a young age in structured interviews. Outcomes: Emerging interview themes: making sense of the stroke, conceptions of caring and having been cared for, transition of relationship. | 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 21.7 Studies Evaluating Institutionalization of Young Stroke Patients

<table>
<thead>
<tr>
<th>Author, Year, Country PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>MacKay and Nias (1979) UK No Score</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>
</tr>
<tr>
<td>Hindfelt and Nilsson (1992) Sweden No Score</td>
<td>74 young adults (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>
</tr>
<tr>
<td>Adunsky et al. (1992) Israel No Score</td>
<td>35 young stroke 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>
</tr>
<tr>
<td>Lindberg et al. (1992) USA No Score</td>
<td>324 consecutive long-term survivors of subarachnoid hemorrhage (SAH) 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>
</tr>
<tr>
<td>Falconer et al. (1994) USA No Score</td>
<td>260 patients with acute stroke (&lt;120 days) 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>
</tr>
<tr>
<td>Teasell et al. (2000) Canada No Score</td>
<td>83 consecutive stroke 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>
</tr>
<tr>
<td>Schnitzler et al. (2014) France Prospective No Score TPS Mean=NA NStart=33,896 NEnd=33,896</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</td>
</tr>
</tbody>
</table>
10.0% of stroke participants 18-59yr and in 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 Young Stroke Patients

<table>
<thead>
<tr>
<th>Author, Year Country PEDro Score</th>
<th>Methods</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Isaacs et al. (1976)</strong> UK No Score</td>
<td>29 stroke 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><strong>Hindfelt and Nilsson (1977)</strong> Sweden No Score</td>
<td>60 young adults (age 16-40 years, mean age at stroke onset was 30.85 years) who suffered an acute ischemic stroke 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><strong>MacKay and Nias (1979)</strong> UK No Score</td>
<td>90 stroke patients under the age of 65 years included.</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><strong>Coughlan and Humphreys (1982)</strong> UK No Score</td>
<td>The spouses of 170 surviving stroke patients 3 to 8 years post-stroke 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><strong>Sjogren (1982)</strong> Sweden No Score</td>
<td>51 stroke 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 reduced following stroke.</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Sample Details</td>
</tr>
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<td>-------------------------------</td>
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</tr>
<tr>
<td>Bogousslavsky and Regli (1987)</td>
<td>Switzerland</td>
<td>41 ischemic stroke patients under 30 years of age were included. Mean follow-up was 46 months post-stroke.</td>
</tr>
<tr>
<td>Black-Schaffer and Osberg (1990)</td>
<td>USA</td>
<td>79 first-ever stroke patients aged 21 to 65 years, employed at the time of stroke, discharged from rehabilitation at least 6 months before follow-up and available for a telephone questionnaire were included. Work was defined as full-time and part-time competitive employment, homemaking, and full-time university studies.</td>
</tr>
<tr>
<td>Hindfelt and Nilsson (1992)</td>
<td>Sweden</td>
<td>74 young ischemic stroke patients between the ages of 16 and 40 (&gt;1 month post stroke) were included in this study. Follow up ranged from 13-26 years following stroke onset.</td>
</tr>
<tr>
<td>Lindberg et al. (1992)</td>
<td>USA</td>
<td>324 consecutive long-term survivors of subarachnoid hemorrhage (SAH) included.</td>
</tr>
<tr>
<td>Saeki et al. (1993)</td>
<td>Japan</td>
<td>230 first-ever stroke patients younger than 65 years of age and working as a student, housewife or employed at the time of stroke included. Mean follow-up length was 43 months.</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Score</td>
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<tr>
<td>Ferro &amp; Crespo (1994)</td>
<td>Portugal</td>
<td>No Score</td>
</tr>
<tr>
<td>Kappelle et al. (1994)</td>
<td>Sweden</td>
<td>No Score</td>
</tr>
<tr>
<td>Saeki et al. (1995)</td>
<td>Japan</td>
<td>No Score</td>
</tr>
<tr>
<td>Malm et al. (1998)</td>
<td>Sweden</td>
<td>No Score</td>
</tr>
<tr>
<td>Neau et al. (1998)</td>
<td>France</td>
<td>No Score</td>
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<tr>
<td>Marini et al. (1999)</td>
<td>Italy</td>
<td>No Score</td>
</tr>
<tr>
<td>Teasell et al. (2000)</td>
<td>Canada</td>
<td>No Score</td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Age Range</td>
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<tr>
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<tr>
<td>Kersten et al. (2002)</td>
<td>UK</td>
<td>18-45; 46-65</td>
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<tr>
<td>Leys et al. (2002)</td>
<td>France</td>
<td>15-45</td>
</tr>
<tr>
<td>Musolino et al. (2003)</td>
<td>Italy</td>
<td>17-45</td>
</tr>
<tr>
<td>Vestling et al. (2003)</td>
<td>Sweden</td>
<td>15-55</td>
</tr>
<tr>
<td>Röding et al. (2003)</td>
<td>Sweden</td>
<td>37-54</td>
</tr>
<tr>
<td>Rodriguez et al. (2004)</td>
<td>Spain</td>
<td>15-55</td>
</tr>
</tbody>
</table>
### Varona et al. (2004) Spain No Score

272 young stroke patients with ischemic stroke were reviewed over 27 years to identify potential predictors of mortality, reoccurrence of stroke and poor functional recovery. 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.

### Hofgren et al. (2007) Sweden No Score

Information about vocational status before and after first ever stroke of 58 patients below the age of 65 was gathered. 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.

### Glozier et al. (2008) New Zealand No Score

210 younger stroke 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. 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.

### Gabriele & Renate (2009) Germany No Score

70 stroke survivors younger than 65 that were employed prior to their stroke were examined regarding their employment. Patients were examined a year following the first interview. 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.

### Lindström et al. (2009) Sweden No Score

1068 patients between the ages of 18-55 years who experienced first ever stroke were contacted to gain information about their life following stroke. 82% were working at the time of their stroke and 65% returned to work post-stroke, with no significant difference between males and females or age groups. Those who were self-employed were more likely to return to work than those in private or public employment. Higher socioeconomic status and the belief that the patient would not be a burden on others were also associated with a greater rate of return to work.

### Saeki & Toyonaga (2010) Japan No Score

In a prospective cohort study, data from 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,
This review reports the rate of successful return to work (RTW) for younger stroke survivors with aphasia. Nine studies were identified (aphasia N=415, total N=1612).

**Graham et al.** (2011)  
**Canada**  
**No Score**  
Younger survivors with aphasia were less likely to return to work post stroke than those without. The average rate of successful RTW for young survivors with aphasia was 28.4% compared to 44.7% for all young stroke survivors.

**Hackett et al.** (2012)  
**Australia**  
**No Score**  
A prospective cohort study, with data from 271 stroke survivors (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).

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.

**Peters et al.** (2013)  
**Nigeria**  
**No Score**  
A Prospective cohort study, including 101 community dwelling stroke survivors (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.

**McAllister et al.** (2013)  
**New Zealand**  
**No Score**  
A comparative cohort 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.

**Kauranen et al.** (2013)  
**Finland**  
**Retrospective**  
**No Score**  
**TPS Mean = NA**  
**NStart=140**  
**NEnd=140**  
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<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<0.01), education (p<0.05), 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.

<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Intervention</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maaijwee et al.</strong> (2014)</td>
<td>Mean age=NA; Gender: Males=296, Females=398.</td>
<td>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.</td>
<td>Unemployment post-stroke was reported by 202 (29.1%) participants in 2010. Full and partial unemployment in women 35-44yr was significantly more prevalent compared to the general population (26.8% vs. 7.3%) (p&lt;0.0001). Full and partial unemployment in women 45-54yr was significantly more prevalent compared to the general population (25.9% vs. 11.9%) (p&lt;0.0001). Full and partial unemployment in men 35-44yr was significantly more prevalent compared to the general population (32.9% vs. 5.0%) (p&lt;0.0001). Full and partial unemployment in men 45-54yr was significantly more prevalent compared to the general population (26.6% vs. 9.4%) (p&lt;0.0001).</td>
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<tr>
<td>Netherlands Retrospective</td>
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<td></td>
</tr>
<tr>
<td>No Score</td>
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<tr>
<td>TPSoverall&gt;8.1yr</td>
<td></td>
<td></td>
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<tr>
<td>Nstart=694</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nend=694</td>
<td></td>
<td></td>
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<tr>
<td><strong>de Bruijn et al.</strong> (2015)</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>Poor functional outcomes (mRS&gt;2) were observed in 10.6% of participants. The current employment rate was significantly greater in healthy controls compared to post-stroke participants (stroke=63.5%, no stroke=95.1%; p&lt;0.001). Anxiety was prevalent in 53 (31.9%) patients. Depression was prevalent in 61 (37.2%) patients. Unemployment at follow-up was significantly correlated with the Physical health domain of the WHOQOL (p=0.01), fatigue (p&lt;0.001), a higher mRS score (p&lt;0.001), and presence of depression (p&lt;0.001) and anxiety (p&lt;0.001).</td>
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<td>Netherlands Retrospective</td>
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<td>Nend=170</td>
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</table>

### Table 21.9.1 Studies Evaluating Future Needs for Young Stroke Patients

<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Intervention</th>
<th>Outcomes</th>
</tr>
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<tbody>
<tr>
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<td>TPSoverall&gt;8.1yr</td>
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<tr>
<td>Nstart=694</td>
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<tr>
<td>Netherlands Retrospective</td>
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<tr>
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<td>TPSoverall&gt;4.9yr</td>
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<td>Nend=170</td>
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<td>Author, Year Country PEDro Score</td>
<td>Methods</td>
<td>Outcomes</td>
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<td>---------------------------------</td>
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<tr>
<td><strong>Hartke &amp; Brashler (1994) USA</strong> No Score</td>
<td>These patients were on average 44 years (range 21-57) of age and 4 years post-stroke onset (range 1-21 years),</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>
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</tr>
<tr>
<td><strong>Röding et al. (2003) Sweden</strong> No Score</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>
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<tr>
<td><strong>Stone (2005) Canada</strong></td>
<td>22 female hemorrhagic stroke survivors, 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>
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</tr>
<tr>
<td><strong>Naess et al. (2005b) Norway</strong></td>
<td>196 patients (aged 15-49) were studied after their first stroke (mean follow-up time 6 years) 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>
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<tr>
<td><strong>Naess et al. (2006) Norway</strong> No Score</td>
<td>232 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 fatigued had significantly reduced score for all the items of the SF-36.</td>
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<tr>
<td><strong>Stone (2007) Canada</strong> No Score</td>
<td>83 narratives were drawn from a stroke survivor internet site. Content analysis was performed to determine themes.</td>
<td>71% of the writers were women. Majority were &lt;48 years of age (96% of females and 79% of males). The majority of writers were &lt;10 years post-stroke. Themes identified included symptoms, doctors and hospitals, rehabilitation</td>
<td></td>
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</tbody>
</table>
and recovery, disabilities, and misc. reflections. Overall, narrators show a need to share and discuss their experiences with other survivors.

### Snögren et al. (2009)

**Sweden**

71 patients between the ages of 22 and 64 were interviewed and filled out a questionnaire to help identify disabilities following stroke. An average of 22 months had passed since stroke onset. Only one patient had no symptoms at all, 24% had no significant disabilities, 24% had slight disability, 21% had moderate disability, 24% had moderately severe disability and one person had a severe disability. 15% had impaired communication, 62% presented with muscle weakness, 40% were walking impaired and 25% had depression. The most difficult issues were activities that were physically demanding. Environmental factors seen as barriers to accomplishing tasks were sound, societal attitudes and community members.

### Bugnicourt et al. (2014)

**France**

**Prospective**

<table>
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<th>No Score</th>
<th>TPS Overall</th>
<th>Start</th>
<th>End</th>
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<td></td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>13.1mo</td>
<td>156</td>
<td>104</td>
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</tbody>
</table>

**Population:** Mean age = 48.0yr; Gender: Males = 62, Females = 44.

**Intervention:** A questionnaire relating to sexual function was mailed to participants under 60yr with a first ever ischemic stroke or TIA from 2010 to 2012.

**Outcomes:** Prevalence of sexual impairment post-stroke; Living situation; Prevalence of risk factors; Current drug treatment; Hospital Anxiety and Depression Scale (HADS): Anxiety, Depression.

1. Participants reported living with a partner in 84 (81%) cases, living alone in 20 (19%) cases, and 2 participants reported being divorced.
2. Impaired sexual activity was reported in 30 (29%) participants.
3. No significant differences in the main risk factors were observed between sexually impaired participants and not sexually impaired participants.
4. Angiotensin-converting enzyme (ACE) inhibitors were significantly more likely to be taken by sexually impaired participants vs. not sexually impaired participants (73% vs. 31%; p<0.001).
5. Diuretics were significantly more likely to be taken by sexually impaired participants vs. not sexually impaired participants (50% vs. 19%; p=0.003).
6. Anxiety was reported in a significantly greater proportion of sexually impaired participants vs. not sexually impaired participants (43% vs. 15%; p=0.004).
7. Depression was reported in a significantly greater proportion of sexually impaired participants vs. not sexually impaired participants (40% vs. 7%; p<0.001).

### Chen et al. (2014)

**Taiwan**

**Retrospective**

<table>
<thead>
<tr>
<th>No Score</th>
<th>TPS Mean = NA</th>
<th>Start</th>
<th>End</th>
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<tr>
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<td>N</td>
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<tr>
<td>568</td>
<td>568</td>
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</table>

**Population:** Mean age = 65.71yr; Gender: Males = 283, Females = 285.

**Intervention:** Patients <65yr, 65-75yr and ≥75yr with a stroke admitted for rehabilitation between 2002 and 2012 were retrospectively reviewed.

**Outcomes:** Stroke characteristics; Prevalence of depression and anxiety; Prevalence of risk factors.

1. The prevalence of depression at the initial hospitalization was not significantly different between age groups (<65yr = 5.5%, 65-75 = 9.2%, ≥75 = 5.2%) (p=0.214).
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).

### Palmcrantz et al. (2014)

**Population:** Mean age = 57±6yr; Gender: Males = 100, Females = 50.

1. Prevalent self-reported impairments included fatigue in 67 (45%) participants,
<table>
<thead>
<tr>
<th>Country</th>
<th>Design</th>
<th>Score</th>
<th>TPS Mean</th>
<th>N Start</th>
<th>N End</th>
<th>Population</th>
<th>Intervention</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>Prospective</td>
<td>No Score</td>
<td>Mean=NA</td>
<td>Start=150</td>
<td>End=150</td>
<td>Patients 18-64yr with a stroke from 2000 to 2006 were administered a survey in 2007.</td>
<td>Prevalence of risk factors; Prevalence of post-stroke impairments; Support; Anxiety or depression.</td>
<td>Anxiety in 27 (18%), depression in 27 (18%), and pain in 28 (19%).</td>
</tr>
<tr>
<td>Sweden</td>
<td>Prospective</td>
<td>No Score</td>
<td>Mean=NA</td>
<td>Start=150</td>
<td>End=150</td>
<td>Patients 18-64yr with a stroke from 2000 to 2006 were administered a survey in 2007.</td>
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</tr>
<tr>
<td>Sweden</td>
<td>Prospective</td>
<td>No Score</td>
<td>Mean=NA</td>
<td>Start=150</td>
<td>End=150</td>
<td>Patients 18-64yr with a stroke from 2000 to 2006 were administered a survey in 2007.</td>
<td>Prevalence of risk factors; Prevalence of post-stroke impairments; Support; Anxiety or depression.</td>
<td>Anxiety in 27 (18%), depression in 27 (18%), and pain in 28 (19%).</td>
</tr>
<tr>
<td>Sobreiro et al. (2014) Brazil</td>
<td>Prospective</td>
<td>No Score</td>
<td>Mean=12±3.8d</td>
<td>Start=87</td>
<td>End=87</td>
<td>Patients 18-64yr with a stroke from 2000 to 2006 were administered a survey in 2007.</td>
<td>Prevalence of risk factors; Prevalence of post-stroke impairments; Support; Anxiety or depression.</td>
<td>Anxiety in 27 (18%), depression in 27 (18%), and pain in 28 (19%).</td>
</tr>
<tr>
<td>Maaijwee et al. (2015) Netherlands</td>
<td>Retrospective</td>
<td>No Score</td>
<td>Overall&gt;8.3yr</td>
<td>Start=511</td>
<td>End=511</td>
<td>Patients 18-50yr with a first ever stroke from 1980 to 2010 were included.</td>
<td>Prevalence of fatigue; Prevalent risk factors; Instrumental Activities of Daily Living (IADL); Modified Rankin Scale (mRS).</td>
<td>Fatigue was prevalent in significantly more stroke participants compared to healthy controls (41% vs. 18.4%) (p=0.0005).</td>
</tr>
<tr>
<td>Simonetti et al. (2015) Switzerland</td>
<td>Retrospective</td>
<td>No Score</td>
<td>Mean=NA</td>
<td>Start=249</td>
<td>End=249</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>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>
<td>Recurrent stroke occurred in 5 (6%) children and 7 (5%) young adults.</td>
</tr>
</tbody>
</table>

**Notes:**
- Sobreiro et al. (2014) Brazil
- Maaijwee et al. (2015) Netherlands
- Simonetti et al. (2015) Switzerland

**References:**
- Sobreiro et al. (2014) Brazil
- Maaijwee et al. (2015) Netherlands
- Simonetti et al. (2015) Switzerland

**Website:**
www.ebrsr.com
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%).

9. 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%).

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

---

**Population:** Mean age=57.7±11.0yr; Gender: Males=19, Females=11.  
**Intervention:** A multicenter observational study was conducted on young stroke participants 18-55yr.  
**Outcomes:** Incidence of clinically relevant depressive symptoms (CRDS) according to the Beck Depression Inventory (BDI); National Institute of Health and Stroke Scale (NIHSS); Prevalence of common stroke risk factors.

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 35-44yr, 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.


