EBRSR
[Evidence-Based Review of Stroke Rehabilitation]

21

Rehabilitation of Younger Patients Post Stroke

Evidence Tables

Andreea Cotoi MSc, Cristina Batey MD, Norhayati Hussein MBBS, Shannon Janzen MSc, Robert Teasell MD

Last Updated: March 2018

Dr. Robert Teasell
Parkwood Institute, 550 Wellington Road, London, Ontario, Canada, N6C 0A7
Phone: 519.685.4000 ● Web: www.ebrsr.com ● Email: Robert.Teasell@sjhc.london.on.ca

Table of Contents

21.1 Incidence

Table 21.1 Studies Evaluating the Incidence of Stroke in Younger Individuals

Author, Year Country Study Design Time Post Stroke Sample Size	Methods	Outcomes
Abu-Zeid et al. (1975) Canada Observational TPS=NA N=1367	Patients in the Manitoba area were included in this study over an 18-month period.	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.
Bonita et al. (1984) New Zealand Observational TPS=NA N=680	All stroke patients over the age of 15 in the area of Central Auckland were included in this study.	Men on average had higher age-specific event rates compared to women, except in the oldest age-group (>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.
Nencini et al. (1988) Italy Observational TPS=NA N=47	Patients with a first-ever stroke, ages of 15 to 44 years, from Florence were followed over a 3-year period.	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.
Koul et al. (1990) India Observational TPS=NA N=91	Patients in the rural northwest India area were included in this survey study.	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.
Mayo et al. (1991) Canada Case Series TPS=NA N=37,000	Patients in the province of Quebec were included.	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 >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.

Kittner et al. (1993) USA Case Series TPS=NA N=117	Patients aged 15 to 44 years from the Baltimore area in 1988.	Ischemic stroke incidence rates for a population of 100 000 were 10.3 for white men, 22.8 for black men, 10.8 for white women, and 20.7 for black women. Intracerebral hemorrhage incidence rates for a population of 100 000 were 4.6 for white men, 14.2 for black men, 1.5 for white women and 4.8 for black women.
Rozenthul-Sorokin et al. (1996) Israel Observational TPS=NA N=253	Patients with first stroke (ages 17-49) admitted to all hospitals in Israel over the course of 1 year.	The incidence rate for young stroke patients per 100 000 population was 10.36 after age-and sex-adjustments. The incidence of stroke in females was almost half that of males.
Johansson et al. (2000) Sweden Case Series TPS=NA N=2316	Patients with first-ever stroke (median age of 76.3 years) from the University Hospital of Lund were included.	After age- and sex- adjustments the stroke incidence rate for patients under the age of 75 years was 94/100 000 person-years in 1983-1985. The incidence rate increased to 117/100 000 person-years in 1993-1995. The incidence rate for stroke patients over the age of 75 years was 1477/100 000 person-years in 1983-1985, which increased to 1560/100 000 person-years in 1993-1995.
Marini et al. (2001) Italy Observational TPS=NA N=4353	Patients younger than 45 years of age with first-ever stroke were included in this 5-year study.	The crude annual incidence rate for stroke in young patients was 10.18/100 000 (95% CI, 8.14 to 12.57). With increasing age, stroke incidence rates greatly increased. Thirty percent of strokes occurred in patients under the age of 35 years. The crude annual incidence of stroke for the various stroke types was as follows: subarachnoid hemorrhage, 2.29/100,000; intracerebral hemorrhage, 2.06/100,000; and cerebral infarction 5.83/100,000.
Jacobs et al. (2002) USA Observational TPS=NA N=74	Patients with first stroke, aged 20 to 44 years old were included.	The incidence rate for stroke in young adults was 23/100 000.
Naess et al. (2002) Norway Case Series TPS=NA N=232	Patients, ages 15-49, diagnosed with first-ever cerebral infarction during 1988-1997 in Hordaland County, Norway.	The average annual incidence rate was 11.4/100 000. For men, the average annual incidence rate was 12.9/100 000 and for women it was 9.7/100 000.
Di Carlo et al. (2003) Italy Observational TPS=NA N=179,186	Residents of the province of Vibo Valentia that experienced a first-ever stroke were followed and the incidence evaluated.	Crude incidence rate of total stroke per 1000 inhabitants per year in adults aged 0-44 was 0.10, in adults 45-54 was 0.69, and in adults 55-64 it was 1.49. Up to age 85, with every 10 years the frequency of first-ever stroke approximately doubled.
Medin et al. (2004)	Patients between the ages of 30-65 discharged	Crude total incidence was 117.1/100 000 for

Sweden Observational TPS=NA N=43,389	from a public hospital in Sweden with the diagnosis of first-ever stroke from 1989 until 2000 were included.	men and 63.8/100 000 for women. It was found that, between 1989 and 2000, age-standardized stroke incidence increased in both men and women that were 30-65 years of age.
Rasura et al. (2006) Italy Observational TPS=NA N=394	Patients with ischemic stroke aged 14-47 years were included. Incidence of cerebral ischemia and risk factors in young adults were evaluated.	The crude annual incidence rate for stroke in young patients was 8.8/100 000.
Ghandehari & Izadi-Mood (2006) Iran Observational TPS=NA N=124	Patients with ischemic stroke aged 15–45 years were registered in Southern Khorasan stroke data bank over a 5-year period.	The incidence of ischemic stroke for young stroke patients 8/100 000.
Bejot et al. (2008) France Observational TPS=NA N=715	Patients with lacunar strokes were examined over a period of 17 years. Participants were stratified according to age, gender, and etiology.	The incidence of lacunar stroke for patients below the age of 65 was 8.4 per 100 000.
Cabral et al. (2009) Brazil Observational TPS=NA N=1323	Patients within one year of stroke (759 first ever) occurring in Joinville, Brazil were included.	Crude incidence rates of first ever stroke for patients of various age groups were as follows: 25-34 years of age, 9.2/100,000; 35-44, 26.8/100,000; and 45-54, 123/100,000.
Harmsen et al. (2009) Sweden Case Series TPS=NA N=28,154	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.	The incidence rate for male patients ages 20-44 during a one year period for various stroke types were as follows: all stroke, 12/100,000; intracerebral hemorrhage, 5/100,000; and ischemic stroke, 5/100,000. The incidence rate for female patients ages 20-44 during a one year period for various stroke types were as follows: all stroke, 16/100,000; intracerebral hemorrhage, 2/100,000; and ischemic stroke, 10/100,000. Stroke incidence has not significantly changed since 1987.
Lewsey et al. (2009) Scotland Case Series TPS=NA N=213,358	Patients who experienced a stroke during 1986 to 2005 in Scotland were identified and incidence rates were evaluated.	In 2005, 13.6% and 9.3% of all strokes occurred in men and women, respectively, below 55 years of age. This was an increase in rates from 1986.
Onwuchekwa et al. (2009) Nigeria Case Series TPS=NA N=611	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.	Young stroke patients were 8.8% (54 individuals) of the total stroke population (611 individuals).There was no significant difference in incidence rates between males and females. Of the young stroke patients, 64.8% were identified as having a cerebral infarction and 24.1% identified as having an intracerebral hemorrhage.
Vega et al. (2009)	Patients 14 years and older were recorded by 3	Incidence of acute episodes of stroke for

Spain Observational TPS=NA N=201,025	Spanish health sentinel networks.	patients 15-54 years of age were 9.6 per 100,000 individuals for women and 15 per 100,000 for men. Total incidence rate was 12 per 100,000.
Corso et al. (2009) Italy Case Series TPS=NA N=1024	Patients from the Valley of Aosta with stroke onset during 2004 and 2008 were included.	Incidence rates of stroke for various age-groups per year were as follows: 0-14 years of age, 3/100,000; 15-24, 14/100,000; 25-34, 14/100, 000; 35-44, 40/100,000; 45-54, 58/100,000; and 55-64, 166/100,000.
Putaala et al. (2009a) Finland Case Series TPS=NA N=1008	Patients with first ever ischemic stroke patients between the ages of 15-49 during 1994 to 2007 were evaluated.	Average annual occurrence rates were 10.8/100,000 overall, 13.3/100,000 for males, and 7.8/100,000 for females. There was an overall male preponderance but the females were significantly younger.
Sridharan et al. (2009) India Observational TPS=NA N=541	The incidence of first-ever ischemic stroke was found for patients in a South Indian community using a standardized questionnaire about stroke events as well as using multiple overlapping supplementary methods (n=541).	Incidence rates of stroke per 100 000 inhabitants per year for the urban community were 1.6 for ages 15-24, 10.1 for ages 25-34, 29.9 for ages 35-44 and 94.9 for ages 45-54. Rates in the rural community were 0 for ages 15-24, 7.4 for ages 25-34, 26.6 for ages 35-44 and 141.0 for ages 45-54.
Manobianca et al. (2010) Italy Observational TPS=NA N=127	Patients that experienced first ever stroke were identified in order to determine age-specific incidence of stroke subtypes.	Incidence rates (per 100 000 per year) of cerebral infarction (CI), intracerebral haemorrhage (ICH), subarachnoid haemorrhage (SH) and undetermined stroke (US) were determined for different age groups. For ages 0-14, the rates for the different types were as follows: CI, 8; IH, 0; SH, 0; and US, 0. For ages 15-34 incidence rates were 0 for all four types. For ages 35-44: CI, 8; IH, 0; SH, 0; and US, 0.
Zhao et al. (2010) China Case Series TPS=NA N=81,298	Patients older than 18 years of age from the City Staff Medical Insurance Registry in Lhasa between October 2006 and October 2008 were included.	Crude average incidence rate per 100 000 per year (95% CI) for various age groups were as follows: 20-29, 4.199 (3.376-5.022); 30-39, 14.081 (12.488-15.674); 40-49, 41.001 (13.44-68.558); and 50-59, 116.088 (100.138-232.041).
Kulesh et al. (2010) Belarus Case Series TPS=NA N=2069	Patients of all ages who had first-ever stroke between January 2001 and December 2003.	Incidence rates per 100 000 person per year (95% CI) for various age groups were as follows: <25, 1 (0.2-3); 25-34, 8 (4-14); 35-44, 37 (28-48); 45-54, 236 (210-264).
Kang et al. (2011) South Korea Case Series TPS=NA N=NA	Patients aged 45 to 54 with or without prior stroke. Results were derived from the national epidemiologic data of the Korean Health Disease study.	The prevalence of stroke in the studies general male population was 0.68% and 0.47% in females. The risk of new-onset stroke in the study among people without prior stroke was 176/100,000 in males and 113/100,000 in females. The number of stroke cases (incidence of stroke in general population) was 214/100,000 in males and 135/100,000 in females.
Bjorn-Mortensen et al. (2013)	**Population:** Mean age=NA; Gender: Males=74, Females=82.	1. Stroke incidence per 100,000 person-years across age groups was as follows: 8 for 25-

Greenland Case Series TPS=NA N_{Start}=156 N_{End}=156	**Intervention:** The incidence rate of stroke in stroke survivors discharged from 2011-2012 was determined. **Outcomes:** Stroke incidence rates.	34yr, 104 for 35-44yr, 166 for 45-54yr, 559 for 55-64yr, 891 for 65-74yr, and 832 for 75-84yr. 2. Stroke incidence rates across age groups were not significantly different between males and females.
Copstein et al. (2013) Brazil Case Series TPS=NA N_{Start}=3391 N_{End}=3391	**Population:** Mean age=NA; Gender: Males=1496, Females=1895. **Intervention:** The prevalence of stroke was determined in a vulnerable community. **Outcomes:** Stroke prevalence; Smoking prevalence in stroke participants; Hypertension prevalence in stroke participants.	1. The prevalence of stroke was 3.4% for 20-39yr, 9.2% for 40-59yr, 18.4% for 60-79yr, and 14.5% for ≥80yr; the prevalence of stroke was significantly different across age groups (p<0.001).
Janes et al. (2013) Italy Case Series TPS=NA N_{Start}=153,312 N_{End}=153,312	**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.
Kim et al. (2013) South Korea Case Series TPS=NA N_{Start}=102,210 N_{End}=102,210	**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).
Gonzalez-Perez et al.	**Population:** Mean age=NA; Gender: NA.	1. Over the 6yr study period, the standardized

(2013) UK Observational TPS=NA N_{Start}=3036 N_{End}=3036	**Intervention:** Individuals 20-89yr with a record on The Health Improvement Network (THIN) UK were followed until intracerebral hemorrhage (ICH), subarachnoid hemorrhage (SAH), or death was recorded. Data was collected from 2000 to 2008. The number of confirmed cases of hemorrhagic stroke was 1797 for ICH and 1340 for SAH. **Outcomes:** 30d case fatality following stroke; Excess mortality rate: <1yr, >1yr, Overall.	incidence for hemorrhagic stroke within the THIN database (N=2,110,327) was 22.5 per 100,000 person-years.
Rosengren et al. (2013) Sweden Case Series TPS=NA N_{Start}=391,081 N_{End}=391,081	**Population:** Mean age=72.5±9.8yr; Gender: Males=208900, Females=18218. **Intervention:** 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%). **Outcomes:** Incidence of stroke; Mortality.	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.
Rutten-Jacobs et al. (2013b) Netherlands Observational TPS=NA N_{Start}=724 N_{End}=724	**Population:** Mean age=40.5±7.8yr; Gender: Males=344, Females=380. **Intervention:** Patients with a first ever stroke from 1980-2010 were assessed during follow-up assessments from 2009-2012. **Outcomes:** Cumulative 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. 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.
Béjot et al. (2014) France Case Series TPS=NA N_{Start}=4506 N_{End}=4506	**Population:** Median age=42yr; Gender: Males=1908, Females=1423. **Intervention:** Patients with a stroke from 1985 to 2011 were included. **Outcomes:** Incidence rates of stroke; Prevalence of risk factors.	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 <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<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<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 >85yr did not

		significantly change between time periods. 5. The incidence rate of ischemic stroke in participants <55yr increased non-significantly from 1985-1993 (8.1/100000) to 1994-2002 (10.7/100000), and increased significantly from 1994-2002 to 2003-2011 (18.1/100000) (p<0.001). 6. The incidence rates of hemorrhagic and undetermined stroke did not significantly change between time periods.
Koton et al. (2014) Israel Case Series TPS=NA N_{Start}=14,357 N_{End}=14,357	**Population:** Mean age=54.1±5.8yr; Gender: Males=6402, Females=7955. **Intervention:** The incidence rate of stroke from 2007 to 2009 was determined in a population. **Outcomes:** Stroke incidence rate; Crude cumulative incidence of mortality.	1. The stroke incidence rate per 100,000 person-years was 2.19 for the <65yr group and 5.29 for the ≥65yr group.
Schnitzler et al. (2014) France Observational TPS=NA N_{Start}=33,896 N_{End}=33,896	**Population:** Mean age=NA; Gender: Males=15092, Females=18804. **Intervention:** A survey was administered to participants with and without stroke in 2007. **Outcomes:** Stroke incidence rate; Institutionalization; Modified Rankin Scale (mRS).	1. The stroke incidence rate was 3.2 for participants ≤50yr, 0.4 for 18-59yr and 2.9 for 60-74yr. 2. Stroke incidence in the ≤50yr group was significantly greater for males compared to females (3.6 vs 2.9) (p<0.05).
Bensenor et al. (2015) Brazil Case Series TPS=NA N_{Start}=2,231,000 N_{End}=2,231,000	**Population:** Mean age=NA; Gender: Males=1117000, Females=1115000. **Intervention:** The incidence rate of stroke in a general population >18yr was assessed. **Outcomes:** Stroke incidence rates.	1. Stroke incidence rates were 1.6% for males and 1.4% for females. 2. The stroke incidence rates across age groups were as follows: 0.1% for 18-29yr, 1.1% for 30-59yr, 2.9% for 60-64yr, 5.1% for 65-75yr, and 7.3% for ≥75yr.
Li et al. (2015) China Case Series TPS=NA N_{Start}=14,538 N_{End}=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). 3. Ischemic stroke incidence rates per 100,000 person-years in participants <45yr increased non-significantly from 1992 to 2012 (1992-1998=10.1, 1999-2005=15.5, 2006-2012=22.9). 4. Ischemic stroke incidence rates per 100,000 person-years in participants 45-64yr significantly increased from 1992 to 2012 (1992-1998=137.4, 1999-2005=199.1, 2006-2012=484.6) (p<0.05).
Okon et al. (2015) Nigeria	**Population:** Mean age=NA; Gender: Males=184, Females=114.	1. The stroke incidence rate per 100,000 person-years was 4.04 for participants 0-

Case Series TPS=NA N_{Start}=298 N_{End}=298	**Intervention:** The incidence rate of first ever stroke from 2010 to 2011 was determined in a population. **Outcomes:** Stroke incidence rates.	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 for 35-44yr, 11.97 for 45-54yr and 27.27 for 55-64yr. 3. The rate of intracerebral hemorrhages per 100,000 person-years was 1.62 for participants 0-34yr, 1.51 for 35-44yr, 7.98 for 45-54yr, and 14.35 for 55-64yr. 4. The rate of subarachnoid hemorrhages per 100,000 person-years was 1.61 for participants 0-34yr, 1.51 for 35-44yr, 3.99 for 45-54yr, and 4.30 for 55-64yr.
Ozer et al. (2015) Turkey Case Series TPS=NA N_{Start}=619 N_{End}=619	**Population:** Younger Group (YG; n=32): Mean age=37.7±6.1; Gender: Male=13, Female=19. Older Group (OL; n=587): Mean age=71.2±11.3; Gender: Male=271, Female=316. **Intervention:** Hospital records of patients who had acute ischemic stroke from January 2007 to November 2014 were retrospectively analyzed by age. **Outcomes:** Incidence.	1. Incidence of stroke in YG group compared to the overall sample size was 5.2%.
Tan et al. (2015) Singapore Case Series TPS=NA N_{Start}=40,623 N_{End}=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 stroke incidence rate over the study period was 3.33 for participants <50yr, -1.26 for 50-64yr and -3.62 for ≥65yr. 2. The annual percentage change in the stroke incidence rate over the study period was more negative in females compared to males (-2.94 vs. -1.80).
Vangen-Lønne et al. (2015) Norway Case Series TPS=NA N_{Start}=36,575 N_{End}=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 stroke incidence rate for women 30-49yr per 100,000 person-years significantly increased from 1986-1990 to 2006-2010 (1986-1990=0.09, 2006-2010=0.19) (p=0.0033). 2. The stroke incidence rate for men 30-49yr per 100,000 person-years increased non significantly from 1977-1980 to 2006-2010 (1977-1980=0.11, 2006-2010=0.67) (p=0.135). 3. The stroke incidence rate for women 50-64yr per 100,000 person-years significantly increased from 1991-1995 to 2006-2010 (1991-1995=1.96, 2006-2010=0.93) (p=0.028). 4. The stroke incidence rate for men 50-64yr per 100,000 person-years significantly increased from 1989-1990 to 2006-2010 (1989-1990=0.55, 2006-2010=2.22) (p<0.0001).
Wang et al. (2015)	**Population:** Mean age=NA; Gender:	1. The stroke incidence rate per 100,000

Taiwan Case Series TPS=NA N_{Start}=14,830 N_{End}=14,830	Males=7686, Females=7144. **Intervention:** Stroke incidence was determined in a population from 1992-2012. **Outcomes:** Stroke incidence rate.	person-years between 1992-1998 and 2006-2012 increased 2.3 fold for the <45yr group (p<0.05), 2.6 fold for the 45-64yr group (p<0.05), and 1.1 fold for the ≥65yr group (p<0.05). 2. The age standardized incidence rate of stroke from 1992-2012 increased annually by 5.6% for participants <45yr (p<0.05), 10.7% for 45-64yr (p<0.05), and 4.3% for ≥65yr (p<0.05).
González-Gómez et al. (2016) Spain Case Series TPS=NA N_{Start}=110 N_{End}=110	**Population:** Mean age=46.4±8.1yr; Gender: Males=67, Females=43. **Intervention:** Younger patients (<55yr) who were admitted to a stroke unit in Spain in 2014 were retrospectively analyzed. **Outcomes:** Incidence.	1. There were 110 strokes suffered by patients <55yr out of a total of 830 stroke admissions (13.3%).

21.2 Etiology

Table 21.2 Studies Evaluating Stroke Etiologies in Younger Individuals

Author, Year Country Study Design Time Post Stroke Sample Size	Methods	Outcomes
Snyder & Ramirez-Lassepas (1980) USA Case Series TPS=NA N=61	Patients ages 16-49 (38 men and 23 women), with cerebral infarction. Mean follow-up 2.4 years.	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.
Adams et al. (1986) USA Case Series TPS=NA N=144	Patients aged 15-45 with cerebral infarction.	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.
Ferro & Crespo (1988) Portugal Case Series	Patients between 15 and 50 years old post stroke.	Eight etiological categories were identified. Stroke was the result of cerebral atherosclerosis for 89 (35.0%) patients, cardiac emboli for 78

TPS=NA N=254		(30.7%), intracerebral hemorrhage for 21 (8.3%), vasospasm for 14 (5.5%), hematogolic 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 <40 yrs old was cardiac embolism and for 41-50 yrs old was atherosclerosis.
Federico et al. (1990) Italy Case Series TPS=NA N=56	Patients with ischemic stroke between the ages of 17 to 45 years old were included.	Etiologies or predisposing factors were as follows: 21 had juvenile atherosclerosis, 13 had cerebral embolism, 4 had secondary coagulopathies, 6 had non atherosclerotic vasculopatheies, 3 had traumas of the skull and neck, 2 had migraines, 1 used oral contraceptive and 6 were unknown.
Love & Biller (1990) USA Observational TPS=NA N=286	Patients with cerebral infarction between the ages of 15-45 years in an Iowa university hospital.	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 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.
Bevan et al. (1990) USA Case Series TPS=NA N=113	Patients between the ages of 15-45 admitted to a Vermont hospital were included.	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.
Awada (1994) Saudi Arabia Case Series TPS=NA N=120	Patients with stroke between the ages of 15 and 45 years old were evaluated.	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%.
Ferro & Crespo (1994) Portugal Observational TPS=NA	Patients under the age of 45 years with long-term follow-up, mean of 43.1 months.	Etiologies that were more commonly identified were: cardioembolic (19%), large-vessel atheromatous disease (15%), single-perforator disease (10%), multiple causes (3%), dissection

N=215		(7%), arteritis (5%), hematologic disorder (1%) and other rare conditions (7%).
Adams et al. (1995) USA Case Series TPS=NA N=329	Patients ages 15-45 were evaluated during a 15.5 year period.	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%.
Barinagarre-Menteria et al. (1996) Mexico Observational TPS<3mo N=300	Patients younger than 40 years with cerebral infarction were included.	Etiologies were: cryptogenic (unknown) in 32%, nonatherosclerotic vasculopathy in 27%, cardioembolism in 24%, hematological disturbance in 10%, migraine in 3% and premature atherosclerosis in 3%. Authors reported atherosclerosis was an uncommon cause of cerebral infarction in patients < 40 yrs.
Siqueira Neto et al. (1996) Brazil Observational TPS=NA N=106	Patients between ages of 15 to 40 years subdivided into 2 age groups (15 to 29 years and 30 to 40 years). Etiology classification from trial of ORG 10172 in acute stroke treatment (TOAST) was used.	9 (8.5%) had large-artery atherosclerosis, 13 (12.3%) had small-vessel occlusion or lacunes, 30 (28.3%) had cardioembolism, 37 (34.9%) had other determined causes and 17 (16%) had undetermined causes of stroke.
You et al. (1997) Australia Observational TPS=NA N=201	Patients with first-onset stroke between ages of 15 to 55 years were included. Stroke patients were matched for age and sex with individuals in their neighbourhoods (controls).	Patients with diabetes, hypertension, heart disease, long-term heavy alcohol consumption and current smokers were at a significantly increased risk of stroke. 52% of cases were thromboembolic; however, 14% had unknown etiology of cerebral infarctions.
Kristensen et al. (1997) Sweden Observational TPS<3mo N=88	Patients with first-ever ischemic stroke aged 18 to 44 were included. Follow-up occurred at 4 and 12 months post-stroke onset.	79% patients had a cause for their stroke identified. Most common etiology was cardioembolism (33%). Other probable causes included: patent foramen ovale or atrial septal aneurysm (28%), IgG anticardiolipin antibodies (4.7%), atherothrombotic vasculopthy (3.7%), oral contraceptives (7%) and migraine (1%).
Kittner et al. (1998) USA Case Series TPS=NA N=428	Patients with first stroke aged 15 to 44 years with primary or secondary diagnosis of cerebral infraction were included.	Sixty-one percent of the patients were black. A possible cause of stroke was determined in 212 (49.7%) patients. The distribution of etiologies for the 428 patients was as follows: cardiac embolism, 15.4%; lacunar, 9.8%; hematologic and other, 8.9%; non-atherosclerotic vasculopathy, 5.6%; illicit drug use, 4.7%; oral contraceptive use, 2.6%; large artery

		atherosclerosis, 1.9%; and migraine, 0.7%. 136 (31.8%) patients had unknown etiology. 69 stroke patients experienced a recurrent stroke.
Ruiz-Sandoval et al. (1999) Mexico Observational TPS=NA N=200	Patients with intracerebral hemorrhage (age 15-40) were classified by risk factors, haemorrhage location, etiology and prognosis.	High cholesterol, hypertension, tobacco and alcohol use were determined to be significant risk factors. Etiology was determined as arteriovenous malformation 33%, cavernous angioma 16%, unknown 15%, and hypertension in 11% of the sample.
Kittner et al. (1999) USA Observational TPS=NA N=167	Women with first-ever ischemic stroke between the ages of 15 to 44 were compared to 328 control subjects. Risk factor data and plasma homocysteine was measured.	Race did not affect median homocysteine levels. Homocysteine level was found to be an independent risk factor for stroke. 83 (50%) patients had one probable cause of stroke, 32 (29%) had no probable cause but at least 1 possible cause, and 52 (31%) had an unknown cause of stroke.
Gilon et al. (1999) USA Observational TPS=NA N=213	Patients with ischemic stroke or TIA under the age of 45 years were compared to 263 control patients without heart disease.	Of 213 stroke patients, cause of stroke was determined in 142 cases and undetermined in 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.
Camerlingo et al. (2000) Italy Observational TPS=NA N=135	Patients with first-ever cerebral infarction, aged 16 to 45 years old, were evaluated and followed up a mean of 68.8 months.	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.
Kwon et al. (2000) South Korea Observational TPS=NA N=149	Patients aged 15 to 44 years old with first-ever ischemic stroke.	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.
Chan et al. (2000) Canada Case Series TPS=NA N=197	Patients aged 15-45 years old with a diagnosis of ischemic stroke were reviewed to determine the etiology of each stroke.	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.
Wityk et al. (2000) USA Observational TPS=NA N=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 & lipoprotein testing was done.	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.
Lee et al. (2002) Taiwan Observational TPS=NA N=264	264 stroke patients between 18 to 45 years old. Stroke risk factors and stroke subtype distribution were studied.	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 (23.5%).There were 4 main stroke risk factors including hyperlipidemia (53.1%), smoking (49.8%), hypertension (45.8%), and family history of stroke (29.3%).
Jacobs et al. (2002) USA Case Series TPS=NA N=74	Patients with first stroke aged 20 to 44 years. Relative Risk (RR) of stroke was calculated for White, Black, and Hispanic backgrounds.	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.
Tan et al. (2002) Singapore Observational TPS=NA N=109	Patients with first-ever ischemic stroke under the age of 50 and above age 88 and gender matched controls.	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 B_{12} level than controls. 48 patients had small-artery/lacunar stroke, 30 had large-artery stroke, 18 had either “other etiologies” or undetermined etiology, and 13 had cardioembolic stroke.
Anzini et al. (2004) Italy Observational TPS<24hr N=141	Patients with ischemic strokes (81 males) aged 18-46 were paired with 192 sex/age matched controls. 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.
Mehndiratta et al. (2004) India	Patients aged 15 to 40 years old.	Spontaneous intracranial hemorrhagic stroke accounted for 14.2% of patients, whereas

Case Series TPS=NA N=127		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.
Bos et al. (2005) Netherlands Observational TPS=NA N=161	Patients, aged 18 to 45 years, with cerebral infarction or TIA were included.	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, 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 Observational TPS=NA N=130	Patients with ischemic stroke (age 14-45, mean age 33.8) were 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.	Etiology in young patients was determined as unknown 69.2%, cardioembolism 14.6%, large artery atherosclerosis 7.7%, small vessel occlusion 3.8%, and other 4.6%. 16.1% of young patients were identified as presenting potential thrombophilic states as opposed to 13% of elderly patients.
Lai et al. (2005) Taiwan Case Series TPS=NA N=296	Patients (224 male, 72 female) with spontaneous intracerebral haemorrhage patients aged 15-45 were assessed between 2000 and 2001 to determine location, etiology, and risk factors.	Determined causes of ICH were hypertension 46.6%, vascular anomaly 18.4%, coagulopathy 5.4%, tumour, 6.1% undetermined 10.1%, cryptogenic 4.4%, smoking/alcohol use 8.8%, and other 1.7%.
Rasura et al. (2006) Italy Observational TPS=NA N=394	Patients with ischemic stroke 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.	Risk factors of stroke patients included smoking (56%), migraine (26%), Diabetes Mellitus (2%), hyperlipdaemia (15%), hypertension (23%), and oral contraceptives (38%). Etiology of stroke patients was: cardioembolism in 34%, atherothrombosis in 12%, non-atherosclerotic vasculopathies in 14%, other causes in 13%, lacunar stroke in 2.5%, migraine in 1%, and undetermined causes in 24%. Subdivision of subjects into 2 cohorts based on age (14-35 and 35-47 years) revealed that diabetes,

		hypertension, hyperlipidemia, smoking and alcohol abuse were significantly more common (P<0.05) in the older age group.
Ghandehari & Izadi-Mood (2006) Iran Case Series TPS=NA N=124	Patients with ischemic stroke aged 15-45 years registered in Southern Khorasan stroke data bank over a 5-year period. Etiology classification used TOAST criteria.	Cardioembolic mechanism comprised 54% of stroke etiology in young adults. Rheumatic valvular disease (RVD) was present in 32% of the patients and caused 2.5 preventable stroke cases per 100,000 'young adults' per year. Atrial fibrillation was present in 29 patients (23%), all of whom had RVD or mechanical heart valve. Also, 8 (6.45%) patients had atherosclerosis, 3 (2.42%) patients had lacunar infarction and 35 (28.2%) had unknown etiology.
Piechowski-Jozwiak et al. (2007) Poland Observational TPS=NA N=94	Patients with ischemic stroke <55 years of age were investigated for anti- Chlamydia pneumonia IgA and IgG antibodies and were divided into subgroups according to TOAST.	Etiology was determined for ischemic stroke patients. Cardioembolism occurred in 8.5%, large artery atherosclerosis in 13.8%, small vessel occlusion in 15.9%, other determined etiology in 15.9%, and 45.7% of the patients had unknown etiology.
Lipska et al. (2007) India Observational TPS=NA N=214	Patients between the ages of 15-45 were enrolled in this case-control study determining risk factors for ischemic stroke. Stroke causes were categorized according to TOAST criteria.	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".
Varona et al. (2007) Spain Observational TPS=NA N=272	Patients with first-ever ischemic stroke aged 15-45 (177 male and 95 female). Etiologic diagnosis made using TOAST criteria.	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%).
Arnold et al. (2008) Switzerland Observational TPS=NA N=1004	Patients (137 between the ages of 16 and 45) with first ever acute ischemic stroke were enrolled.	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%.
Jovanović et al. (2008) Serbia Observational TPS=NA N=865	Patients between the ages of 15 and 45 who experienced first ever transitory ischemic attack were enrolled in a study to determine risk factors involved in ischemic attack. TOAST criteria were used to assign the most likely cause of ischemic stroke.	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.
Putaala et al. (2009a) Finland Observational	Patients aged 15-49 who experienced first-ever ischemic stroke were admitted to the study and trends were analyzed.	According to the TOAST criteria, percentages of patients within each subgroup were as follows: large-artery atherosclerosis, 3.9%;

TPS=NA N=1008		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%.
Samiullah et al. (2010) India Observational TPS=NA N=50	Patients between the ages of 15 and 35 to determine the etiological pattern of strokes in young patients.	The most common cause of stroke was found to be infective meningitis which was found in 34% of the cases. Following that causes were cardio-embolism 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%).
Spengos & Vemmos (2010) Athens Observational TPS=NA N=252	Patients 45 years old and younger who experienced first ever ischemic stroke In Athens between 1999 and 2008 were included. Etiology of stroke was classified according to TOAST criteria.	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.
Tan et al. (2010) Malaysia Observational TPS=NA N=128	Patients from Australia and Malaysia under the age of 50 who experienced first ever ischemic stroke were recruited.	In Australia, 9.8% of strokes are large-vessel atherosclerosis, 14.8% are small-vessel occlusion, 21.3% are cardioembolism, 22.9% are by another determined cause and 31.0% are of undetermined etiology. In Malaysia, 28.3% of strokes are large-vessel atherosclerosis, 32.8% are small-vessel occlusion, 12.6% are cardioembolism, 5% are by another determined cause and 21.0% are of undetermined etiology.
Balci et al. (2011) Turkey Case Series TPS=NA N=192	Patients with ischemic stroke and 18-47 years of age were included in this study. 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.	An atherosclerotic vasculopathy was detected in 26.5% of the patients, non-atherosclerotic vasculopathy was detected in 13%, 6% were classified as having a lacunar infarction, 20% as having a cardiac embolism, 3.5% had a migrainous stroke, 10% had a determined cause other than the ones previously listed and 21% had an undetermined cause.
Dharmasaroja et al. (2011) Thailand Observational TPS=NA N=99	Patients with ischemic stroke and transient ischemic attack between the ages of 15 and 50 were included in this study. Etiology were examined by age and stroke subtypes were classified by the TOAST criteria.	Subtypes for ages 15-30 were as follows: transient ischemic attack (TIA), 8%; Other determined etiology, 33%; and undetermined etiology (UND), 58%. Subtypes for ages 31-40 were as follows: TIA, 8%; large artery atherosclerosis (LAA), 16%; small artery occlusion (SAO), 20%; cardioembolic (CE), 8%; other determined etiology, 28%; UND, 20%. Subtypes for ages 31-40 were as follows: TIA, 3%; LAA, 11%; SAO, 29%; CE, 18%; other determined etiology, 18%; and UND, 21%.
Fromm et al. (2011) Norway Observational TPS=NA	Patients with acute cerebral infarction were enrolled in the Bergen Stroke Study (100 patients were <50 years old).	3% of the patients <50 experienced a stroke etiology of large-artery atherosclerosis, 21% cardiac embolism, 14% small vessel disease, 23% are other known causes, and 39% were from

N=1217		unknown causes.
Larrue et al. (2011) France Observational TPS=NA N=318	Patients (195 men and 123 women) aged 16–54 years treated for acute ischemic stroke in a tertiary stroke unit were included in this retrospective analysis.	131 patients were aged 16–44 years, and 187 were aged 45–54 years. A definite cause of stroke (ASCO [atherosclerosis, small-vessel disease, cardiac source, other cause] grade 1) could be identified in 145 patients (45.5%). An uncertain cause of stroke (ASCO grade 2) was found in 59 (18.5%) of patients. Most (130 of 145) definite causes were identified by initial evaluation. The 2 major causes of stroke were patent foramen ovale associated with atrial septal aneurysm (PFO-ASA) (20 of 131 or 15.3%) and dissection of the cervical or cerebral artery (19 of 131 or 14.5%) in patients aged 16–44 years and large-vessel atherosclerosis (37 of 187 or 19.8%) and PFO-ASA (23 of 187 or 12.3%) in patients aged 45–54 years.
Martínez-Sánchez et al. (2011) Spain Case Series TPS=NA N=310	Patients up to age 50 who experienced first ever cerebral infarction.	Of the women included in the study, 7.8% experienced an atherothrombotic stroke, 27.3% a cardioembolic stroke, 13.3% a lacunar stroke, 22.7% experienced a stroke of undetermined origin and 28.7% a stroke of unusual cause. Of the men included in the study, 15.9% experienced an atherothrombotic stroke, 21.4% a cardioembolic stroke, 20.3% a lacunar stroke, 16.5% experienced a stroke of undetermined origin and 25.3% a stroke of unusual cause.
Munshi et al. (2011) India Observational TPS=NA N=525	Patients with ischemic stroke were included. 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.	Analyzed +488 G/A polymorphism in TNF-a gene and 1612 5A/6A polymorphism in MMP-3 gene. Allelic and genotypic frequencies of TNF-a G/A polymorphism differed significantly between patients and healthy controls ($p< 0.001$). A stepwise logistic regression analysis confirmed these findings ($p<0.001$). Evaluating the association of this polymorphism with stroke subtypes, found significant association with intracranial large artery atherosclerosis, extracranial large artery atherosclerosis, and stroke of undetermined etiology.
Patella et al. (2011) Italy Observational TPS=NA N=94	Patients with first ever ischemic stroke under the age of 45 were prospectively evaluated. Strokes were classified according to TOAST and Baltimore classification and Bamford criteria.	6.4% of patients experienced a stroke resulting from atherosclerotic vasculopathy, 21.3% from non-atherosclerotic vasculopathy (dissection or vasculitis), 3.2% from lacunar infarct, 34% from cardioembolism, 7.4% from other causes (anitiphospholipid antibody, lupus anticoagulant, polycythemia, and C&S protein deficiency) and 27.7% of patients had a stroke resulting from undetermined causes.
Wolff et al. (2011) France	Patients younger than 45 years of age who were admitted to stroke unit for ischemic stroke.	The most common etiology was multifocal intracranal stenosis (N=11), followed by

Observational TPS=NA N=48	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.	monoarterial intracranial stenosis (N=10), extracranial dissection (N=9), and finally cardioembolism (N=6).
Zhang et al. (2011) China Case Series TPS=NA N=669	Patients between the ages of 18 and 45 years with cerebral infarction were examined. Stroke subtypes were classified according to the TOAST system.	Of the women evaluated in the study, stroke subtypes were as follows: arteriosclerosis, 25%; lacunar, 42.3%; cardioembolic, 14.1%; other and undetermined, 18.6%. Of the men evaluated in the study, stroke subtypes were as follows: arteriosclerosis, 40.5%; lacunar, 41.9%; cardioembolic, 6.5%; other and undetermined, 11.4%.
Hankey (2012) Australia Observational TPS=NA N=894,576	Collaborative analysis of 57 prospective studies in which adults were followed up for a mean of 13 years.	Individuals with a BMI of 30 kg/m² or more have double the incidence of ischemic and haemorrhagic stroke compared with individuals with a BMI of less than23 kg/m². Each unit increase in BMI is associated with an increase in the adjusted risk of stroke by about 6% (relative risk 6%, 95% CI 4–8). Among adults who are overweight or obese (BMI 25–50 kg/m²), each 5 kg/m² increase in BMI is associated with about 40% higher mortality from stroke (hazard ratio 1·39, 95% CI 1·31–1·48).
Arntz et al. (2013) Arntz et al. (2013) Arntz et al. (2015) Netherlands Observational TPS>9.1yr N_{Start}=697 N_{End}=697	**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. Strokes were classified as large-artery in 161 (25.5%) participants, cardiac embolism in 84 (13.3%), lacunar in 60 (9.5%), multiple origin in 17 (2.7%), other in 91 (14.4%), and undetermined in 218 (34.5%).
Barlas et al. (2013) Turkey Case Series TPS=NA N_{Start}=3331 N_{End}=3331	**Population:** Median age=42yr; Gender: Males=1908, Females=1423. **Intervention:** Young adults (15-49yr) hospitalized for a stroke from 1988 to 2010 were included. Patients were divided by those <42yr (N=301) and those ≥42yr (N=274). **Outcomes:** Stroke etiology; Risk factors.	1. Stroke etiology was determined to be large-artery atherosclerosis in 9% of participants, cardiac embolism in 17%, small-vessel occlusion in 12%, cervical artery dissection in 13%, other and non-dissection in 9%, and 40% had undetermined etiology. 2. Significant etiological differences between participants <42yr vs. ≥42yr were observed in the proportion of large-artery atherosclerosis (5% vs. 12%; p<0.001), small-vessel occlusion (6% vs. 17%; p<0.001), cardiac embolism (20% vs. 17%; p<0.001), cervical artery dissection (15% vs. 11%; p<0.001), other non-dissection causes

		(12% vs. 7%; p<0.001), and undetermined etiology (42% vs. 38%; p<0.031). 3. Among participants with a cardioembolic origin, patent foramen ovale was present in 127 (42.2%) <42yr and in 93 (33.9%) ≥42yr. 4. Among participants with a cardioembolic origin, atrial fibrillation was present in 28 (9.3%) <42yr and in 59 (21.5%) ≥42yr.
Chen et al. (2013) Taiwan Case Series TPS=NA N_{Start}=973 N_{End}=973	**Population:** Young Participants (N=368): Mean age=53.9yr; Gender: Males=261, Females=107; Older Participants (N=605): Mean age=75.8, Gender: Males=306, Females=299. **Intervention:** Patients with an ischemic stroke from 2005 to 2008 were included. Patients were divided between <65yr and ≥65yr. **Outcomes:** Stroke etiology; Prevalence of risk factors; Modified Rankin Scale (mRS); Barthel Index (BI).	1. In the younger group, strokes were classified as large vessel in 138 (37.5%) participants, cardioembolism in 23 (6.3%), small vessel disease in 152 (41.3%), other in 32 (8.7%), and undetermined in 23 (6.3%). 2. Stroke etiology was significantly different between groups in regards to small vessel disease (<65yr=41.3%, ≥65yr=34.0%; p=0.02), lacunar infarct (<65yr=41.3%, ≥65yr=34.5%; p=0.03), other determined etiology (<65yr=8.7%, ≥65yr=2.1%; p<0.001), cardioembolism (<65yr=6.3%, ≥65yr=16.7%; p<0.001) and total anterior circulation infarct (<65yr=12.2%, ≥65yr=22.8%; p<0.001).
Dharmasaroja et al. (2013) Thailand Observational TPS=NA N_{Start}=261 N_{End}=261	**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).	1. Stroke etiology in participants ≤60yr was determined to be large artery atherosclerosis in 31 (29%) participants, cardioembolic in 26 (24%), small artery occlusion in 48 (44%), and undetermined in 3 (3%).
Dubuc et al. (2013) Canada Case Series TPS=NA N_{Start}=100 N_{End}=100	**Population:** Mean age=40.5yr; Gender: Males=55, Females=45. **Intervention:** Patients 16-55yr with an ischemic stroke with an undetermined etiology from 2002 to 2010 were included. **Outcomes:** Stroke etiology; Fabry disease prevalence; Prevalence of alpha-galactosidase A gene mutations.	1. Stroke etiology was determined to be non-lacunar in the carotid artery in 52 (52%) participants, non-lacunar vertebrobasilar in 35 (35%), and lacunar in 13 (13%).
Eun et al. (2013) South Korea Case Series TPS>26.4mo N_{Start}=551 N_{End}=551	**Population:** Mean age=66.0yr; Gender: Males=55, Females=45. **Intervention:** Patients >40yr with a first ever ischemic stroke from 2007 to 2009 were included. Patients were divided into age groups of 40-64yr (N=235) and ≥65yr (N=316). **Outcomes:** Stroke etiology; Prevalent risk factors; Mortality; Major adverse cardiovascular events; Prevalence of recurrent stroke; Risk of stroke.	1. Stroke etiology in participants 40-64yrwas determined to be large artery atherosclerosis in 73 (31.3%) participants, cardioembolic in 28 (11.9%), small artery occlusion 72 (30.6%), other in 13 (5.5%) and undetermined in 49 (20.9%). 2. The proportion of participants with an undetermined etiology was significantly greater in the 40-64yr group compared to the ≥65yr group (p=0.014).
Naess et al. (2013)	**Population:** Deceased at Follow-up: Mean	1. Stroke etiology was classified as

Norway Observational TPS_{Mean}=18.3yr N_{Start}=224 N_{End}=224	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:** Prevalence of risk factors; Stroke etiology.	atherosclerosis in 33 (14.7%) participants, cardioembolism in 16 (7.1%), small vessel disease in 34 (15.2%), dissection in 14 (6.2%), prothrombotic state in 16 (7.1%), and unknown in 99 (44.2%).
Nakagawa et al. (2013) USA Case Series TPS=NA N_{Start}=511 N_{End}=511	**Population:** Mean age=39.8yr; Gender: Males=242, Females=269. **Intervention:** Patients 18-49yr with a stroke from 2002 to 2006 were included. **Outcomes:** Stroke etiology.	1. Stroke etiology was significantly different between males and females for cardioembolism (males=26, females=16) (p=0.05), miscellaneous vasculopathy (males=14, females=38) (p=0.01), migraine related (males=1, females=10) (p=0.02), vasculitis (males=4, females=8) (p=0.001) cerebral venous thrombosis (males=4, females=15) (p=0.001), substance abuse related (males=26, females=15) (p=0.05), and intracerebral hemorrhage (males=63, females=43) (p=0.01). 2. Stroke etiology was not significantly different between males and females for large vessel disease (males=19, females=24) and small vessel disease (males=25, females=30).
Rolfs et al. (2013) Germany Observational TPS=NA N_{Start}=3396 N_{End}=3396	**Population:** Median age=46yr; Gender: NA. **Intervention:** Patient charts from individuals with stroke 18-55yr from 47 centres across 15 European countries were evaluated. **Outcomes:** Demographical variables; Clinical variables.	1. Stroke etiology was classified as atherosclerosis in 18.6% of participants, cardiac embolic origin in 16.7%, small artery occlusion in 13.5%, other determined cause in 17.8%, and undetermined in 33.4%. 2. In the strata from 18-24yr 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).
Rutten-Jacobs et al. (2013b) Netherlands Observational TPS=NA N_{Start}=724 N_{End}=724	**Population:** Mean age=40.5±7.8yr; Gender: Males=344, Females=380. **Intervention:** Patients with a first ever stroke from 1980-2010 were assessed during follow-up assessments from 2009-2012. **Outcomes:** Cumulative 20yr risk of stroke; Cumulative 20yr risk of any vascular event; Stroke etiology; Incidence rate of any vascular event and recurrent stroke; Demographic	1. The etiology of intracerebral hemorrhage was hypertension for 23.5% of participants, arteriovenous malformation (AVM) in 20.6%, cavernous angioma in 4.4%, medication use in 5.9%, bleeding disorder in 5.9%, substance abuse in 1.5%, septic embolism in 1.5%, and unknown in 36.7%. 2. Stroke subtypes of artherothrombotic stroke, cardioembolic stroke, and lacunar

	variables.	stroke were associated with recurrent stroke (HR=2.72; 2.49; 2.92).
Smajlovic et al. (2013) Bosnia & Herzegovina Case Series TPS=NA N_{Start}=3864 N_{End}=3864	**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 stoke from 2001 to 2005 was retrospectively analyzed. **Outcomes:** Risk factors; Stroke types; Stroke severity; Mortality; One month outcome; Modified Rankin Scale (mRS).	1. Subarachnoid hemorrhages were more frequent in young adults compared with older participants (22.1% vs. 3.5%; p<0.0001), intracerebral hemorrhages were similarly frequent in both groups (16.9% vs. 15.8%; p=0.17), and ischemic strokes were the predominant stroke type in the older group (61% vs. 73.8%; p=0.0004). 2. Young participants had more frequent lacunar strokes (26.6% vs. 16.1%; p=0.01), and stroke due to other etiology (8.5% vs. 1.8%; p=0.0004) and less frequent atherothrombotic (14.9% vs. 28.7%; p=0.002) and cardioembolitic stroke (9.6% vs. 19.2%; p=0.01) than older participants; no significant difference was observed in the frequency of strokes with undetermined etiology (40.4% vs. 34.2%; p=0.2).
de Bruijn et al. (2014) Netherlands Observational TPS>1yr N_{Start}=96 N_{End}=96	**Population:** Median age=43.0yr; Gender: Males=44, Females=52. **Intervention:** Patients 18-49yr with a first ever ischemic stroke from 2000 to 2010 were included and underwent a neuropsychological examination between April and June 2011. Patients were also compared to healthy controls (N=61). **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.	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%).
Bugnicourt et al. (2014) France Observational TPS>13.1mo N_{Start}=156 N_{End}=104	**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. 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%).
Bulder et al. (2014) Netherlands Case Series TPS_{Mean}=6yr N_{Start}=17	**Population:** Mean age=19.3yr; Gender: Males=5, Females=12. **Intervention:** Patients aged 5-50yr with a first ever ischemic stroke in the middle cerebral artery (MCA) from 1994 to 2011 were included.	1. All strokes were caused by a non-atherosclerotic unilateral intracranial arteriopathy of the proximal MCA or distal internal carotid artery. 2. Severe arteriopathy of the MCA occurred in

N_{End}=17	**Outcomes:** Stroke etiology; Modified Rankin Scale (mRS).	9 participants and in the internal carotid artery of 1 participant; 7 participants had mild arteriopathy.
Chraa et al. (2014) Morocco Observational TPS=NA N_{Start}=128 N_{End}=128	**Population:** Mean age=28.3yr; Gender: Males=76, Females=52. **Intervention:** 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; Outcomes at follow-up; Modified Rankin Scale (mRS).	1. Strokes 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%).
Dash et al. (2014) India Case Series TPS=NA N_{Start}=440 N_{End}=440	**Population:** Mean age=38.9yr; Gender: Males=367, Females=73. **Intervention:** Patients 18-45yr with an ischemic stroke from 2005 to 2010 were included. **Outcomes:** Prevalence of risk factors; Stroke etiology.	1. Stroke etiology was determined to be large vessel atherosclerosis in 21 (4.7%) participants, cardioembolic in 62 (14%), small vessel disease in 30 (6.8%), other in 76 (17.3%), and undetermined in 251 (57%). 2. Across genders, cardoembolic strokes were significantly more prevalent in females (Males=10.8%, Females=30.1%; p=0.000), small artery disease was significantly more prevalent in females (Males=5.44%, Females=13.69%; p=0.011), other causes were significantly more prevalent in females (Males=15.5%, Females=26.0%; p=0.030), and undetermined strokes were significantly more prevalent in males (Males=63.2%, Females=26.0%; p=0.001). 3. Compared to participants 36-45yr, participants 18-35yr were significantly more likely to have a stroke with an undetermined cause (18-35=66.6%, 36-45=52.9%; p=0.008) and were significantly less likely to have a stroke with a cardioembolic origin (18-35=3%, 36-45=18.8%; p=0.0001).
Kalita et al. (2014) India Case Series TPS=NA N_{Start}=404 N_{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 Case Series	**Population:** Mean age=59.7yr; Gender: Males=529, Females=345. **Intervention:** Patients >14yr with an ischemic	1. Stroke etiology was significantly different between age groups (p=0.001) with a greater proportion of strokes in

TPS=NA N_{Start}=874 N_{End}=874	stroke in 2007 were included. **Outcomes:** Prevalent risk factors; In-hospital complications; Modified Rankin Scale (mRS); Stroke etiology.	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 Case Series TPS=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. 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 strokes with an undetermined origin in ≤35yr participants compared to >35yr (p=0.028); no significant differences were observed between males and females.
Aarnio et al. (2015) Finland Observational TPS>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. Stroke resulted from large-artery atherosclerosis in 75 (7.5%) participants, cardiac embolism in 197(19.7%), small-vessel occlusion in 138 (13.8%), internal carotid artery dissection in 71 (7.1%), vertebral artery dissection in 84 (8.7%), rare cause without dissection in 106 (10.6%) and from an undetermined cause in 331(33.0%).
de Bruijn et al. (2015) Netherlands Case Series TPS>4.9yr N_{Start}=170 N_{End}=170	**Population:** Mean age=41.4yr; Gender: Males=75, Females=95. **Intervention:** Patients with a first ever ischemic stroke from 2000 to 2010 were included. Patients were also compared to healthy controls (n=61). **Outcomes:** Employment rate; Modified Rankin Scale (mRS); Hospital Anxiety and Depression Scale (HADS): Depression, Anxiety; Stroke etiology.	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%)
Cruz-Herranz et al. (2015) Spain Observational TPS=NA N_{Start}=102 N_{End}=102	**Population:** Mean age=35yr; Gender: Males=0, Females=102. **Intervention:** Women <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. **Outcomes:** Stroke etiology; Modified Rankin Scale (mRS); Prevalent risk factors; Pregnancy following stroke;	1. 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%). 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.
Fazekas et al. (2015)	**Population:** Fabry Disease (EG; n=34): Median	1. Presence or extent of white matter

Austria Case Series TPS=NA N_{Start}=3203 N_{End}=3203	age=45yr (33-49); Gender: Males=10, Females=24. Non-Fabry Disease (CG; n=3169): Median age=46yr (40-51); Gender: Males=1880, Females=1289. **Intervention:** Younger patients who suffered a stroke was compared between those who had Fabry disease (EG) and those who did not (CG). **Outcomes:** MRI Findings.	hyperintensities, infarct localization, vertebrobasilar artery dilatation, T1-signal hyperintensity of the pulvinar thalami, or any other MRI finding did not distinguish patients with FD from non-FD cerebrovascular event patients (all p<0.05).
Jaffre et al. (2015) France Case Series TPS=NA N_{Start}=436 N_{End}=400	**Population:** Mean age=44.5±8.5yr; Gender: Males=244, Females=156. **Intervention:** Patients 18-54yr treated for first-ever ischemic stroke from 2006-2012 were included. **Outcomes:** Stroke etiology; Risks associated with cryptogenic stroke.	1. Identifiable potential causes of stroke were found in 48.7% of participants. The potential causes are listed as follows: atherosclerosis (16.3%), small-vessel disease (7.0%), cardiac pathology (9.3%), and other potential cause of stroke (65 participants, 16.3%), including 11% with artery dissection. 2. Multivariable analyses showed that cryptogenic stroke was significantly associated with current tobacco use (p=0.002), low LDL cholesterol (p=0.001), and elevated triglycerides (p=0.001). 3. Among participants with carotid stroke, non-obstructive carotid atherosclerosis was not more frequent on the symptomatic side (23.8%) compared to the asymptomatic side (21.9%). 4. Current tobacco use was significantly associated with non-obstructive carotid plaque and thrombus in a univariable analysis, and remained statistically significant in the multivariable analysis for each carotid plaque (p =0.001) and carotid thrombosis (p =0.03).
Koivunen et al. (2015) Finland Case Series TPS=NA N_{Start}=1257 N_{End}=1257	**Population:** Younger Patients (YG; n=336): Median age=42yr; Gender: Male=200, Female=136. Older Patients (OL; n=921): Age range≥50yr. **Intervention:** Young patients (<50yr) diagnosed with a first-ever intracranial hemorrhage in Helsinki University Central Hospital between January 2000 and March 2010 (YG) were analyzed retrospectively. Comparisons were performed amongst demographic subgroups and with patients over ≥50yr of age enrolled between January 2005 and March 2010 (OL). **Outcomes:** Etiology.	1. Structural lesions were more common among the YG group compared to the OL group (p<0.001). 2. The cause remained unknown in 32.1% of all YG and in 22.5% of those who underwent MRI and any angiography (n=89, p=0.023).
Ozer et al. (2015) Turkey Case Series TPS=NA N_{Start}=619 N_{End}=619	**Population:** Younger Group (YG; n=32): Mean age=37.7±6.1; Gender: Male=13, Female=19. Older Group (OL; n=587): Mean age=71.2±11.3; Gender: Male=271, Female=316. **Intervention:** Hospital records of patients who had acute ischemic stroke from January 2007 to	1. Cardioaortic embolism was the most common etiologic stroke subtype in both groups; however, other causes were significantly more frequent in the YG group compared with OL group.

	November 2014 were retrospectively analyzed by age. **Outcomes:** Etiology.	
Simonetti et al. (2015) Switzerland Case Series TPS=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 Observational TPS=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).
Fromm et al. (2016) Norway Observational TPS=NA N_{Start}=150 N_{End}=150	**Population:** Stroke Patients (EG; n=150): Mean age=48.5yr; Gender: Males=101, Females=49. Non-Stroke Controls (CG; n=84): Mean age=49.3yr; Gender: Males=21, Females=63. **Intervention:** Younger patients who suffered a stroke (EG) were compared to those who did not (CG) in a population from Norway. **Outcomes:** Stroke Etiology; Carotid Intima-Media Thickness (cIMT).	1. The causes of stroke in the EG group were 5.3% large-artery atherosclerosis (LAA), 26.7% cardioembolism, 21.3% small-artery occlusion (SAO), 10% stroke of other determined cause, and 36.7% stroke of undetermined cause (SUC). 2. cIMT was increased in patients with LAA (1.56mm, p=0.002), SAO (1.11mm, p=0.006), and SUC (1.10mm, p=0.004) compared to the CG group (cIMT 0.86mm).
González-Gómez et al. (2016) Spain Case Series TPS=NA N_{Start}=110 N_{End}=110	**Population:** Mean age=46.4±8.1yr; Gender: Males=67, Females=43. **Intervention:** Younger patients (<55yr) who were admitted to a stroke unit in Spain in 2014 were retrospectively analyzed. **Outcomes:** Etiology.	1. 83.6% of the stroke cases were ischaemic (30.4% were cryptogenic, 23.9% were lacunar, 16.3% were from uncommon causes, 15.2% were atherothrombotic and 14.1% were cardioembolic), 12.7% were haemorrhagic (78.6% were hypertensive), and 3.6% were venous sinus thrombosis.

Ilinca et al. (2016) Sweden Case Series TPS=NA N_{Start}=426 N_{End}=338	**Population:** Age≤55yr. **Intervention:** Younger patients (<55yr) who were registered in the Lund Stroke Register (LSR) between 2004 and 2013 were retrospectively analyzed. **Outcomes:** Incidence.	1. Out of the 4103 patients registered in the LSR, 426 patients were ≤55yr (10.4%); 286 (67.1%) had ischemic stroke, 68 (16.0%) intracranial hemorrhage, and 70 (16.4%) had subarachnoid hemorrhage, while 0.5% were unknown.
Nacu et al. (2016) Norway Case Series TPS=NA N_{Start}=228 N_{End}=228	**Population:** Age Range=15-49yr; Gender: Male=152, Female=76. **Intervention:** Patients consecutively admitted to a neurovascular centre in Norway with acute ischaemic stroke between 2006 and 2012 were included and retrospectively analyzed. **Outcomes:** Etiology.	1. There were significantly greater rates of cardioembolism (p<0.001) or undetermined cause (p<0.001) stroke subtype.

21.3 Risk Factors

Table 21.3 Studies Evaluating Risk Factors of Stroke in Younger Individuals

Author, Year Country Study Design Time Post Stroke Sample Size	Methods	Outcomes
Calviere et al. (2013) France Case Series TPS=NA N_{Start}=100 N_{End}=100	**Population:** Mean age=44.8yr; Gender: Males=60, Females=40. **Intervention:** Patients aged 16-55yr with an Ischemic from 2006 to 2012 were included. **Outcomes:** Stroke etiology; Prevalence of risk factors.	1. Prevalent risk factors included hypertension in 18 (18%) participants, diabetes in 3 (3%), smoking in 45 (45%), and hypercholesterolemia in 46 (46%). 2. Migraines were diagnosed in 35 (35%) participants. 3. >1 silent brain infarcts found in 36 (36%) participants with 23 having a cerebellar infarct, 8 cortical, and lacunar in 9. 4. Migraines with aura were significantly more prevalent in participants with a silent brain infarct compared to those without (25% vs. 6.3 %; p=0.01).
Chen et al. (2013) Taiwan Case Series TPS=NA N_{Start}=973 N_{End}=973	**Population:** Young Participants (N=368): Mean age=53.9yr; Gender: Males=261, Females=107; Older Participants (N=605): Mean age=75.8, Gender: Males=306, Females=299. **Intervention:** Patients with an Ischemic from 2005 to 2008 were included. Patients were divided between <65yr and ≥65yr. **Outcomes:** Stroke etiology; Prevalence of risk factors; Modified Rankin Scale (mRS); Barthel Index (BI).	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).
Naess et al. (2013) Norway	**Population:** Deceased at Follow-up: Mean age=43.1±7.9yr; Alive at Follow-up: Mean	1. Diabetes mellitus on admittance was more prevalent in participants deceased at

Observational TPS_{Mean}=18.3yr N_{Start}=224 N_{End}=224	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:** Prevalence of risk factors; Stroke etiology.	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 & Herzegovina Case Series TPS=NA N_{Start}=3864 N_{End}=3864	**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 stoke from 2001 to 2005 was retrospectively analyzed. **Outcomes:** Risk factors; Stroke types; Stroke severity; Mortality; One month outcome; Modified Rankin Scale (mRS).	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%).
Dash et al. (2014) India Case Series TPS=NA N_{Start}=440 N_{End}=440	**Population:** Mean age=38.9yr; Gender: Males=367, Females=73. **Intervention:** Patients 18-45yr with an Ischemic from 2005 to 2010 were included. **Outcomes:** Prevalence of risk factors; Stroke etiology.	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).

Khealani et al. (2014) Pakistan Case Series TPS=NA N_{Start}=874 N_{End}=874	**Population:** Mean age=59.7yr; Gender: Males=529, Females=345. **Intervention:** Patients >14yr with an Ischemic in 2007 were included. **Outcomes:** Prevalent risk factors; In-hospital complications; Modified Rankin Scale (mRS); Stroke etiology.	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%).
Park et al. (2014) South Korea Case Series TPS=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 number of participants with a history of cardiovascular and cerebrovascular diseases was significantly higher in EA than YA (p<0.001). 3. Compared to EA, the proportion of participants exercising, smoking, and consuming alcohol was significantly higher in YA (p<0.001). 4. The most prevalent risk factors in YA participants were diabetes mellitus (7.8%), hypertension (18.0%), cerebrovascular disease (7.2%), cardiovascular disease (4.0%), alcohol drinking (53.1%), current smoker (47.8%), and former smoker (9.2%).
Renna et al. (2014) Italy Case Series TPS=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 the entire population were dyslipidemia (52.7%), smoking (47.3%), hypertension (39.3%), and patent foramen ovale (32.8%). 2. Other risk factors included alcohol consumption (8.3%), migraine with aura (5.7%), hyperhomocysteinemia (15.7%), obesity (16%), and history of TIA/stroke (12.7%). 3. Comparing risk factors between age groups revealed significant differences in hypertension (p<0.0001), dyslipidemia (p=0.001), smoking (p=0.034), and obesity (p=0.009); a higher proportion of participants >35yr compared to ≤35yr was observed for each factor.
Shi et al. (2014) China Case Series TPS=NA	**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;	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,

N_{Start}=351 N_{End}=351	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 antithyroperpxidase.	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 Observational TPS=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). **Outcomes:** Risk factors; National Institute of Health Stroke Scale (NIHSS); Modified Rankin Scale (mRS).	1. The following risk factors were significantly more prevalent in the young stroke group vs. healthy controls: hypertension (46.6% vs. 19.0%; p=0.000), hyperlipidemia (33.2% vs. 20.9%; p=0.009), smoking history (43.5% vs. 22.8%; p=0.000), high homocysteine (41.3% vs. 21.5%; p=0.000), poor sleep quality (47.1% vs. 29.1%; p=0.000), family history of stroke (35.4% vs. 20.9%; p=0.002), diabetes (19.7% vs. 11.4%; p=0.030), and drinking history (49.8% vs. 32.9%; p=0.001); the proportion of females was not significantly different between stroke and control groups (13.8% vs. 19.8%; p=0.191). 2. Statistically significant variables associated with young stroke were hypertension (p=0.000), hyperlipidemia (p=0.003), smoking history (p=0.004), high homocysteine (p=0.006), poor sleep quality (p=0.016), family history of stroke (p=0.039), and drinking history (p=0.024). 3. The following prognostic factors were significantly different between self-care patients (mRS<3) vs. dependent patients (mRS>3): NIHSS (p=0.000), high homocysteine (34.5% vs. 57.5%; p=0.001), and poor sleep quality (41.3% vs. 58.9%; p=0.014). 4. Statistically significant prognostic factors associated with young stroke were NIHSS (p=0.02), poor sleep quality (p=0.045), and high homocysteine (p=0.009).
Fullerton et al. (2015) USA	**Population:** Median age=19yr; Gender: Males=111, Females=102.	1. The prevalence of hypertension was significantly different between groups with

Observational TPS=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.	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 Observational TPS=NA N_{Start}=8284 N_{End}=8284	**Population:** Ischemic (N=6180): Mean age=18.6±1.0yr; Gender: Males=6180, Females=0; Hemorrhagic stroke (N=2104): Mean age=18.5±1.0yr; Gender: Males=2104, Females=0. **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 attributable risk (PAR) for Ischemic of 0.69 (95% CI 0.55–0.80). 2. Similar risk factors were also found for hemorrhagic stroke including aerobic fitness at conscription (HR=0.82 per SD increase), high BMI at conscription (HR=1.18 per SD increase), alcohol intoxication at follow-up (HR=2.92), diabetes at follow-up (HR=2.06) and low annual income 15yr post-conscription (HR=0.75). All risk factors were significantly associated with a total population attributable risk (PAR) of 0.88% for hemorrhagic stroke (95% CI 0.74–0.95; p<0.001). 3. Compared to healthy controls, a significantly greater proportion of individuals with Ischemic had a father with stroke (12.1% vs. 9.5%; p<0.05) and a mother with stroke (12.1% vs. 7.6%; p<0.05). 4. Compared to healthy controls, a significantly greater proportion of individuals with hemorrhagic stroke had a father with stroke (11.8% vs. 9.5%; p<0.05) and a mother with stroke (11.6% vs. 7.6%;

		p<0.05).
Koivunen et al. (2015) Finland Case Series TPS=NA N_{Start}=1257 N_{End}=1257	**Population:** Younger Patients (YG; n=336): Median age=42yr; Gender: Male=200, Female=136. Older Patients (OL; n=921): Age range≥50yr. **Intervention:** Young patients (<50yr) diagnosed with a first-ever intracranial hemorrhage in Helsinki University Central Hospital between January 2000 and March 2010 (YG) were analyzed retrospectively. Comparisons were performed amongst demographic subgroups and with patients over ≥50yr of age enrolled between January 2005 and March 2010 (OL). **Outcomes:** Risk Factors.	1. The most prevalent risk factors in the YG group were hypertension (29.8%) and smoking (22.3%).
Ozer et al. (2015) Turkey Case Series TPS=NA N_{Start}=619 N_{End}=619	**Population:** Younger Group (YG; n=32): Mean age=37.7±6.1; Gender: Male=13, Female=19. Older Group (OL; n=587): Mean age=71.2±11.3; Gender: Male=271, Female=316. **Intervention:** Hospital records of patients who had acute ischemic stroke from January 2007 to November 2014 were retrospectively analyzed by age. **Outcomes:** Risk Factors.	1. The rates of hypertension, diabetes mellitus, atrial fibrillation, and coronary artery disease were significantly lower in YG group compared with the OL group (all p<0.05).
Pezzini et al. (2015) Italy Case Series TPS=NA N_{Start}=1881 N_{End}=1881	**Population:** Age range: 18-45yr; Gender: Unreported **Intervention:** Hospital records of patients who had acute ischemic stroke from January 2000 to January 2012 were retrospectively. Patients were analyzed by family history of arterial thrombosis (FH; n=85). **Outcomes:** Risk Factors.	1. Compared with patients without FH of premature arterial thrombosis, those with FH were more often smokers and carriers of procoagulant abnormalities. 2. Smoking, the A1691 mutation in factor V gene, and the A20210 mutation in the prothrombin gene were associated with FH of premature stroke. 3. Recurrent events occurred more frequently in the subgroup of patients with FH of premature stroke (p=0.051) compared to patients without such a FH.
Simonetti et al. (2015) Switzerland Observational TPS=NA N_{Start}=624 N_{End}=624	**Population:** Median age=46yr; Gender: Males=374, Females=250. **Intervention:** Young participants (16-55yr) with stroke were prospectively recruited in a multicentre study. **Outcomes:** Risk factors; Mortality at 3mo follow-up; Stroke etiology; Recurrence of cerebrovascular events; Modified Rankin Scale (mRS);	1. 96% of participants had ≥1 vascular risk factor while 73% of participants had ≥1 modifiable vascular risk factor. 2. In terms of risk factors for participants 16-45yr (N=284), 35% had hypercholesterolemia, 41% smoked, 21% had hypertension, 13% had a prior stroke or TIA, 2.5% had diabetes, 2.5% had coronary heart disease, 1.8% had atrial fibrillation, 12% had thrombophilia, 31% of women were taking oral contraceptives, 1.5% of women were on hormone replacement therapy, and 18% have a family history of stroke. 3. In terms of risk factors for participants 46-55yr (N=340), 58% had hypercholesterolemia, 45% smoked, 46%

		had hypertension, 14% had a prior stroke or TIA, 13% had diabetes, 8% had coronary heart disease, 5% had atrial fibrillation, 4.3% had thrombophilia, 3.7% of women were on oral contraceptives, 0.9% of women were on hormone replacement therapy, and 30% have a family history of stroke. 4. The frequency of risk factors was significantly different between age groups ($p<0.05$ for all) for all factors except smoking and prior stroke or TIA; the 46-55yr group had higher frequencies for all risk factors except for thrombophilia and women with oestrogen intake. 5. The 46-55yr age group had a significantly higher number of modifiable risk factors compared to younger participants ($p<0.001$).
Thijs et al. (2015) Belgium Case Series TPS=NA N_{Start}=4232 N_{End}=4232	**Population:** Age range<55yr. **Intervention:** Data from the Stroke in Fabry Patients study was retrospectively analyzed. **Outcomes:** Risk Factors.	1. Family history of stroke was present in 1578 of the 4232 patients (37.3%). 2. Female patients more often had a history of stroke in the maternal lineage ($p=0.027$) compared to paternal lineage. 3. Patients with a parental history of stroke more commonly had siblings with stroke ($p=0.047$).
González-Gómez et al. (2016) Spain Case Series TPS=NA N_{Start}=110 N_{End}=110	**Population:** Mean age=46.4±8.1yr; Gender: Males=67, Females=43. **Intervention:** Younger patients (<55yr) who were admitted to a stroke unit in Spain in 2014 were retrospectively analyzed. **Outcomes:** Risk Factors.	1. Common risk factors were smoking (56.4%), arterial hypertension (50%), dyslipidaemia (42.7%), obesity (33%), diabetes (18.2%) and emboligenic heart disease (12.7%)
Ilinca et al. (2016) Sweden Case Series TPS=NA N_{Start}=426 N_{End}=338	**Population:** Age≤55yr. **Intervention:** Younger patients (<55yr) who were registered in the Lund Stroke Register (LSR) between 2004 and 2013 were retrospectively analyzed. **Outcomes:** Family History Questionnaire.	1. 45/338 (13%) or patients who completed the questionnaire had at least 2 family members with stroke. 2. 2.4% consisted of patients with no cardiovascular risk factors and at least 1 family member with early stroke onset.
Nacu et al. (2016) Norway Case Series TPS=NA N_{Start}=228 N_{End}=228	**Population:** Age Range=15-49yr; Gender: Male=152, Female=76. **Intervention:** Patients consecutively admitted to a neurovascular centre in Norway with acute ischaemic stroke between 2006 and 2012 were included and retrospectively analyzed. **Outcomes:** Risk Factors.	1. Significant risk factors were hypertension ($p=0.005$) and smoking ($p=0.03$). 2. History of cardiovascular disease did not significantly correlate with stroke (all $p\geq0.31$).

21.4 Recovery and Prognosis

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

Author, Year Country Study Design Time Post Stroke Sample Size	Methods	Outcomes
Hindfelt & Nilsson (1977) Sweden Case Series TPS=NA N=60	Patients (age 16-40 years, mean age at stroke onset 30.85 years) who suffered an acute ischemic stroke were included. Patients were followed an average of 51 months.	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.
Coughlan & Humphreys (1982) UK Observational TPS=3-8yr N=170	Spouses of patients completed postal questionnaires. All patients were under the age of 65 at the time of their stroke.	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 ($P<0.05$). 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.
Ferro & Crespo (1988) Portugal Observational TPS=NA N=254	Patients between the ages of 15 and 50 were included.	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.
Bogousslavsky & Regli (1987) Switzerland Observational TPS=NA N=41	Patients with ischemic stroke under 30 years of age were included. Mean follow-up was 46 months post stroke.	3 patients died acutely. Annual incidence of death was 0.7% and that of recurrent stroke was 0.7%. One patient who survived the acute phase died during follow-up. This patient died of renal failure due to systemic lupus erythematosus, 48 months after stroke. One patient with intracerebral arteritis suffered another stroke 10 months after the initial event. The authors noted that subacute prognosis was good.
Chancellor et al. (1989) New Zealand Observational TPS=NA N=66	Patients (<40 years old) with acute non-hemorrhagic cerebral infarction (n=63) or transient ischemic attack (n=3) included. Follow-up was a mean of 3 years following the initial presentation.	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.
Adunsky et al. (1992)	Patients aged 18 to 40 years old admitted to an	Mean time to admission was almost 1 month

Israel Observational TPS=NA N=35	Israeli rehabilitation facility were included.	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<0.01), but not between discharge and follow-up. Young stroke patients significantly improved in standing, sitting, transfer and walking abilities (p<0.02) during hospitalization. At follow-up significant improvements remained for standing and walking ability (p<0.01). There were no deaths during the study period.
Hindfelt & Nilsson (1992) Sweden Observational TPS>1mo N=74	Patients with ischemic stroke between the ages of 16 and 40 were included in this study. Follow up ranged from 13-26 years following stroke onset.	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.
Lindberg et al. (1992) USA Observational TPS=NA N=324	Patients with long-term subarachnoid hemorrhage were included.	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.
Falconer et al. (1994) USA Observational TPS<120d N=260	Patients with acute stroke (<120 days) admitted to inpatient stroke rehabilitation with LOS more than 7 days included. Patients categorized into 3 groups: 1) <65 years old (n=100), 2) 65-74 years old (n=75) or 3) ≥75 years old (n=85).	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.
Ferro & Crespo (1994) Portugal Observational TPS=NA N=215	Patients under the age of 45 years to describe their functional and vocational positions after a long-term follow up, a mean of 43.1 months.	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<0.0001). 4 patients died at follow-up, all had a major stroke.
Kappelle et al. (1994) Sweden Observational TPS=NA N=296	Patients with ischemic stroke between the ages of 15 to 45 years who had been referred to a tertiary medical center underwent a follow-up assessment.	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 Observational TPS<3mo	Patients younger than 40 years with the cerebral infarction were 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

N=300		patients (4%) suffered from recurrent cerebral infarctions.
Rozenthul-Sorokin et al. (1996) Israel Observational TPS=NA N=253	Patients with first stroke (ages 17-49) were admitted to hospitals in Israel over 1 year. A questionnaire containing 88 questions was used for evaluation of the patients.	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 Observational TPS=NA N=71	Patients aged 15 to 45 years old experienced a cerebral infarction. Follow-up was done by interview and with neurological examination for 65 of the patients a mean of 31.7 months.	At follow-up 2 patients were dead, 7 experienced post-stroke seizures and 4 patients had recurrent strokes. Post-stroke depression occurred in 48.3% of patients and it was found to be significantly associated with severe disability and a bad general outcome. No problems were reported by 69.8% of patients, 11.1% reported a moderate handicap and 20% reported having a major handicap. 73% of patients returned to work at a mean of 8mo post-stroke.
Marini et al. (1999) Italy Observational TPS=NA N=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 Observational TPS=NA N=135	Patients with first-ever cerebral infarction, aged 16 to 45 years old, were evaluated and followed up for a mean of 68.8 months.	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.
Marini et al. (2001) Italy Case Series TPS=NA N=89	Patients younger than 45 years of age with first-ever stroke were included.	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<0.0001).
Kersten et al. (2002) UK	Southampton Needs Assessment Questionnaires were distributed to people with stroke for 2 age	Good levels of mobility (able to walk 10 meters independently inside and unaided outside) were

Observational TPS=NA N=315	groups (18-45 years; 46-65 years) suffering from chronic stroke.	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
Leys et al. (2002) France Observational TPS=NA N=287	Patients with ischemic stroke aged 15 to 45 years old were included.	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.
Black-Schaffer & Winston (2004) USA Observational TPS=NA N=979	Patients were assessed using the Functional Independence Measure (FIM) at admission and discharge. Age, length of stay, severity of stroke, and amount returning home post-discharge were measured.	Younger stroke patients (<50 years of age) had greater increase in FIM scores from admission to discharge. Younger patients were also more likely to be discharged home. There was no difference in FIM between younger and older cohort in those with high admission FIM scores (>80). Younger patients stayed an average of 23 days longer in hospital, but this may be due to the likelihood of older patients being discharged to nursing homes. Overall, age was negatively related to functional outcome.
Varona et al. (2004) Spain Case Series TPS=NA N=272	Patients with ischemic stroke were reviewed over 27 years to identify potential predictors of mortality, reoccurrence of stroke and poor functional recovery.	During follow-up 12% (30) of patients died and information on long-term functional handicaps was obtained from 88% (240) of patients at follow-up. 90% were independent following stroke, 26% had no disability and 11% had major deficits. 95% of patients could walk without aid from another person at follow-up. Cardiovascular risk factors and artery atherosclerosis in the carotid artery were predictors of negative long-term outcome.
Naess et al. (2004) Norway Observational TPS=NA N=232	Patients who experienced a first-ever cerebral infarction that were between the ages of 15 and 49 were included in this study.	After a mean time to follow-up of 5.7 years, 23 (9.9%) patients had died, 23 (9.9%) experienced recurrence of cerebral infarction, 24 (10.5%) developed post-stroke seizures, and 77.9% of all patients had a favourable functional outcome (mRS ≤2).
Naess et al. (2005b) Norway Observational TPS=NA N=192	Patients aged 15 to 49 years old experienced cerebral infarction and 212 controls were interviewed.	53% of stroke patients and 31% of controls reported fatigue (P<0.001). There were significant associations between fatigue and poor functional outcome (P=0.001), and fatigue and depression (P<0.001).
Naess et al. (2005a) Norway Observational TPS=NA N=232	Patients aged 15 to 49 years old with first-ever ischemic stroke were included.	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.
Nedeltchev et al. (2005) Switzerland Observational TPS=NA N=203	Patients with ischemic stroke (aged 16-45) were included. Outcomes were assessed three months after admission. Risk factors and stroke etiology were determined, and the Modified Rankin Scale (mRS) was used to classify	68% of patients had a favourable outcome (mRS 0-1), 29% unfavourable (mRS 2-5), and 3% died (mRS 6). Diabetes mellitus was associated an unfavourable clinical outcome. The annual risk of stroke recurrence was 3% for all patients and

	recovery.	11.7% for patients with a history of TIA. Most common risk factors included smoking (46%), hypercholesterolemia (39%), and hypertension (19%).
Naess et al. (2006) Norway Observational TPS=NA N=232	2Ppatients aged 15 to 49 years with first-ever cerebral infarction and 215 control subjects were included.	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<0.001). Also, stroke patient who were depressed, unemployed or fatigued had significantly reduced score for all the items of the SF-36.
Cabral et al. (2009) Brazil Observational TPS<1yr N=1323	Patients (759 first ever strokes) occurring in Joinville, Brazil were prospectively ascertained.	Crude mortality rates for men who suffered a stroke during 2005 and 2006 per 100,000 were as follows: <24 years, 0; 25-34 years, 0; 35-44 years, 6.6;4 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: <24 years, 0; 25-34 years, 1.1; 35-44 years, 9.1;4 45-54 years, 27.9; 55-64, 35.0.
Putaala et al. (2009b) Finland Observational TPS=NA N=1008	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.	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 over the age of 45.
Naess et al. (2009) Norway Observational TPS=NA N=195	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.	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.
Röding et al. (2009) Sweden Observational TPS=8-36mo N=1068	Patients 18–55 years of age with first-ever stroke answered questions about their physical and cognitive abilities before and after the stroke.	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 significantly more deterioration in both physical and cognitive functions than men.
Röding et al. (2010) Sweden Observational TPS=8-36mo N=1068	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.	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.

Ellis (2010) USA Case Series TPS=NA N=41,587	Patients from a national data set (the Nationwide Inpatient Sample) between the ages of 18-44 were identified (5% of all stroke patients). Discharge disposition and type of stroke was recorded.	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.
Putaala et al. (2010) Finland Case Series TPS=NA N=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.	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.
Spengos & Vemmos (2010) Greece Observational TPS=NA N=253	Patients with ischemic stroke were prospectively enrolled in the Athens Young Stroke Registry. Patients were 45 years of age or younger.	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 in survival rate. At the end of the follow-up period (mean follow-up period being 52.4 months), 86.2% of all patients were independent (mRs score 0-2) and 6.7% of all patients were significantly disabled.
Greisenegger et al. (2011) Austria Case Series TPS=NA N=677	Patients with ischemic stroke or transient ischemic attack between the ages of 18 and 59 were identified in the Vienna Stroke Registry.	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.
Knoflach et al. (2012) Austria Case Series	Patients with acute ischemic stroke, functionally independent before stroke, recorded in the Austrian Stroke Unit Registry with 3-month	Good outcome scores (modified Rankin Scale score $\leq$2) was more common among young stroke patients (92.1% and 88.2% in the age

TPS=NA N=14,256	follow-up data.	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.
Palmcrantz et al. (2012) Sweden Case Series TPS=NA N=192	Patients (63 <65 years) with 12-month follow-up data.	Younger stoke 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.
Toni et al. (2012) Italy Case Series TPS=NA N=27671	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). Post-hoc analysis to evaluate the clinical course and factors associated with intravenous thrombolysis was conducted.	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).
Vibo et al. (2012) Estonia Observational TPS=NA N=1206	Patients who were young (≤ 55 years) with first ever stroke, investigating long-term survival.	Increasing age (0-44 years versus 45-54 years) and hemorrhagic stroke subtype were associated with lower long-term survival rates.
Arntz et al. (2013) Arntz et al. (2013) Arntz et al. (2015) Netherlands Observational TPS=NA N_{Start}=697 N_{End}=697	**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 Observational TPS=NA N_{Start}=261 N_{End}=261	**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).	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 Case Series TPS>26.4mo N_{Start}=551 N_{End}=551	**Population:** Mean age=66.0yr; Gender: Males=55, Females=45. **Intervention:** Patients >40yr with a first ever ischemic stroke from 2007 to 2009 were included. Patients were divided into age groups of 40-64yr (N=235) and ≥65yr (N=316). **Outcomes:** Stroke etiology; Prevalent risk factors; Mortality; Major adverse cardiovascular events; Prevalence of recurrent stroke; Risk of stroke.	1. Recurrent strokes were significantly more prevalent in the 40-64yr group compared to the ≥65yr group (3.8% vs. 21.7%; p<0.001). 2. The cumulative risk of stroke was significantly lower in the 40-64yr group compared to the ≥65yr group at 1yr (1.7% vs. 7.3%; p<0.05) and at 3yr (2.6% vs. 12.0%; p<0.05). 3. Major adverse cardiovascular events were significantly more prevalent in the ≥65yr group compared to the 40-64yr group (20.6% vs. 7.2%; p<0.001). 4. Mortality was significantly higher in the

		≥65yr group compared to the 40-64yr group (8.9% vs. 0.9%; p<0.001).
Giang et al. (2013) Sweden Observational TPS=NA N_{Start}=17,149 N_{End}=17,149	**Population:** Mean age=NA; Gender: Males=10739, Females=6410. **Intervention:** Patients 18-54yr with an ischemic stroke from 1987 to 2006 were included. **Outcomes:** Prevalent risk factors; Standardized Mortality Ratio (observed deaths over expected deaths); Cause of death; 4yr mortality rate.	1. Death occurred in 1265 participants within 4yr post-stroke. 2. Standardized mortality ratios were higher in the 18-44yr group compared to the 45-54yr group in both males (18-44yr=9.15, 45=54yr=5.11) and females (18-44yr=12.12, 45=54yr=6.37). 3. The standardized mortality ratio in males decreased between 1987-1991 and 1992-1996 (5.99 to 5.13) but increased from 1997-2001 and from 2002-2006 (5.18 to 5.88). 4. The standardized mortality ratio in females decreased consistently between 1987-1991 and 2002-2006 (8.65 to 5.91). 5. The 4yr mortality risk from 1987-2006 decreased by 32% in males and 45% in women. 6. The cause of death was stroke in 418 (33%) participants, coronary heart disease in 249 (19.7%), other cardiovascular diseases in 125 (9.88%), malignancies in 244 (19.3%), and other causes in 438 (34.6%). 7. The cause of death was significantly different between males and females in regards to cardiovascular diseases (males=50.3%, females=36.4%; p<0.0001) and malignancies (males=15.3%, females=28.4%; p<0.0001).
Gonzalez-Perez et al. (2013) UK Observational TPS=NA N_{Start}=3036 N_{End}=3036	**Population:** Mean age=NA; Gender: NA. **Intervention:** Individuals 20-89yr with a record on The Health Improvement Network (THIN) UK were followed until intracerebral hemorrhage (ICH), subarachnoid hemorrhage (SAH), or death was recorded. Data was collected from 2000 to 2008. The number of confirmed cases of hemorrhagic stroke was 1797 for ICH and 1340 for SAH. **Outcomes:** 30d case fatality following stroke; Excess mortality rate: <1yr, >1yr, Overall.	1. Over the 6yr study period, the standardized incidence for hemorrhagic stroke within the THIN database (N=2,110,327) was 22.5 per 100,000 person-years. 2. Overall, the 30d case-fatality for hemorrhagic stroke for this population was 36.3%. Case fatality after ICH was 42.0%, compared with 28.7% after SAH. However, this difference between the two stroke groups was not significant (p>0.05). For both groups, the case fatality rated 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).
Hansen et al. (2013) Sweden Observational TPS=NA N_{Start}=323 N_{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 Observational TPS=NA N_{sSart}=681 N_{End}=70	**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. **Outcomes:** Modified Rankin Scale (mRS); Prevalence of infections preceding and post-stroke; All-cause mortality.	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 common PI subtype was upper respiratory tract infection. 2. After adjusting for demographic variables, risk factors, stroke severity and subtype, lesion size, presence of multiterritorial lesions, PSI, and highest levels of inflammatory parameters, PI remained independently associated with unfavorable 3mo outcome (mRS>2) (p=0.002). 3. After adjusting for demographic variables, risk factors, stroke severity and subtype, lesion size, presence of multiterritorial lesions, and PI, individuals with PSI had a

		significantly higher risk of an unfavorable outcome at 3mo compared to individuals without PSI (mRS>2) (p=0.031). 4. Results showed that PIs were not associated with recurrent ischemic stroke (p=0.323) or composite of vascular end points (p=0.157). Similarly, PSI was not significantly associated with the risk of recurrent ischemic stroke p=0.124). 5. An increased risk of all-cause mortality was not found to be impacted by PIs (p=0.124) however, individuals with PSI had a higher mortality during the follow-up period.
Janes et al. (2013) Italy Case Series TPS=NA N_{Start}=153,312 N_{End}=153,312	**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. The total case fatality rate for a first ever stroke was 20.6 at 28d, 25.8 at 90d, and 30.0 at 180d. 2. Case fatality was higher for a first ever intracerebral hemorrhage (ICH) compared to a first ever ischemic stroke (IS) at all time points (28d: ICH=31.6, IS=16.8; 90d; ICH=36.8, IS=22.9; 180d: ICH=37.9, IS=27.3).
Kim et al. (2013) South Korea Case Series TPS=NA N_{Start}=102,210 N_{End}=102,210	**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. Readmission following stroke in the 0-29yr group was 6.14% after 1yr, 2.82% after 2yr, 2.67% after 3yr, and 1.49% after 4yr. 2. Readmission following a stroke in the 30-44yr group was 6.80% after 1yr, 3.17% after 2yr, 2.27% after 3yr, and 2.02% after 4yr. 3. Readmission following a stroke in the 45-54yr group was 8.21% after 1yr, 4.59% after 2yr, 3.57% after 3yr and 2.89% after 4yr.
Kropp et al. (2013) Europe Case Series TPS=NA N_{Start}= 4431 N_{End}=4431	**Population:** Mean age=44.7±8.1yr; Gender: Males= 2,630, Females= 1,801. **Intervention:** Patients 18-55yr with a transient ischemic attack (TIA) or ischemic stroke (IS) were included in this multicenter observational study. **Outcomes:** Occurrence of a headache during a cerebrovascular event (CVE); Lesion size; Lesion location.	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	**Population:** Mean age=62.1±12.5yr; Gender: Males=124, Females=90. **Intervention:** A multicenter analysis of long-	1. Physical complications (mainly pain) at 1yr post-stroke were present in a significantly greater proportion of participants ≥60yr

Observational TPS=NA N_{Start}=214 N_{End}=214	term morbidities in participants with stroke was conducted. Follow-up assessments were conducted for at least 1yr post-stroke. **Outcomes:** Complications 1yr post-stroke: Physical, Psychological.	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 & Krupskaya (2013) Russia Case Series TPS=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:** Mortality rate.	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. (2013b) Netherlands Observational TPS=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 artherothrombotic stroke, cardioembolic stroke, and lacunar stroke were associated with recurrent stroke (HR=2.72; 2.49; 2.92).

Rutten-Jacobs et al. (2013a) Netherlands Observational TPS=NA N_{Start}=959 N_{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 Observational TPS=NA N_{Start}=277 N_{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.	1. Participants with ischemic stroke had a worse cognitive performance on six domains after a mean follow-up of 11yr compared with controls (processing speed: p<0.0001; working memory: p<0.0001; immediate memory: p=0.0002; delayed memory: p<0.0001; executive functioning: p<0.0001); visuo-construction was not significantly different between groups. 2. Longer follow-up duration was associated with a lower scores for immediate memory (p=0.001), delayed memory (p<0.0001), and executive functioning (p=0.004); however, after exclusion of participants with recurrent stroke, there was no longer a significant negative relation between follow-up duration and executive functioning score in participants with ischemic stroke. 3. The proportion of participants with a below average performance or a cognitive

		impairment on a cognitive domain was significantly higher in the stroke group compared to the healthy group for all 7 cognitive domains (p<0.0071 for all). 4. Up to 50% of all participants with ischemic stroke had a below average performance or cognitive impairment. Cognitive impairment affected ≤34.5% of participants.
Smajlovic et al. (2013) Bosnia & Herzegovina Case Series TPS=NA N_{Start}=3864 N_{End}=3864	**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 stoke from 2001 to 2005 was retrospectively analyzed. **Outcomes:** Risk factors; Stroke types; Stroke severity; Mortality; One month outcome; Modified Rankin Scale (mRS).	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).
Tiamkao et al. (2013) Thailand Observational TPS=NA N_{Start}=85 N_{End}=85	**Population:** Mean age=35.9±6.2yr; Gender: Males=47, Females=38. **Intervention:** All participants <45yr who were diagnosed with stroke between 1996 and 2010 and had completed workshops for causes of stroke in the young were analysed and followed up a year after. **Outcomes:** Outcomes were defined as favorable (i.e. if participant had normal functional ability or mild disability but the participant was employed) or non-favorable; Risk factors; Stroke etiology; Survival rate; Return to work.	1. 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).
Waje-Andreasen et al. (2013) Norway Observational TPS=NA N_{Start}=232 N_{End}=232	**Population:** Patients (N=232): Mean age=41.1±7.5yr; Gender: NA. **Intervention:** Patients with an index-stroke between 1988 and 1997 were retrospectively selected and compared with age and sex-matched controls (N=167). Follow-up assessments were conducted from 2004-2005 where participants were clinically examined. **Outcomes:** Modified Rankin Scale (mRS); Memory problems; Risk factors; Work status.	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. 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 Case Series TPS=NA N_{Start}=NA N_{End}=NA	**Population:** Mean age=NA; Gender: Males=NA, Females=NA. **Intervention:** Stroke mortality was determined for individuals 45-54yr in 1999. **Outcomes:** Stroke mortality rate.	1. The mean stroke mortality rate per 100,000 per year in 1999 for males 45-54yr was 35.43 in South America, 28.37 in Asia, 98.53 in Africa, 21.43 in Europe, and 12.87 in Canada, USA, Australia and New Zealand. 2. The mean stroke mortality rate per 100,000 per year in 1999 for females 45-54yr was 29.75 in South America, 14.99 in Asia, 56.07 in Africa, 13.61 in Europe, and 11.28 in Canada, USA, Australia and New Zealand.
Aarnio et al. (2015) Finland Observational TPS=NA N_{Start}=970 N_{End}=970	**Population:** Median age=44yr; Gender: Males=608, Females=362. **Intervention:** Follow-up data from young adults (15-49yr) with a first ever ischemic from 1994 to 2011 who survived ≥30d were included. The mean follow-up time was 10.2yr. **Outcomes:** Mortality; Risk factors; Stroke etiology; Standardized mortality ratio (observed deaths over expected deaths); Absolute risk of death; Absolute excess risk of death.	1. At follow-up, 152 (15.7%) patients had died with death in 15 (9.9%) due to ischemic stroke, 8 (5.3%) due to hemorrhagic stroke, 45 (29.6%) due to a cardioaortic cause, 29 (19.1%) due to malignancy, 10 (6.6%) due to infection, and 45 (29.6%) due to other causes. 2. Death occurred in 22 participants 15-39 and in 130 participants aged 40-49. 3. The standardized mortality ratio was 5.42 in participants 15-39yr and 6.94 in participants 40-49yr; the absolute risk of death per 1000 person-years was 6.87 in the 15-39yr group and 19.42 in the 40-49yr group; the absolute excess risk of death per 1000 person-years was 5.60 in the 15-39yr group and 15.05 in the 40-49yr group. 4. Recurrent strokes occurred in 132 (13.6%) participants with 117 experiencing ischemic stroke and 13 experiencing hemorrhagic stroke. 5. The median recurrent stroke time was 3.7yr.
de Bruijn et al. (2014) Netherlands Observational TPS>1yr N_{Start}=96 N_{End}=96	**Population:** Median age=43.0yr; Gender: Males=44, Females=52. **Intervention:** Patients 18-49yr with a first ever ischemic stroke from 2000 to 2010 were included and underwent a neuropsychological examination between April and June 2011. Patients were also compared to healthy controls (N=61).	1. Compared to healthy controls, patients performed significantly worse on the Stroop Color-Word Test Part 1 (stroke=52.4±16.3, no stroke=40.5±7.1; p<0.001), the Symbol-Digit Substitution Task (stroke=63.8±18.3, no stroke=79.6±13.5; p<0.001), and the learning slope component of the Word Pair

	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.	Test (stroke=2.9±2.0, no stroke=4.5±2.0; p=0.002). 2. Compared to healthy controls, participants performed significantly better on the ROCF Copy component (median: stroke=34, no stroke=36; p<0.001). 3. No other significant differences between groups were observed in the other cognitive outcomes.
Bulder et al. (2014) Netherlands Case Series TPS_{Mean}=6yr N_{Start}=17 N_{End}=17	**Population:** Mean age=19.3yr; Gender: Males=5, Females=12. **Intervention:** Patients aged 5-50yr with a first ever ischemic stroke in the middle cerebral artery (MCA) from 1994 to 2011 were included. **Outcomes:** Stroke etiology; Modified Rankin Scale (mRS).	1. All strokes were caused by a non-atherosclerotic unilateral intracranial arteriopathy of the proximal MCA or distal internal carotid artery. 2. Severe arteriopathy of the MCA occurred in 9 participants and in the internal carotid artery of 1 participant; 7 participants had mild arteriopathy. 3. Poor functional outcomes (mRS>2) were observed in 4 participants, 8 had a mRS score of 2, 3 had a score of 1, and 2 had a score of 0.
Chraa et al. (2014) Morocco Observational TPS=NA N_{Start}=128 N_{End}=128	**Population:** Mean age=28.3yr; Gender: Males=76, Females=52. **Intervention:** 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; Outcomes at follow-up; Modified Rankin Scale (mRS).	1. Outcomes observed at the follow-up assessment included death in 21 (16.4%) participants, full recovery in 49 (38.2%), a residual motor defect in 38 (29.6%), epilepsy in 7 (5.5%), vascular dementia in 2 (1.6%), poor functional outcomes (mRS>2) in 49 (38.2%), and 11 (8.6%) were lost to follow-up.
Ghatan et al. (2014) USA Observational TPS=NA N_{Start}=19 N_{End}=19	**Population:** Mean age=12.3yr; Gender: Males=13, Females=6. **Intervention:** Patients with a stroke who underwent surgery for epilepsy from 2005 to 2012 were included. The mean follow-up duration was 4.5yr. **Outcomes:** Epilepsy duration; Modified Rankin Scale (mRS); Functional improvement: Cognition, Behaviour, Quality of life.	1. Epilepsy duration was a mean of 9.3yr. 2. Poor functional outcomes (mRS>2) were observed in 11 (57.9%) participants. 3. Functional improvement in terms of cognition, behaviour, and quality of life was observed in all participants with 4 participants showing mild to moderate improvement and 15 participants showing marked improvement.
Ghatanatti et al. (2014) India Case Series TPS=NA N_{Start}=4 N_{End}=4	**Population:** Mean age=27.2yr; Gender: Males=1, Females=3. **Intervention:** Patients who experienced a stroke following a valvular surgery and anticoagulant use were included. **Outcomes:** Stroke etiology; Mortality; Surgical operation.	1. Stroke was classified as hemorrhagic in 3 participants and thromboembolic in 1 participant. 2. 2 participants with a hemorrhagic stroke died at a mean of 3.5d post-stroke and the other 2 participants were revived. 3. Both participants that received a mitral valve replacement expired and both participants that received a double valve replacement were revived.
Kalita et al. (2014) India Case Series	**Population:** Mean age= 41.6yr; Gender: Males=308, Females=96. **Intervention:** Patients 16-50yr with an	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).

TPS=NA N_{Start}=404 N_{End}=404	intracerebral hemorrhage (ICH) with a stroke from 2001-2010 were retrospectively analyzed. **Outcomes:** Prevalent risk factors; ICH etiology; Glasgow Outcome Scale (GOS); 1mo mortality.	2. A multivariable analysis showed that low GCS (p<0.001), large size ICH (p=0.01), and high leukocyte counts (p=0.03) were significantly associated with 1mo mortality.
Khealani et al. (2014) Pakistan Case Series TPS=NA N_{Start}=874 N_{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. In-hospital complications were not significantly different between age groups with participants <45yr reporting 10 cases of pneumonia, 3 cases of urinary tract infections and 1 case of gastrointestinal bleeding. 2. mRS scores at discharge were not significantly different between age groups with participants <45yr showing a poor functional outcome (mRS>2) in 81 (65.8%) cases compared to 64.8% for >45yr.
Koton et al. (2014) Israel Case Series TPS=NA N_{Start}=14,357 N_{End}=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 crude cumulative incidence of mortality 30d post-stroke was 0.11 for patients <65yr and 0.10 for patients ≥65yr. 2. The crude cumulative incidence of mortality 1yr post-stroke was 0.18 for patients <65yr and 0.123 for patients 65yr. 3. The crude cumulative incidence of mortality 5yr post-stroke was 0.0.34 for patients<65yr and 0.44 for patients ≥65yr. 4. The crude cumulative incidence of mortality at the end of follow-up was 0.49for patients <65yr and 0.66 for patients ≥65yr.
Liu et al. (2015) China Observational TPS=NA N_{Start}=179 N_{End}=179	**Population:** Mean age=37.6±6.2yr; Gender: Males=134, Females=45. **Intervention:** Patients <45yr with an ischemic stroke from 2005 to 2012 that had received either aggressive (AMM) or routine medical management (RMM) were included. RMM participants received antiplatelet therapy, a cholesterol-lowering agent, and intravenous penicillin for 10-14d. AMM participants received high-dose methylprednisolone pulse therapy for 5d in addition to oral prednisone sequential therapy for >3mo. A follow-up assessment was conducted at a median of 25mo. **Outcomes:** Angiographic outcomes at follow-up; 2yr cumulative stroke-free survival rate; Recurrent stroke rate.	1. Angiographic outcomes at follow-up were significantly different between groups with more RMM participants showing cases of progression (RMM=20.9%, AMM=5.6%), no change (RMM =39.5%, AMM=31.0%) or a new lesion (RMM=16.3%, AMM=1.4%); a greater proportion of AMM showed improvement (RMM=23.3%, AMM=62.0%) (p=0.002). 2. The 2yr cumulative stroke-free survival rate was significantly greater in the AMM group compared to RMM (92.6% vs. 86.3%) (p=0.006). 3. Recurrent strokes occurred in a significantly greater proportion of RMM participants compared to AMM (18.9% vs. 1.7%) (p=0.001).
Lindmark et al. (2014) Sweden Case Series TPS=NA N_{Start}=62,497 N_{End}=62,497	**Population:** Mean age=NA; Gender: Males=NA, Females=NA. **Intervention:** The fatality rate of stroke participants from 2001 to 2009 was determined. **Outcomes:** Case fatality rates.	1. The case fatality rate for participants 8-28d post-stroke was 1.1% for the 18-54yr group, 1.4% for the 55-64yr group, and 2.2% for the 65-74yr group. 2. The case fatality rate for participants 28d-1yr post-stroke was 1.9% for the 18-54yr group, 3.3% for the 55-64yr group, and

		5.9% for the 65-74yr group. 3. Survival probability curves show a higher probability of survival associated with higher education and higher income. 4. Associations between socioeconomic status and case fatality were significant for education, income, cohabitation ($p<0.001$ for all) and country of birth ($p<0.05$); a lower case fatality was associated with a higher level of education, a higher level of income and with cohabitation vs. living alone. 5. Multivariate analyses revealed significant associations between case fatality and the following factors: highest attained education 29d-1yr post-stroke ($p=0.046$) but not 8d-28d post-stroke, income group for both 8d-28d ($p=0.001$) and 29d-1yr post-stroke ($p<0.001$), cohabitation for both 8d-28d ($p=0.04$) and 29d-1yr post-stroke ($p<0.001$); a lower case fatality was associated with a higher level of education, a higher level of income, and with cohabitation vs. living alone.
Maaijwee et al. (2014) Netherlands Observational TPS=NA N_{Start}=437 N_{End}=437	**Population:** Mean age: TIA: 40.9±8.0yr, Ischemic Stroke: 40.0±7.7yr; Gender: Males=198, Females=239. **Intervention:** Patients 18-50yr with a first ever stroke from 1980 to 2010 were included. Ischemic stroke participants were also compared to healthy controls. **Outcomes:** Prevalence of subjective executive and memory failures; Prevalent risk factors.	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 ($p<0.01$). 5. Subjective executive failures were significantly more prevalent in ischemic stroke participants compared to healthy controls ($p<0.001$).
Park et al. (2014) South Korea Case Series TPS=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	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 ($p<0.001$),

	with event and process of care; Clinical parameters; Laboratory and radiologic examinations; Emergency care procedures; Mortality at discharge; Modified Rankin Scale (mRS).	receiving anticoagulant therapy and an operation at another hospital (p=0.011; p=0.028), median time to a brain CT scan (p=0.015), emergency department image <10min (p=0.016), and the proportion of participants who received an operation at their hospital of care (p=0.002); all variables were greater in the EA group except for the median time to a brain CT scan. 3. Overall hospital mortality was higher in EA at 3.1% compared to 1.1% in YA (p<0.001). 4. mRS scores before the event were significantly higher in EA compared to YA with 9.4% and 3.3% of elderly and young adults in the moderate to severe disability category (p<0.001). 5. The change in mRS scores from before the event to discharge was significantly different between groups with a greater proportion of EA participants having a worsened score and a greater proportion of YA participants with an unchanged score (p<0.001).
Rutten-Jacobs et al. (2014) Netherlands Observational TPS=NA N_{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.
Synhaeve et al. (2014) Netherlands Observational TPS=NA N_{Start}=722 N_{End}=722	**Population:** Mean age=40.5±7.8yr; Gender: Males=344, Females=378. **Intervention:** Patients with first-ever stroke admitted between 1980 and 2010 were followed for an average of 9.1yr. **Outcomes:** Modified Rankin Scale (mRS); Instrumental Activities of Daily Living Scale (iADL).	1. At discharge, 2.4% of participants with TIA, 30.2% of participants with ischemic stroke (IS), and 69.7% with intracerebral hemorrhage (ICH) had a poor functional outcome according to mRS scores >2. After a mean follow-up of 9.1yr, a poor mRS outcome was present in 16.8% of participants with TIA, 36.5% with IS and

		49.3% with ICH. 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<8). 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<0.001) and iADL (33.3% vs. 11.5%; p<0.001). 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<0.001). 5. Patients admitted before 1990 had more incident strokes than those admitted after 2000 (17.0% vs. 10.1%, p=0.036). 6. Significant predictors of poor functional outcomes according to the mRS were NIHSS at admission (p<0.001), incident stroke (p<0.001), age at baseline (p=0.002), and incident cardiovascular disease (p<0.001). 7. Significant predictors of poor functional outcomes according to the iADL were NIHSS at admission (p<0.001) and incident stroke (p<0.001).
Tsivgoulis et al. (2014) Greece Case Series TPS=NA N_{Start}=1134 N_{End}=1134	**Population:** Mean age=37.4±7.0yr; Gender: Males=667, Females=467. **Intervention:** Data from participants 18-45yr admitted to an international multicentre study with first-ever acute stroke was retrospectively assessed for risk factors associated with several outcomes. **Outcomes:** Mortality; Modified Rankin Scale (mRS); Risk factors; National Institute of Health Stroke Scale (NIHSS).	1. White participants had lower stroke severity according to NIHSS scores at hospital admission than Black and Asian participants (p<0.017 for both). 2. Intracerebral hemorrhage was more common in Blacks (26.6%) than in the combined subgroup of Whites and Asians (10.4%, p<0.001). 3. The 30d mortality rate was 5.8% for the entire population and was significantly different across the three races (p<0.001): Blacks 10.0%, Whites 6.0%, Asians 1.9%. 4. Race (p=0.026), admission NIHSS score (p<0.001), coronary artery disease (p=0.012), and history of congestive heart failure (p=0.021) were found to be independent predictors of 30d mortality. 5. Blacks and Whites had a higher likelihood of 30d mortality in comparison to Asians (p=0.021; p=0.023). 6. The rates of 30d favorable functional outcome differed (p<0.001) across the racial groups, with 63.5% of Whites, 41.8% of Blacks, and 39.9% of Asians

		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).
Zanaty et al. (2014) USA Observational TPS=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.
Aarnio et al. (2015) Finland Observational TPS=NA 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) Netherlands Case Series TPS>4.9yr N_{Start}=170 N_{End}=170	**Population:** Mean age=41.4yr; Gender: Males=75, Females=95. **Intervention:** Patients with a first ever ischemic stroke from 2000 to 2010 were included. Patients were also compared to healthy controls (n=61). **Outcomes:** Employment rate; Modified Rankin Scale (mRS); Hospital Anxiety and Depression Scale (HADS): Depression, Anxiety; Stroke etiology.	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:	1. Recurrent strokes occurred in 52 (19.2%)

USA Observational TPS=NA N_{Start}=271 N_{End}=213	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.	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) China Observational TPS=NA N_{Start}=431 N_{End}=150	**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 Case Series TPS=NA N_{Start}=78,096 N_{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.
Krishnamurthi et al. (2015) US Case Series TPS=NA N_{Start}=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);	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

N_{End}=NA	Stroke mortality; Prevalence of stroke.	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.
Koivunen et al. (2015) Finland Case Series TPS=NA N_{Start}=1257 N_{End}=1257	**Population:** Younger Patients (YG; n=336): Median age=42yr; Gender: Male=200, Female=136. Older Patients (OL; n=921): Age range≥50yr. **Intervention:** Young patients (<50yr) diagnosed with a first-ever intracranial hemorrhage in Helsinki University Central Hospital between January 2000 and March 2010 (YG) were analyzed retrospectively. Comparisons were performed amongst demographic subgroups and with patients over ≥50yr of age enrolled between January 2005 and March 2010 (OL). **Outcomes:** Mortality.	1. 3mo mortality rate was lower in YG group compared with OL group (17.0% vs. 32.7%, p<0.001).
Maaijwee et al. (2015) Netherlands Case Series TPS>8.3yr N_{Start}=511 N_{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 Observational TPS>6mo N_{Start}=105 N_{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):	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). 3. No significant differences between OS and

	Basic activities of daily living, Instrumental activities of daily living.	YS groups were observed on the BAPM Basic activities of daily living. 4. BAPM scores for all domains in the YS group were not significantly different between scores reported by the participant compared to scores reported by relatives rating the participants.
Ojha et al. (2015) China Case Series TPS=NA N_{Start}=123 N_{End}=123	**Population:** Age Range: <46yr(n=51), 46-50yr(n=72); Gender: Male=98, Female=25. **Intervention:** Younger patients who had acute ischemic stroke from January 2007 to July 2012 were retrospectively analyzed. **Outcomes:** Risk Factors.	1. Risk factors were hypertension (72.4 %), dyslipidemia (55.3 %), smoking (54.4 %) and diabetes (33.3 %). 2. Small artery atherosclerosis was found in 54 patients (43.9 %), with higher prevalence in patients of 46-50yr.
Ozer et al. (2015) Turkey Case Series TPS=NA N_{Start}=619 N_{End}=619	**Population:** Younger Group (YG; n=32): Mean age=37.7±6.1; Gender: Male=13, Female=19. Older Group (OL; n=587): Mean age=71.2±11.3; Gender: Male=271, Female=316. **Intervention:** Hospital records of patients who had acute ischemic stroke from January 2007 to November 2014 were retrospectively analyzed by age. **Outcomes:** National Institute of Health Stroke Scale (NIHSS); Modified Rankin Scale (mRS).	1. The mean NIHSS score at admission and hospital mortality was significantly lower in YG group compared with OL group (p=0.006 and p=0.043 respectively). 2. The median follow-up mRS was significantly lower in YG group compared with OL group (p<0.001).
Reuter et al. Germany Case Series TPS=NA N_{Start}=51,735 N_{End}=51,735	**Population:** Younger Patients (YG; n=4,140): Age range: 18-50yr; Gender: Male=2,481, Female=1,659. Older Patients (OL; n=47,595): Age range: 18-50yr; Gender: Male=28,201, Female=19,394. **Intervention:** Hospital records of patients who had acute ischemic stroke and underwent intravenous thrombosis (IVT) from January 2008 to December 2012 were retrospectively. Patients were analyzed by age. **Outcomes:** Modified Rankin Scale (mRS); Mortality.	1. Both YG and OL groups showed similar numbers of patients with mRS of 0-1 at discharge (p=0.003 vs. p<0.001, respectively). 2. Both YG and OL groups showed similar numbers of in-hospital mortality (p=0.33 vs. p=0.22, respectively).
Rutten-Jacobs et al. (2015) Netherlands Observational TPS=NA N_{Start}=845 N_{End}=845	**Population:** Mean age=40.3±7.9yr; Gender: Males=388, Females=457. **Intervention:** Data from young participants with a first ever transient ischemic attack or ischemic stroke admitted between 1980 and 2010 was evaluated. **Outcomes:** Cause-specific mortality; Survival status; Expected mortality.	1. The mean follow-up time was 12yr, during which 146 participants died. 2. The cause-specific observed 20yr cumulative mortality rate was 5.3% for stroke. 3. The absolute excess risk of all cause death was highest at 10-15yr after the index event and was mainly attributed to a vascular disease and most pronounced in men.
Simonetti et al. (2015) Switzerland Observational TPS=NA N_{Start}=624 N_{End}=624	**Population:** Median age=46yr; Gender: Males=374, Females=250. **Intervention:** Young participants (16-55yr) with stroke were prospectively recruited in a multicentre study. **Outcomes:** Risk factors; Mortality at 3mo	1. At the 3mo follow-up assessment, 61% of participants had a favourable outcome according to mRS scores of 0-1, 2.9% of participants had died, and 2.7% had a recurrent cerebrovascular event (1.2% for ischemic stroke, and 1.5% for TIA).

	follow-up; Stroke etiology; Recurrence of cerebrovascular events; Modified Rankin Scale (mRS);	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 Case Series TPS=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. 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%; 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).
Synhaeve et al. (2015) Netherlands Observational TPS=NA N_{Start}=277 N_{End}=277	**Population:** Mean age=40.0±7.7yr; Gender: Males=123, Females=154. **Intervention:** Patients with first ever stroke admitted between 1980 and 2010 were followed-up and assessed between 2009 and 2012 with a mean follow-up time of 11.0yr. **Outcomes:** Modified Rankin Scale (mRS); Instrumental Activities of Daily Living Scale (iADL); Hospital Anxiety and Depression Scale (HADS); Cognitive domains: Processing speed, Working memory, Immediate memory, Delayed memory, Visuoconstruction, Attention, Executive functioning, Global cognitive function.	1. At follow-up, a poor functional outcome according to mRS score >2 was observed in 8.3% of participants and a poor iADL outcome (score <8) was found in 13.7% of participants. 2. According to the HADS, 19.3% of participants had scores suggestive of depression at follow-up. 3. Working memory was significantly associated with a poor functional outcome according to the mRS (p=0.001); each z score increase in working memory performance was related to a decreased risk of poor functional outcome. 4. Working memory and processing speed were significantly associated with a poor functional outcome according to the iADL (p=0.001 for both); each z score increase in working memory performance and processing speed (was related to a decreased risk of poor functional outcome. 5. The presence of impairments on any of the individual cognitive domains did not significantly influence poor functional outcomes according to the mRS; impairment in Global cognitive function was significantly associated with a poor functional outcome according to the iADL (p=0.004).
Tan et al. (2015) Singapore Case Series TPS=NA N_{Start}=40,623 N_{End}=40,623	**Population:** Mean age=NA; Gender: Males=15092, Females=18804. **Intervention:** Patients ≥15yr with a stroke from 2006 to 2012 were included. **Outcomes:** Stroke incidence rate; 28d case fatality rate.	1. The annual percentage change in the 28d case fatality rate over the study period was -2.45 for participants <50yr, -3.66 for 50-64yr and -2.84 for ≥65yr. 2. The annual percentage change in the 28d case fatality rate over the study period was more negative in females compared to males (-4.11 vs. -1.91).
Vangen-Lønne et al. (2015) Norway Case Series TPS=NA N_{Start}=36,575 N_{End}=36,575	**Population:** Mean age=NA; Gender: Males=NA, Females=NA. **Intervention:** Individuals ≥30yr without a previous ischemic or unclassifiable stroke were included. **Outcomes:** Stroke incidence rate; 30d case fatality rate.	1. The 30d case fatality rate for ischemic strokes was 8% in participants 30-84yr and 23% in participants ≥85yr. 2. The 30d case fatality rate for unclassifiable strokes was 30% in participants 30-84yr and 63% in participants ≥85yr. 3. The 30d case fatality rate for ischemic

		strokes in women 30-84yr increased significantly from 1995-2000 to 2006-2010 (1995-2000=9.0%, 2006-2010=12.2%) (p=0.013). 4. The 30d case fatality rate for ischemic strokes in men 30-84yr decreased significantly from 1995-2000 to 2006-2010 (1995-2000=9.0%, 2006-2010=4.3%) (p=0.022).
González-Gómez et al. (2016) Spain Case Series TPS=NA N_{Start}=110 N_{End}=110	**Population:** Mean age=46.4±8.1yr; Gender: Males=67, Females=43. **Intervention:** Younger patients (<55yr) who were admitted to a stroke unit in Spain in 2014 were retrospectively analyzed. **Outcomes:** Prognosis.	1. 23.3% of the ischaemic stroke cases underwent reperfusion treatments in the acute phase with 62.5% achieving levels of functional independence at 3mo.
Kes et al. (2016) Sweden Case Series TPS=NA N_{Start}=396 N_{End}=396	**Population:** Younger Patients (YG; n=24): Mean age=42.07±4.8yr; Gender: Male=19, Female=5. Older Patients (OL; n=372): Mean age=75.35±8.03yr; Gender: Male=167, Female=205. **Intervention:** Patients who were registered in a Croatian stroke unit in 2004 were retrospectively analyzed. **Outcomes:** Prognosis.	1. YG group tended to recover better than the OL group. 2. The most important in-hospital laboratory findings in YG patients were elevated lipid levels, while OL patients had elevated serum glucose and C-reactive protein.
Maaijwee et al. (2016) Netherlands Case Series TPS_{Mean}=10.6±8.4yr N_{Start}=511 N_{End}=511	**Population:** Median age=40yr (18-50); Gender: Unknown. **Intervention:** Young patients (<50yr) with ischemic stroke (n=325) or transient ischemic attack (n=186) (EG) were retrospectively analyzed and compared to healthy controls (CG; n=147). **Outcomes:** Hospital Anxiety and Depression Scale (HADS); Modified Ranking Scale (mRS).	1. There were a significantly greater number of EG patients with depressive (p=0.001) and anxiety (p<0.001) symptoms on the HADS compared to the CG group. 2. In ischemic stroke patients, poor HADS scores were associated with poor functional outcomes measured by mRS.

21.5 Rehabilitation

Table 21.5.1 Studies Evaluating the Rehabilitation of Younger Individuals Post Stroke

Author, Year Country Study Design Time Post Stroke Sample Size	Methods	Outcome
Kappelle et al. (1994) Sweden Observational TPS=NA N=212	Patients (aged 15-45 years) with ischemic stroke received quality of life scores obtained after a mean follow-up of 6 years.	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 or social functioning. Over 1/4 of the patients rated quality of life poor in these spheres. Almost half were diagnosed as depressed.
Kersten et al. (2002) UK Observational TPS=NA N=313	Southampton Needs Assessment Questionnaires were distributed to people with stroke for two age groups (18-45 years; 46-65 years) suffering from chronic stroke. Patients reported services they received 12-months prior to the survey.	38% (119) saw physiotherapists, 23% (74) were treated by a nurse, 19% (60) saw an occupational therapist, 18% (58) saw a dietician, 15% (47) saw a speech-language therapist and 15% (47) saw a social worker.
Low et al. (2003) UK Observational TPS=NA N=135	Southampton Needs Assessment Questionnaires were distributed to young stroke patients.	Unmet needs included intellectual fulfillment for 44 (34%) of patients, physiotherapy for 43 (33%), and help with activities of non-care in 43 (33%).
Röding et al. (2003) Sweden Observational TPS=NA N=5	Qualitative interview of 2 women and 3 men from age 37 to 54 years who suffered from stroke.	Fatigue interfered with the ability to participate in daily activities. Informants reported a lack of participation during their hospital stay and rehabilitation program. They felt as though they were walking alongside the process. The patients wanted more information regarding the goal of rehabilitation. They also found that rehabilitation was focused on older patients. They expressed a desire to have age-adapted rehabilitation programs.
Hama et al. (2007) Japan Observational TPS=NA N=452	Patients were examined for effect of sitting balance on activities of daily living (ADL). Sample was divided to compare young patients (<65) with older patients (≥65). Depression relating to sitting balance was also evaluated.	Young patients made up 39.6% of the sample. 24.5% of those needing assistance maintaining a 10-minute sitting position were young. 81.6% of those young patients needing assistance had improved at discharge, compared to only 56.4% of elderly patients who improved. Older patients generally were associated with higher incidence of physical impairment and functional disability, poorer outcomes, more occurrences of depression, and longer hospitalization.
Muller et al. (2014) USA Pre-Post TPS>1.4yr N_{Start}=13 N_{End}=13	**Population:** Mean age=45.8yr; Gender: Males=10, Females=3. **Intervention:** Patients 18-65yr attended the young empowerment stroke support program for a mean of 7 times over 18wk. Meetings were for 90min each and provided support and education on topics including driving and communication strategies post-stroke. **Outcomes:** Employment status; Community Integration Questionnaire (CIQ): Home integration, Social integration, Productivity integration; Stroke Impact Scale (SIS): Handicap, Emotion, Communication, Memory, Impaired activities of daily living (ADL), Mobility, Hand	1. 12 participants reported working pre stroke, 1 participant reported being retired, and only 1 participant returned to work post-stroke. 2. SIS Handicap domain increased significantly post-intervention (ΔM=12.3) (p=0.034). 3. CIQ Home integration score increased significantly post-intervention (ΔM=3.35) (p=0.028). 4. CIQ total score increased significantly post-intervention (ΔM=1.74) (p=0.002). 5. No other significant changes were observed in domains of the SIS and CIQ. 6. Positive changes on the SIS were observed

	function, Strength, Self-perceived recovery.	in 9 participants on the Handicap domain, 8 on the ADL domain, 7 on Communication, 7 on Self-perceived recovery, 6 for Strength, and 5 for Emotion; clinically important differences were observed in 2 participants on the ADL domain, in 6 on Self-perceived recovery, and in 4 on Strength. 7. Positive changes on the CIQ were observed in 10 participants on CIQ total score, 12 on Home integration, 7 on Social integration, and 4 on Productivity integration; no participants demonstrated clinically important differences on the CIQ.

21.6 Family Stress

Table 21.6 Studies Evaluating Family Stress for Younger Individuals Post Stroke

Author, Year Country Study Design Time Post Stroke Sample Size	Methods	Outcomes
Hindfelt & Nilsson (1977) Sweden Case Series TPS=NA N=60	Patients (age 16-40 years, mean age at stroke onset 30.85 years) who suffered an acute ischemic stroke were included. Patients were followed an average of 51 months.	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.
MacKay & Nias (1979) UK Case Series TPS=NA N=90	Patients under the age of 65 years included.	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.
Coughlan & Humphreys (1982) UK Observational TPS=3-8yr N=170	Spouses of patients completed postal questionnaires. All patients were under the age of 65 at the time of their stroke.	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.
Hindfelt & Nilsson (1992) Sweden Observational TPS=NA N=74	Patient (age 16-40 years, mean age at stroke onset was 29.5 years) suffered a chronic ischemic stroke. Patients were followed for 13-26 years.	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.
Teasell et al. (2000) Canada Observational TPS=NA N=83	Patients younger than 30 and admitted to rehabilitation in a Canadian tertiary-care hospital were included.	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.
Lackey & Gates (2001) USA Case Series TPS=NA N=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.	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.
Kersten et al. (2002) UK Observational TPS=NA N=315	Southampton Needs Assessment Questionnaires were distributed to two age groups (18-45 years; 46-65 years) after chronic stroke.	Difficulties in sex life were reported in 64% of the patients who thought questions about the changes in their sex life were appropriate.
Leys et al. (2002) France Observational TPS=NA N=287	Patients with ischemic stroke aged 15 to 45 years old were included.	At follow-up 20 (7%) patients reported divorce as a result of stroke.
Röding et al. (2003) Sweden Observational TPS=NA N=5	Qualitative interview for 2 women and 3 men from 37 to 54 years old who suffered from stroke.	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 family they felt that expectations were too high and too much to handle. The men, who had been previously responsible for the families' economic needs, considered economic factors

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

UK Observational TPS=1.6-7.5yr N=17		between the SS and caregiver responses, which were grouped into four broad superordinate themes, (1) emotional turmoil, (2) significance of parents, (2) negotiating independence versus dependence, and (4) changed relationships.
Lawrence & Kinn (2013) UK Observational TPS=3mo-2yr N_{Start}=11 N_{End}=11	**Population:** Mean age=41.3yr; Gender: Males=6, Females=5. **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) UK Case Series TPS_{Mean}=4.6±2.8yr N_{Start}=8 N_{End}=8	**Population:** Mean age=51±8.75yr; Gender: Males=7, Females=1. **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.

21.7 Institutionalization

Table 21.7 Studies Evaluating Institutionalization of Younger Individuals Post Stroke

Author, Year	Methods	Outcomes

Country Study Design Time Post Stroke Sample Size		
MacKay & Nias (1979) UK Case Series TPS=NA N=90	90 stroke patients under the age of 65 were included.	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.
Hindfelt & Nilsson (1992) Sweden Observational TPS=NA N=74	Patient (age 16-40 years, mean age at stroke onset was 29.5 years) suffered a chronic ischemic stroke. Patients were followed for 13-26 years.	Most of these patients had minor needs. Only one of them was institutionalized.
Adunsky et al. (1992) Israel Observational TPS=NA N=35	Patients 18 to 40 years old admitted to an Israeli rehabilitation facility were included.	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 "organic intellectual impairment."
Lindberg et al. (1992) USA Observational TPS=NA N=324	Patients with subarachnoid hemorrhage were included.	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.
Falconer et al. (1994) USA Observational TPS<120d N=260	Patients admitted to inpatient stroke rehabilitation with a length of stay more than 7 days were included. Patients were categorized into 3 groups: 1) <65 years old (n=100), 2) 65-74 years old (n=75) or 3) ≥75 years old (n=85).	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.
Teasell et al. (2000) Canada Observational TPS=NA N=83	Patients younger than 30 and admitted to rehabilitation in a Canadian tertiary-care hospital were included.	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.
Schnitzler et al. (2014) France Observational TPS_{Mean}=NA N_{Start}=33,896 N_{End}=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 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<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<2) in 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 Younger Individuals Post Stroke

Author, Year Country Study Design Time Post Stroke Sample Size	Methods	Outcomes
Isaacs et al. (1976) UK Case Series TPS=NA N=29	Patients admitted to a stroke rehabilitation ward were followed at home for a period of 3 years, or until death.	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.
Hindfelt & Nilsson (1977) Sweden Case Series TPS=NA N=60	Patients (age 16-40 years, mean age at stroke onset 30.85 years) who suffered an acute ischemic stroke were included. Patients were followed an average of 51 months.	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.
MacKay & Nias (1979) UK Case Series TPS=NA N=90	Patients under the age of 65 years included.	45 of the 90 patients were working at the time of their stroke. However, only 17 had returned to work within 6 months post-stroke and of these there was a mean loss of 111 working days per patient. At 6 months, 27 of the patients had died.
Coughlan & Humphreys (1982) UK Observational TPS=3-8yr N=170	Spouses of patients completed postal questionnaires. All patients were under the age of 65 at the time of their stroke.	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%).
Sjogren (1982) Sweden Observational TPS=NA N=51	Patients with hemiplegia younger than 65 years of age were consecutively admitted to the department of physical medicine and rehabilitation.	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.
Bogousslavsky & Regli (1987) Switzerland Observational TPS_{Mean}=46mo N=41	Patients with ischemic stroke under 30 years of age were included.	Only 7 of the 37 patients (18.9%) remained disabled by severe neurological deficits, with an inability to resume their previous activities. However, 30 patients (81.8%) did well; 11 had no disability and 19 had returned to work and were fully employed despite a persisting mild neurological deficit.
Black-Schaffer & Osberg (1990) USA Observational TPS=NA N=79	First-ever stroke, 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.	39 (49%) patients returned to work by the time of follow-up, a mean of 3.1 months after discharge. Factors which had a negative impact upon success of return to work included aphasia, a longer rehabilitation stay, a decreased Barthel index and prior alcohol consumption. Of those returning to work, data was available on 34 patients indicating only 11 had returned to work the same number of hours as before their stroke while 23 had returned to work a reduced number of hours with an average reduction of 17.4 hours per week. However, 16 patients still maintained full-time work with the discrepancy indicating at least 5 had to cut back on the number of hours worked despite working full-time.
Hindfelt & Nilsson (1992) Sweden Observational TPS>1mo N=74	Patients with ischemic stroke between the ages of 16 and 40 were included in this study. Follow up ranged from 13-26 years following stroke onset.	61% (39/62) returned to full-time hours, 11% (7/62) returned to part-time employment and 27% (17/62) retired following stroke. Of the retired patients, 8 had moderate to severe neurological impairments.
Lindberg et al. (1992) USA Observational TPS=NA N=324	Consecutive long-term patients with subarachnoid hemorrhage were included.	87% of patients were employed prior to stroke onset. Of these, 57% were able to return to work and 40% received pensions for disability. Significantly fewer patients who returned to work reported impairments compared to patients who were unable to return to work. In 48% (143) a decrease in leisure activities was noted, mainly outdoor activities.
Saeki et al. (1993) Japan Observational TPS_{Mean}=43mo N=230	Patients with first-ever stroke younger than 65 years of age and working as a student, housewife or employed at the time of stroke included.	58% (134) of patients returned to work at the time of follow-up. Factors associated with return to work included: education, occupation, previous hypertension, prior alcohol drinking, maximum weakness, diagnosed side of hemiplegia, higher cortical functions, urinary and bowel incontinence and ADLs. The study found that patients with severe muscle weakness were 4 to 6 times less likely to return to work compared to patients with normal muscle strength, patients with apraxia were 4 to 5 times less likely to return to work in comparison to patients without apraxia and

		blue-collar workers were 3 times less likely to return to work compared to white-collar.
Ferro & Crespo (1994) Portugal Observational TPS=NA N=215	Patients under the age of 45 years to describe their functional and vocational positions after a long-term follow up, a mean of 43.1 months.	73% of the survivors had returned to work (including all housewives, students, and full or part-time workers) and 18% retired. Therefore, most of the patients returned to an active working life. Patients who drank alcohol (more than 60 g/d), who were disabled at follow-up, who had a major stroke or who were male were significantly more likely to retire.
Kappelle et al. (1994) Sweden Observational TPS=NA N=296	Patients with ischemic stroke between the ages of 15 to 45 years who had been referred to a tertiary medical center.	42% of patients had a job and of these 23% required an occupational adjustment. Sixty-one percent of the unemployed patients were unable to return to work due to a disability.
Saeki et al. (1995) Japan Case Series TPS=NA N=183	Patients younger than 65 years who experienced first-ever stroke and were working at the time of the stroke. The longitudinal trends of patients returning to work after stroke as well as predictors for return to work were evaluated.	It was found that the curve of proportion of return to work was nonlinear. Two steep slopes emerged, one during the first six months and the other from 12 to 18 months. It was also found that patients were more likely to return to work if they had less impaired muscle strength, no apraxia, and if they worked at a white collar job.
Malm et al. (1998) Sweden Observational TPS=NA N=24	Patients (12 women and 12 men) between the ages of 18 and 44 years with a brainstem or cerebellar infarction included. Follow-up was completed at 4 and 12 months.	Outcomes were favorable for 22 (92%) of the patients at 4 and 12 months follow-up as seen from the Modified Rankin Scale. At 4 months post-stroke 12 (52%) patients were on sick leave regardless of residual functional deficits. By 12 months follow-up the corresponding figure moved to 10 (43%) patients. One year following stroke 57% of patients were working full-time. Headache, tiredness, anxiety, irritation and memory problems prevented the remaining patients from returning to previous employment in spite of adjustments made to their previous job credited. These symptoms were aggravated by functional or cognitive activities and were often ignored by medical doctors and therapists.
Neau et al. (1998) France Observational TPS=NA N=71	Young adults aged 15 to 45 years old with cerebral infarction. Follow-up was done by interview and with neurological examination for 65 of the patients a mean of 31.7 months post-stroke.	46 (73%) patients returned to previous employment, however, 12 (26.1%) required occupational adjustments.
Marini et al. (1999) Italy Observational TPS=NA N=333	Patients with first-ever transient ischemic attack or ischemic stroke aged 15 to 44 years were followed up.	At follow-up, 169 (55.6%) returned to previous employment, and 86 (28.3%) remained unemployed in spite of recovery.

Teasell et al. (2000) Canada Observational TPS=NA N=83	Patients younger than 30 admitted to Canadian tertiary-care hospital rehabilitation.	64 (77%) of the patients had a previous job or were a student before the onset of stroke. 3 months following discharge 13 (20%) of them went back to being a student or returned to work. Only 2 of the 7 students returned to school, and 1 started working part-time. Only 5 of the 53 patients who were working full-time prior to stroke returned to full-time work.
Kersten et al. (2002) UK Observational TPS=NA N=315	Southampton Needs Assessment Questionnaires were distributed to two age groups (18-45 years; 46-65 years) after chronic stroke.	315 returned the questionnaire, of which 65% had to give up their prior job and 14% required an adjustment in the number of hours they worked. Patients unable to return to work had significantly more unmet needs than patients with reduced hours, and those patients had significantly more unmet needs than patients who returned to their previous employment with unchanged working hours.
Leys et al. (2002) France Observational TPS=NA N=287	Patients with ischemic stroke aged 15 to 45 years old were included.	After 3 years, 12 (4.2%) lost their job regardless of the fact that their mRS score was ≤1.22. Almost 8% of patients died at follow-up, and of those 265 surviving patient 8 (3%) did not return to work because of personal reasons. 142 (49.5%) returned to their previous job, with 10 of them needing work adjustments. Thirty (10.5%) of the patients obtained a new job, social insurance deemed 43 (15%) unable to return to work due to medical conditions, 42 patients were unable to find employment and 12 patients lost their job post-stroke.
Musolino et al. (2003) Italy Observational TPS<24hr N=60	Patients (ages 17 to 45 years old) with either ischemic stroke (n=55) or TIA (n=5) at admission to the hospital were included. A follow-up was done a year after discharge from the hospital.	37 (68.5%) patients had returned to work, however adjustments to amount of time worked and type of job were necessary for 10 (27%) of the patients.
Vestling et al. (2003) Sweden Case Series TPS_{Mean}=2.7yr N=12	Data was collected regarding return to work for patients 60 years or younger following a stroke. Medical records and postal questionnaires were used for data collection.	41% of patients returned to work following stroke, a greater proportion of that number being males. Sixty-one percent of those who returned to work had decreased their hours. Those who returned to work reported being more satisfied with life.
Röding et al. (2003) Sweden Observational TPS=NA N=5	Qualitative interview for 2 women and 3 men from 37 to 54 years old who suffered from stroke.	Participants felt that the most difficult stroke deficit they had to endure was fatigue. It was overwhelming and they felt they had no control over their fatigue; rather it affected their entire being. Fatigue hindered these individuals return to full-time employment and had a negative effect on family and social situations. Women felt it was difficult to keep up with housework with cognitive deficits. The consequences of

		fatigue accounted for the reason that they were not able to resume a full time job.
Rodriguez et al. (2004) Spain Observational TPS=NA N=111	Patients (15-55 years) discharged from a Hospital with a cerebrovascular diagnosis included.	Nearly 80% of all patients were employed prior to stroke, but only 50.2% returned to work post-stroke. Patients who had no vascular risk factors and those that suffered from an ischemic stroke had a better functional recovery and were more likely to return to work. Statistical significance was seen with the Barthel Index and Modified Rankin Scale scores for patients that returned to work in comparison with patients who did not.
Varona et al. (2004) Spain Case Series TPS=NA N=272	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 Observational TPS=NA N=58	Information about vocational status before and after first ever stroke of 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 Observational TPS=NA N=210	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 Observational TPS=NA N=70	Patients younger than 65 that were employed prior to their stroke were examined regarding their employment. Patients were examined a year following the first interview.	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 Observational	Patients between the ages of 18-55 years who experienced first ever stroke were contacted to gain information about their life following	82% were working at the time of their stroke and 65% returned to work post-stroke, with no significant difference between males and

TPS=NA N=1068	stroke.	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 Observational TPS=NA N=325	Patients 15-64 years of age after first ever stroke who had an active employment status at the time of stroke were collected.	55% of patients reported successful return to work by 18 months after stroke onset. 50% of those returned within 100 days from onset. Function of the hand and leg with hemiplegia, an ability to perform ADLs independently and gender all impacted early return to work. Males were 3 times more likely to return early.
Hackett et al. (2012) Australia Observational TPS=NA N=271	Individuals post stroke (72% male; mean age 51±10 years) who were in full-time or part-time paid employment immediately before stroke. First ever stroke survivors (N=109) were matched by age, sex, and functional impairment with injured individuals (N=429).	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 Observational TPS=NA N=101	Community-dwelling individuals post stroke (56% male; mean age of 47.2±12.3 years) who had been in paid employment before their stroke and not suffering from any clinically diagnosed ailment that limits their ability to work.	More than half (55%) of patients returned to work after the stroke event. Overall, functional status (no significant disability or mild disability) and post-stroke duration (3-12 months) were significant predictors of return to work.
McAllister et al. (2013) New Zealand Observational TPS=NA N=109	Comparative study between people unable to work (on no-fault Accident Compensation Corporation) due to stroke versus another illness.	The odds of returning to work were significantly lower for participants in the stroke group compared to the injury group. The odds were still reduced when taking into account possible confounding factor (e.g., cognitive impairment) and 'Low' or 'High' personal income at baseline.
Kauranen et al. (2013) Finland Case Series TPS=NA N_{Start}= 140 N_{End}=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.
Maaijwee et al. (2014) Netherlands Case Series TPS>8.1yr N_{Start}=694 N_{End}=694	**Population:** Mean age=NA; Gender: Males=296, Females=398. **Intervention:** Patients 18-50yr with a first ever stroke from 1980 to 2010 were included. A follow-up assessment was conducted at a mean of 8yr. **Outcomes:** Unemployment rate.	1. Unemployment post-stroke was reported by 202 (29.1%) participants in 2010. 2. Full and partial unemployment in women 35-44yr was significantly more prevalent compared to the general population (26.8% vs. 7.3%) (p<0.0001). 3. Full and partial unemployment in women 45-54yr was significantly more prevalent compared to the general population (25.9% vs. 11.9%) (p<0.0001). 4. Full and partial unemployment in men 35-44yr was significantly more prevalent compared to the general population (32.9% vs. 5.0%) (p<0.0001). 5. Full and partial unemployment in men 45-54yr was significantly more prevalent compared to the general population (26.6% vs. 9.4%) (p<0.0001).
de Bruijn et al. (2015) Netherlands Case Series TPS>4.9yr N_{Start}=170 N_{End}=170	**Population:** Mean age=41.4yr; Gender: Males=75, Females=95. **Intervention:** Patients with a first ever ischemic stroke from 2000 to 2010 were included. Patients were also compared to healthy controls (n=61). **Outcomes:** Employment rate; Modified Rankin Scale (mRS); Hospital Anxiety and Depression Scale (HADS): Depression, Anxiety; Stroke etiology; World Health Organization Quality of Life Scale (WHOQOL): Physical health, Psychological functioning, Social relationships, Environment, General QoL; Fatigue Assessment Scale (FAS).	1. Poor functional outcomes (mRS>2) were observed in 10.6% of participants. 2. The current employment rate was significantly greater in healthy controls compared to post-stroke participants (stroke=63.5%, no stroke=95.1%; p<0.001). 3. Anxiety was prevalent in 53 (31.9%) patients. 4. Depression was prevalent in 61 (37.2%) patients. 5. Unemployment at follow-up was significantly correlated with the Physical health domain of the WHOQOL (p=0.01), fatigue (p<0.001), a higher mRS score (p<0.001), and presence of depression

		(p<0.001) and anxiety (p<0.001).

21.9 Ongoing Care

Table 21.9.1 Studies Evaluating Ongoing Care of Younger Individuals Post Stroke

Author, Year Country Study Design Time Post Stroke Sample Size	Methods	Outcomes
Hartke & Brashler (1994) USA Observational TPS_{Mean}=4yr N=100	Patients were on average 44 years (range 21-57) of age.	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.
Röding et al. (2003) Sweden Observational TPS=NA N=5	Qualitative interviews from 2 women and 3 men, ages 37-54, who suffered from a 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 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.
Stone (2005) Canada Observational N=22	Female patients with hemorrhagic stroke, aged 19-57, were interviewed. Content was analyzed for common issues and themes.	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.
Naess et al. (2005b) Norway Observational TPS_{Mean}=6yr N=196	Patients (aged 15-49) were studied after their first stroke for post-stroke depression (PSD), etiology, and risk factors.	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.
Naess et al. (2006) Norway Observational TPS=NA N=232	Patients aged 15 to 49 years with first-ever cerebral infarction and 215 control subjects were included.	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<0.001). Also, stroke patient who were depressed, unemployed or

		fatigued had significantly reduced score for all the items of the SF-36.
Stone (2007) Canada Observational TPS=NA N=83	Narratives were drawn from an internet site. Content analysis was performed to determine themes.	71% of the writers were women. Majority were <48 years of age (96% of females and 79% of males). The majority of writers were <10 years post-stroke. Themes identified included symptoms, doctors and hospitals, rehabilitation 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 Observational TPS_{Mean}=22mo N=71	Patients between the ages of 22 and 64 were interviewed and filled out a questionnaire to help identify disabilities following stroke.	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 Observational TPS>13.1mo N_{Start}=156 N_{End}=104	**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)	**Population:** Mean age=65.71yr; Gender:	1. The prevalence of depression at the initial

Taiwan Case Series TPS=NA N_{Start}=568 N_{End}=568	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.	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) Sweden Observational TPS=NA N_{Start}=150 N_{End}=150	**Population:** Mean age=57±6yr; Gender: Males=100, Females=50. **Intervention:** Patients 18-64yr with a stroke from 2000 to 2006 were administered a survey in 2007. **Outcomes:** Prevalence of risk factors; Prevalence of post-stroke impairments; Support; Anxiety or depression.	1. Prevalent self-reported impairments included fatigue in 67 (45%) participants, anxiety in 27 (18%), depression in 27 (18%), and pain in 28 (19%). 2. In regards to support post-stroke, 51 (34%) participants reported being dependent on a significant other, 39 (26%) reported no support from a significant other, 24 (16%) reported receiving assistance from a personal care provider or personal assistant, 65 (43%) reported living alone, and 74 (50%) reported not receiving any stroke related checkups. 3. Anxiety or depression was significantly more prevalent in young stroke participants compared to an aged and geographically matched healthy population (53% vs. 36%) (p=0.0156).
Sobreiro et al. (2014) Brazil Observational TPS_{Mean}=12±3.8d N_{Start}=87 N_{End}=87	**Population:** Mean age=50.7±14.5yr; Gender: Males=54, Females=33. **Intervention:** Data from participants admitted with a first ever ischemic stroke was prospectively analyzed. **Outcomes:** Hamilton Rating Scale for Depression (HAM-D-31): Retardation, Fatigue/Interest; Wechsler Digit Span Task; Wechsler Adult Intelligence Scale-Revised; Verbal Fluency Test (FAS); Victoria Stroop Test: Dots stoop (D), Color stroop (C), Stroop interference.	1. Retardation domain of HAM-D-31 was associated with poor performance on the FAS (p=0.003) 2. Significant associations were observed between Retardation and FAS performance (p=0.003) and between Fatigue/Interest and Stroop interference (p=0.003); no other significant associations were found between the performance on neuropsychological tests with total HAM-D-31 scores or with other HAM-D-31 domains.
Maaijwee et al. (2015) Netherlands Case Series TPS>8.3yr N_{Start}=511 N_{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.
Simonetti et al. (2015) Switzerland Case Series TPS=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	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%)

	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.	(p=0.0896). 3. Mortality was not significantly different between age groups (children=14%, young adults=7%) (p=0.121). 4. Functional outcomes were not significantly different between groups in regards to having some form of paresis (children=55%, young adults=48%; p=0.330), impaired balance (children=10%, young adults=11%; p=1.000), visual disturbances (children=5%, young adults=8%; p=0.581), language difficulties (children=21%, young adults=26%; p=0.421), seizures (children=15%, young adults=11%; p=0.403), and headaches (children=4%, young adults=7%; p=0.381). 5. Psychological outcomes were not significantly different between groups in regards to having a psychological/psychiatric disorder (children=15%, young adults=19%; p=0.466), fatigue (children=13%, young adults=18%; p=0.452), and difficulty concentrating or memory problems (children=10%, young adults=11%; p=1.00). 6. Behavioural disturbances were significantly more prevalent in children (children=13%, young adults=5%; p=0.040). 7. Young adults reported living at home without special care in 127 (89%) cases, at home with special care in 11 (8%), and at a nursing home in 4 (3%). 8. Young adults reported returning to work or regular schooling in 93 (68%) cases, special needs schooling or part-time work/work training in 29 (21%), and being unable to work or read in 15 (11%). 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).
Tanislav et al. (2015) Germany Case Series TPS<3mo N_{Start}=5023 N_{End}=5023	**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	1. CRDS were present in 202 (10.1%) participants with significantly more females having CRDS compared to males (12.6% vs. 8.2%) (p<0.001) 2. The proportion of participants with CRDS was significantly different between age groups with 1.0% being between 18-24yr, 6.9% between 25-34yr, 25.7% between 35-

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

References

Aarnio, K., Joensuu, H., Haapaniemi, E., Melkas, S., Kaste, M., Tatlisumak, T., & Putaala, J. (2015). Cancer in young adults with ischemic stroke. *Stroke (00392499), 46*(6), 1601-1606 1606p.

Abu-Zeid, H. A., Choi, N. W., & Nelson, N. A. (1975). Epidemiologic features of cerebrovascular disease in Manitoba: incidence by age, sex and residence, with etiologic implications. *Can.Med.Assoc.J., 113*(5), 379-384.

Adams, H. P., Jr., Butler, M. J., Biller, J., & Toffol, G. J. (1986). Nonhemorrhagic cerebral infarction in young adults. *Arch.Neurol., 43*(8), 793-796.

Adams, H. P., Jr., Kappelle, L. J., Biller, J., Gordon, D. L., Love, B. B., Gomez, F., & Heffner, M. (1995). Ischemic stroke in young adults. Experience in 329 patients enrolled in the Iowa Registry of stroke in young adults. *Arch.Neurol., 52*(5), 491-495.

Adunsky, A., Hershkowitz, M., Rabbi, R., Asher-Sivron, L., & Ohry, A. (1992). Functional recovery in young stroke patients. *Arch.Phys.Med.Rehabil., 73*(9), 859-862.

Anzini, A., Cassone, A., Rasura, M., Ciervo, A., Beccia, M., Di, L. F., & Fieschi, C. (2004). Chlamydia pneumoniae infection in young stroke patients: a case--control study. *Eur.J.Neurol., 11*(5), 321-327.

Arnold, M., Halpern, M., Meier, N., Fischer, U., Haefeli, T., Kappeler, L., Brekenfeld, C., Mattle, H. P., & Nedeltchev, K. (2008). Age-dependent differences in demographics, risk factors, co-morbidity, etiology, management, and clinical outcome of acute ischemic stroke. *J.Neurol., 255*(10), 1503-1507.

Arntz, R., Maaijwee, N., Rutten-Jacobs, L., Schoonderwaldt, H., Dorresteijn, L., van, D. E., & de, L. F. (2013). Epilepsy after TIA or stroke in young patients impairs long-term functional outcome: The FUTURE Study. *Neurology, 81*(22), 1907-1913.

Arntz, R., Rutten-Jacobs, L., Maaijwee, N., Schoonderwaldt, H., Dorresteijn, L., van Dijk, E., & de Leeuw, F. E. (2013). Post-stroke epilepsy in young adults: a long-term follow-up study. *Plos One, 8*(2), e55498.

Arntz, R. M., Rutten-Jacobs, L. C., Maaijwee, N. A., Schoonderwaldt, H. C., Dorresteijn, L. D., van Dijk, E. J., & de Leeuw, F. E. (2015). Poststroke Epilepsy Is Associated With a High Mortality After a Stroke at Young Age: Follow-Up of Transient Ischemic Attack and Stroke Patients and Unelucidated Risk Factor Evaluation Study. *Stroke, 46*(8), 2309-2311.

Awada, A. (1994). Stroke in Saudi Arabian young adults: a study of 120 cases. *Acta Neurol.Scand., 89*(5), 323-328.

Balci, K., Utku, U., Asil, T., & Celik, Y. (2011). Ischemic stroke in young adults: risk factors, subtypes, and prognosis. *Neurologist., 17*(1), 16-20.

Barinagarrementeria, F., T, F., J, H., & C, C. (1996). Cerebral infarction in people under 40 years. *Cerebrovasc.Dis., 6*, 75-79.

Barlas, N. Y., Putaala, J., Waje-Andreassen, U., Vassilopoulou, S., Nardi, K., Odier, C., Hofgart, G., Engelter, S., Burow, A., Mihalka, L., Kloss, M., Ferrari, J., Lemmens, R., Coban, O., Haapaniemi, E., Maaijwee, N., Rutten-Jacobs, L., Bersano, A., Cereda, C., Baron, P., Borellini, L., Valcarenghi, C., Thomassen, L., Grau, A. J., Palm, F., Urbanek, C., Tuncay, R., Durukan Tolvanen, A., van Dijk, E. J., de Leeuw, F. E., Thijs, V., Greisenegger, S., Vemmos, K., Lichy, C., Bereczki, D., Csiba, L., Michel, P., Leys, D., Spengos, K., Naess, H., Tatlisumak, T., & Bahar, S. Z. (2013). Etiology of first-ever ischaemic stroke in European young adults: the 15 cities young stroke study. *European Journal of Neurology, 20*(11), 1431-1439.

Bejot, Y., Catteau, A. l., Caillier, M., Rouaud, O., Durier, J., Marie, C., Di Carlo, A., Osseby, G. V., Moreau, T., & Giroud, M. (2008). Trends in Incidence, Risk Factors, and Survival in Symptomatic Lacunar Stroke in Dijon, France, From 1989 to 2006 A Population-Based Study. *Stroke, 39*(7), 1945-1951.

Bejot, Y., Daubail, B., Jacquin, A., Durier, J., Osseby, G. V., Rouaud, O., & Giroud, M. (2014). Trends in the incidence of ischaemic stroke in young adults between 1985 and 2011: the Dijon Stroke Registry. *J Neurol Neurosurg Psychiatry, 85*(5), 509-513.

Bensenor, I. M., Goulart, A. C., Szwarcwald, C. L., Vieira, M. L. F. P., Malta, D. C., & Lotufo, P. A. (2015). Prevalence of stroke and associated disability in Brazil: National health survey - 2013. *Arquivos de Neuro-Psiquiatria, 73*(9), 746-750.

Bevan, H., Sharma, K., & Bradley, W. (1990). Stroke in young adults. *Stroke, 21*(3), 382-386.

Bjorn-Mortensen, K., Lynggaard, F., & Pedersen, M. L. (2013). Incidence of Greenlandic stroke-survivors in Greenland: a 2-year cross-sectional study. *Int J Circumpolar Health, 72*, 22626.

Black-Schaffer, R. M., & Osberg, J. S. (1990). Return to work after stroke: development of a predictive model. *Arch.Phys.Med.Rehabil., 71*(5), 285-290.

Black-Schaffer, R. M., & Winston, C. (2004). Age and functional outcome after stroke. *Top.Stroke Rehabil., 11*(2), 23-32.

Bogousslavsky, J., & Regli, F. (1987). Ischemic stroke in adults younger than 30 years of age. Cause and prognosis. *Arch.Neurol., 44*(5), 479-482.

Bonita, R., Beaglehole, R., & North, J. D. (1984). Event, incidence and case fatality rates of cerebrovascular disease in Auckland, New Zealand. *Am.J.Epidemiol., 120*(2), 236-243.

Bos, M. J., van Goor, M. L., Koudstaal, P. J., & Dippel, D. W. (2005). Plasma homocysteine is a risk factor for recurrent vascular events in young patients with an ischaemic stroke or TIA. *J.Neurol., 252*(3), 332-337.

Bugnicourt, J. M., Hamy, O., Canaple, S., Lamy, C., & Legrand, C. (2014). Impaired sexual activity in young ischaemic stroke patients: an observational study. *Eur J Neurol, 21*(1), 140-146.

Bulder, M. M., Bokkers, R. P., Hendrikse, J., Kappelle, L. J., Braun, K. P., & Klijn, C. J. (2014). Arterial spin labeling perfusion MRI in children and young adults with previous ischemic stroke and unilateral intracranial arteriopathy. *Cerebrovasc Dis, 37*(1), 14-21.

Cabral, N. L., Goncalves, A. R., Longo, A. L., Moro, C. H., Costa, G., Amaral, C. H., Souza, M. V., Eluf-Neto, J., & Fonseca, L. A. (2009). Trends in stroke incidence, mortality and case fatality rates in Joinville, Brazil: 1995-2006. *J.Neurol.Neurosurg.Psychiatry, 80*(7), 749-754.

Calviere, L., Tall, P., Massabuau, P., Bonneville, F., & Larrue, V. (2013). Migraine with aura and silent brain infarcts lack of mediation of patent foramen ovale. *Eur J Neurol, 20*(12), 1560-1565.

Camerlingo, M., Casto, L., Censori, B., Ferraro, B., Caverni, L., Manara, O., Finazzi, G., Radice, E., Drago, G., De Tommasi, S. M., Gotti, E., Barbui, T., & Mamoli, A. (2000). Recurrence after first cerebral infarction in young adults. *Acta Neurol.Scand., 102*(2), 87-93.

Cameron, J. I., Cheung, A. M., Streiner, D. L., Coyte, P. C., & Stewart, D. E. (2011). Stroke survivor depressive symptoms are associated with family caregiver depression during the first 2 years poststroke. *Stroke, 42*(2), 302-306.

Carod-Artal, F. J., Nunes, S. V., Portugal, D., Silva, T. V., & Vargas, A. P. (2005). Ischemic stroke subtypes and thrombophilia in young and elderly Brazilian stroke patients admitted to a rehabilitation hospital. *Stroke, 36*(9), 2012-2014.

Chan, M. T., Nadareishvili, Z. G., & Norris, J. W. (2000). Diagnostic strategies in young patients with ischemic stroke in Canada. *Can.J.Neurol.Sci., 27*(2), 120-124.

Chancellor, A. M., Glasgow, G. L., Ockelford, P. A., Johns, A., & Smith, J. (1989). Etiology, prognosis, and hemostatic function after cerebral infarction in young adults. *Stroke, 20*(4), 477-482.

Chen, C. M., Hsu, H. C., Chang, C. H., Lin, C. H., Chen, K. H., Hsieh, W. C., & Chang, W. M. (2014). Age-based prediction of incidence of complications during inpatient stroke rehabilitation: a retrospective longitudinal cohort study. *BMC Geriatr, 14*, 41.

Chen, Y. M., Lin, Y. J., & Po, H. L. (2013). Comparison of the risk factor profile, stroke subtypes, and outcomes between stroke patients aged 65 years or younger and elderly stroke patients: A hospital-based study. *International Journal of Gerontology, 7*(4), 205-208.

Chraa, M., Louhab, N., & Kissani, N. (2014). Stroke in young adults: about 128 cases. *Pan Afr Med J, 17*, 37.

Copstein, L., Fernandes, J. G., & Bastos, G. A. N. (2013). Prevalence and risk factors for stroke in a population of Southern Brazil. *Arquivos de Neuro-Psiquiatria, 71*(5), 294-300.

Corso, G., Bottacchi, E., Giardini, G., De la Pierre, F., Meloni, T., Pesenti, C. M., Ponzetti, C., & Veronese, M. M. (2009). Community-based study of stroke incidence in the Valley of Aosta, Italy. CARe-cerebrovascular Aosta Registry: years 2004-2005. *Neuroepidemiology, 32*(3), 186-195.

Coughlan, A. K., & Humphrey, M. (1982). Presenile stroke: long-term outcome for patients and their families. *Rheumatol.Rehabil., 21*(2), 115-122.

Cruz-Herranz, A., Illan-Gala, I., Martinez-Sanchez, P., Fuentes, B., & Diez-Tejedor, E. (2015). Recurrence of stroke amongst women of reproductive age: impact of and on subsequent pregnancies. *Eur J Neurol, 22*(4), 681-e642.

Dash, D., Bhashin, A., Pandit, A. K., Tripathi, M., Bhatia, R., Prasad, K., & Padma, M. V. (2014). Risk Factors and Etiologies of Ischemic Strokes in Young Patients: A Tertiary Hospital Study in North India. *Journal of Stroke, 16*(3), 173-177.

de Bruijn, M., Synhaeve, N. E., van Rijsbergen, M. W. A., de Leeuw, F. E., Jansen, B. P. W., & de Kort, P. L. M. (2014). Long-Term Cognitive Outcome of Ischaemic Stroke in Young Adults. *Cerebrovascular Diseases, 37*(5), 376-381.

De Bruijn, M. A. A. M., Synhaeve, N. E., Van Rijsbergen, M. W. A., De Leeuw, F. E., Mark, R. E., Jansen, B. P. W., & De Kort, P. L. M. (2015). Quality of Life after Young Ischemic Stroke of Mild Severity is Mainly Influenced by Psychological Factors. *Journal of Stroke and Cerebrovascular Diseases, 24*(10), 2183-2188.

Dharmasaroja, P. A., Muengtaweepongsa, S., & Dharmasaroja, P. (2013). Intravenous thrombolysis in Thai patients with acute ischemic stroke: role of aging. *J Stroke Cerebrovasc Dis, 22*(3), 227-231.

Dharmasaroja, P. A., Muengtaweepongsa, S., Lechawanich, C., & Pattaraarchachai, J. (2011). Causes of ischemic stroke in young adults in Thailand: a pilot study. *J.Stroke Cerebrovasc.Dis., 20*(3), 247-250.

Di, C. A., Inzitari, D., Galati, F., Baldereschi, M., Giunta, V., Grillo, G., Furchi, A., Manno, V., Naso, F., Vecchio, A., & Consoli, D. (2003). A prospective community-based study of stroke in Southern Italy: the Vibo Valentia incidence of stroke study (VISS). Methodology, incidence and case fatality at 28 days, 3 and 12 months. *Cerebrovasc.Dis., 16*(4), 410-417.

Dubuc, V., Moore, D. F., Gioia, L. C., Saposnik, G., Selchen, D., & Lanthier, S. (2013). Prevalence of fabry disease in young patients with cryptogenic ischemic stroke. *Journal of Stroke & Cerebrovascular Diseases, 22*(8), 1288-1292 1285p.

Ellis, C. (2010). Stroke in young adults. *Disabil Health J, 3*(3), 222-224.

Eun, M.-Y., Seo, W.-K., Lee, J., Kim, M., Kim, J., Kim, J. H., Oh, K., & Koh, S.-B. (2013). Age-dependent predictors for recurrent stroke: The paradoxical role of triglycerides. *European Neurology, 69*(3), 171-178.

Falconer, J. A., Naughton, B. J., Strasser, D. C., & Sinacore, J. M. (1994). Stroke inpatient rehabilitation: a comparison across age groups. *J.Am.Geriatr.Soc., 42*(1), 39-44.

Fazekas, F., Enzinger, C., Schmidt, R., Grittner, U., Giese, A. K., Hennerici, M. G., Huber, R., Jungehulsing, G. J., Kaps, M., Kessler, C., Martus, P., Putaala, J., Ropele, S., Tanislav, C., Tatlisumak, T., Thijs, V., von Sarnowski, B., Norrving, B., & Rolfs, A. (2015). Brain magnetic resonance imaging findings fail to suspect Fabry disease in young patients with an acute cerebrovascular event. *Stroke, 46*(6), 1548-1553.

Federico, F., Calvario, T., Di, T. N., & Paradiso, F. (1990). Ischaemic cerebral infarction in young adults. *Acta Neurol.(Napoli), 12*(2), 101-108.

Ferro, J. M., & Crespo, M. (1988). Young adult stroke: neuropsychological dysfunction and recovery. *Stroke, 19*(8), 982-986.

Ferro, J. M., & Crespo, M. (1994). Prognosis after transient ischemic attack and ischemic stroke in young adults. *Stroke, 25*(8), 1611-1616.

Fromm, A., Haaland, O. A., Naess, H., Thomassen, L., & Waje-Andreassen, U. (2016). Atherosclerosis in Trial of Org 10172 in Acute Stroke Treatment Subtypes among Young and Middle-Aged Stroke Patients: The Norwegian Stroke in the Young Study. *J Stroke Cerebrovasc Dis, 25*(4), 825-830.

Fromm, A., Waje-Andreassen, U., Thomassen, L., & Naess, H. (2011). Comparison between ischemic stroke patients< 50 years andΓëÑ 50 years admitted to a single centre: the Bergen Stroke Study. *Stroke research and treatment, 2011*.

Fullerton, H. J., Stratton, K., Mueller, S., Leisenring, W. W., Armstrong, G. T., Weathers, R. E., Stovall, M., Sklar, C. A., Goldsby, R. E., Robison, L. L., & Krull, K. R. (2015). Recurrent stroke in childhood cancer survivors. *Neurology, 85*(12), 1056-1064.

Gabriele, W., & Renate, S. (2009). Work loss following stroke. *Disabil.Rehabil., 31*(18), 1487-1493.

Ghandehari, K., & Moud, Z. I. (2006). Incidence and etiology of ischemic stroke in Persian young adults. *Acta Neurol.Scand., 113*(2), 121-124.

Ghatan, S., McGoldrick, P., Palmese, C., La Vega-Talbott, M., Kang, H., Kokoszka, M. A., Goodman, R. R., & Wolf, S. M. (2014). Surgical management of medically refractory epilepsy due to early childhood stroke. *J Neurosurg Pediatr, 14*(1), 58-67.

Ghatanatti, R., Tirkey, S. S., & Teli, A. (2014). Cerebral stroke after valvular surgery in young patients: case studies. *J Clin Diagn Res, 8*(3), 151-152.

Giang, K. W., Bjorck, L., Nielsen, S., Novak, M., Sandstrom, T. Z., Jern, C., Toren, K., & Rosengren, A. (2013). Twenty-year trends in long-term mortality risk in 17,149 survivors of ischemic stroke less than 55 years of age. *Stroke, 44*(12), 3338-3343.

Gilon, D., Buonanno, F. S., Joffe, M. M., Leavitt, M., Marshall, J. E., Kistler, J. P., & Levine, R. A. (1999). Lack of evidence of an association between mitral-valve prolapse and stroke in young patients. *N.Engl.J.Med., 341*(1), 8-13.

Glozier, N., Hackett, M. L., Parag, V., & Anderson, C. S. (2008). The influence of psychiatric morbidity on return to paid work after stroke in younger adults: the Auckland Regional Community Stroke (ARCOS) Study, 2002 to 2003. *Stroke, 39*(5), 1526-1532.

Goeggel Simonetti, B., Cavelti, A., Arnold, M., Bigi, S., Regenyi, M., Mattle, H. P., Gralla, J., Fluss, J., Weber, P., Hackenberg, A., Steinlin, M., & Fischer, U. (2015). Long-term outcome after arterial ischemic stroke in children and young adults. *Neurology, 84*(19), 1941-1947.

Gonzalez-Gomez, F. J., Perez-Torre, P., DeFelipe, A., Vera, R., Matute, C., Cruz-Culebras, A., Alvarez-Velasco, R., & Masjuan, J. (2016). Stroke in young adults: Incidence rate, risk factors, treatment and prognosis

Ictus en adultos jovenes: incidencia, factores de riesgo, tratamiento y pronostico. *Revista Clinica Espanola, 216*(7), 345-351.

Gonzalez-Perez, A., Gaist, D., Wallander, M. A., McFeat, G., & Garcia-Rodriguez, L. A. (2013). Mortality after hemorrhagic stroke: data from general practice (The Health Improvement Network). *Neurology, 81*(6), 559-565.

Greisenegger, S., Zehetmayer, S., Ferrari, J., Lang, W., Fizek, J., Auff, E., Lalouschek, W., & Serles, W. (2011). Clinical predictors of death in young and middle-aged patients with ischemic stroke or transient ischemic attack: long-term results of the Vienna Stroke Registry. *Journal of Neurology, 258*(6), 1105-1113.

Hackett, M. L., Glozier, N., Jan, S., & Lindley, R. (2012). Returning to paid employment after stroke: The Psychosocial Outcomes in StrokE (POISE) cohort study. *Plos One, 7*(7).

Hama, S., Yamashita, H., Shigenobu, M., Watanabe, A., Hiramoto, K., Takimoto, Y., Arakawa, R., Kurisu, K., Yamawaki, S., & Kitaoka, T. (2007). Sitting balance as an early predictor of functional improvement in association with depressive symptoms in stroke patients. *Psychiatry Clin.Neurosci., 61*(5), 543-551.

Hankey, G. J. (2012). Nutrition and the risk of stroke. *Lancet Neurol., 11*(1), 66-81.

Hansen, B. M., Nilsson, O. G., Anderson, H., Norrving, B., Saveland, H., & Lindgren, A. (2013). Long term (13 years) prognosis after primary intracerebral haemorrhage: a prospective population based study of long term mortality, prognostic factors and causes of death. *J Neurol Neurosurg Psychiatry, 84*(10), 1150-1155.

Harmsen, P., Wilhelmsen, L., & Jacobsson, A. (2009). Stroke incidence and mortality rates 1987 to 2006 related to secular trends of cardiovascular risk factors in Gothenburg, Sweden. *Stroke, 40*(8), 2691-2697.

Hartke, R. J., & Brashler, R. (1994). Assessment of the needs of the young stroke survivor. *Topics in Stroke Rehabilitation, 1*(1), 15-24.

Heikinheimo, T., Broman, J., Haapaniemi, E., Kaste, M., Tatlisumak, T., & Putaala, J. (2013). Preceding and poststroke infections in young adults with first-ever ischemic stroke: effect on short-term and long-term outcomes. *Stroke, 44*(12), 3331-3337.

Hindfelt, B., & Nilsson, O. (1977). The prognosis of ischemic stroke in young adults. *Acta Neurol.Scand., 55*(2), 123-130.

Hindfelt, B., & Nilsson, O. (1992). Long-term prognosis of ischemic stroke in young adults. *Acta Neurol.Scand., 86*(5), 440-445.

Hofgren, C., Bjorkdahl, A., Esbjornsson, E., & Sunnerhagen, K. S. (2007). Recovery after stroke: cognition, ADL function and return to work. *Acta Neurol.Scand., 115*(2), 73-80.

Hogstrom, G., Nordstrom, A., Eriksson, M., & Nordstrom, P. (2015). Risk factors assessed in adolescence and the later risk of stroke in men: a 33-year follow-up study. *Cerebrovasc Dis, 39*(1), 63-71.

Huang, Y., Yang, S., & Jia, J. (2015). Factors related to long-term post-stroke cognitive impairment in young adult ischemic stroke. *Med Sci Monit, 21*, 654-660.

Ilinca, A., Kristoffersson, U., Soller, M., & Lindgren, A. G. (2016). Familial aggregation of stroke amongst young patients in Lund Stroke Register. *Eur J Neurol, 23*(2), 401-407.

Isaacs, B., Neville, Y., & Rushford, I. (1976). The stricken: the social consequences of stroke. *Age and ageing, 5*(3), 188-192.

Jacobs, B. S., Boden-Albala, B., Lin, I. F., & Sacco, R. L. (2002). Stroke in the young in the northern Manhattan stroke study. *Stroke, 33*(12), 2789-2793.

Jaffre, A., Ruidavets, J. B., Nasr, N., Guidolin, B., Ferrieres, J., & Larrue, V. (2015). Tobacco Use and Cryptogenic Stroke in Young Adults. *J Stroke Cerebrovasc Dis, 24*(12), 2694-2700.

Janes, F., Gigli, G. L., D'Anna, L., Cancelli, I., Perelli, A., Canal, G., Russo, V., Zanchettin, B., & Valente, M. (2013). Stroke incidence and 30-day and six-month case fatality rates in Udine, Italy: A population-based prospective study. *International Journal of Stroke, 8*(100 A), 100-105.

Johansson, B., Norrving, B., & Lindgren, A. (2000). Increased stroke incidence in Lund-Orup, Sweden, between 1983 to 1985 and 1993 to 1995. *Stroke, 31*(2), 481-486.

Jones, L., & Morris, R. (2013). Experiences of adult stroke survivors and their parent carers: A qualitative study. *Clinical Rehabilitation, 27*(3), 272-280.

Jovanovic, D. R., Beslac-Bumbasirevic, L., Raicevic, R., Zidverc-Trajkovic, J., & Ercegovac, M. D. (2008). Etiology of ischemic stroke among young adults of Serbia. *Vojnosanit.Pregl., 65*(11), 803-809.

Kalita, J., Goyal, G., Kumar, P., & Misra, U. K. (2014). Intracerebral hemorrhage in young from a tertiary neurology center in North India. *Journal of the Neurological Sciences, 336*(1-2), 42-47.

Kang, H. Y., Lim, S. J., Suh, H. S., & Liew, D. (2011). Estimating the lifetime economic burden of stroke according to the age of onset in South Korea: a cost of illness study. *BMC.Public Health, 11*, 646.

Kappelle, L. J., Adams, H. P., Jr., Heffner, M. L., Torner, J. C., Gomez, F., & Biller, J. (1994). Prognosis of young adults with ischemic stroke. A long-term follow-up study assessing recurrent vascular events and functional outcome in the Iowa Registry of Stroke in Young Adults. *Stroke, 25*(7), 1360-1365.

Kato, Y., Hayashi, T., Tanahashi, N., & Kobayashi, S. (2015). Cardioembolic stroke is the most serious problem in the aging society: Japan standard stroke registry study. *J Stroke Cerebrovasc Dis, 24*(4), 811-814.

Kauranen, T., Turunen, K., Laari, S., Mustanoja, S., Baumann, P., & Poutiainen, E. (2013). The severity of cognitive deficits predicts return to work after a first-ever ischaemic stroke. *J Neurol Neurosurg Psychiatry, 84*(3), 316-321.

Kersten, P., Low, J. T., Ashburn, A., George, S. L., & McLellan, D. L. (2002). The unmet needs of young people who have had a stroke: results of a national UK survey. *Disabil.Rehabil., 24*(16), 860-866.

Kes, V. B., Jurašić, M. J., Zavoreo, I., Lisak, M., Jeleč, V., & Matovina, L. Z. (2016). Age and gender differences in acute stroke hospital patients. *Acta Clinica Croatica, 55*(1), 69-78.

Khealani, B. A., Khan, M., Tariq, M., Malik, A., Siddiqi, A. I., Awan, S., & Wasay, M. (2014). Ischemic strokes in Pakistan: observations from the national acute ischemic stroke database. *J Stroke Cerebrovasc Dis, 23*(6), 1640-1647.

Kim, R. B., Kim, B. G., Kim, Y. M., Seo, J. W., Lim, Y. S., Kim, H. S., Lee, H. J., Moon, J. Y., Kim, K. Y., Shin, J. Y., Park, H. K., Song, J. K., Park, K. S., Jeong, B. G., Park, C. G., Shin, H. Y., Kang, J. W., Oh, G. J., Lee, Y. H., Seong, I. W., Yoo, W. S., & Hong, Y. S. (2013). Trends in the incidence of hospitalized acute myocardial infarction and stroke in Korea, 2006-2010. *Journal of Korean Medical Science, 28*(1), 16-24.

Kittner, S., McCarter, R. J., Sherwin, R., Sloan, M., Stern, B. J., Johnson, C. J., Buchholz, D., MJ, S., & Price, T. R. (1993). Black-White Difference in Stroke Risk Among Young Adults. *Stroke, 24*, 13-15.

Kittner, S. J., Giles, W. H., Macko, R. F., Hebel, J. R., Wozniak, M. A., Wityk, R. J., Stolley, P. D., Stern, B. J., Sloan, M. A., Sherwin, R., Price, T. R., McCarter, R. J., Johnson, C. J., Earley, C. J., Buchholz, D. W., & Malinow, M. R. (1999). Homocyst(e)ine and risk of cerebral infarction in a biracial population : the stroke prevention in young women study. *Stroke, 30*(8), 1554-1560.

Kittner, S. J., Stern, B. J., Wozniak, M., Buchholz, D. W., Earley, C. J., Feeser, B. R., Johnson, C. J., Macko, R. F., McCarter, R. J., Price, T. R., Sherwin, R., Sloan, M. A., & Wityk, R. J. (1998). Cerebral infarction in young adults: the Baltimore-Washington Cooperative Young Stroke Study. *Neurology, 50*(4), 890-894.

Knoflach, M., Matosevic, B., RÇ¬cker, M., Furtner, M., Mair, A., Wille, G., Zangerle, A., Werner, P., Ferrari, J., Schmidauer, C., Seyfang, L., Kiechl, S., & Willeit, J. (2012). Functional recovery after ischemic stroke - A matter of age: Data from the Austrian Stroke Unit Registry. *Neurology, 78*(4), 279-285.

Koivunen, R. J., Satopaa, J., Meretoja, A., Strbian, D., Haapaniemi, E., Niemela, M., Tatlisumak, T., & Putaala, J. (2015). Incidence, risk factors, etiology, severity and short-term outcome of non-traumatic intracerebral hemorrhage in young adults. *Eur J Neurol, 22*(1), 123-132.

Koton, S., Schneider, A. L., Rosamond, W. D., Shahar, E., Sang, Y., Gottesman, R. F., & Coresh, J. (2014). Stroke incidence and mortality trends in US communities, 1987 to 2011. *Jama, 312*(3), 259-268.

Koul, R., Motta, A., & Razdan, S. (1990). Epidemiology of young strokes in rural Kashmir, India. *Acta Neurol.Scand., 82*(1), 1-3.

Krishnamurthi, R. V., Moran, A. E., Feigin, V. L., Barker-Collo, S., Norrving, B., Mensah, G. A., Taylor, S., Naghavi, M., Forouzanfar, M. H., Nguyen, G., Johnson, C. O., Vos, T., Murray, C. J., & Roth, G. A. (2015). Stroke Prevalence, Mortality and Disability-Adjusted Life Years in Adults Aged 20-64

Years in 1990-2013: Data from the Global Burden of Disease 2013 Study. *Neuroepidemiology, 45*(3), 190-202.

Kristensen, B., Malm, J., Carlberg, B., Stegmayr, B., Backman, C., Fagerlund, M., & Olsson, T. (1997). Epidemiology and etiology of ischemic stroke in young adults aged 18 to 44 years in northern Sweden. *Stroke, 28*(9), 1702-1709.

Kropp, P., Holzhausen, M., Kolodny, E., Becker, U., Dichgans, M., Diez-Tejedor, E., Enzinger, C., Fazekas, F., Fuentes, B., Karpinska, A., Meyer, W., Tanislav, C., Bottcher, T., & Rolfs, A. (2013). Headache as a symptom at stroke onset in 4,431 young ischaemic stroke patients. Results from the "Stroke in Young Fabry Patients (SIFAP1) study". *J Neural Transm (Vienna), 120*(10), 1433-1440.

Kulesh, S. D., Filina, N. A., Frantava, N. M., Zhytko, N. L., Kastsinevich, T. M., Kliatskova, L. A., Shumskas, M. S., Hilz, M. J., Schwab, S., & Kolominsky-Rabas, P. L. (2010). Incidence and case-fatality of stroke on the East border of the European union: The Grodno Stroke Study. *Stroke, 41*(12), 2726-2730.

Kuptniratsaikul, V., Kovindha, A., Suethanapornkul, S., Manimmanakorn, N., & Archongka, Y. (2013). Long-term morbidities in stroke survivors: a prospective multicenter study of Thai stroke rehabilitation registry. *BMC Geriatr, 13*, 33.

Kwon, S. U., Kim, J. S., Lee, J. H., & Lee, M. C. (2000). Ischemic stroke in Korean young adults. *Acta Neurol.Scand., 101*(1), 19-24.

Lackey, N. R., & Gates, M. F. (2001). Adults' recollections of their experiences as young caregivers of family members with chronic physical illnesses. *J.Adv.Nurs., 34*(3), 320-328.

Lai, S. L., Chen, S. T., Lee, T. H., Ro, L. S., & Hsu, S. P. (2005). Spontaneous intracerebral hemorrhage in young adults. *Eur.J.Neurol., 12*(4), 310-316.

Larrue, V., Berhoune, N., Massabuau, P., Calviere, L., Raposo, N., Viguier, A., & Nasr, N. (2011). Etiologic investigation of ischemic stroke in young adults. *Neurology, 76*(23), 1983-1988.

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.

Lee, T. H., Hsu, W. C., Chen, C. J., & Chen, S. T. (2002). Etiologic study of young ischemic stroke in Taiwan. *Stroke, 33*(8), 1950-1955.

Lewsey, J. D., Jhund, P. S., Gillies, M., Chalmers, J. W., Redpath, A., Kelso, L., Briggs, A., Walters, M., Langhorne, P., Capewell, S., McMurray, J. J., & MacIntyre, K. (2009). Age- and sex-specific trends in fatal incidence and hospitalized incidence of stroke in Scotland, 1986 to 2005. *Circ.Cardiovasc.Qual.Outcomes., 2*(5), 475-483.

Leys, D., Bandu, L., Henon, H., Lucas, C., Mounier-Vehier, F., Rondepierre, P., & Godefroy, O. (2002). Clinical outcome in 287 consecutive young adults (15 to 45 years) with ischemic stroke. *Neurology, 59*(1), 26-33.

Li, B., Lou, Y. Z., Gu, H. F., Long, X., Wang, T., Wei, J., Wang, J. H., Tu, J., & Ning, X. J. (2015). Trends in Incidence of Stroke and Transition of Stroke Subtypes in Rural Tianjin China: A Population-Based Study from 1992 to 2012. *Plos One, 10*(10), 13.

Lindberg, M., Angquist, K. A., Fodstad, H., Fugl-Meyer, K., & Fugl-Meyer, A. R. (1992). Self-reported prevalence of disability after subarachnoid haemorrhage, with special emphasis on return to leisure and work. *Br.J.Neurosurg., 6*(4), 297-304.

Lindmark, A., Glader, E. L., Asplund, K., Norrving, B., & Eriksson, M. (2014). Socioeconomic disparities in stroke case fatality--Observations from Riks-Stroke, the Swedish stroke register. *Int J Stroke, 9*(4), 429-436.

Lindstrom, B., Roding, J., & Sundelin, G. (2009). Positive attitudes and preserved high level of motor performance are important factors for return to work in younger persons after stroke: a national survey. *J.Rehabil.Med., 41*(9), 714-718.

Lipska, K., Sylaja, P. N., Sarma, P. S., Thankappan, K. R., Kutty, V. R., Vasan, R. S., & Radhakrishnan, K. (2007). Risk factors for acute ischaemic stroke in young adults in South India. *J.Neurol.Neurosurg.Psychiatry, 78*(9), 959-963.

Liu, Y., Huang, X., He, X., Zhou, Y., Jiang, X., Chen-Kiang, S., Jaffrey, S. R., & Xu, G. (2015). A novel effect of thalidomide and its analogs: suppression of cereblon ubiquitination enhances ubiquitin ligase function. *FASEB J, 29*(12), 4829-4839.

Love, B. B., & Biller, J. (1990). Stroke in the young- Cardiac causes. *Stroke Clinical Updates, 1*, 13-16.

Low, J. T., Kersten, P., Ashburn, A., George, S., & McLellan, D. L. (2003). A study to evaluate the met and unmet needs of members belonging to Young Stroke groups affiliated with the Stroke Association. *Disabil.Rehabil., 25*(18), 1052-1056.

Maaijwee, N. A., Arntz, R. M., Rutten-Jacobs, L. C., Schaapsmeerders, P., Schoonderwaldt, H. C., van Dijk, E. J., & de Leeuw, F. E. (2015). Post-stroke fatigue and its association with poor functional outcome after stroke in young adults. *J Neurol Neurosurg Psychiatry, 86*(10), 1120-1126.

Maaijwee, N. A., Schaapsmeerders, P., Rutten-Jacobs, L. C., Arntz, R. M., Schoonderwaldt, H. C., van Dijk, E. J., Kessels, R. P., & de Leeuw, F. E. (2014). Subjective cognitive failures after stroke in young adults: prevalent but not related to cognitive impairment. *J Neurol, 261*(7), 1300-1308.

Maaijwee, N. A., Tendolkar, I., Rutten-Jacobs, L. C., Arntz, R. M., Schaapsmeerders, P., Dorresteijn, L. D., Schoonderwaldt, H. C., van Dijk, E. J., & de Leeuw, F. E. (2016). Long-term depressive symptoms and anxiety after transient ischaemic attack or ischaemic stroke in young adults. *Eur J Neurol, 23*(8), 1262-1268.

Mackay, A., & Nias, B. C. (1979). Strokes in the young and middle-aged: consequences to the family and to society. *J.R.Coll.Physicians Lond, 13*(2), 106-112.

Malm, J., Kristensen, B., Karlsson, T., Carlberg, B., Fagerlund, M., & Olsson, T. (1998). Cognitive impairment in young adults with infratentorial infarcts. *Neurology, 51*(2), 433-440.

Man, D., Yip, C., Lee, G., Fleming, J., & Shum, D. (2015). Self-report prospective memory problems in people with stroke. *Brain Inj, 29*(3), 329-335.

Manobianca, G., Zoccolella, S., Petruzzellis, A., Miccoli, A., & Logroscino, G. (2010). The incidence of major stroke subtypes in southern Italy: a population-based study. *Eur.J.Neurol., 17*(9), 1148-1155.

Marini, C., Totaro, R., & Carolei, A. (1999). Long-term prognosis of cerebral ischemia in young adults. National Research Council Study Group on Stroke in the Young. *Stroke, 30*(11), 2320-2325.

Marini, C., Totaro, R., De, S. F., Ciancarelli, I., Baldassarre, M., & Carolei, A. (2001). Stroke in young adults in the community-based L'Aquila registry: incidence and prognosis. *Stroke, 32*(1), 52-56.

Martinez-Sanchez, P., Fuentes, B., Fernandez-Dominguez, J., Ortega-Casarrubios Mde, L., Aguilar-Amar, M. J., Abenza-Abildua, M. J., Idrovo-Freire, L., & Diez-Tejedor, E. (2011). Young women have poorer outcomes than men after stroke. *Cerebrovasc Dis, 31*(5), 455-463.

Martinsen, R., Kirkevold, M., & Sveen, U. (2012). Younger stroke survivors' experiences of family life in a long-term perspective: a narrative hermeneutic phenomenological study. *Nurs Res Pract, 2012*, 948791.

Martirosyan, V., & Krupskaya, J. (2013). Study of the Factors Influencing Mortality from the Cerebral Stroke in Patients of Different Ages.

Mayo, N. E., Goldberg, M. S., Levy, A. R., Danys, I., & Korner-Bitensky, N. (1991). Changing rates of stroke in the province of Quebec, Canada: 1981-1988. *Stroke, 22*(5), 590-595.

McAllister, S., Derrett, S., Audas, R., Herbison, P., & Paul, C. (2013). Do different types of financial support after illness or injury affect socio-economic outcomes? A natural experiment in New Zealand. *Soc Sci.Med, 85*, 93-102.

Medin, J., Nordlund, A., & Ekberg, K. (2004). Increasing stroke incidence in Sweden between 1989 and 2000 among persons aged 30 to 65 years: evidence from the Swedish Hospital Discharge Register. *Stroke, 35*(5), 1047-1051.

Mehndiratta, M. M., Agarwal, P., Sen, K., & Sharma, B. (2004). Stroke in young adults: a study from a university hospital in north India. *Medical science monitor: international medical journal of experimental and clinical research, 10*(9), CR535.

Muller, M., Toth-Cohen, S., & Mulcahey, M. J. (2014). Development and evaluation of a hospital-based peer support group for younger individuals with stroke. *Occup Ther Health Care, 28*(3), 277-295.

Munshi, A., Rajeshwar, K., Kaul, S., Al-Hazzani, A., Alshatwi, A. A., Shafi, G., Balakrishna, N., & Jyothy, A. (2011). Association of tumor necrosis factor-alpha and matrix metalloproteinase-3 gene variants with stroke. *Eur.J.Neurol., 18*(8), 1053-1059.

Musolino, R., La, S. P., Granata, A., Gallitto, G., Leggiadro, N., Carerj, S., Manganaro, A., Tripodi, F., Epifanio, A., Gangemi, S., & Di, P. R. (2003). Ischaemic stroke in young people: a prospective and long-term follow-up study. *Cerebrovasc.Dis., 15*(1-2), 121-128.

Nacu, A., Fromm, A., Sand, K. M., Waje-Andreassen, U., Thomassen, L., & Naess, H. (2016). Age dependency of ischaemic stroke subtypes and vascular risk factors in western Norway: the Bergen Norwegian Stroke Cooperation Study. *Acta Neurol Scand, 133*(3), 202-207.

Naess, H., Hammersvik, L., & Skeie, G. O. (2009). Aphasia among young patients with ischemic stroke on long-term follow-up. *J.Stroke Cerebrovasc.Dis., 18*(4), 247-250.

Naess, H., Nyland, H. I., Thomassen, L., Aarseth, J., & Myhr, K. M. (2004). Long-term outcome of cerebral infarction in young adults. *Acta Neurol.Scand., 110*(2), 107-112.

Naess, H., Nyland, H. I., Thomassen, L., Aarseth, J., & Myhr, K. M. (2005a). Fatigue at long-term follow-up in young adults with cerebral infarction. *Cerebrovasc.Dis., 20*(4), 245-250.

Naess, H., Nyland, H. I., Thomassen, L., Aarseth, J., & Myhr, K. M. (2005b). Mild depression in young adults with cerebral infarction at long-term follow-up: a population-based study. *Eur.J.Neurol., 12*(3), 194-198.

Naess, H., Nyland, H. I., Thomassen, L., Aarseth, J., Nyland, G., & Myhr, K. M. (2002). Incidence and short-term outcome of cerebral infarction in young adults in western Norway. *Stroke, 33*(8), 2105-2108.

Naess, H., Waje-Andreassen, U., & Nyland, H. (2013). Risk factor burden predicts long-term mortality in young patients with arterial cerebral infarction. *Acta Neurol Scand, 127*(2), 92-96.

Naess, H., Waje-Andreassen, U., Thomassen, L., Nyland, H., & Myhr, K. M. (2006). Health-related quality of life among young adults with ischemic stroke on long-term follow-up. *Stroke, 37*(5), 1232-1236.

Nakagawa, E., & Hoffmann, M. (2013). Young women's stroke etiology differs from that in young men: An analysis of 511 patients. *Neurology International, 5*(3), 37-40.

Neau, J. P., Ingrand, P., Mouille-Brachet, C., Rosier, M. P., Couderq, C., Alvarez, A., & Gil, R. (1998). Functional recovery and social outcome after cerebral infarction in young adults. *Cerebrovasc.Dis., 8*(5), 296-302.

Nedeltchev, K., der Maur, T. A., Georgiadis, D., Arnold, M., Caso, V., Mattle, H. P., Schroth, G., Remonda, L., Sturzenegger, M., Fischer, U., & Baumgartner, R. W. (2005). Ischaemic stroke in young adults: predictors of outcome and recurrence. *J.Neurol.Neurosurg.Psychiatry, 76*(2), 191-195.

Nencini, P., Inzitari, D., Baruffi, M. C., Fratiglioni, L., Gagliardi, R., Benvenuti, L., Buccheri, A. M., Cecchi, L., Passigli, A., Rosselli, A., & . (1988). Incidence of stroke in young adults in Florence, Italy. *Stroke, 19*(8), 977-981.

Ojha, R., Huang, D., An, H., Liu, R., Du, C., Shen, N., Tu, Z., & Li, Y. (2015). Distribution of ischemic infarction and stenosis of intra- and extracranial arteries in young Chinese patients with ischemic stroke. *BMC Cardiovasc Disord, 15*, 158.

Okon, M., Adebobola, N. I., Julius, S., Adebimpe, O., Taiwo, A. O., Akinyemi, A., & Thomas, N. I. (2015). Stroke incidence and case fatality rate in an urban population. *Journal of Stroke and Cerebrovascular Diseases, 24*(4), 771-777.

Onwuchekwa, A. C., Onwuchekwa, R. C., & Asekomeh, E. G. (2009). Stroke in young Nigerian adults. *J.Vasc.Nurs., 27*(4), 98-102.

Ozer, I. S., Sorgun, M. H., Rzayev, S., Kuzu, M., Tezcan, S., Yilmaz, V., Ulukan, C., Cotur, H., Rawandi, A., & Isikay, C. T. (2015). Etiologic subtypes, risk factors, and outcomes of acute ischemic stroke in young patients

Genc Iskemik Inme Hastalarinda Inme Etiyolojisi, Risk Faktorleri ve Hastalarin Izlemdeki Fonksiyonel Durumlari. *Turk Noroloji Dergisi, 21*(4), 159-164.

Palmcrantz, S., Holmqvist, L. W., Sommerfeld, D. K., Tistad, M., Ytterberg, C., & von, K. L. (2012). Differences between younger and older individuals in their use of care and rehabilitation but not in self-perceived global recovery 1year after stroke. *J Neurol.Sci., 321*(1-2), 29-34.

Palmcrantz, S., Widen Holmqvist, L., & Sommerfeld, D. K. (2014). Young individuals with stroke: a cross sectional study of long-term disability associated with self-rated global health. *BMC Neurol, 14*, 20.

Park, W. B., Cho, J. S., Shin, S. D., Kong, S. Y., Kim, J. J., Lim, Y. S., Yang, H. J., & Lee, G. (2014). Comparison of epidemiology, emergency care, and outcomes of acute ischemic stroke between young adults and elderly in Korean population: a multicenter observational study. *J Korean Med Sci, 29*(7), 985-991.

Patella, R., Spalloni, A., Ferrari, M., La Starza, S., Bozzao, A., & Rasura, M. (2011). Cerebral ischemia in young patients (under 45 years of age): clinical and neuroradiological follow-up. *Neurol Sci, 32*(3), 427-432.

Peters, G., Buni, S., Oyeyemi, A., & Hamzat, T. (2013). Determinants of return to work among Nigerian stroke survivors. *Disability & Rehabilitation, 35*(6), 455-459.

Pezzini, A., Grassi, M., Lodigiani, C., Patella, R., Gandolfo, C., Zini, A., Delodovici, M. L., Paciaroni, M., Del Sette, M., Toriello, A., Musolino, R., Calabr, O. R. S., Bovi, P., Adami, A. D., Silvestrelli, G., Sessa, M., Cavallini, A., Marcheselli, S., Bonifati, D. M., Checcarelli, N., Tancredi, L., Chiti, A., Zotto, L. D., Spalloni, A., Costa, P., Giacalone, G., Ferrazzi, P., Poli, L., Morotti, A., Rasura, M., Simone, A. M., Gamba, M., Cerrato, P., Micieli, G., Melis, M., Massucco, D., De Giuli, V., Pepe, D., Iacoviello, L., & Padovani, A. (2015). Determinants of premature familial arterial thrombosis in patients with juvenile ischaemic stroke: The Italian project on stroke in young adults (IPSYS). *Thrombosis and Haemostasis, 113*(3), 641-648.

Piechowski-Jozwiak, B., Mickielewicz, A., Gaciong, Z., Berent, H., & Kwiecinski, H. (2007). Elevated levels of anti-Chlamydia pneumoniae IgA and IgG antibodies in young adults with ischemic stroke. *Acta Neurol.Scand., 116*(3), 144-149.

Putaala, J., Curtze, S., Hiltunen, S., Tolppanen, H., Kaste, M., & Tatlisumak, T. (2009a). Causes of death and predictors of 5-year mortality in young adults after first-ever ischemic stroke: the Helsinki Young Stroke Registry. *Stroke, 40*(8), 2698-2703.

Putaala, J., Haapaniemi, E., Metso, A. J., Metso, T. M., Artto, V., Kaste, M., & Tatlisumak, T. (2010). Recurrent ischemic events in young adults after first-ever ischemic stroke. *Ann.Neurol., 68*(5), 661-671.

Putaala, J., Metso, A. J., Metso, T. M., Konkola, N., Kraemer, Y., Haapaniemi, E., Kaste, M., & Tatlisumak, T. (2009b). Analysis of 1008 consecutive patients aged 15 to 49 with first-ever ischemic stroke: the Helsinki young stroke registry. *Stroke, 40*(4), 1195-1203.

Quinn, K., Murray, C. D., & Malone, C. (2014). The experience of couples when one partner has a stroke at a young age: an interpretative phenomenological analysis. *Disabil Rehabil, 36*(20), 1670-1678.

Rasura, M., Spalloni, A., Ferrari, M., De, C. S., Patella, R., Lisi, F., & Beccia, M. (2006). A case series of young stroke in Rome. *Eur.J.Neurol., 13*(2), 146-152.

Renna, R., Pilato, F., Profice, P., Della Marca, G., Broccolini, A., Morosetti, R., Frisullo, G., Rossi, E., De Stefano, V., & Di Lazzaro, V. (2014). Risk factor and etiology analysis of ischemic stroke in young adult patients. *Journal of Stroke & Cerebrovascular Diseases, 23*(3), e221-227 221p.

Röding, J. (2009). *Stroke in the younger: Self-reported impact on work situation, cognitive function, physical function and life satisfaction-A national survey.* UmeÃ¥ University.

Röding, J., Glader, E. L., Malm, J., & Lindstrom, B. (2010). Life satisfaction in younger individuals after stroke: different predisposing factors among men and women. *J.Rehabil.Med., 42*(2), 155-161.

Röding, J., Lindstrom, B., Malm, J., & Ohman, A. (2003). Frustrated and invisible--younger stroke patients' experiences of the rehabilitation process. *Disabil.Rehabil., 25*(15), 867-874.

Rodriguez, J., Exposito, J. A., Salvador, J., Ferrand, P., Perez, J. C., & del, P. R. (2004). [Functional recovery and return to work in the young patient after a stroke]. *Neurologia, 19*(4), 160-167.

Rolfs, A., Fazekas, F., Grittner, U., Dichgans, M., Martus, P., Holzhausen, M., Böttcher, T., Heuschmann, P. U., Tatlisumak, T., Tanislav, C., Jungehulsing, G. J., Giese, A. K., Putaala, J., Huber, R., Bodechtel, U., Lichy, C., Enzinger, C., Schmidt, R., Hennerici, M. G., & Kaps, M. (2013). Acute cerebrovascular disease in the young: the stroke in young fabry patients study. *Stroke (00392499), 44*(2), 340-349 310p.

Rosengren, A., Giang, K. W., Lappas, G., Jern, C., Torén, K., & Björck, L. (2013). Twenty-four-year trends in the incidence of ischemic stroke in sweden from 1987 to 2010. *Stroke (00392499), 44*(9), 2388-2393 2386p.

Rozenthul-Sorokin, N., Ronen, R., Tamir, A., Geva, H., & Eldar, R. (1996). Stroke in the young in Israel. Incidence and outcomes. *Stroke, 27*(5), 838-841.

Ruiz-Sandoval, J. L., Cantu, C., & Barinagarrementeria, F. (1999). Intracerebral hemorrhage in young people: analysis of risk factors, location, causes, and prognosis. *Stroke, 30*(3), 537-541.

Rutten-Jacobs, L. C., Arntz, R. M., Maaijwee, N. A., Schoonderwaldt, H. C., Dorresteijn, L. D., van Dijk, E. J., & de Leeuw, F. E. (2013a). Long-term mortality after stroke among adults aged 18 to 50 years. *Jama, 309*(11), 1136-1144.

Rutten-Jacobs, L. C., Arntz, R. M., Maaijwee, N. A., Schoonderwaldt, H. C., Dorresteijn, L. D., van Dijk, E. J., & de Leeuw, F. E. (2015). Cardiovascular disease is the main cause of long-term excess mortality after ischemic stroke in young adults. *Hypertension, 65*(3), 670-675.

Rutten-Jacobs, L. C., Keurlings, P. A., Arntz, R. M., Maaijwee, N. A., Schoonderwaldt, H. C., Dorresteijn, L. D., van der Vlugt, M. J., van Dijk, E. J., & de Leeuw, F. E. (2014). High incidence of diabetes after stroke in young adults and risk of recurrent vascular events: the FUTURE study. *PLoS One, 9*(1), e87171.

Rutten-Jacobs, L. C., Maaijwee, N. A., Arntz, R. M., Schoonderwaldt, H. C., Dorresteijn, L. D., van der Vlugt, M. J., van Dijk, E. J., & de Leeuw, F. E. (2013b). Long-term risk of recurrent vascular events after young stroke: The FUTURE study. *Ann Neurol, 74*(4), 592-601.

Saeki, S., Ogata, H., Okubo, T., Takahashi, K., & Hoshuyama, T. (1993). Factors influencing return to work after stroke in Japan. *Stroke, 24*(8), 1182-1185.

Saeki, S., Ogata, H., Okubo, T., Takahashi, K., & Hoshuyama, T. (1995). Return to work after stroke. A follow-up study. *Stroke, 26*(3), 399-401.

Saeki, S., & Toyonaga, T. (2010). Determinants of early return to work after first stroke in Japan. *J.Rehabil.Med., 42*(3), 254-258.

Samiullah, S., Humaira, M., Hanif, G., Ghouri, A. A., & Shaikh, K. (2010). Etiological patterns of stroke in young patients at a tertiary care hospital. *J.Pak.Med.Assoc., 60*(3), 201-204.

Schaapsmeerders, P., Maaijwee, N. A., Van Dijk, E. J., Rutten-Jacobs, L. C., Arntz, R. M., Schoonderwaldt, H. C., Dorresteijn, L. D., Kessels, R. P., & de Leeuw, F. E. (2013). Long-term cognitive impairment after first-ever ischemic stroke in young adults. *Stroke, 44*(6), 1621-1628.

Schnitzler, A., Woimant, F., Tuppin, P., & de Peretti, C. (2014). Prevalence of self-reported stroke and disability in the French adult population: a transversal study. *Plos One, 9*(12), e115375.

Shi, Z., Zhang, X., Chen, Z., Liebeskind, D. S., & Lou, M. (2014). Elevated thyroid autoantibodies and intracranial stenosis in stroke at an early age. *Int J Stroke, 9*(6), 735-740.

Simonetti, B. G., Mono, M. L., Huynh-Do, U., Michel, P., Odier, C., Sztajzel, R., Lyrer, P., Engelter, S. T., Bonati, L., Gensicke, H., Traenka, C., Tettenborn, B., Weder, B., Fischer, U., Galimanis, A., Jung, S. M., Luedi, R., De Marchis, G. M., Weck, A., Cereda, C. W., Baumgartner, R., Bassetti, C. L., Mattle, H. P., Nedeltchev, K., & Arnold, M. (2015). Risk factors, aetiology and outcome of ischaemic stroke in young adults: the Swiss Young Stroke Study (SYSS). *J Neurol, 262*(9), 2025-2032.

Siqueira Neto, J. L., Santos, A. C., Fabio, S. R. C., & Sakamoto, A. C. (1996). Cerebral infarction in patients aged 15 to 40 years. *Stroke, 27*(11), 2016-2019.

Sjogren, K. (1982). Leisure after stroke. *Int.Rehabil.Med., 4*(2), 80-87.

Smajlovic, D., Salihovic, D., Ibrahimagic, O. C., & Sinanovic, O. (2013). Characteristics of stroke in young adults in Tuzla Canton, Bosnia and Herzegovina. *Coll Antropol, 37*(2), 515-519.

Snogren, M., & Sunnerhagen, K. S. (2009). Description of functional disability among younger stroke patients: exploration of activity and participation and environmental factors. *Int.J.Rehabil.Res., 32*(2), 124-131.

Snyder, B. D., & Ramirez-Lassepas, M. (1980). Cerebral infarction in young adults. Long term prognosis. *Stroke, 11*(2), 149-153.

Sobreiro, M. F., Miotto, E. C., Terroni, L., Tinone, G., Iosifescu, D. V., de Lucia, M. C., Scaff, M., Leite Cda, C., Amaro, E., Jr., & Fraguas, R. (2014). Executive function and depressive symptoms of retardation in nonelderly stroke patients. *J Clin Exp Neuropsychol, 36*(6), 636-647.

Spengos, K., & Vemmos, K. (2010). Risk factors, etiology, and outcome of first-ever ischemic stroke in young adults aged 15 to 45 - the Athens young stroke registry. *Eur.J.Neurol., 17*(11), 1358-1364.

Sridharan, S. E., Unnikrishnan, J. P., Sukumaran, S., Sylaja, P. N., Nayak, S. D., Sarma, P. S., & Radhakrishnan, K. (2009). Incidence, types, risk factors, and outcome of stroke in a developing country: the Trivandrum Stroke Registry. *Stroke, 40*(4), 1212-1218.

Stone, S. D. (2005). Reactions to invisible disability: the experiences of young women survivors of hemorrhagic stroke. *Disabil.Rehabil., 27*(6), 293-304.

Stone, S. D. (2007). Patient concerns posthaemorrhagic stroke: a study of the Internet narratives of patients with ruptured arteriovenous malformation. *J.Clin.Nurs., 16*(2), 289-297.

Synhaeve, N. E., Arntz, R. M., Maaijwee, N. A., Rutten-Jacobs, L. C., Schoonderwaldt, H. C., Dorresteijn, L. D., de Kort, P. L., van Dijk, E. J., & de Leeuw, F. E. (2014). Poor long-term functional outcome after stroke among adults aged 18 to 50 years: Follow-Up of Transient Ischemic Attack and Stroke Patients and Unelucidated Risk Factor Evaluation (FUTURE) study. *Stroke, 45*(4), 1157-1160.

Synhaeve, N. E., Schaapsmeerders, P., Arntz, R. M., Maaijwee, N. A., Rutten-Jacobs, L. C., Schoonderwaldt, H. C., Dorresteijn, L. D., de Kort, P. L., van Dijk, E. J., Kessels, R. P., & de Leeuw, F. E. (2015). Cognitive performance and poor long-term functional outcome after young stroke. *Neurology, 85*(9), 776-782.

Tan, C. S., Muller-Riemenschneider, F., Ng, S. H., Tan, P. Z., Chan, B. P., Tang, K. F., Ahmad, A., Kong, K. H., Chang, H. M., Chow, K. Y., Koh, G. C., & Venketasubramanian, N. (2015). Trends in Stroke Incidence and 28-Day Case Fatality in a Nationwide Stroke Registry of a Multiethnic Asian Population. *Stroke, 46*(10), 2728-2734.

Tan, K. S., Tan, C. T., Churilov, L., MacKay, M. T., & Donnan, G. A. (2010). Risk factors and aetiology of cerebral infarction in young adults: a comparative study between Malaysia and Australia. *Int.J.Stroke, 5*(5), 428-430.

Tan, N. C., Venketasubramanian, N., Saw, S. M., & Tjia, H. T. (2002). Hyperhomocyst(e)inemia and risk of ischemic stroke among young Asian adults. *Stroke, 33*(8), 1956-1962.

Tanislav, C., Kropp, P., Grittner, U., Holzhausen, M., Fazekas, F., Jungehulsing, G. J., Tatlisumak, T., von Sarnowski, B., Putaala, J., Huber, R., Thijs, V., Schmidt, R., Kaps, M., Enzinger, C., Dichgans, M., Norrving, B., & Rolfs, A. (2015). Clinically relevant depressive symptoms in young stroke patients - results of the sifap1 study. *Neuroepidemiology, 44*(1), 30-38.

Teasell, R. W., McRae, R., & Finestone, H. M. (2000). Social issues in the rehabilitation of younger stroke patients. *Archives of physical medicine and rehabilitation, 81*(2), 205-209.

Thijs, V., Grittner, U., Dichgans, M., Enzinger, C., Fazekas, F., Giese, A. K., Kessler, C., Kolodny, E., Kropp, P., Martus, P., Norrving, B., Ringelstein, E. B., Rothwell, P. M., Schmidt, R., Tanislav, C., Tatlisumak, T., von Sarnowski, B., & Rolfs, A. (2015). Family History in Young Patients With Stroke. *Stroke, 46*(7), 1975-1978.

Tiamkao, S., Sawanyawisuth, K., Silaruks, S., Kiatchoosakun, S., Tatsanavivat, P., Chotmongkol, V., & Klungboonkrong, V. (2013). Correlation of causes and outcomes in stroke in the young. *J Stroke Cerebrovasc Dis, 22*(1), 55-57.

Toni, D., Ahmed, N., Anzini, A., Lorenzano, S., Brozman, M., Kaste, M., Mikulik, R., Putaala, J., & Wahlgren, N. (2012). Intravenous thrombolysis in young stroke patients results from the SITS-ISTR. *Neurology, 78*(12), 880-887.

Trivedi, M. M., Ryan, K. A., & Cole, J. W. (2015). Ethnic differences in ischemic stroke subtypes in young-onset stroke: The Stroke Prevention in Young Adults Study. *BMC Neurology, 15*(1).

Tsivgoulis, G., Putaala, J., Sharma, V. K., Balucani, C., Martin-Schild, S., Giannopoulos, S., Batala, L., Krogias, C., Palazzo, P., Bavarsad Shahripour, R., Arvaniti, C., Barlinn, K., Strbian, D., Haapaniemi, E., Flamouridou, M., Vadikolias, K., Heliopoulos, I., Voumvourakis, K., Triantafyllou, N., Azarpazhooh, M. R., Athanasiadis, D., Kosmidou, M., Katsanos, A. H., Vasdekis, S. N., Stefanis, L., Stamboulis, E., Piperidou, C., Tatlisumak, T., & Alexandrov, A. V. (2014). Racial disparities in early mortality in 1,134 young patients with acute stroke. *Neurol Sci, 35*(7), 1041-1049.

Vangen-Lonne, A. M., Wilsgaard, T., Johnsen, S. H., Carlsson, M., & Mathiesen, E. B. (2015). Time trends in incidence and case fatality of ischemic stroke: the tromso study 1977-2010. *Stroke, 46*(5), 1173-1179.

Varona, J. F., Bermejo, F., Guerra, J. M., & Molina, J. A. (2004). Long-term prognosis of ischemic stroke in young adults. Study of 272 cases. *J Neurol, 251*(12), 1507-1514.

Varona, J. F., Guerra, J. M., Bermejo, F., Molina, J. A., & Gomez, d. l. C. (2007). Causes of ischemic stroke in young adults, and evolution of the etiological diagnosis over the long term. *Eur.Neurol., 57*(4), 212-218.

Vega, T., Zurriaga, O., Ramos, J. M., Gil, M., Alamo, R., Lozano, J. E., Lopez, A., Miralles, M. T., Vaca, P., & Alvarez, M. M. (2009). Stroke in Spain: epidemiologic incidence and patterns; a health sentinel network study. *J.Stroke Cerebrovasc.Dis., 18*(1), 11-16.

Vestling, M., Tufvesson, B., & Iwarsson, S. (2003). Indicators for return to work after stroke and the importance of work for subjective well-being and life satisfaction. *J.Rehabil.Med., 35*(3), 127-131.

Vibo, R., Schneider, S., & KÇïrv, J. (2012). Long-term survival of young stroke patients: A population-based study of two stroke registries from Tartu, Estonia. *Stroke research and treatment*.

Visser-Meily, A., Post, M., Meijer, A. M., Maas, C., Ketelaar, M., & Lindeman, E. (2005a). Children's adjustment to a parent's stroke: determinants of health status and psychological problems, and the role of support from the rehabilitation team. *J.Rehabil.Med., 37*(4), 236-241.

Visser-Meily, A., Post, M., Meijer, A. M., van, d. P., I, Maas, C., & Lindeman, E. (2005b). When a parent has a stroke: clinical course and prediction of mood, behavior problems, and health status of their young children. *Stroke, 36*(11), 2436-2440.

Waje-Andreassen, U., Thomassen, L., Jusufovic, M., Power, K. N., Eide, G. E., Vedeler, C. A., & Naess, H. (2013). Ischaemic stroke at a young age is a serious event - final results of a population-based long-term follow-up in Western Norway. *European Journal of Neurology, 20*(5), 818-823.

Wang, J., An, Z., Li, B., Yang, L., Tu, J., Gu, H., Zhan, C., Liu, B., Su, T. C., & Ning, X. (2015). Increasing stroke incidence and prevalence of risk factors in a low-income Chinese population. *Neurology, 84*(4), 374-381.

Wityk, R. J., Kittner, S. J., Jenner, J. L., Hebel, J. R., Epstein, A., Wozniak, M. A., Stolley, P. D., Stern, B. J., Sloan, M. A., Price, T. R., McCarter, R. J., Macko, R. F., Johnson, C. J., Earley, C. J., Buchholz, D. W., & Schaefer, E. J. (2000). Lipoprotein (a) and the risk of ischemic stroke in young women. *Atherosclerosis, 150*(2), 389-396.

Wolff, V., Lauer, V., Rouyer, O., Sellal, F., Meyer, N., Raul, J. S., Sabourdy, C., Boujan, F., Jahn, C., Beaujeux, R., & Marescaux, C. (2011). Cannabis use, ischemic stroke, and multifocal intracranial vasoconstriction: a prospective study in 48 consecutive young patients. *Stroke, 42*(6), 1778-1780.

Wu, S. H., Woo, J., & Zhang, X. H. (2013). Worldwide socioeconomic status and stroke mortality: an ecological study. *Int J Equity Health, 12*, 42.

You, R. X., McNeil, J. J., O'Malley, H. M., Davis, S. M., Thrift, A. G., & Donnan, G. A. (1997). Risk factors for stroke due to cerebral infarction in young adults. *Stroke, 28*(10), 1913-1918.

Zanaty, M., Chalouhi, N., Starke, R. M., Tjoumakaris, S., Hasan, D., Hann, S., Ajiboye, N., Liu, K. C., Rosenwasser, R. H., Manasseh, P., & Jabbour, P. (2014). Endovascular stroke intervention in the very young. *Clin Neurol Neurosurg, 127*, 15-18.

Zhang, B., Pu, S., Zhang, W., Yang, N., Shen, G., Yin, J., Yi, Y., Gao, Q., & Gao, C. (2011). Sex differences in risk factors, etiology, and short-term outcome of cerebral infarction in young patients. *Atherosclerosis, 216*(2), 420-425.

Zhang, S., Chang, C., Zhang, J., Song, B., Fang, H., & Xu, Y. (2014). Correlation analysis of sleep quality and youth ischemic stroke. *Behav Neurol, 2014*, 246841.

Zhao, Y., Yao, Z., D'Souza, W., Zhu, C., Chun, H., Zhuoga, C., Zhang, Q., Hu, X., & Zhou, D. (2010). An epidemiological survey of stroke in Lhasa, Tibet, China. *Stroke, 41*(12), 2739-2743.