Stroke Registry Report 2014

National Registry of Diseases Office (NRDO)

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Acknowledgement

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Period:

01 January 2005 – 31 December 2014

Age coverage:

1) Analysis include adult patients 15 years and above
2) Analysis limit to 25-64 working group patients, and also follow MONICA criteria

1 KEY FINDINGS

Stroke Incidence, 2014

In the final analysis, 6943 were adults aged 15 years and older **(Table 4.1.1)**.

Of all the stroke cases in 2014, 81.2% were ischaemic stroke, 15.5% were parenchymal haemorrhage and 3.1% were subarachnoid haemorrhage.

There were 19 (0.27%) stroke cases of “unknown” aetiology. All of these cases did not have a CT scan brain performed.

The median age of all stroke patients admitted to the hospitals was 67 (15-105) years; 68 (15-105) years for ischaemic stroke, 64 (16-102) years for haemorrhagic stroke and 84 (51-102) years for unknown aetiology. The median age for first-ever stroke admitted to the hospitals was 66 (15-105) years.

The crude incidence rate for all stroke patients admitted to the public hospitals was 212.8 per 100,000 population. The age-standardised incidence rate was 157.7 per 100,000 population **(Table 4.1.2)**.

Malays had the highest overall age-standardised incidence for those aged 15 years and above followed by Indians and Chinese **(Table 4.1.2)**, similarly for 25-64 years first-ever and recurrent stroke **(Table 4.1.3)**.

Generally males were affected more than females, with the incidence rate being 1.7 times higher in males for those aged 15 years and above. For the 25 – 64 years age group, the incidence of stroke among males was 2.2 times more than females. Malays had higher age-specific rates than all other ethnic groups, among both males and females **(Table 4.1.4)**.

Stroke Incidence, 2005-2014

There were increasing trends observed in all the groups during the period 2005-2014: the number of cases rose from

- 448 to 590 for haemorrhagic stroke among the females,
- 503 to 697 for haemorrhagic stroke among the males,
- 2039 to 2307 for ischaemic stroke among the females and
- 2419 to 3330 for ischaemic stroke among the males **(Figure 4.2.1)**.

For those aged 15 years and above **(Figure 4.2.2)** among males and females, there was a decrease in the age-standardised incidence rates for ischaemic stroke.

The age-specific incidence rates were highest among patients aged 75 years and above. But there was a decline in rates for those aged 75 years and above in the period 2005 to 2013 for both genders **(Figures 4.2.4)**.

For recurrent stroke only, the age-standardised incidence rates decreased among ischaemic stroke both for males and females among those aged 15 years and above (**Figures 4.2.5**). While the rate decreased only in ischaemic stroke among the males in those aged 25-64 group (**Figures 4.2.6**).

Linear regression was performed to compute Average Annual Percent Change (AAPC) when trending was observed (**Table 4.2.1**).

Stroke In-Hospital Mortality, 2014

A total of 707 hospital deaths occurred among stroke patients admitted to public hospitals in 2014 **(Table 4.3.1)**. 10.2% of all stroke cases (first-ever and recurrent) died during hospitalisation while 9.7% died for first-ever stroke.

Of the hospital deaths, 53.9% were ischaemic stroke, 44.1% were haemorrhagic stroke while 2.0% were strokes of unknown aetiology.

The age-standardised mortality rate was 15.1 per 100,000 population (95% CI 13.9, 16.2) for aged 15 years and above **(Table 4.3.2)**. For the age group 25 to 64 years, the age-standardised mortality rate was 7.1 per 100,000 population (95% CI 6.1, 8.1) **(Table 4.3.3)**.

Malays had the highest age-standardised mortality rate compared to Chinese and Indians for both genders for those 15 years and above, (**Table 4.3.2)**, **s**imilarly, in the 25-64 age group for both genders **(Table 4.3.3)**. The age-specific mortality rates for hospital deaths are shown in **Table (4.3.4)**.

There were more elderly amongst ischaemic stroke patients who died, compared with haemorrhagic stroke patients who died (**Figure 4.3.1)**.

Stroke In-Hospital Mortality, 2005-2014

For all patients aged 15 years and above, the age-standardised mortality rates for ischaemic and haemorrahgic strokes in both genders were stable with little variation from 2005 to 2012, but the rate decreased to 7.1 among female ischaemic stroke cases in 2014 and the rates decreased among both males and females for haemorrhagic stroke cases in 2014 **(Figure 4.4.1)**. The rate decreased significantly among females in those aged 15

years and above from 2005 to 2014, with AAPC -3.25%, 95%CI (-4.69% to -1.78%) and p=0.001.

For patients aged 25-64, there was no obvious downward or upward trend observed for haemorrhagic or ischaemic stroke among both females and males during 2005 to 2012, but the rates all dropped among males and females for ischaemic and haemorrhagic strokes in 2014 **(Figure 4.4.2)**.

As for the age-specific incidence rates, the age-specific mortality rates were highest among patients aged 75 years and older in the period 2005-2014 for both genders **(Figure 4.4.3)**.

In-hospital mortality, adjusted for age, race, gender, medical histories, stroke pathway and blood sugar level, was estimated using logistic regression **(Table 4.4.1)**, and the adjusted mortality rate was stable during 2005-2014. The adjusted mortality rate for ischaemic stroke was less than a third of haemorrhagic stroke.

Mortality after Stroke Onset, 2013 & 2014

A total number of 1545 patients who had stroke in the year 2013 died from all causes. Of these, 30.2%, 50.3% and 64.9% of deaths (cumulative) occurred at less than 7 days, 30 days and 90 days post-stroke respectively. The corresponding proportions at 6 months and 12 months post-stroke were 75.6% and 88.6% respectively **(Table 4.5.1)**.

A total number of 783 stroke patients who had stroke in the year 2013 died due to stroke only. Of these, 50.5%, 74.2% and 86.3% of deaths (cumulative) occurred at less than 7 days, 30 days and 90 days post-stroke respectively. The corresponding proportions at 6 months and 12 months post-stroke were 92.0% and 97.6% respectively **(Table 4.5.1)**.

Up to the censor date, 12.0% of patients died due to stroke only and 23.6% died from all cause of death.

The 30-day case fatality rate for all 2014 stroke cases (regardless of place of occurrence) was 10.2%. Among males, 30-day case fatality rate was 5.3% for ischaemic stroke and 21.7% for haemorrhagic stroke. While among females, 30-day case fatality rate was 9.2% for ischaemic stroke and 26.1% for haemorrhagic stroke.

The mortality rate within 7 days admission was 17.3% for haemorrhagic stroke, and 40.9% for stroke of unknown subtype. For ischaemic stroke, there were minimal variations in mortality trends during the various time periods **(Figure 4.5.2)**.

In this report, we include age-sex standardised case-fatality rate for ischaemic stroke in adults aged 45 and above using 2011 data. The rate in Singapore was below OECD average **(Figure 4.6.1)**.

Ethnic Differences in Risk Factors, 2014

Indian stroke patients had the highest proportion of risk factors **(Table 4.7.1)** compared to the other ethnicities. This is with the exception of atrial fibrillation and a history of hypertension.

Among the various independent risk factors for stroke, Malays and Indians were more likely than Chinese to have a history of diabetes, high blood glucose levels (≥ 10 mmol/l), ischaemic heart disease, hyperlipidemia, smoking and hypertension at the time of admission **(Table 4.7.2)**.

Ischaemic Stroke Treatment, 2005-2014

The percentage of patients with history of atrial fibrillation or patients with newly diagnosed atrial fibrillation who were given anticoagulants has remained stable in the period 2005-2013, but increased to 48% in 2014. The proportion of patients receiving thrombolysis treatment has increased from 0.5% in 2005 to 6.3% in 2014 **(Figure 4.8.1)**.

Length of Hospital Stay (LOS) and Discharge Information, 2005-2014

The LOS among haemorrhagic stroke patients was about one week longer than that among ischaemic stroke patients **(Figure 4.9.1)**.

From the hospitals, 50.6% of stroke patients were discharged to their homes, 9.0% were transferred to community hospitals and 20.4% were sent for rehabilitation in acute hospitals, 3.1% to nursing homes, 0.1% to other hospitals for stroke management and 6.6% to other hospitals for management of disease conditions other than stroke.

Audit Parameters, 2014

Urinary tract infection was the most common complication during hospitalisation **(Section 4.10)**. The proportion of stroke patients who had their CT or MRI brain scans done within 24 hours of admission was 91.3%.

DEFINITIONS / GLOSSARY

MediClaims	-	MediClaims is used in Singapore to process the patient's Medisave and MediShield claims.
Paediatric age group	-	Aged between 0 and 14 years (inclusive).
Singapore residents	-	Citizens and permanent residents
Age-Standardised Incidence Rate	-	The age-standardised incidence rate is used to age-standardise incidence against the age structure of Singapore's population as at the 2010 Census. This metric is used to compare the incidence rates in Singapore over time and across regions.
Planning areas	-	Areas demarcated in the Urban Redevelopment Authority's Master Plan 2008.Unless otherwise stated, all the age-standardised rates in this report are per 100,000 world standard population. Singapore Residents include citizens and permanent residents.

AF	Atrial Fibrillation
LOS	Length Of Stay
CT	Computed Tomography
HIDS	Hospital In-patient Discharge Summary
ASR	Age-Standardised Incidence Rate
MHA	Ministry of Home Affairs
MONICA	Monitoring Trends and Determinants in Cardiovascular Disease, World Health Organization
MRI	Magnetic Resonance Imaging
NRDO	National Registry of Diseases Office
NRIC	National Registration Identity Card
TIA	Transient Ischaemic Attack

2 INTRODUCTION

The function of the National Registry of Diseases Office (NRDO) is to collect and analyse data to support the national disease management plans, policy formulation and programme planning.

The Singapore Stroke Registry was set up in 2002 to obtain epidemiological and clinical data on stroke cases diagnosed in Singapore from all public hospitals. This report is based on the data collected for the year 2014.

3 SOURCE OF DATA AND DATA COLLECTION

The source of data is mainly from the MediClaims listing. Case finding was supplemented by Hospital In-patient Discharge Summary (HIDS) review and from the death registry at the Ministry of Home Affairs (MHA). Name lists from MediClaims, HIDS and MHA were merged using the NRIC number to obtain the master patient list. The patient lists for the respective hospitals were then generated from the master list. Case notes were then traced from the medical record offices at the respective hospitals and the cases were verified by the registry coordinators. Once the cases were verified, data was captured electronically into registry forms which were later uploaded and transferred into the database in the National Registry of Diseases System. Cases that were diagnosed and also those who died at emergency departments of the various hospitals were included in the report.

Cases extracted from MediClaims, HIDS and MHA were coded based on the International Classification of Diseases 9th Revision (ICD-9 Clinical Modification). It covered ICD–9 codes: 430, 431, 432, 433, 434, 436 and 437 and ICD-10 codes from I60 to I69 while excluding 432.1 (Subdural haemorrhage), 435 (Transient cerebral ischaemia) and 438 (Late effects of cerebrovascular disease) for ICD-9 and I62.0, I62.1, G45 and I69 for ICD-10.

The MONICA (Monitoring Trends and Determinants in Cardiovascular Disease, World Health Organization) criteria were used for episode management. Recurrence of stroke after 28 days of the preceding recorded stroke episode was counted as another episode. Stroke episodes that occurred within the year 2014 were recorded.

Population denominators were derived using Department of Statistics mid-year population estimates. Crude rates were computed using these denominators. Segi world population was used for direct standardisation to calculate age-standardised rates. The 2014 population was used as the denominator to calculate incidence and mortality rates. Singapore residents i.e. citizens and permanent residents of Singapore and stroke cases 15 years and above, were included in the analysis.

The data and analysis only covers public hospitals in Singapore namely Alexandra Hospital (AH), Changi General Hospital (CGH), Khoo Teck Puat Hospital (KTPH), KK Women's & Children's Hospital (KKH), National University Hospital (NUH), Singapore General Hospital (SGH) and Tan Tock Seng Hospital (TTSH). Data from private hospitals are not included in the analysis.

The stroke mortality in this report covers deaths as at 30 June 2015 among patients who had stroke in the year 2014; include in-hospital deaths and outside of hospital deaths.

4 FINDINGS

4.1 Incidence of Stroke Admitted to Public Hospitals, 2014

The total number of stroke admissions for 2014 was 7846. The total number of stroke episodes among Singapore residents in public hospitals in 2014 was 6947. Four were in the paediatric age group. 6943 were adults aged 15 years and older **(Table 4.1.1)**.

Of all the stroke cases in 2014, 81.2% were ischaemic stroke, 15.5% were parenchymal haemorrhage and 3.1% were subarachnoid haemorrhage.

TABLE 4.1.1: Number of Stroke (First-Ever and Recurrent) Cases among Singapore Residents admitted to Public Hospitals, 2014.

Gender	Race	Ischaemic	Haemorrhagic		Unknown	Total
			Subarachnoid	Parenchymal		
Male	Chinese	2471	53	506	6	3036
	Malay	511	13	88	1	613
	Indian	285	4	24	0	313
	Others	63	0	9	0	72
	Subtotal	3330	697		7	4034
Gender	**Race**	**Ischaemic**	**Haemorrhagic**		**Unknown**	**Total**
			Subarachnoid	**Parenchymal**		
Female	Chinese	1753	115	358	12	2238
	Malay	375	18	70	0	463
	Indian	141	6	10	0	157
	Others	38	4	9	0	51
	Subtotal	2307	590		12	2909
Grand Total						6943

The crude incidence rate for all stroke patients admitted to the public hospitals was 212.8 per 100,000 population. The age-standardised incidence rate was 157.7 per 100,000 population **(Table 4.1.2)**.

Malays had the highest overall age-standardised incidence for those aged 15 years and above followed by Indians and Chinese **(Table 4.1.2)**.

TABLE 4.1.2: Crude and Age-Standardised Incidence Rate of Total (First-Ever and Recurrent) Stroke among Singapore Residents aged above 15 Years Admitted to Public Hospitals, 2014

Gender	Race	Ischaemic		Haemorrhagic		Unknown		Total	
		CR	ASR 95% CI	CR	ASR 95% CI	CR	ASR 95% CI	CR	ASR 95% CI
Male	Chinese	207.1 (198.9-215.3)	152.7 (146.6-158.8)	46.9 (43.0-50.7)	35.3 (32.3-38.3)	0.5 (0.1-0.9)	0.4 (0.1-0.7)	254.5 (245.4-263.5)	188.4 (181.6-195.1)
	Malay	249.9 (228.2-271.5)	246.4 (224.3-268.4)	49.4 (39.8-59.0)	48.9 (39.1-58.7)	0.5 (0.0-1.4)	0.4 (0.0-1.2)	299.7 (276.0-323.5)	295.7 (271.6-319.8)
	Indian	193.9 (171.4-216.4)	195.6 (172.0-219.2)	19.0 (12.0-26.1)	19.1 (11.8-26.4)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	212.9 (189.3-236.5)	214.6 (190.0-239.3)
	Others	132.1 (99.5-164.7)	145.2 (107.2-183.2)	18.9 (6.5-31.2)	18.0 (5.5-30.6)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	150.9 (116.1-185.8)	163.3 (123.3-203.2)
	Subtotal	209.1 (202.0-216.2)	165.2 (159.6-170.9)	43.8 (40.5-47.0)	35.1 (32.4-37.7)	0.4 (0.1-0.8)	0.3 (0.1-0.6)	253.3 (245.5-261.2)	200.6 (194.4-206.9)
Gender	**Race**	**Ischaemic**		**Haemorrhagic**		**Unknown**		**Total**	
		CR	**ASR 95% CI**	**CR**	**ASR 95% CI**	**CR**	**ASR 95% CI**	**CR**	**ASR 95% CI**
Female	Chinese	138.0 (131.5-144.4)	82.1 (78.1-86.1)	37.2 (33.9-40.6)	24.5 (22.2-26.9)	0.9 (0.4-1.5)	0.4 (0.2-0.7)	176.1 (168.8-183.4)	107.1 (102.4-111.7)
	Malay	178.6 (160.5-196.6)	156.7 (140.4-172.9)	41.9 (33.1-50.7)	37.1 (29.1-45.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	220.5 (200.4-240.5)	193.7 (175.7-211.8)
	Indian	103.1 (86.1-120.1)	96.9 (80.7-113.2)	11.7 (6.0-17.4)	11.6 (5.8-17.4)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	114.8 (96.8-132.7)	108.5 (91.3-125.8)
	Others	71.8 (49.0-94.7)	103.3 (68.3-138.3)	24.6 (11.2-37.9)	31.2 (12.0-50.4)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	96.4 (69.9-122.9)	134.5 (94.7-174.3)
	Subtotal	138.1 (132.5-143.7)	91.2 (87.3-95.1)	35.3 (32.5-38.2)	25.1 (23.0-27.2)	0.7 (0.3-1.1)	0.4 (0.1-0.6)	174.1 (167.8-180.5)	116.6 (112.2-121.0)
Grand Total								212.8 (207.8-217.8)	157.7 (154.0-161.5)

Similarly, Malays had the highest age-standardised incidence rates for 25-64 years first-ever and recurrent stroke **(Table 4.1.3).** The Singapore National Health Survey 2010 showed that Malays had higher prevalence of risk factors of stroke, such as hypertension, hyperlipidemia and smoking.

TABLE 4.1.3: Crude and Age-Standardised Incidence Rate of Total (First-Ever and Recurrent) Stroke among Singapore Residents aged 25-64 Years Admitted to Public Hospitals, 2014

Gender	Race	Ischaemic		Haemorrhagic		Unknown		Total	
		CR	ASR 95% CI	CR	ASR 95% CI	CR	ASR 95% CI	CR	ASR 95% CI
Male	Chinese	129.6 (122.0-137.3)	104.4 (98.2-110.7)	35.7 (31.7-39.7)	29.8 (26.4-33.2)	0.1 (0.0-0.3)	0.1 (0.0-0.3)	165.5 (156.8-174.1)	134.3 (127.2-141.4)
	Malay	214.8 (190.4-239.1)	187.7 (166.0-209.4)	48.8 (37.2-60.4)	45.7 (34.6-56.8)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	263.6 (236.6-290.6)	233.4 (209.1-257.8)
	Indian	151.7 (129.0-174.5)	156.9 (132.9-180.8)	15.1 (7.9-22.3)	16.5 (8.5-24.5)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	166.8 (143.0-190.6)	173.4 (148.1-198.6)
	Others	95.8 (64.9-126.7)	99.6 (66.1-133.1)	15.5 (3.1-28.0)	15.9 (2.2-29.6)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	111.4 (78.1-144.6)	115.6 (79.4-151.7)
	Subtotal	141.1 (134.2-148.0)	118.1 (112.3-123.9)	34.6 (31.2-38.0)	29.8 (26.9-32.8)	0.1 (0.0-0.3)	0.1 (0.0-0.2)	175.8 (168.1-183.5)	148.0 (141.5-154.6)
Gender	**Race**	**Ischaemic**		**Haemorrhagic**		**Unknown**		**Total**	
		CR	**ASR 95% CI**	**CR**	**ASR 95% CI**	**CR**	**ASR 95% CI**	**CR**	**ASR 95% CI**
Female	Chinese	46.0 (41.5-50.4)	38.6 (34.8-42.4)	21.5 (18.4-24.5)	18.6 (15.9-21.2)	0.1 (0.0-0.3)	0.1 (0.0-0.3)	67.6 (62.2-73.0)	57.3 (52.7-61.9)
	Malay	107.3 (90.4-124.3)	92.4 (77.6-107.2)	39.0 (28.8-49.3)	35.7 (26.2-45.3)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	146.4 (126.6-166.2)	128.2 (110.6-145.7)
	Indian	62.4 (47.0-77.8)	63.6 (47.8-79.5)	5.9 (1.2-10.7)	6.7 (1.3-12.0)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	68.4 (52.2-84.5)	70.3 (53.5-87.0)
	Others	28.0 (12.1-43.8)	55.2 (22.6-87.8)	16.3 (4.2-28.4)	20.6 (2.8-38.5)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	44.3 (24.4-64.2)	75.9 (38.7-113.0)
	Subtotal	54.2 (50.0-58.4)	47.1 (43.4-50.8)	22.1 (19.4-24.8)	19.6 (17.2-22.0)	0.1 (0.0-0.3)	0.1 (0.0-0.2)	76.4 (71.4-81.4)	66.7 (62.3-71.1)
Grand Total								125.2 (120.6-129.7)	107.2 (103.3-111.1)

Malays generally had higher age-specific incidence rates than all other ethnic groups, among both males and females **(Table 4.1.4)**.

TABLE 4.1.4: Age-Specific Incidence Rates of Stroke among Singapore Residents Admitted to Public Hospitals by Race and Gender, 2014

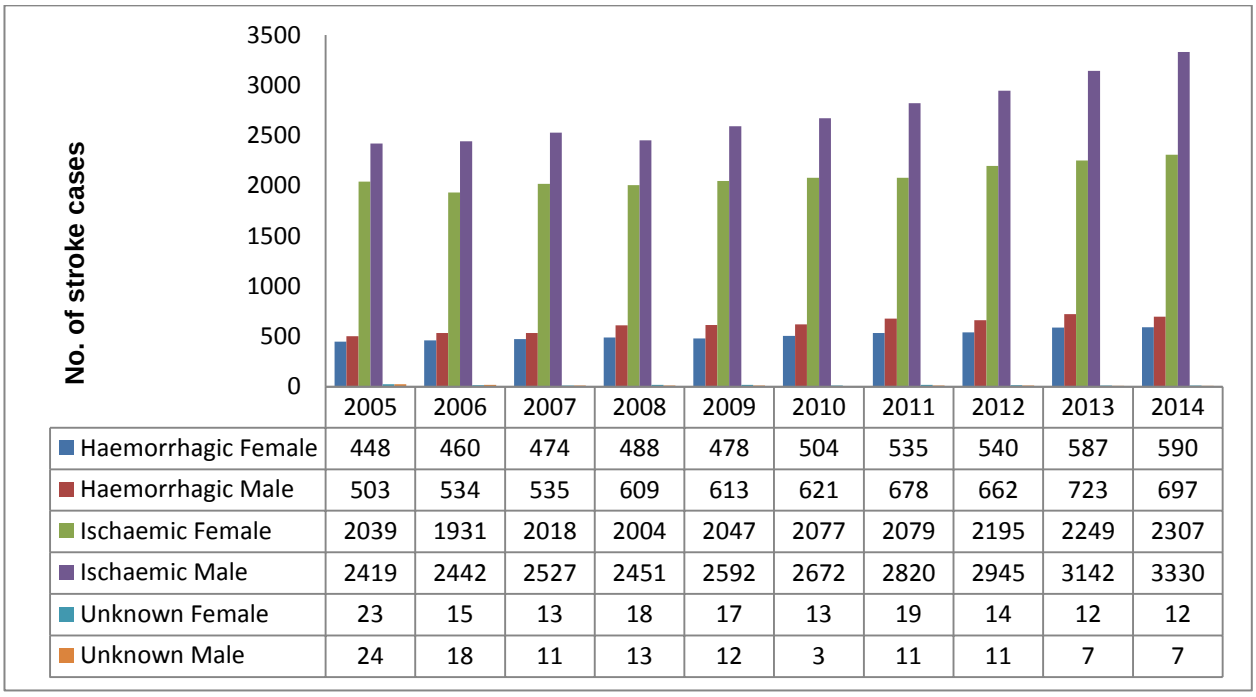
Gender	Race	Age Group						
		15-	25-	35-	45-	55-	65-	≥ 75
Male	Chinese	4.9	11.2	54.7	168.4	423.6	776.3	1451.0
	Malay	6.2	12.6	113.8	306.2	701.0	1253.8	1725.0
	Indian	0.0	15.3	39.0	234.1	545.5	895.2	1279.3
	Others	0.0	14.6	46.5	149.8	334.9	661.9	1504.5
	Subtotal	4.6	11.9	58.1	192.0	461.2	822.1	1465.3
Gender	**Race**	**Age Group**						
		15-	**25-**	**35-**	**45-**	**55-**	**65-**	**≥ 75**
Female	Chinese	3.4	8.1	21.3	75.6	171.5	439.2	1340.5
	Malay	0.0	15.4	46.6	181.0	373.2	762.2	1867.5
	Indian	0.0	13.6	30.0	78.2	214.5	366.2	1172.0
	Others	0.0	8.9	11.6	48.1	269.3	456.0	1977.8
	Subtotal	2.4	9.7	24.2	89.1	199.3	464.8	1385.2
Grand Total		3.5	10.8	40.6	140.5	330.1	635.0	1417.6

4.2 Incidence Trends of Stroke for Admission to Public Hospitals, 2005-2014

There were increasing trends observed in all the groups during the period 2005-2014: the number of cases rose from

- 448 to 590 for haemorrhagic stroke among the females,
- 503 to 697 for haemorrhagic stroke among the males,
- 2039 to 2307 for ischaemic stroke among the females and
- 2419 to 3330 for ischaemic stroke among the males **(Figure 4.2.1).**

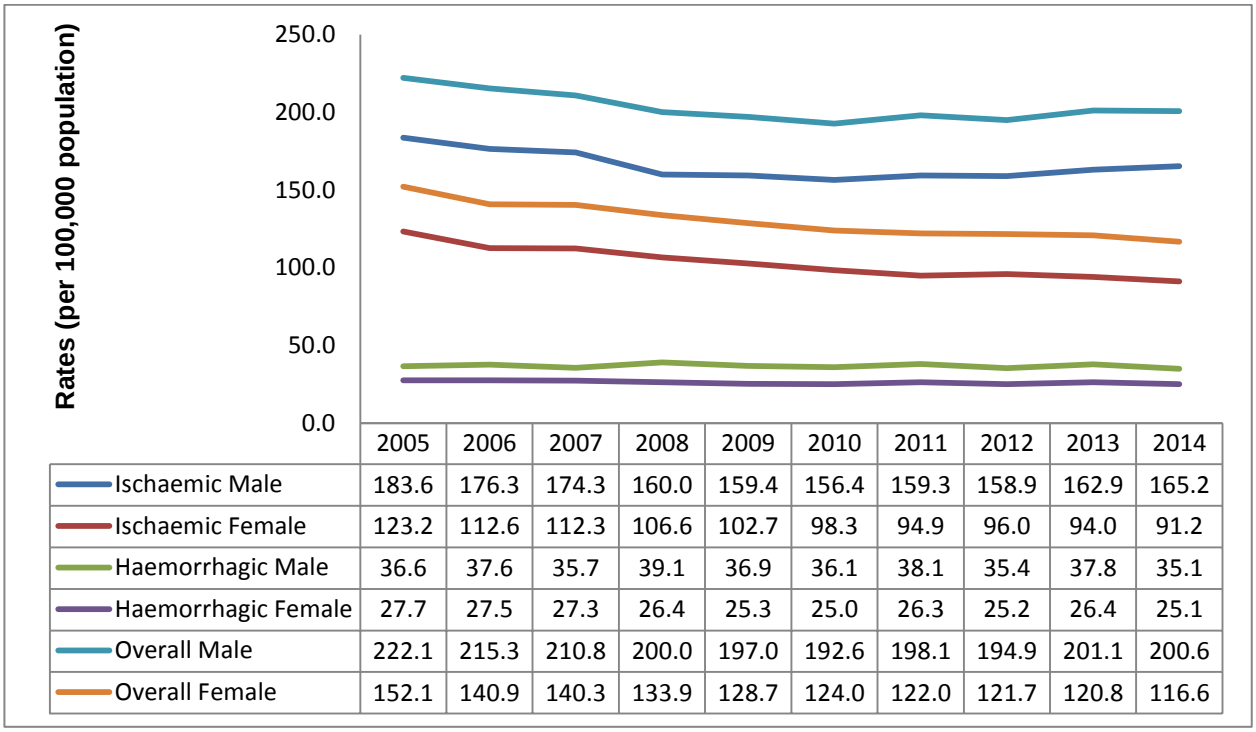
FIGURE 4.2.1: Number of Stroke (First-Ever and Recurrent) Cases among Singapore Residents Admitted to Public Hospitals, 2005-2014



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Haemorrhagic Female	448	460	474	488	478	504	535	540	587	590
Haemorrhagic Male	503	534	535	609	613	621	678	662	723	697
Ischaemic Female	2039	1931	2018	2004	2047	2077	2079	2195	2249	2307
Ischaemic Male	2419	2442	2527	2451	2592	2672	2820	2945	3142	3330
Unknown Female	23	15	13	18	17	13	19	14	12	12
Unknown Male	24	18	11	13	12	3	11	11	7	7

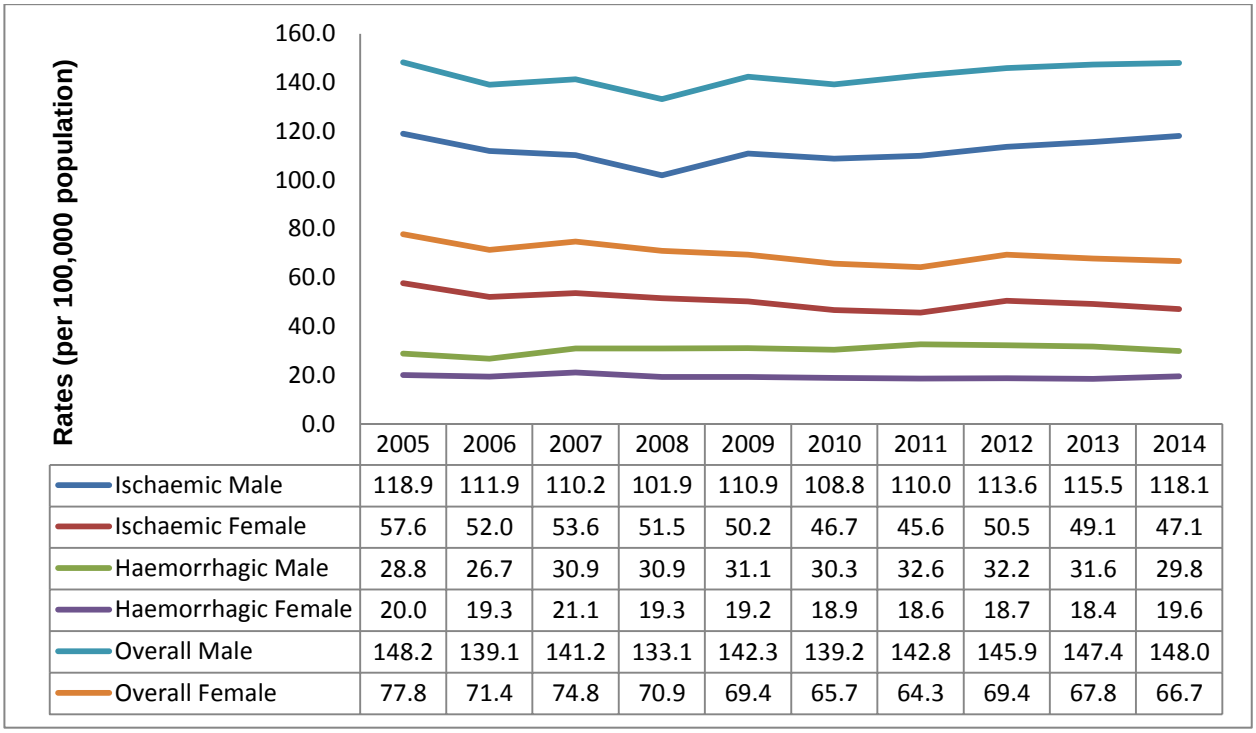
For those aged 15 years and above **(Figure 4.2.2)** among males and females, there was a decrease in the age-standardised incidence rates for ischaemic stroke. This corresponds to the decreasing national prevalence of hypertension (from 27.3% in 1998 to 23.5% in 2010), hyperlipidemia (from 25.4% in 1998 to 17.4% in 2010) and smoking (from 15.2% in 1998 to 14.3% in 2010) in Singapore citizens aged 18-69 years.

FIGURE 4.2.2: Age-Standardised Incidence Rate of Total (First-Ever and Recurrent) Stroke among Singapore Residents aged above 15 Years Admitted to Public Hospitals, 2005-2014



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Ischaemic Male	183.6	176.3	174.3	160.0	159.4	156.4	159.3	158.9	162.9	165.2
Ischaemic Female	123.2	112.6	112.3	106.6	102.7	98.3	94.9	96.0	94.0	91.2
Haemorrhagic Male	36.6	37.6	35.7	39.1	36.9	36.1	38.1	35.4	37.8	35.1
Haemorrhagic Female	27.7	27.5	27.3	26.4	25.3	25.0	26.3	25.2	26.4	25.1
Overall Male	222.1	215.3	210.8	200.0	197.0	192.6	198.1	194.9	201.1	200.6
Overall Female	152.1	140.9	140.3	133.9	128.7	124.0	122.0	121.7	120.8	116.6

FIGURE 4.2.3: Age-Standardised Incidence Rate of Total (First-Ever and Recurrent) Stroke among Singapore Residents aged 25-64 Years Admitted to Public Hospitals, 2005-2014

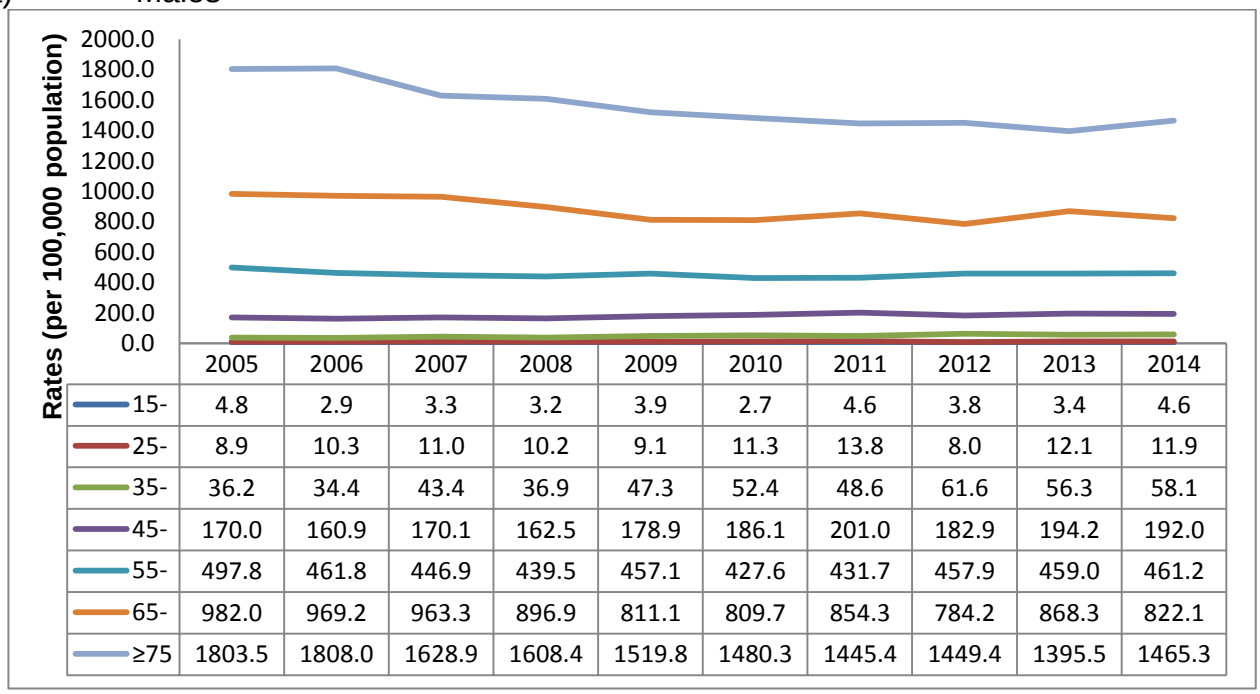


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Ischaemic Male	118.9	111.9	110.2	101.9	110.9	108.8	110.0	113.6	115.5	118.1
Ischaemic Female	57.6	52.0	53.6	51.5	50.2	46.7	45.6	50.5	49.1	47.1
Haemorrhagic Male	28.8	26.7	30.9	30.9	31.1	30.3	32.6	32.2	31.6	29.8
Haemorrhagic Female	20.0	19.3	21.1	19.3	19.2	18.9	18.6	18.7	18.4	19.6
Overall Male	148.2	139.1	141.2	133.1	142.3	139.2	142.8	145.9	147.4	148.0
Overall Female	77.8	71.4	74.8	70.9	69.4	65.7	64.3	69.4	67.8	66.7

The age-specific incidence rates were highest among patients aged 75 years and above. But there was a decline in rates for those aged 75 years and above in the period 2005 to 2013 for both genders **(Figure 4.2.4).**

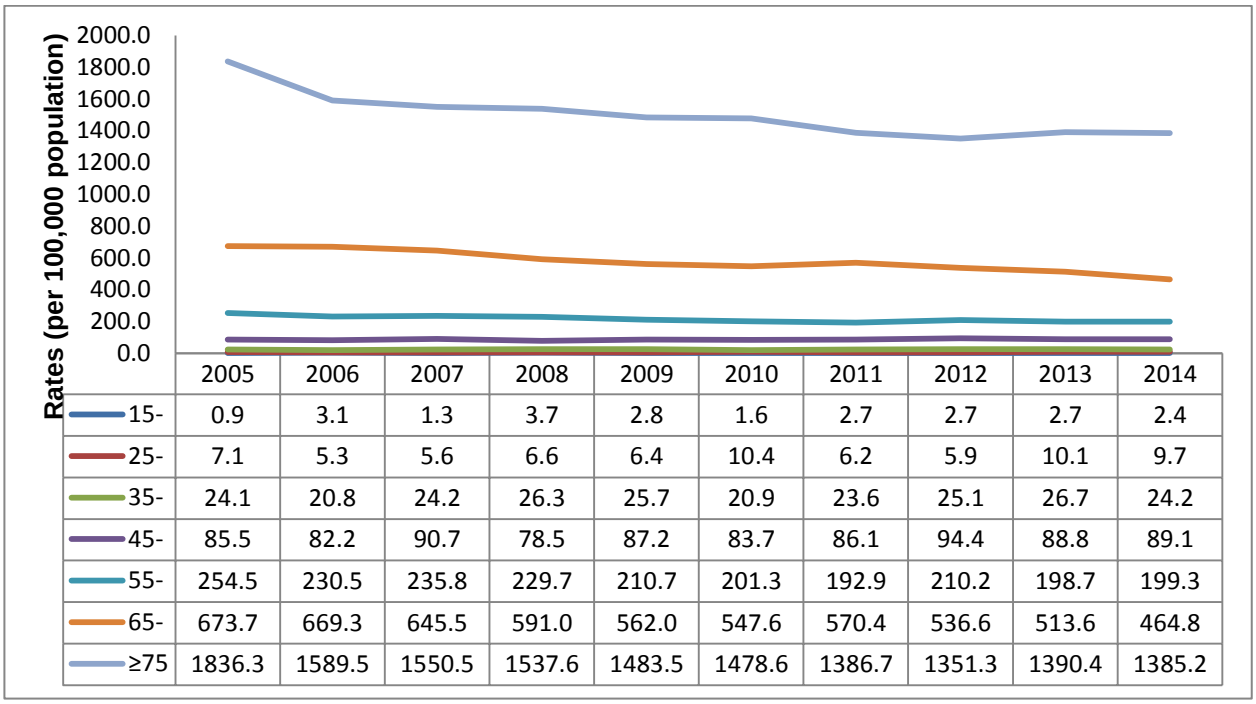
FIGURE 4.2.4: Age-specific Incidence Rates of Stroke among Singapore Residents Admitted to Public Hospitals by Gender, 2005-2014

a) Males



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
15-	4.8	2.9	3.3	3.2	3.9	2.7	4.6	3.8	3.4	4.6
25-	8.9	10.3	11.0	10.2	9.1	11.3	13.8	8.0	12.1	11.9
35-	36.2	34.4	43.4	36.9	47.3	52.4	48.6	61.6	56.3	58.1
45-	170.0	160.9	170.1	162.5	178.9	186.1	201.0	182.9	194.2	192.0
55-	497.8	461.8	446.9	439.5	457.1	427.6	431.7	457.9	459.0	461.2
65-	982.0	969.2	963.3	896.9	811.1	809.7	854.3	784.2	868.3	822.1
≥75	1803.5	1808.0	1628.9	1608.4	1519.8	1480.3	1445.4	1449.4	1395.5	1465.3

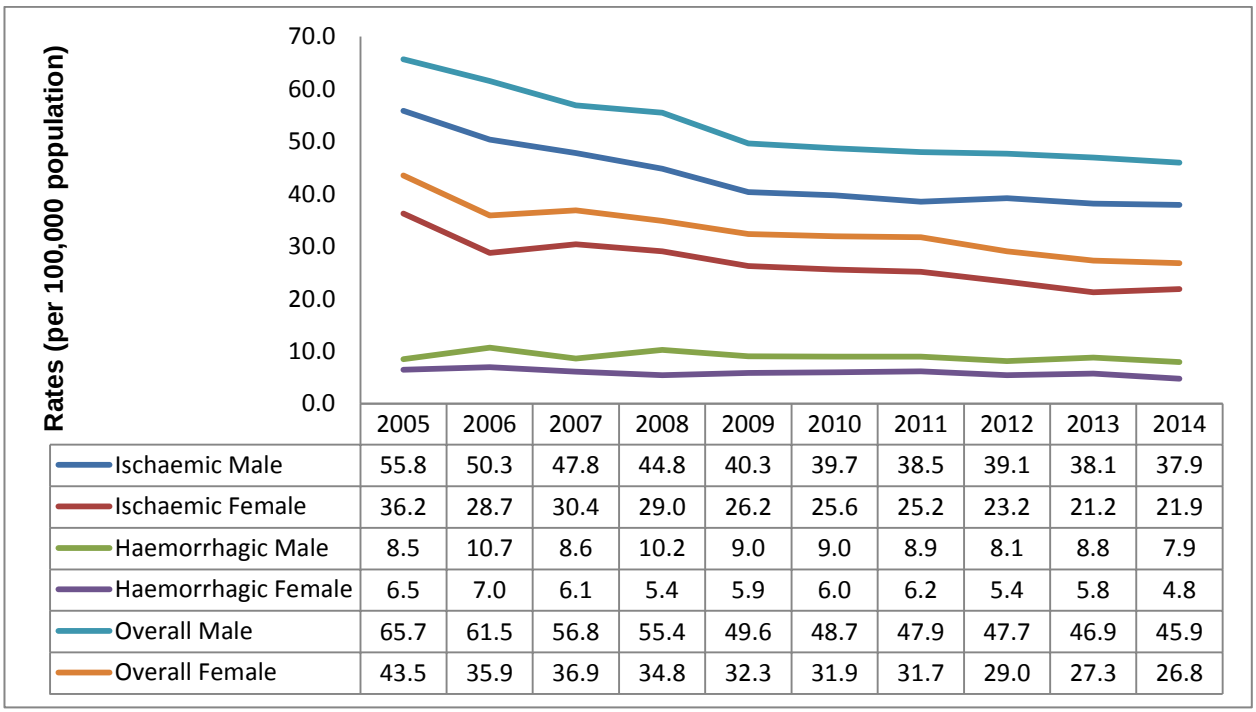
b) Females



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
15-	0.9	3.1	1.3	3.7	2.8	1.6	2.7	2.7	2.7	2.4
25-	7.1	5.3	5.6	6.6	6.4	10.4	6.2	5.9	10.1	9.7
35-	24.1	20.8	24.2	26.3	25.7	20.9	23.6	25.1	26.7	24.2
45-	85.5	82.2	90.7	78.5	87.2	83.7	86.1	94.4	88.8	89.1
55-	254.5	230.5	235.8	229.7	210.7	201.3	192.9	210.2	198.7	199.3
65-	673.7	669.3	645.5	591.0	562.0	547.6	570.4	536.6	513.6	464.8
≥75	1836.3	1589.5	1550.5	1537.6	1483.5	1478.6	1386.7	1351.3	1390.4	1385.2

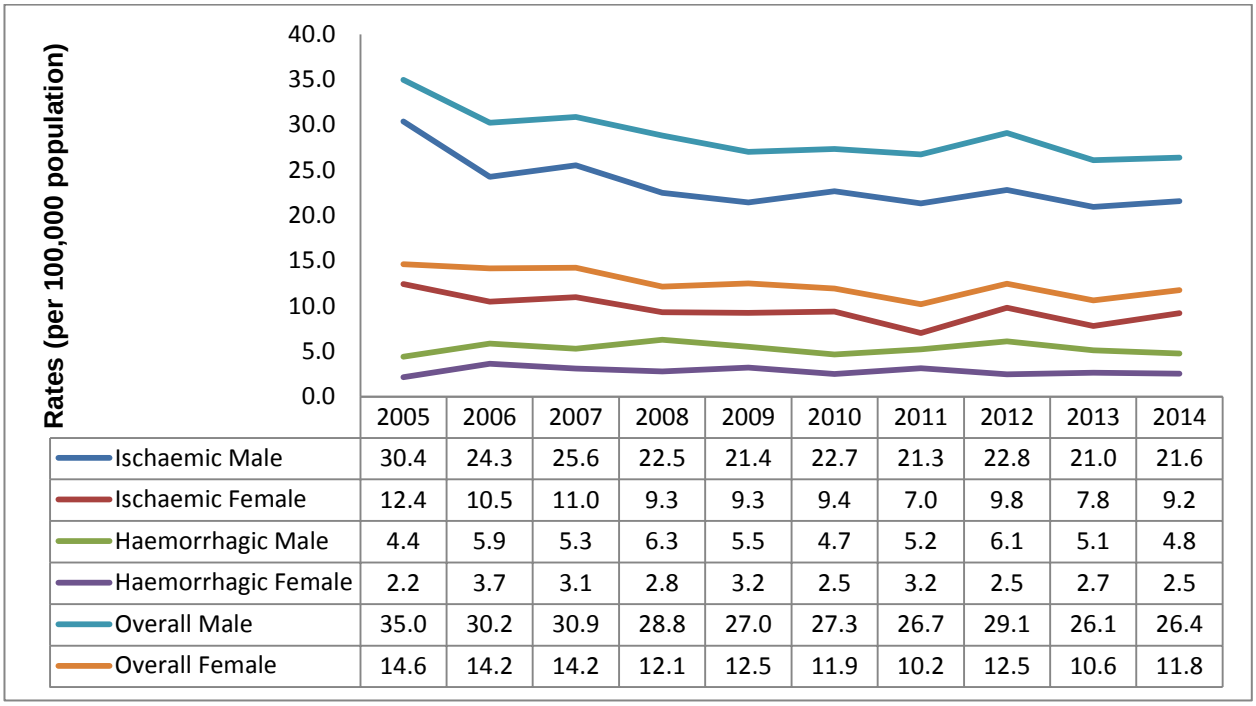
For recurrent stroke only, the age-standardised incidence rates decreased among ischaemic stroke both for males and females among those aged 15 years and above **(Figure 4.2.5)** , while the rate decreased only among male ischaemic in those aged 25-64 group (**Figure 4.2.6**).

FIGURE 4.2.5: Age-Standardised Incidence Rate of Total (Recurrent only) Stroke among Singapore Residents aged above 15 Years Admitted to Public Hospitals, 2005-2014



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Ischaemic Male	55.8	50.3	47.8	44.8	40.3	39.7	38.5	39.1	38.1	37.9
Ischaemic Female	36.2	28.7	30.4	29.0	26.2	25.6	25.2	23.2	21.2	21.9
Haemorrhagic Male	8.5	10.7	8.6	10.2	9.0	9.0	8.9	8.1	8.8	7.9
Haemorrhagic Female	6.5	7.0	6.1	5.4	5.9	6.0	6.2	5.4	5.8	4.8
Overall Male	65.7	61.5	56.8	55.4	49.6	48.7	47.9	47.7	46.9	45.9
Overall Female	43.5	35.9	36.9	34.8	32.3	31.9	31.7	29.0	27.3	26.8

FIGURE 4.2.6: Age-Standardised Incidence Rate of Total (Recurrent only) Stroke among Singapore Residents aged 25-64 Years Admitted to Public Hospitals, 2005-2014



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Ischaemic Male	30.4	24.3	25.6	22.5	21.4	22.7	21.3	22.8	21.0	21.6
Ischaemic Female	12.4	10.5	11.0	9.3	9.3	9.4	7.0	9.8	7.8	9.2
Haemorrhagic Male	4.4	5.9	5.3	6.3	5.5	4.7	5.2	6.1	5.1	4.8
Haemorrhagic Female	2.2	3.7	3.1	2.8	3.2	2.5	3.2	2.5	2.7	2.5
Overall Male	35.0	30.2	30.9	28.8	27.0	27.3	26.7	29.1	26.1	26.4
Overall Female	14.6	14.2	14.2	12.1	12.5	11.9	10.2	12.5	10.6	11.8

Linear regression was performed to generate Average Annual Percent Change (AAPC) when trending was observed (**Table 4.2.1**).

TABLE 4.2.1: AAPC for Stroke Trends 2005-2014

Include	Age	Type	Gender	AAPC	95%CI	P
First-ever & Recurrent	15 +	Ischaemic	Female	-3.1%	-3.7% to -2.5%	<0.0001
First-ever & Recurrent	15 +	Ischaemic	Male	-1.2%	-2.3% to -0.1%	0.032
Recurrent	15 +	Ischaemic	Male	-4.1%	-5.4% to -2.8%	<0.0001
Recurrent	15 +	Ischaemic	Female	-5.0%	-6.3% to -3.7%	<0.0001
Recurrent	25-64	Ischaemic	Male	-2.9%	-4.7% to -1.0%	0.008

* Only those with significant trends (P value <0.05) were shown in the above table.

4.3 Mortality from Stroke during Hospitalisation, 2014

A total of 707 hospital deaths occurred among stroke patients admitted to public hospitals in 2014 **(Table 4.3.1)**. The mortality rate for all stroke cases (first-ever and recurrent) during hospitalisation was 10.2% while for first-ever stroke it was 9.7%.

Of the hospital deaths, 53.9% were ischaemic stroke, 44.1% were haemorrhagic stroke while 2.0% were strokes of unknown aetiology. The proportion of in-hospital death among parenchymal haemorrhagic stroke cases was 23.7% (N=255), while the proportion among subarachnoid haemorrhagic stroke cases was 26.8% (N=57). Due to the small number of subarachnoid haemorrhagic stroke cases and the small difference among these two sub-types (parenchymal and subarachnoid), we combined them under haemorrhagic stroke when reporting the in-hospital mortality statistics.

TABLE 4.3.1: Number of Hospital Deaths (First-Ever and Recurrent) among Singapore Residents Admitted to Public Hospitals, 2014

Gender	Race	Ischaemic	Haemorrhagic		Unknown	Total
			Subarachnoid	Parenchymal		
Male	Chinese	133	20	106	3	262
	Malay	36	3	19	1	59
	Indian	9	0	8	0	17
	Others	4	0	2	0	6
	Subtotal	182	158		4	344
Gender	**Race**	**Ischaemic**	**Haemorrhagic**		**Unknown**	**Total**
			Subarachnoid	**Parenchymal**		
Female	Chinese	151	24	94	10	279
	Malay	32	7	19	0	58
	Indian	6	3	2	0	11
	Others	10	0	5	0	15
	Subtotal	199	154		10	363
Grand Total						707

The age-standardised mortality rate was 15.1 (95%CI 13.9, 16.2) per 100,000 population (**Table 4.3.2**). For those 15 years and above, Malays had the highest age-standardised mortality rate compared to Chinese and Indians for both genders.

TABLE 4.3.2: Crude and Age-Standardised Mortality Rates of Total (First-Ever and Recurrent) Stroke among Singapore Residents aged above 15 years Admitted to Public Hospitals, 2014

Gender	Race	Ischaemic		Haemorrhagic		Unknown		Total	
		CR	ASR 95% CI	CR	ASR 95% CI	CR	ASR 95% CI	CR	ASR 95% CI
Male	Chinese	11.1 (9.3-13.0)	8.2 (6.8-9.7)	10.6 (8.7-12.4)	7.7 (6.4-9.1)	0.3 (0.0-0.5)	0.2 (0.0-0.4)	22.0 (19.3-24.6)	16.1 (14.2-18.1)
	Malay	17.6 (11.9-23.4)	18.4 (12.2-24.5)	10.8 (6.3-15.3)	11.0 (6.2-15.8)	0.5 (0.0-1.4)	0.4 (0.0-1.2)	28.8 (21.5-36.2)	29.8 (22.0-37.6)
	Indian	6.1 (2.1-10.1)	6.6 (2.1-11.1)	5.4 (1.7-9.2)	5.3 (1.5-9.2)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	11.6 (6.1-17.1)	11.9 (6.0-17.9)
	Others	8.4 (0.2-16.6)	12.8 (0.0-25.5)	4.2 (0.0-10.0)	4.0 (0.0-9.9)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	12.6 (2.5-22.6)	16.8 (2.7-30.8)
	Subtotal	11.4 (9.8-13.1)	9.1 (7.8-10.4)	9.9 (8.4-11.5)	7.8 (6.5-9.0)	0.3 (0.0-0.5)	0.2 (0.0-0.4)	21.6 (19.3-23.9)	17.0 (15.2-18.9)
Gender	**Race**	**Ischaemic**		**Haemorrhagic**		**Unknown**		**Total**	
		CR	**ASR 95% CI**	**CR**	**ASR 95% CI**	**CR**	**ASR 95% CI**	**CR**	**ASR 95% CI**
Female	Chinese	11.9 (10.0-13.8)	6.3 (5.2-7.4)	9.3 (7.6-11.0)	5.3 (4.2-6.3)	0.8 (0.3-1.3)	0.4 (0.1-0.6)	22.0 (19.4-24.5)	11.9 (10.4-13.4)
	Malay	15.2 (10.0-20.5)	12.4 (7.9-16.8)	12.4 (7.6-17.1)	11.1 (6.7-15.5)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	27.6 (20.5-34.7)	23.5 (17.2-29.7)
	Indian	4.4 (0.9-7.9)	3.9 (0.7-7.0)	3.7 (0.5-6.9)	3.9 (0.5-7.3)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	8.0 (3.3-12.8)	7.8 (3.1-12.4)
	Others	18.9 (7.2-30.6)	25.8 (8.3-43.3)	9.5 (1.2-17.7)	13.5 (0.5-26.5)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	28.4 (14.0-42.7)	39.4 (17.6-61.1)
	Subtotal	11.9 (10.3-13.6)	7.1 (6.0-8.1)	9.2 (7.8-10.7)	5.9 (4.9-6.8)	0.6 (0.2-1.0)	0.3 (0.1-0.5)	21.7 (19.5-24.0)	13.2 (11.8-14.7)
Grand Total								21.7 (20.1-23.3)	15.1 (13.9-16.2)

For the age group 25 to 64 years, the age-standardised mortality rate was 7.1 (95% CI 6.1, 8.1) per 100,000 population (**Table 4.3.3**). Similarly, Malays had the highest mortality in the 25-64 age group for both genders.

The higher proportion of medical illnesses among Malays, such as diabetes (Malay 38.5% vs Chinese 37.7%) and hyperlipidaemia (Malay 70.9% vs Chinese 65.6%) and smoking (Malay 31.6% vs Chinese 23.7%), lead to higher mortality rate.

TABLE 4.3.3: Crude and Age-Standardised Mortality Rate of Total (First-Ever and Recurrent) Stroke among Singapore Residents aged 25-64 Years Admitted to Public Hospitals, 2014

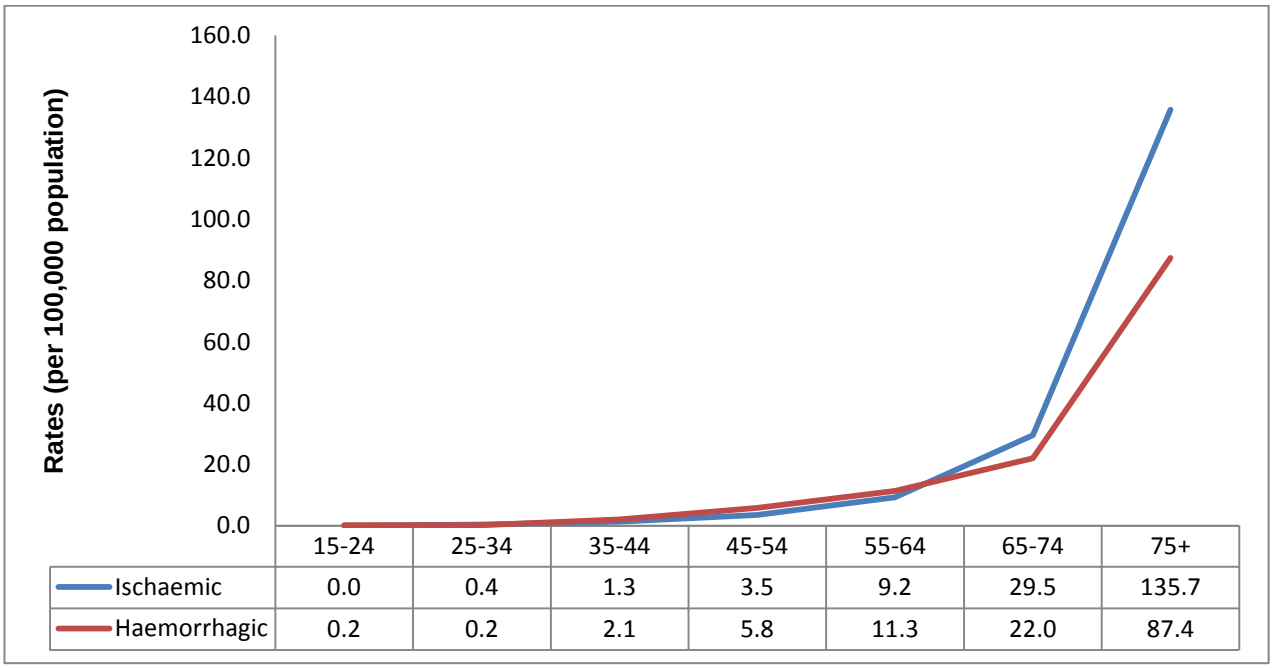
Gender	Race	Ischaemic		Haemorrhagic		Unknown		Total	
		CR	ASR 95% CI	CR	ASR 95% CI	CR	ASR 95% CI	CR	ASR 95% CI
Male	Chinese	4.0 (2.7-5.4)	3.2 (2.1-4.2)	5.9 (4.3-7.5)	5.0 (3.6-6.4)	0.1 (0.0-0.3)	0.1 (0.0-0.3)	10.0 (7.9-12.1)	8.3 (6.5-10.0)
	Malay	10.8 (5.3-16.2)	10.2 (4.9-15.5)	8.6 (3.7-13.5)	7.7 (3.2-12.2)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	19.4 (12.1-26.7)	17.9 (11.0-24.8)
	Indian	1.8 (0.0-4.2)	2.0 (0.0-4.8)	2.7 (0.0-5.7)	2.7 (0.0-5.8)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	4.4 (0.5-8.3)	4.7 (0.5-8.9)
	Others	0.0 (0.0-0.0)	0.0 (0.0-0.0)	5.2 (0.0-12.4)	6.2 (0.0-15.2)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	5.2 (0.0-12.4)	6.2 (0.0-15.2)
	Subtotal	4.5 (3.2-5.7)	3.7 (2.7-4.8)	5.9 (4.5-7.3)	5.1 (3.8-6.3)	0.1 (0.0-0.3)	0.1 (0.0-0.2)	10.4 (8.6-12.3)	8.9 (7.3-10.5)
Gender	**Race**	**Ischaemic**		**Haemorrhagic**		**Unknown**		**Total**	
		CR	**ASR 95% CI**	**CR**	**ASR 95% CI**	**CR**	**ASR 95% CI**	**CR**	**ASR 95% CI**
Female	Chinese	2.2 (1.3-3.2)	1.9 (1.1-2.8)	2.7 (1.6-3.8)	2.2 (1.3-3.2)	0.1 (0.0-0.3)	0.1 (0.0-0.3)	5.0 (3.6-6.5)	4.3 (3.0-5.5)
	Malay	4.9 (1.3-8.5)	4.4 (1.1-7.7)	9.8 (4.6-14.9)	9.4 (4.4-14.3)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	14.6 (8.4-20.9)	13.8 (7.8-19.8)
	Indian	1.0 (0.0-2.9)	0.9 (0.0-2.7)	2.0 (0.0-4.7)	2.3 (0.0-5.4)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	3.0 (0.0-6.3)	3.2 (0.0-6.8)
	Others	2.3 (0.0-6.9)	2.6 (0.0-7.8)	4.7 (0.0-11.1)	7.9 (0.0-19.9)	0.0 (0.0-0.0)	0.0 (0.0-0.0)	7.0 (0.0-14.9)	10.5 (0.0-23.7)
	Subtotal	2.5 (1.6-3.3)	2.2 (1.4-3.0)	3.6 (2.5-4.6)	3.1 (2.2-4.1)	0.1 (0.0-0.3)	0.1 (0.0-0.2)	6.1 (4.7-7.5)	5.4 (4.1-6.6)
Grand Total								8.2 (7.1-9.4)	7.1 (6.1-8.1)

TABLE 4.3.4: Age-Specific Mortality Rates of Stroke among Singapore Residents Admitted to Public Hospitals by Race and Gender, 2014

Gender	Race	Age Group						
		15-	25-	35-	45-	55-	65-	≥ 75
Male	Chinese	0.0	0.5	4.6	10.4	24.1	56.8	213.1
	Malay	0.0	2.5	10.0	12.2	62.2	128.1	292.9
	Indian	0.0	0.0	2.6	6.7	11.0	40.7	195.1
	Others	0.0	0.0	0.0	8.8	18.6	94.6	200.6
	Subtotal	0.0	0.7	4.7	10.3	27.4	62.6	219.0
Gender	**Race**	**Age Group**						
		15-	**25-**	**35-**	**45-**	**55-**	**65-**	**≥ 75**
Female	Chinese	0.6	0.0	1.7	8.1	10.5	38.2	226.8
	Malay	0.0	2.6	9.3	11.9	39.6	70.0	337.3
	Indian	0.0	0.0	0.0	4.1	11.6	24.4	121.2
	Others	0.0	0.0	0.0	19.2	24.5	195.4	712.0
	Subtotal	0.4	0.3	2.2	8.7	14.2	42.1	237.2
Grand Total		0.2	0.5	3.4	9.5	20.8	51.9	229.8

There were more elderly amongst ischaemic stroke patients who died, compared with haemorrhagic stroke patients who died **(Figure 4.3.1)**.

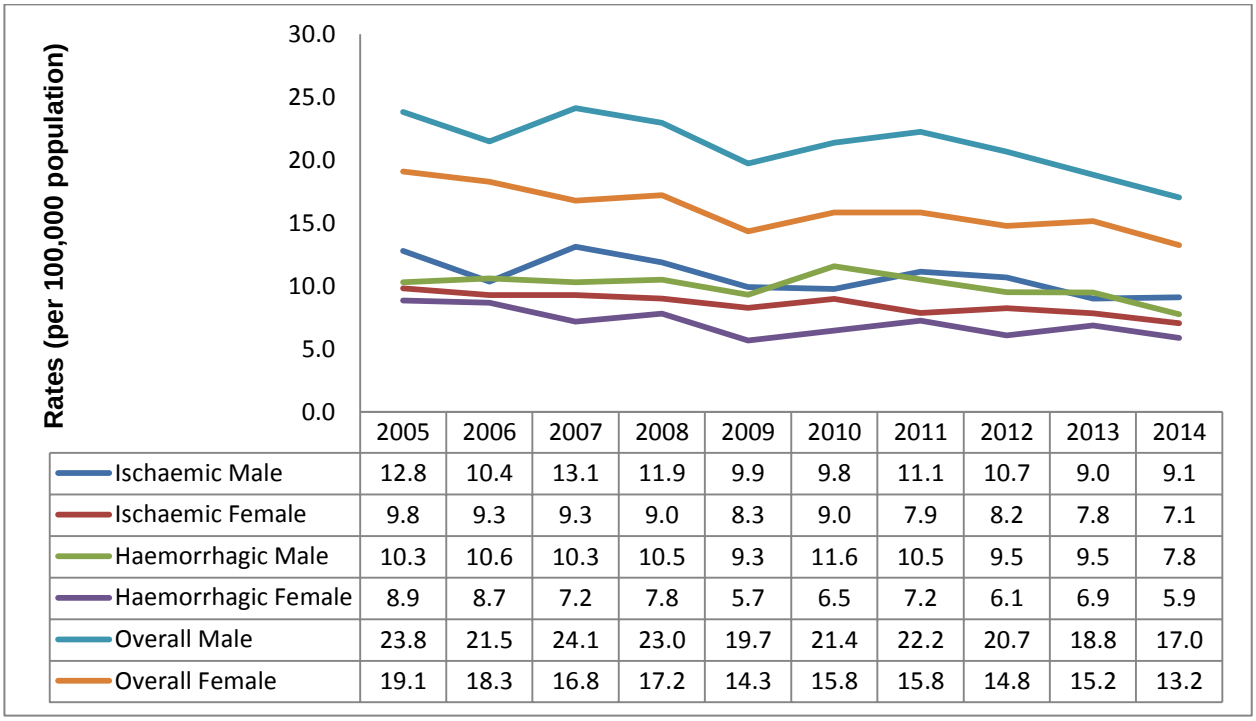
FIGURE 4.3.1: Age-Specific Mortality Rates of Stroke among Singapore Residents Admitted to Public Hospitals by Etiology, 2014



4.4 Mortality Trends from Stroke during Hospitalisation, 2005-2014

For all patients aged 15 years and above, the age-standardised mortality rates for ischaemic and haemorrahgic strokes in both genders were stable with little variation from 2005 to 2012, but the rate decreased to 7.1 among female ischaemic in 2014 and the rates decreased among both males and females for haemorrhagic in 2014 **(Figure 4.4.1).** The rate decreased significantly among females in those aged 15 years and above from 2005 to 2014, with AAPC -3.25%, 95%CI (-4.69% to -1.78%) and p=0.001.

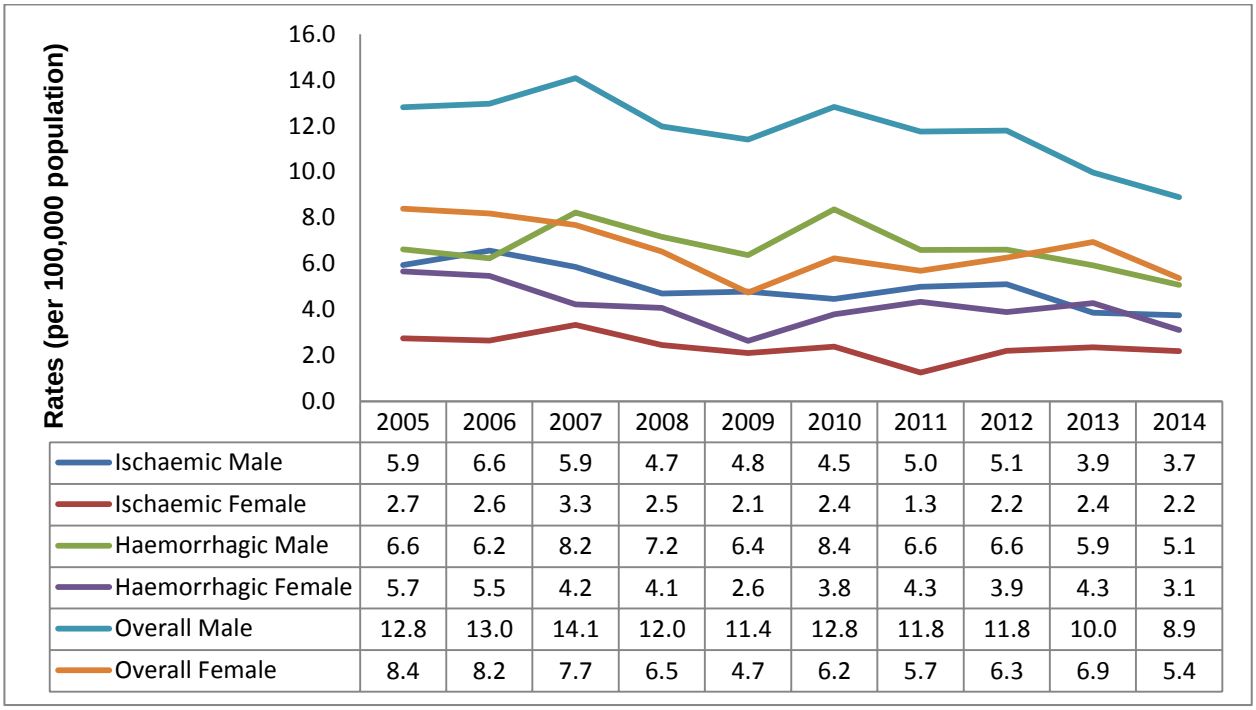
FIGURE 4.4.1: Age-Standardised Mortality Rate of Total (First-Ever and Recurrent) Stroke among Singapore Residents aged above 15 Years Admitted to Public Hospitals, 2005-2014



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Ischaemic Male	12.8	10.4	13.1	11.9	9.9	9.8	11.1	10.7	9.0	9.1
Ischaemic Female	9.8	9.3	9.3	9.0	8.3	9.0	7.9	8.2	7.8	7.1
Haemorrhagic Male	10.3	10.6	10.3	10.5	9.3	11.6	10.5	9.5	9.5	7.8
Haemorrhagic Female	8.9	8.7	7.2	7.8	5.7	6.5	7.2	6.1	6.9	5.9
Overall Male	23.8	21.5	24.1	23.0	19.7	21.4	22.2	20.7	18.8	17.0
Overall Female	19.1	18.3	16.8	17.2	14.3	15.8	15.8	14.8	15.2	13.2

For patients aged 25-64, there was no obvious downward or upward trend observed for haemorrhagic or ischaemic stroke among both females and males during 2005 to 2012, but the rates all dropped among males and females for ischaemic and haemorrhagic strokes in 2014 **(Figure 4.4.2)**.

FIGURE 4.4.2: Age-Standardised Mortality Rates of Total (First-Ever and Recurrent) Stroke among Singapore Residents aged 25-64 Years Admitted to Public Hospitals, 2005-2014

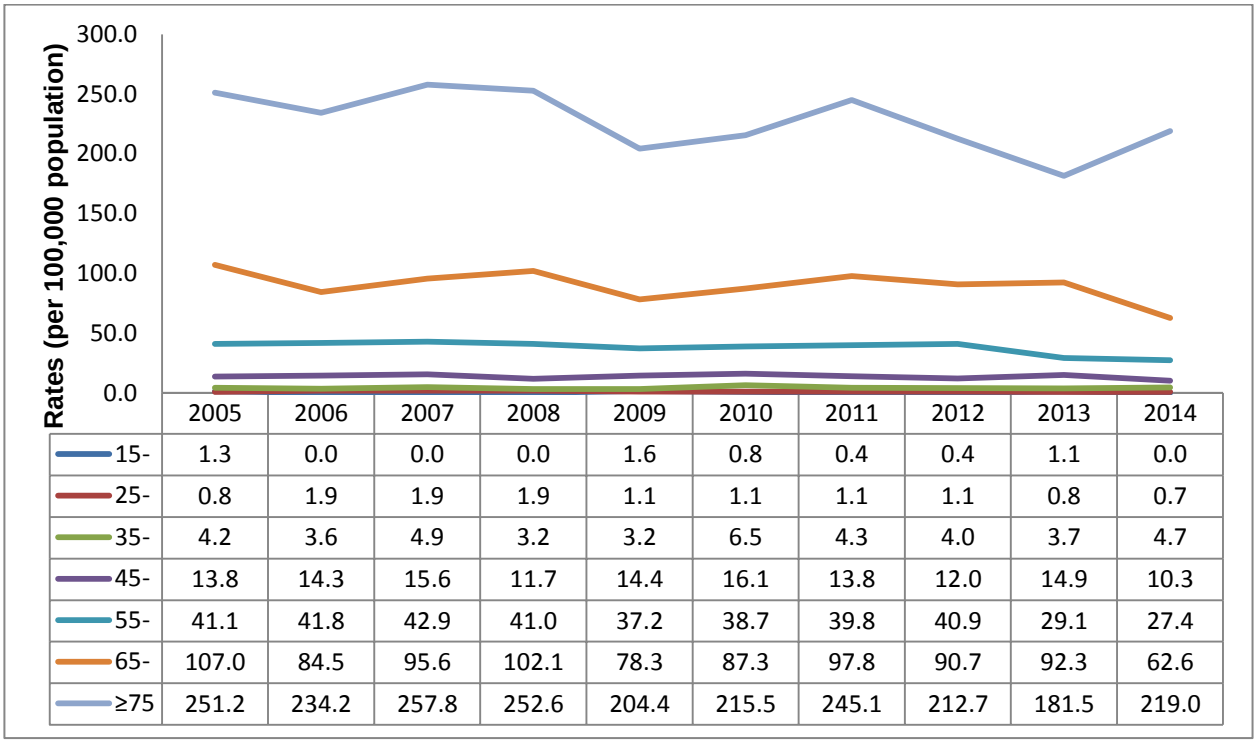


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Ischaemic Male	5.9	6.6	5.9	4.7	4.8	4.5	5.0	5.1	3.9	3.7
Ischaemic Female	2.7	2.6	3.3	2.5	2.1	2.4	1.3	2.2	2.4	2.2
Haemorrhagic Male	6.6	6.2	8.2	7.2	6.4	8.4	6.6	6.6	5.9	5.1
Haemorrhagic Female	5.7	5.5	4.2	4.1	2.6	3.8	4.3	3.9	4.3	3.1
Overall Male	12.8	13.0	14.1	12.0	11.4	12.8	11.8	11.8	10.0	8.9
Overall Female	8.4	8.2	7.7	6.5	4.7	6.2	5.7	6.3	6.9	5.4

As for the age-specific incidence rates, the age-specific mortality rates were highest among patients aged 75 years and older in the period 2005-2014 for both genders **(Figure 4.4.3)**.

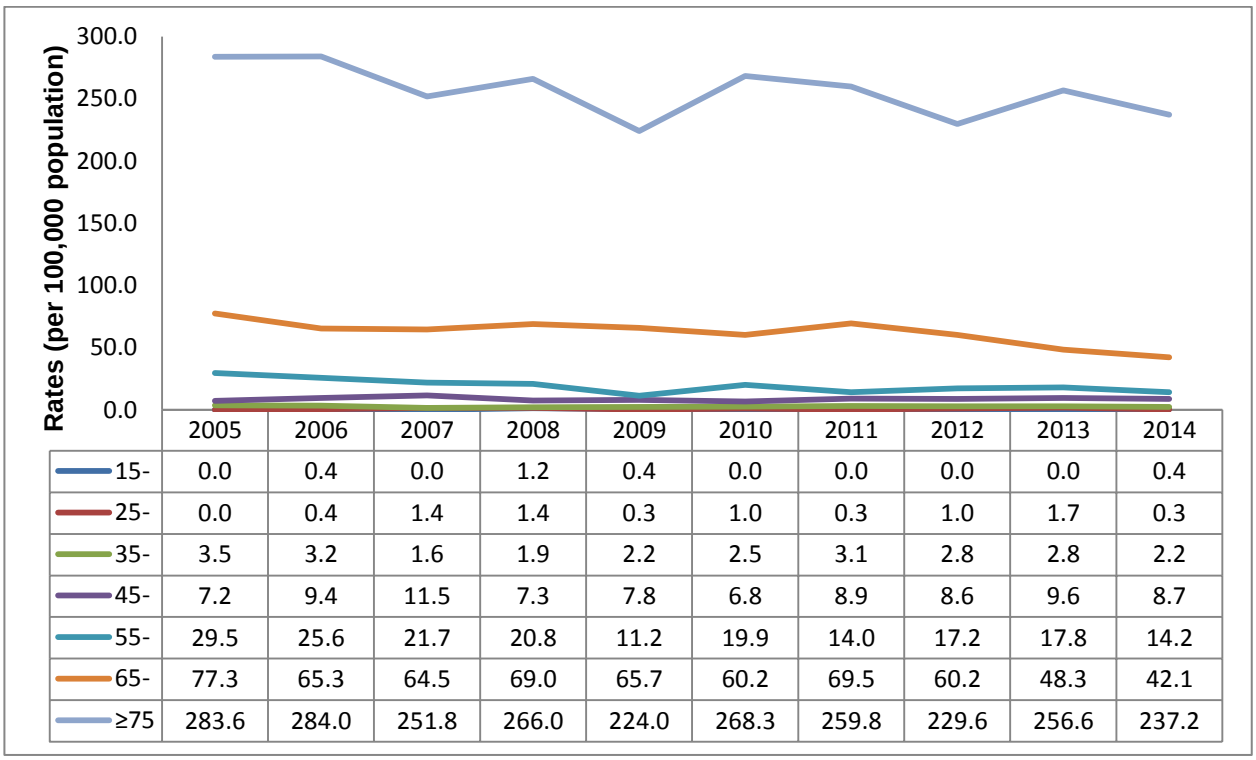
FIGURE 4.4.3: Age-Specific Mortality Rates of Stroke among Singapore Residents Admitted to Public Hospitals by Gender, 2005-2014

a) Males



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
15-	1.3	0.0	0.0	0.0	1.6	0.8	0.4	0.4	1.1	0.0
25-	0.8	1.9	1.9	1.9	1.1	1.1	1.1	1.1	0.8	0.7
35-	4.2	3.6	4.9	3.2	3.2	6.5	4.3	4.0	3.7	4.7
45-	13.8	14.3	15.6	11.7	14.4	16.1	13.8	12.0	14.9	10.3
55-	41.1	41.8	42.9	41.0	37.2	38.7	39.8	40.9	29.1	27.4
65-	107.0	84.5	95.6	102.1	78.3	87.3	97.8	90.7	92.3	62.6
≥75	251.2	234.2	257.8	252.6	204.4	215.5	245.1	212.7	181.5	219.0

b) Females



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
15-	0.0	0.4	0.0	1.2	0.4	0.0	0.0	0.0	0.0	0.4
25-	0.0	0.4	1.4	1.4	0.3	1.0	0.3	1.0	1.7	0.3
35-	3.5	3.2	1.6	1.9	2.2	2.5	3.1	2.8	2.8	2.2
45-	7.2	9.4	11.5	7.3	7.8	6.8	8.9	8.6	9.6	8.7
55-	29.5	25.6	21.7	20.8	11.2	19.9	14.0	17.2	17.8	14.2
65-	77.3	65.3	64.5	69.0	65.7	60.2	69.5	60.2	48.3	42.1
≥75	283.6	284.0	251.8	266.0	224.0	268.3	259.8	229.6	256.6	237.2

In-hospital mortality, adjusted for age, race, gender, medical histories, stroke pathway and blood sugar level, was estimated using logistic regression **(Table 4.4.1),** and the adjusted mortality rate was stable during 2005-2014. The adjusted mortality rate for ischaemic stroke was less than a third of that for haemorrhagic stroke.

TABLE 4.4.1: In-hospital Mortality by Stroke Subtype, 2014

		Incident Cases	Hospital Deaths	Crude Rate	Adjusted Rate†	95% CI
Ischaemic stroke	1st ever	4297	282	6.6	7.0	6.2 – 7.8
	Recurrent	1340	95	7.1	8.9	7.1 – 10.7
	Overall	5637	377	6.7	7.5	6.7 - 8.3
Haemorrhagic stroke	1st ever	1002	221	22.1	25.5	22.1 – 28.9
	Recurrent	285	88	30.9	32.8	25.9 – 39.6
	Overall	1287	309	24.0	27.2	24.2 – 30.2

† The rate has been adjusted by age, race, gender, medical histories, clinical pathway and blood sugar level.

4.5 Mortality after Stroke Onset, 2013 & 2014

The total number patients who had stroke episodes in the year 2013 who died from all causes was 1545. Of these, 30.2%, 50.3% and 64.9% of mortalities (cumulative) occurred at less than 7 days, 30 days and 90 days post-stroke, respectively. The corresponding proportions at 6 months and 12 months post-stroke were 75.6% and 88.6% respectively **(Table 4.5.1)**.

A total number of 783 stroke patients who had stroke in the year 2013 died due to stroke only. Of these, 50.5%, 74.2% and 86.3% of deaths (cumulative) occurred at less than 7 days, 30 days and 90 days post-stroke respectively. The corresponding proportions at 6 months and 12 months post-stroke were 92.0% and 97.6% respectively **(Table 4.5.1)**.

Up to the censor date, 12.0% of patients died due to stroke only and 23.6% died from all cause of death.

The 30-day case fatality rate for all 2014 stroke cases (regardless of place of occurrence) was 10.2%. Among males, 30-day case fatality rate was 5.3% for ischaemic stroke and 21.7% for haemorrhagic stroke. While among females, 30-day case fatality rate was 9.2% for ischaemic stroke and 26.1% for haemorrhagic stroke.

TABLE 4.5.1: Cumulative Frequencies of All Cause Mortalities and Stroke Mortalities at Various Time-periods after Stroke Onset, 2013

Time period after stroke onset	Cumulative frequency (%) of all cause mortalities	Cumulative frequency (%) of mortalities due to stroke
< 7 days	466 (30.16)	395 (50.45)
< 30 days	777 (50.29)	581 (74.20)
< 90 days	1003 (64.92)	676 (86.33)
6 months post stroke	1168 (75.60)	720 (91.95)
1 year post stroke	1369 (88.61)	764 (97.57)
Total no. of mortalities (as of 31 Dec 2014)	1545 (100.00)	783 (100.00)

The mortality rate within 7 days of admission was 17.3% for haemorrhagic stroke, and 40.9% for stroke of unknown subtype. For ischaemic stroke, there were minimal variations in mortality trends during the various time periods **(Figure 4.5.2)**.

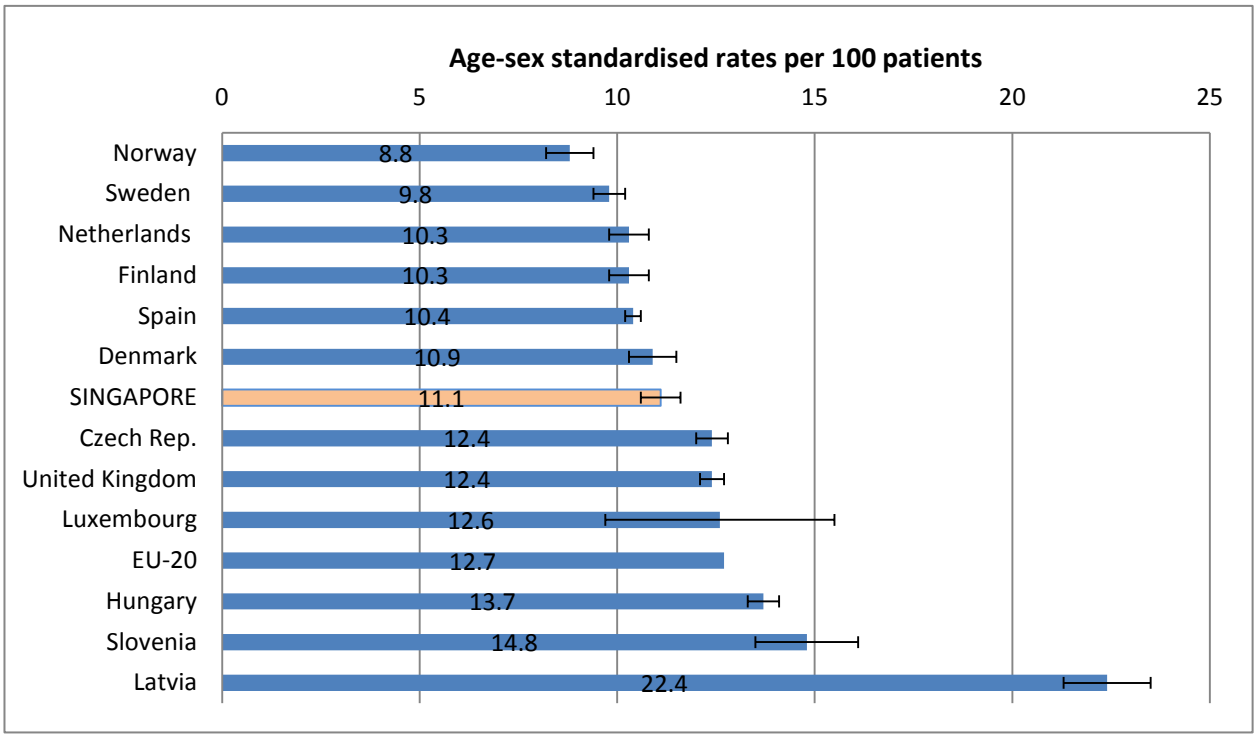
FIGURE 4.5.2: Proportion of Cases Died by Stroke Aetiology at Various Time Periods after admission, 2014

	0-6 days	7-29 days	30-89 days	>=90 days
Haemorrhagic	17.3	5.6	2.2	4.5
Ischaemic	3.1	3.7	3.2	5.6
Unknown	40.9	31.8	4.5	4.5

4.6 Age-sex standardised Case Fatality Rate in Comparison with OECD

In this report, we included age-sex standardised case-fatality rate for ischaemic stroke in adults aged 45 and above using 2011 data. The rate in Singapore was below OECD average **(Figure 4.6.1)**.

FIGURE 4.6.1: Case-fatality within 30 days after admission for ischemic stroke in adults aged 45 and over, 2011 (or nearest year)



4.7 Ethnic Differences in Risk Factors, 2014

Indian stroke patients had the highest proportion of risk factors **(Table 4.7.1)** compared to the other ethnicities. This is with the exception of atrial fibrillation and a history of hypertension.

TABLE 4.7.1: Proportion of Significant Risk Factors for Stroke Incidence in Ethnic Groups, 2014

Risk Factor	Chinese (%)	Malay (%)	Indian (%)	Others (%)
History of Diabetes Mellitus	32.7	45.8	54.0	37.7
Blood sugar>=10mmol/l on admission	24.9	36.1	37.2	25.9
History of Ischaemic Heart Disease	20.0	25.8	32.6	18.8
History of Smoking	34.0	41.5	44.3	30.6
History of Hyperlipidaemia	60.0	66.5	68.7	60.0
History of Atrial Fibrillation	13.9	12.0	8.3	14.1
History of Hypertension	76.1	80.6	77.9	70.6
History of Peripheral Vascular Diseases	2.48	3.44	5.11	3.53
History of TIA	4.63	3.07	5.96	3.53

Among the various risk factors for stroke, Malays and Indians were more likely than Chinese to have a history of diabetes, high blood glucose levels (≥ 10 mmol/l), ischaemic heart disease, hyperlipidemia, smoking and hypertension at the time of admission **(Table 4.7.2)**.

TABLE 4.7.2: Multivariable Analysis of Significant Risk Factors (logistic regression) for Stroke Incidence (adjusted for Age and Gender), 2014

Risk Factors	Race	OR	p	95% CI
History of Diabetes Mellitus:	Chinese	Reference Category		
	Malay	1.84*	<0.0001	1.61; 2.11
	Indian	2.56*	<0.0001	2.11; 3.10
	Others	1.33	0.2064	0.85; 2.08
Blood glucose = 10 mmol/l: (upon admission to hospital)	Chinese	Reference Category		
	Malay	1.65*	<0.0001	1.43; 1.89
	Indian	1.76*	<0.0001	1.44; 2.14
	Others	1.01	0.9600	0.62; 1.65
History of Ischaemic Heart Disease:	Chinese	Reference Category		
	Malay	1.68*	<0.0001	1.44; 1.97
	Indian	2.22*	<0.0001	1.79; 2.74
	Others	1.12*	0.6850	0.64; 1.96

History of Smoking:	Chinese	Reference Category		
	Malay	1.45*	<0.0001	1.24; 1.69
	Indian	1.31*	0.0157	1.05; 1.63
	Others	0.70	0.1817	0.42, 1.18
History of Hyperlipidaemia:	Chinese	Reference Category		
	Malay	1.54*	<0.0001	1.34; 1.78
	Indian	1.70*	<0.0001	1.38; 2.09
	Others	1.20	0.4218	0.77; 1.88
History of Atrial Fibrillation:	Chinese	Reference Category		
	Malay	1.08	0.4520	0.88; 1.33
	Indian	0.69*	0.0360	0.49; 0.98
	Others	1.37	0.3338	0.72; 2.60
History of Hypertension:	Chinese	Reference Category		
	Malay	1.58*	<0.0001	1.33; 1.87
	Indian	1.33*	0.0155	1.06; 1.69
	Others	0.95	0.8197	0.58; 1.54
History of Peripheral Vascular Diseases:	Chinese	Reference Category		
	Malay	1.43	0.0582	0.99; 2.08
	Indian	2.13*	0.0010	1.36; 3.32
	Others	1.47	0.5162	0.46; 4.72
History of TIA:	Chinese	Reference Category		
	Malay	0.67*	0.0309	0.46; 0.96
	Indian	1.34	0.1612	0.89; 2.00
	Others	0.77	0.6639	0.24; 2.47

4.8 Ischaemic Stroke Treatment, 2005-2014

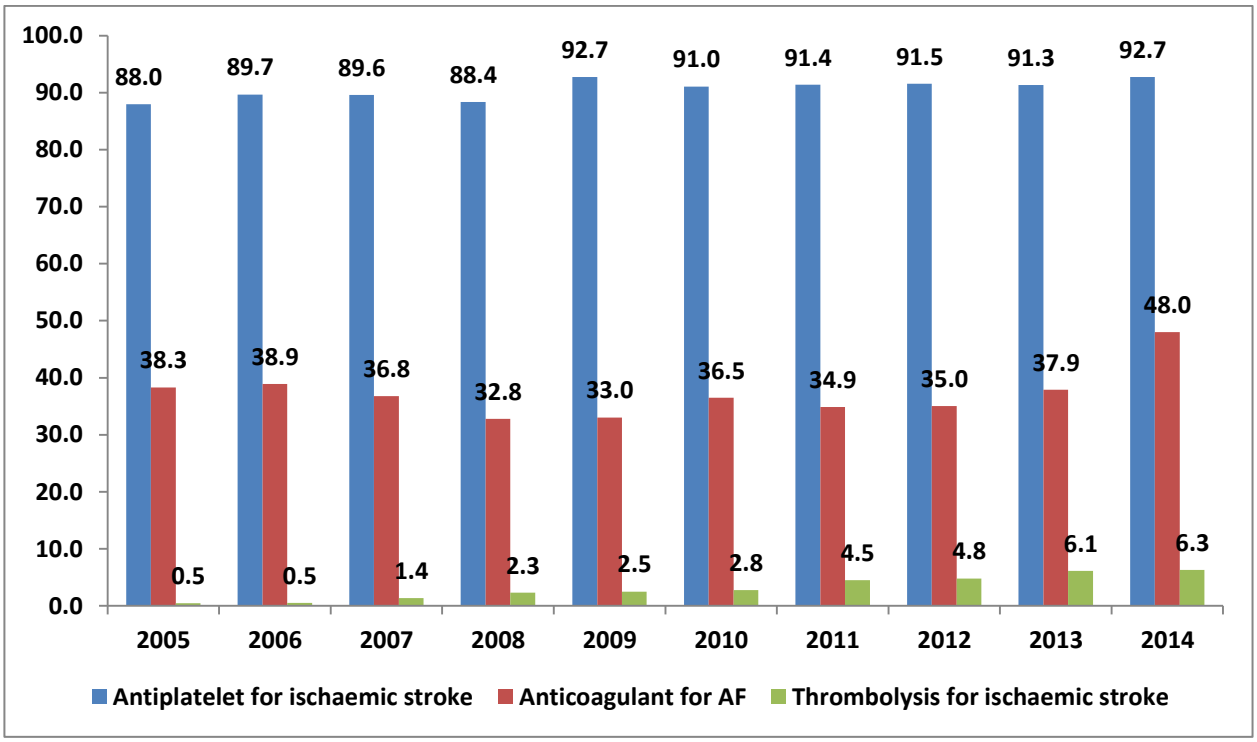
TABLE 4.8.1: Antiplatelet, Anticoagulant Treatment for Ischaemic Stroke, 2014

Ischaemic Stroke	1st ever stroke (%)	Recurrent stroke (%)	Overall (%)
Antiplatelet only	81.3	77.5	80.4
Anticoagulant only	2.0	5.0	2.7
Antiplatelet & Anticoagulant	12.8	12.3	12.7

Note: exclude those had contraindication

The percentage of patients with history of atrial fibrillation or patients with newly diagnosed atrial fibrillation who were given anticoagulants has remained stable from 2005 to 2013, but increased to 48% in 2014. The proportion of patients receiving thrombolysis treatment has increased from 0.5% in 2005 to 6.3% in 2014 **(Figure 4.8.1)**.

FIGURE 4.8.1: Antiplatelet, Anticoagulant, Thrombolysis Treatment for Ischaemic Stroke, 2005-2014



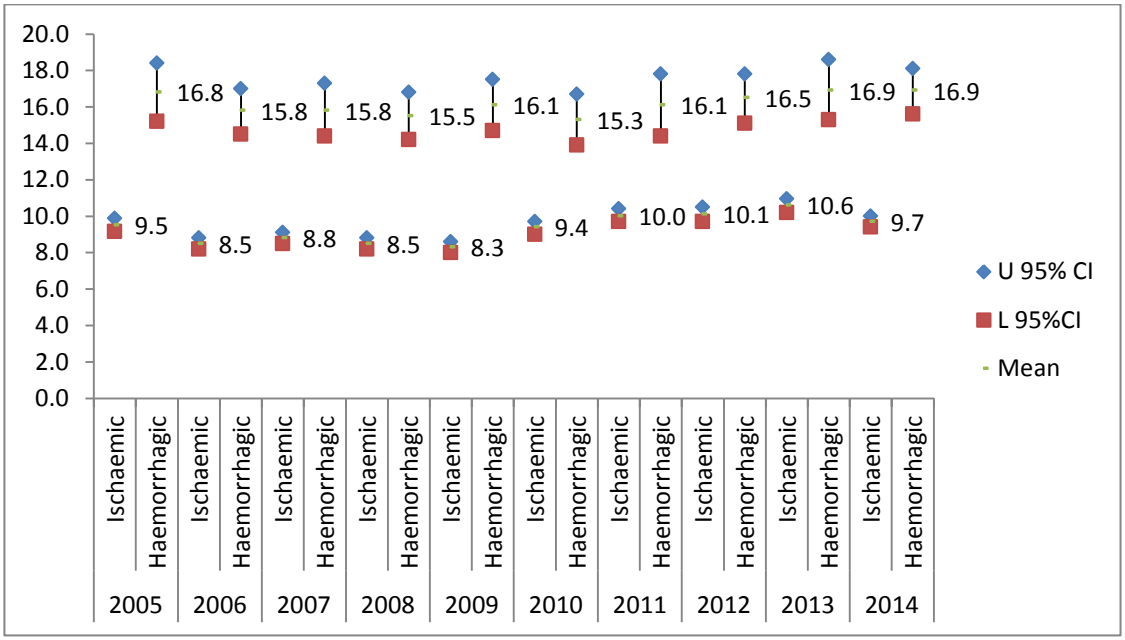
Note: exclude those had contraindication for Antiplatelet & Anticoagulant; More conditions as contraindication captured since July2014 for Anticoagulant

4.9 Length of Hospital Stay and Discharge Information, 2005-2014

The LOS among haemorrhagic stroke patients was about one week longer than that among ischaemic stroke patients **(Figure 4.9.1)**.

From the hospitals, 50.6% of stroke patients were discharged to their homes, 9.0% were transferred to community hospitals and 20.4% were sent for rehabilitation in acute hospitals, 3.1% to nursing homes, 0.1% to other hospitals for stroke management and 6.6% to other hospitals for management of disease conditions other than stroke. Stroke patients who were transferred from restructured hospitals to the rehabilitation unit residing in other hospitals were included in the category 'rehab in acute hospitals', such as from TTSH to Ang Mo Kio Community Hospital, SGH to Bright Vision Hospital, and NUH to West Point Hospital.

FIGURE 4.9.1: Length of Hospital Stay (days), Mean 95%CI, 2005-2014



4.10 Audit Parameters (Timing for Neuro-imaging, In-hospital Events), 2014

A total of 85.2% of the stroke patients had their CT brain scan done during hospitalisation.
76.5% had CT scans done within 24 hours of admission.
65.9% had undergone MRI brain scan during hospitalisation.
91.3% had CT or MRI brain scan done within 24 hours of their admission to the hospitals.

ECG was done in 97.9% of admissions.

66.4% of stroke episodes were managed using stroke care pathways during their hospitalisation.

16.2 % of stroke episodes had developed at least one inpatient event (complications) during their hospitalisation.

The common in-patient events (complications) developed during the hospitalisation were urinary tract infection (9.1%), pneumonia (6.4%), septicaemia (0.6%), deep vein thrombosis (0.6%), angina/acute myocardial infarction (2.0%), pulmonary embolism (0.2%) and recurrent stroke within 28 days (0.7%).