Singapore Stroke Registry
Annual Report 2018

National Registry of Diseases Office
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Acknowledgement

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1. GLOSSARY

AF	Atrial fibrillation/ flutter
ASIR	Age-standardised incidence rate
ASMR	Age-standardised mortality rate
ASU	Acute stroke unit
CFR	Case fatality rate
CI	Confidence interval
CIR	Crude incidence rate
CMR	Crude mortality rate
CT	Computed tomography
HS	Haemorrhagic stroke
ICD	International Classification of Diseases
IQR	Interquartile range
IS	Ischaemic stroke
LOS	Length of stay
MHA	Ministry of Home Affairs
MONICA	Monitoring Trends and Determinants in Cardiovascular Disease
MRI	Magnetic resonance imaging
NRIC	National Registration Identity Card
SCDF	Singapore Civil Defence Force
SSR	Singapore Stroke Registry

2. EXECUTIVE SUMMARY

The number of stroke episodes increased from 5,760 episodes in 2009 to 8,326 episodes in 2018. The age-standardised incidence rate (ASIR) remained stable, ranging between 156.3 and 162.3 per 100,000 population in the past decade.

The number of stroke deaths fluctuated, ranging between 630 and 844 in 2009 to 2018. The age-standardised mortality rate (ASMR) declined significantly from 17.3 per 100,000 population in 2009 to 12.6 per 100,000 population in 2018. The number of stroke deaths within 30 days from onset fluctuated, ranging between 481 and 638 in the decade from 2009 to 2018. The 30-day case fatality rate (CFR) decreased significantly from 8.4% in 2009 to 6.4% in 2018.

Hypertension and hyperlipidemia were consistently the two most common risk factors among stroke patients across the years. More than four-fifths of the patients had hypertension (82.4%) and hyperlipidemia (83.7%) in 2018. The proportions of patients with hypertension and hyperlipidemia had remained at these levels over the years.

3. INTRODUCTION

Cerebrovascular disease was the fourth most common cause of death in 2018, accounting for 6.0% of all deaths in Singapore[1]. Stroke is a type of cerebrovascular disease.

There are two main types of stroke – ischaemic stroke (IS) and haemorrhage stroke (HS). IS is more prevalent and it occurred due to blockage of blood vessel limiting blood flow to the brain. HS is more severe and it occurred due to rupture of blood vessel causing bleeding in the brain. IS is usually treated with blood thinning drug such as anti-platelet and anti-coagulant, while HS is usually treated with surgery or endovascular therapy.

Common risk factors of stroke are hypertension, hyperlipidemia, diabetes, atrial fibrillation/flutter (AF), smoking and old age. Singapore's population is rapidly ageing. The old-age support ratio dropped from 7.5 people aged 20 to 64 years per person aged 65 years and above in 2009 to 4.8 in 2018[2]. With a rapidly ageing population, we can expect the incidence of stroke to rise. In order to mitigate the impact of stroke, preventive measures that reduce cerebrovascular risk, as well as post-stroke interventions that improve prognosis and reduce recurrence risk, are essential.

[1] Principal Causes of Death. Ministry of Health, Singapore; 2019.
[2] SingStat Population Trends. Department of Statistics, Singapore; 2019.

4. METHODOLOGY

The National Registry of Diseases Office collects and analyses epidemiological data to support policy and programme planning and evaluation.

The Singapore Stroke Registry (SSR) was set up in 2002 as a joint effort championed by representatives from all public healthcare institutions. Data collection started with contribution from Tan Tock Seng Hospital and Singapore General Hospital. Data was subsequently received from all public healthcare institutions by 2005.

Data sources

The SSR receives stroke case notifications from

1. All public healthcare institutions via the Hospital In-patient Discharge Summary,
2. Ministry of Health via the Mediclaims list, and
3. Death Registry of the Ministry of Home Affairs (MHA) via the death list.

The International Classification of Diseases 9th Revision (ICD-9) Clinical Modification codes 430 to 437 (excluding 432.1 and 435) were used to identify stroke cases in the data sources prior to 2012, while the ICD-10 Australian Modification codes I60 to I68 (excluding I62.0 and I62.1) were used for stroke cases diagnosed from 2012 onwards. A master patient list was created by merging data from these sources using the patients' unique National Registration Identification Card (NRIC) number.

The registry coordinators confirmed the diagnosis of stroke by viewing the patients' medical records, before extracting relevant detailed clinical information from the medical records. All cases collected by the SSR were diagnosed as stroke by a certified doctor, with clinical signs of disturbance of cerebral function lasting more than 24 hours and with no apparent cause other than a vascular origin.

The MONICA (Monitoring Trends and Determinants in Cardiovascular Disease) criterion was used for episode management, whereby a recurring stroke after 28 days of a preceding episode will be counted as another episode[3].

The death status of all patients registered in the SSR were updated till 30 September 2019 by matching the patients' NRIC number with the death information from the MHA.

[3] Thorvaldsen P et al. Stroke trends in the MONICA project. Stroke 1997; 28(3): 500-506.

Population estimate

The Singapore population estimates, used to calculate the incidence rates and mortality rates in this report, were obtained from the Singapore Department of Statistics which releases mid-year population estimates of Singapore residents (i.e. Singapore citizens and permanent residents) annually[4]. The Segi World population estimates used for age standardisation are available on the World Health Organisation website[5].

Incidence rate

The incidence rate in each year was calculated by taking the number of stroke episodes that occurred in a year, divided by the number of Singapore residents in the same year. The count was based on the onset date of each stroke episode. Patients were categorised into 5-year age groups and age standardisation was done using the direct method with the Segi World population as the standardisation weights.

Mortality rate

The mortality rate in each year was calculated by taking the number of deaths with stroke as the primary cause of death occurring in a year, divided by the number of Singapore residents in the same year. The count was based on the death date of each stroke patient. Patients were categorised into 5-year age groups and age standardisation was done using the direct method with the Segi World population as the standardisation weights.

Case fatality rate

The case fatality rate in each year was calculated by taking the number of deaths with stroke as the primary cause of death that occurred within 30 days from onset of stroke, regardless of whether the death occurred within or outside hospital in a year, divided by the number of stroke episodes in the same year. The count was based on the onset date of each stroke patient. This indicator reflects the severity of stroke, the timeliness of healthcare delivery and the effectiveness of stroke treatment.

This report focuses on Singapore residents, aged 15 years and above, diagnosed with stroke and treated in public healthcare institutions in the past decade, from 2009 to 2018 as they stood on 18 February 2020. All findings in this report, except mortality and case fatality, were based on episodes. The registry started capturing onset date and time in 2014, but these information were often not available as the initial symptoms of stroke might be subtle. Hence, hospital arrival date and time were used as proxy in this report if the onset date and time were not available.

[4] SingStat Table Builder, Population and Population Structure, Annual Population, Singapore Residents by age group, ethnic group and sex. Department of Statistics, Singapore.
[5] Omar BA et al. Age standardization of rates: a new WHO standard. GPE discussion paper series: no. 31. EIP.GPE/EBD World Health Organization 2001.

5. FINDINGS

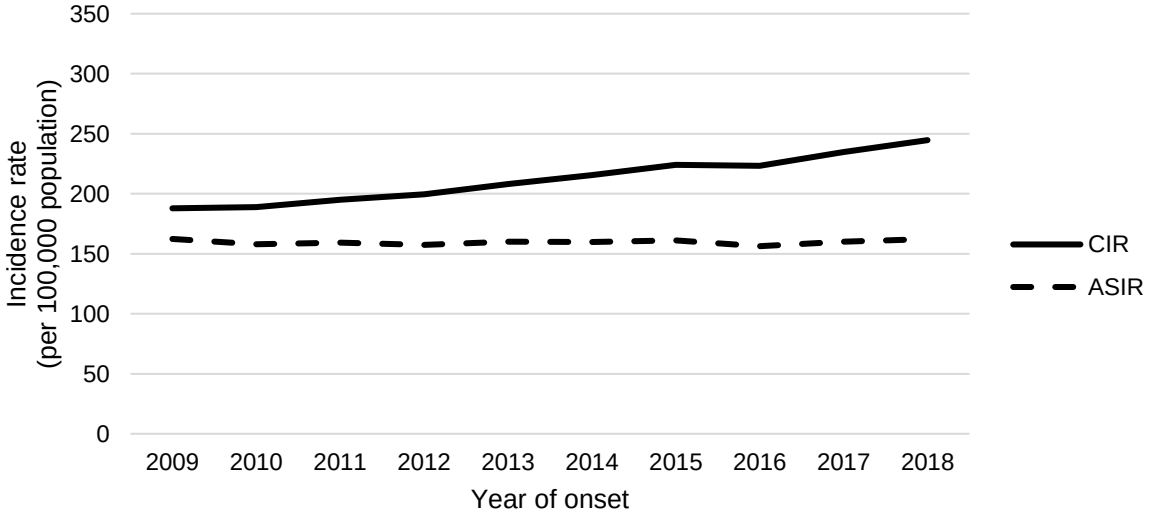
5.1 Incidence

The number of stroke episodes increased from 5,760 episodes in 2009 to 8,326 episodes in 2018 (Table 5.1.1). The crude incidence rate (CIR) increased significantly from 187.9 per 100,000 population in 2009 to 244.7 per 100,000 population in 2018 (p<0.001) (Figure 5.1.1). However, when Singapore's ageing population was taken into consideration, the ASIR remained stable, ranging between 156.3 and 162.3 per 100,000 population in the past decade.

Table 5.1.1: Incidence number and rate of stroke (per 100,000 population)

Year of onset	Number	CIR	95% CI	ASIR	95% CI
2009	5760	187.9	183.0-192.7	162.3	158.1-166.6
2010	5890	188.9	184.1-193.8	158.0	153.9-162.1
2011	6143	194.9	190.0-199.7	159.2	155.1-163.2
2012	6367	199.5	194.6-204.4	157.5	153.6-161.4
2013	6720	208.1	203.1-213.1	160.2	156.3-164.1
2014	7029	215.4	210.4-220.5	159.8	156.0-163.6
2015	7399	224.2	219.1-229.3	161.1	157.4-164.9
2016	7456	223.4	218.3-228.5	156.3	152.7-159.9
2017	7917	234.8	229.7-240.0	160.2	156.5-163.8
2018	8326	244.7	239.4-249.9	162.1	158.5-165.7
P for trend	-	<0.001	-	0.808	-

Figure 5.1.1: Incidence rate of stroke (per 100,000 population)



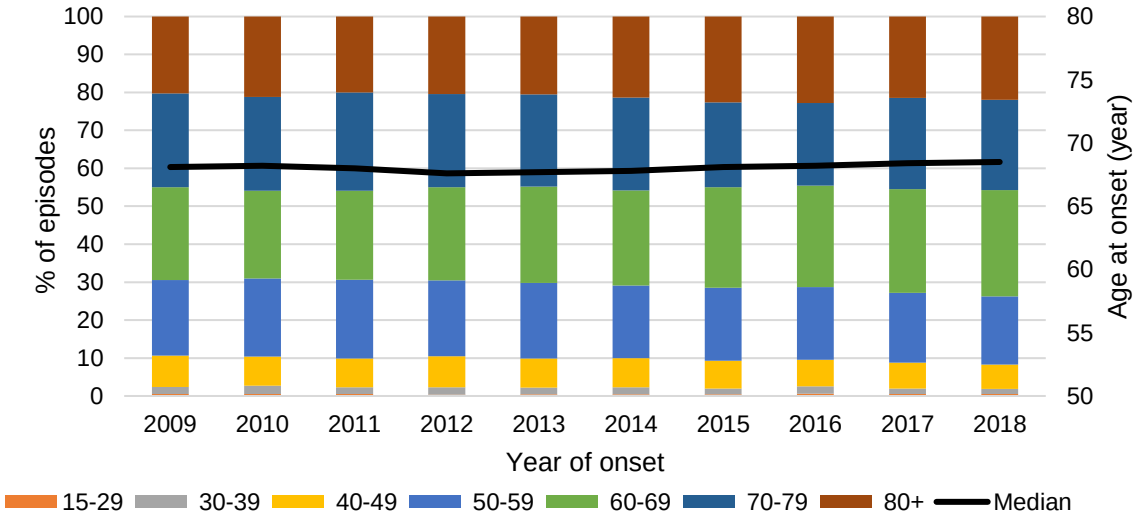
The median age at onset of stroke ranged from 67.6 to 68.5 years in the past decade (Table 5.1.2). About 3 in 4 of the patients were aged 60 years and above in 2018 (Figure 5.1.2).

Table 5.1.2: Age distribution at onset of stroke

Year of onset	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2009	68.1	31	0.5	106	1.8	475	8.2
2010	68.2	30	0.5	129	2.2	455	7.7
2011	68.0	34	0.6	109	1.8	463	7.5
2012	67.6	24	0.4	123	1.9	518	8.1
2013	67.7	30	0.4	117	1.7	518	7.7
2014	67.8	31	0.4	128	1.8	542	7.7
2015	68.1	32	0.4	112	1.5	542	7.3
2016	68.2	42	0.6	149	2.0	521	7.0
2017	68.4	41	0.5	116	1.5	539	6.8
2018	68.5	41	0.5	117	1.4	530	6.4

Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2009	1150	20.0	1405	24.4	1426	24.8	1167	20.3
2010	1208	20.5	1362	23.1	1457	24.7	1249	21.2
2011	1274	20.7	1445	23.5	1589	25.9	1229	20.0
2012	1273	20.0	1567	24.6	1560	24.5	1302	20.4
2013	1338	19.9	1706	25.4	1631	24.3	1380	20.5
2014	1346	19.1	1761	25.1	1719	24.5	1502	21.4
2015	1426	19.3	1957	26.4	1653	22.3	1677	22.7
2016	1428	19.2	1991	26.7	1623	21.8	1702	22.8
2017	1457	18.4	2161	27.3	1903	24.0	1700	21.5
2018	1501	18.0	2327	27.9	1981	23.8	1829	22.0

Figure 5.1.2: Age distribution at onset of stroke



The age-specific incidence rate increased with age, with the oldest age group having the highest incidence rate (Figure 5.1.3a). Over the past decade, significant rise in incidence rates were observed for the 15-29 years, 40-49 years, and 50-59 years age groups (Table 5.1.3). However, significant drop in incidence rate was observed among those aged 70-79 years (Figure 5.1.3b).

Table 5.1.3: Age-specific incidence rate of stroke (per 100,000 population)

Year of onset	Overall		Age 15-29		Age 30-39		Age 40-49	
	CIR	95% CI	CIR	95% CI	CIR	95% CI	CIR	95% CI
2009	187.9	183.0-192.7	4.0	2.6-5.4	17.2	14.0-20.5	74.7	68.0-81.5
2010	188.9	184.1-193.8	3.8	2.5-5.2	20.8	17.3-24.4	71.9	65.3-78.5
2011	194.9	190.0-199.7	4.4	2.9-5.8	17.8	14.4-21.1	73.4	66.7-80.1
2012	199.5	194.6-204.4	3.1	1.9-4.3	20.2	16.6-23.8	82.3	75.2-89.3
2013	208.1	203.1-213.1	3.9	2.5-5.2	19.4	15.9-22.9	82.4	75.3-89.5
2014	215.4	210.4-220.5	4.0	2.6-5.4	21.5	17.8-25.3	86.8	79.5-94.1
2015	224.2	219.1-229.3	4.1	2.7-5.5	18.9	15.4-22.4	87.4	80.0-94.8
2016	223.4	218.3-228.5	5.4	3.8-7.0	25.4	21.3-29.4	84.8	77.5-92.0
2017	234.8	229.7-240.0	5.2	3.6-6.8	20.0	16.4-23.6	87.7	80.3-95.1
2018	244.7	239.4-249.9	5.3	3.7-6.9	20.0	16.4-23.6	86.7	79.3-94.1
P for trend	<0.001	-	0.026	-	0.170	-	0.001	-
Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	CIR	95% CI	CIR	95% CI	CIR	95% CI	CIR	95% CI
2009	214.0	201.7-226.4	491.3	465.6-516.9	957.7	908.0-1007.4	1798.2	1695.0-1901.3
2010	218.9	206.6-231.3	448.8	424.9-472.6	923.3	875.9-970.8	1808.0	1707.8-1908.3
2011	224.0	211.7-236.3	450.7	427.5-474.0	952.1	905.3-998.9	1676.7	1582.9-1770.4
2012	218.7	206.6-230.7	457.0	434.4-479.6	906.4	861.5-951.4	1675.7	1584.7-1766.7
2013	225.2	213.1-237.3	463.7	441.7-485.7	924.1	879.2-968.9	1678.8	1590.3-1767.4
2014	222.9	211.0-234.8	448.4	427.5-469.4	938.8	894.4-983.2	1720.6	1633.6-1807.6
2015	233.7	221.6-245.8	462.7	442.2-483.2	899.1	855.8-942.5	1794.6	1708.7-1880.5
2016	232.1	220.1-244.2	442.6	423.1-462.0	846.4	805.2-887.6	1740.3	1657.6-1823.0
2017	237.1	224.9-249.3	463.1	443.6-482.6	900.0	859.6-940.4	1678.6	1598.8-1758.4
2018	244.7	232.3-257.1	481.0	461.5-500.5	865.5	827.4-903.7	1711.3	1632.8-1789.7
P for trend	<0.001	-	0.929	-	0.008	-	0.362	-

Figure 5.1.3a: Age-specific incidence rate of stroke (per 100,000 population) across age groups

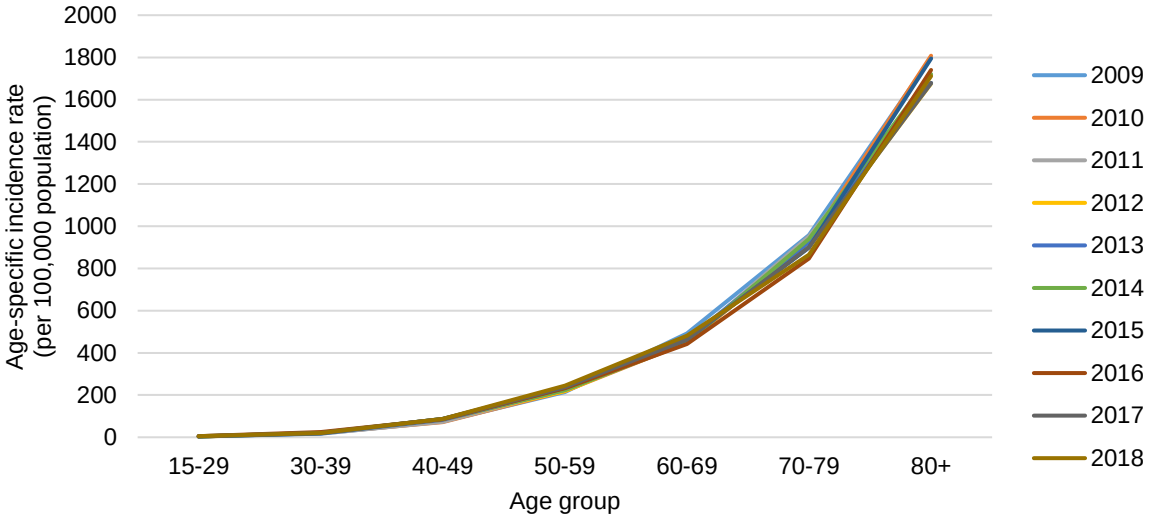
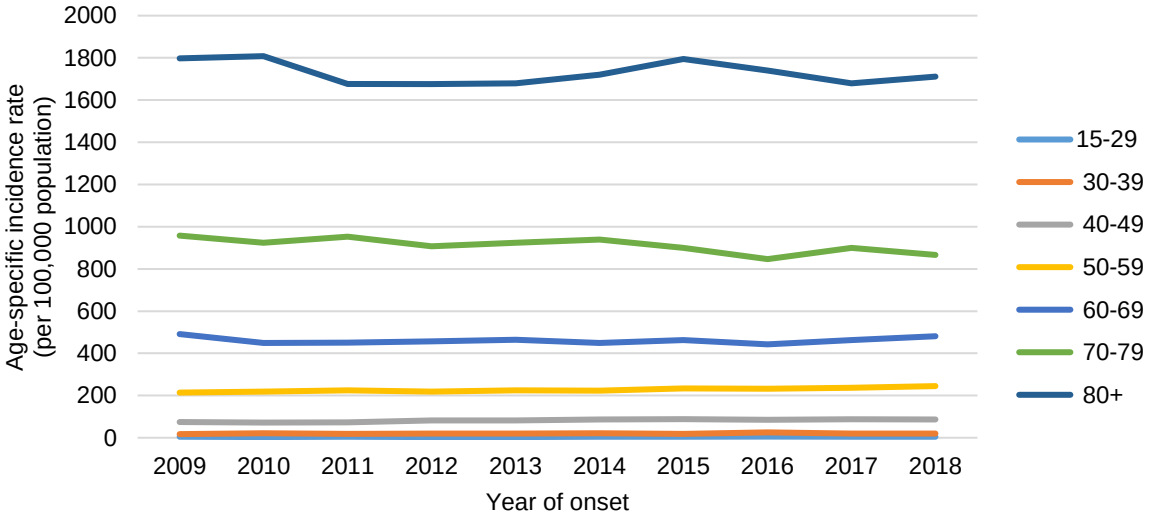


Figure 5.1.3b: Age-specific incidence rate of stroke (per 100,000 population) across years



Although the gender distribution was almost equal in the general population, there were more males suffering from stroke than females (Table 5.1.4). The ASIR for males was consistently higher than females across the years (Figure 5.1.4). Males had an ASIR of 211.7 per 100,000 population, while females had an ASIR of 114.5 per 100,000 population in 2018. A significant upward trend in ASIR among males was observed over the years (p=0.004). In contrast, a significant drop in ASIR was seen for females over the years (p=0.001).

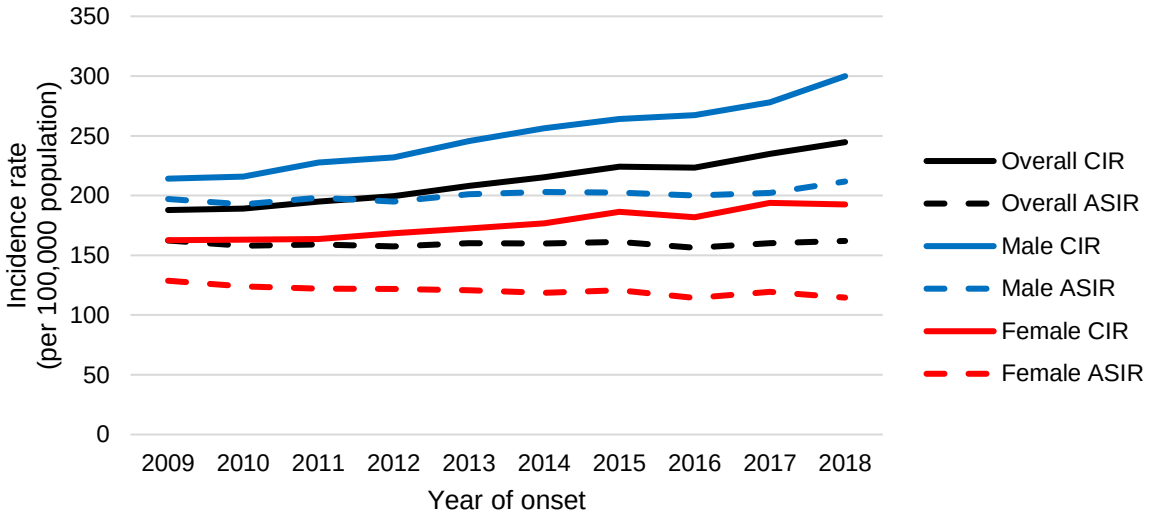
Males were known to have higher risk of stroke compared to females. The underlying causes were multifactorial and related to the pathophysiological gender differences in stroke[6]. Furthermore, the prevalence of hypertension, hyperlipidemia, diabetes and smoking were higher among males than females in the general population as shown in the National Population Health Survey 2017[7].

Table 5.1.4: Incidence number and rate of stroke (per 100,000 population) by gender

Male						
Year of onset	**Number**	**%**	**CIR**	**95% CI**	**ASIR**	**95% CI**
2009	3218	55.9	214.1	206.7-221.5	197.1	190.2-204.0
2010	3296	56.0	215.9	208.5-223.3	192.6	185.9-199.3
2011	3510	57.1	227.5	220.0-235.1	198.1	191.4-204.8
2012	3618	56.8	231.8	224.3-239.4	194.9	188.5-201.3
2013	3872	57.6	245.5	237.7-253.2	201.1	194.7-207.5
2014	4079	58.0	256.2	248.3-264.0	203.0	196.7-209.2
2015	4249	57.4	264.0	256.1-271.9	202.5	196.4-208.7
2016	4346	58.3	267.3	259.4-275.3	200.1	194.1-206.2
2017	4562	57.6	278.1	270.0-286.1	202.2	196.2-208.1
2018	4961	59.6	299.9	291.5-308.2	211.7	205.8-217.7
P for trend	-	-	<0.001	-	0.004	-
Female						
Year of onset	**Number**	**%**	**CIR**	**95% CI**	**ASIR**	**95% CI**
2009	2542	44.1	162.6	156.3-168.9	128.7	123.5-133.8
2010	2594	44.0	163.1	156.8-169.4	124.0	119.0-128.9
2011	2633	42.9	163.6	157.3-169.8	122.0	117.1-126.8
2012	2749	43.2	168.5	162.2-174.8	121.7	117.0-126.5
2013	2848	42.4	172.4	166.0-178.7	120.8	116.2-125.4
2014	2950	42.0	176.6	170.2-183.0	118.5	114.0-122.9
2015	3150	42.6	186.3	179.8-192.8	120.8	116.4-125.2
2016	3110	41.7	181.7	175.3-188.1	114.3	110.1-118.5
2017	3355	42.4	193.9	187.3-200.4	119.5	115.2-123.7
2018	3365	40.4	192.4	185.9-198.9	114.5	110.5-118.6
P for trend	-	-	<0.001	-	0.001	-

[6] Reeves MJ et al. Sex differences in stroke: epidemiology, clinical presentation, medical care, and outcomes. Lancet Neurology 2008; 7(10): 915-926.
[7] National Population Health Survey 2017. Ministry of Health, Singapore.

Figure 5.1.4: Incidence rate of stroke (per 100,000 population) by gender



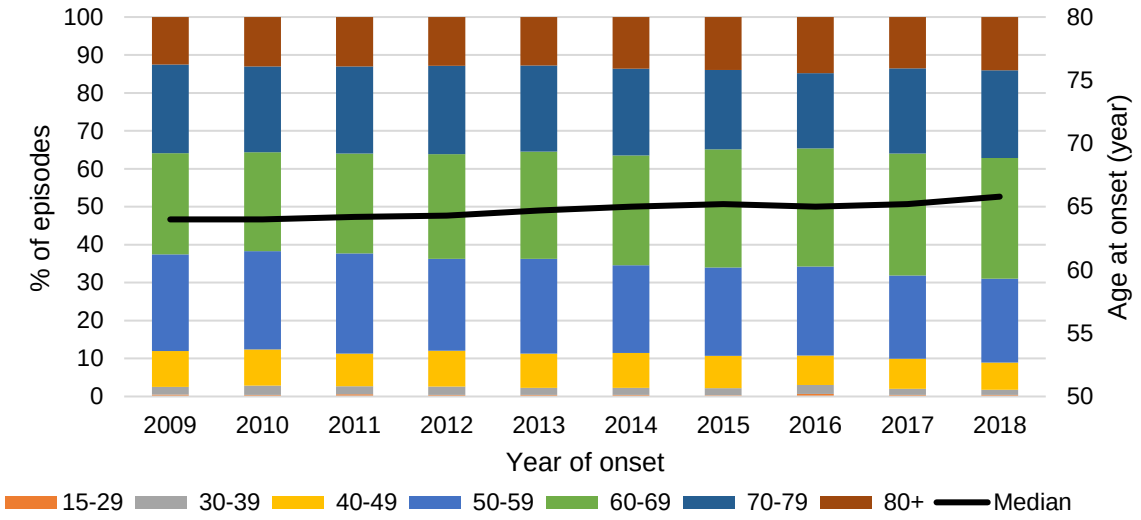
The median age at onset of stroke among males increased from 64.0 years in 2009 to 65.8 years in 2018 (Table 5.1.5a). The highest proportion of stroke episodes was found among males aged 60-69 years (31.8%) in 2018 (Figure 5.1.5a).

Table 5.1.5a: Age distribution at onset of stroke among males

Year of onset	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2009	64.0	17	0.5	64	2.0	304	9.4
2010	64.0	15	0.5	79	2.4	316	9.6
2011	64.2	20	0.6	75	2.1	301	8.6
2012	64.3	14	0.4	80	2.2	344	9.5
2013	64.7	16	0.4	72	1.9	349	9.0
2014	65.0	18	0.4	76	1.9	375	9.2
2015	65.2	15	0.4	77	1.8	362	8.5
2016	65.0	28	0.6	105	2.4	338	7.8
2017	65.2	19	0.4	74	1.6	361	7.9
2018	65.8	21	0.4	66	1.3	358	7.2

Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2009	820	25.5	857	26.6	754	23.4	402	12.5
2010	853	25.9	859	26.1	744	22.6	430	13.0
2011	929	26.5	923	26.3	806	23.0	456	13.0
2012	875	24.2	997	27.6	842	23.3	466	12.9
2013	969	25.0	1094	28.3	878	22.7	494	12.8
2014	942	23.1	1181	29.0	933	22.9	554	13.6
2015	989	23.3	1323	31.1	890	20.9	593	14.0
2016	1018	23.4	1352	31.1	861	19.8	644	14.8
2017	999	21.9	1467	32.2	1026	22.5	616	13.5
2018	1097	22.1	1578	31.8	1144	23.1	697	14.0

Figure 5.1.5a: Age distribution at onset of stroke among males

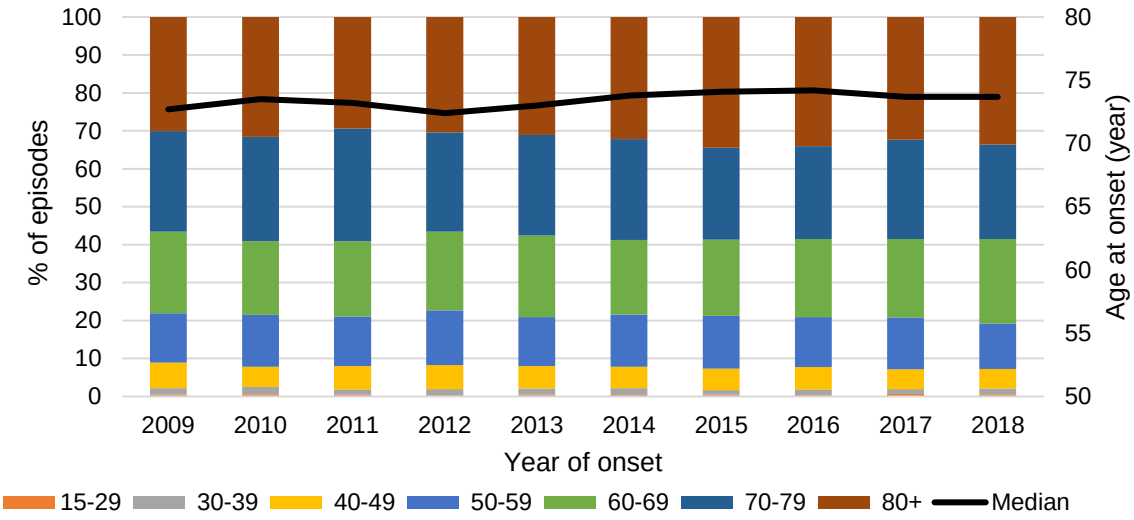


The median age at onset of stroke among females ranged from 72.7 to 74.2 years in the past decade (Table 5.1.5b), about 8 years older than the median age at onset among males (Table 5.1.5a). The highest proportion of stroke episodes was found among females aged 80 years and above (33.6%) in 2018 (Figure 5.1.5b).

Table 5.1.5b: Age distribution at onset of stroke among females

Year of onset	Overall		Age 15-29		Age 30-39		Age 40-49	
	Median age		Number	%	Number	%	Number	%
2009	72.7		14	0.6	42	1.7	171	6.7
2010	73.5		15	0.6	50	1.9	139	5.4
2011	73.2		14	0.5	34	1.3	162	6.2
2012	72.4		10	0.4	43	1.6	174	6.3
2013	73.0		14	0.5	45	1.6	169	5.9
2014	73.8		13	0.4	52	1.8	167	5.7
2015	74.1		17	0.5	35	1.1	180	5.7
2016	74.2		14	0.5	44	1.4	183	5.9
2017	73.7		22	0.7	42	1.3	178	5.3
2018	73.7		20	0.6	51	1.5	172	5.1
Year of onset	**Age 50-59**		**Age 60-69**		**Age 70-79**		**Age 80+**	
	Number	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
2009	330	13.0	548	21.6	672	26.4	765	30.1
2010	355	13.7	503	19.4	713	27.5	819	31.6
2011	345	13.1	522	19.8	783	29.7	773	29.4
2012	398	14.5	570	20.7	718	26.1	836	30.4
2013	369	13.0	612	21.5	753	26.4	886	31.1
2014	404	13.7	580	19.7	786	26.6	948	32.1
2015	437	13.9	634	20.1	763	24.2	1084	34.4
2016	410	13.2	639	20.5	762	24.5	1058	34.0
2017	458	13.7	694	20.7	877	26.1	1084	32.3
2018	404	12.0	749	22.3	837	24.9	1132	33.6

Figure 5.1.5b: Age distribution at onset of stroke among females



Although the ethnic distribution of the stroke patients was similar to the ethnic distribution of the general population (Table 5.1.6), Chinese and Indians consistently had lower ASIRs than Malays across the years (Figure 5.1.6). The ASIRs were 150.1, 253.3 and 162.7 per 100,000 population for Chinese, Malays and Indians respectively in 2018.

The prevalence of hypertension, high low-density lipoprotein cholesterol, obesity and smoking were higher among Malays, relative to Chinese and Indians in the general population as shown by the National Health Survey 2010[8].

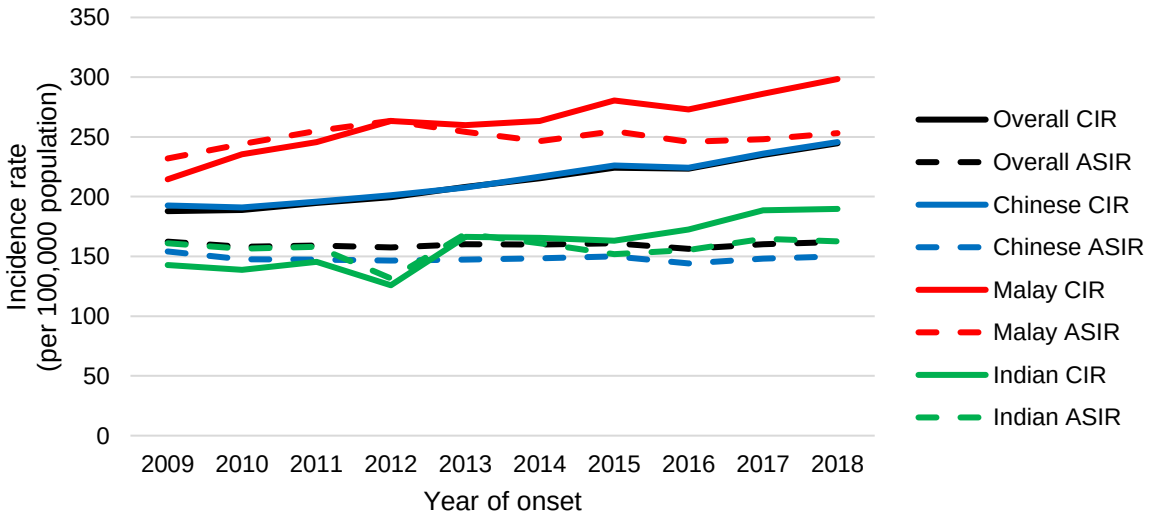
Table 5.1.6: Incidence number and rate (per 100,000 population) of stroke by ethnicity

Chinese						
Year of onset	**Number**	**%**	**CIR**	**95% CI**	**ASIR**	**95% CI**
2009	4473	77.7	192.7	187.0-198.3	154.1	149.5-158.7
2010	4499	76.4	191.0	185.4-196.6	147.5	143.1-151.9
2011	4664	75.9	195.8	190.2-201.5	147.3	143.0-151.6
2012	4850	76.2	201.1	195.5-206.8	146.5	142.3-150.7
2013	5066	75.4	207.7	202.0-213.4	147.4	143.3-151.5
2014	5342	76.0	216.8	211.0-222.6	148.5	144.4-152.6
2015	5637	76.2	226.1	220.2-232.0	150.1	146.1-154.2
2016	5649	75.8	224.1	218.3-230.0	144.1	140.2-148.0
2017	6006	75.9	235.9	230.0-241.9	148.1	144.2-151.9
2018	6312	75.8	245.7	239.6-251.7	150.1	146.3-154.0
P for trend	-	-	<0.001	-	0.495	-

[8] National Health Survey 2010. Ministry of Health, Singapore.

Malay						
Year of onset	**Number**	**%**	**CIR**	**95% CI**	**ASIR**	**95% CI**
2009	824	14.3	214.5	199.9-229.2	232.0	215.5-248.4
2010	921	15.6	235.4	220.2-250.6	244.1	227.7-260.5
2011	975	15.9	245.5	230.1-260.9	255.2	238.4-271.9
2012	1061	16.7	263.3	247.4-279.1	263.4	247.1-279.7
2013	1062	15.8	259.8	244.2-275.4	254.2	238.5-269.8
2014	1092	15.5	263.4	247.8-279.1	246.3	231.4-261.3
2015	1178	15.9	280.4	264.4-296.4	254.7	239.8-269.5
2016	1162	15.6	272.9	257.2-288.6	245.8	231.3-260.4
2017	1233	15.6	286.2	270.2-302.1	248.0	233.9-262.1
2018	1299	15.6	298.4	282.2-314.7	253.3	239.3-267.3
P for trend	-	-	<0.001	-	0.383	-
Indian						
Year of onset	**Number**	**%**	**CIR**	**95% CI**	**ASIR**	**95% CI**
2009	383	6.6	142.9	128.5-157.2	160.9	144.1-177.6
2010	379	6.4	138.7	124.8-152.7	156.6	140.2-172.9
2011	401	6.5	145.4	131.2-159.6	157.9	141.8-174.0
2012	351	5.5	125.9	112.7-139.0	131.6	117.4-145.8
2013	468	7.0	166.4	151.4-181.5	168.8	153.1-184.5
2014	470	6.7	165.6	150.6-180.6	160.9	146.0-175.8
2015	467	6.3	163.2	148.4-178.1	151.8	137.7-165.9
2016	498	6.7	172.6	157.5-187.8	155.3	141.4-169.3
2017	549	6.9	188.5	172.7-204.2	164.7	150.7-178.7
2018	558	6.7	189.7	174.0-205.5	162.7	149.1-176.3
P for trend	-	-	0.001	-	0.578	-

Figure 5.1.6: Incidence rate of stroke (per 100,000 population) by ethnicity



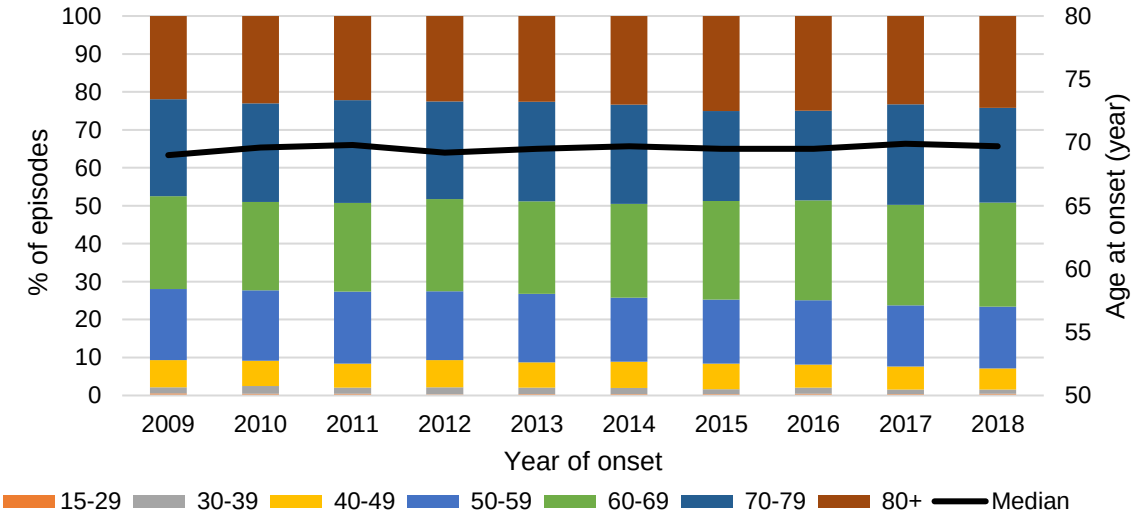
Chinese had the oldest median age at onset of stroke, which ranged from 69.0 to 69.9 years in the past decade (Table 5.1.7a). The proportion of stroke patients aged 70 years and above was also highest among Chinese (49.2%), compared to about a third among Malays and Indians in 2018 (Figures 5.1.7a to 5.1.7c).

Table 5.1.7a: Age distribution at onset of stroke among Chinese

Year of onset	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2009	69.0	24	0.5	71	1.6	323	7.2
2010	69.6	22	0.5	89	2.0	302	6.7
2011	69.8	23	0.5	74	1.6	294	6.3
2012	69.2	13	0.3	93	1.9	348	7.2
2013	69.5	18	0.4	85	1.7	339	6.7
2014	69.7	22	0.4	83	1.6	370	6.9
2015	69.5	20	0.4	74	1.3	378	6.7
2016	69.5	26	0.5	90	1.6	345	6.1
2017	69.9	23	0.4	73	1.2	364	6.1
2018	69.7	28	0.4	68	1.1	355	5.6

Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2009	835	18.7	1096	24.5	1142	25.5	982	22.0
2010	832	18.5	1051	23.4	1168	26.0	1035	23.0
2011	885	19.0	1091	23.4	1264	27.1	1033	22.1
2012	877	18.1	1181	24.4	1245	25.7	1093	22.5
2013	913	18.0	1238	24.4	1330	26.3	1143	22.6
2014	904	16.9	1317	24.7	1398	26.2	1248	23.4
2015	951	16.9	1467	26.0	1337	23.7	1410	25.0
2016	956	16.9	1488	26.3	1335	23.6	1409	24.9
2017	966	16.1	1593	26.5	1588	26.4	1399	23.3
2018	1027	16.3	1729	27.4	1579	25.0	1526	24.2

Figure 5.1.7a: Age distribution at onset of stroke among Chinese



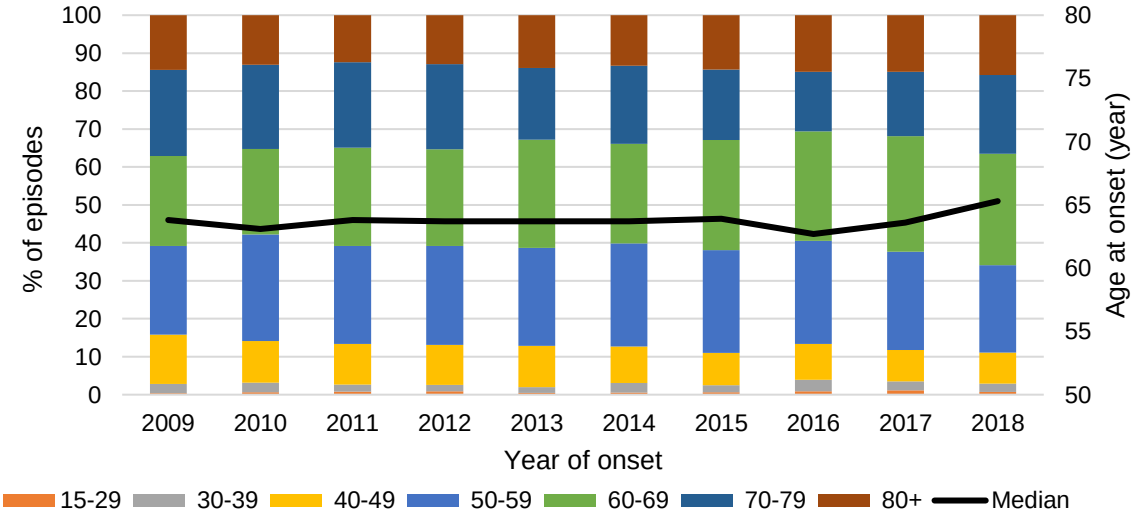
The median age at onset of stroke among Malays ranged from 62.7 to 65.3 years in the past decade (Table 5.1.7b). The highest proportion of stroke episodes was found among Malays aged 60-69 years (29.4%) in 2018 (Figure 5.1.7b).

Table 5.1.7b: Age distribution at onset of stroke among Malays

Year of onset	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2009	63.8	3	0.4	20	2.4	107	13.0
2010	63.1	6	0.7	23	2.5	101	11.0
2011	63.8	8	0.8	18	1.8	104	10.7
2012	63.7	9	0.8	18	1.7	112	10.6
2013	63.7	5	0.5	16	1.5	116	10.9
2014	63.7	6	0.5	28	2.6	105	9.6
2015	63.9	7	0.6	22	1.9	101	8.6
2016	62.7	10	0.9	36	3.1	109	9.4
2017	63.6	14	1.1	29	2.4	102	8.3
2018	65.3	9	0.7	29	2.2	106	8.2

Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2009	193	23.4	195	23.7	187	22.7	119	14.4
2010	259	28.1	207	22.5	205	22.3	120	13.0
2011	252	25.8	253	25.9	219	22.5	121	12.4
2012	277	26.1	270	25.4	238	22.4	137	12.9
2013	274	25.8	303	28.5	200	18.8	148	13.9
2014	296	27.1	287	26.3	225	20.6	145	13.3
2015	319	27.1	342	29.0	218	18.5	169	14.3
2016	316	27.2	335	28.8	183	15.7	173	14.9
2017	319	25.9	376	30.5	209	17.0	184	14.9
2018	299	23.0	382	29.4	269	20.7	205	15.8

Figure 5.1.7b: Age distribution at onset of stroke among Malays



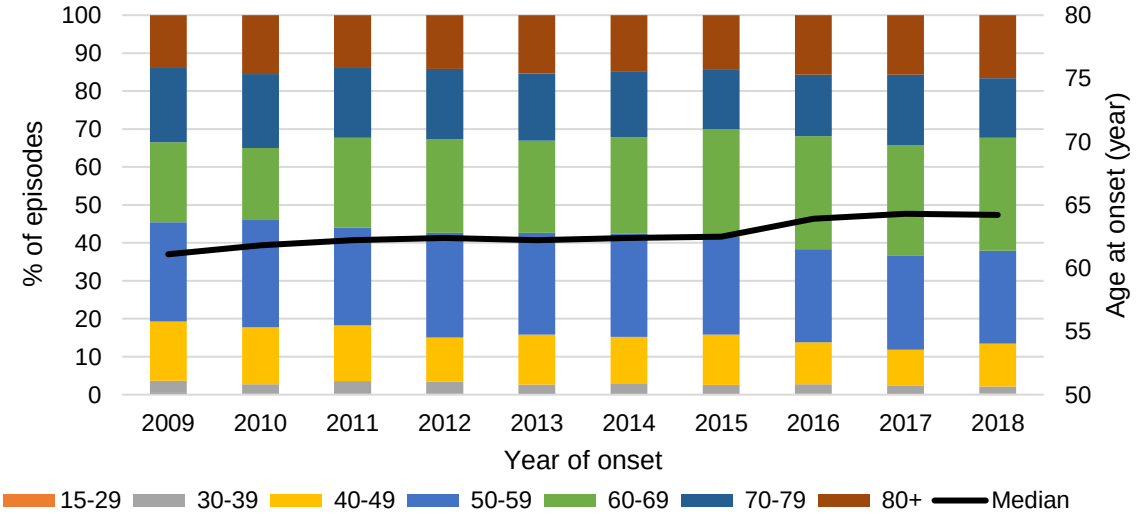
The median age at onset of stroke among Indians increased from 63.2 years in 2009 to 63.9 years in 2018 (Table 5.1.7c). The highest proportion of stroke episodes was found among Indians aged 60-69 years (31.9%) in 2018 (Figure 5.1.7c).

Table 5.1.7c: Age distribution at onset of stroke among Indians

Year of onset	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2009	63.2	3	0.8	11	2.9	35	9.1
2010	63.2	2	0.5	10	2.6	39	10.3
2011	62.6	2	0.5	16	4.0	51	12.7
2012	61.5	2	0.6	8	2.3	42	12.0
2013	62.3	6	1.3	10	2.1	48	10.3
2014	63.5	3	0.6	10	2.1	52	11.1
2015	63.5	4	0.9	15	3.2	46	9.9
2016	64.2	4	0.8	20	4.0	49	9.8
2017	63.1	2	0.4	10	1.8	52	9.5
2018	63.9	2	0.4	12	2.2	47	8.4

Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2009	107	27.9	93	24.3	84	21.9	50	13.1
2010	97	25.6	93	24.5	69	18.2	69	18.2
2011	109	27.2	84	20.9	86	21.4	53	13.2
2012	98	27.9	90	25.6	61	17.4	50	14.2
2013	127	27.1	142	30.3	73	15.6	62	13.2
2014	123	26.2	122	26.0	81	17.2	79	16.8
2015	128	27.4	122	26.1	81	17.3	71	15.2
2016	124	24.9	133	26.7	83	16.7	85	17.1
2017	145	26.4	159	29.0	88	16.0	93	16.9
2018	140	25.1	178	31.9	104	18.6	75	13.4

Figure 5.1.7c: Age distribution at onset of stroke among Indians

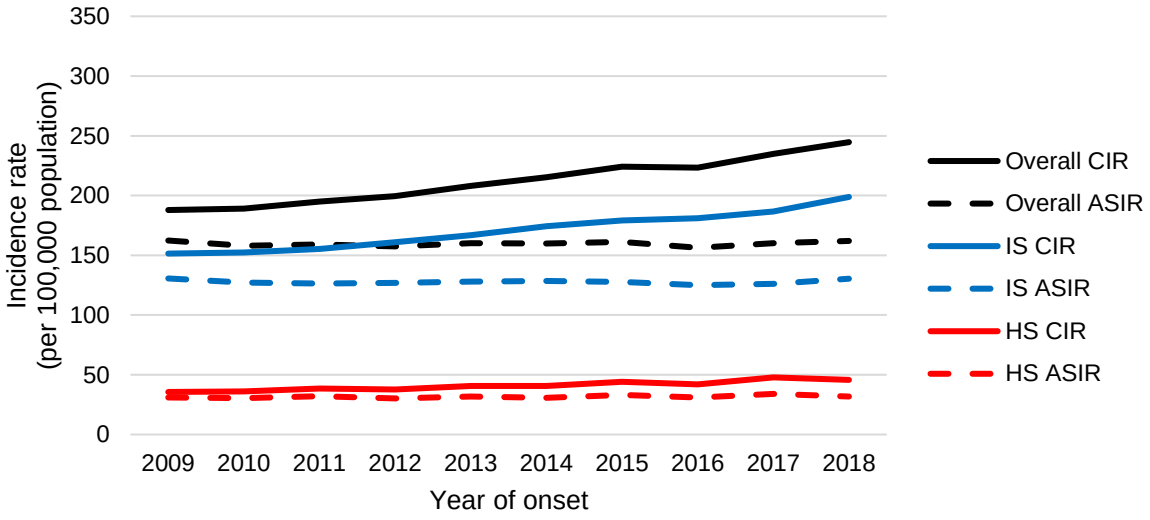


There were more IS than HS episodes (Table 5.1.8) and the ASIR for IS was consistently higher than HS across the years (Figure 5.1.8). The ASIRs were 130.3 and 31.7 per 100,000 population for IS and HS respectively in 2018.

Table 5.1.8: Incidence number and rate of stroke (per 100,000 population) by subtype

Ischaemic stroke						
Year of onset	**Number**	**%**	**CIR**	**95% CI**	**ASIR**	**95% CI**
2009	4641	80.6	151.4	147.0-155.7	130.6	126.8-134.4
2010	4749	80.6	152.3	148.0-156.7	127.2	123.5-130.9
2011	4900	79.8	155.4	151.1-159.8	126.4	122.8-130.0
2012	5140	80.7	161.0	156.6-165.4	126.8	123.2-130.3
2013	5391	80.2	166.9	162.5-171.4	127.9	124.4-131.3
2014	5687	80.9	174.3	169.8-178.8	128.6	125.2-132.0
2015	5915	79.9	179.2	174.7-183.8	127.7	124.3-131.0
2016	6037	81.0	180.9	176.3-185.5	125.0	121.8-128.3
2017	6295	79.5	186.7	182.1-191.3	126.0	122.8-129.1
2018	6764	81.2	198.8	194.0-203.5	130.3	127.1-133.4
P for trend	-	-	<0.001	-	0.675	-
Haemorrhage stroke						
Year of onset	**Number**	**%**	**CIR**	**95% CI**	**ASIR**	**95% CI**
2009	1090	18.9	35.6	33.4-37.7	30.9	29.1-32.8
2010	1125	19.1	36.1	34.0-38.2	30.4	28.6-32.2
2011	1213	19.7	38.5	36.3-40.6	32.0	30.2-33.9
2012	1202	18.9	37.7	35.5-39.8	30.2	28.4-31.9
2013	1310	19.5	40.6	38.4-42.8	31.9	30.1-33.7
2014	1322	18.8	40.5	38.3-42.7	30.8	29.1-32.5
2015	1459	19.7	44.2	41.9-46.5	33.0	31.3-34.8
2016	1403	18.8	42.0	39.8-44.2	30.9	29.3-32.6
2017	1612	20.4	47.8	45.5-50.1	34.0	32.3-35.7
2018	1552	18.6	45.6	43.3-47.9	31.7	30.0-33.3
P for trend	-	-	<0.001	-	0.121	-

Figure 5.1.8: Incidence rate of stroke (per 100,000 population) by subtype



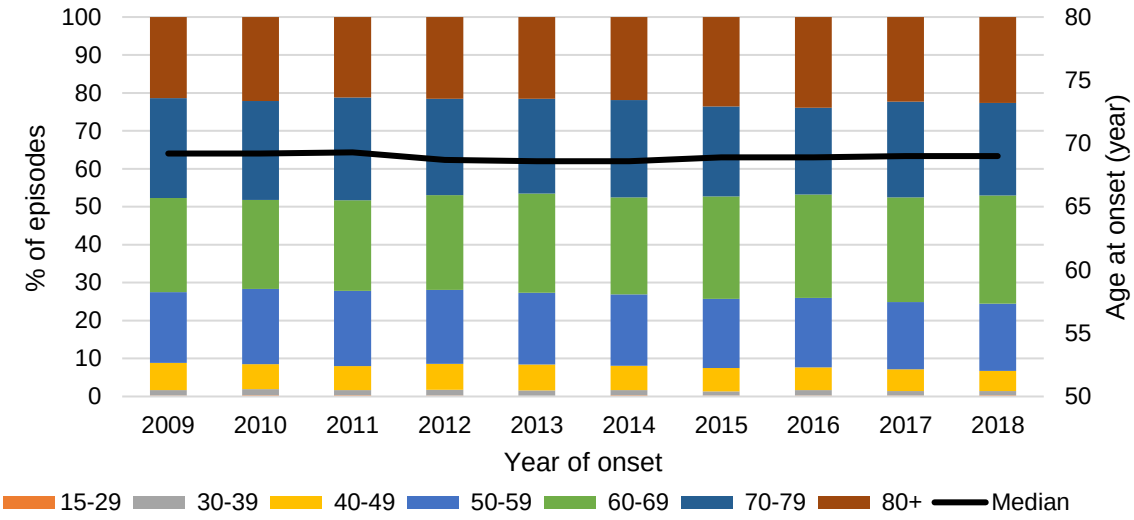
The median age at onset of IS ranged from 68.6 to 69.3 years in the past decade (Table 5.1.9a). The highest proportion of IS episodes was found among patients aged 60-69 years (28.5%) in 2018 (Figure 5.1.9a).

Table 5.1.9a: Age distribution at onset of ischaemic stroke

Year of onset	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2009	69.2	13	0.3	67	1.4	330	7.1
2010	69.2	16	0.3	75	1.6	315	6.6
2011	69.3	16	0.3	67	1.4	311	6.3
2012	68.7	13	0.3	77	1.5	352	6.8
2013	68.6	8	0.1	77	1.4	369	6.8
2014	68.6	20	0.4	77	1.4	365	6.4
2015	68.9	15	0.3	64	1.1	363	6.1
2016	68.9	15	0.2	87	1.4	361	6.0
2017	69.0	17	0.3	73	1.2	363	5.8
2018	69.0	21	0.3	77	1.1	361	5.3

Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2009	868	18.7	1150	24.8	1220	26.3	993	21.4
2010	940	19.8	1115	23.5	1239	26.1	1049	22.1
2011	969	19.8	1173	23.9	1323	27.0	1041	21.2
2012	1001	19.5	1285	25.0	1306	25.4	1106	21.5
2013	1019	18.9	1411	26.2	1346	25.0	1161	21.5
2014	1068	18.8	1453	25.5	1458	25.6	1246	21.9
2015	1079	18.2	1599	27.0	1402	23.7	1393	23.6
2016	1106	18.3	1647	27.3	1380	22.9	1441	23.9
2017	1112	17.7	1740	27.6	1584	25.2	1406	22.3
2018	1194	17.7	1930	28.5	1648	24.4	1533	22.7

Figure 5.1.9a: Age distribution at onset of ischaemic stroke



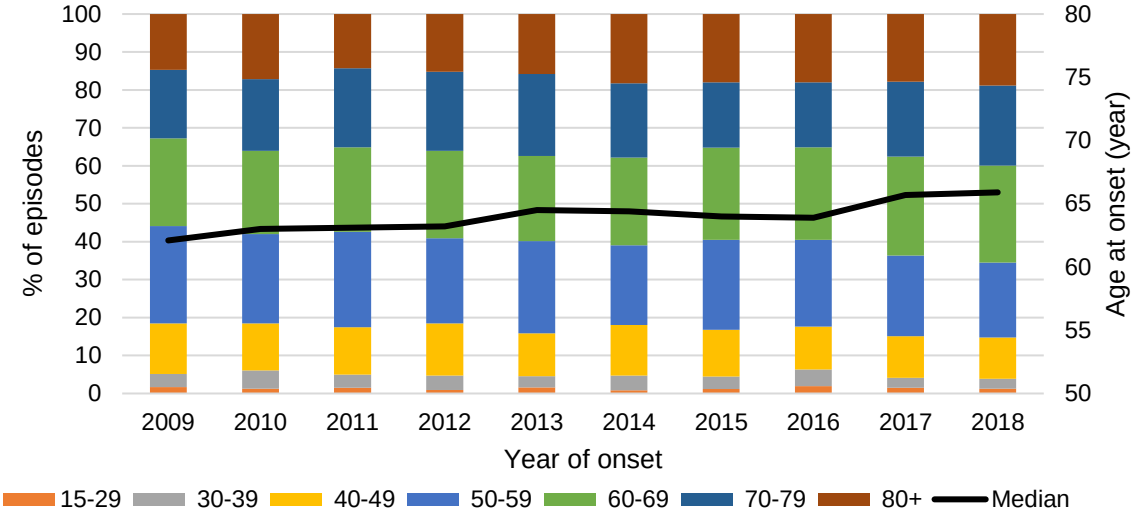
The median age at onset of HS increased from 62.1 years in 2009 to 65.9 years in 2018 (Table 5.1.9b), a few years younger than the median age at onset of IS (Table 5.1.9a). The highest proportion of HS episodes was found among patients aged 60-69 years (25.6%) in 2018 (Figure 5.1.9b).

Table 5.1.9b: Age distribution at onset of haemorrhage stroke

Year of onset	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2009	62.1	18	1.7	38	3.5	145	13.3
2010	63.0	14	1.2	54	4.8	140	12.4
2011	63.1	18	1.5	42	3.5	152	12.5
2012	63.2	11	0.9	46	3.8	165	13.7
2013	64.5	21	1.6	39	3.0	148	11.3
2014	64.4	11	0.8	51	3.9	177	13.4
2015	64.0	17	1.2	48	3.3	180	12.3
2016	63.9	27	1.9	62	4.4	158	11.3
2017	65.7	24	1.5	43	2.7	176	10.9
2018	65.9	20	1.3	40	2.6	169	10.9

Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2009	280	25.7	252	23.1	197	18.1	160	14.7
2010	265	23.6	246	21.9	213	18.9	193	17.2
2011	305	25.1	270	22.3	253	20.9	173	14.3
2012	270	22.5	277	23.0	250	20.8	183	15.2
2013	318	24.3	294	22.4	283	21.6	207	15.8
2014	277	21.0	306	23.1	259	19.6	241	18.2
2015	346	23.7	354	24.3	251	17.2	263	18.0
2016	321	22.9	342	24.4	240	17.1	253	18.0
2017	343	21.3	420	26.1	318	19.7	288	17.9
2018	306	19.7	397	25.6	328	21.1	292	18.8

Figure 5.1.9b: Age distribution at onset of haemorrhage stroke



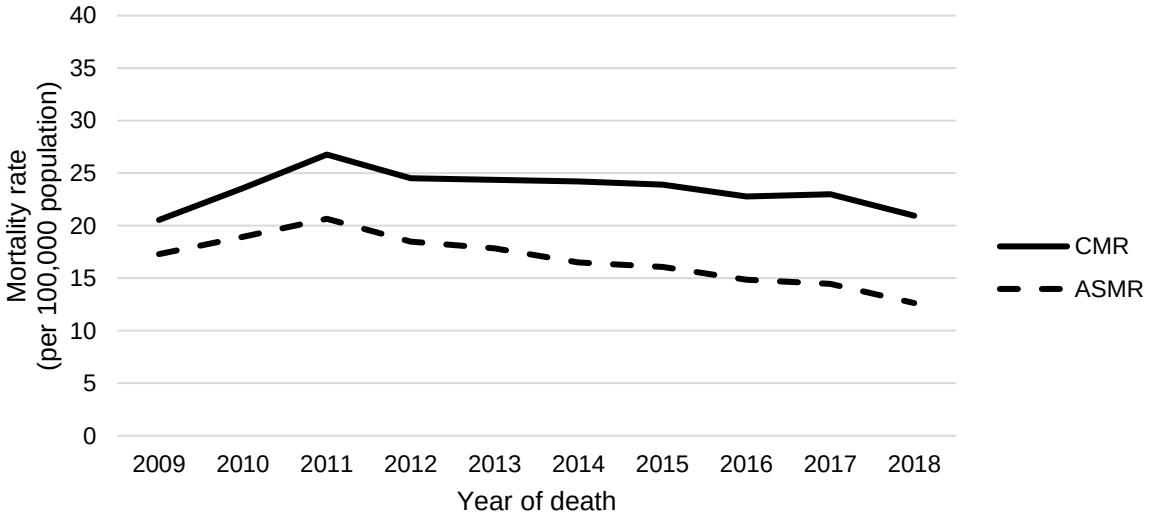
5.2 Mortality

The number of stroke deaths fluctuated, ranging between 630 and 844 in the decade from 2009 to 2018 (Table 5.2.1). The crude mortality rate (CMR) fluctuated between 20.5 and 26.8 per 100,000 population in the same period (Figure 5.2.1). However, taking into account of Singapore's ageing population, the ASMR declined significantly from 17.3 per 100,000 population in 2009 to 12.6 per 100,000 population in 2018 (p=0.001). This decreasing trend in ASMR was likely due to the speedier commencement of stroke treatment.

Table 5.2.1: Mortality number and rate of stroke (per 100,000 population)

Year of death	Number	CMR	95% CI	ASMR	95% CI
2009	630	20.5	18.9-22.2	17.3	15.9-18.7
2010	735	23.6	21.9-25.3	18.9	17.5-20.3
2011	844	26.8	25.0-28.6	20.7	19.2-22.1
2012	783	24.5	22.8-26.2	18.5	17.2-19.8
2013	787	24.4	22.7-26.1	17.8	16.6-19.1
2014	790	24.2	22.5-25.9	16.5	15.3-17.7
2015	789	23.9	22.2-25.6	16.1	14.9-17.2
2016	760	22.8	21.2-24.4	14.8	13.8-15.9
2017	775	23.0	21.4-24.6	14.5	13.4-15.5
2018	713	21.0	19.4-22.5	12.6	11.7-13.6
P for trend	-	0.575	-	0.001	-

Figure 5.2.1: Mortality rate of stroke (per 100,000 population)



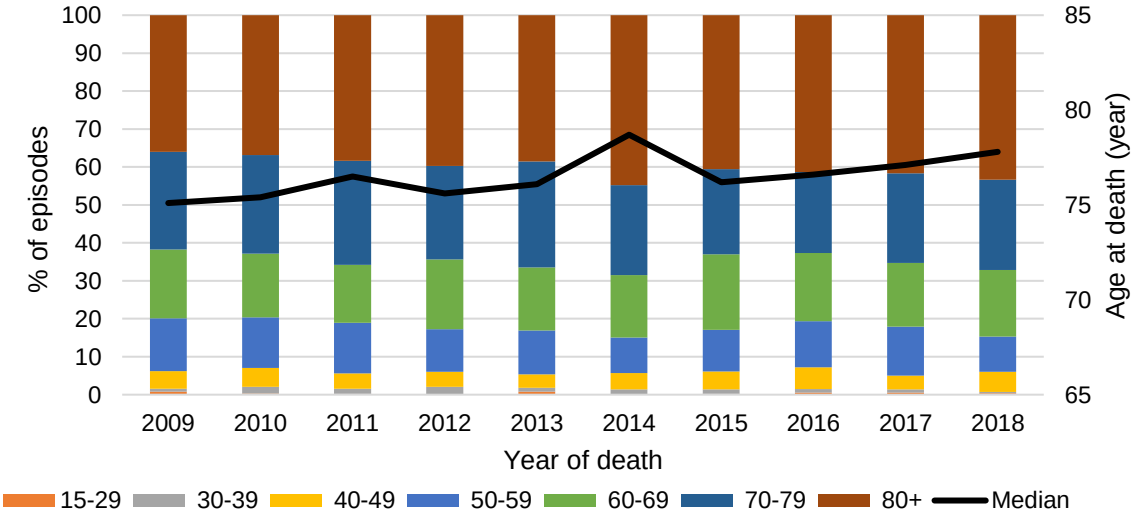
The median age at death increased from 75.1 years in 2009 to 77.8 years in 2018 (Table 5.2.2). Close to half of the patients who died of stroke in 2018 were aged 80 years and above (Figure 5.2.2).

Table 5.2.2: Age distribution at death of stroke

Year of death	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2009	75.1	5	0.8	5	0.8	29	4.6
2010	75.4	2	0.3	13	1.8	37	5.0
2011	76.5	2	0.2	11	1.3	34	4.0
2012	75.6	0	0.0	16	2.0	31	4.0
2013	76.1	6	0.8	8	1.0	28	3.6
2014	78.7	1	0.1	10	1.3	34	4.3
2015	76.2	2	0.3	9	1.1	37	4.7
2016	76.6	4	0.5	7	0.9	44	5.8
2017	77.1	4	0.5	7	0.9	28	3.6
2018	77.8	3	0.4	2	0.3	38	5.3

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2009	88	14.0	114	18.1	162	25.7	227	36.0
2010	98	13.3	123	16.7	191	26.0	271	36.9
2011	113	13.4	129	15.3	231	27.4	324	38.4
2012	88	11.2	144	18.4	193	24.6	311	39.7
2013	91	11.6	131	16.6	220	28.0	303	38.5
2014	74	9.4	130	16.5	187	23.7	354	44.8
2015	87	11.0	157	19.9	177	22.4	320	40.6
2016	92	12.1	137	18.0	162	21.3	314	41.3
2017	100	12.9	130	16.8	183	23.6	323	41.7
2018	66	9.3	125	17.5	170	23.8	309	43.3

Figure 5.2.2: Age distribution at death of stroke



The age-specific mortality rate increased with age, with the oldest age group having the highest mortality rate (Figure 5.2.3a). Over the past decade, significant drop in mortality rates were observed for all the age groups aged 50 years and above (Table 5.2.3). The drop in mortality rate was fastest among those aged 80 years and above (Figure 5.2.3b).

Table 5.2.3: Age-specific mortality rate of stroke (per 100,000 population)

Year of death	Overall		Age 15-29		Age 30-39		Age 40-49	
	CMR	95% CI	CMR	95% CI	CMR	95% CI	CMR	95% CI
2009	20.5	18.9-22.2	0.6	0.1-1.2	0.8	0.1-1.5	4.6	2.9-6.2
2010	23.6	21.9-25.3	0.3	0.0-0.6	2.1	1.0-3.2	5.8	4.0-7.7
2011	26.8	25.0-28.6	0.3	0.0-0.6	1.8	0.7-2.9	5.4	3.6-7.2
2012	24.5	22.8-26.2	0.0	0.0-0.0	2.6	1.3-3.9	4.9	3.2-6.7
2013	24.4	22.7-26.1	0.8	0.2-1.4	1.3	0.4-2.2	4.5	2.8-6.1
2014	24.2	22.5-25.9	0.1	0.0-0.4	1.7	0.6-2.7	5.4	3.6-7.3
2015	23.9	22.2-25.6	0.3	0.0-0.6	1.5	0.5-2.5	6.0	4.0-7.9
2016	22.8	21.2-24.4	0.5	0.0-1.0	1.2	0.3-2.1	7.2	5.0-9.3
2017	23.0	21.4-24.6	0.5	0.0-1.0	1.2	0.3-2.1	4.6	2.9-6.2
2018	21.0	19.4-22.5	0.4	0.0-0.8	0.3	0.0-0.8	6.2	4.2-8.2
P for trend	0.575	-	0.985	-	0.151	-	0.261	-
Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	CMR	95% CI	CMR	95% CI	CMR	95% CI	CMR	95% CI
2009	16.4	13.0-19.8	39.9	32.5-47.2	108.8	92.0-125.5	349.5	304.0-394.9
2010	17.8	14.2-21.3	40.5	33.4-47.7	121.0	103.9-138.2	392.3	345.6-439.0
2011	19.9	16.2-23.5	40.2	33.3-47.2	138.3	120.5-156.2	442.2	394.1-490.4
2012	15.1	12.0-18.3	42.0	35.1-48.9	112.2	96.3-128.0	400.4	355.9-444.9
2013	15.3	12.2-18.5	35.6	29.5-41.7	124.7	108.3-141.2	368.4	326.9-409.8
2014	12.3	9.5-15.0	33.1	27.4-38.8	102.1	87.5-116.8	405.5	363.3-447.8
2015	14.3	11.3-17.3	37.1	31.3-42.9	96.3	82.1-110.5	342.4	304.9-380.0
2016	15.0	11.9-18.0	30.5	25.4-35.6	84.5	71.5-97.5	321.1	285.6-356.6
2017	16.3	13.1-19.5	27.9	23.1-32.6	86.5	74.0-99.1	318.9	284.1-353.7
2018	10.8	8.2-13.4	25.8	21.3-30.4	74.3	63.1-85.4	289.1	256.9-321.3
P for trend	0.042	-	<0.001	-	0.002	-	0.019	-

Figure 5.2.3a: Age-specific mortality rate of stroke (per 100,000 population) across age groups

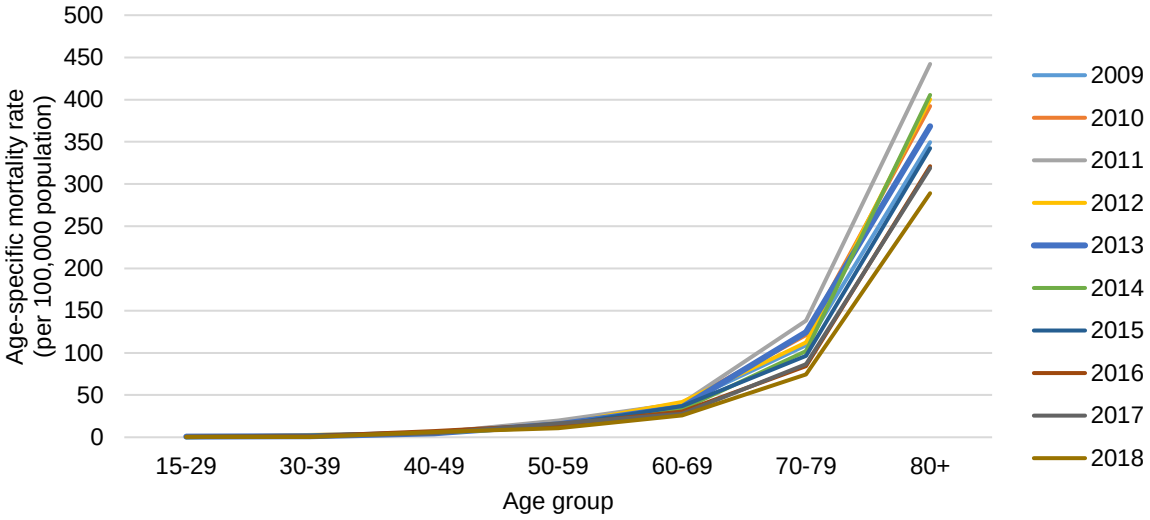
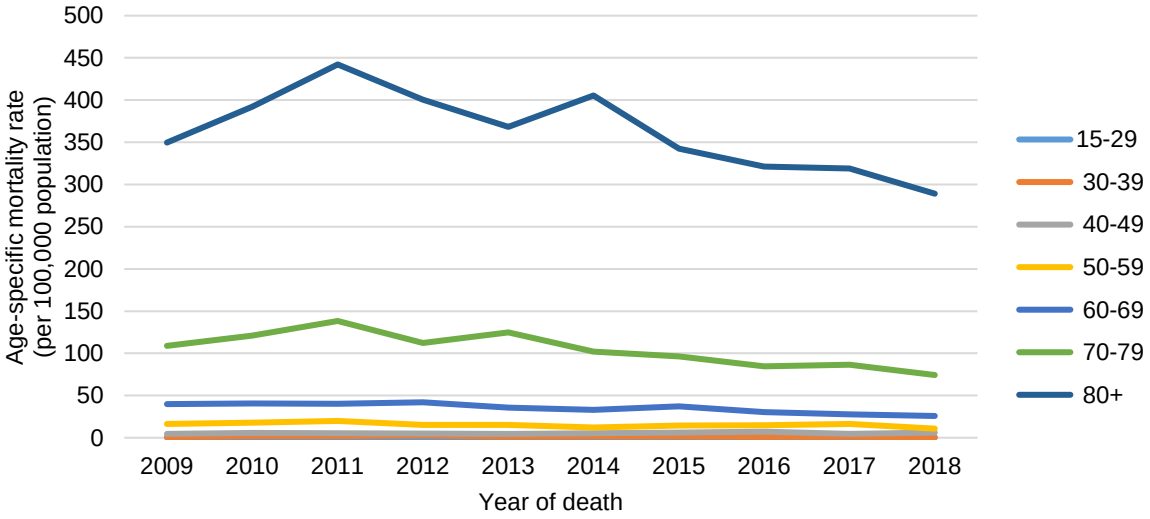


Figure 5.2.3b: Age-specific mortality rate of stroke (per 100,000 population) across years

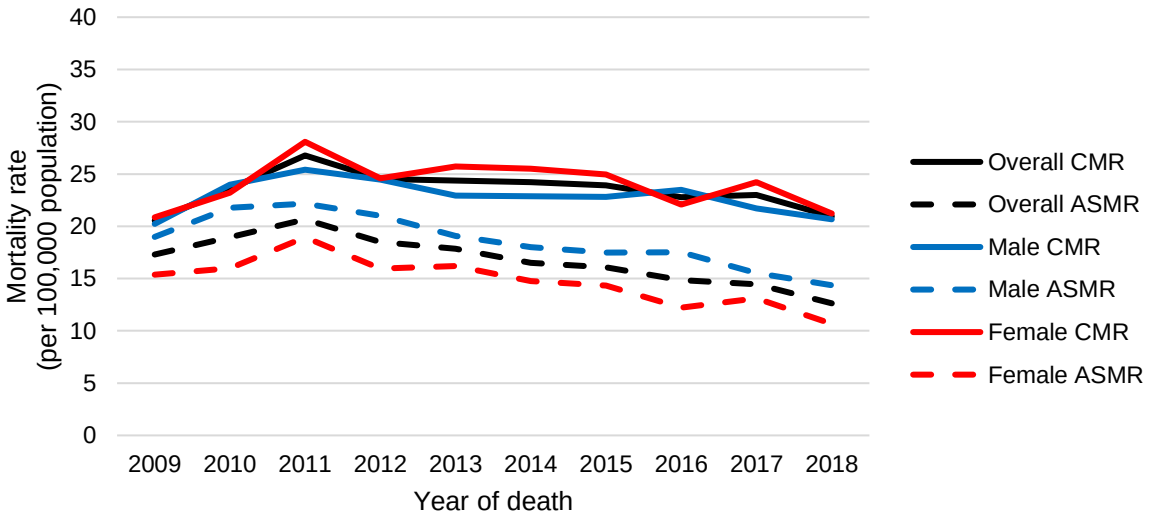


As the ASIR was consistently higher among males than females across the years (Table 5.1.4), the ASMR was also consistently higher among males (Table 5.2.4). Males had an ASMR of 14.4 per 100,000 population, while females had an ASMR of 10.7 per 100,000 population in 2018. The ASMRs declined significantly over the years for both genders (males: p=0.001, females: p=0.003) (Figure 5.2.4).

Table 5.2.4: Mortality number and rate of stroke (per 100,000 population) by gender

Male						
Year of death	**Number**	**%**	**CMR**	**95% CI**	**ASMR**	**95% CI**
2009	304	48.3	20.2	18.0-22.5	19.0	16.8-21.2
2010	366	49.8	24.0	21.5-26.4	21.8	19.5-24.1
2011	392	46.4	25.4	22.9-27.9	22.2	19.9-24.4
2012	382	48.8	24.5	22.0-26.9	21.0	18.9-23.2
2013	362	46.0	22.9	20.6-25.3	19.1	17.1-21.1
2014	364	46.1	22.9	20.5-25.2	18.0	16.1-19.9
2015	367	46.5	22.8	20.5-25.1	17.5	15.7-19.3
2016	382	50.3	23.5	21.1-25.9	17.5	15.7-19.3
2017	356	45.9	21.7	19.4-24.0	15.5	13.9-17.2
2018	342	48.0	20.7	18.5-22.9	14.4	12.8-15.9
P for trend	-	-	0.438	-	0.001	-
Female						
Year of death	**Number**	**%**	**CMR**	**95% CI**	**ASMR**	**95% CI**
2009	326	51.7	20.9	18.6-23.1	15.4	13.6-17.1
2010	369	50.2	23.2	20.8-25.6	16.0	14.3-17.7
2011	452	53.6	28.1	25.5-30.7	18.9	17.1-20.8
2012	401	51.2	24.6	22.2-27.0	16.0	14.3-17.6
2013	425	54.0	25.7	23.3-28.2	16.2	14.6-17.8
2014	426	53.9	25.5	23.1-27.9	14.8	13.3-16.2
2015	422	53.5	25.0	22.6-27.3	14.3	12.9-15.8
2016	378	49.7	22.1	19.9-24.3	12.2	10.9-13.5
2017	419	54.1	24.2	21.9-26.5	13.1	11.8-14.4
2018	371	52.0	21.2	19.1-23.4	10.7	9.5-11.8
P for trend	-	-	0.689	-	0.003	-

Figure 5.2.4: Mortality rate of stroke (per 100,000 population) by gender



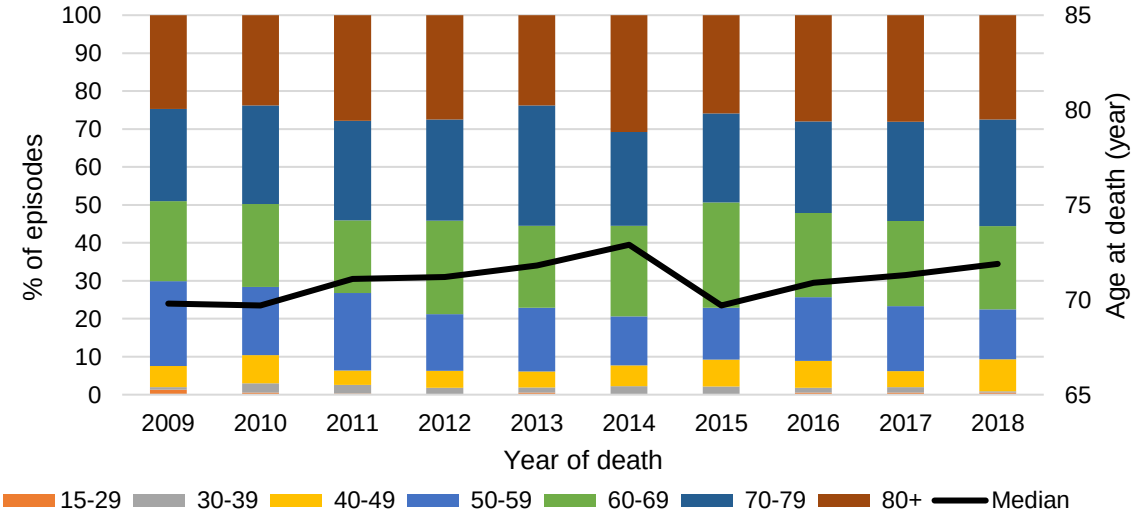
The median age at death among males ranged from 69.7 to 72.9 years in the past decade (Table 5.2.5a). About half of the stroke deaths was observed among males aged 70 years and above in 2018 (Figure 5.2.5a).

Table 5.2.5a: Age distribution at death of stroke among males

Year of death	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2009	69.8	4	1.3	2	0.7	17	5.6
2010	69.7	2	0.5	9	2.5	27	7.4
2011	71.1	1	0.3	9	2.3	15	3.8
2012	71.2	0	0.0	7	1.8	17	4.5
2013	71.8	2	0.6	5	1.4	15	4.1
2014	72.9	0	0.0	8	2.2	20	5.5
2015	69.7	0	0.0	8	2.2	26	7.1
2016	70.9	2	0.5	5	1.3	27	7.1
2017	71.3	2	0.6	5	1.4	15	4.2
2018	71.9	2	0.6	1	0.3	29	8.5

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2009	68	22.4	64	21.1	74	24.3	75	24.7
2010	66	18.0	80	21.9	95	26.0	87	23.8
2011	80	20.4	75	19.1	103	26.3	109	27.8
2012	57	14.9	94	24.6	102	26.7	105	27.5
2013	61	16.9	78	21.5	115	31.8	86	23.8
2014	47	12.9	87	23.9	90	24.7	112	30.8
2015	50	13.6	102	27.8	86	23.4	95	25.9
2016	64	16.8	85	22.3	92	24.1	107	28.0
2017	61	17.1	80	22.5	93	26.1	100	28.1
2018	45	13.2	75	21.9	96	28.1	94	27.5

Figure 5.2.5a: Age distribution at death of stroke among males



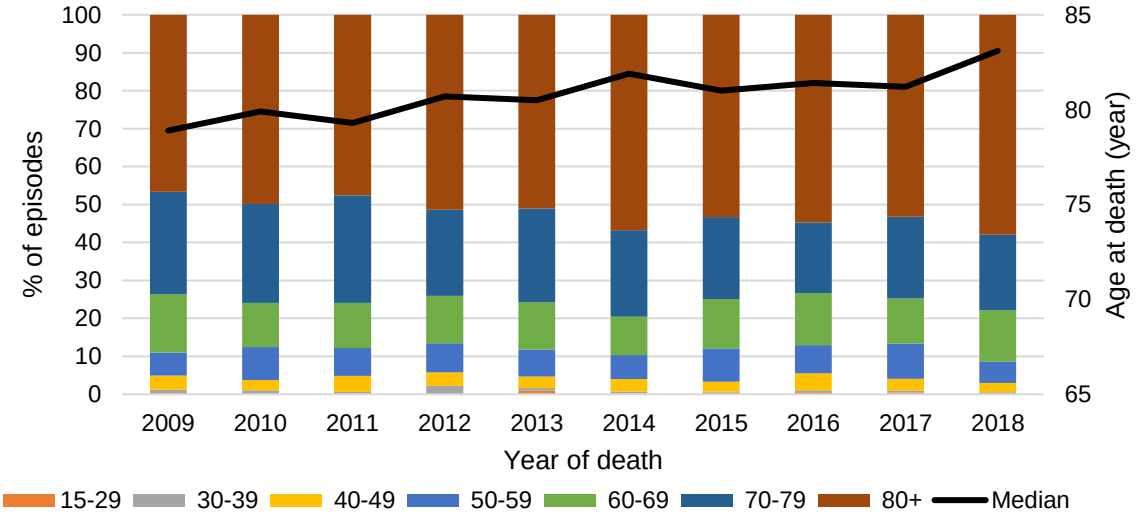
Females, having an older median age at onset of stroke compared to males (Tables 5.1.5a and 5.1.5b), also had an older median age at death relative to males. The median age at death of stroke among females increased from 78.9 years in 2009 to 83.1 years in 2018 (Table 5.2.5b). Close to three-fifths of the stroke deaths among females in 2018 were aged 80 years and above (Figure 5.2.5b).

Table 5.2.5b: Age distribution at death of stroke among females

Year of death	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2009	78.9	1	0.3	3	0.9	12	3.7
2010	79.9	0	0.0	4	1.1	10	2.7
2011	79.3	1	0.2	2	0.4	19	4.2
2012	80.7	0	0.0	9	2.2	14	3.5
2013	80.5	4	0.9	3	0.7	13	3.1
2014	81.9	1	0.2	2	0.5	14	3.3
2015	81.0	2	0.5	1	0.2	11	2.6
2016	81.4	2	0.5	2	0.5	17	4.5
2017	81.2	2	0.5	2	0.5	13	3.1
2018	83.1	1	0.3	1	0.3	9	2.4

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2009	20	6.1	50	15.3	88	27.0	152	46.6
2010	32	8.7	43	11.7	96	26.0	184	49.9
2011	33	7.3	54	11.9	128	28.3	215	47.6
2012	31	7.7	50	12.5	91	22.7	206	51.4
2013	30	7.1	53	12.5	105	24.7	217	51.1
2014	27	6.3	43	10.1	97	22.8	242	56.8
2015	37	8.8	55	13.0	91	21.6	225	53.3
2016	28	7.4	52	13.8	70	18.5	207	54.8
2017	39	9.3	50	11.9	90	21.5	223	53.2
2018	21	5.7	50	13.5	74	19.9	215	58.0

Figure 5.2.5b: Age distribution at death of stroke among females

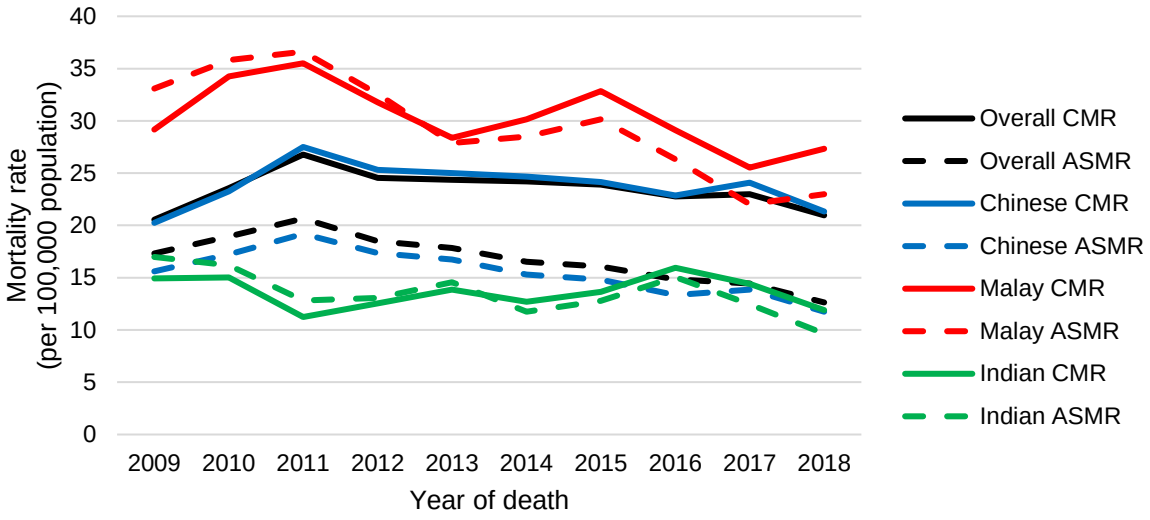


As Chinese and Indians consistently had lower ASIRs than Malays across the years (Table 5.1.6), they also consistently had lower ASMRs (Table 5.2.6). The ASMRs of 11.7 and 9.7 per 100,000 population among Chinese and Indians respectively were lower than the ASMR for Malays (23.0 per 100,000 population) in 2018. The ASMRs showed significant downward trend over the years for all the three ethnic groups (Chinese: p=0.004, Malays: p<0.001, Indians: p=0.022) (Figure 5.2.6).

Table 5.2.6: Mortality number and rate of stroke (per 100,000 population) by ethnicity

Chinese						
Year of death	**Number**	**%**	**CMR**	**95% CI**	**ASMR**	**95% CI**
2009	470	74.6	20.2	18.4-22.1	15.6	14.2-17.1
2010	548	74.6	23.3	21.3-25.2	17.2	15.7-18.7
2011	655	77.6	27.5	25.4-29.6	19.2	17.7-20.7
2012	610	77.9	25.3	23.3-27.3	17.4	15.9-18.8
2013	610	77.5	25.0	23.0-27.0	16.7	15.4-18.1
2014	608	77.0	24.7	22.7-26.6	15.3	14.0-16.5
2015	602	76.3	24.1	22.2-26.1	14.8	13.6-16.0
2016	576	75.8	22.9	21.0-24.7	13.4	12.2-14.5
2017	613	79.1	24.1	22.2-26.0	13.9	12.7-15.0
2018	548	76.9	21.3	19.5-23.1	11.7	10.7-12.8
P for trend	-	-	0.837	-	0.004	-
Malay						
Year of death	**Number**	**%**	**CMR**	**95% CI**	**ASMR**	**95% CI**
2009	112	17.8	29.2	23.8-34.6	33.1	26.7-39.4
2010	134	18.2	34.3	28.5-40.1	35.8	29.5-42.1
2011	141	16.7	35.5	29.6-41.4	36.6	30.3-42.9
2012	128	16.3	31.8	26.3-37.3	32.6	26.7-38.4
2013	116	14.7	28.4	23.2-33.5	27.9	22.7-33.1
2014	125	15.8	30.2	24.9-35.4	28.5	23.4-33.6
2015	138	17.5	32.8	27.4-38.3	30.1	25.0-35.3
2016	124	16.3	29.1	24.0-34.2	26.3	21.5-31.1
2017	110	14.2	25.5	20.8-30.3	22.0	17.8-26.2
2018	119	16.7	27.3	22.4-32.3	23.0	18.8-27.2
P for trend	-	-	0.055	-	<0.001	-
Indian						
Year of death	**Number**	**%**	**CMR**	**95% CI**	**ASMR**	**95% CI**
2009	40	6.3	14.9	10.3-19.5	17.0	11.5-22.5
2010	41	5.6	15.0	10.4-19.6	16.2	11.0-21.3
2011	31	3.7	11.2	7.3-15.2	12.8	8.1-17.6
2012	35	4.5	12.5	8.4-16.7	13.1	8.6-17.6
2013	39	5.0	13.9	9.5-18.2	14.6	9.9-19.2
2014	36	4.6	12.7	8.5-16.8	11.7	7.8-15.7
2015	39	4.9	13.6	9.4-17.9	12.8	8.6-16.9
2016	46	6.1	15.9	11.3-20.6	15.0	10.5-19.6
2017	42	5.4	14.4	10.1-18.8	12.5	8.6-16.3
2018	35	4.9	11.9	8.0-15.8	9.7	6.4-12.9
P for trend	-	-	0.859	-	0.022	-

Figure 5.2.6: Mortality rate of stroke (per 100,000 population) by ethnicity



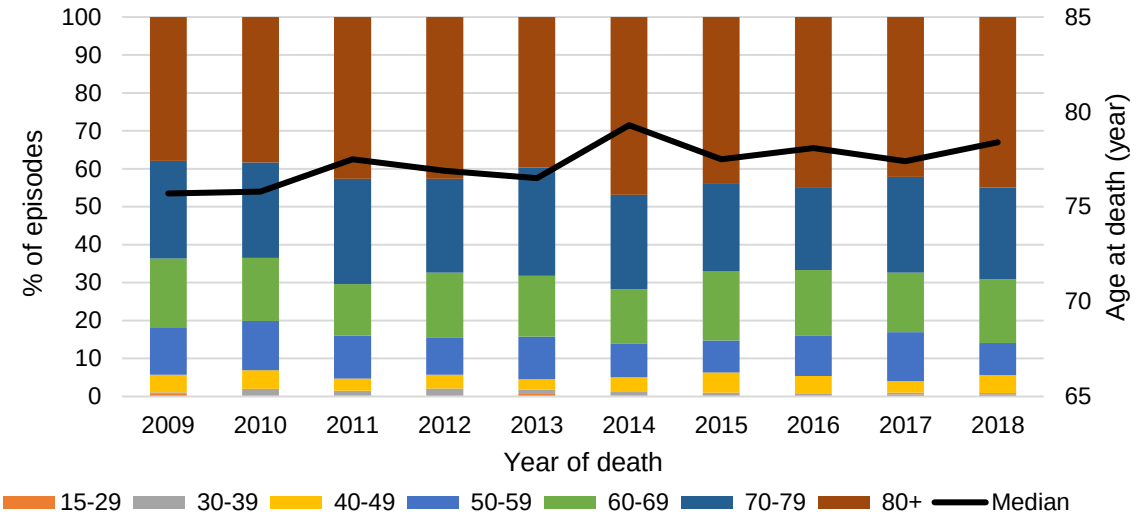
Similar to having the oldest median age at onset of stroke (Tables 5.1.7a to 5.1.7c), Chinese also had the oldest median age at death, which increased from 75.7 years in 2009 to 78.4 years in 2018 (Table 5.2.7a). The highest proportion of stroke deaths was observed among Chinese aged 80 years and above (44.9%) in 2018 (Figure 5.2.7a).

Table 5.2.7a: Age distribution at death of stroke among Chinese

Year of death	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2009	75.7	3	0.6	2	0.4	22	4.7
2010	75.8	2	0.4	9	1.6	27	4.9
2011	77.5	1	0.2	9	1.4	21	3.2
2012	76.9	0	0.0	13	2.1	22	3.6
2013	76.5	4	0.7	7	1.1	17	2.8
2014	79.3	1	0.2	6	1.0	24	3.9
2015	77.5	2	0.3	4	0.7	32	5.3
2016	78.1	2	0.3	3	0.5	26	4.5
2017	77.4	3	0.5	3	0.5	19	3.1
2018	78.4	3	0.5	2	0.4	26	4.7

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2009	58	12.3	86	18.3	121	25.7	178	37.9
2010	71	13.0	91	16.6	138	25.2	210	38.3
2011	74	11.3	89	13.6	182	27.8	279	42.6
2012	59	9.7	105	17.2	151	24.8	260	42.6
2013	68	11.1	98	16.1	174	28.5	242	39.7
2014	54	8.9	87	14.3	151	24.8	285	46.9
2015	51	8.5	110	18.3	138	22.9	265	44.0
2016	62	10.8	99	17.2	126	21.9	258	44.8
2017	79	12.9	96	15.7	155	25.3	258	42.1
2018	46	8.4	92	16.8	133	24.3	246	44.9

Figure 5.2.7a: Age distribution at death of stroke among Chinese



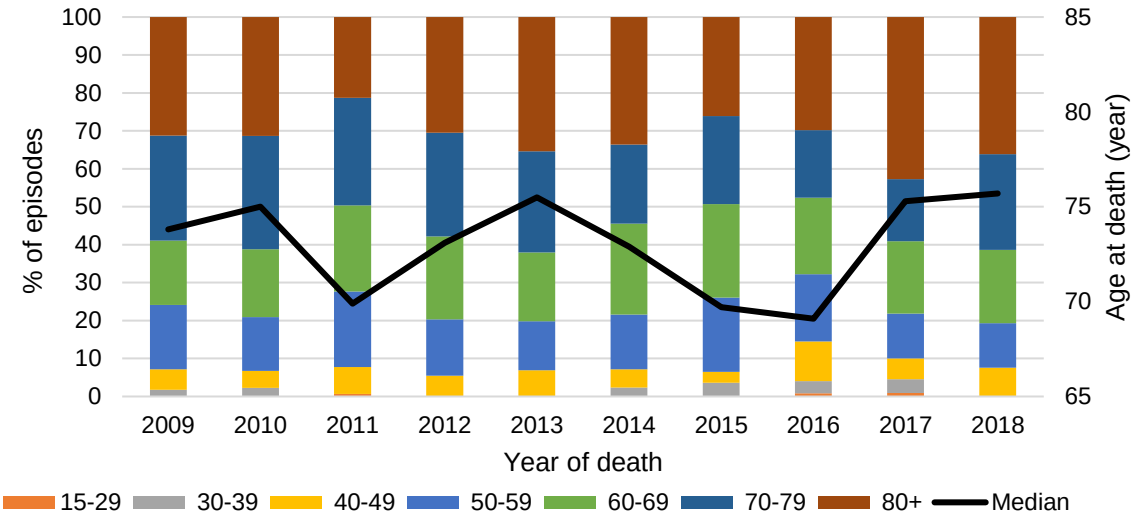
The median age at death among Malays ranged from 69.1 to 75.7 years in the past decade (Table 5.2.7b). The highest proportion of stroke deaths was observed among Malays aged 80 years and above (36.1%) in 2018 (Figure 5.2.7b).

Table 5.2.7b: Age distribution at death of stroke among Malays

Year of death	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2009	73.8	0	0.0	2	1.8	6	5.4
2010	75.0	0	0.0	3	2.2	6	4.5
2011	69.9	1	0.7	0	0.0	10	7.1
2012	73.1	0	0.0	0	0.0	7	5.5
2013	75.5	0	0.0	0	0.0	8	6.9
2014	72.9	0	0.0	3	2.4	6	4.8
2015	69.7	0	0.0	5	3.6	4	2.9
2016	69.1	1	0.8	4	3.2	13	10.5
2017	75.3	1	0.9	4	3.6	6	5.5
2018	75.7	0	0.0	0	0.0	9	7.6

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2009	19	17.0	19	17.0	31	27.7	35	31.3
2010	19	14.2	24	17.9	40	29.9	42	31.3
2011	28	19.9	32	22.7	40	28.4	30	21.3
2012	19	14.8	28	21.9	35	27.3	39	30.5
2013	15	12.9	21	18.1	31	26.7	41	35.3
2014	18	14.4	30	24.0	26	20.8	42	33.6
2015	27	19.6	34	24.6	32	23.2	36	26.1
2016	22	17.7	25	20.2	22	17.7	37	29.8
2017	13	11.8	21	19.1	18	16.4	47	42.7
2018	14	11.8	23	19.3	30	25.2	43	36.1

Figure 5.2.7b: Age distribution at death of stroke among Malays



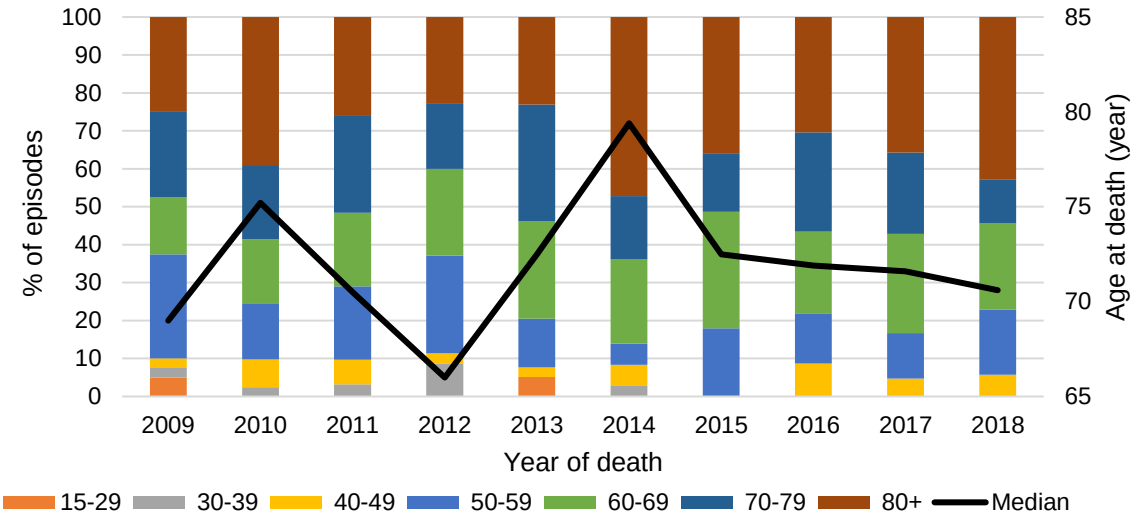
The median age at death among Indians ranged from 66.0 to 79.4 years in the past decade (Table 5.2.7c). The highest proportion of stroke deaths was observed among Indians aged 80 years and above (42.9%) in 2018 (Figure 5.2.7c).

Table 5.2.7c: Age distribution at death of stroke among Indians

Year of death	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2009	69.0	2	5.0	1	2.5	1	2.5
2010	75.2	0	0.0	1	2.4	3	7.3
2011	70.5	0	0.0	1	3.2	2	6.5
2012	66.0	0	0.0	3	8.6	1	2.9
2013	72.5	2	5.1	0	0.0	1	2.6
2014	79.4	0	0.0	1	2.8	2	5.6
2015	72.5	0	0.0	0	0.0	0	0.0
2016	71.9	0	0.0	0	0.0	4	8.7
2017	71.6	0	0.0	0	0.0	2	4.8
2018	70.6	0	0.0	0	0.0	2	5.7

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2009	11	27.5	6	15.0	9	22.5	10	25.0
2010	6	14.6	7	17.1	8	19.5	16	39.0
2011	6	19.4	6	19.4	8	25.8	8	25.8
2012	9	25.7	8	22.9	6	17.1	8	22.9
2013	5	12.8	10	25.6	12	30.8	9	23.1
2014	2	5.6	8	22.2	6	16.7	17	47.2
2015	7	17.9	12	30.8	6	15.4	14	35.9
2016	6	13.0	10	21.7	12	26.1	14	30.4
2017	5	11.9	11	26.2	9	21.4	15	35.7
2018	6	17.1	8	22.9	4	11.4	15	42.9

Figure 5.2.7c: Age distribution at death of stroke among Indians



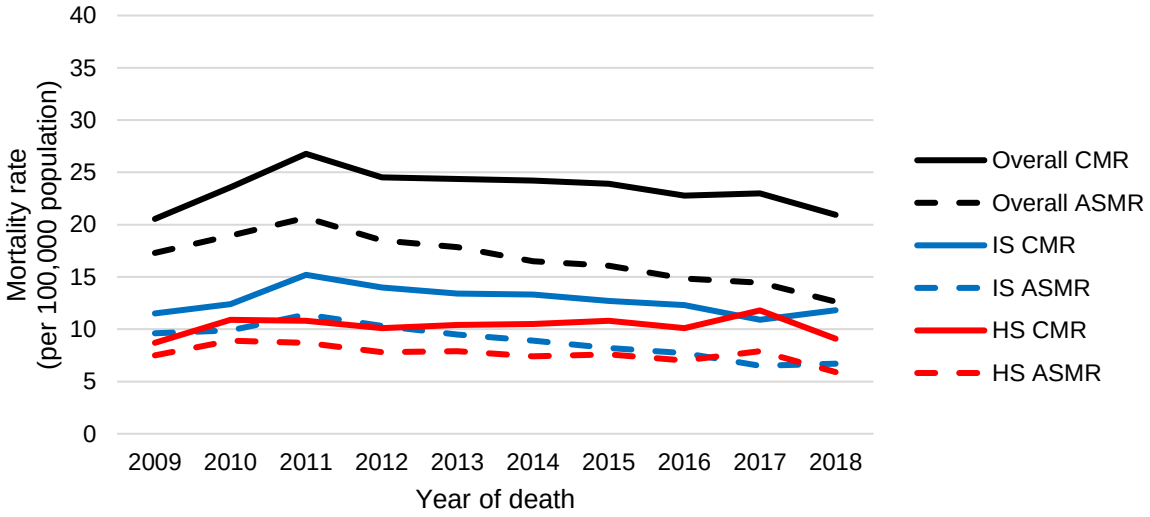
As the ASIR of IS was consistently higher than HS across the years (Table 5.1.8), the ASMR of IS was also generally higher (Table 5.2.8). The ASMR of IS declined significantly from 9.6 per 100,000 population in 2009 to 6.7 per 100,000 population in 2018 (p=0.001). Similarly, the ASMR of HS declined significantly from 7.5 per 100,000 population in 2009 to 5.9 per 100,000 population in 2018 (p=0.032) (Figure 5.2.8).

Table 5.2.8: Mortality number and rate of stroke (per 100,000 population) by subtype

Ischaemic stroke						
Year of death	**Number**	**%**	**CMR**	**95% CI**	**ASMR**	**95% CI**
2009	354	56.2	11.5	10.3-12.7	9.6	8.6-10.6
2010	388	52.8	12.4	11.2-13.7	9.9	8.9-10.9
2011	479	56.8	15.2	13.8-16.6	11.4	10.3-12.4
2012	447	57.1	14.0	12.7-15.3	10.3	9.4-11.3
2013	434	55.1	13.4	12.2-14.7	9.5	8.6-10.4
2014	434	54.9	13.3	12.1-14.6	8.9	8.0-9.7
2015	420	53.2	12.7	11.5-13.9	8.2	7.4-9.1
2016	412	54.2	12.3	11.2-13.5	7.7	6.9-8.4
2017	369	47.6	10.9	9.8-12.1	6.5	5.8-7.1
2018	400	56.1	11.8	10.6-12.9	6.7	6.1-7.4
P for trend	-	-	0.281	-	0.001	-

Haemorrhage stroke						
Year of death	**Number**	**%**	**CMR**	**95% CI**	**ASMR**	**95% CI**
2009	267	42.4	8.7	7.7-9.8	7.5	6.5-8.4
2010	340	46.3	10.9	9.7-12.1	8.9	7.9-9.9
2011	341	40.4	10.8	9.7-12.0	8.7	7.7-9.6
2012	322	41.1	10.1	9.0-11.2	7.8	6.9-8.7
2013	337	42.8	10.4	9.3-11.5	7.9	7.1-8.8
2014	342	43.3	10.5	9.4-11.6	7.4	6.6-8.2
2015	356	45.1	10.8	9.7-11.9	7.6	6.8-8.4
2016	338	44.5	10.1	9.0-11.2	7.0	6.2-7.7
2017	398	51.4	11.8	10.6-13.0	7.9	7.1-8.6
2018	311	43.6	9.1	8.1-10.2	5.9	5.2-6.5
P for trend	-	-	0.634	-	0.032	-

Figure 5.2.8: Mortality rate of stroke (per 100,000 population) by subtype



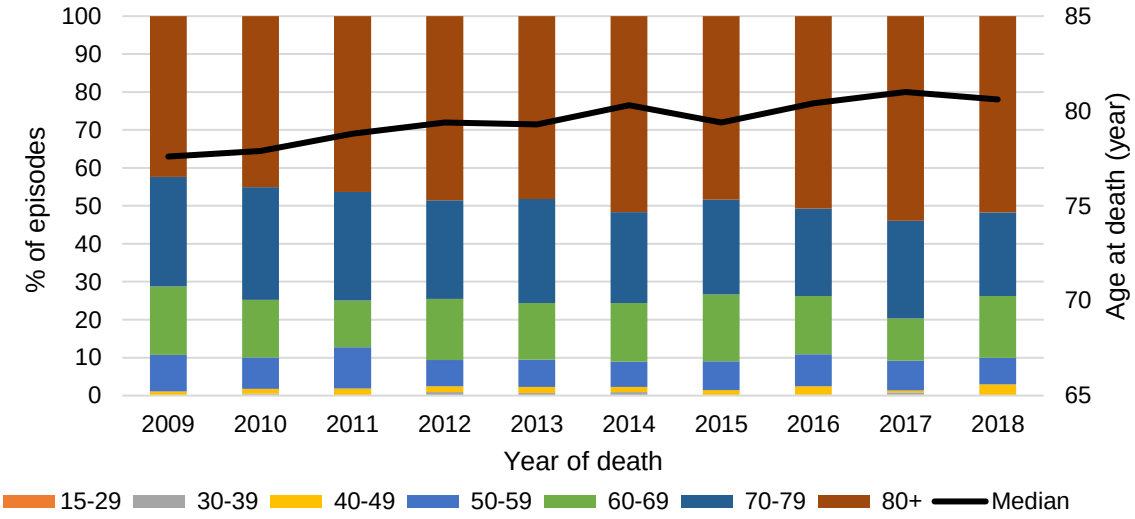
The median age at death among IS patients increased from 77.6 years in 2009 to 80.6 years in 2018 (Table 5.2.9a). The highest proportion of stroke deaths was observed among IS patients aged 80 years and above (51.8%) in 2018 (Figure 5.2.9a).

Table 5.2.9a: Age distribution at death of ischaemic stroke

Year of death	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2009	77.6	0	0.0	0	0.0	4	1.1
2010	77.9	1	0.3	1	0.3	5	1.3
2011	78.8	0	0.0	0	0.0	9	1.9
2012	79.4	0	0.0	4	0.9	7	1.6
2013	79.3	0	0.0	3	0.7	7	1.6
2014	80.3	0	0.0	4	0.9	6	1.4
2015	79.4	0	0.0	0	0.0	6	1.4
2016	80.4	1	0.2	0	0.0	9	2.2
2017	81.0	1	0.3	2	0.5	2	0.5
2018	80.6	0	0.0	0	0.0	12	3.0

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2009	34	9.6	64	18.1	102	28.8	150	42.4
2010	32	8.2	59	15.2	115	29.6	175	45.1
2011	52	10.9	59	12.3	137	28.6	222	46.3
2012	31	6.9	72	16.1	116	26.0	217	48.5
2013	31	7.1	65	15.0	119	27.4	209	48.2
2014	29	6.7	67	15.4	104	24.0	224	51.6
2015	32	7.6	74	17.6	105	25.0	203	48.3
2016	35	8.5	63	15.3	95	23.1	209	50.7
2017	29	7.9	41	11.1	95	25.7	199	53.9
2018	28	7.0	65	16.3	88	22.0	207	51.8

Figure 5.2.9a: Age distribution at death of ischaemic stroke



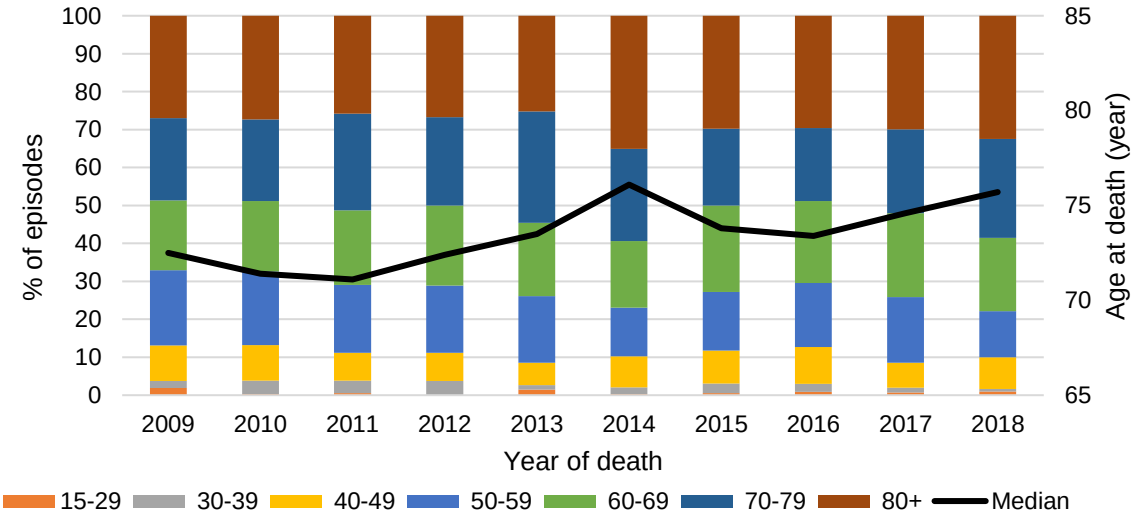
Similar to having a younger median age at stroke onset (Tables 5.1.9a and 5.1.9b), HS patients had a younger median age at death than IS patients. The median age at death for HS patients increased from 72.5 years in 2009 to 75.7 years in 2018 (Table 5.2.9b). The highest proportion of stroke deaths was observed among HS patients aged 80 years and above (32.5%) in 2018 (Figure 5.2.9b).

Table 5.2.9b: Age distribution at death of haemorrhage stroke

Year of death	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2009	72.5	5	1.9	5	1.9	25	9.4
2010	71.4	1	0.3	12	3.5	32	9.4
2011	71.1	2	0.6	11	3.2	25	7.3
2012	72.4	0	0.0	12	3.7	24	7.5
2013	73.5	5	1.5	4	1.2	20	5.9
2014	76.1	1	0.3	6	1.8	28	8.2
2015	73.8	2	0.6	9	2.5	31	8.7
2016	73.4	3	0.9	7	2.1	33	9.8
2017	74.6	3	0.8	5	1.3	26	6.5
2018	75.7	3	1.0	2	0.6	26	8.4

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2009	53	19.9	49	18.4	58	21.7	72	27.0
2010	66	19.4	63	18.5	73	21.5	93	27.4
2011	61	17.9	67	19.6	87	25.5	88	25.8
2012	57	17.7	68	21.1	75	23.3	86	26.7
2013	59	17.5	65	19.3	99	29.4	85	25.2
2014	44	12.9	60	17.5	83	24.3	120	35.1
2015	55	15.4	81	22.8	72	20.2	106	29.8
2016	57	16.9	73	21.6	65	19.2	100	29.6
2017	69	17.3	88	22.1	88	22.1	119	29.9
2018	38	12.2	60	19.3	81	26.0	101	32.5

Figure 5.2.9b: Age distribution at death of haemorrhage stroke



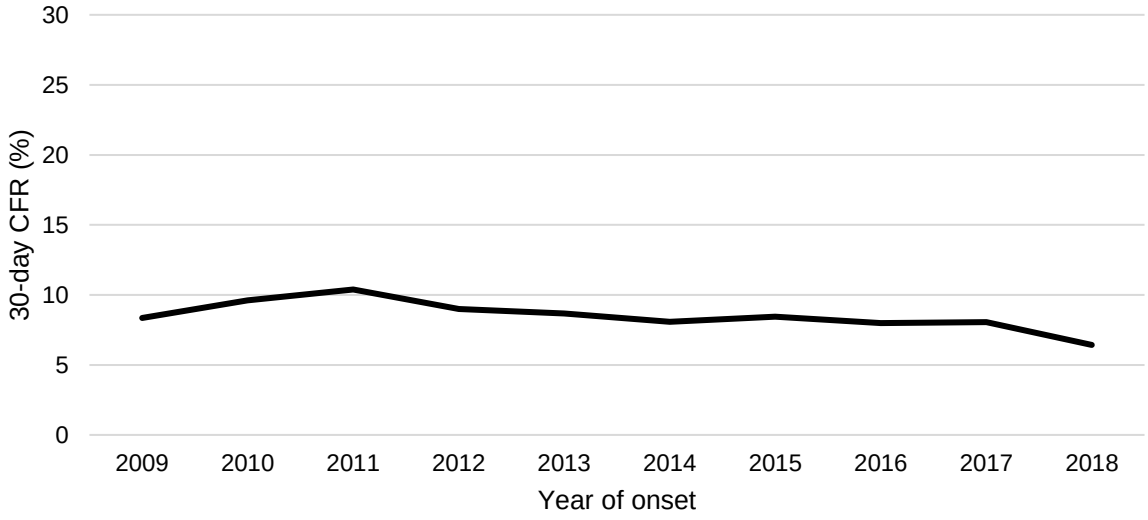
5.3 30-Day Case Fatality

Despite a rise in the number of stroke episodes (Table 5.1.1), there was no corresponding increase in the number of stroke deaths within 30 days from onset of stroke. The number of stroke deaths within 30 days fluctuated, ranging between 481 and 638 in the past decade (Table 5.3.1). The CFR decreased significantly from 8.4% in 2009 to 6.4% in 2018 (p=0.011) (Figure 5.3.1). Faster start of stroke treatment was likely to have contributed to the decreasing trend in case fatality.

Table 5.3.1: Case fatality number and rate of stroke (%)

Year of onset	Number	CFR	95% CI
2009	481	8.4	7.6-9.1
2010	566	9.6	8.8-10.4
2011	638	10.4	9.6-11.2
2012	572	9.0	8.2-9.7
2013	583	8.7	8.0-9.4
2014	568	8.1	7.4-8.7
2015	624	8.4	7.8-9.1
2016	595	8.0	7.3-8.6
2017	637	8.0	7.4-8.7
2018	535	6.4	5.9-7.0
P for trend	-	0.011	-

Figure 5.3.1: Case fatality rate of stroke (%)

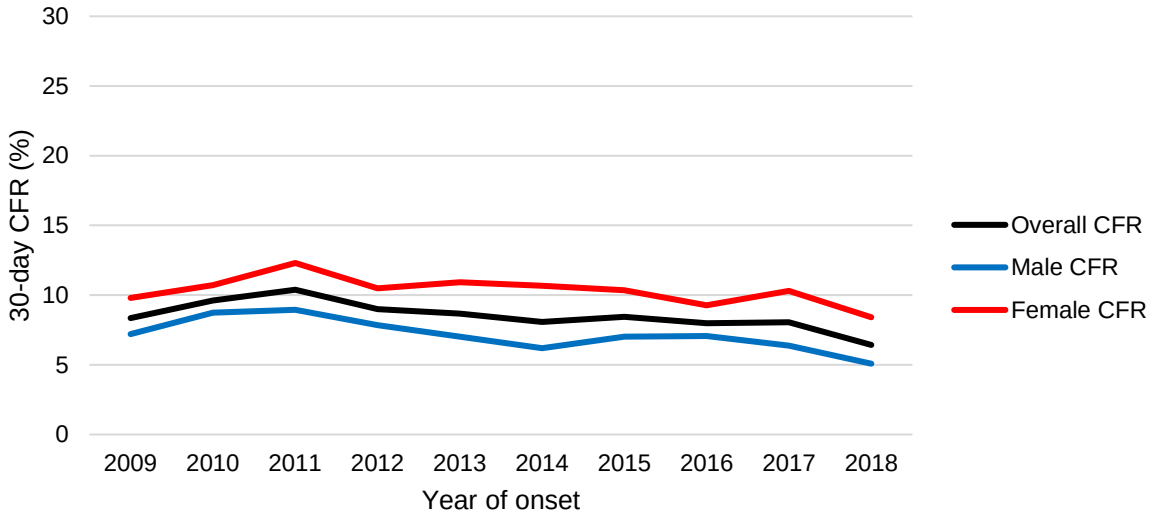


Although the ASMR for males was consistently higher than females across the years (Table 5.2.4), the CFR for males was consistently lower than females (Table 5.3.2). The CFR was 5.1% for males and 8.4% for females in 2018. As females tended to have stroke at an older age than males (Tables 5.1.5a and 5.1.5b), they were likely to have more co-morbidities when stroke happened, making them more susceptible to poorer prognosis. The CFR fell significantly over the years for males (p=0.010) but not for females (p=0.088) (Figure 5.3.2).

Table 5.3.2: Case fatality number and rate of stroke (%) by gender

Male				
Year of onset	**Number**	**%**	**CFR**	**95% CI**
2009	232	48.2	7.2	6.3-8.1
2010	288	50.9	8.7	7.7-9.7
2011	314	49.2	8.9	8.0-9.9
2012	284	49.7	7.8	6.9-8.8
2013	272	46.7	7.0	6.2-7.9
2014	253	44.5	6.2	5.4-7.0
2015	298	47.8	7.0	6.2-7.8
2016	307	51.6	7.1	6.3-7.9
2017	291	45.7	6.4	5.6-7.1
2018	252	47.1	5.1	4.5-5.7
P for trend	-	-	0.010	-
Female				
Year of onset	**Number**	**%**	**CFR**	**95% CI**
2009	249	51.8	9.8	8.6-11.0
2010	278	49.1	10.7	9.5-12.0
2011	324	50.8	12.3	11.0-13.6
2012	288	50.3	10.5	9.3-11.7
2013	311	53.3	10.9	9.7-12.1
2014	315	55.5	10.7	9.5-11.9
2015	326	52.2	10.3	9.2-11.5
2016	288	48.4	9.3	8.2-10.3
2017	346	54.3	10.3	9.2-11.4
2018	283	52.9	8.4	7.4-9.4
P for trend	-	-	0.088	-

Figure 5.3.2: Case fatality rate of stroke (%) by gender



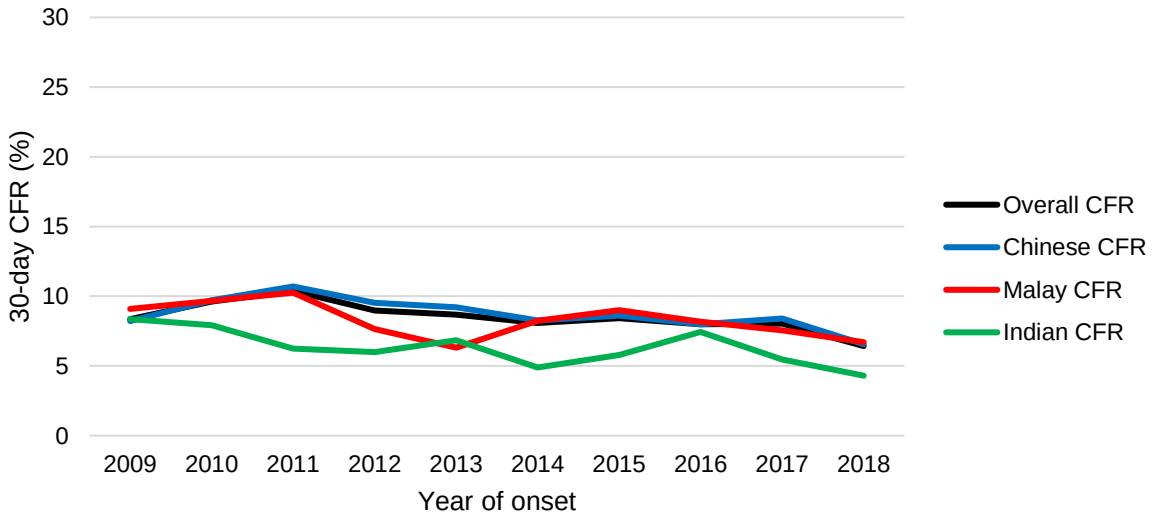
Although Chinese consistently had lower ASMR than Malays (Table 5.2.6), their CFRs were not distinctly different across the years (Table 5.3.3). This was likely due to Chinese being older at stroke onset than Malays (Tables 5.1.7a and 5.1.7b). Similar to the trends in ASMR, Indians generally had the lowest CFR among the three ethnic groups. The CFRs were 6.6%, 6.7% and 4.3% for Chinese, Malays and Indians respectively in 2018. The CFRs fell significantly over the years for Chinese (p=0.033) and Indians (p=0.023) but not for Malays (p=0.083) (Figure 5.3.3).

Table 5.3.3: Case fatality number and rate of stroke (%) by ethnicity

Chinese				
Year of onset	**Number**	**%**	**CFR**	**95% CI**
2009	368	76.5	8.2	7.4-9.1
2010	437	77.2	9.7	8.8-10.6
2011	499	78.2	10.7	9.8-11.6
2012	462	80.8	9.5	8.7-10.4
2013	466	79.9	9.2	8.4-10.0
2014	441	77.6	8.3	7.5-9.0
2015	485	77.7	8.6	7.8-9.4
2016	451	75.8	8.0	7.2-8.7
2017	504	79.1	8.4	7.7-9.1
2018	414	77.4	6.6	5.9-7.2
P for trend	-	-	0.033	-

Malay				
Year of onset	**Number**	**%**	**CFR**	**95% CI**
2009	75	15.6	9.1	7.0-11.2
2010	89	15.7	9.7	7.7-11.7
2011	100	15.7	10.3	8.2-12.3
2012	81	14.2	7.6	6.0-9.3
2013	67	11.5	6.3	4.8-7.8
2014	90	15.8	8.2	6.5-9.9
2015	106	17.0	9.0	7.3-10.7
2016	95	16.0	8.2	6.5-9.8
2017	93	14.6	7.5	6.0-9.1
2018	87	16.3	6.7	5.3-8.1
P for trend	-	-	0.083	-
Indian				
Year of onset	**Number**	**%**	**CFR**	**95% CI**
2009	32	6.7	8.4	5.5-11.2
2010	30	5.3	7.9	5.1-10.7
2011	25	3.9	6.2	3.8-8.7
2012	21	3.7	6.0	3.4-8.5
2013	32	5.5	6.8	4.5-9.2
2014	23	4.0	4.9	2.9-6.9
2015	27	4.3	5.8	3.6-8.0
2016	37	6.2	7.4	5.0-9.8
2017	30	4.7	5.5	3.5-7.4
2018	24	4.5	4.3	2.6-6.0
P for trend	-	-	0.023	-

Figure 5.3.3: Case fatality rate of stroke (%) by ethnicity

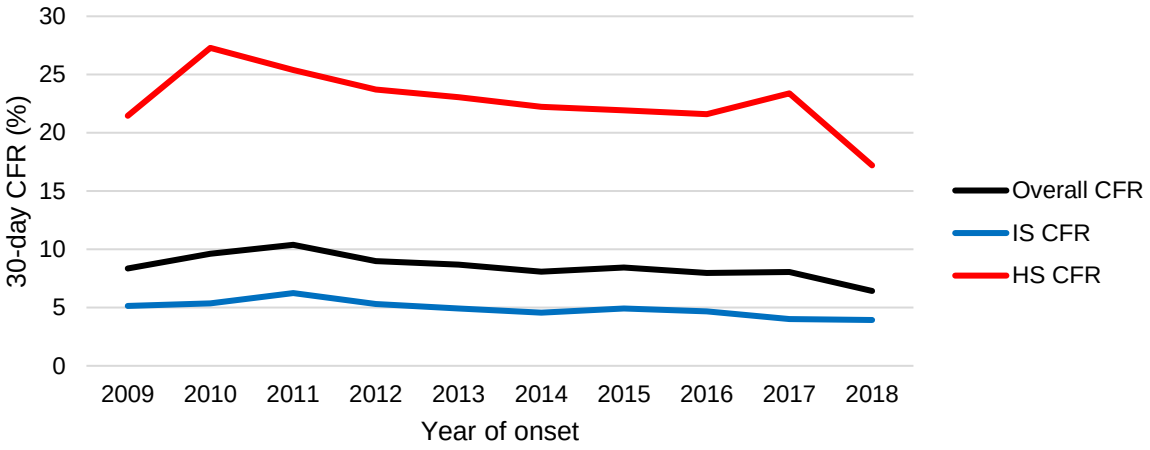


Although IS patients generally had a higher ASMR than HS patients across the years (Table 5.2.8), the CFR among IS patients was consistently lower than HS patients (Table 5.3.4). The CFRs were 3.9% and 17.2% for IS and HS patients respectively in 2018. A plausible reason was that HS is more severe. While the CFR for IS patients fell significantly over the years (p=0.004), the fall was not significant for HS patients (p=0.052) (Figure 5.3.4).

Table 5.3.4: Case fatality number and rate of stroke (%) by subtype

Ischaemic stroke				
Year of onset	**Number**	**%**	**CFR**	**95% CI**
2009	238	49.5	5.1	4.5-5.8
2010	254	44.9	5.3	4.7-6.0
2011	306	48.0	6.2	5.5-6.9
2012	273	47.7	5.3	4.7-5.9
2013	265	45.5	4.9	4.3-5.5
2014	260	45.8	4.6	4.0-5.1
2015	291	46.6	4.9	4.4-5.5
2016	282	47.4	4.7	4.1-5.2
2017	253	39.7	4.0	3.5-4.5
2018	266	49.7	3.9	3.5-4.4
P for trend	-	-	0.004	-
Haemorrhage stroke				
Year of onset	**Number**	**%**	**CFR**	**95% CI**
2009	234	48.6	21.5	18.7-24.2
2010	307	54.2	27.3	24.2-30.3
2011	308	48.3	25.4	22.6-28.2
2012	285	49.8	23.7	21.0-26.5
2013	302	51.8	23.1	20.5-25.7
2014	294	51.8	22.2	19.7-24.8
2015	320	51.3	21.9	19.5-24.3
2016	303	50.9	21.6	19.2-24.0
2017	377	59.2	23.4	21.0-25.7
2018	267	49.9	17.2	15.1-19.3
P for trend	-	-	0.052	-

Figure 5.3.4: Case fatality rate of stroke (%) by subtype

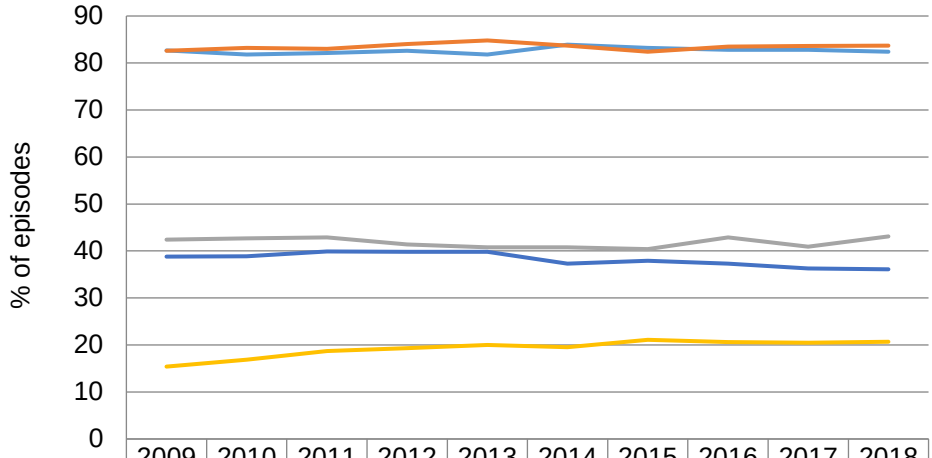


5.4 Risk Factors

Hypertension, hyperlipidemia, diabetes and smoking are well established modifiable risk factors of stroke[9]. Hypertension, hyperlipidemia, diabetes and atrial fibrillation/flutter (AF) were defined as positive if there was history of the condition or if it was newly diagnosed during index admission. Smoking included former and current smoker. As a patient could have multiple risk factors, the percentages in Figure 5.5.1 will not add up to 100% for each year.

Hypertension and hyperlipidemia were consistently the two most common risk factors among stroke patients across the years (Figure 5.5.1). 82.4% of the patients had hypertension and 83.7% had hyperlipidemia in 2018. Diabetes, smoking and AF were also prevalent among stroke patients, with 43.1%, 36.1% and 20.7% of them having these risk factors respectively in 2018. The proportion of patients with AF rose slightly over the years, while the proportion of patients who smoked dropped slightly. While the proportion with hypertension was similar among IS and HS patients, all the other risk factors were more prevalent among IS patients, suggesting that IS is more preventable with a healthy lifestyle (Figure 5.5.2).

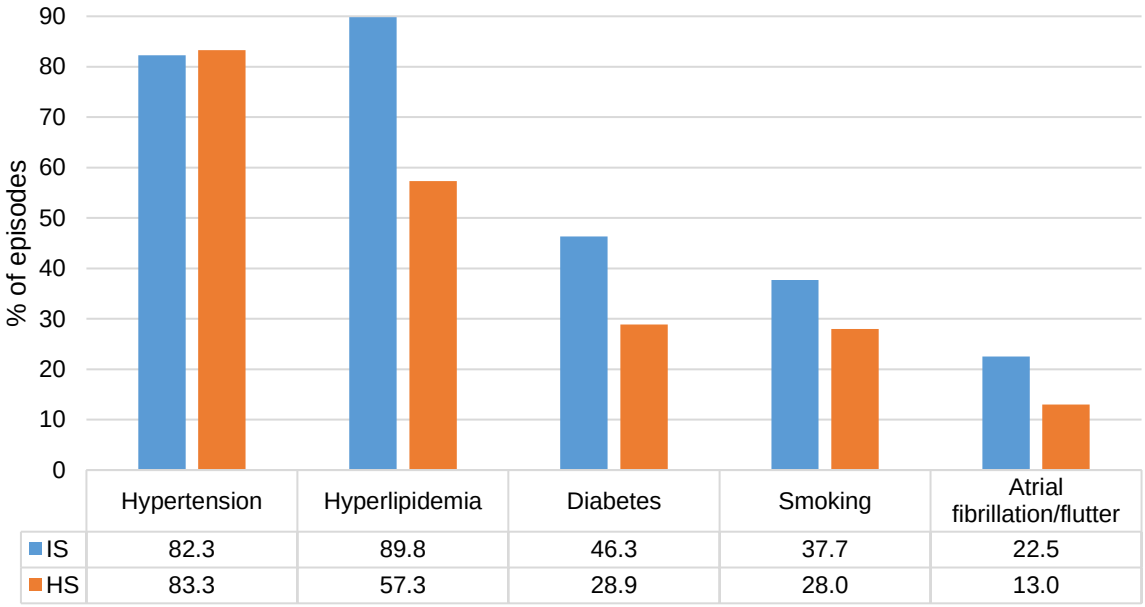
Figure 5.5.1: Risk factors of stroke (%)



Year of onset	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Hypertension	82.7	81.8	82.1	82.6	81.8	83.9	83.2	82.8	82.8	82.4
Hyperlipidemia	82.6	83.2	83.0	84.0	84.8	83.7	82.4	83.5	83.6	83.7
Diabetes	42.4	42.7	42.9	41.4	40.8	40.8	40.4	42.9	40.9	43.1
Smoking	38.8	38.9	39.9	39.8	39.8	37.3	37.9	37.3	36.3	36.1
Atrial fibrillation/flutter	15.4	16.9	18.7	19.3	20.0	19.5	21.1	20.6	20.5	20.7

[9] Boehme AK et al. Stroke risk factors, genetics, and prevention. Circulation Research 2017; 120(3): 472-495.

Figure 5.5.2: Risk factors (%) by stroke subtype in 2018



	Hypertension	Hyperlipidemia	Diabetes	Smoking	Atrial fibrillation/flutter
IS	82.3	89.8	46.3	37.7	22.5
HS	83.3	57.3	28.9	28.0	13.0

6. CONCLUSION

The top contributor to the combined burden of early death and disability in Singapore was cardiovascular diseases and they accounted for 14.2% of the total disability-adjusted life years in 2017[10]. It is therefore important for individuals with high risk of stroke to take preventive action. One can reduce his/her chances of developing stroke by adopting a healthy lifestyle, such as eating all food in moderation and opting for healthier products, exercising and maintaining a healthy weight, avoiding smoking, going for health screening and follow-ups, and controlling blood pressure, cholesterol and glucose levels well. For individuals with symptoms of stroke, seeking medical help promptly plays a crucial role in improving prognosis and recovery. For individuals who survived a stroke, adherence to medication and healthy lifestyle can reduce the risk of subsequent cardiovascular event and death.

[10] The Burden of Disease in Singapore, 1990-2017. Ministry of Health, Singapore.